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**Working Paper**

## Stock Prices and Real Economic Activity Empirical Results for Germany

Research Notes, No. 20

**Provided in Cooperation with:**

Deutsche Bank Research, Frankfurt am Main

*Suggested Citation:* Forster, Katrin (2005) : Stock Prices and Real Economic Activity Empirical Results for Germany, Research Notes, No. 20, Deutsche Bank Research, Frankfurt a. M.

This Version is available at:

<https://hdl.handle.net/10419/21882>

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# Stock prices and real economic activity

## Empirical results for Germany

October 14, 2005

Since the mid-1990s, large movements in stock prices have not only raised central bankers' and policy-makers' interest in their implications for real economic activity, but have also led to extensive empirical research in this field. While most of the studies have focussed on the United States or the euro area as a whole, this paper is one of the few providing empirical evidence for Germany.

Despite the fact that the significance of equity markets remains much smaller in Germany than in other industrial countries, the empirical analysis confirms that stock price movements are relevant for the German economy: overall, stock price movements have had an impact on both domestic consumption and domestic private investment in recent years. Less surprisingly, the effects prove to be of much less significance than for other countries, in particular the United States, where stock market effects have been substantial.

However, as it can be expected that the equity markets will gain further importance in Germany in the long term – e.g. in connection with the need for households to increase privately funded pensions and for many German companies to strengthen their equity and diversify their financing resources – the paper also concludes that the real economy will register more significant effects in future.

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# Stock Prices and Real Economic Activity

## Empirical Results for Germany

Katrin Forster

October 2005

### 1 Introduction

Large swings in stock prices over the last few years have raised the interest of the general public and policy-makers in stock market developments and increased the focus on their impact on the economy. In view of the sharp rise in stock prices in the second half of the 1990s hitting its peak in March 2000, attention initially focused on inflationary pressures and the danger of a bursting stock market bubble. With prices dropping sharply from April 2000 onwards, worries about negative consequences for the cyclical development gained weight. Although stock markets have recovered since then, the question about the role of stock market effects for the real economy remains a matter of interest.

Stock price movements may play a role in economic developments through a number of transmissions channels. In contrast to the United States, for which a large number of empirical studies quantifying stock price effects exists, there have only been a few studies for Europe and even less so for Germany. The aim of this paper is to help closing this gap and to provide empirical evidence for Germany for two of the major transmission channels: the consumption-wealth-channel, and the q-channel on private investment.

Although the German stock market has gained importance since the beginning of the 1990s, the significance of equity markets remains much smaller than in other industrial countries such as the United States or the United Kingdom with a long-established "equity culture" (table 1). One could therefore expect the effects of stock price movements on the German economy to be much smaller than for the aforementioned countries. Nevertheless, given that the importance of the equity

markets within the German financial system is expected to increase significantly in the longer term, the impact of stock price movements on the macroeconomic development should also increase. Although this paper focuses on empirical exam-

**Table 1: International comparison of stock market capitalisation**

*)	1996	2000	2002	2003
Germany	29%	68%	35%	45%
Euro area	35%	90%	53%	60%
United States	114%	153%	107%	131%
United Kingdom	142%	184%	114%	137%
Japan	68%	69%	52%	69%

\*: As percentage of GDP

Source: DEUTSCHES AKTIENINSTITUT (2004), table 05-3.

inations for Germany, it is important to understand the main channels established by economic theory through which stock price movements may influence economic developments.<sup>1</sup> The general approach of this paper is therefore not only to explore possible stock market effects empirically, but, more specifically, to test for the relevance of those transmission channels which are well-founded in theory. Hence, empirical results for the consumption-wealth effect and a q-investment function are presented in section 3 and 4, followed by a brief conclusion in section 5.

## 2 Stock prices and economic activity: Main transmission channels

In theory, stock price movements may have direct effects on private investment and consumption via three main channels: the q-channel on private investment, the balance sheet-channel, and the consumption-wealth-channel (figure 1).

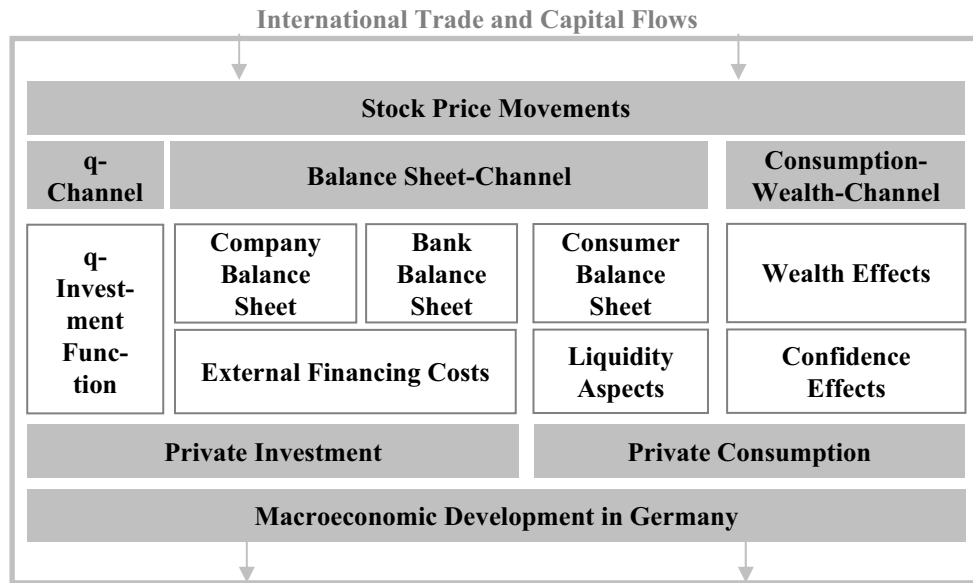
The first channel through which stock price movements may have a direct impact on private investment is the **q-channel** - an approach initially developed by TOBIN (in collaboration with BRAINARD)<sup>2</sup> which has dominated much of the empirical

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<sup>1</sup>There are also theoretical reasons for the reverse causation, i.e. current output influencing future stock prices, to hold (see e.g. PARK (1997)). However, they are not considered in this paper.

<sup>2</sup>TOBIN (1961), BRAINARD and TOBIN (1968)

**Figure 1: Overview on the main transmission channels**



investment literature over the past decades.<sup>3</sup> Tobin argued that the ratio of the stock price to the replacement cost of capital, a statistic which has become known as Tobin's  $q$ , should be considered as a good indicator of a company's incentive to invest, and that, moreover, this variable is the only relevant determinant for a company's investment. If Tobin's  $q$  is greater than one, then capital is more valuable if employed inside the company, and the (increase in the) company's market value is greater than it costs to produce it. As rising stock prices directly result in an increase in Tobin's  $q$ , it would be profitable for the company to expand its capital stock, leading to an increase in investment spending, aggregate demand and aggregate output.

A second channel through which stock price movements may influence investment decisions - not only of listed companies, but of all companies holding stocks - is the **balance sheet-channel**. Because of asymmetric information in credit markets, the ability of companies to borrow depends, among other factors, on the value of collateral they can provide. As stock prices increase, the value of collateral of companies holding stocks increases, enhancing their access to external funds for investment. Particularly in the case of declining stock prices, important "second-round effects" on the financing capacities of companies may occur: Declining stock prices leading to a decrease in investment demand in the first place, may be accompanied by a general deterioration of aggregate demand and overall economic conditions. With profits and cash flows falling as a result thereof, a company's ability to finance in-

<sup>3</sup>For an overview of different modelling strategies and empirical results see CHIRINKO (1993).

vestment spending by internal funds may worsen as well, starting a self-enhancing process, which has also been called "financial accelerator".<sup>4</sup>

In addition to the balance sheet-channel affecting a company's investment decisions, changes in net wealth caused by movements in stock prices can also have an effect on both the lending behavior of banks and the consumption of private households. With stock prices falling and the resulting impairments being recorded on the asset side of banks' balance sheets, banks' equity might fall to such a low level that the bank might be forced to reduce lending because of regulatory capital requirements and the increased cost of issuing new equity.<sup>5</sup> Similarly, with regard to private households, balance sheet effects might on the one hand result in reduced consumption, if falling stock prices reduce the value of collateral and thereby worsen households' ability to raise additional loans. On the other hand, the deterioration in the households' balance sheet is also associated with a decline in liquidity, potentially leading consumers to fear for their solvency and, as a result, to postpone irreversible purchases of durable goods and housing.<sup>6</sup>

Regarding the effects of stock price fluctuations on private consumption, however, most of the empirical studies have focused on the **consumption-wealth-channel**. For households holding stocks, a permanent increase in stock prices implies an increase in financial wealth. Assuming that consumers aim at smoothing their consumption over time, the increase in financial wealth results in higher current and future consumption, stimulating aggregate demand and output.

Besides these three channels through which stock price movements directly affect the investment and consumption demand of companies and consumers having access to equity finance or holding stocks, stock prices may also affect investments indirectly<sup>7</sup> via **confidence effects**. Stock prices are often used as leading indicators of cyclical developments and may therefore also influence consumption and investment decisions albeit not causing them. A decline in stock prices may, for example, be interpreted as a signal for increased downward risks to future economic activity and employment. This may hurt consumer confidence and current aggregate con-

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<sup>4</sup>BERNANKE ET AL. (1996, 1999)

<sup>5</sup>Low-capital banks may even forgo profitable lending opportunities when the regulatory capital requirement is not currently binding in order to lower the risk of future capital inadequacy. Also see VAN DEN HEUVEL (2002).

<sup>6</sup>This argument was first raised by MISHKIN (1978), who examined this as a possible link between the Great Crash and the decline in consumption.

<sup>7</sup>A similar distinction between "direct" and "indirect" effects of stock price changes is made by LUDWIG and SLOK (2002) and DYNAN and MAKI (2001).

sumption of households - even if these do not own stock. Likewise, a general decline in stock prices may also lead companies (irrespective of being able to issue new equity in the stock market) to lower their profit expectations and curtail investment plans.

In addition to these transmission channels having an impact on the macroeconomic development via domestic consumption and investment, the repercussions of stock market movements on the economies of other countries are also relevant to the economy's exposure owing to companies' international capital and trading links. Besides effects on foreign demand, the state of the foreign equity markets also plays a role for the above-mentioned transmission mechanisms. Retail and institutional investors are increasingly holding foreign equities and domestic companies may even be quoted on foreign stock exchanges. Changes in foreign stock prices are therefore associated with changes in financial wealth of domestic companies and consumers, or with changes in the market value of capital, possibly affecting domestic demand via the consumer-wealth and the balance sheet-channel or (in case of a foreign listing) the q-channel.

Assessing the overall impact of stock price movements on the macroeconomic development would require a quantification of all effects operating through these transmission channels. However, primarily due to the lack of appropriate micro databases, most of the international empirical studies have focused either on the consumption-wealth or the q-channel. Evidence on the balance sheet-channel directly associated with changes in stock prices is rather weak. For the most part, literature has focused on balance sheet effects in the framework of analyzing the effects of restrictive monetary policy impulses.<sup>8</sup> However, under certain conditions, these studies allow a first insight on the size of stock market effects operating via this channel.<sup>9</sup> Regarding the role of confidence effects, there are only a few studies for the United States.<sup>10</sup> Studies for Europe, and Germany, have mostly been limited to analyzing the correlation between stock prices and confidence indicators<sup>11</sup> and the relevance of stock prices as leading indicators.<sup>12</sup>

Although the aim of the research project was to assess the overall impact of stock

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<sup>8</sup>See, for example, BERNANKE and GERTLER (1995); OLINER and RUDEBUSCH (1996)

<sup>9</sup>For details see FORSTER (2004), pp. 90-108.

<sup>10</sup>Most studies focus on the role of confidence effects for consumption (see, for example, OTOO (1999); STARR-McCLUER (1998); LUDVIGSON (2004)).

<sup>11</sup>See, for example, DEUTSCHE BUNDESBANK (2003).

<sup>12</sup>See, for example, OSBORN and SENSIER (2002); HASSAPIS and KALYVITIS (2002).

price movements on the German economy, for the purpose of this paper, the presentation will be limited to the results of the estimation for the consumption-wealth effect and the q-investment function. The research project differs from other recent empirical work for Germany<sup>13</sup> in various aspects. With regard to the consumption-wealth effect, the research project, for the first time for Germany, pursues an estimation approach comparable to the one used in recent international studies, and provides more comprehensive results than other studies for Germany. The estimation of the q-investment function is based on a very recent panel data set covering more than 100 German (non-financial) listed-companies. Moreover, for the first time, data from consolidated accounts rather than from stand-alone accounts is used estimating a q-investment function for Germany.

### 3 The consumption-wealth-channel

The increased importance of shares as an investment tool has raised the potential of the occurrence of corresponding wealth effects to occur, and stimulated much of the international research on possible effects of stock price movements on macroeconomic developments. If households holding stock do not only fund consumption out of current disposable income but also out of financial wealth, the consumption-wealth effect may become an important transmission channel.

Theoretically, the relationship between wealth and consumption can either be based on the life-cycle model<sup>14</sup> or the permanent income hypothesis<sup>15</sup>, both of which imply a linear relationship between aggregate consumption, (labor) income and financial wealth.<sup>16</sup> As consumers are assumed to smoothen their consumption over time, both theories imply that permanent increases in stock prices associated with an increase in financial wealth will lead to higher current and future consumption. Though the empirical approach is not conditional on any particular consumption theory, reference to these theoretical models may explain why in most international studies, no distinction is made between stock market-related and -unrelated wealth. In

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<sup>13</sup>Regarding the consumption-wealth-effect, this research project is most closely related to the studies of REIMERS (1997); HASSLER (2001b); DEUTSCHE BUNDESBANK (2003). For other recent studies on the q-investment function for Germany see GEBAUER ET AL. (1994); GEHRKE (1994); BEHR and BELLGARDT (1998, 2000).

<sup>14</sup>See BRUMBERG and MODIGLIANI (1954, 1979), and ANDO and MODIGLIANI (1963).

<sup>15</sup>See FRIEDMAN (1957)

<sup>16</sup>For a general model that comprises both, the life-cycle model and the permanent income hypothesis, see GALI (1990).



accordance with these studies, and to ensure comparability therewith, the research project has also been based on total financial net worth.<sup>17</sup>

To assess the importance of the consumption-wealth-channel for Germany, this paper follows the approach chosen by LUDVIGSON and STEINDEL (1999) who used a vector-error correction model (VECM) to study the effects of stock price changes on U.S. consumption. The advantage of this approach is that it does not only allow to account for the time series properties of aggregate consumption, financial wealth and disposable income, but also to distinguish between short- and long-term effects of stock price movements.

### 3.1 The data

The empirical analysis for Germany is based on quarterly data on consumption and disposable income taken from National Accounts (*Volkswirtschaftliche Gesamtrechnungen*); data on private households' net financial wealth is only available on an annual basis and taken from Financial Accounts of Deutsche Bundesbank. All data is real *per capita* and not adjusted for seasonality. Further, the estimation is based on log values.

As most of the international studies are based on quarterly data, the first problem of the research project was to obtain quarterly values for net financial wealth. Values for the first three quarters have been calculated assuming that net financial wealth evolves according to the development of the leading German stock market index, the DAX.<sup>18</sup>

Following WOLTERS (1988) and HASSLER (2000) who find evidence that the oil crisis 1973/1974 coincides with a structural break in German consumption functions, the estimation period commences in the first quarter 1976 and lasts through the third quarter 2003. Data through the fourth quarter 1990 is for West Germany only, whereas thereafter for Germany as a whole.

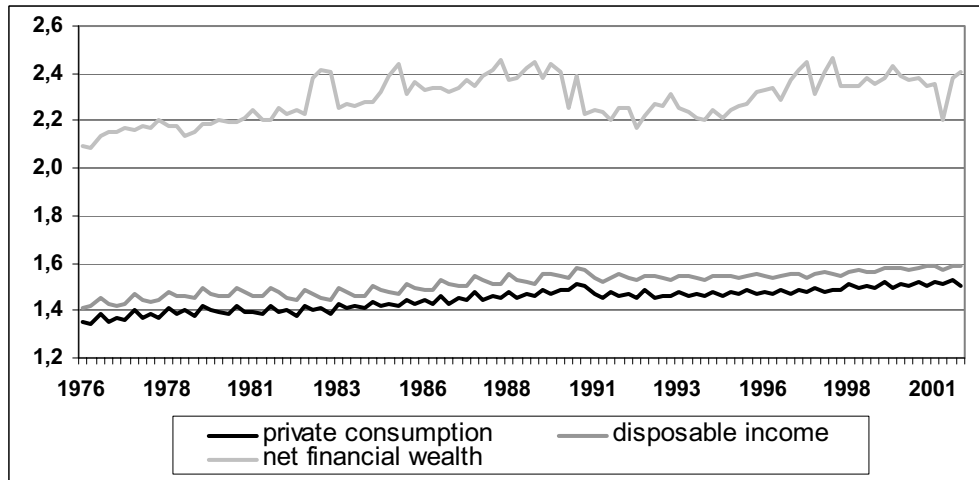
Figure 2 shows the time series used, all exhibiting a general upward trend. After the first quarter of 1991, there is a clear decline in the levels of all series, i.e. the *per capita* values for Germany as a whole first fell short of the previous values (which

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<sup>17</sup>However, as fluctuation in net worth are largely driven by fluctuations in stock market wealth, the results would not change fundamentally if stock market wealth instead of financial wealth was used in the estimation. For details see FORSTER (2004), pp. 119-121.

<sup>18</sup>Due to the high correlation of the change in net financial wealth and the change in the DAX, this seems to be a reasonable assumption; for further details see FORSTER (2004), pp. 119-121.

Figure 2: Private consumption, disposable income and net financial wealth



Note: All time series are in logs and real *per capita*.

were only for West Germany), only slowly reaching these higher levels later again. The consumption and the disposable income series exhibit a regular seasonal pattern, whereas it should be noted that this pattern seems to have changed markedly after the unification. To account for a possible structural break and the seasonal pattern, a step-dummy (the "unification"-dummy) taking the value of 0 before unification and 1 thereafter, and centered seasonal dummies have been added to the estimation equation. In addition to these simple dummies, centered seasonal dummies multiplied by the "unification"-dummy are added to account for the possible break in the seasonal pattern.

Unit root tests confirm that all variables are I(1)-variables (table 2). Running these tests care had to be taken, as - due to the "unification"-dummy - standard critical values were not valid in this case.<sup>19</sup>

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<sup>19</sup>However, as HASSLER (2001) shows, for obtaining the appropriate critical values, the "unification"-dummy can - as a simple rule of thumb - be treated as an additional I(1)-variable.

**Table 2: Unit root tests**

variable	$\hat{\rho}$	t-value	lags (k)
$c_t$	-0,12	-1,80	1 - 5
$y_t$	-0,09	-2,01	1 - 5
$w_t$	-0,33	-1,83	0
$\Delta(c_t)$	-1,13	-5,21 <sup>**</sup> )	3
$\Delta(y_t)$	-1,02	-4,84 <sup>**</sup> )	3
$\Delta(w_t)$	-1,53	-9,05 <sup>**</sup> )	1

<sup>\*\*</sup>): Significant at the 1%-level

*Note:* All time series (private consumption ( $c_t$ ), disposable income ( $y_t$ ), and net financial wealth ( $w_t$ ) of private households) are real *per capita* and in logs. In levels, the parameter  $\rho$  is defined by the following test equation:  $\Delta x_t = \rho x_{t-1} + season + wv_{91:Q1} + \sum_{i=1}^k \phi_i \Delta x_{t-i} + \sum_{i=0}^k (i wv_{91:Q1})_{t-i} + u_t$ . Correspondingly, in first difference (growth rates) the following equation holds:  $\Delta^2 x_t = \rho \Delta x_{t-1} + const + season + \sum_{i=1}^k \phi_i \Delta^2 x_{t-i} + \sum_{i=0}^k (i wv_{91:Q1})_{t-i} + u_t$ . Thereby,  $wv_{91:Q1}$  represents the "unification"-step dummy,  $i wv_{91:Q1}$  is the corresponding impulse dummy, taking the value one in 1991:1, and zero otherwise. *season* embraces the modelling of the seasonal pattern.

## 3.2 Empirical results

Running a Johansen-test and estimating the correspondent vector error correction-model (VECM), allows to estimate the long-term effect of changes in net financial wealth on private consumption and to analyze short-term adjustment processes.

The Johansen-test suggests that there is a single cointegrating relationship between private consumption, disposable income and wealth (table 3). Estimating the coin-

**Table 3: Results of the Johansen-test**

null hypothesis $H_0$	estimated eigenvalue	Trace- statistic	critical value
$r = 0$	0,222	42,654 <sup>**</sup> )	35,531
$r \leq 1$	0,104	15,758	19,431
$r \leq 2$	0,036	3,956	6,015

<sup>\*\*</sup>): Significant at the 1%-level

The critical values were estimated with Disco 1.4.

tegrating VAR(4)-model<sup>20</sup> gives the following long-term relationship:

$$c_t = 0,89509y_t + 0,0542w_t + 0,0038wv_{91:1} \quad (1)$$

As the "unification"-dummy turns out to be insignificant<sup>21</sup>, this variable has been dropped from the cointegrating relation. The re-estimated long-term relation therefore becomes:

$$c_t = 0,949y_t + 0,039w_t \quad (2)$$

As all variables have been defined in logs, these parameters firstly represent point estimates for the log responses, i.e. estimates for the wealth and income elasticity of private consumption. The implied level propensities are 0,81 and 0,02. In other words, these estimates suggest that, in the long-term, if households' equity wealth changes by 100 Euro, household's consumption increases or decreases by 2 Euro.

Compared to estimates of the wealth effect for other economies, especially for economies with more developed equity markets, changes in equity wealth seem to have a rather limited effect on consumption in Germany. For the United States, for example, LUDVIGSON und STEINDEL (1999) find that a 100 dollar-increase in wealth leads to a three-to-four dollar trend increase in consumption. Within Europe, consumption-wealth elasticities are found to be much higher for France and Italy, reaching 0,3% compared to not even 0,1% for Germany.<sup>22</sup> However, given the substantial market swings over the past few years, the effect on consumption growth can nevertheless be deemed to be considerable. According to similar estimates for the consumption-wealth elasticity, DEUTSCHE BUNDESBANK (2003) assessed that in 2002, the drop in stock prices by around 40 per cent potentially reduced consumption growth by 0,2 to 0,4 percentage points. Moreover, as the international evidence shows that the size of the consumption-wealth effect significantly depends on the importance of the equity markets, stock market wealth effects in Germany can be expected to reach similar levels with German equity markets developing further.

Summarizing further empirical results not presented here in this paper, the VECM provides no evidence for significant short-term adjustment effects. The error correction-term, representing deviations from the long-term relationship, is only significant in

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<sup>20</sup>VAR(4) indicates that a lag length of 4 is chosen for variables in levels. The choice of the lag length is based on the Akaike-information criterion. Alternative criteria (Schwartz and Hannan-Quinn) point toward a lag length of 1.

<sup>21</sup>The time series are therefore "co-breaking". For more details on the definition see HENDRY und MIZON (1998), p. 280.

<sup>22</sup>See BERTAUT (2002), table 4, p. 25. Similar results for the U.S. and Europe were also found by the IMF and the OECD (see IMF (2002), BOONE ET AL. (1998, 2001)).

the income equation<sup>23</sup>. Further, the impulse response function does not point toward a significant short-term reaction of consumption growth on wealth shocks, either. Lastly, the research project finds only weak evidence for the asymmetry of the reaction to stock price movements, i.e. that the change in consumption growth differs when considering either rising or falling stock prices.<sup>24</sup>

## 4 The q-channel

Besides stock price movements having an impact on consumption, they may also play an important role for investment spending, and in particular for the investment spending of companies having access to equity finance. The second part of the research project has therefore focused on estimating a q-investment function for a panel of major German listed companies. Although the aim of this empirical analysis was to assess the relevance of stock price effects operating through the q-channel, it is also worth noting that, in addition to being one of the few studies for Germany using micro data, this is the first time, that data from consolidated accounts rather than from stand-alone accounts has been used estimating the q-function.

### 4.1 The data

The q-model has been estimated using data for an unbalanced panel of 111 major listed<sup>25</sup> German (non-financial) companies over the period 1987-2002. Company accounting data has been taken from the Hoppenstedt Database<sup>26</sup>, data on stock prices and market capitalization have been derived from Datastream.

As a first step, the q-variable has been constructed.<sup>27</sup> Although theory, strictly speaking, suggests that the estimation should be based on marginal q, as in most

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<sup>23</sup>As shown in the book version of my dissertation, positive deviations may be interpreted as expected increases in future income. According to what might be expected looking at the theory, the  $ecm_{t-1}$  enters the income equation with a positive sign.

<sup>24</sup>Interpreting the error-correction term in the income equation as measuring the adjustment in expected future income, the positive growth in income - which should finally also lead to higher consumption - following stock price increases is (at the ten percent level) significantly higher than decreases in income growth in times of falling stock prices.

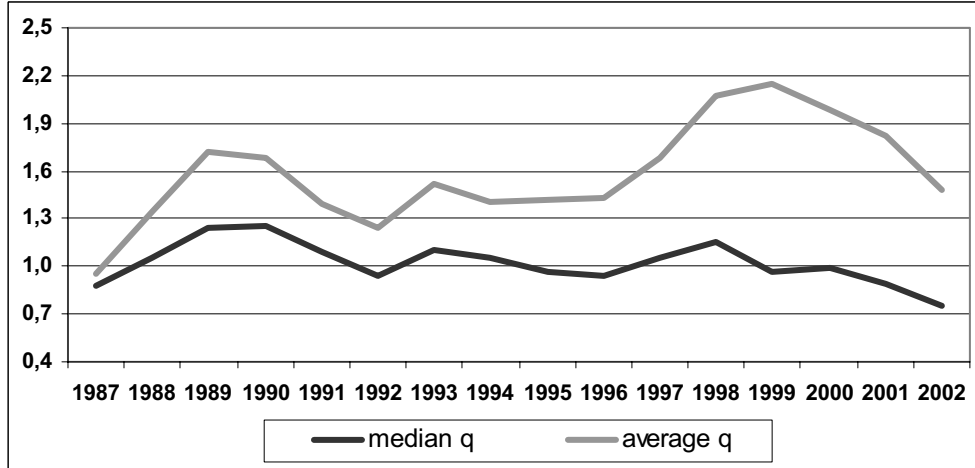
<sup>25</sup>Included in the data set are all companies that, at the start of this project in October 2003, were listed in the Prime-Segment of the German Stock Exchange.

<sup>26</sup>The author is indebted to Hoppenstedt Financial Information GmbH for providing the data.

<sup>27</sup>The detailed computation of this variable is described in the appendix.

previous empirical studies, average  $q$  has been used here. Figure 3 shows the development of the median and average values. In line with the underlying theory, median

**Figure 3: Median and average  $q$  (1987-2002)**



Source: Own calculations, annual data

values fluctuate around the equilibrium value of 1, whereas the average values reach a significantly higher level - a pattern which points toward outliers. Especially the  $q$ -values of tech-companies, which have been gaining importance at the end of the 1990s have been found to be much higher than  $q$ -values of companies in classical industry sectors.

## 4.2 Empirical results

According to the theory, investment in period  $t$ , should only depend on current values of  $q$ .<sup>28</sup> To control for the different size of the companies, investment has divided by the company's capital stock.

Equation (3) represents the starting point of the empirical analysis:

$$\frac{I}{K}{}^{it} = \alpha + \beta q_{it}^a + u_{it} \quad (3)$$

- $\frac{I}{K}{}^{it}$  : investment ratio of company  $i$  in year  $t$
- $q_{it}$  : average  $q$  of company  $i$  at the beginning of year  $t$
- $u_{it}$  : stochastic error-term

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<sup>28</sup>Under the assumptions of the theoretical model  $q$  is a sufficient statistic, i.e. lagged values of  $q$  or other variables should not enter the investment equation.

The error-term may contain company-specific effects ( $\alpha_i$ ) and time-specific effects ( $\alpha_t$ ), as well as an idiosyncratic shock  $v_{it}$ . Therefore, the following component structure of the disturbances has been adopted:

$$u_{it} = \alpha_t + \alpha_i + v_{it}. \quad (4)$$

As - according to the theory -, nothing restricts  $u_{it}$  from being serially correlated, a second dynamic specification of the investment equation can be formulated:

$$\frac{I}{K}{}^{it} = \alpha_i + \alpha_t + \beta_1 q_{it}^a + \beta_2 q_{i,t-1}^a + \beta_3 \frac{I}{K}{}^{i,t-1} + v_{it} \quad (5)$$

However, more general dynamic structures are not consistent with the model. Using this dynamic specification, it had therefore to be tested whether the model is truly consistent with the error term  $u_{it}$  following an AR(1)-process.<sup>29</sup>

Accounting for possible endogeneity problems and allowing for the possibility of the more general, dynamic model including the lagged dependent variable, the q-investment function has been estimated in first differences using a Generalised Method of Moments (GMM) estimator.<sup>30</sup>

Table 4 shows the results of the estimation of the q-investment model. Column (1) presents the results for the base model (equation (3)). The coefficient of the q-variable is positive and significant, and in contrast to other studies, the m1- and the m2-statistic do not provide a signal of dynamic misspecification. The Sargan-test confirms the validity of using lagged q-variables as GMM-instruments. Column (2) shows the results for the dynamic model. As in the base model, the coefficient of the q-variable is positive and significant. The lagged q-variable shows the expected positive sign, but does not turn out to be significant.

The coefficient of the q-variable also remains virtually unchanged and significant when different sets of instrumental variables are used. Measurement errors in the q-variable, and in particular those which might result from stock prices being detached from their fundamental values, do not seem to play a major role for this data set. In contrast to recent studies for the United States and the United Kingdom where

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<sup>29</sup>In this case, the corresponding common factor restriction must hold, i.e.  $\beta_2 = -\beta_1\beta_3$  (also see BLUNDELL ET AL. (1995), p. 700).

<sup>30</sup>For more details on this estimator see ARELLANO and BOND (1991, 2001), and BALTAGI (2001), pp. 131-136. For other recent studies also using GMM-estimators see, among others, AUDRETSCH and ELSTON (2002), ALONSO-BORREGO and BENTOLILA (1994).

**Table 4: GMM-estimation results of the q-investment model (in first differences)**

variable	standard model (1)	dynamic model (2)
$\Delta q_{it}$	0,021* (0,009)	0,032* (0,013)
$\Delta q_{i,t-1}$	- -	-0,010 (0,008)
$\Delta(\frac{I}{K})_{i,t-1}$	- -	0,064* (0,033)
AR(1)-test ( $m_1$ )	-3,686 [0,000]	-3,353 [0,001]
AR(2)-test ( $m_2$ )	-0,097 [0,923]	1,165 [0,244]
Sargan test	64,11 [0,437]	66,26 [0,244]
Comfac	- -	2.191 [0,138]
Instrumental variables	$q_{t-2}, \dots, q_{t-7}$	$q_{t-2}, \dots, q_{t-4}$ $(I/K)_{t-2}, \dots, (I/K)_{t-4}$

\*: Significant at the 5%-level

*Note:* The table shows values of the parameters and test statistics, robust standard errors (in ( )) and p-values of the test statistics (in [ ]). Time dummies were included in all equations.  $m_2$ , a test of second order serial correlation in the residuals, is asymptotically distributed  $N(0,1)$ , under the null hypothesis of no serial correlation. The Sargan-test, a Test of overidentifying restrictions, is asymptotically distributed  $\chi_{n-p}^2$ , n being the number of instruments, p the number of estimated parameters. The comfac-statistic is a test of the common factor restriction, asymptotically distributed as  $\chi_r^2$ , with r given by the number of non-linear restrictions (for details see ARELLANO and BOND (1991).)

BOND and CUMMINS (2001) and BOND ET AL. (2003) found it impossible to find valid GMM-instruments and argued that this was due to q-values reflecting non-fundamental stock price movements, instrument sets turned out to be valid in all specifications shown here.

Adding further variables confirms a typical result found in many other international studies that, in contrast to the theory, q is not confirmed to be a sufficient statistic empirically. As shown in the appendix, besides the coefficient of the q-variable, coefficients of both, turnover and cash flow variables, may turn out to be significant

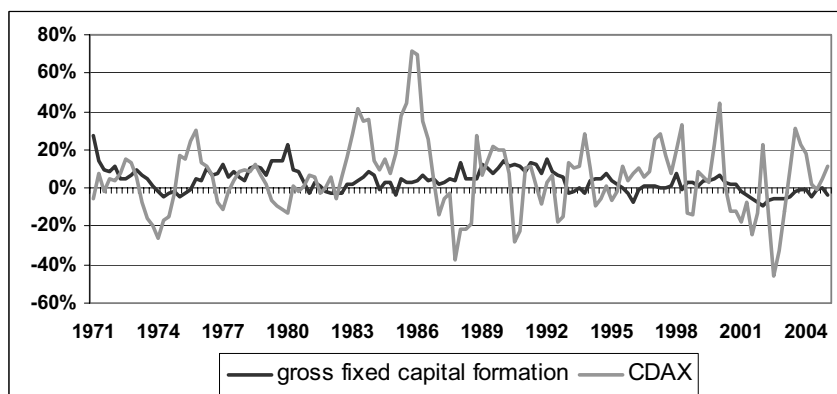


in some specifications. This general finding has been subject of an extensive, ongoing debate, the detailed analysis of which is outside the scope of this paper. More importantly here, with regard to assessing the impact of stock price movements on investment in Germany, is that also when adding these further variables the estimates of the coefficient of the q-variable prove to be very robust; i.e. the coefficient on the q-variable remains significant and within the same range as the estimates given by the base and the dynamic model.

However, whilst the q-variable is therewith found to be a significant determinant of investment, the small size of the coefficient leads to conclude that, at least over the period from 1987 to 2002, the q-channel has not played a major role for private investment. At least in the short run, it appears that the investment rate is rather unresponsive to variations in equity values. Considering, for example, an increase in market value of the company leading to a 10%-rise of the q-variable, this would be associated with an immediate rise in the investment rate of only 0,8%. This is a rather small effect, and further taking into account that only 0,2% of all German companies are incorporated in the form of stock corporations (*Aktiengesellschaften*), one may even come to the conclusion that the impact of stock price movements on investment via the q-channel are negligible.

The results of this empirical analysis are, however, to be discounted by the following aspects. Firstly, the overall impact on the economy may be larger if non-quoted companies adjust their investment plans in response to stock price developments and the investment behavior of quoted companies. Secondly, the estimation may underestimate most recent effects via the q-channel as many companies that have entered the stock market since the end of the 1990's are not contained in the data set. The use of lagged values as GMM-instruments implies that companies could only be included in the data if at least data for eight consecutive years was available. The increase in the correlation between equity returns and annual growth rates of gross fixed capital formation since the second half of the 1990s might indicate that stock price movements have become more important for private investment activity (figure 4).

**Figure 4: Equity returns and gross capital formation**



Source: CDAX: Deutsche Bundesbank; gross fixed capital formation (in current prices, from the first quarter 1970 through the fourth quarter 1990 for West Germany, data for Germany as a whole thereafter (through the first quarter 2005): Federal Statistical Office; year-on-year percentage change, quarterly data

## 5 Conclusion

Since the mid 1990s, interest in the question of how significant movements in stock prices and financial wealth affect consumer expenditure and companies' investment demand has increased. On a world-wide basis, stock markets have gained importance and substantial market swings have enhanced fears that stock market movements can cause sharp fluctuations in aggregate demand.

While the evidence for other countries, and in particular for the United States, shows that over the past few years stock market effects have been substantial, the results of the research project presented in this paper suggest that effects on the German economy, so far, have been rather limited. However, given the comparatively low stock market participation of German households and companies, this result is not surprising. Nevertheless, it is important to highlight that despite the fact that stock markets still play a minor role in the German economy, the empirical analysis confirms the existence of the main transmission channels of stock price movements. This is not only the case, as shown by the results of the research project presented in this paper, with respect of the consumption-wealth- and the q-channel, but also with respect of the balance sheet channels. Given that these transmission channels exist and that the importance of equity markets in Germany is expected to increase - e.g. in connection with the growing importance of privately funded pensions, the need of many German companies to strengthen their equity and to diversify their financing resources, and due to other structural reforms further supporting investors'

confidence (e.g. improvement of corporate governance) - more significant effects on the real economy are likely to be seen in the future.

# Appendix

## Computation of the q-variable

The approach used in this paper is based on the formula used by GEBAUER ET AL. (1994). In modification to the formula used by these authors, total intangibles are also deduced from the numerator.

*Formula for the calculation of Tobin's q:*

$$q_t = \frac{EK_t + FK_t - FA_t - IV_t}{(p_k K)_t} \quad (6)$$

with:

- $EK_t$  : market value of equity
- $FK_t$  : market value of outstanding debt
- $FA_t$  : market value of total (financial) investments
- $IV_t$  : market value of intangibles
- $(p_k K)_t$  : replacement value of the capital stock

As in almost all previous studies, book values of debt, financial investments and intangibles are used as proxies for unknown market values. Details of the calculation of the replacement value of the capital stock are given in the appendix of FORSTER (2004).

## Further results of the estimation of the q-investment model

**Table 5: GMM-estimation results of the q-investment model (in first differences) with further variables added**

Variable	(1)	(2)	(3)
$\Delta q_{it}$	0.031** (0,013)	0,030** (0,012)	0,028** (0,010)
$\Delta(\frac{C}{K})_{i,t}$	-	0,093* (0,057)	0,091* (0,054)
$\Delta(\frac{C}{K})_{i,t-1}$	0,033 (0,043)	-	0,063* (0,038)
$\Delta(\frac{Y}{K})_{i,t}$	-	0,062** (0,016)	0,067** (0,016)
$\Delta(\frac{Y}{K})_{i,t-1}$	-	-	-0,009 (0,007)
AR(2)-Test ( $m_2$ )	0,178 [0,859]	-0,776 [0,208]	-1,053 [0,292]
Sargan Test	62,70 [0,147]	89,67 [0,193]	91,99 [0,151]
Instrumental- variablen	$q_{t-2,t-3}$ $(C/K)_{t-2,t-3}$	$q_{t-2,t-3}$ $(C/K)_{t-2,t-3}$ $(Y/K)_{t-2,t-3}$	$q_{t-2,t-3}$ $(C/K)_{t-2,t-3}$ $(Y/K)_{t-2,t-3}$

\*\* : Significant at the 5%-level, \* : 10%-level

*Note:* The table shows values of the parameters and test statistics, robust standard errors (in ( )) and p-values of the test statistics (in [ ]) that are obtained when estimating equation 3 with additional variables, current and lagged values of the cash flow-capital stock-ratio ( $CF/K$ ) and/or the turnover-capital stock-ratio( $Y/K$ ). For details on the test statistics see table 4.

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ISSN Print: 1610-1502 / ISSN Internet: 1610-1499 / ISSN e-mail: 1610-1480