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Considering the Shareholder Perspective: Value–based Management Systems and Stock Market Performance*

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Abstract

We empirically study the use of value–based management systems in listed German firms and examine implications for firms' stock market performance. Using a novel, hand–collected data set covering 1,083 firm years from 2002 to 2008, we find that value–based management systems become increasingly common. Specifically, in 2008 42% of our sample firms have implemented such a system. In the empirical analysis, we find that firms that implement value–based management systems earn statistically significant and economically substantial abnormal stock market returns measured within a two-year adoption phase. These excess returns are not jeopardized by poor post-adoption returns. In the analysis, we carefully control for risk and account for endogeneity concerns. Overall, our findings support the view that shareholders consider the adoption of a value–based management system as a credible signal that management will focus on shareholder interests and that such systems actually increase shareholder value.

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1 Introduction

Value–based management systems rely on performance indicators that combine traditional accounting–based measures of firm performance with performance expectations of shareholders *(e.g. Ryan and Trahan, 2007)*.[1] Thus, with the increasing acceptance of the shareholder value principle, value-based management (VBM) systems have received much interest among managers, consultancy firms, and the financial press. Surprisingly, however, solid empirical evidence on the adoption of of VBM systems and the implications for firm performance — and more precisely for shareholders — is rather scare. With this paper, we aim to narrow this gap by studying the use of VBM systems in German listed firms and examining implications for the firms' stock market performance.

Today, shareholder value maximization is a commonly accepted goal of listed firms. Accordingly, any appropriate monitoring and incentive metric should consider investors' return expectations when evaluating managerial decisions. This is exactly what VBM metrics do: By considering returns (from invested capital) and the cost of invested capital simultaneously, VBM metrics bridge the gap between traditional — generally accounting–based — measures of firm performance and return expectations of investors. In other words, VBM metrics bring together accounting–oriented costs of operations, on the one hand and investors' opportunity cost of capital on the other. Thus, VBM metrics may constitute the basis for an economically meaningful integrated management strategy and financial control system *(e.g. Ryan and Trahan, 2007)*. Now, while this might rationalize why VBM systems have gained increasing interest, evidence on whether firms that adopt VBM systems are rewarded by superior firm performance is scarce and inconclusive. Thus, many authors ask for more research on that issue *(e.g. Davies, 2000; Ittner and Larcker, 2001; Lueg and Schäffer, 2010)*.

To gain (further) insights into the performance implications of VBM systems, we study a broad set of 178 German listed firms over a period from 2002 to 2008. Therefore, we carefully screen the annual reports of these firms and code information on whether or not a particular firm has implemented a VBM system. Note, that a natural way to study the issue is found in a classical event study design (see *Kothari and Warner, 2006* for a discussion of the event study method). However, in the context of VBM systems it is quite difficult to identify an effective *event date*, i.e. the date where the implementation of the VBM system becomes public for the

[1] We define *value–based management systems* as all types of integrated management strategy and financial control systems that rely on a metric which considers return (on invested capital) and the cost – or at least the amount – of invested capital simultaneously. We call the latter a *value–based management metric*.

first time (and in a credible manner). This becomes obvious, if one envisions the process of implementing such a management and control system in a (large) organization. And in fact, when we checked whether we can find ad-hoc announcements or news clippings on firm's implementing VBM systems or even changing their management control system, we could not find any reliable (and simultaneously usable) event. Therefore, we argue that a systematic annual report search is the best research strategy to consistently identifying whether or not a firm has implemented a VBM system.[2]

The annual report search gives us 1,083 firm year observations, for which we collect a variety of additional data. We then examine implications of the adoption of VBM systems on a firm's stock market returns. We focus on stock market returns as a performance measure for two reasons: First, it provides a direct measure for shareholder wealth effects *(e.g. Kothari and Warner, 2006)*. Second, it is less exposed to endogeneity concerns, since the firm-specific performance level is supposed to be reflected in the current valuation level.From a methodological perspective, we then proceed in two steps. First, we conduct a rather basic event study and second, we use regression analysis to examine performance implications of VBM systems. From a conceptual point of view, we argue that VBM systems help to remind managers of shareholder's interests. Adopting that view, VBM systems represent an effective mechanism to align interests of shareholders and managers. In line with this argument, we then hypothesize that the adoption of VBM systems is rewarded by superior stock market performance.

Analyzing the data, we observe an increasing propensity to implement a VBM system system: While in 2002 only one fourth of our sample firms have adopted a VBM systems, in 2008 42% of our sample firms have. Moreover, we find substantial size effects: In 2008 87% of our largest firms have adopted a VBM system. When we examine the implications for stock returns, we find that that firms which adopt VBM systems in fact earn superior stock market returns during the adoption phase. These *excess* returns, which are carefully adjusted for risk, are statistically significant and economically substantial. Moreover, these returns are not jeopardized by poor post-adoption returns and are robust against endogeneity concerns regarding the timing of the adoption. Overall, our findings support the view that shareholders consider the adoption of a value–based management system as a credible signal that management will focus on shareholder interests and that such systems actually increase shareholder value.

[2]Note, that our arguments are similar to the ones found in *Dittmann, Maug and Schneider (2009)*, who study the effect of bankers on boards. Moreover, note that screening the annual reports our sample is not affected by a potential response bias as most other studies on VBM are, since they use survey data (see also the discussion in *Lueg and Schäffer, 2010*).

We contribute to the existing literature in several ways. First, we directly examine implications for shareholder wealth. Prior literature generally analyzes the effect of VBM systems on operating performance using accounting figures *(e.g. Ryan and Trahan, 2007)*. Operating performance measures, however, are problematic since managers have some discretion with respect to accounting figures, e.g. timing of earnings (see *Lev (1989)*, *Dechow, Sloan and Sweeney (1995)*, *Sloan (1996)* and *Dechow and Skinner (2000)* for general discussions of *earnings management*.) Second, our analysis is based on a comprehensive panel data set that allows a thorough econometric analysis. This is an important issue, since the analysis of performance effect poses serious econometric problems *(e.g. Börsch–Supan and Köke, 2002)*. In line with that *Lueg and Schäffer (2010, p. 2)* argue that ill-defined data sets and methodological issues impair most of the existing analyses of VBM systems. Finally, we provide evidence on the adoption of VBM systems outside the Anglo–Saxon region. While the existing literature mainly focuses on US firms, we provide evidence of the adoption and the effects of VBM systems in Germany. Germany is known for its bank– and insider–oriented governance system with rather weak shareholder protection and is famous for its more equitable Rhine Capitalism. Generally, Germany is considered to be less shareholder oriented and thus provides an interesting setting for an analysis of VBM systems *(e.g. Böhmer, 2002; Goergen, Manjon and Renneboog, 2008)*.

The remainder of the paper is organized as follows. Section 2 reviews the related literature. Section 3 describes the data set and Section 4 discusses the distribution of VBM systems in Germany. Section 5 examines the effects of VBM systems on firms' stock market performance, and Section 6 concludes.

2 Related literature

The VBM approach aims to provide an integrated strategy and control system in order to create superior value for shareholders *(e.g. Ameels, Bruggeman and Scheipers, 2003; Ryan and Trahan, 2007)*. While *Ittner and Larcker (2001)* provide an extensive survey, the origins of the VBM approach date back almost three decades when *Rappaport* established the management doctrine of shareholder value *(e.g. Rappaport, 1981)*. The fundamental idea of *Rappaport*'s shareholder value approach is to align internal corporate goals with shareholders interest of value maximization in order to mitigate agency costs in publicly listed firms caused by the increasing separation of ownership and control. Since then, there has been a steadily increasing tendency to focus on shareholder value concepts in corporate management. As a result a large number of VBM

systems have been developed *(e.g. Ittner and Larcker, 2001; Ryan and Trahan, 2007; Lueg and Schäffer, 2010)* and there is evidence that after the adoption of a VBM system investment behavior of firms changes *(e.g. Balachandran, 2006)*.

In concept, VBM systems are built on several pillars that provide a consistent basis to evaluate, monitor and control managerial decisions over time *(e.g. Malmi and Ikaheimo, 2003; Ameels, Bruggeman and Scheipers, 2003)*. The key element of VBM systems is the fact that they rely on a metric which considers returns and the cost of invested capital simultaneously.[3] Accordingly, VBM systems link the two fundamentals of value creation: The returns generated by the firm's assets and the resources necessary to finance these assets. Thus, many commentators — in particular from consulting companies — argue that VBM systems may improve managerial decision making by identifying which investment alternatives create or destroy value: To create value, companies must generate returns on invested capital that exceed the cost of capital. They argue that VBM systems help to remind managers of shareholder's interests and thus create shareholder value. Essentially, VBM proponents claim that VBM systems represent an effective mechanism to align interests of shareholders and managers.

While from a conceptual point of view properly designed VBM metrics seem to provide a promising basis for a value-enhancing management and strategy tool, the question whether the adoption of a VBM system actually improves firm performance is an empirical one. And in fact, as *Ittner and Larcker (2001)* and *Lueg and Schäffer (2010)* point out the question whether actually implemented VBM systems can keep the conceptual promise of increasing firm performance is one of the most fundamental issues in VBM research. However, in spite of the rising number of firms adopting VBM systems and the increasing attention of researchers and the financial press solid empirical evidence on implications for firm performance and stock market returns is still very limited. This is quite surprising, especially considering that the primary goal of the VBM approach is to create superior long–term value for shareholders *(e.g. Stern, Stewart and Chew, 1995; Copeland, Koller and Murrin, 2000)*.[4]

Notable exceptions are *Athanassakos (2007)*, *Ryan and Trahan (2007)* and *Hogan and Lewis (2005)*. Examining Canadian firms, *Athanassakos (2007)* finds that firm with a VBM system earn higher stock market returns. *Ryan and Trahan (2007)* use an event–study approach to study

[3] *Ameels, Bruggeman and Scheipers (2003)* provide a nice survey of commonly used VBM metrics.

[4] There are several studies investigating the explanatory power of VBM metrics for shareholder value. The results of these studies are, however, also inconclusive. For instance, while *Stern, Stewart and Chew (1995)* and *O'Byrne (1996)* find that VBM metrics outperform traditional accounting measures when explaining stock returns, other studies do not find much evidence for that, neither in the Anglo–Saxon area (e.g. *Biddle, Bowen and Wallace (2005)* or *Dodd and Chen (1996)*) nor the European area *Kyriazis and Anastassis (2007)*.

effects for residual income of US firms and find that firm performance significantly improves after the adoption of a VBM system. *Hogan and Lewis (2005)* show that companies using residual income-based compensation plans have improved shareholder value creation after the implementation. Though, results do nor differ from a set of non-adopting control firms.

All studies, however, are limited in various ways. First, the studies of *Athanassakos (2007)* and *Ryan and Trahan (2007)* are based on survey data. Thus, both studies are faced with the standard selection bias problem. To overcome this problem, we adopt the research approach of *Lovata and Costigan (2002)* and collect our data from annual reports. Second, the analysis in *Athanassakos (2007)* is a pure cross–sectional analysis based on a sample of 39 respondents. To overcome the standard endogeneity concern of such studies, we collect an extensive panel data set and employ econometric methods that allows us to make use of the time–series dimension of our data set. Third, the study of *Ryan and Trahan (2007)* measures firm performance in terms of residual income. However, it is still an open issue whether residual income by itself is linked to shareholder value creation, which is the ultimate goal of any VBM system. Moreover, an improvement in residual income after adopting a VBM system may not only be due to an enhancement of operating activities within the firm but also due to earnings management and other accounting issues. To overcome these problems, we take a rather direct approach and examine the effect of the adoption of VBM systems upon a firm's stock market performance. Fourth, the study of *Hogan and Lewis (2005)* concentrates on companies using residual income-based compensation plans, similar to studies of *Wallace (1997)* and *Kleiman (1999)*. Therefore, we expand this approach and examine all companies using VBM systems irrespective of its type, e.g. economic profit, cash value added or cash flow return on investment. Further, our study is not limited to residual income-based compensation plans, rather we include all companies using a management control system considering return on investment and its cost of capital.

3 Sample selection and data collection process

In this section we discuss the sample selection and our data collection process. Descriptive statistics for our variables are then found in Table 2 in Section 4.

3.1 Sample selection

We define our sample as the set of all firms that have been listed in one of the four major German stock indices (DAX, MDAX, SDAX and TecDAX) during the sample period. We define the sample sample period as 2002 to 2008.[5] To avoid survivorship bias, firms qualify for our analysis in case that they have been listed in one of the indices once during the sample period. Accordingly, we collect for each of the indices the list of constituents at the end of each year in the sample period and identify the corresponding firms.Firms with stocks listed in one of these four indices have to comply with the Prime Standard regulations and attract significant media and analyst coverage.[6] Accordingly, we expect these firms to offer the highest degree of transparency regarding management strategy and control systems.

Based on the constituent lists, we identify 236 equity securities that have been listed in on of the four indices during our sample period. Adopting standard procedures, solely non-financial German firms qualify for our sample. Accordingly, we eliminate 20 securities with foreign ISIN, two securities due to double listings (i.e. the corresponding firm is listed in the indices with common and preferred stocks), and 36 securities of financial firms.

This procedure leaves us with a final sample of 178 securities and 178 corresponding firms. Given our sample period of seven years, this corresponds to 1,246 firm year observations. However, in 142 of these cases firms are not listed or do not complying with the Prime Standard regulations, so we eliminate these observations. Moreover, for 21 firm year observations (i.e. some 2% of observations) we are unable to find publicly available annual reports. Accordingly, our final sample consists of 1,083 firm year observations. Table 1 summarizes the sample construction.

3.2 Data collection process

We now describe the data collection process. Thereby, we distinguish between stock returns, standard firm characteristics and information on whether firms use VBM systems. While the former two are rather easily accessible through commercial databases, there is no primary

[5]The German stock indices have been restructured early 2003. We use the early 2003 constituents lists for the year 2002. This index restructuring represents a natural starting point, since there exists no similar classification structure prior to 2002.

[6]In EU countries, firms can generally choose between two different points of access to equity capital markets. Beside the *EU–regulated market* most exchanges also offer a market regulated by themselves. The two markets differ with respect to legal basis and status but also with respect to transparency requirements. Within the EU–regulated market the Frankfurt Stock Exchange (FWB — Frankfurter Wertpapierbörse), which is the most relevant German stock exchange, allows firms to list in one of two different market segments. While firms only willing to fulfill the EU–regulated minimum transparency level only have to list in the General Standard, firms opting for a listing in the Prime Standard have to fulfill additional transparency requirements.

Table 1: Sample description

PANEL A: Cross-sectional perspective

	# firms
Equity securities listed in major stock indices (2002-2008)	236
- Foreign ISIN	20
- Double listings	2
- Financial institutions (ICB Classification)	36
= Firms in final sample	178

Panel B: Firm year perspective

	# firm years
Maximum firm years for sample period (178 x 7 years)	1,246
- Years without listing in Prime Standard	142
- Missing annual reports	21
= Firm years in final sample	1,083

Notes: The table describes our sample. While Panel A focuses on the cross–sectional perspective, Panel B also considers the time dimension of our panel data set. Basically, we concentrate on German firms listed in one of the four major German indices (DAX, MDAX, TecDAX and SDAX) and our sample period is 2002 to 2008. Within our sample period 236 different equity securities listed in one of the four stock indices. The corresponding non-financial German firms qualify for our sample. Accordingly, we eliminate 20 securities with Foreign ISIN, 2 securities due to double listings (i.e. the corresponding firm is listed in the indices with common and preferred stocks), and 36 securities of financial firms. This procedure leaves us with a final sample of 178 securities and 178 corresponding firms. Covering a sample period of seven years, this corresponds to 1,246 firm year observations. However, in 142 of them firms are not listed or do not complying with the Prime Standard regulations (the listing segment with EU-regulated transparency standards). We eliminate these observations. Moreover, for 21 firm year observations we are unable to find publicly available annual reports. Accordingly, our final sample consists of 1,083 firm year observations.

source of information on VBM and its implementation level in German firms. Accordingly, we had to hand-collect this information.

Stock return data: Firm-specific stock return data is extracted from Thomson Datastream and stock returns are calculated using the most liquid stock of the firm. However, according to *Ince and Porter (2006)* on has to be careful with Datastream's return data. Accordingly, we carefully examined these data. For instance, we skipped observations with zero return for five subsequent month. Moreover, following *Kothari and Warner (2006)* a long-term analysis of stock-returns requires careful adjustments for risk. To do so, we examine two types of *excess returns* (explained below), which we calculate based on risk factors for the German market as reported by *Hanauer, Kaserer and Rapp (2010)*.

Firm characteristics: We collect standard firm characteristics from Thomson Worldscope and Hoppenstedt Aktienführer. Firm characteristics are used as control variables in our regression analysis.

From Thomson Worldscope, we collect information on firm size (*size*), stock market valuation (*market-to-book*), operating performance (*return on equity*), diversification levels (divers), firm growth (*growth*), asset structure (*intangibility*), RnD-intensity (*rnd-ratio*) and financial leverage (*leverage*). Specifically, we measure firm size as the logarithm of the book value of total assets. Stock market valuation level is proxied by the market-to-book ratio of equity. Operating performance is measured by return on equity. Diversification is measured as 1 minus sales in the largest business segment deflated by total sales of the firm and Firm growth is proxied by the 2-years sales growth. Asset structure is measured by intangible assets deflated by total assets and RnD-intensity by research and development expenditures deflated by sales. Financial leverage is calculated as long-term debt to total assets. Finally, industry affiliation of firms is determined according to ICB industries offered by Dow Jones Indexes and FTSE.

Finally, we collect information on ownership concentration (*free float*) from Hoppenstedt Aktienführer. All firm characteristics are explained in detail in Panel C in Table 6 in the appendix and descriptives are found in Table 2 below.

Information on the use of VBM systems: Since there is (to the best of our knowledge) no publicly accessible database with information on VBM and its implementation level in German firms, we have to hand-collect this information. Our approach here is annual report research, which differentiates us from most other studies on VBM systems (e.g. *Ryan and Trahan (1999)* and *Gleich, Sasse, Gräf and Kogler (2002)* for an overview of German studies). This gives us two

distinct advantages which stand out: First, our sample is not affected by a potential response bias, and second, we use the main source of capital market communication to identify whether firms use a VBM system.

To collect the data, we carefully review each of the annual reports, in particular the management report, the financials, the value management section, and the governance report. To ensure consistency, we defined decision rules ex ante. According to these criteria a company has implemented a VBM system in a particular year, if an internal control system with an integrated VBM metric is described and this measure is used as a target or controlling mechanism. Thereby, we follow *Ryan and Trahan (2007)* and distinguish four types of VBM systems, according to the underlying VBM metric:

Type 1:: Absolute figures on the basis of cash flows including the discounted cash flow model and the cash value added *(Rappaport, 1998)*.

Type 2:: Absolute figures on the basis of accounting data called residual income measures that display excess earnings over a capital charge adjusted to firm's risk *(Young and O'Byrne, 2001)*.

Type 3:: Cash Flow Return on Investment as relative figure on the basis of cash flows calculated as the difference between generated cash flows and the economical capital consumption, divided by total assets employed *(Myers, 1996)*.

Type 4:: Relative value oriented figures on the basis of accounting data like Return on Invested Capital or Return in Capital Employed. These measures do not directly consider the cost of capital, but are typically compared to firm's cost of capital in order to evaluative corporate performance *(Copeland, Koller and Murrin, 2000)*.

If the VBM metric is one amongst several (non-VBM) metrics, we say that the firm has adopted a VBM system. If, in contrast, a VBM metric is only mentioned as part of a key figures overview, but is not specifically described in the annual report as a control mechanism, then our rules say that the firm is to be classified as a non-adopter. We double-checked all cases and carefully discussed problematic cases.

During our data collection process, we examine 1,083 annual reports and classify the corresponding firm year observations on whether or not the corresponding firm has implemented a VBM system. This information is coded in the dummy variable *vbms*, which takes the value 1 for firm years in which firm has implemented a management and control system relying on a VBM metric.

Beyond the simple implementation dummy, we also examine whether firms just recently

invented a VBM system. Specifically, for firms that have implemented a VBM system, we also examine whether the firm has implemented the system in the current year or whether it was already established the year before. We code this information in two dummy variables: While *vbms intro* is a dummy variable taking the value 1 for firm years in which firms have implemented a VBM system for the first time (*initial implementation*), *vbms established* is a dummy that takes the value 1 for firm years in which firms have implemented a VBM system but not for the first time. Obviously, we can only observe initial implementations only between the years. Accordingly, since we only screen annual reports from 2002 to 2008, there are six time periods, where we can observe initial implementations.

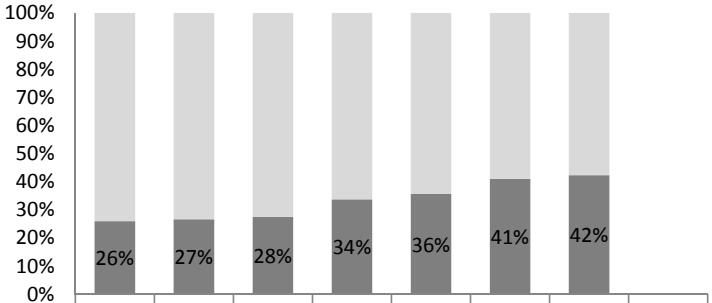
Our research approach is similar to the one used by *Lovata and Costigan (2002)*, who also collect their data from annual reports. Such an approach is based on two fundamental assumptions: a) that firms that have implemented a VBM system are likely to mention this fact in the annual report and b) that firms that report about the adoption of VBM systems, have actually implemented such a system. We are quite confident with respect to the latter presumption, since reporting about the adoption of a VBM system without actually having implemented it, would cause significant legal liabilities for all board members and even the auditor. We accept certain reservations with respect to our presumption a). However, there seems to be hardly a reason why firms should hide the information of having adopted a VBM system. And even if some firms might be inclined to keep secret the fact of the adoption of a VBM system, then we accept that our approach will underestimate the likelihood of having implemented a VBM system. Note that an approach that underestimates the actual likelihood of a VBM adoption will also underestimate the effect of VBM systems. Thus, our approach can be considered to be rather conservative, not only from the perspective of estimating the likelihood of implementations but also with respect to the estimation of VBM effects.

4 Value–based management systems in Germany

In this section, we report evidence on the adoption of VBM systems in German listed firms. Figure 1 illustrates the development of VBM systems within our sample. Overall, we observe that in one third of our firm year observations, we observe that firms use a VBM system. Thereby, we observe an increasing propensity to implement such systems: While in 2002 only one fourth of firms classify as *adopters*, in 2008 42% of our sample firms do. These findings are in line with the findings of *Ruhwedel and Schultze (2002)*, *Aders, Hebertinger, Schaffer, and Wiedemann (2003)*

and *Homburg, Toksal, and Gödde (2004)*, *Lueg (2008, 2010)* and others. Based on survey data the authors also find increasing adoption of VBM systems in Germany listed firms.

Figure 1: Development of VBM systems within the sample



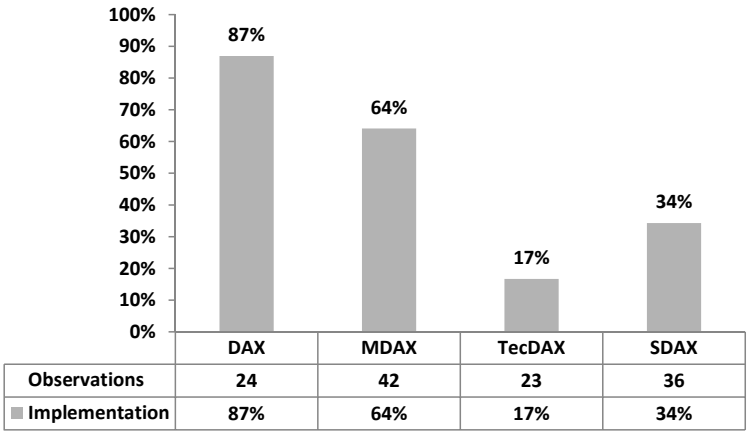
	2002	2003	2004	2005	2006	2007	2008	Total
Observations	150	150	149	157	160	161	156	1,083
VBMS = 0	74%	73%	72%	66%	64%	59%	58%	67%
VBMS = 1	26%	27%	28%	34%	36%	41%	42%	33%

Notes: The figure illustrates the development of VBM systems within the sample firms.

When we examine which firms actually implement VBM systems, we find a substantial size effect, which is illustrated in Figure 2. While in 2008 87% of our DAX firms qualify as adopters, only 17% (34%) of TecDax (SDAX) firms do.

This size effect becomes even more transparent, when looking at the descriptive statistics reported in Table 2. While Panel A reports means and medians for all firms, Panel B (C) report means for firms without (with) VBM system, and Panel D t-values for a comparison of corresponding means.

Figure 2: VBM system implementations in the four indices



	DAX	MDAX	TecDAX	SDAX
Observations	24	42	23	36
Implementation	87%	64%	17%	34%

Notes: The figure illustrates the distribution of VBM system implementations across the four indices in 2008.

Table 2: Descriptive statistics

	Panel A: All firms			**Panel B:** Firms without VBMS		**Panel C:** Firms with VBMS		**Panel D:** Comparison of means
Variable	Observations	Mean	Median	Observations	Mean	Observations	Mean	t-value
vbms	1083	0.33	0.00	721	0.00	362	1.00	n/a
vbms intro	1083	0.03	0.00	721	0.00	362	0.10	n/a
vbms established	1083	0.30	0.00	721	0.00	362	0.90	n/a
size	1071	7.03	6.82	711	6.31	360	8.46	-19.90****
market-to-book	1083	2.28	1.80	721	2.33	362	2.18	1.21
return on equity	1083	6.99	16.89	721	0.39	362	20.13	-2.63***
divers	1054	0.35	0.35	694	0.30	360	0.44	-10.02****
intangibility	1069	4.81	0.51	709	6.82	360	0.84	1.99**
rnd-dummy	1083	0.68	1.00	721	0.62	362	0.80	-6.10****
rnd-ratio	1079	0.10	0.01	717	0.13	362	0.02	2.11**
growth	1036	1.68	1.24	677	1.89	359	1.29	4.52****
leverage	1071	0.14	0.12	711	0.14	360	0.16	-2.40**
free float	1054	0.55	0.56	694	0.53	360	0.59	-3.72****
masr	855	4.40	0.16	532	2.83	323	6.98	-1.59
rasr	838	1.29	-1.87	520	0.76	318	2.15	-0.49

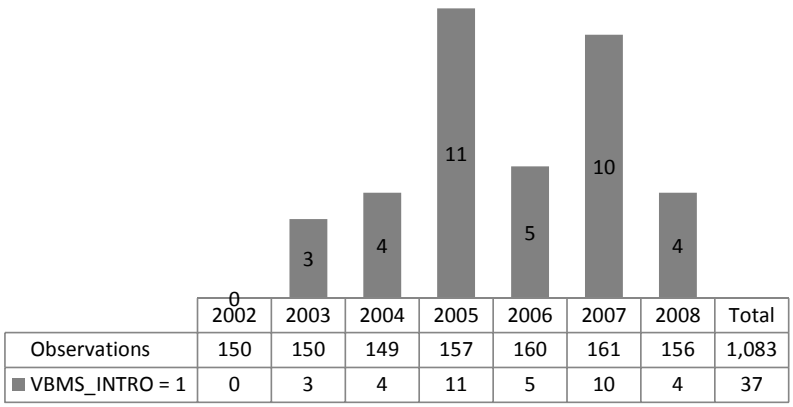
Notes: The table reports descriptive statistics for all our variables. *market-to-book* and *return on equity* are winsorized (at the 1% level). Panel A reports mean and median values of each variable for the aggregate sample. Panel B (Panel C) reports mean values of each variable for firm years without VBMS (with VBMS). Panel D reports t-values for simple difference in mean tests. All variables are described in detail in Table 6. Statistical significance at the 0.1%, 1%, 5%, and 10% level is indicated by ****, ***, **, and *, respectively.

With Panel B – D it becomes transparent that firms adopting a VBM system are significantly larger than non-adopters. This results holds even, when we use different measures for firm size (e.g. total sales, employees, or market capitalization). Moreover, the simple univariate tests reveal that adopters have higher operating performance, are more diversified, but have less intangibles in their balance sheet. Moreover, adopters show lower RnD-intensity and lower growth rates. Similar, adopters are characterized by lower leverage and lower risk. However, adopters have less concentrated ownership structure.

The last two variable (*masr* and *rasr*) are our two excess returns. While we will explain their construction in Section 5.1 in detail, we already note here that in the simple mean-comparison we do not observe any statistical significant performance differences between adopting and non-adopting firms.

For the subsequent analysis, we are particularly interested in initial implementations of VBM systems (coded in our *vbms intro* dummy variable), since they allow us to disentangle the adoption effect of VBM systems from the general effect of VBM systems. Figure 3 illustrates that we observe 37 initial implementations. It is interesting to observe that we find particularly many new implementations in the years 2005 and 2007.

Figure 3: Initial reporting of VBM systems



	2002	2003	2004	2005	2006	2007	2008	Total
Observations	150	150	149	157	160	161	156	1,083
VBMS_INTRO = 1	0	3	4	11	5	10	4	37

Notes: The figure illustrates the introduction of VBM systems within our sample firms.

5 Value–based management systems and stock market performance

In this section, we examine implications of VBM systems on firms' stock market performance. We start with a discussion of our research strategy. To carefully account for risk, we follow a two step approach. We first calculate excess returns and use these excess returns for the empirical analysis. Within the empirical analysis, we proceed in three steps. First, we we conduct simple univariate tests of excess returns of firms initially implementing a VBM system. Second, we perform standard regression analyses to gain further insights. Third, we examine the robustness of our results by applying instrument variable methods.

5.1 Research strategy

We are interested in the effect of VBM systems on the firm's stock market performance. To study this problem, we proceed in two steps: First, we conduct a rather basic event study for initial implementations. Since we cannot clearly identify an effective event date, we choose to examine a rather long event phase, which we will call *adoption phase*. Second, we use regression analysis to examine performance implications of VBM systems in general. The regression analysis does not only allow to check the robustness of our event study results but also to examine whether possible performance effects found in the event study analysis are subsequently jeopardized by offsetting post-adoption returns.

A central issue in the analysis of long-term stock returns is the issue of risk-adjustment (e.g. *Kothari and Warner, 2006*; *Kothari, Leone and Wasley, 2005*). It is well know, that the cross-section of stock returns is affected by various *factors* (see *Fama and French (1993)* and *Carhart (1997)* for the US, and *Hanauer, Kaserer and Rapp (2010)* for recent evidence from the German stock market). Accordingly, our analysis has to account for these factors, no matter whether they are actual *risk factors* or simply proxies for *market anomalies (e.g. Kothari and Warner, 2006)*.

We carefully consider these factors by analyszing *excess* (or *abnormal*) returns instead of unandjusted total shareholder returns in our analysis. Essentially, excess returns ($ESR_{j,t}$) of a stock j in period t is defined as the difference between the stock's unadjusted total shareholder return ($TSR_{j,t}$) in that period and the corresponding expected return of the stock ($ETSR_{j,t}$) predicted by some model for stock price behavior, i.e.

$$ESR_{j,t} = TSR_{j,t} - ETSR_{j,t}. \tag{1}$$

While the literature knows various methods to calculate excess returns (e.g. *Brown and*

Warner, 1980; *Kothari and Warner, 2006*; *MacKinlay, 1997*; or *Kothari and Warner, 2006*), we only consider two measures of excess return:[7]

- The *market-adjusted excess return* is calculated as the difference between the firms' stock return and the return of an investment in a broad portfolio of German non-financial CDAX-firms as calculated by *Hanauer, Kaserer and Rapp (2010)* *(e.g. Brown and Warner, 1980)*.

- The *risk-adjusted excess return* is calculated as the difference between the firms' stock return and the return of a *Carhart (1997)*-equivalent investment, i.e. an investment with the same sensitivities to the four *Carhart (1997)*-risk factors *(e.g. Kothari, Leone and Wasley, 2005)*.

To calculate the risk-adjusted excess return, we use the risk-factors of the German stock market as calculated by *Hanauer, Kaserer and Rapp (2010)* and determine sensitivities based on a three-year estimation period.

From a conceptual perspective, the market-adjusted excess return relies on a simple market model, while the risk-adjusted excess return relies on the analysis of *Carhart (1997)*, which was heavily influenced by the analysis of *Fama and French (1993)*. The four factor model of *Carhart (1997)* is the most complete commonly applied factor model of asset pricing *(e.g. Campbell, 2000)*. Accordingly, risk-adjusted excess returns seem more appropriate for the analysis than market-adjusted returns. However, since even today various studies rely on a simple market model *(Kothari and Warner, 2006)*, to allow for comparability of results we also report results for market-adjusted excess returns.

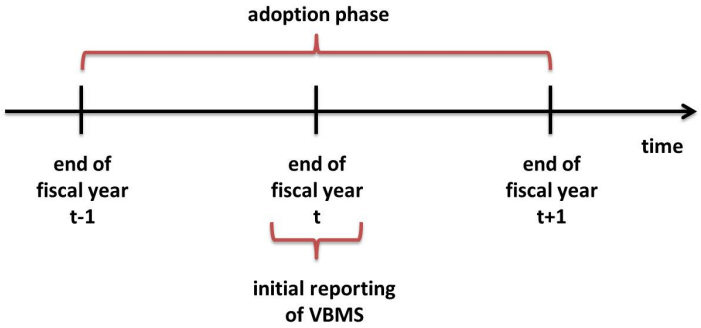
As already mentioned, we were able to identify 37 initial implementations. Unfortunately, we face the problem, that we cannot clearly define an *event* as used in classical event-studies. Accordingly, we examine the stock price behavior over an *adoption phase*, which we define as the time interval spanning the fiscal year in which the firm initially implements the VBM system plus the following fiscal year (see Figure 4).

With this idea in mind, we consider annualized returns over a two years horizons subsequently. More precisely, our variables of interest are

- the annualized market-adjusted stock return over two years, labeled *masr*, which is defined as the excess return of the firm's stock compared to an investment in a broad portfolio of German non-financial CDAX-firms and

[7] See also *Campbell, Lo, and MacKinlay (1997)* and *Lyon, Barber and Tsai (1999)* and *Kothari and Warner (2006)* for a critical discussion methods to test long-run excess returns.

Figure 4: Illustration of adoption phase



Notes: The figure illustrates the timing of the adoption phase.

- the annualized risk-adjusted stock return over two years, labeled *rasr*, which is defined as the excess return of the firm's stock compared to a *Carhart (1997)*-equivalent investment strategy.

With these variables, we then conduct a three-step empirical analysis. First, we use simple univariate analyses to examine whether firms that initially implement a VBM system earn excess returns over the adoption phase. Second, we perform standard regression analyses to confirm the results of the univariate analysis and to gain further insights, specifically, concerning post-adoption returns. Finally, we account for endogeneity concerns with respect to the timing of the adoption of VBM systems and re-examine the regression results using instrument variable methods.

As we have seen already in Table 2 reporting descriptive statistics, in the univariate setting there is no significant difference between the excess performance of VBM adopting firms and their counterparts, i.e. firms without a VBM system. However, whether this holds true for the adoption phase or in a multivariate regression setting, is examined in Section 5.2 and 5.3, respectively.

5.2 Simple univariate analysis

In the first step of the empirical analysis, we examine whether firms that adopt a VBM system earn superior returns during the adoption phase. Although we observe 37 introductions, excess returns are only feasible for 29 introductions. Table 3 reports average annualized excess returns for these firms during the adoption phase. They amount to 8.99% in the case of the market-

adjusted excess return *masr* and 13.17% in the case of the risk-adjusted excess return *rasr*.

Table 3: Univariate tests of stock returns during the introduction phase of VBMS

Method		**t-test**		**Wilcoxon signed-rank test**
	Observations	Mean	t-value	z-value
masr	29	8.99	1.92*	1.676*
rasr	29	13.17	3.28***	2.822***

Notes: We report simple univariate tests of a firm's stock price performance during the introduction phase of VBMS. We identify 37 introduction phases within our sample. To capture the effect of the introduction on the firm's stock price performance, we measure the firm's stock return over two years: the year in which the firm introduces the system and the successive year. We measure the firm's stock price performance in two ways. First, we use *masr*, an annualized 2-years market-adjusted stock return (in %) defined as the excess return of the firm's stock compared to an investment in a broad portfolio of German non-financial CDAX-firms as calculated by *Hanauer, Kaserer and Rapp (2010)*. Second, we use *rasr*, an annualized 2-years risk-adjusted stock return (in %) defined as the excess return of the firm's stock compared to a *Carhart (1997)* equivalent investment. In the table we report average values for *masr* and *rasr* for 29 introduction phases, for which we can observe *masr* and *rasr*. Moreover, we report t-values for simple t-tests and z-values for Wilcoxon signed-rank tests. Statistical significance at the 0.1%, 1%, 5%, and 10% level is indicated by ****, ***, **, and *, respectively.

A simple t-test reveals that both values are significantly different from zero. This finding is reinforced by the result of a Wilcoxon signed-rank test. However, if we compare the excess returns with the excess returns of all other firms in our sample (not reported here), then we only find statistical differences for the risk-adjusted excess return.

These findings provide first evidence, that firms that adopt a VBM system are rewarded by the stock market: shareholders seem to consider the adoption of a value–based management system as a credible signal that management will focus on shareholder interests, which in turn increases shareholder value.

5.3 Regression analysis

In the second step, we perform standard regression analyses. Thereby, the goal is twofold: First, we aim to confirm the findings from the univariate analysis. Second, we examine whether we find positive effects beyond the adoption phase or whether the positive effect of a VBMS-adoption even disappears over time.

We examine these issues in a multivariate regression setting. Specifically, we follow *Dey (2008)* and others and include the lagged performance measure on the right hand side of the

regression equation. More precisely, we estimate the following model

$$ESR = \alpha + \beta_1 \cdot \textit{vbms intro} + \beta_2 \cdot \textit{vbms established} + \gamma_0 \cdot lESR + \sum_j \gamma_j X_j + \varepsilon \qquad (2)$$

where ESR ($lESR$) is the (lagged) excess stock return, *vbms intro* and *vbms established* are the variables discussed above, $X_1, \cdots, X_J$ represents the vector of control variables, and ε accounts for the unexplained residual of the left hand side variable.[8]

Essentially, Model (2) examines, whether our variables of interest have explanatory power (for a firm's stock market performance) beyond the lagged endogenous variable and other controls. As a robustness test, we also estimate a version of model (2) where all controll variables are lagged one period. Such a model is a version of the adjusted Granger specification as discussed by *Dittmann, Maug and Schneider (2009)*.

The results reported in Table 4 confirm the results from the above analysis: Firms earn substantial excess returns during the adoption phase. Depending on the model the excess return during the 2-year adoption phase is found to be between 10% (Model SR.1) and 16% p.a. (Model SR.3). These figures are both statistical (highly) significant and economically quite substantial.

Moreover, model SR.1 in the first column of Table 4 suggests that VBMS-adopting firms are also able to earn market-adjusted excess returns even after the adoption phase. However, the analysis of risk-adjusted excess returns in model SR.2 and SR.3 reveals that while there might be tendencies for positive effects, they are hardly statistically significant. Still, it is interesting to note, that the adoption effects are not jeopardized by poor post-adoption returns.

Robustness of results: In the third step, we challenge our previous findings taking into account endogeneity concerns with respect to the timing of the adoption of a VBM system. To be more concrete, a critical commentator might raise the concern that the timing of the VBMS-adoption is a discretionary decision of the firm's own management. Specifically, the management might want to establish a novel management and strategy tool, when it anticipates that the firm will perform well in the future. A simple reason might be that changing the management system might allow the management to alter its compensation structures and thus it might deliberately time the adoption of a VBM system. Obviously, in such a scenario standard OLS methods as applied in Table 4 would produce biased results. We account for such concerns

[8] In Model (2) we use the common notation with a one-period lagged endogenous variable on the right hand side *(e.g. Dey, 2008)*. Note, however, that our performance period is 2 years, i.e. we measure *masr* and *rasr* over two years. Now, since we use yearly observations in the regression specifications below, the right hand side variable $lESR$ in these specifications is actually lagged for two periods.

Table 4: Explaining market-adjusted and risk-adjusted stock returns

Model	**SR.1**	**SR.2**	**SR.3**
Dependent variable	*masr*	*rasr*	*rasr*
Estimation Method	OLS	OLS	OLS
SE Method	Clustered Robust	Clustered Robust	Clustered Robust
vbms intro	10.110**	14.628***	16.137****
	[2.29]	[3.21]	[3.56]
vbms established	7.912***	4.900	5.781*
	[2.62]	[1.45]	[1.73]
masr [-2]	0.010		
	[0.16]		
rasr [-2]		0.027	0.095**
		[0.54]	[2.10]
size	0.050	-0.368	
	[0.07]	[-0.39]	
size [-1]			-0.017
			[-0.02]
market-to-book [-1]	-1.503	-0.724	-0.649
	[-1.33]	[-0.79]	[-0.93]
return on equity	0.211****	0.202****	
	[4.42]	[3.56]	
return on equity [-1]			-0.050****
			[-15.19]
divers	8.448	4.084	
	[1.45]	[0.64]	
divers [-1]			-0.292
			[-0.04]
intangibility	-0.032****	0.004	
	[-3.42]	[0.40]	
intangibility [-1]			-0.020**
			[-2.33]
rnd-ratio	-0.323	-0.108	
	[-0.41]	[-0.10]	
rnd-ratio [-1]			0.259
			[0.39]
growth	6.129****	4.440**	
	[4.53]	[2.51]	
growth [-1]			2.361**
			[2.21]
leverage	-13.439*	-8.968	
	[-1.73]	[-1.04]	
leverage [-1]			4.262
			[0.42]
free float	-5.483	-2.764	
	[-1.08]	[-0.47]	
free float [-1]			-4.891
			[-0.76]
Industry effects	Yes	Yes	Yes
Year effects	Yes	Yes	Yes
Observations	650	627	624
Firms	133	133	134
adj. R^2	0.222	0.120	0.126

Notes: The table reports results of regression models explaining firms' market- and risk-adjusted stock price performance. We measure a firm's stock return over two years, i.e. the current and the coming year and in two ways. First, we use *masr*, a 2-year market-adjusted stock return (in %) defined as the excess return of the firm's stock compared to an investment in a broad portfolio consisting of all German non-financial CDAX-firms as calculated by *Hanauer, Kaserer and Rapp (2010)*. Second, we use *rasr*, a 2-year risk-adjusted stock return (in %) defined as the excess return of the firm's stock compared to a *Carhart (1997)* equivalent investment (monthly risk factors are taken from *Hanauer, Kaserer and Rapp (2010)* and sensitivities are determined on a 3-year estimation window). While model SR.1 explains *masr*, model SR.2 and SR.3 explain *rasr*. Our primary variables of interest are *vbms intro* and *vbms established*. *vbms intro* is a dummy variable indicating whether the firm has adopted a VBMS in the particular year and *vbms established* indicates whether the firm has an established VBMS in place. In each of the models we follow *Dey (2008)* and others and use the lagged endogenous variable as a right hand side variable, i.e. we ask whether our variables of interest have explanatory power beyond the lagged endogenous variable. Moreover, in each of the models we control for various firm characteristics as well as fixed time and industry effects. While model SR.1 and SR.2 use current firm characteristics, in model SR.3 firm characteristics are lagged one period. Accordingly, model SR.3 is a version of the adjusted Granger specification as discussed by *Dittmann, Maug and Schneider (2009)*. All variables are described in detail in Table 6. We report Huber/White heteroscedasticity robust t-values that allow for clustering on firm level in brackets. Statistical significance at the 0.1%, 1%, 5%, and 10% level is indicated by ****, ***, **, and *, respectively.

by applying instrument variable (IV) methods.[9]

Results of our IV-estimates are reported in Table 5.We estimate three models: Model SR.4 and SR.5 use a pooled approach with fixed year and industry effects and replicate model SR.1 and SR.2 from Table 4, where we follow *Dey (2008)* and others and use the lagged endogenous variable as an additional right hand side variable. In contrast, model SR.6 uses a firm-fixed effects approach. Allowing for fixed firm effects, we only use standard firm characteristics and do not consider the lagged endogenous variable, since this would severely bias our SE estimates. In all three models, we instrument our variable of interest *vbms intro* by *vbms prop*, which aims to measure external pressure to implement a VBM system. More precisely, *vbms prop* is calculated as the annual average degree of VBMS-implementation within the industry where the firm itself is not considered, whenever the firm has not implemented a VBM system (and zero otherwise). While the level of *vbms prop* is determined outside the firm by considering the implementation level within the corresponding industry, it it has substantial explanatory power for our variable of interest *vbms intro* in the first stage regressions (corresponding z-values are well above 10).

Again, the results of the IV-analysis support our previous findings: Firms that adopt a VBM system earn substantial excess returns during the adoption phase and these effects are not reversed subsequently. While the coefficients of interest in the IV-models are actually even higher than in the standard OLS regression, the fixed firm effects model SR.6 confirms the level of the OLS estimate: There the risk-adjusted excess return is estimated to be close to the 10% to 16% p.a. from the OLS estimates.

Overall, these findings reinforce the evidence found in the univariate analysis of adoption returns that VBMS-adopting firms are rewarded by the stock market. Moreover, these adoption effects do not disappear over time suggesting that the adoption of a VBM system actually increase shareholder value.

6 Conclusion and Outlook

VBM systems have generated increasing interest among managers, consultancy firms, and the financial press. Surprisingly, however, empirical evidence on the relationship between the adoption of VBM systems and firm performance is scarce. With this study we aim to fill that gap: We empirically examine the effect of VBM systems on firm performance, in particular on

[9] IV methods allow to circumvent the endogeneity problem. The challenge, however, is to find an appropriate instrument (see *Wooldridge (2002)* for a detailed discussion).

Table 5: Explaining risk-adjusted stock returns using instrument-variable methods

Model	**SR.4**	**SR.5**	**SR.6**
Dependent variable	*rasr*	*rasr*	*rasr*
Estimation Method	IVA	IVA	IVA-FFE
SE Method	Clustered Robust	Clustered Robust	Jackknife
vbms intro	29.588****	29.608****	17.857*
	[3.71]	[3.72]	[1.83]
vbms established	6.873*	6.672*	8.617
	[1.97]	[1.90]	[1.32]
rasr [-2]		0.028	
		[0.55]	
size	-0.569	-0.468	-35.495****
	[-0.62]	[-0.49]	[-4.26]
market-to-book [-1]	-0.590	-0.669	-6.119**
	[-0.68]	[-0.73]	[-2.52]
return on equity	0.203****	0.195****	-0.038
	[3.48]	[3.42]	[-0.15]
divers	4.519	4.438	
	[0.70]	[0.70]	
intangibility	0.005	0.005	
	[0.47]	[0.47]	
rnd-ratio	-0.054	0.011	
	[-0.05]	[0.01]	
growth	4.913***	4.594**	
	[2.82]	[2.53]	
leverage	-9.876	-9.704	67.094**
	[-1.13]	[-1.12]	[2.49]
free float	-3.702	-3.880	-34.391***
	[-0.63]	[-0.66]	[-2.75]
Instrument(s)	*rasr* [-2], *vbms prop*	*vbms prop*	*vbms prop*
Industry effects	Yes	Yes	No
Firm effects	No	No	Yes
Year effects	Yes	Yes	Yes
Observations	623	623	824
Firms	133	133	140
adj. R^2	n/a	n/a	n/a

Notes: The table reports results of regression models using the instrument variable approach to explain firms' risk-adjusted stock price performance *rasr*, which is defined as the excess return (in %) of the firm's stock compared to a *Carhart (1997)* equivalent investment over two years. Our primary variable of interest is *vbms intro*, which is a dummy variable indicating whether the firm has adopted a VBMS in the particular year. We use an instrument variable approach (IVA) to account for possible endogeneity concerns with respect to the timing of the introduction of the VBMS. Our instrument is *vbms prop*, which aims to measure external pressure to implement a VBM system. More precisely, *vbms prop* is calculated as the annual average degree of VBMS implementation within the industry where the firm itself is not considered, whenever the firm has not implemented a VBM system (and zero otherwise). Model SR.4 uses a pooled approach with fixed year and industry effects and replicates model SR.3 from Table 4, where we follow *Dey (2008)* and others and use the lagged endogenous variable as a right hand side variable, i.e. we ask whether our variable of interest has explanatory power beyond the lagged endogenous variable. In contrast, model SR.5 uses a firm-fixed effects approach. Allowing for fixed firm effects, we only use standard firm characteristics and do not consider the lagged endogenous variable, since this would severely bias our SE estimates. All variables are described in detail in Table 6. We report Huber/White heteroscedasticity robust t-values that allow for clustering on firm level in brackets for model SR.4-5 and Jacknife standard errors for model SR.6. Statistical significance at the 0.1%, 1%, 5%, and 10% level is indicated by ****, ***, **, and *, respectively.

firms' stock market returns. We focus on stock market returns as a performance measure for two reasons: First, it provides a direct measure for shareholder wealth effects, second, it is less exposed to endogeneity concerns, since the firm-specific performance level is supposed to be reflected in the current valuation level.

To examine our research questions, we use a novel hand–collected panel data set covering 1,083 firm years of large German firms between 2002 and 2008. Carefully screening annual reports of our sample firms, we find an increasing propensity to implement a VBM system system: While in 2002 only one fourth of our sample firms have adopted a VBM systems, in 2008 42% of our sample firms have. Moreover, we find substantial size effects: In 2008 87% of non-financial firms listed in the DAX have adopted a VBM system.

Assuming that VBM systems are an effective governance mechanism to align interests of shareholders and managers, we hypothesize that the adoption of VBM systems is rewarded by superior stock market performance. In the empirical analysis, we then find that firms which use VBM systems in fact earn abnormal stock market returns. These returns, which are carefully adjusted for risk, are statistically significant and economically substantial: Depending on the model the excess return during the 2-year adoption phase is found to be between 10% (Model SR.1) and 16% p.a. (Model SR.3). Moreover, these returns are not jeopardized by poor post-adoption returns. Moreover, they are robust against endogeneity concerns regarding the timing of the adoption.

In sum, we conclude that our findings support the view that shareholders consider the adoption of a value–based management system as a credible signal that management will focus on shareholder interests and that such systems actually improve shareholder value.

However, we also note that our analysis has some limitations and leaves some question unresolved. First, our analysis is *outside-in* and we cannot differentiate between various levels of VBMS-implementation. It would be interesting to see, whether various degrees of implementation levels, e.g. whether or not management compensation is linked to the VBM metric, affect firm performance in different ways. Second, our analysis does not examine the way how managerial decision making in VBMS-adopting firms differs from their counterparts. Thus, further research is needed to understand whether firm decisions, e.g. payout decisions or more general capital allocation within the firm, of VBMS-adopting firms are superior. Finally, critical commentators might argue that its not the adoption of a VBM system, but the adoption of any reasonable management and strategy tool, which drives our results. While this arguments seems unreasonable to us, since also non-adopting firms in our sample might have implemented a

management and strategy tool, further research is needed to convince critics. In sum, all three points provide fruitful avenues for further research.

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A Definition of variables

Table 6: Definition of variables

Variable	Description	Source
Panel A: VBMS data		
vbms	Dummy variable taking the value 1 for firm years in which firms have implemented a management and control system relying on a value-based performance metric	annual reports, individual research
vbms intro	Dummy variable taking the value 1 for firm years in which firms have implemented a management and control system relying on a value-based performance metric for the first time	– " –
vbms established	Dummy variable taking the value 1 for firm years in which firms have implemented a management and control system relying on a value-based performance metric for at least the second year in the sample period	– " –
vbms prop	Measure of external pressure to implement a VBM system calculated as the annual average degree of VBMS implementation within the industry where the firm itself is not considered, whenever the firm has not implemented a VBM system (and zero otherwise)	own calculation
Panel B: Stock return data		
masr	annualized 2-year market-adjusted stock return (in %), defined as the excess return of the firm's stock compared with an investment in a broad portfolio of German non-financial CDAX-firms as calculated by *Hanauer, Kaserer and Rapp (2010)* (we eliminate observations with four successive monthly return equal to zero)	Thomson Datastream, own calculation
rasr	annualized 2-year risk-adjusted stock return (in %), defined as the excess return of the firm's stock compared with a *Carhart (1997)* equivalent investment (monthly risk factors are taken from *Hanauer, Kaserer and Rapp (2010)* and sensitivities are determined on a 3-year estimation window; we eliminate observations with four successive monthly return equal to zero)	– " –
Panel C: Firm characteristics		
size	Firm size measured by logarithm of total assets	Thomson Financial
market-to-book	Measure of valuation level of equity defined as market capitalization of equity divided by the book value of equity (winsorized as the 1%-level on an annual basis and undetermined for firm years with negative book value of equity)	– " –
return on equity	Measure of operating performance defined as earnings before taxes (EBT) deflated by the book value of equity (winsorized as the 1%-level on an annual basis and undetermined for firm years with negative book value of equity)	– " –
divers	Measure of diversification calculated as 1 minus sales (or revenues) of the largest segment deflated by total sales (or revenues)	– " –
growth	Maesure of firm growth calculated as current sales deflated by sales the year before last year	– " –
intangibility	Measure of intangibility of assets calculated as intangible assets divided by fixed assets	– " –
rnd-dummy	Dummy variable taking the value of 1 in the case that the firm reports research and development expenditures	– " –
rnd-ratio	Measure of RnD intensity calculated as research and development expenditures deflated by total sales (firms not reporting RnD expenditures are treated as having zero research and development expenditures)	– " –
leverage	Leverage measure calculated as long-term debt deflated by total assets	– " –
free float	Measure of free float calculated as 1 minus percentage of voting rights accumulated by the three largest shareholders reported by Hoppensted Aktienführer	Hoppenstedt Aktienführer

Notes: The table describes our variables, their definition and their sources. Stock returns are calculated using the most liquid stock of the firm.