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The impact of Business Intelligence systems on stock return volatility

Eran Rubin [a,*], Amir Rubin [b]

[a] Faculty of Technology Management, Holon Institute of Technology (HIT), Holon, Israel
[b] Beedie School of Business, Simon Fraser University, BC, Canada and IDC, Herzliya, Israel

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ABSTRACT

Business Intelligence (BI) systems support decision-making and information-sharing in increasingly complex organizational environments. As investment in these systems is steadily increasing in a wide range of industries, it is important to understand their economic effect. Under BI, information can be accessed in a timelier manner, decisions become increasingly data driven, and reports become more informative. This, in turn, can lead to more consistent company behavior and performance. We therefore hypothesized that BI systems could help reduce the company's stock return volatility. To test this hypothesis, we empirically analyzed a large sample of firms that had deployed a BI system. Our results indicated a significant reduction in stock return volatility subsequent to BI deployment. The reduction in volatility is of similar magnitude whether the BI system is implemented to serve upper or middle management, or the knowledge workforce. Overall, the results suggested that BI systems reduce the financial risk of an organization.

1. Introduction

Business Intelligence (BI) systems support decision-making in the increasingly complex environments in which organizations operate; they allow companies to aggregate and present data in different ways. Thus, as enterprise systems provide and consume greater volumes of operational data from multiple sources, companies using BI systems can exploit the new information to gain knowledge about the business domain. This knowledge is typically associated with customer needs, the competition, conditions in the industry, and general economic, technological, and cultural trends.

Naturally, the deployment of BI systems allows for more informed decision-making. Yet the economic value of these systems is still hard to determine using traditional payoff measures. It is rare that such systems pay for themselves by cost reductions alone, since savings are only a small portion of the payoffs associated with BI deployment. As a result, researchers and practitioners have called for better ways to evaluate BI systems' economic effect to understand their role and better justify their procurement.

We assumed that when a firm deploys a BI system, the risk associated with holding its stock is likely to decrease, because such systems help generate comprehensive reports that improve access to corporate information and this benefits many different groups of users, from specialists in financial reporting to salespeople and board members; it also reduces the probability of underperformance or sudden extreme decisions due to late arrival of information. Also, BI systems facilitate data-based decision strategies, by shifting the basis for decision-making from intuition to data. Intuition-based decisions are often driven by the subconscious and emotions rather than a rational decision processes. Thus, BI promotes consistent decisions and reduces risk caused by inconsistencies in the decision-making process.

Using stock return volatility as our measure of firm risk, we found support for a moderating effect of BI systems following deployment. The reduction in volatility was significant and of similar magnitude regardless of whether the BI system was implemented to serve upper or middle management, or the knowledge workforce. The essence of our main result is shown in Fig. 1, which plots the squared errors of the regression specification $r_t = \alpha_0 + \varepsilon_t$, where r_t is the return at time t, and ε_t is the error term at time t. This represents the mean volatility experienced by 129 firms during a period of 540 trading days around their BI deployment date. While different firms implemented BI at different times in the 1999–2007 period, a clear trend in volatility reduction subsequent to deployment is evident. Errors were averaged across firms each trading day.

While the properties of BI systems suggest their risk-reduction potential, other IT investments may also influence a firm's risk. A paper by Dewan et al. [7] suggested that IT investments are generally associated with the exercising of a real option. They further argue that the opportunity cost of exercising these options should lead to an increase in the company's hurdle rate and can be

* Corresponding author.
E-mail addresses: eranr@hit.ac.il (E. Rubin), arubin@sfu.ca (A. Rubin).

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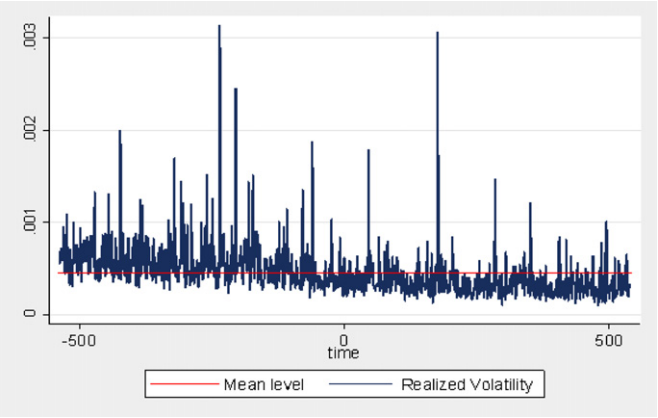

Fig. 1. The squared errors of the regression specification against time, pooled across all firms.

a significant contributor to the company's risk premium. In other studies, e.g., Ref. [6], similar results occurred in e-commerce initiatives.

2. Literature review

2.1. Business Intelligence

Broadly, the objective of BI systems is to improve the timeliness and quality of inputs to the decision process; they help companies store, find, and analyze the information they need to make better decisions.

BI systems are the natural evolution of DSS. March and Hevner [13] considered them to be composed of the DSS subsystems, as such subsystems correspond to the data warehouse in BI, and the model subsystem corresponds to the online analytical processing, knowledge discovery, and data-mining tools in BI.

BI systems are well suited to study the effects of information systems on company-related risk for two reasons. First, they are a type of enterprise system (ES) that function across different areas of the organization and are expected to have a wide effect across it. In contrast, implementation of other types of systems may not lead to enterprise-wide change.

Second, they are effective in examining volatility, while other ES do not limit their attention to decision-making and information flow. When other ES are employed, a business often undergoes dramatic changes, such as business process reengineering and organizational restructuring [12]. The effects of such improvements on volatility are ambiguous. Furthermore, other ES usually demand more significant investment and a higher level of commitment.

BI tools are being incorporated into an increasing number of businesses for use by financial managers, business executives, IT managers, and business analysts. The global BI market was worth about $8.4 billion in 2008, and is forecasted to grow to $13 billion by 2013 [3].

2.2. Event studies on IT

Since the suggestion of a "productivity paradox" was first introduced, numerous studies have proposed ways to study the relation between IT investment and outcomes. Different models have been developed to value IT investment and various productivity measures have been suggested (e.g., [5]).

One popular line of research examines the effects of IT investment on accounting performance measures such as administrative expenses, sales, number of employees, ROE, and ROA. However, early studies resulted in mixed evidence. It has been noted that the relationship between IT and productivity is more complex than suggested [17].

In subsequent research, a new productivity paradox has emerged: rather than a lack of productivity gains, highly abnormal returns on investment were found. Thus, it appeared that companies have been underinvesting in IT.

Seeking alternative measures of IT value, a recent line of research built on the traditional event study methodology.[1] Based on the notion that IT value can be determined by analyzing stock returns following announcements of IT expenditures, this approach assumed that rational investors value both the tangible and intangible benefits of an investment and hence that the market's reaction to an investment announcement captures the implications of system deployment.

Event studies have been gaining popularity in IS research in recent years. For instance, the event study approach has been used to measure the value associated with e-commerce initiatives, value creation in information-industry convergence, security breach announcements [10], and application service provider adoption [11]. Still, it is important to realize that an implicit assumption in traditional event studies is that the consequences of an event are effectively understood on investment announcement. However, IT deployment is a complex process that is affected by many ambiguous factors, including management support, affiliation, and system acceptance, and therefore this assumption may raise concerns. In contrast, event studies on volatility do not require that the market immediately understand the implications of BI systems. Rather, a lengthy event window may be defined, which allows the researcher to detect changes in volatility when the event date is not clearly defined, and it allows the market to consider the effects of a BI system over time.

Interestingly, while the effects of IT investments on stock prices have been intensively researched, studies on the effects of IT investments on stock return volatility have only recently begun to emerge. Dewan et al. explain that abnormal returns are associated with IT by incorporating IT risk measures. Dewan and Ren found that the risk-increasing properties of IT hold in the case of e-commerce initiatives. These studies highlight important effects of IT; however, the effects of other types of IT initiatives had still to be explored.

3. Theoretical foundations – Business Intelligence and volatility

BI systems improve information access through their reporting and forecasting properties. We argue that their functionalities reduce a firm's stock return volatility.

3.1. Volatility

Volatility is generally defined as the standard deviation of an asset's return. As the price of a stock changes over time, so does the variation in stock prices. It is therefore natural to think of a stock's volatility as characterized by the uncertainty that surrounds its value. Consequently, price changes are expected when new information, such as a change in dividends or report of corporate events arrives at the marketplace. The literature has long claimed, however, that the market is much more volatile than one would expect from changes in value. In recent studies, researchers have used intraday data to identify announcement effects (e.g., [2]) and found that most information concerning an event was incorporat-

[1] The empirical analysis of our paper can be considered an event study (on the return variance), we use the term "traditional event study" to refer to any study that focuses on the return of a company's stock.