



How do competitive environments moderate CRM value?

Alfred Zhu Liu^a, Hongju Liu^b, Sean Xin Xu^{c,*}

^a School of Business, University at Albany, SUNY, Albany, NY 12222, USA

^b School of Business, University of Connecticut, Storrs, CT 06269, USA

^c School of Economics and Management, Tsinghua University, Beijing, China, 100084

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ABSTRACT

Customer relationship management (CRM) plays a critical role in e-business. In this study we seek to quantify the value of Internet-based CRM applications, and the purpose of our research is to identify the mechanisms underlying CRM value creation. Using a unique dataset collected from vendor archives of CRM implementations, we find an increase in firm value associated with CRM applications. This value implication, however, is attributable to integration of CRM with existing enterprise resource planning (ERP) applications, instead of installing CRM functional modules per se. Further, we find that the integration contributes more value in markets featuring higher product differentiation or lower entry costs. Together these findings shed light on the mechanisms through which CRM applications increase firm value in specific competitive environments.

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1. Introduction

Customer relationship management (CRM) plays a critical role in e-business.¹ As pointed out by a preface article in the *Decision Support Systems'* special issue on CRM: “businesses are increasingly realizing the importance of knowing their customers better. E-businesses... are focusing their marketing efforts on building lasting ties with customers through improved Customer Relationship Management” [39, p.83]. It is thus imperative to assess CRM value given the widespread adoption of e-business in today's market (e.g., [33,38,47,68,80]).

CRM applications are enterprise information systems that digitize business processes at the customer-facing end of the value chain, including marketing, sales, and post-sales support [26]. Vendors of modern CRM applications are increasingly developing their systems based on the Internet [55].² Over a common Internet architecture, CRM applications and e-business are evolving toward an integrative suite [38,47,73]. In this study we focus on such Internet-based CRM applications, and the *purpose of our research* is to identify the mechanisms underlying CRM value creation.

As CRM applications focus on the implementation of an important marketing concept, customer relationship management, it is natural

to examine the implications of CRM applications from the framework of *market orientation* proposed by Kohli and Jaworski [43]. In their seminal paper, Kohli and Jaworski [43], from the perspective of the implementation of the marketing concept, define market orientation as the “organizationwide generation, dissemination, and responsiveness to market intelligence” (p.6). In their framework, antecedents such as interdepartmental dynamics and organizational systems are key aspects that determine the success of market orientation. And one critical consequence of market orientation is firms' business performance, whose linkage to market orientation can be moderated by environmental factors such as competition (e.g., [3,21,36,51,53]). We draw upon this framework to examine the mechanisms underlying CRM value creation and develop two related research questions, as follows.

First, Kohli and Jaworski [43] propose that interdepartmental dynamics and organizational systems are important antecedents of market orientation. For example, it is critical for a variety of departments to be aware of customer needs and to be responsive to those needs. Therefore, market orientation can be positively related to interdepartmental connectedness. In a CRM implementation, more functional modules typically generate market intelligence in multiple fronts and involve more departments within an organization, and integration with ERP facilitates interdepartmental information exchange and hence improves the entire business' responsiveness to customer needs. Regarding the functional modules, CRM applications offer rich functions to collect, process, and use customer data. The e-business literature [68] develops a notion of e-commerce CRM (ECCRM) and contends that “ECCRM systems support relationships with individual customers by maintaining rich and longitudinal data about them and rendering it useful at the touchpoint” [80, p.18]. Prior research has maintained a relationship between installing CRM *functional modules* and customer satisfaction [55]. However, as enterprise systems

* Corresponding author. Tel.: +86 10 62794508.

E-mail address: xuxin@sem.tsinghua.edu.cn (S.X. Xu).

¹ E-business refers to the use of networks and particularly the Internet for communications and transactions between businesses and consumers [75].

² Mithas et al. [55] analyzed impacts of CRM applications on customer satisfaction during the 2001–2002 period, and they noted that “the study's time frame encompasses a period when firms made significant investments in IT, particularly Internet-based and integrated suites of CRM systems” (p.206). For example, PeopleSoft Enterprise CRM[®] builds on Pure Internet Architecture[®], which uses the Web as the interface for users to access customer data, and stores and transmits the data using Internet-compatible protocols.

are evolving toward maturity and standardization, CRM's functional modules tend to become commodity-like [51]. This may weaken CRM's potential to render competitive advantage and increase firm value [14]. It remains an important topic to understand CRM value creation as the extant literature documents mixed findings.³

To better leverage customer information through the entire corporate value chain, firms are engaged in application integration [63]. While CRM applications extract customer information from customer-facing processes, enterprise resource planning (ERP) applications leverage the information to configure product offerings, scheduling, and fulfillment [35]. *Integrated CRM and ERP applications* automatically notify each other of customer-related information [63]. Therefore, CRM–ERP integration increases interdepartmental connectedness, facilitates the dissemination of market intelligence among multiple departments and improves the entire organization's responsiveness to consumer demands. To further support this argument, we use the following examples to illustrate how CRM–ERP integration is exploited by best-practice e-businesses in a variety of industry sectors for delivering quality service and enabling customization.

1. High-tech firms (e.g., Dell and IBM) integrate customer-facing processes with ERP that manage corporate resources at the backend. The integration enables collaborative planning and efficient coordination of resources along the entire corporate value chain, thus supporting products/services delivering [50,71].
2. In the apparel industry, online retailers integrate customer-facing e-business systems with ERP applications that manage product offerings and inventory. The integration enables online consumers to design their personalized packages by combining pieces of apparels that they desire [25,47].
3. Such integration has also played an important role in enabling personalized offerings in other e-business sectors such as tourism, e.g., Travelocity [73].

In sum, we are motivated to investigate the first research question (RQ1) as follows:

RQ1: Is there a positive value implication of CRM applications? And, if yes, what are the roles of installing CRM functional modules and integrating CRM with ERP applications in the value creation of CRM?

Second, the framework proposed by Kohli and Jaworski [43] also suggests that there can be environmental moderators—such as competition—on the linkage between market orientation and business performance. The salient role of competition is emphasized because the competitive environment clearly affects the consequence of marketing activities. As customers evolve along with the competitive landscape, an organization must monitor and respond to customers' changing preferences. Thus we incorporate the moderating roles of the competitive environments into our research model on CRM value creation.

The moderating effect of competition on CRM value can be addressed from two angles. First, from a marketing perspective, the benefits of market orientation are greater for firms in a competitive industry [43]. The marginal effect of investments in CRM applications therefore is related to the characteristics of the competitive market. To achieve successful CRM implementation, it is important to inform managers about where—i.e., in what specific competitive environments—they can expect salient CRM value. Second, from an IT perspective, impacts of IT are situated within the industrial contexts where firms deploy IT, and competition is a key industry factor that shapes how IT is applied to digitize business processes and generate value [53]. As IT and competition become more tightly connected than ever before, a growing strand of research explores “the nature of the link between IT and competitiveness” [51]. We extend this strand of studies to the context of CRM applications.

There are cases suggesting that, when e-businesses face intense competition as manifested in customer switching and therefore reduced profitability, CRM appears particularly valuable [44]. Yet, to our knowledge, the literature lacks systematic research addressing the question of whether and how CRM value would be contingent on competition.⁴ Therefore, our second research question (RQ2) is:

RQ2: Would CRM value be contingent on the competitive environments? If so, how?

To address these two research questions, we directly connect CRM applications to shareholder value. Theoretically, this may better capture CRM's intangible benefits [74]. Practically, it is appealing to measure shareholder value in order to justify the multimillion-dollar investment in CRM [49]. To date, evidence linking CRM applications to shareholder value is lacking in the literature [74]. To bridge this gap, we examine the relationship of CRM applications to shareholder value as measured by Tobin's *q*. This relationship represents the *value implication of CRM applications* (or, *CRM value* for short).

2. Literature underpinnings

2.1. Literature on the business value of CRM applications

Vendors (e.g., SAP and Oracle) provide modern CRM applications as a suite of functional modules. Firms can install CRM applications' marketing modules to build a multi-channel platform to distribute campaign information, sales modules to manage the selling process from lead generation to order capture to transaction, and post-sales support modules to digitize customer-support activities and offer a platform for customer self-service. Previous studies suggest that these customer-oriented functional modules, may increase efficiencies in front-line service operations and result in improved customer information.⁵

In the front office, CRM's marketing modules build on a central customer data depository in the back office and continuously collect and store customer-related information in this depository, including customer responses to campaigns, historical data about customer requests, and information about customers' first and repeat purchases [55]. Such information improves firms' knowledge about customer preferences [22], purchasing behaviors [38,54], and demand changes [58]. As such, the richer customer information helps sales forces effectively target profitable prospects [15] and enables customer self-service by providing a knowledge base of solutions [22,55]. Prior studies suggest that these front-office applications reduce the costs to reach customers and increase efficiencies in campaign execution [37], reduce administrative time in selling and enable efficient management of pipelines [1], and help identify effective solutions for customer requests and reduce response time [60].

Although the above benefits should theoretically increase firm profitability, prior studies report mixed findings about the relationships of CRM applications to return on assets (ROA), return on sales (ROS), and return on equity (ROE) (e.g., [13,34,66]; also see Appendix A). One explanation is that accounting measures may not well reflect IT-enabled intangibles and firms may experience a delay in performance improvement [14]. Hence, it is appropriate to use a forward-looking, market-based measure to assess IT value like Tobin's *q* [8].

2.2. Literature on IT infrastructure integration

A key message from the literature is that IT infrastructure integration is essential to realizing the full benefits of seamless information exchange (e.g., [27,48,55,63]). IT infrastructure integration can be

³ As reported in a recent study [34, p.593]: “CRM efforts contribute positively to firm performance..., but some studies have also found negative or insignificant results.... Furthermore, in the business press, examples of highly publicized CRM failures are rife.”

⁴ A review of the CRM literature calls for research to bridge this literature gap and emphasizes the importance of such research: “We find this omission in the CRM literature especially surprising.... We believe that a failure to integrate competition into a firm's CRM activities potentially puts it at serious risk” [13, p.161].

⁵ Appendix A presents selected empirical studies on the business value of CRM.

implemented on two levels: data consistency and application integration [63]. Data consistency means the use of compatible data definitions and application integration refers to the extent of real-time communications between applications. *Integration of CRM and ERP applications* means that each application automatically notifies the other about changes in customer-related information (e.g., customer profiles, orders, product offerings, configure-to-order requests, production scheduling, accounts and payments, fulfillment and delivery, etc.), thereby strengthening communications at the application level.

The literature⁶ so far provides limited evidence on how integration of CRM and ERP enhances firm value. Aral et al. [4] show that firms adopting *both* ERP and CRM enjoy more salient performance improvement than those adopting ERP only. Their findings suggest that firms can benefit from using CRM along with other enterprise applications. However, modern CRM and ERP applications may still lack data consistency if configured to local contexts [30]. To solve this problem, vendors offer a variety of IT services to enhance information exchange. For instance, vendors help firms use transformation engines to convert data between applications, install infrastructure software (e.g., message-oriented middleware) to route data, implement enterprise application adapters—if available—to connect applications, and develop integration tools (e.g., master data management) to allow input data to be shared among custom and packaged applications [52].

This study extends the literature in three ways: (1) We include the integration of CRM and ERP applications in the analysis of CRM's value creation. We directly measure integration of CRM with ERP applications by identifying formal IT services that strengthen automated communications between the two, using a unique dataset containing vendor's implementation archives that reliably document the integration. When integration is performed by our sample firms, ERP automatically transfers stock information and product modification to CRM applications for marketing and order processing; CRM applications automatically forward customer orders to ERP for production planning and inventory management.⁷ (2) We investigate how market competition moderates CRM value. A vast majority of the CRM literature examines the performance variation of CRM users from within the firm. We link the performance of CRM also to the external market in which firms compete. (3) We examine whether CRM applications are directly related to shareholder value, which captures the long-term future benefits of CRM applications that may not be reflected in short-term accounting performance. These extensions lead to our research model as shown in Fig. 1. Next we define model variables and form hypotheses.

3. Model and hypotheses

3.1. Market value and CRM applications

In our model, we examine the value implication of CRM applications using Tobin's q (Q), a useful measure to gauge intangible value created by IT [8,14]: it refers to the market value of a firm scaled by the replacement value of its assets.

The key inputs of value creation in our model are CRM applications. Vendors like SAP and Oracle provide functional modules for CRM and offer IT services to help firms integrate CRM with ERP.⁸ Accordingly, we use two measures to represent firms' CRM applications:

- *number of CRM functional modules installed* (MODULE), and
- *integration of CRM applications with ERP* (INTEGRATION), which

refers to whether changes in customer-related data in one application can be automatically communicated to the other; it requires IT services to be tailored to the applications' business contexts.

CRM functional modules (MODULE) may create value by increasing efficiencies in the customer-facing processes and by generating timely and comprehensive customer information (as reviewed above in Section 2.1). Integrating CRM and ERP applications (INTEGRATION) may further improve operational efficiencies by enabling value-chain processes to rapidly adjust to each other [6]. Integration can automatically update production plans and inventory levels in ERP, which helps avoid inventory costs that may occur with back orders or expedited shipping. For example, Ingram Micro, a global wholesaler, lowered its operational costs by deploying a trading system integrated with its ERP [71]. Companies can also integrate order-processing systems with ERP applications that manage product offerings. This enables sales forces to have real-time information about company policies and promotions, as well as any wrong product codes or obsolete designs, thus reducing overhead caused by order conflict [56]. Similarly, integrating CRM applications and ERP accounting systems helps increase efficiencies in debt collection, by notifying each other about updates in payments and accounts [4].

In addition, integration helps the entire corporate value chain leverage customer-related information toward improved product quality [71]. For instance, integration allows such value-chain processes as research and design, production, and logistics and fulfillment to capitalize on timely information about customer preferences, inquiries, and feedback [9,72]. Empirical research suggests that customer-information sharing along the value chain can improve internal operations in terms of more suitable design and improved product quality [63]. Therefore, in our first hypothesis we posit that *CRM applications have a positive value implication, i.e., are positively related to Tobin's q* . More specifically,

Hypothesis 1a (H1a). The number of CRM functional modules is positively related to Tobin's q .

Hypothesis 1b (H1b). Integration of CRM with ERP is positively related to Tobin's q .

3.2. Moderating effects of competition

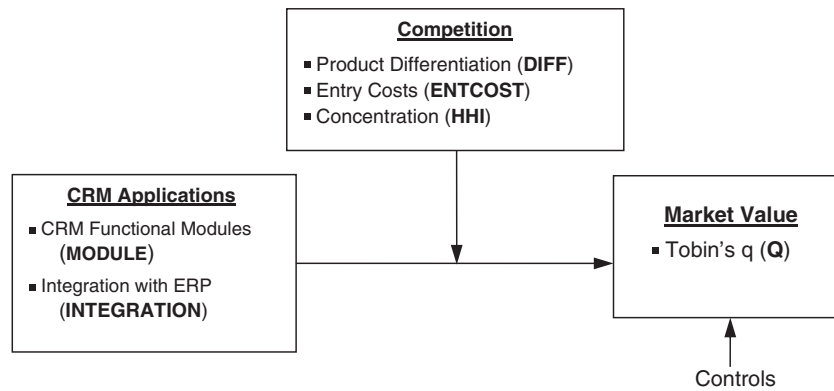
The heterogeneity in and, sometimes, contradicting findings about CRM's impact on performance raise the question of when CRM creates positive value for firms and their shareholders. In addition to incorporating whether CRM is integrated into the entire value chain (as proxy for by the integration of CRM and ERP), we also consider firms' competitive environments. As proposed by Kohli and Jaworski [43], competition is an important moderator for the performance impact of market orientation. For example, they argue that a monopolist would perform well regardless of whether or not it generates and acts on marketing intelligence, whereas the benefits of such activities are greater for organizations in more competitive industries.

Several prior studies have addressed this issue from a broader perspective. Boulding and Staelin [12] assess the generalizable effects of strategic actions on firm performance and one issue they address is what factors allow a firm to sustain excess returns due to a strategic initiative in the face of competitive reactions. In the context of returns to R&D spending, they identify conditions where knowledge about excess returns would not allow firms to compete away the excess returns. Others examine the moderating effect of competition in the context of IT value creation. For example, Melville et al. [53] investigate the productivity impact of information technology across competitive regimes, focusing on the moderating role of the competition. They demonstrate that IT provides enhanced productivity to firms in more competitive industries, and emphasize the importance of incorporating the competitive environment in studies of the productive impacts of information technology. Dong et al. [21] examine the value of IT to supply chains. Using a model incorporating

⁶ Appendix B is a review of the literature on IT infrastructure integration.

⁷ This is different than prior research that taps into integration by examining the co-existence of enterprise applications or uses a multiplicative interaction term to model applications integration (see Appendix B).

⁸ Such applications are sometimes called as an "integrated CRM and ERP suite" [61].



Note. Controls include pre-implementation performance, industry average performance, current and lagged accounting earnings, experience of using ERP, firm size, business scope, debt-to-equity leverage ratio, growth rate, capital investment intensity, marketing expenditure intensity, R&D expenditure intensity, and industry dummies.

Fig. 1. Research model.

the moderating effect of competition, they find that certain IT-related resources, in particular IT applications integration and managerial skills, are more valuable in more competitive environments.

Given that CRM is a strategic initiative that involves both marketing and IT, its impact on a firm's performance should also be examined in the competitive environment in which the firm operates. For example, what characteristics of the market competition would allow a firm to sustain the competitive advantage originated from its CRM implementation? As pointed out by Boulding et al. [13], it is surprising to see the lack of empirical evidence on the moderating role of competition on the performance impact of CRM.

We consider a multi-dimensional characterization of product market competition [42]. Specifically, we investigate three dimensions: concentration, product differentiation, and entry costs. Following Cohen and Levin [17], *market concentration* refers to the Herfindahl-Hirschman index (HHI); *entry costs* (ENTCOST) refer to the sunk costs that firms incur when entering a market [76], *product differentiation* (DIFF) is conversely related to product substitutability, the extent to which products in the market can substitute for each other [5,70]. We discuss the possible moderating effect of each one as follows.

3.3. Product differentiation

Competing in a differentiated-product market, firms can increase profits by providing customized products/services to meet customers' differentiated needs [7]. Although there may be various approaches to achieve product differentiation (e.g., tailored product feature, product mix, etc.), Barney's [7] conceptual analysis emphasizes that "in the end, product differentiation is limited only by environmental opportunities and creativity in exploiting those opportunities" (p.304). Accordingly, firms need to firstly obtain information about market opportunities and secondly rely on value chain processes to make responsive changes in products/services. In each of the two steps, firms can leverage CRM applications.

Firstly, a differentiated-product market features diverse demands. Using CRM modules helps firms collect data about customers' preferences and buying habits [55], based on which they can identify nanosegments (i.e., finer-grained market segmentation) to reveal heterogeneous customer preferences [2]. This customer information can be used for custom product design to better match existing customers' preferences and increase products' attractiveness to prospects [19,41]. In comparison, such information may be less valuable in a commodity market where custom product design may be unnecessary or infeasible [80].

Secondly, firms can integrate CRM applications with ERP, to ingrain customer information into the entire value chain. This helps improve

the collaboration of value chain processes and resource allocation to satisfy customer demands [6,71]. For instance, integration supports differentiation via bundling of products/services, by bridging the order capture for a custom bundle and the configuration of the bundle in customization centers, suppliers, and business partners [47]. Another approach to customization is producing modular components and finalizing customized products via assemble-to-order. A key to the success of this approach is order accuracy, i.e., accurate specification of customer requirements in production and inventory management [45]. Case studies confirm that exchanging order information with logistics helps ensure order accuracy [45]. Therefore, CRM-ERP integration enables not only accurate captures of customized requirements, but also timely responses in warehouses, assembly lines, and fulfillment centers. These benefits of CRM-ERP integration are especially salient in a market featuring diverse demands and differentiated products. By contrast, in a highly commoditized industry customer demand and production technology are relatively uniform, in which case it can be more challenging for firms to benefit from the detailed customer information [28,80].

In sum, following Barney's [7] conceptual analysis, we expect that firms in a differentiated-product market are better positioned to leverage CRM applications to sense and address customers' diverse demands than firms in a commodity market.

Hypothesis 2 (H2). CRM applications have a more positive value implication in markets featuring higher product differentiation.

3.4. Entry costs

In markets without significant entry barriers, firms face the constant threat of competition from new entrants and therefore profit erosion. Incumbents in such markets can cope with this threat by either improving operation efficiency and lowering costs or enhancing customer satisfaction and thus customer loyalty [7]. CRM applications, especially when integrated with ERP, improve both customer loyalty and operation efficiency, and consequently may serve to deter further entry into these markets.

Prior literature shows that CRM applications can improve customer satisfaction [55]. In return, customer satisfaction leads to repurchase and positive word of mouth, increasing sales and enlarging the customer base [11]. The increased scale of incumbents' operation may discourage market entry by potential competitors [7]. Customer satisfaction also increases customer loyalty [10,38,54]. Higher customer retention helps reduce sales and service costs [64] and long-term customer relationships have been found to lower customer management costs [65].

Moreover, integration of CRM modules with ERP applications injects customer information into a broad reach of internal operations along corporate value chains (managed by ERP applications). This further helps increase customer satisfaction which is influenced not only by companies' marketing activities at the front end but also by a variety of operations at the back end [61]. Integration of CRM and ERP applications creates an "information value chain" [71] in that customer information flows through the entire corporate value chain and consequently various value chain processes coordinate to satisfy customers.⁹ Detailed knowledge about customers would allow a firm to better forecast the demand and optimize the production process [9]. Conversely, a lack of such integrated applications may cause errors and even failures of order fulfillment, which is detrimental to customer satisfaction [31]. Integrating CRM and ERP helps avoid those errors, and furthermore, enables firms to leverage information value chains to better meet regional customer demand and reduce lead time [20], consequently increasing customer satisfaction.

In summary, CRM applications help incumbents in markets with low entry costs retain future profitability that otherwise could be competed away, while in markets with high entry costs, such benefits of CRM applications may not be as crucial.

Hypothesis 3 (H3). CRM applications have a more positive value implication in markets with lower entry costs.

3.5. Market concentration

Market concentration is a conventional measure of product market competition. However, there are alternative perspectives with respect to how CRM value may be contingent on market concentration. Firms in less concentrated markets lack the economic rents rendered by monopoly power and thus need other approaches to improve performance, such as IT-enabled efficiencies [53]. CRM applications may help firms increase efficiencies and improve quality of customer services, and better services may allow firms to charge a premium for their products [23]. Such benefits may be larger, at the margin, for firms in less concentrated markets than for monopolists [46]. This suggests a negative moderating effect of concentration on CRM value.

Several other perspectives, however, suggest a positive moderating effect of market concentration on CRM value. First, lower concentration may drive technology diffusion [17], which may compete away benefits from new technologies. On the contrary, higher concentration may help capitalize cost savings and the premium for better services by providing insulation from rivalry, which may result in a more positive link from CRM applications to Tobin's q [69]. Additionally, firms in concentrated markets may have more slack resources to engage in technology innovations and thus are more likely to achieve success in using new technologies [29].

Because of the different perspectives, we examine the moderating effect of market concentration on CRM value without predicting its net effect.

4. Method

4.1. Data and sample

We collect data about CRM applications from a major vendor (one of the top five in terms of its U.S. market share). This vendor has developed its CRM application based on the Internet architecture, that is, offering a

⁹ A case in point is the aforementioned process of product design that uses the most current customer information to respond to customers' evolving needs [50]. In another case, when customers change their profiles, an information value chain can automatically update customer records in the back office, reducing chances of using incorrect customer information in order fulfillment. An exemplar of success is United Parcel Service (UPS), which uses integrated CRM and ERP applications to transmit real-time customer information obtained in customer encounters to subsequent operations for service delivery [63].

Web-based user interface and using Internet-compatible protocols, e.g., HTML and XML, for data display and transmission.

Our sample frame includes companies that acquired CRM applications from this vendor from 2001 to 2005. Our sample selection involves the following steps. We are allowed to review this vendor's internal implementation documentation over the sample period about all buyers that declared willingness in their purchase agreements to share information with outside researchers. This helps minimize the risk of sample selection bias from vendor screening or post-purchase self-selection. From the vendor's documentation, we collect information about the timeline of implementation (i.e., the year and quarter of CRM implementation and when applications went live). This gives us a unique opportunity to quantify the market valuation of CRM implementations. We exclude governmental, educational, and non-profit organizations because we estimate Tobin's q . With these constraints, we obtain a sample of 193 firms (including private and public firms). By reviewing the vendor's implementation documentation, we are able to identify what specific functional modules each of the sample firms ordered and whether the firm ordered services to integrate CRM with ERP. We have confirmed with the vendor that it implemented the ordered modules and delivered the IT services for integration. We then merge the dataset with financial data from Compustat. Anderson et al. [3, p.1367] relate a firm's IT spending information (mainly about enterprise systems) disclosed in a quarter to the firm's market values in subsequent quarters. They find that the IT spending information has a significant relationship with the firm's future, end-of-quarter market values within one year, and that the IT spending information loses significance in explaining future market values in a longer window period. An implication to our study is that the financial market adjusts firms' market values within one year subsequent to investments in enterprise systems. We therefore retrieve financial data for each sample firm for four quarters after CRM applications go live. This procedure yields a sample of 281 observations (firm-quarters). Table 1 shows sample characteristics.

4.2. Comparison of firm value before and after CRM implementation

We start with examining our sample firms' Tobin's q (Q) before and after CRM implementation, which provides an intuitive demonstration of the value implication of CRM applications. An increase in Q after CRM implementation provides direct evidence in support of the notion that CRM increases firm value. Following Cotteleer and Bendoly [20], Fig. 2 presents the median values of sample firms' Q . Before CRM implementation, our sample firms experience deterioration in firm value as measured by Q . However, after CRM implementation, this downward drift of firm value is reversed and the average firm value starts to increase. This comparison of Q over a period centered at CRM implementation is illustrative about the impact of CRM applications on firm value.

4.3. Regression equation

To test the research model (Fig. 1) and the associated hypotheses (H1a–H3), we propose a regression equation as follows:

$$\begin{aligned}
 Q = & \text{constant} + \alpha_1 \text{MODULE} + \alpha_2 \text{INTEGRATION} \\
 & + \lambda_1 \text{DIFF} + \lambda_2 \text{DIFF} * \text{MODULE} + \lambda_3 \text{DIFF} * \text{INTEGRATION} \\
 & + \mu_1 \text{ENTCOST} + \mu_2 \text{ENTCOST} * \text{MODULE} + \mu_3 \text{ENTCOST} * \text{INTEGRATION} \\
 & + \theta_1 \text{HHI} + \theta_2 \text{HHI} * \text{MODULE} + \theta_3 \text{HHI} * \text{INTEGRATION} \\
 & + \text{controls}
 \end{aligned}
 \tag{1}$$

This regression relates Tobin's q (Q) to CRM applications (MODULE and INTEGRATION) to gauge CRM value. It includes interactions between CRM and three competition variables (DIFF, ENTCOST, and HHI) to assess the moderating effect of competition. These are theoretical variables for our hypothesis testing, summarized in Table 2 and described in detail below.

Table 1
Sample characteristics.

Category	Number of Obs.
by the YEAR when CRM applications went live	
2001	8
2002	44
2003	48
2004	116
2005	65
Total	281
by the INDUSTRY classification of the CRM users	
Distribution	32
Financial service	40
Manufacturing	84
Business service	69
Transportation service	20
Others	36
Total	281
by the NUMBER of CRM functional modules used	
1	100
2	80
3	68
4	25
5	8
Total	281
by INTEGRATION, i.e., whether firms integrated CRM with ERP applications	
Yes	56
No	225
Total	281

4.3.1. Variables for CRM applications

4.3.1.1. *MODULE*. The vendor's archive lists the number of CRM functional modules (*MODULE*) installed by a firm, which prior studies use as a proxy for the number of customer-oriented functions supported (e.g., [37,55]).¹⁰

4.3.1.2. *INTEGRATION*. The vendor's archive also documents whether formal IT services for application integration are ordered in the implementation contract—i.e., integrating CRM applications with existing ERP. Because the costs of CRM–ERP integration are a significant part of the total costs of CRM implementation, e.g., 30 to 50% of the total implementation costs [62,67], the vendor's implementation archive contains clear records for such IT services. This provides a unique opportunity to test the value implication of such integration. Rather than capturing the list of various technological solutions for CRM–ERP integration (e.g., transformation engines, data warehouse, middleware, application adapters, etc.), our measure for *INTEGRATION* indicates the outcome [72], i.e., whether or not the integration has been established. Such an indicator for integration follows prior research that uses archival implementation data to measure IT integration; for example, Mukhopadhyay and Kekre [56] use a manufacturer's archival data to indicate whether or not electronic data interchange is integrated with customers' order-processing systems.

¹⁰ The functional modules installed by our sample firms include Marketing, Online Marketing, Telemarketing, Multi-Channel Integration (enabling customers to personalize their communication channels), Sales (managing prospects' profiles, identifying up-selling and cross-selling opportunities), Mobile Sales, Order Capture, Order Capture Self Service (enabling customers to place orders and check order status via the Web), Product Configuration (particularly for complex products/services), Sales Incentive Management (managing the incentive plan for sales forces), Strategic Account Planning (focusing on high-potential accounts), Support, Support for Customer Self Service, Quality (tracking product quality and customer satisfaction), Field Service (supporting service technicians in the field), CRM Warehouse (analyzing operational efficiencies of customer service employees), and Information Synchronization (between CRM applications and tools for personal information management).

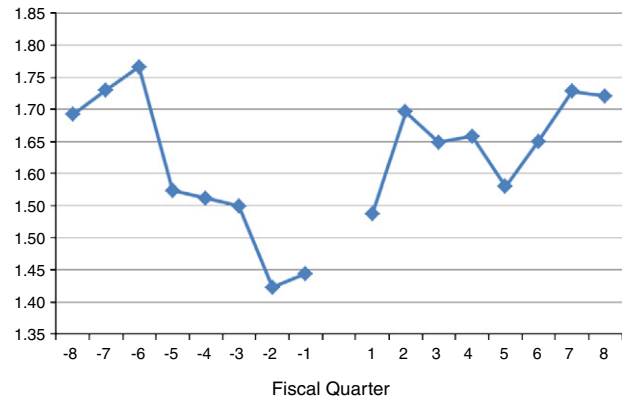


Fig. 2. Tobin's q of sample firms before and after CRM application implementation. Fig. 2 shows the median values of Tobin's q of sample firms from 4 quarters before to 4 quarters after CRM implementation. Quarter 1 is the first quarter after CRM implementation (going live). Quarter -1 is the most recent quarter before implementation. In our sample, CRM application implementation takes 8 months on average.

4.3.2. Variables for competition

Data used to compute the three competition variables (*DIFF*, *ENTCOST*, and *HHI*) are extracted from Compustat in the most recent year *before* CRM applications go live. Accordingly, they reflect the characteristics of a firm's competition environment before it starts using the vendor's CRM systems.

4.3.2.1. *DIFF*. We measure product differentiation (*DIFF*) using the variation (i.e., mean-scaled standard deviation) of the firm-level price–cost margins across all individual firms in an industry (defined by 4-digit SIC). *DIFF* is a proxy for product differentiation, because the variation of firm-level price–cost margin is positively related to product differentiation among firms [57]. A greater value of *DIFF* indicates a more differentiated product market.

4.3.2.2. *ENTCOST*. We measure entry cost (*ENTCOST*) using the natural log of the weighted average of investment in fixed assets for all individual firms in an industry (defined by 4-digit SIC), weighted by each firm's market share [42]. Accordingly, *ENTCOST* represents the normal level of capital expenditure required for an entrant to operate and compete with incumbents in an industry, thus serving as a proxy for entry costs. A greater value of *ENTCOST* suggests a higher entry barrier.

4.3.2.3. *HHI*. We measure market concentration using the Herfindahl–Hirschman index (*HHI*) [17]. We compute *HHI* as the sum of the squared market share for all individual firms in an industry (defined by 4-digit SIC). The greater the value of *HHI*, the higher is the market concentration.

4.3.3. Control variables

We also controls for other factors that may influence *Q* in our regression analysis following prior literature (e.g., [8,16,77,79]), including pre-implementation performance (*PRIOR_Q*) and industry average performance (*IND_Q*), current and lagged accounting earnings (*ROA*, *ROA₋₁*, *ROA₋₄*), firm size (*SIZE*), business scope (*SCOPE*), financial leverage (*LEV*), growth rate (*GROWTH*), capital investment intensity (*CAP_INT*), marketing expenditure intensity (*MKT_INT*), R&D expenditure intensity (*RD_INT*), and industry dummies. To better quantify the value of *INTEGRATION*, we also add a binary variable indicating whether a firm has ERP in use and an interaction between *MODULE* and this binary variable (*ERP* and *ERP*MODULE*). Definitions and data sources for these control variables are listed in Table 2.

Table 2
Variables.

(Data sources: C = Compustat; V = Vendor's implementation archive).

Variables	Measures	Data Sources
Theoretical variables		
Q (Tobin's q)	The value of common stock at the end of a fiscal quarter plus the value of preferred stock plus total debt, divided by total assets	C
MODULE (CRM functional modules)	The number of CRM functional modules installed by firms	V
INTEGRATION (CRM–ERP integration)	A binary variable: it equals 1 if firms integrate CRM modules with existing ERP applications, and 0 otherwise.	V
DIFF (product differentiation)	The variation (i.e., mean-scaled standard deviation) of the firm-level price–cost margin across all firms in Compustat in an industry (4-digit SIC). This variation is positively related to product differentiation among firms. Hence, higher DIFF indicates a more differentiated product market.	C
ENTCOST (entry costs)	The natural log of the weighted average of the costs of fixed assets for all firms in Compustat in an industry (4-digit SIC), weighted by each firm's market share. ENTCOST represents the average capital expenditure required for an entrant to operate in an industry. As such, higher ENTCOST suggests greater entry costs.	C
HHI (Herfindahl-Hirschman index of concentration)	The sum of the squared market share (in terms of sales) for all individual firms in Compustat in an industry (4-digit SIC). The greater the value of HHI, the higher the market concentration.	C
Control variables		
PRIOR_Q (pre-implementation perf.)	The value of Q in the most recent quarter before CRM implementation	C
IND_Q (industry average performance)	The average value of Q in a particular industry as defined by 4-digit SIC	C
ROA (return on assets)	Accounting earnings divided by total assets	C
ERP (having ERP in use)	Equals 1 if firms have ERP and 0 otherwise.	V
SIZE (firm size)	The number of employees, log transformed	C
SCOPE (business scope)	The number of business segments	C
LEV (debt-to-equity leverage)	Book value of debt divided by book value of equity	C
GROWTH (firm growth)	Growth rate of sales	C
CAP_INT (capital investment intensity)	Capital investment as percentage of total assets	C
MKT_INT (marketing intensity)	Selling, general, and administrative expenses divided by sales	C
RD_INT (R&D intensity)	R&D expenses divided by sales	C

5. Results

5.1. Results of hypothesis testing

Table 3 presents the regression results. We mean-center all variables involved in interactions. Before discussing the results of hypothesis testing, it is worth noting that the overall results for controls are consistent with extant research.¹¹

5.1.1. H1a/H1b: value implications of CRM applications (MODULE and INTEGRATION)

As shown in Table 3, we do not find consistently positive and significant coefficients on MODULE, so we do not find consistent support for H1a. This is consistent with the recently documented mixed results about the performance implication of CRM implementations [13,34,66]. On the other hand, the coefficients on INTEGRATION are consistently positive and significant, suggesting its role as a salient value generator. We thus find support for H1b, in that CRM applications create value mainly through INTEGRATION.

5.1.2. H2: moderation effect of product differentiation (DIFF)

Column (B) of Table 3 presents the moderating effects of competition on CRM value. The coefficient on DIFF*MODULE is not significant, while that on DIFF*INTEGRATION is significantly positive. This suggests

¹¹ Among the control variables, the lagged Q and industry average Q have positive coefficients [8,77]. We find positive coefficients on accounting earnings, although they are not significant [79]. Firm size plays a positive role [16]. Results for other controls (scope, growth, market share, capital intensity, and marketing and R&D expenditures) are elusive; prior studies also report inconclusive results about these variables [3,8,16]. A positive coefficient on HHI is consistent with higher profitability due to concentration [69]. A positive coefficient on DIFF is consistent with the notion that differentiation allows firms to avoid price competition [42]. We find a negative coefficient on ENTCOST. Recall that our measure of ENTCOST captures industry-level fixed assets (see Table 2). As such, firms in industries with higher ENTCOST on average may have higher tangible assets and thus lower Q. This is consistent with evidence in the literature [8]. ERP has a negative sign and the interaction between ERP and MODULE has a positive sign. Although Hitt et al. [35] present positive impacts of ERP on firm performance during the 1986–1998 period, Aral et al. [4] use more recent data from 1998 to 2005 and find negative impacts of ERP on firm profitability.

Table 3
Regression results – CRM value implication and competition.

(Dependent variable = Tobin's q).

	(A)	(B)
	CRM applications	CRM applications + competition
CRM applications		
MODULE	0.119 (0.40)	0.310** (0.03)
INTEGRATION	0.840** (0.03)	1.078*** (0.00)
Competition		
DIFF		1.756 (0.18)
DIFF*MODULE		1.073 (0.40)
DIFF*INTEGRATION		6.838*** (0.01)
ENTCOST		−0.144 (0.24)
ENTCOST*MODULE		0.038 (0.70)
ENTCOST*INTEGRATION		−0.735*** (0.00)
HHI		1.514* (0.08)
HHI*MODULE		0.523 (0.49)
HHI*INTEGRATION		9.183*** (0.01)
Control variables	Included	Included
# of observations	193	177
R-squared	0.760	0.822
LR test of model fit	94.00	105.87
(p-value)	(0.00)	(0.00)

See Table 2 for variable definition. P-values are shown in parentheses for 2-tailed tests based on panel data regression with random effects. *** p<0.01, ** p<0.05, * p<0.10. Controls are not tabulated for the sake of brevity, while the results are discussed in detail in the text.

a greater value of CRM–ERP integration in differentiated-product markets, partially supporting H2.

5.1.3. H3: moderation effect of entry costs (ENTCOST)

Column (B) of Table 3 shows that the coefficient on ENTCOST*MODULE is not significant, while that on ENTCOST*INTEGRATION is significantly negative. This partially supports H3, suggesting a greater value of CRM–ERP integration given lower entry costs.

5.1.4. Moderating effect of market concentration (HHI)

As shown in Column (B) of Table 3, the coefficient on HHI*MODULE is not significant and the coefficient on HHI*INTEGRATION is significantly positive. Our robustness checks (more on this below), however, do not offer consistent evidence for a positive interaction between HHI and INTEGRATION. These mixed results may be attributable to the conflicting effects of concentration on CRM value as reviewed earlier (i.e., monopoly power, slack, and insulation from rivalry).

5.2. Robustness checks

5.2.1. Robustness to sampling

Table 4 reports additional tests to examine the robustness of our results to sampling. Column (A) addresses a concern related to sample selection, in that firms with high market value are likely to have needed resources to invest in CRM applications. We follow a two-step approach introduced by Heckman [32] and applied by Bharadwaj et al. [9]. In the first step, we follow Bharadwaj et al. [9] to separate sample firms into two groups: We sum standardized MODULE and standardized INTEGRATION and code firms with values of the sum above/below the sample mean as one/zero. We then estimate a probit model to assess the effects of competition, ERP in use, pre-implementation Q, CRM experience (EXP)—i.e., indicating whether the firms had experience of using CRM before implementing the vendor's system, firm size and scope, and industry and time dummies. We identify these explanatory variables from the literature.¹² The estimated probit model is as follows:

$$\begin{aligned}
 \text{Estimated probit equation} = & 4.662 + 3.313\text{HHI} \\
 & (0.000) + (0.000) \\
 & + 0.013\text{ENTCOST} + 2.934\text{DIFF} \\
 & (0.893) + (0.029) \\
 & + 1.618\text{ERP} + 0.384\text{PRIORQ} \\
 & (0.000) + (0.000) \\
 & + 0.737\text{EXP} - 0.602\text{SIZE} - 0.124\text{SCOPE} \\
 & (0.032) - (0.000) - (0.050) \\
 & + \text{industry and year dummies}
 \end{aligned}
 \tag{2}$$

where p-values are shown in parentheses.

The estimated Eq. (2) shows that HHI, DIFF, ERP, previous Tobin's q, and EXP positively affect CRM application as expected. SIZE and SCOPE play a negative role, suggesting that inertia may act as a barrier to CRM application [55]. ENTCOST is nonsignificant, possibly because of its correlation with firm size (see Table 3). Based on the probit model, we compute an Inverse Mills Ratio (IMR) and include it in the second-stage performance regression to account for endogeneity [9].

¹² We include these variables in the probit model because the competition environment may affect firms' incentive to use CRM applications, ERP in use offers a platform for developing application integration, pre-implementation Q may affect the available resources for CRM implementation, CRM experience may render an "absorptive capacity" for using newer applications [18], and larger firm size/scope may generate economies of scale/scope in IT applications but may also result in greater organizational inertia [55].

Table 4
Robustness check – robustness to sampling.

(Dependent variable = Tobin's q).

	(A) Endogeneity test	(B) Winsorize top and bottom 5%	(C) Cook's D below 2
MODULE	0.261 (0.18)	0.276** (0.05)	0.332** (0.02)
INTEGRATION	1.020** (0.03)	1.193*** (0.00)	1.187*** (0.00)
DIFF	1.324 (0.32)	2.722* (0.04)	1.750 (0.19)
DIFF*MODULE	1.057 (0.41)	1.349 (0.28)	1.164 (0.37)
DIFF*INTEGRATION	6.418** (0.02)	9.902*** (0.00)	7.174*** (0.01)
ENTCOST	−0.120 (0.32)	−0.148 (0.23)	−0.162 (0.19)
ENTCOST*MODULE	0.030 (0.76)	0.030 (0.77)	−0.003 (0.98)
ENTCOST*INTEGRATION	−0.498* (0.08)	−0.654*** (0.01)	−0.876*** (0.00)
HHI	1.316 (0.13)	2.006 (0.05)	1.474 (0.10)
HHI*MODULE	0.392 (0.61)	0.753 (0.44)	0.592 (0.45)
HHI*INTEGRATION	8.065** (0.02)	10.621*** (0.00)	9.687*** (0.01)
Inverse Mills Ratio	−0.140 (0.59)		
Control variables	Included	Included	Included
# of observations	169	177	175
R-squared	0.816	0.834	0.815
LR test of model fit (p-value)	102.51 (0.00)	109.79 (0.00)	110.9 (0.00)

See Table 2 for variable definition. P-values are shown in parentheses for 2-tailed tests based on panel data regression with random effects. *** p<0.01, ** p<0.05, * p<0.10. Controls are not tabulated for the sake of brevity, while the results are discussed in detail in the text.

Table 4 Column (A) shows that, after modeling endogeneity by including IMR, the results for CRM applications and competition variables remain qualitatively unchanged. This test suggests that sample selection is not a harmful issue in our regression.

Columns (B) and (C) report the robustness of our results to influential cases, if any, in our sample. We winsorize each of the three competition variables by setting the values in the bottom and top 5 percentiles to the values of the 5th and 95th percentiles, respectively. We report the result in Column (B). Alternatively, we exclude observations with Cook's D greater than or equal to 2 and report the result in Column (C). These tests show that our findings regarding CRM value and the moderating effects of competition remain qualitatively unchanged, indicating that our findings are not sensitive to outliers, if any.

5.2.2. Robustness to alternative performance measures

We conduct an additional test to use accounting performance measures to address CRM value. This test can be useful in two ways. First, it provides additional evidence about the value of CRM applications following an approach comparable to those used in prior studies (reviewed in Appendix A). Second, any accounting performance improvement observed after CRM implementation provides corroborating evidence that a positive association between CRM applications and firm value reflects CRM value instead of market fluctuations. Accounting performance improvement after CRM implementation can help investors understand the benefits of CRM applications and incorporate their assessment into firm valuation. Based on a widely

accepted quarterly forecasting model [24,59] from the accounting literature, we specify the following regression equation:

$$\begin{aligned} \text{Performance} = & \text{constant} + \alpha_1 \text{MODULE} + \alpha_2 \text{INTEGRATION} \\ & + \lambda_1 \text{DIFF} + \lambda_2 \text{DIFF} * \text{MODULE} + \lambda_3 \text{DIFF} * \text{INTEGRATION} \\ & + \mu_1 \text{ENTCOST} + \mu_2 \text{ENTCOST} * \text{MODULE} + \mu_3 \text{ENTCOST} * \text{INTEGRATION} \\ & + \theta_1 \text{HHI} + \theta_2 \text{HHI} * \text{MODULE} + \theta_3 \text{HHI} * \text{INTEGRATION} \\ & + \gamma_1 \text{Performance}_{-1} + \gamma_2 \text{Performance}_{-4} \end{aligned} \quad (3)$$

where Performance is measured by ROS, ROA, or ROE. The model includes lagged performance measures in quarters t-1 and t-4 (i.e., Performance₋₁ and Performance₋₄) to adjust for seasonality [24,59].

Table 5 presents the regression results, which deliver three messages. First, using ROE to address CRM value, we find that the overall model is not significant (i.e., a nonsignificant F-test). We do observe that current ROE is weakly associated with lagged ROE, suggesting a poor fit of the model on forecasting ROE for our sample.¹³ Second, the results on ROS and ROA emphasize the salient role of CRM–ERP integration instead of CRM modules. This highlights the impact of integration on the accounting performance measures. Third, the competition variables moderate CRM value as expected. Overall, these results consistently identify CRM value and suggest moderating effects of competition, although they are weaker compared to the earlier results based on Tobin's q (which makes sense as accounting performance improvement may be incomplete in our testing period).

Following the same approach as in Fig. 2, we also examine our sample firms' accounting performance before and after CRM implementation to further understand the performance impact of CRM. We include three profitability ratios: ROS (Fig. 3A), ROA (Fig. 3C), and ROE (Fig. 3E). Together, these ratios show a consistent pattern of performance improvement after CRM implementation. Firms in our sample experience performance deterioration in the pre-implementation periods, but appear to break or reverse the downward trend in the post-implementation periods. We also report asset turnover (ASTURN) and the debt-to-assets leverage ratio (DEBTAST) to articulate the three profitability ratios. Fig. 3B shows that ASTURN increases approximately one year after CRM implementation, suggesting a delayed improvement. ROS and ASTURN together explain the above-average ROA for our sample firms. Because ROE is determined by ROA and leverage (debt-to-assets), the decrease in DEBTAST in quarters 7 and 8 (Fig. 3D) could be the reason for the decrease in ROE in the same periods (Fig. 3E). Overall, the above analysis shows immediate improvement in returns on sales and delayed improvement in operation efficiency, leading to improved future profitability.

6. Discussion

Using archival data from a leading vendor of Internet-based CRM applications, our study provides evidence of how CRM applications affect firm value and reveals how various dimensions of competition moderate CRM value. The findings are robust to a series of tests concerning endogeneity, outliers, and performance measures.

6.1. Finding #1: integration of CRM with ERP applications is found to be a salient mechanism for creating CRM value (answering RQ1)

We examine how CRM applications affect market-based firm value as measured by Tobin's q, answering the call for research to assess the direct link between CRM applications and market value [74]. More broadly, by examining payoffs to Internet-based CRM, our study adds new evidence to the literature on payoffs to Internet-based e-business [39,68,80].

This study advances our understanding of the mechanisms underlying CRM value creation, by examining value creation via installing functional modules and via integrating with ERP. The nonsignificant

¹³ We examine the sample firms' debt-to-assets leverage ratio and find that it has high variability. This may weaken the model's explanatory power for ROE.

Table 5

Robustness check – alternative models using accounting performance.

(Dependent variable = ROS/ROA/ROE).

	(A)	(B)	(C)
	DV = ROS	DV = ROA	DV = ROE
MODULE	−0.001 (0.94)	0.001 (0.66)	0.032 (0.43)
INTEGRATION	0.054*** (0.01)	0.006 (0.13)	0.16 (0.40)
DIFF	0.202*** (0.01)	−0.005 (0.77)	0.257 (0.37)
DIFF*MODULE	0.038 (0.56)	0.003 (0.86)	−0.019 (0.94)
DIFF*INTEGRATION	0.588*** (0.00)	0.063* (0.09)	0.444 (0.39)
ENTCOST	0.007 (0.14)	0.005** (0.02)	−0.063 (0.24)
ENTCOST*MODULE	−0.008 (0.09)	−0.001 (0.55)	−0.065 (0.32)
ENTCOST*INTEGRATION	−0.032*** (0.01)	−0.007** (0.05)	−0.289 (0.27)
HHI	0.046 (0.39)	0.025 (0.11)	−0.086 (0.64)
HHI*MODULE	0.05 (0.32)	0.001 (0.92)	0.223 (0.27)
HHI*INTEGRATION	0.191 (0.19)	−0.006 (0.86)	0.577 (0.37)
Performance ₋₁	0.318** (0.03)	0.241* (0.09)	0.202** (0.04)
Performance ₋₄	0.241** (0.04)	0.477*** (0.00)	−0.02 (0.83)
Constant	0.049 (0.01)	−0.003 (0.54)	0.066 (0.15)
# of observations	228	223	223
R-squared	0.369	0.370	0.136
F statistics	30.91	8.83	1.08
(p-value)	(0.00)	(0.00)	(0.38)

See Table 2 for variable definitions. P-values are shown in parentheses for 2-tailed tests based on panel data regression with random effects. *** p<0.01, ** p<0.05, * p<0.10.

coefficients on MODULE in Table 3 and on the interactions between MODULE and DIFF/ENCOST/HHI seem to suggest that purchasing commercial modules may not help a firm establish a significant competitive advantage. Typical CRM modules provide out-of-the-box functions accessible through the market; thus, they are less immune to threats of competitors' imitation which drives away IT value. In contrast, integrating enterprise applications requires management support and appropriate mechanisms to facilitate coordination with the vendor [8]. Further, integration may induce changes in how business processes coordinate [6]. Therefore, once established, integration may improve a firm's long-term competitiveness because it is more difficult for potential competitors to imitate integration. This finding also contributes to the literature on IT infrastructure integration (Appendix B), by using information about integration directly obtained from a vendor that explicitly implemented integration, and by using market-based valuation to quantify the value of integration.

6.2. Finding #2: integration of CRM with ERP applications plays a more important role in markets featuring higher product differentiation or lower entry barriers (answering RQ2)

Our work answers the call for research to synthesize CRM and market competition into a systematic framework [13]. In doing so, we have paved another stone toward developing a holistic framework to understand CRM value creation. This finding also adds to the growing literature on IT and competition [51] by showing new evidence that competition is *multi-dimensional* in its relation to CRM value.

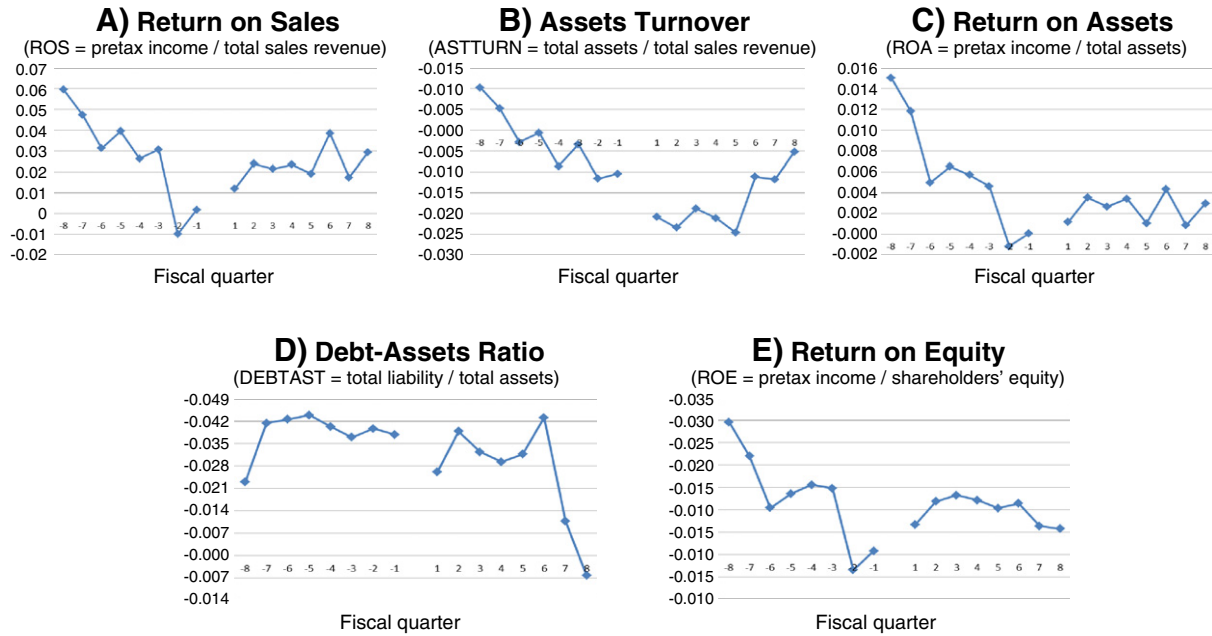


Fig. 3. Matched performance of sample firms, before and after CRM application implementation. Each of the Fig. 3A–E shows the median value of a matched performance measure of sample firms. In any given quarter, a sample firm's matched performance is its performance minus the median performance of its matched group in the same quarter. In our sample, CRM applications implementation takes 8 months on average. Quarter 1 is the first quarter after CRM implementation (i.e., going live). Quarter –1 is the most recent quarter before implementation.

This study has several managerial implications. Our results, showing the significant value implication of integration between CRM and ERP, could be useful for managers who are currently evaluating or implementing CRM applications. The results imply that firms can create significant value by developing an integrative digital platform consisting of ERP and CRM. This finding points to the importance of broader IT infrastructure integration, instead of cumulating functional modules within a software system. When choosing vendors, firms need to take into consideration the vendors' capability of developing integration. Our results also offer a guideline to help executives better realize the returns to their CRM investment, given the nature of product market competition. Firms in markets providing more differentiated products or having lower entry costs can be more proactive about joining the wave of CRM initiatives. Another implication is for CRM vendors, who need to pay attention to developing application adapters to facilitate the integration of enterprise systems. This may help increase the market valuation of their products.

Our findings also set the stage for future research in understanding CRM value creation. While in this work we have demonstrated the value implications of CRM implementations, the effectiveness of CRM deployment may also depend on the specific uses of CRM applications. As such, addressing the economic impacts of CRM “use” is an important direction for future research.¹⁴ Also, different CRM applications (e.g. different functional modules or similar modules sold by different vendors) may have different performance. It is important for future research to use a broader representation of CRM vendors to cross-validate our findings. It would also be interesting to investigate whether there are other dimensions of competition that may moderate CRM value. We hope that our theoretical perspectives and findings will stimulate and encourage more research into this important phenomenon.

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Appendix A. Selected empirical studies on the business Value of CRM applications

Business value of CRM applications	Selected empirical studies
I. Benefits of CRM applications in customer-facing processes	
(1) Efficiency gains in the front office	Ahearne, Jones, Rapp, and Mathieu [1]; Jayachandran, Sharma, Kaufman, and Raman [37]; Minami and Dawson [40]; Karimi, Somers, and Gupta [54]; among others
(2) Improved customer information in the back office	Albert, Goes, and Gupta [2]; Cao and Gruca [15]; Ernst, Hoyer, Krafft, and Krieger [22]; Mithas, Krishnan, and Fornell [55]; Padmanabhan, Zheng, and Kimbrough [58]; among others
II. There is mixed evidence about the relationship of CRM applications to the overall firm profitability.	
	Aral, Brynjolfsson, and Wu [4]; Coltman [19]; Hillebrand, Nijholt, and Nijssen [34]; Minami and Dawson [54]; Reinartz, Krafft, and Hoyer [66]; among others

¹⁴ We thank an anonymous reviewer for suggesting this direction for future research.

Appendix B. Selected empirical studies on IT infrastructure integration

Research	Variables for IT infrastructure integration	Data	Key findings
<i>This study</i>			
	Whether CRM applications are integrated with existing ERP	Archival data from a major CRM vendor	Value implications of CRM applications are contingent on multi-dimensional competition.
<i>Prior studies examining IT infrastructure integration that explicitly involves CRM applications</i>			
Aral, Brynjolfsson, and Wu [4]	Adoption of SCM/CRM when ERP applications are in use	Archival data from a major vendor	Firms that adopt ERP and SCM/CRM perform better than those that adopt ERP only.
Mithas, Krishnan, and Fornell [55]	An interaction term between CRM applications and supply chain information sharing	Survey of large U.S. firms by <i>InformationWeek</i>	Firms with better supply-chain information sharing are more likely to improve customer knowledge when using CRM applications.
Rai, Patnayakuni, and Seth [63]	Data consistency, real-time communications among SCM, ERP, and CRM applications	Survey in the manufacturing and retail sectors	Integrated IT infrastructures enable firms to develop higher-order capability of supply chain process integration.
<i>Other selected studies</i>			
Bharadwaj, Bharadwaj, and Bendoly [9]	Integrated information systems (IS) capability, i.e., providing integrated access to relevant data and coordinating with supply chain partners	Survey in the manufacturing industry	The greater the integrated IS capability, the stronger the performance impacts of cross-functional and interorganizational coordination.
Gosain, Malhotra, and El Sawy [27]	Structured data connectivity and standardized interfaces with supply chain partners	Survey of firms associated with RosettaNet	Structured data connectivity and standardized interfaces improve supply chain flexibility.
Hitt, Wu, and Zhou [35]	The scope of ERP modules in use from the same vendor	Archival data from a major vendor	Use of more ERP modules is associated with higher performance.
Mukhopadhyay and Kekre [56]	Whether procurement data can be exchanged with internal product databases	A manufacturer's archival data	Integration leads to strategic benefits for a supplier.
Saraf, Langdon, and Gosain [72]	Capability of sharing data and integrating software applications with customers and channel partners	Survey in the high-tech and financial services sector	Integration capability improves knowledge sharing and process coupling with customers and channel partners.
Xu, Zhu, and Zhu [78]	Electronic integration based on open-standard networks	Survey in the financial services industry	The degree of electronic integration is affected by network effects and firms' experience with related technologies.

CRM = customer relationship management; SCM = supply chain management; ERP = enterprise resource planning.

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Alfred Zhu Liu is an Assistant Professor at the School of Business, University at Albany, SUNY. He received his Ph.D. from the University of California, Irvine. His research interests include credit rating and accounting information in risk assessment, analyst forecast and valuation, management disclosure, and information technology. His research has been published in the *Journal of Financial Economics*.

Hongju Liu is Assistant Professor at the Department of Marketing, University of Connecticut School of Business. He received his Ph.D. from the University of Chicago. His current research focuses on the application of dynamic structural models to study firms' strategic decisions. He is also interested in technology markets, network effects, and pricing. His papers have been published in the *Journal of Marketing Research* and *Marketing Science*.

Sean Xin Xu is an Associate Professor at the School of Economics and Management, Tsinghua University. He received his Ph.D. from the University of California, Irvine. His current research interests include IT value under different corporate governance structures, post-adoptive behaviors of IT use, social media, enterprise systems and information risk, and IT use in supply chain contexts. His papers have been published in *Management Science*, *MIS Quarterly*, *Information Systems Research*, *Journal of MIS*, *Strategic Management Journal*, *European Journal of Information Systems*, and *International Journal of Technology Management*. He is serving on the editorial board of *Information Systems Research* as an Associate Editor, and that of *MIS Quarterly* as a Guest Associate Editor.