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The Impact of Customer Relationship Management Implementation on Cost and Profit Efficiencies: Evidence from the U.S. Commercial Banking Industry

The impact of customer relationship management (CRM) implementation on firm performance is an issue of considerable debate. This study examines the impact of CRM implementation on two metrics of firm performance—operational (cost) efficiency and the ability of firms to generate profits (profit efficiency)—using a large sample of U.S. commercial banks. The authors use stochastic frontier analysis to estimate cost and profit efficiencies and employ hierarchical linear modeling to assess the effect of CRM implementation on cost and profit efficiencies. They find that CRM implementation is associated with a decline in cost efficiency but an increase in profit efficiency. A firm-level factor, CRM commitment, reduces the negative effect of CRM implementation on cost efficiency. The authors also find that two adoption-related factors, time of adoption and time since adoption, influence the relationship between CRM implementation and cost and profit efficiencies. Early adopters benefit less from CRM implementation than late adopters. However, time since adoption improves the performance of firms that implement CRM. By demonstrating the different ways CRM implementation influences cost and profit measures, the study provides valuable insights to CRM researchers and managers.

Keywords: cost efficiency, profit efficiency, stochastic frontier analysis, customer relationship management

Over the past decade, many firms have implemented customer relationship management (CRM), a set of information processes and technology tools that enable the development of firm–customer relationships (Rogers 2005). How does CRM affect organizational performance? In general, the academic literature suggests that CRM offers a firm strategic benefits, such as greater customer satisfaction and loyalty (Kumar and Shah 2004), higher response to cross-selling efforts (Anderson 1996), and better word-of-mouth publicity. Overall, there is a strong sense that CRM efforts improve firm performance (see the special section on CRM in the October 2005 issue of *Journal of Marketing*). Boulding and colleagues (2005) note that CRM has the potential to enhance both firm performance and customer benefits through the dual creation of value. According to this view, CRM enables firms to augment the value they extract from customers, while customers gain greater value because firms meet their specific needs.

More recently, however, highly publicized failures of CRM implementation have led to skepticism among managers about its much-vaunted potential to generate firm value (Ryals 2005; Zablah, Bellenger, and Johnston 2004). For example, one industry study reveals that the majority of CRM projects fall short of delivering strategic value because they fail to grow customer loyalty, revenues, and profits sufficiently (Thompson 2005). Several articles in the business press refer to the inability of CRM implementation to generate firm value (Rigby, Reichheld, and Schefter 2002; Whiting 2001). From the perspective of managers in firms that have implemented CRM, or plan to do so, these reports are disconcerting. As far as managers of firms that provide CRM technology and related services are concerned, reports that CRM efforts are not effective are particularly alarming. As such, exploration of the impact of CRM on different organizational performance measures is required to reassess its potential to create firm value and to justify the investments firms have made in this area.

Previous studies have examined the influence of CRM on intermediate metrics, such as customer satisfaction and loyalty (e.g., Jayachandran et al. 2005; Mithas, Krishnan, and Fornell 2005). However, the impact of CRM implementation on firm profitability has not received sufficient atten-

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tion from academics (Kumar 2008). More important, an examination of the influence of CRM on firm performance using longitudinal data has been lacking (Boulding et al. 2005), thus limiting researchers from making assessments about the causal relationship between CRM and firm profitability.

In addition, prior research has not established a clear relationship between CRM implementation and organizational efficiency, a measure of how well a firm uses its resources in producing outputs. This is particularly surprising because industry analysts predict that 70% of CRM spending in the coming years will be justified by its potential to increase efficiency (Thompson and Maoz 2005). If CRM implementation improves a firm's efficiency in addition to enhancing customer value, the case for its wider adoption can be bolstered. Indeed, considering the issue of dual value creation expected from CRM implementation, enhancement of firm efficiency could be an additional aspect of value creation for firms, supplementing the value extracted from customers by providing more effective solutions to their needs.

The key research questions addressed in this study are as follows: First, how does CRM implementation affect a firm's efficiency? Second, how does CRM implementation influence a firm's profitability? By focusing on the impact of CRM on both efficiency and profitability, this study offers a comprehensive view of its role in dual value creation in organizations. Potentially enhancing the value of this study is the notion that assessing the impact of marketing investments, such as those on CRM, on firm performance has become a major concern for scholars and practitioners (Rust et al. 2004). Therefore, this study also contributes to the stream of literature that assesses the potential of marketing investments to generate firm value. Furthermore, given that CRM adoption is complex, it is necessary to examine which firm-level and adoption-level factors influence the relationship between CRM and firm performance. Providing insights into factors that moderate the relationship between CRM and firm performance will enable managers and researchers to understand the contextual influences on the relationship between CRM implementation and firm performance.

We address our research questions using data from the banking industry. We estimate cost and profit performance for banks and observe how they vary when CRM is implemented. We find that implementing CRM decreases firm efficiency, though firms seem to recover over time. Regardless, CRM implementation enhances a firm's ability to earn profits. In other words, implementing CRM requires additional resources. Despite this, firms that implement CRM generate revenue that exceeds the additional costs. In effect, the results of this study support the contention that CRM enables firms to generate higher-quality products and services, albeit at higher costs. The higher quality of their products and services enables these firms to gain a revenue differential that overcomes the higher cost of using CRM. Thus, by implementing CRM, firms create value for themselves by generating value for their customers. Therefore, we find evidence in favor of the dual value creation role of CRM, except that the higher profits for firms are not from efficiency enhancement but rather from revenue enhancement. We also examine the moderating effect of firm-level characteristics on the impact of CRM on firm performance. To the best of our knowledge, this is the first empirical longitudinal study to evaluate the impact of CRM implementation on both cost efficiency and profitability.

We organize the article as follows: We begin with a discussion of CRM implementation in organizations. Then, we provide theoretical arguments for the relationship between CRM and cost efficiency and profitability, with cost efficiency and profitability conceptualized on the basis of stochastic frontier analysis (SFA) methods (Aigner, Lovell, and Schmidt 1977; Berger and Mester 1997; McAllister and McManus 1993). Following this, we explain our research methodology and present the results. Finally, we discuss the managerial and research implications of this study and outline future research directions.

CRM Implementation and Firm Performance: Hypotheses

Prior research has suggested that firms implement CRM to boost their ability to communicate with customers, provide them feedback in a timely manner, analyze customer information, and customize offerings (Day 2003). The technology components of CRM include front-office applications that support sales, marketing, and service and back-office applications that help integrate and analyze the data (Greenberg 2001; Jayachandran et al. 2005). The front-office components of CRM facilitate efficient information flow between a firm and its customers through reciprocal communications and by enabling the routing of information to appropriate employees in sales, marketing, and service. Thus, CRM implementation tries to facilitate the smooth dissemination of customer knowledge throughout the organization to improve the quality of decision making (Ryals 2005). The back-office parts of CRM include database and data-mining tools that help identify and track customer needs better and faster. Creating a database of centralized customer information is a critical aspect of a firm's CRM activities. The data-mining tools offered with CRM enhance firms' understanding of customer behavior and enable more appropriate customization of their products and services. The back-office components of CRM technology also facilitate the integration of customer information that originates from multiple sources because customers interact with a firm through various points, such as sales, marketing, and service.

Firms that have stronger relationships with customers enjoy higher profitability (e.g., Bolton 1998; Reinartz, Thomas, and Kumar 2005). Indeed, firms create and maintain portfolios of profitable customer relationships by identifying valuable customers, ensuring better communications with them, and customizing products and services to meet their needs (Venkatesan and Kumar 2004). In turn, customers are likely to stay longer in their relationship with these firms, purchase more often, and show lower propensity to switch to competitors (Johnson and Selnes 2004). However, when firms customize their products and services, they may sacrifice the scale advantages that are possible

from the production of standardized products (Pine, Victor, and Boyton 1993). Thus, it is imperative to examine the impact of CRM implementation on different aspects of firm performance, such as cost and profit. In this regard, our study examines the impact of CRM implementation on the operational efficiency of firms and their ability to realize maximum profits. By focusing on these two measures of performance, we provide an assessment of the impact of CRM implementation on the performance of a firm relative to the performance of its rivals.

Impact on Cost Efficiency

Cost efficiency describes how well a firm uses its resources to produce a given output mix, and it depends on the extent to which it limits the wasting of resources. Cost efficiency is defined as the ratio of actual costs expended to minimum costs that could have been expended in producing the output mix (Farrell 1957; Greene 1993). The implementation of CRM could be resource intensive. Compared with firms that produce standardized outputs, firms that adopt CRM face additional costs, such as those associated with the customization of outputs and customer information management. The customization of products and services results in firms losing the scale advantages of mass production (Pine, Victor, and Boyton 1993). In manufacturing, customization involves inefficiencies in supply chain management, such that firms may need to store more components and manufacture and deliver small batch sizes or single units. For services, customizing requires better-skilled and -trained employees. Employing skilled workers and training them to a level at which they can customize services to meet the demands of individual customers is likely to be less cost efficient than delivering standardized services. As a consequence, the average costs of production are likely to be higher for firms when they practice CRM than when they focus on transactional marketing.

The cost of customer information management could also increase for firms pursuing CRM because information processes for CRM are more complex than those required for transactional marketing (Jayachandran et al. 2005). This is so because in CRM, firms focus on individuals or narrow segments of customers rather than on broad segments of customers. Therefore, for a given number of customers, the volume of customer information that firms implementing CRM must manage will be higher than that for firms engaging in transactional marketing. Higher volume of customer information means increased costs of customer management and lower cost efficiency. It could be argued that the higher volume of customer information may be handled efficiently by CRM through its capabilities for storing, analyzing, and disseminating large volumes of data (Clemons, Reddi, and Row 1993). However, although the technology may neutralize the inefficiency caused by the need to handle large volumes of data, the firm must still deal with the inefficiency of customization that implementing CRM implies. In effect, implementing CRM may help a firm deal with the heavy volume of data more efficiently, but the firm will be undertaking customization with its higher attendant costs and may do so at a higher volume after implementing CRM. Thus:

H_1: CRM implementation has a negative effect on cost efficiency.

Impact on Profit Efficiency

Marketing studies traditionally focus on profit measures, such as return on investments and assets. In this study, we are interested in whether firms enhance their performance, and the extent to which they do so in comparison with their rivals, when they implement CRM. Therefore, we focus on profit efficiency, which measures how close a firm gets to generating maximum possible profits, given input prices and outputs and compared with a best-practice frontier (Akhigbe and McNulty 2005; Vennet 2002). Profit efficiency is the ratio of the profits a firm could have generated to the profits it actually generated. The cost efficiency concept assesses the allocation of resources within a firm. However, cost efficiency measures do not estimate how well a firm meets market demand by effectively matching customer needs (Akhavein, Berger, and Humphrey 1997). A firm may be cost efficient by optimally using its resources in producing a given mix of outputs. Despite being cost efficient, however, this firm may not realize maximum possible profits if it fails to estimate market demand correctly and, as a result, produces outputs that do not effectively match customer needs. To address this issue, profit efficiency was introduced as a more inclusive concept than cost efficiency (Berger, Cummins, and Weiss 1995). Profit efficiency focuses on unobserved differences in the extent to which the output of different firms meets customer needs, and it accounts for the notion that some firms may incur additional costs in providing superior services and products but are rewarded for these efforts through higher revenues. In effect, the profit efficiency concept captures the cost of inputs required to produce a certain level of outputs and the additional revenues generated by producing outputs that are best suited to meeting customer needs.

Firms that deploy CRM are expected to produce outputs that match consumer needs to a better degree than firms that use transactional marketing. These firms will build stronger relationships by customizing products using their superior customer knowledge. As such, firms that implement CRM may achieve greater customer satisfaction (Mithas, Krishnan, and Fornell 2005) and higher rates of customer retention (Gustaffson, Johnson, and Roos 2005). Consequently, these firms may also obtain a price premium and enjoy superior performance (Reinartz, Krafft, and Hoyer 2004). In effect, even if firms that implement CRM face higher costs, their ability to provide products and services that match customer needs in a superior manner enables them to generate higher profits.

H_2: CRM implementation has a positive impact on profit efficiency.

Moderators of the Effect of CRM on Cost and Profit Efficiency

Firm-level factors and adoption-related factors may influence the impact of CRM adoption on firm performance. In accordance with the behavioral theory of the firm (Cyert

and March [1963] 1992), the motivation of the firm to pursue a strategic action and its ability to leverage the action may influence the impact of the action on its performance (Jayachandran and Varadarajan 2006). We consider the moderating impact of one motivation-related firm-level factor (CRM commitment) and one ability-related firm-level factor (firm size) on the relationship between CRM and cost and profit efficiency. Organizational learning theory suggests that adoption-related issues, such as experience with a technology, both systemically and within a firm, can influence the impact of its adoption on firm performance (Grewal, Comer, and Mehta 2001). We consider the moderating impact of two adoption-related factors (time of adoption and time since adoption) on the relationship between CRM and cost and profit efficiency.

CRM commitment (firm-related factor). Firms that implement CRM vary on the extent to which they are committed to using a CRM strategy. The implementation of CRM with the appropriate strategic focus is important for firms to derive full advantage from the technology (Boulding et al. 2005; Day 2003; *Financial Services Technology* 2007; Jayachandran et al. 2005). Research in the related area of enterprise resource planning implementation has observed that strategic focus influences the relationship between enterprise resource planning adoption and firm performance (Stratman 2007). Reports from business consulting firms also indicate that a key reason for the failure of CRM initiatives is the lack of clear objectives and commitment to CRM. Many firms consider CRM implementation an information technology department initiative. In such cases, CRM is implemented without clear business objectives, leading to a lack of commitment (The Boston Consulting Group 2007). Therefore, we examine whether, among firms that implement CRM, those that are deeply committed to a CRM strategy do better. Strategic use of CRM implies a CRM strategy that is customer centric and not product focused or channel focused (Day 2003). Thus, firms that are deeply committed, and thus motivated, to pursuing a CRM strategy will use customer data based on customer needs and lifetime value more effectively to offer customized solutions. In effect, firms that are committed to a CRM strategy will not make the mistake of viewing CRM as a mere technology solution but instead will focus on the underlying processes and approach CRM with clear business objectives (Jayachandran et al. 2005). Thus:

H_3: Firms that are more committed to a CRM strategy (a) suffer a lower decline in cost efficiency after CRM implementation and (b) experience a higher increase in profit efficiency after CRM implementation.

Firm size (firm-related factor). In the banking context, the size of a bank may moderate the impact of CRM implementation on cost and profit efficiency. Larger firms have higher volumes of data that CRM may help manage more efficiently. Therefore, compared with smaller banks, larger banks may enjoy higher levels of cost efficiency and profit efficiency by implementing CRM. In other words, their size may bestow larger banks with the ability to leverage CRM with greater efficiency. However, it is also possible that smaller banks find it easier to align their processes with the demands of CRM technology and therefore implement CRM more effectively. If so, smaller banks may have the ability to leverage CRM more effectively and may benefit more from CRM implementation. Given the conflicting indications, we leave this issue to be determined empirically.

Time of adoption (adoption-related factor). Anecdotal industry evidence (e.g., Thompson 2005) and industry surveys (*Financial Services Technology* 2007) suggest that many early CRM projects failed because of the immaturity of CRM technology and lack of experience with the use of CRM. Furthermore, several early CRM projects were conceived of as technology implementation projects without sufficient modification of attendant processes, leading to suboptimal outcomes (Jayachandran et al. 2005; Reinartz, Krafft, and Hoyer 2004). However, over time, CRM suppliers will gain experience with implementing the technology. This will lead to the emergence of stable best practices in CRM implementation. In other words, over time, experiential learning is likely to lead to both the maturity in CRM processes and the stability in CRM technology. As a result, the learning that takes place among CRM users and CRM service and technology providers will lead to better implementation of CRM. Furthermore, through competitive benchmarking and industry-level learning, firms are likely to select CRM processes and technologies that suit their needs better. Thus:

H_4: Early adopters of CRM suffer (a) greater declines in cost efficiency and (b) lower increases in profit efficiency than late adopters.

Time since adoption (adoption-related factor). Experience is a major source of learning for firms (Sinkula 1994). Learning through experience is a trial-and-error process from which firms develop proprietary knowledge bases that lead to expertise and competitive advantage. For example, Grewal, Comer, and Mehta (2001) suggest that learning from experience influences the expertise of a firm in using electronic markets. Although firms may vary in the rate at which they learn, it is likely that as time elapses after CRM implementation, firms will enhance their ability to use CRM effectively (Jayachandran et al. 2005). For example, Reinartz, Krafft, and Hoyer (2004) note that CRM technology investments offer positive returns only after initial implementation-related problems are overcome. If this is indeed the case, firms are more likely to learn to manage the diseconomies that lead to diminishing cost efficiency as time elapses. Furthermore, firms are likely to implement CRM with greater effectiveness to meet personalized customer needs, thus boosting their ability to gain higher prices and retain customers. In other words, learning over time through experience enhances the expertise level of CRM users, enabling them to implement CRM more efficiently and effectively. Thus:

H_{5a}: The negative impact of CRM implementation on cost efficiency decreases over time.

H_{5b}: The positive impact of CRM implementation on profit efficiency increases over time.

Control Variables

Prior research (e.g., Berger and Mester 1997; DeYoung and Hasan 1998; McAllister and McManus 1993) has identified several bank characteristics that, apart from CRM implementation use, may cause variance in the estimated efficiency scores. Therefore, in the analysis, we accounted for characteristics such as firm size, whether the firm was public or private, and whether it was involved in any mergers and acquisitions (M&As). The size of the bank, in addition to influencing the effect of CRM on efficiency, may have a direct effect on efficiency by virtue of economies of scale and scope. Banks with different ownership structures may differ in their cost and profit efficiencies as a result of variation in the cost of access to funds (Hauner 2004). Often, M&As are followed by the integration of operations and a focus on efficiency. As such, M&A activity may have an effect on cost and profit efficiency as well.

Hypotheses Testing

We tested the hypotheses on a sample of firms from the U.S. commercial banking industry by employing frontier efficiency methods to estimate cost and profit efficiencies. Typical efficiency studies estimate cost efficiency by measuring how far a firm's inputs or costs are from the efficient frontier or "best practice" for a given set of firms (Greene 1993). Similar logic can be applied to estimate profit efficiency as well (e.g., Bauer, Berger, and Humphrey 1993). For this study, we derive measurements of both cost and profit efficiencies from cost and profit functions using SFA (Aigner, Lovell, and Schmidt 1977; Berger and Mester 1997; McAllister and McManus 1993). The SFA approach and similar approaches, such as data envelopment analysis, are becoming increasingly popular in the marketing and related literature streams (e.g., Grewal and Slotegraaf 2007; Luo and Donthu 2006). Overall, we followed a three-step procedure to explore the effects of CRM on cost and profit efficiencies. In the first stage, we estimated cost and profit functions for commercial banks. In the second stage, we employed the residuals from the regression equations to calculate efficiency scores. In the third stage, we estimated the impact of CRM implementation on cost and profit efficiency.

Sample Selection and Data

The choice of U.S. commercial banks as the sample for this study was driven by several considerations. First, banking provides a unique context for efficiency studies because all commercial banks use similar inputs (labor, deposits, and purchased funds) and produce similar outputs (service fees, loans, and securities). As such, we can provide meaningful comparisons of the performance of different banks (Berger, Hancock, and Humphrey 1993). Second, because the financial services firms were early adopters of CRM (Thompson 2005), a sufficient time horizon is available in the data to study the effects of CRM implementation on cost and profit efficiencies. Furthermore, in previous research, the financial services industry has proved to be a fruitful context to examine the effects of CRM (e.g., Ryals 2005). Finally, the Federal Deposit Insurance Corporation requires commercial banks to report their financial information in the *Reports of Condition and Income* (available at http://www.fdic.gov/regulations/resources/call/Index.html). Therefore, a consistent and reliable source of longitudinal data for efficiency studies is available in the banking industry (Berger and Mester 1997).

We used the LexisNexis database to identify and collect data about CRM implementation.[1] We used search terms that are commonly associated with customer relationship management (e.g., "CRM," "e-commerce," "database," "software," "customer relations"). By doing so, we tracked announcements of CRM vendors and clients that are reported by different industry news sources (e.g., *Computerworld*, PR Newswire, Business Wire, *U.S. Banker*). Overall, we identified 125 U.S. commercial banks that had implemented CRM during this data observation period. If a bank implements CRM during a specific period, we assigned that bank a 1 for this and subsequent periods. We confirmed the accuracy of these data using several approaches. First, for 38 banks (30% of our sample), we found multiple reports from different news sources that confirmed CRM implementation. Second, for most banks in the sample, we identified the CRM suites or products that were implemented. We used this information to confirm that the products implemented conformed to the accepted definition of CRM (e.g., Jayachandran et al. 2005). Finally, we contacted 16 marketing managers employed with the banks in our sample to confirm the secondary data on CRM implementation and obtained 100% confirmation for the subsample. As such, there is reason to believe that the CRM implementation data obtained from secondary sources are accurate.

Cost and Profit Efficiency Estimation

To calculate cost and profit efficiency scores, we used balance sheet and income variables reported in the *Reports of Condition and Income*. Following the approach advocated by Bauer, Berger, and Humphrey (1993), Berger and DeYoung (1997), and Berger and Mester (1997), we employed the cost of deposits, labor, marketing, and purchased funds as inputs. These variables are measured as ratios. For example, we calculated the cost of deposits as the ratio of interest paid on to the quantity of deposits. We measured the cost of labor as an average annual salary in thousands of dollars (total wage expense divided by the number of employees) and the cost of marketing as the ratio of marketing expenditures to total assets. We measured the cost of purchased funds as the ratio of the total expenses (i.e., interest expense) on such funds to the total value of the funds.

Banks combine these inputs to produce outputs comprising loans, securities, and services. We measured the outputs as quantities or prices, depending on whether cost or profit efficiency is being estimated. Specifically, loans

[1]Our conversations with banking executives and leading CRM vendors revealed that most CRM projects were implemented after 1997. As such, we collected data over a ten-year period spanning from 1997 to 2006.

include all types of loans, such as mortgages, credit cards, personal loans, and business loans. Securities include investments in debt (bonds) and equity (stocks) and are reported at market value. We measured services using fees paid by customers. Table 1 summarizes all the measures we employed in this study.

In the context of efficiency studies (e.g., Aigner, Lovell, and Schmidt 1977; Battese and Coelli 1995; Greene 1993), the error terms from cost and profit functions have two components: a random error (uncontrollable) term and an efficiency (controllable) term. The uncontrollable error term is assumed to be symmetrically distributed, and the controllable error term follows a half-normal distribution (Berger and Mester 1997). Although the efficiency terms can be averaged across the different periods to remove the random error, further exploration of the temporal variation in efficient frontiers will provide insights lost by averaging the residuals (e.g., Lee and Schmidt 1993). In this study, we follow the latter approach, but as discussed subsequently, we take necessary steps to ensure that doing so will not affect the results.

TABLE 1
List of Items Used for Cost and Profit Functions

Item	Description
1. Variable cost	Bank's operating expense
2. Profit	Difference between bank's operating revenues and expenses
3. Price of deposits	Ratio of expenses on deposits (interest and noninterest) to the total amount of deposits
4. Price of labor	Ratio of salary expenses to the total number of full-time employees in thousands of dollars
5. Price of purchased funds	Ratio of expenses of purchased funds (borrowed and federal funds) to the total amount of purchased funds
6. Price of marketing	Ratio of marketing and advertising expenses to the total assets[a]
7. Amount of loans	Total amount of loan accounts
8. Quantity of securities	Total amount of securities
9. Amount of services	Revenues from service fees
10. Price of loans	Interest income from loans divided by total amount of loans
11. Price of securities	Revenues from securities divided by total quantity of securities
12. Price of services	Revenues from fees divided by total assets
13. Financial equity capital	Total shareholder equity
14. Fixed assets	Investments in fixtures, cars, buildings, and capitalized leases
15. NPL	Proportion of loans past due > 90 days

[a]Marketing and advertising expenses equal the difference between noninterest expense and expenses on fixed assets and wages.

According to SFA, the firm with the lowest input requirements to produce a given set of outputs (i.e., having the smallest error from the cost function) forms the cost efficiency frontier. Similarly, the firm with maximum profits from a given set of inputs (i.e., with the maximum error from the profit function) forms the profit efficiency frontier. The closeness of a firm's cost and profit structures to the corresponding frontiers determines its relative cost and profit efficiency. Next, we explain the process of deriving efficiency estimates.

Cost efficiency. We estimated cost efficiency by postulating a relationship among firms' operating costs, input prices, and output quantities (Aigner, Lovell, and Schmidt 1977). This relationship is summarized in the cost function for a given industry at time t (Equation 1), which models the logarithm of a firm's operating costs VC_{it} as a linear function of the logarithms of variable input prices P_{it} (deposits, labor, marketing, and purchased funds), quantities of variable outputs Y_{it} (loans, securities, and services), and fixed inputs Z_{it} (financial equity capital and fixed assets):

$$(1) \qquad \ln VC_{it} = f(\ln P_{it}, \ln Y_{it}, \ln Z_{it}, \ln \nu^c_{it}),$$

where ν^c_{it} is the error term.[2]

We estimate Equation 1 for every time period t (for details, see the Appendix). To capture efficiency, as the first step, we compute a time series of residuals for every firm (Aigner, Lovell, and Schmidt 1977; Bauer, Berger, and Humphrey 1993; Berger, Hancock, and Humphrey 1993; Grosskopf 1993; Horsky and Nelson 1996). This approach is based on the assumption that the closer a firm gets to the cost efficient frontier, the smaller is the error term $\ln(\nu^c_{it})$. Although the true cost efficient frontier cannot be determined, a firm with the smallest residual can be deemed to be closest to the true efficient frontier. In other words, the cost efficient frontier is determined by the firm with the smallest inefficiency score (i.e., smallest error).

For the second step in the analysis, we calculate efficiency term $CEFF_{it}$ for each firm as the exponent of the difference between the residual for a given firm from the cost function and the smallest residual for a given period (Equation 2). In essence, $CEFF_{it}$ represents the distance between a firm's cost structure and the cost structure of the most efficient bank. Thus, higher values of $CEFF_{it}$ correspond to lower cost efficiency:

[2]As we noted previously, $\nu^c_{it} = \varsigma^c_{it} - \pi^c_{it}$, where ς^c_{it} is the normally distributed random error with zero mean and π^c_{it} is the nonnegative (in)efficiency term that follows a half-normal distribution (Greene 1993). When a firm gets closer to the efficient frontier, $\pi^c_{it} \to 0$.

$$(2) \qquad CEFF_{it} = e^{(\ln v^{c}_{it} - \ln v^{c}_{min})}.$$

The residuals from the cost function also contain random error. Therefore, problems may be encountered in estimating the efficient frontier because of the presence of outliers. To limit this problem, we computed truncated measures, as in Berger, Cummins, and Weiss (1995), by setting the top and bottom 5% of v^{c}_{it} equal to the 5th and 95th percentile, respectively. The truncation does not lead to the elimination of observations. Instead, observations with extreme values are assigned lower values. We checked the results for robustness by computing at varying levels of truncation (5% and 10%) and found no differences in the significance or direction of the results. As such, we used the estimated error terms for several banks to form a thick frontier (Bauer, Berger, and Humphrey 1993; Berger and Mester 1997) instead of using the estimated results for just one bank to form the frontier, thus reducing the impact of outliers.

Profit efficiency. We can infer profit efficiency from how close the firm's output mix is to that demanded by the market (Berger, Hancock, and Humphrey 1993). We estimate profit efficiency using profit functions that model operating profits on the basis of the prices of inputs and outputs. As we noted previously, it has a form that is similar to that of the cost function, except that instead of quantities of outputs (Y_{it}) in the cost function, prices of these outputs (I_{it}) are used as predictors in the profit function. Unlike cost efficiency, profit efficiency measures the difference between a firm's profits and the maximum profits for a given mix of input–output prices. Similar to the representation of the cost function (Equation 1), a firm's profit function is modeled by the following regression equation:

$$(3) \qquad \ln(Pr_{it} + \Delta) = f_{\pi}(\ln P_{it},\ \ln I_{it},\ \ln Z_{it},\ \ln v^{p}_{it}),$$

where Pr_{it} is the profit of the ith firm, I_{it} represents the prices of outputs (loans, securities, and services), P_{it} are the variable input prices (deposits, labor, purchased funds, and marketing), and Z_{it} are the fixed inputs (financial equity and fixed assets). We add a constant, Δ, to the operating profits of all banks to ensure that the values are positive. Higher values of $\ln(v^{p}_{it})$ indicate higher profit efficiency because this demonstrates the firm's ability to extract above-average profits.

We compute profit efficiency $PEFF_{it}$ in a manner similar to that used for computing cost efficiency, except that the firm with the maximum residual represents the efficient frontier (Equation 4). Banks with higher residuals from the profit function (Equation 3) demonstrate superior profitability because they earn higher profits than an average bank (Berger, Hancock, and Humphrey 1993). We measure profit efficiency ($PEFF_{it}$) as the distance between the profit of the focal bank and that of the most profitable bank in the sample. As such, profit efficiency is the difference between the maximum residual obtained from fitting the profit function and the residual for the focal bank. Therefore, higher values of $PEFF_{it}$ correspond to lower values of profit efficiency:

$$(4) \qquad PEFF_{it} = e^{(\ln v^{P}_{max} - \ln v^{P}_{it})}.$$

The residuals from the profit function were truncated, as was done with the residuals from the cost function, to reduce the impact of outliers.

Hierarchical Linear Model Development

The next step in the analysis is to estimate the impact of CRM implementation on cost and profit efficiencies. Random coefficients models are well suited to explain the different sources of variation for repeated measures data with continuous outcome variables (Omar et al. 1999). Thus, we employed hierarchical linear models (a special case of random coefficients models) to estimate the impact of CRM implementation on cost and profit efficiencies (Wolfinger 1996). To test the hypotheses, we need to assess whether cost and profit efficiencies vary as a function of CRM implementation after accounting for other firm characteristics that might affect firm cost (profit) efficiency. Furthermore, we need to identify firm-level factors that enhance or attenuate the effect of CRM implementation on cost and profit efficiencies.

Measures of moderators. We measured time after CRM implementation using a variable (T_{it}) that increases with the number of periods after CRM implementation. That is, if a bank implemented CRM in 2000, then T_{it} is equal to the number of years after CRM implementation (i.e., in 2002, $T_{it} = 2$). We measured strategic implementation of CRM by accessing the relevant information from the Financial Services Industry Forum, personal visits, telephone conversations with marketing executives, survey conducted by the Chief Marketing Officers' Council, and our own implementation experience in this industry. We created two groups of firms after reviewing all the information: firms with high ($SI_i = 1$) and low ($SI_i = 0$) degrees of use of CRM strategy. A panel of executives from the banking industry further evaluated this two-group categorization to ensure the validity of the classification. We captured early adoption of CRM by classifying banks that implemented CRM during or before 2002 (the median year of adoption in our sample) as early adopters ($ORD_i = 1$) and others as late adopters ($ORD_i = 0$). This classification has support from industry surveys, such as those reported in *Financial Services Technology* (2007). We used the median value of bank assets (approximately $2.4 billion) to classify banks into two groups ($SIZE_i$: large versus small).

Other variables that affect cost and profit efficiency. We used a dummy variable for public versus private company ($PUBL_i$) using data item Organization Type (RSSD9047) reported in *Reports of Condition and Income*. We used a dummy variable for M&As in the previous period ($M\&A_{it-1}$) to account for changes that may occur in the scale of operations of the merged or acquired banks (Berger and DeYoung 1997).

Sample selection bias. Sample selection process may lead to biased estimates if the criteria for selecting observations are related to the dependent variable. Banks' CRM implementation may be related to macroeconomic conditions that influence firm performance. In times of economic growth, firms are more likely to enjoy better performance and have access to the resources required to implement

CRM. To account for the potential bias in sample selection on account of macroeconomic conditions, we use Lee's (1983) generalization of the Heckman selection correction to create the selection correction variable λ.[3] As in Kalaignanam, Shankar, and Varadarajan's (2007) work, we use the 30-day U.S. treasury bill interest rate (FED) as a proxy of economic conditions to compute the predicted probability of CRM technology implementation and to generate the selection correction term λ_{it-1} used as an independent variable in the model (see Equation 5).

Model

We developed a two-level model to explain the variation in cost efficiency:

$$(5)\quad CEFF_{it} = \beta_{0i} + \beta_1 \times CEFF_{it-1} + \beta_{2i} \times CRM_{it-1} + \beta_3 \times M\&A_{it-1} + \beta_4 \times \lambda_{it-1} + \xi^c_{it},$$

where

$$\beta_{0i} = \gamma_{00} + \gamma_{01} \times PUBL_i + \gamma_{02} \times SIZE_i + r_{0i},$$

$$\beta_{2i} = \gamma_{20} + \gamma_{21} \times T_{it} + \gamma_{22} \times SI_i + \gamma_{23} \times SIZE_i + \gamma_{24} \times ORD_i + r_{2i},$$

$$\xi^c_{it} \sim N(0, \Sigma_i),$$

$$r_{0i} \sim iid(0, \tau_{00}), \text{ and}$$

$$r_{2i} \sim iid(0, \tau_{22}).$$

We used the one-year lagged value of cost efficiency ($CEFF_{it-1}$) to account for inertia in operational or cost efficiency (Bauer, Berger, and Humphrey 1993). The term CRM_{it-1} describes CRM implementation lagged by a period to account for the notion that its impact on efficiency may not be apparent immediately. Because there are multiple observations for each bank, the residual observations within banks could be correlated. Therefore, the assumption of independence of the first-level residuals, ξ^c_{it}, may not be valid (Goldstein, Healy, and Rasbash 1993). We employed different structures for the covariance matrix Σ_i to address this problem. These include an unstructured covariance matrix, one with a compound symmetry, and another one that is autoregressive. We selected the covariance matrix structure that best fits the data from these three structures (Singer 1998; Wolfinger 1996).

As we noted previously, we account for the effect of whether the bank is public or private and its size on cost and profit efficiency. Therefore, one equation at the second level models the mean outcome (intercept in the Level 1 equation [β_0]) as a function of whether the bank is public or private ($PUBL_i$) and the size of the bank. To test the moderating effect of firm-level factors on the impact of CRM on cost efficiency, we modeled the slope for CRM implementation (β_2) as a function of four variables: CRM commitment, firm size, time of implementation, and time since implementation.

The hierarchical model for profit efficiency is similar to that in Equation 5, except that the dependent variable is $PEFF_{it}$ and, instead of lagged value of cost efficiency, we use lagged value of profit efficiency as a predictor in Equation 5. Next, we explain the estimation of the models.

Estimation of the Models

As noted previously, we used the cost and profit efficiency scores to assess the impact of CRM on firm performance. The probit model for selection bias was significant (FED = .149, $p < .05$). The descriptive statistics and correlation matrix are in Table 2.

Impact of CRM on cost efficiency. First, we modeled two sources of variance (within and between banks) by using variables in the Level 1 and Level 2 equations. As a result, we were able to explain 48.2% of the total variance in cost efficiency. Second, we explored the covariance structure of matrix Σ_i arising from the multiple observations per bank. The models with the unstructured error and compound symmetry matrices did not converge. However, the model with AR(1) (autoregressive order of 1) error structure converged. The resulting parameter estimates appear in Table 3.

Impact of CRM on profit efficiency. We employed a hierarchical model to estimate the impact of CRM implementation on profit efficiency, with $PEFF_{it}$ as the dependent variable. With the first- and second-level variables, we explained 21.8% of the variance in profit efficiency scores. Then, we examined the effect of different structures for the within-subject error covariance matrix. The compound symmetry error structure was inferior in terms of fit (–2 log-likelihood ratio [LLR] = 4,148.80, Akaike information criterion [AIC] = 4148.80, Bayesian information criterion [BIC] = 4160.10) compared with the AR(1) structure (–2LLR = 4087.40, AIC = 4087.00, BIC = 4098.70). The final estimates for the model appear in Table 4.

Results of Hypotheses Testing

The positive parameter estimate for the effect of CRM implementation on cost efficiency (γ_{20} = .041, t-value = 2.67) demonstrates that by implementing CRM, firms move away from the cost efficient frontier and become less efficient, in support of H_1 (higher values of CEFF correspond to lower values of cost efficiency). The intercept (γ_{00}) in Equation 5 represents mean operational efficiency for the sample of banks in our data set. Therefore, we conclude that operational efficiency declined approximately 5.4% (.041/.753) as a result of CRM implementation. Banks at a high level of CRM commitment demonstrated lower decline in cost efficiency, as H_{3a} predicted (γ_{22} = –.027, t-value = –2.94). In addition, as H_{4a} predicted, early adopters of CRM experience greater declines in cost efficiency than late adopters (γ_{24} = .099, t-value = 7.88). We also found support for H_{5a} through a negative interaction between CRM and the time since implementation (γ_{21} = –.032, t-value = –9.98), suggesting that cost efficiency, after declining on

[3]In particular, we calculated the selection correction variable λ_{it} as follows: $\lambda_{it} = \phi\{\Phi^{-1}[H_i(t)]\}/[1 - H_i(t)]$, where ϕ is standard normal density function, $H_i(t)$ is a hazard function for bank i in period t, and Φ^{-1} is the inverse of the standard normal distribution.

TABLE 2
Descriptive Statistics

Variable	M	(SD)	1	2	3	4	5	6	7	8	9
1. CRM implementation (CRM)	.446	(.497)	1.000								
2. Strategic focus on CRM (SI)	.200	(.400)	.071	1.000							
3. Bank size (LRG)	.496	(.500)	.083	.264	1.000						
4. Order of implementation (ORD)	.528	(.499)	.338	.192	.233	1.000					
5. Time after implementation (T)	1.419	(2.013)	.678	.102	.099	.409	1.000				
6. Public company (PUBL)	.912	(.214)	−.070	−.168	−.226	−.137	−.087	1.000			
7. M&A	.187	(.390)	−.084	.104	.316	.117	−.108	.108	1.000		
8. Lambda (λ)	16.749	(37.625)	.284	.001	.001	.001	.243	.001	−.026	1.000	
9. Cost efficiency score (CEFF)	1.564	(.163)	.220	−.112	−.155	−.099	.114	.145	−.055	.308	1.000
10. Profit efficiency score (PEFF)	3.792	(1.416)	−.366	−.049	−.096	−.031	−.390	.113	.093	−.049	−.154

Notes: Observations = 1250. All correlations greater than .050 and lower than −.050 are significant at $p < .05$.

TABLE 3
Variation in Cost Efficiency Scores as a Function of CRM Technology Implementation: Test of Hypothesis and Sensitivity Analysis

Predictor Variables	Hypotheses	β (t-Value)	Model with One-Year Lagged Cost: β (t-Value)	Model with Two-Year Lagged Cost: β (t-Value)
Intercept (γ_{00})		.753 (19.93)***	1.287 (42.51)***	1.331 (40.11)***
Public company (PUBL) (γ_{01})		.035 (2.62)**	.055 (2.08)**	.061 (2.15)**
Firm size (SIZE) (γ_{02})		–.036 (–2.95)***	–.044 (–3.17)***	–.045 (–2.40)***
Lagged cost efficiency (CEFF) (β_1)		.483 (20.97)***	.073 (16.71)***	.072 (14.94)***
CRM implementation (CRM) (γ_{20})	H_1	.041 (2.67)***	.039 (2.31)***	.049 (2.67)***
CRM × time (CRM × T) (γ_{21})	H_{3a}	–.032 (–9.98)***	–.006 (–1.69)*	–.019 (–4.33)***
CRM × strategic focus (CRM × SI) (γ_{22})	H_{4a}	–.027 (–2.94)***	–.037 (–1.97)**	–.049 (–2.76)***
CRM × firm size (CRM × SIZE) (γ_{23})		.024 (1.52)	.023 (1.19)	.022 (1.04)
CRM × order (CRM × ORD) (γ_{24})	H_{5a}	.099 (7.88)***	.036 (2.04)**	.071 (4.14)***
Mergers and acquisitions (M&A) (β_3)		.010 (.98)	.004 (.43)	.009 (.92)
Lambda (β_4)		.001 (7.08)***	.001 (12.33)***	.001 (3.71)***

*$p < .10$.
**$p < .05$.
***$p < .01$.

TABLE 4
Variation in Profit Efficiency Scores as a Function of CRM Technology Implementation: Test of Hypothesis and Sensitivity Analysis

Predictor Variables	Hypotheses	β (t-Value)	Model with One-Year Lagged Cost: β (t-Value)	Model with Two-Year Lagged Cost: β (t-Value)
Intercept (γ_{00})		3.291 (19.78)**	3.192 (21.27)**	3.435 (26.06)**
Public company (PUBL) (γ_{01})		.343 (2.66)**	.462 (3.73)**	.360 (3.28)**
Firm size (SIZE) (γ_{02})		–.194 (–2.42)*	–.234 (–3.14)**	–.160 (–2.43)*
Lagged profit efficiency (PEFF) (β_1)		.194 (7.49)**	.235 (8.57)**	.456 (18.92)**
CRM implementation (CRM) (γ_{20})	H_2	–.906 (–8.08)**	–.369 (–3.89)**	–.613 (–9.37)**
CRM × time (CRM × T) (γ_{21})	H_{3b}	–.201 (–7.93)**	–.307(–14.27)**	–.170(–11.83)**
CRM × strategic focus (CRM × SI) (γ_{22})	H_{4b}	.002 (.02)	–.033 (–.37)	.026 (.40)
CRM × firm size (CRM × SIZE) (γ_{23})		.010 (.09)	.032 (.31)	.043 (.59)
CRM × order (CRM × ORD) (γ_{24})	H_{5b}	.824 (8.02)**	1.216 (13.46)**	.503 (8.02)**
Mergers and acquisitions (M&A) (β_3)		.136 (1.57)	.075 (1.22)	.108 (2.54)*
Lambda (β_4)		–.002 (–2.46)*	.003 (4.67)**	.001 (1.45)

*$p < .05$.
**$p < .01$.

CRM implementation, improves over time. However, the impact of CRM on cost efficiency did not vary with bank size (γ_{23} = .024, t-value = 1.52). We found that public banks were less efficient than private banks (γ_{01} = .035, t-value = 2.62). Larger banks were more cost efficient than smaller banks (γ_{02} = –.036, t-value = –2.95), a finding consistent with that in Berger, Hancock, and Humphrey's (1993) study. Recent M&As did not affect cost efficiency (β_3 = .010, t-value = .98).

H_2 proposed that profit efficiency is likely to increase as a result of the implementation of CRM; the findings support this prediction (γ_{20} = –.906, t-value = –8.08; higher values of PEFF correspond to lower values of profit efficiency). Using data from the intercept, we find that after CRM implementation, profitability relative to the most profitable bank in industry increased by 27.5% (.906/3.291). However, the impact of CRM on profit efficiency did not vary for different levels of CRM commitment (γ_{22} = .002, t-value = .02), and H_{3b} was not supported. In accordance with H_{4b}, we find that late adopters are more profit efficient than early adopters (γ_{24} = .824, t-value = 8.02). The positive impact of CRM implementation on profit efficiency grows over time, as H_{5b} predicted (γ_{21} = –.201, t-value = –7.93). The impact of CRM implementation on profit efficiency did not vary between large and small banks (γ_{23} = .010, t-value = .09), though larger banks were more profit efficient in general (γ_{02} = –.194, t-value = –2.42). In addition, private banks were more profit efficient than public banks (γ_{01} = .343, t-value = 2.66). Finally, similar to cost efficiency, past M&As did not have an effect on profit efficiency (β_3 = .136, t-value = 1.57).

To clarify the effect further, we examined the impact of CRM on revenue efficiency—the extent to which firms are successful in generating revenues compared with the best-performing firms using the inputs.[4] Using the same hierarchical linear model formulation, we find that firms that

[4]We estimated revenue efficiency ($RvEFF_{it}$) using (1) an approach similar to that detailed for profit efficiency ($PEFF_{it}$), except that the dependent variable was the bank's revenue, and (2)

implement CRM enhance their revenue efficiency; that is, they generate more revenues from a comparable set of inputs after they implement CRM than they do otherwise (.245, $p < .005$). In other words, CRM implementation enhances revenue efficiency as a means to improve profit efficiency despite a decline in cost efficiency. We argue that this is further evidence of dual value creation from CRM implementation. That is, CRM implementation leads to a decline in cost efficiency but to an increase in profit efficiency by enhancing the revenue efficiency of firms. In other words, firms are able to more than compensate for the increase in cost after CRM implementation through an increase in revenues, possibly through higher customer acquisition, retention, and prices.

Sensitivity Analysis

Prior research has shown that investments may have long-lasting effects on different forms of organizational performance (Rust et al. 2004). Thus, it is important to consider the longer-term effects of past investments that may lead to changes in cost efficiency. Therefore, we checked the robustness of the results by undertaking a sensitivity analysis. To do so, as a initial step, we estimated the cost function and profit functions using lagged values (one and two year) of past investments. Then, we derived cost and profit efficiency scores using Equations 2 and 4, respectively. Finally, we reestimated the cost and profit efficiency models using the new cost and profit efficiency scores. The results of the sensitivity analyses were consistent with previous findings (see Tables 3 and 4).

Discussion

The central premise of this article is that the implementation of CRM has a complex influence on firm performance. Therefore, the objective of this research was to explore the effects of CRM implementation on two aspects of organizational performance: operational efficiency and profitability. Our approach is different from much existing research that studies CRM implementation because it (1) focuses mostly on effectiveness or customer-centric outcomes (e.g., revenues, customer satisfaction, retention, market share, share of wallet) and (2) employs cross-sectional samples (Jayachandran et al. 2005) or case studies (Ryals 2005). Overall, the study addresses criticisms of prior research in CRM in which studies focus on intermediate performance measures and often use cross-sectional data, thus limiting the ability of researchers to unambiguously delineate causality. The SFA employed in this study enabled us to compare an individual firm with the best performers in the whole industry.

We find that CRM implementation can have a negative effect on cost efficiency. However, and importantly, the results also show that CRM implementation enhances the profit efficiency of firms, regardless of its impact on cost efficiency. The decline in cost efficiency that the implementation of CRM engenders decreases over time. This result supports the notion that, over time, firms learn how to use CRM effectively to manage their customer data and develop one-to-one relationships without the diseconomies involved in doing so. Consistent with this notion of learning, we find that firms implementing CRM enhance their ability to increase profit efficiency over time. This result is supported by reports in the business press based on a survey of banking executives conducted by *Financial Services Technology* (2007). The report notes that there were several initial blocks to taking full advantage of CRM that were resolved over time, leading to improvement in performance. We found that firms that are deeply committed to pursuing a CRM strategy are less likely to face the cost inefficiency that implementing CRM may involve. This result is again consistent with the report in the *Financial Services Technology* survey. It is likely that firms that are committed to CRM will build specific capabilities that enable them to take full advantage of the technology.

The results do not support the notion that larger firms are more likely to benefit from implementing CRM. However, we find that firms that implemented CRM early on were more likely to suffer deeper downturns in cost efficiency and enjoy lower profit efficiencies than later adopters. This finding supports the conjecture that early adopters of CRM are likely to adopt when standards are not well developed and CRM suppliers are still fine-tuning their products. Lending validity to this result, the *Financial Services Technology* (2007) report notes that for most early adopters, CRM did not provide the expected results because of the lack of maturity of the technology and low levels of CRM commitment.

Implications for Firms

Implications of main effect results. The results of this study should be of interest to organizations that implement CRM and to managers of CRM technology vendors and consultants. One important finding is the negative impact of CRM on cost efficiency. Overall, we demonstrate that CRM

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revenue function of the firm that models the relationship between the logarithm of its revenues (dependent variable) and inputs, outputs, and fixed inputs. Revenue function is similar to cost function, except that dependent variable in the revenue function is a firm's stream of revenues, not variable costs as in cost function. Similar to cost function (Equation 1), we formulate revenue function as follows:

$$\ln \mathrm{Re}\, v_{it} = f(\ln P_{it},\ \ln Y_{it},\ \ln Z_{it},\ \ln \nu_{it}^{R}),$$

where

Rev_{it} = revenues of firm i at time t,
P_{it} = inputs' prices (deposits, labor, marketing, and purchase funds) for firm i at time t,
Y_{it} = quantities of variable outputs (loans, services, and securities) of firm i,
Z_{it} = firm's fixed inputs (financial equity capital and fixed assets), and
ν_{it}^{R} = the error term.

We estimated revenue function for each period. Then, we formed a series of residuals $\ln(\nu_{it}^{R})$ for each firm. Next, we calculated the revenue efficiency term, $RvEFF_{it}$, for each firm as the exponent of the difference between the largest residual for time t (ν_{tmax}^{R}) and the residual for a given firm from the revenue function (ν_{it}^{R}). We truncated the residuals (ν_{tmax}^{R}) at the 5th and 95th percentiles before calculating revenue efficiency scores.

implementation decreases cost efficiency by an average of 5.4%, emphasizing that the superior ability to understand and satisfy customer needs comes at an extra cost. These findings possibly underscore the notion that firms that pursue relationship marketing build organizational routines differently from firms that adopt a transactional approach. These efforts allow firms to establish and maintain strong long-term customer relationships. However, management of these relationships appears to increase operational complexity, thus leading to an increase in operating costs and a decline in cost efficiency.

Nevertheless, we note that firms observe a 27.5% improvement in profit efficiency. As such, the results demonstrate strong support for the ability of CRM to enhance the profitability of banks. The findings are consistent with the dual value creation argument put forth by Boulding and colleagues (2005). According to the results of this study, the improvement in firm performance through CRM is not necessarily driven by efficiency gains. The enhanced profit efficiency of firms that implement CRM despite the fall in cost efficiency is an indication that these firms gain higher revenues by enhancing customer value.

For the reasons we outlined previously, as firms plan and evaluate their relationship marketing programs, we hope that this research will assist managers in making sound decisions about investments in CRM. Overall, the results imply that the focus on efficiency gains from CRM implementation may be misguided because, regardless of its impact of efficiency, CRM implementation enhances a firm's profit potential. Both CRM vendors and users should be wary of employing CRM implementation merely as a tool to enhance efficiency. Instead, CRM should be viewed as a means of enhanced customer knowledge that enables firms to provide customers with products that meet needs more precisely, thereby increasing customer value. In other words, CRM implementation is not an "efficiency play" but rather an "effectiveness play" for firms because it enables them to serve customers with greater effectiveness, albeit at a higher cost. Therefore, managers of CRM vendors should promote CRM as more of a solution that enhances the effectiveness of a firm's customer relationship strategies than as a means to achieve quick cost reduction through enhanced efficiency.

Implications of moderator effects results. From a managerial perspective, the moderating effects we find are also of relevance. From these results, managers should also note the conditions under which the impact of CRM on firm performance is enhanced or reduced. We find that firms need to be patient with CRM implementation because the negative effect on cost efficiency decreases over time and the positive effect on profit efficiency improves over time. Therefore, it is important to acknowledge that implementing CRM is, as has been argued in the marketing literature, a complex exercise that involves changes in organizational processes and alignment of these processes with technology. It takes time for firms to get this alignment right and for CRM to provide the results that firms expect. Thus, firms should be wary of assessing the effectiveness of CRM implementation on a short-term basis. Although the time frames for CRM implementation to provide positive returns can vary from industry to industry, studies by consulting firms suggest that the relevant time frames for large-scale CRM implementation projects are as much as five years (The Boston Consulting Group 2007). The same study explicitly warns managers to be wary of claims from CRM vendors that implementation of their CRM product will turn a profit in as little as three months. As such, the result from our study, which shows the efficacy of CRM programs improving over time with experience, is consistent with the results reported based on practice. Therefore, CRM vendors should be wary of promising quick returns lest they lose credibility with CRM users. On their part, CRM users should be patient with the process of implementing CRM and should develop benchmarks on performance expectations that are based on realistic time frames.

Consistent with prior research (e.g., Day 2003), we find that CRM commitment (i.e., when a firm develops a strong strategic focus for its CRM program) helps at least in terms of cost efficiency after CRM implementation. Our results show that firms that develop a strong strategic focus on CRM do not suffer the decline in cost efficiency that their counterparts with a less strategic focus on CRM face. Therefore, developing strong CRM commitment may enable a firm to generate profits from CRM implementation relatively faster than if it were to do so as a technology initiative (The Boston Consulting Group 2007). We advise that CRM vendors should be wary of pushing technology solutions on clients that do not have clear commitment to CRM. The relative lack of success of CRM programs that lack strategic focus will have a negative impact on the CRM vendor in the long run.

Managers should also be cognizant of the problems that early adopters of CRM encountered. Our results show that early CRM adopters are likely to suffer higher cost inefficiency and lower levels of profit efficiency. Early adopters of CRM may have ended up using less mature technologies and may have adopted inappropriate processes. A reevaluation of the CRM approach is required for firms that are caught in this bind. From the general perspective of adoption of information technology solutions in firms, the problem with early adoption of CRM offers a few key insights. At one level, this result advocates waiting for the technology to mature so that problems with its implementation are ironed out and a firm can learn from the experience of other firms. However, such advice may be impractical in the highly competitive markets that firms find themselves in, in which each firm is looking for new approaches to gain an edge over its rivals. Therefore, it may be more feasible to advocate phased or modular implementation of new technologies when possible. Such an approach will prevent firms from being locked in to immature technology solutions. At the very least, a phased approach to implementing solutions such as CRM will limit the sunk cost exposure of firms and allow them to migrate to better solutions that emerge as the industry matures.

Implications for different layers of management. This article argues that CRM implementation affects firms in more ways than one. Thus, the findings of this research

should not be assessed simply from the perspective of vendors or buyers of CRM technology or services but also from the viewpoint of different layers of management within the same organization.

Chief executive officers (CEOs) play a pivotal role in directing the attention of employees to innovation and in ensuring the growth and competitiveness of firms. The finding that CRM implementation improves firms' profitability (profit efficiency) despite a decline in operational efficiency should channel the attention of CEOs and senior executives to the strategic value of CRM implementation. In this regard, the success stories of firms such as Harrah's Entertainment (Loveman 2003) and Albertsons (Hymowitz 2004), both of which implemented CRM under the guidance of CEOs, should serve as example of best practices in CRM.

The success of CRM implementation in enhancing firm profitability should highlight the role of chief marketing officers (CMOs) in driving firms to pursue CRM. Given that CRM implementation entails high risks, the CMO could play a key role in helping the management team cope with the complexity and uncertainty associated with the process. In the absence of such stewardship, firms may cut back on CRM spending because the marketing function fails to demonstrate the impact of CRM investments on firm performance. In this regard, the results from this study will help CMOs reduce negative perceptions about CRM implementation and limit poorly informed decisions.

The findings from our study also facilitate a reduction in the communication gap between CMOs and chief information officers (CIOs). The CMO–CIO relationship is critical to the effective implementation of CRM, but it often suffers from mutual misperceptions of goals and approaches. In general, CMOs perceive CIOs as being focused on efficiency and as having little knowledge of marketing and consumers, and CIOs perceive CMOs as not being concerned about the costs or resources required to address their technology needs (Commander 2008). This study shows that the use of CRM is more likely to yield results in the effectiveness area than in the efficiency area. As such, CMOs can articulate the need for CRM implementation by highlighting its effectiveness in profit enhancement, thus ensuring that the excessive focus on efficiency and costs does not prevent CIOs from lending their support to CRM implementation.

Limitations and Research Implications

Although this study produced provocative and meaningful results, there are several avenues for further research as well as limitations that should be discussed. The study finds that CRM implementation can play a key role in developing marketing assets that lead to better performance and deserve due consideration by firms that try to do so in the context of managing customer value. However, before such advice can be offered on a large scale, it should be noted that the use of the commercial banking industry as the sample could lead to a potential industry specificity of the results. Future studies should explore how various industry-specific characteristics drive the direction and magnitude of the impact of CRM on firm performance. It is likely that competitive intensity and turbulence in specific industries have an influence on the relationship between CRM and cost and profit efficiency. In industries with higher intensity of competition and turbulence, firms that effectively implement CRM may enhance their ability to retain customers and thus augment profit efficiency. It should also be kept in mind that findings in a services context may not necessarily translate into a manufacturing context. This is another industry-level difference that needs to be considered when evaluating the results, and further research is required. However, note that prior research has not observed any difference in the impact of CRM on performance between manufacturing and services firms (e.g., Jayachandran et al. 2005; Reinartz, Krafft, and Hoyer 2004).

Nevertheless, the industry specificity of the study, though a limitation from a generalizability perspective, is not without its advantages. As we noted previously, financial services firms, and banks in particular, are pioneers in the CRM arena. This enables us to assess empirically the impact of CRM in an industry that has substantial experience with the technology and thus to obtain a longer-term evaluation of its impact. In addition, the uniformity of inputs and outputs in banking makes accurate comparisons of cost and profit efficiencies across firms feasible.

A key objective of the study was to measure the impact of CRM implementation on two types of firm performance: operational efficiency and profitability. Although we obtained archival data of CRM implementation, it might be argued that CRM implementation can be measured in a finer-grained manner (e.g., Jayachandran et al. 2005). Overall, our data do not account for how CRM implementation varies across firms in scope and scale. Therefore, given that CRM is a complex phenomenon, subjective evaluations of managers may be critical to capture the multifaceted nature of CRM implementation. Employing subjective data will enable a detailed assessment of the effects of CRM on firm performance.

Finally, it may not be appropriate to interpret our results to mean that CRM implementation permanently damages operational efficiency. As we observed, when firms become accustomed to CRM implementation, efficiency gains could materialize over time. In other words, firms could learn how to use CRM implementation more efficiently as they gain greater experience with its implementation. Therefore, a more positive relationship between CRM and both types of performance could arise later. To examine this issue, it might be worthwhile to pursue studies with a wider time horizon and to adopt finer-grained metrics that capture savings because of better coordination.

Appendix
Estimation of Cost and Profit Functions

Specification of Cost Function

We specified the cost function (Equation 1) using the Fourier-flexible functional form (Equation A1), a hybrid form that combines both standard translog and Fourier trigonometric terms and provides superior fit to the standard

translog form (Akhavein, Berger, and Humphrey 1997; Bauer, Berger, and Humphrey 1993; Berger, Cummins, and Weiss 1995; Berger, Hancock, and Humphrey 1993). As Berger, Hancock, and Humphrey (1993) suggest, the dependent variable is normalized with respect to equity and the price of labor, output quantities pertaining to equity, and prices of inputs by the price of labor to derive scale-free estimates of cost efficiency.

$$
\begin{aligned}
(A1)\quad \ln VC_i = {} & \alpha + \sum_{j=1}^{3} \phi_j \times \ln P_{ji} + \sum_k \sum_j \phi_{kj} \times \ln P_{ki} \times \ln P_{ji} \\
& + \sum_{j=1}^{3} \beta_j \times \ln Y_{ji} + \sum_k \sum_j \beta_{kj} \times \ln Y_k \times \ln Y_j \\
& + \kappa_1 \times \ln W_1 + \kappa_2 \times \ln W_2 + \kappa_{12} \times \ln W_1 \times \ln W_2 \\
& + \sum_k \sum_j \psi_{kj} \ln P_j \times \ln Y_k + \sum_k \sum_j \gamma_{kj} \ln P_j \times \ln W_k \\
& + \sum_k \sum_j \phi_{kj} \ln Y_j \times \ln W_k \\
& + \sum_{l=1}^{9} (\delta_l \times \cos z_l + \theta_l \times \sin z_l) \\
& + \sum_l \sum_m [\delta_{lm} \times \cos(z_l + z_m) + \theta_{lm} \times \sin(z_l + z_m)] \\
& + \sum_l \sum_m \sum_n [\delta_{lmn} \times \cos(z_l + z_m + z_n) \\
& + \theta_{lmn} \times \sin(z_l + z_m + z_n)] \\
& + \ln NPL_i + (\ln NPL_i)^2 + \ln v_i^c,
\end{aligned}
$$

where

VC = variable costs of ith company,
P_1 = price of deposits,
P_2 = price of labor,
P_3 = price of purchased funds,
P_4 = price of marketing,
Y_1 = amount of loans,
Y_2 = quantity of securities,
Y_3 = amount of services,
W_1 = financial equity capital,
W_2 = fixed assets, and
NPL = amount of nonperforming loans.

We calculated the trigonometric terms in line with Berger, Cummins, and Weiss's (1995) and Gallant's (1981) recommendations.

We estimate annual cost functions for each of the ten periods rather than a single multiyear efficiency frontier to allow the estimated coefficients to vary across time as market conditions and technology change (DeYoung and Hasan 1998). We employ the bank-specific nonperforming loan ratio to control for market conditions faced by an individual bank (Berger, Cummins, and Weiss 1995; DeYoung and Hasan 1998). We use the residuals to calculate cost efficiency scores.

Profit Function

The profit function (Equation 3) takes the same form as the cost function except that (1) the dependent variable is operating profit instead of variable costs, and (2) instead of output quantities as in cost function, it uses output prices (interest on loans and interest on securities).

$$
\begin{aligned}
(A2)\quad \ln(Pr_{it} + \Delta) = {} & \alpha + \sum_{j=1}^{3} \phi_j \times \ln P_{ji} + \sum_k \sum_j \phi_{kj} \times \ln P_{ki} \times \ln P_{ji} \\
& + \sum_{j=1}^{3} \beta_j \times \ln I_{ji} + \sum_k \sum_j \beta_{kj} \times \ln I_k \times \ln I_j \\
& + \kappa_1 \times \ln W_1 + \kappa_2 \times \ln W_2 + \kappa_{12} \times \ln W_1 \times \ln W_2 \\
& + \sum_k \sum_j \psi_{kj} \ln P_j \times \ln I_k \\
& + \sum_k \sum_j \gamma_{kj} \ln P_j \times \ln W_k \\
& + \sum_k \sum_j \phi_{kj} \ln I_j \times \ln W_k \\
& + \sum_{l=1}^{9} (\delta_l \times \cos z_l + \theta_l \times \sin z_l) \\
& + \sum_l \sum_m [\delta_{lm} \times \cos(z_l + z_m) \\
& + \theta_{lm} \times \sin(z_l + z_m)] \\
& + \sum_l \sum_m \sum_n [\delta_{lmn} \times \cos(z_l + z_m + z_n) \\
& + \theta_{lmn} \times \sin(z_l + z_m + z_n)] \\
& + \ln NPL_i + (\ln NPL_i)^2 + \ln v_i^p,
\end{aligned}
$$

where

Pr = profit of ith company,
P_1 = price of deposits,
P_2 = price of labor,
P_3 = price of purchased funds,
P_4 = price of marketing,
I_1 = price of loans,
I_2 = price of securities,
I_3 = price of services,
W_1 = financial equity capital,
W_2 = fixed assets, and
NPL = amount of nonperforming loans.

The profit function has the same functional form and the same right-hand-side variables as the cost function, except that output prices replace output quantities.

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