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ORGANIZATIONAL SLACK AND INFORMATION TECHNOLOGY INNOVATION ADOPTION IN SMEs

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ABSTRACT

This study explores the relevant dimensions of organizational slack in small and medium enterprises (SMEs) and investigates their impact on adoption of different types of information technology (IT) innovations. Using recent data from a representative sample of 2,296 U.S. SMEs, we find that the slack-innovation relationships previously described in larger firms do not hold well for SMEs. Our results show *potential slack* (measured as access to external credit) to be a strong predictor of technology adoption in SMEs. By contrast, *available slack* appeared not to be a significant factor in SME innovation adoption. Moreover, the direction of the effects of potential slack was moderated by the capital-intensity of the innovation. In particular, e-commerce, which required lesser financial resources for SME adoption, was found to be pursued by those with lesser potential slack. We argue that, in some cases, innovation adoption may represent a form of "bricolage" by resource constrained SMEs.

Keywords: technology adoption, innovation, SMEs, organizational slack, e-commerce, bricolage

INTRODUCTION

Organizations must strike a balance between stability and innovation –i.e., between exploitation of their current business model and processes and exploration and adoption of alternative solutions (March, 1991). Accordingly, understanding the processes by which organizations adjust their propensity to innovate, as well as the conditions most likely to foster innovation in a firm, is an important endeavor that has motivated a large innovation literature in management (see Daniel et al., 2004; Damanpour, 1991; Drazin & Schoonhoven, 1996; and Fiol, 1996, for reviews of this literature).

Prior theory predicting innovation rates highlights the role of organizational slack as an important condition that facilitates exploration and, thus, contributes to a firm's innovativeness (Cyert & March, 1963; Greeve, 2003). On the other hand, slack is also argued to be related to inefficiencies in the use of resources (Bourgeois, 1981) and to less disciplined investment (Jensen, 1986), which may be detrimental to innovation. Given these competing arguments, Nohria and Gulati (1996) argued and found support for an inverted U-shaped relationship between slack and innovation. Their findings suggest that greater levels of slack increase the rate of adoption of technical and administrative innovations, but only up to a point. Beyond this point, excess slack appears to be counterproductive and results in reduced innovation rates.

Subsequent research by Geiger and Cashen (2002) extended Nohria & Gulati's (1996) work by examining the shape of the slack-innovation relationship for different dimensions of slack. Prior studies had distinguished among available slack, recoverable slack, and potential slack (Bourgeois & Singh, 1983; Bromiley, 1991). Geiger & Cashen (2002) found available and recoverable slack to have a curvilinear, inverted-U shaped, relationship with innovation, while potential slack had a linear positive relationship to innovation.

An important limitation of the prior organizational slack literature is that it has overwhelmingly focused on large, publicly traded firms[1]. With regard to the slack-innovation relationship, the technology adoption literature in information systems (IS) has shown a greater interest in small and medium enterprises (SMEs) and, thus, can be seen as filling some of the void left by the broader literature. In particular, a number of studies have explored the role of financial resources as an antecedent to SME adoption of specific IT innovations (e.g., Iacovou, Benbasat, & Dexter, 1995; Kuan & Chau, 2001; Mirchandani & Motwani, 2001). To date, however, this literature can offer only limited and tentative insights regarding slack-innovation relationships: First, most prior SME technology adoption studies undertake a superficial treatment (at best) of financial resource considerations as one of the many factors in the typical technology adoption model. Also, the definition and measurement of financial resource variables differs widely across studies and often deviates form the concept of financial slack. Moreover, in the few cases where financial drivers are operationalized as financial slack (i.e., Grandon & Pearson, 2004; Wang & Cheung, 2004), the reliance on relatively small samples and the focus on a single technological innovation limits the generalizability of findings and prohibits a comparative analysis of the characteristics of the innovation as a possible moderator of the slack-adoption relationship. In sum, there is limited evidence regarding the role of organizational slack on SME innovation adoption. Also, no prior study has investigated how different dimensions of organizational slack may influence innovation in SMEs. Furthermore, the presence of curvilinear relationships between slack and SME adoption has yet to be explored.

Given the importance of SMEs to the U.S. economy (e.g., Bharati & Choudhury, 2006; Small Business Administration, 2006), as well as the expectation that prior findings using samples of large firms will not generalize to the SME context (Dandridge, 1979; Thong, 1999), the lack of in-depth study of the role of organizational slack in the context of small firms represents an important gap in our understanding of slack-innovation relationships. SMEs represent 99.7 percent of all U.S. employers, are responsible for about half of the private sector jobs, and generate about half of the private GDP (Small Business Administration, 2006). Moreover, SMEs play a critical role in industrial innovation and renewal of economic sectors (Baumol, 2002; Small Business Administration, 2003) and, thus, are major contributors to the competitiveness of the economy. At the same time, there are fundamental differences between SMEs and large businesses (Dandridge, 1979; Welsh & White, 1981; Thong, 1999) which suggest that both the levels and types of slack, as well as the mechanisms by which slack influences innovation, may vary across contexts. In particular, SMEs are usually severely resource constrained (Oviatt & NcDougall, 1994; Baker & Nelson, 2005). Also, they exhibit high mortality rates that

result from their double *liabilities of smallness and newness* (Freeman, Caroll, & Hannan, 1983), which affects their willingness to take risks.

The purpose of the present research is to extend prior slack-innovation studies (i.e., Geiger & Cashen, 2002; Nohria & Gulati, 1996) by developing the concept and dimensions of organizational slack in the context of SMEs, and investigating how different types of slack relate to innovation adoption in these firms. Our study is based on a representative sample of 2,296 U.S. SMEs. In an attempt to explore how characteristics of the innovation itself may moderate the slack-innovation relationship, we study SMEs' adoption of two specific information technologies that represent opposite minimum requirements in terms of their capital intensity and complexity: e-commerce and computerized core process technologies.

The remainder of the paper is organized as follows. First we define and discuss organizational innovation and present previous research on IT innovation adoption in SMEs. We then discuss organizational slack as well as the multidimensional aspects of slack and its relationship with innovation. This is followed by a discussion of how the distinctive environment of SMEs is likely to affect both the relevant dimensions of organizational slack and their relationship to innovation adoption. This section concludes with our hypotheses. Next, data and measures are presented followed by methods and results. Finally, we offer a discussion of results, directions for future research, and limitations of the present study.

ORGANIZATIONAL INNOVATION

Organizational innovation research has been approached from many diverse perspectives and has been extensively researched over the past half century. If Rogers (1962) did not originate the field, his work is often given credit for popularizing it. Several distinctions can be made concerning the different research streams in this area. One important distinction (Damanpour & Wischnevsky, 2006) is whether the focus is on internal innovation concerning the development of innovations within an organization (e.g., Cormican & O'Sullivan, 2004; Dougherty & Hardy, 1996; Kivimaki & Lansisalmi, 2000; Wong & Chin, 2007) or on the adoption of innovations within an organization regardless of the origin of the innovation (e.g., Brancheau & Wetherbe, 1990; Compeau, Higgins, & Huff, 1999; Davis, 1989; Kishore & McLean, 2007; Moch & Morse, 1977; Moore & Benbasat, 1991; Venkatesh, Morris, Davis, & Davis, 2003; Yang, Lee, & Lee, 2007). In this research we focus on the later form of adoption of external innovations.

In this context, it is important to define specifically what is meant by an innovation. Although competing definitions exist, most research has adopted a definition similar to that of Damanpour (1991, p. 556), "innovation is defined as adoption of an internally generated or purchased device, system, policy, program, process, product, or service that is new to the adopting organization." This definition provides sufficient specificity as to what is considered an innovation and removes the problem of subjectively determining the level of innovativeness represented by the technology. It simply requires that the

technology be new to the adopting organization. Many other distinctions may be made to differentiate between types of innovations. Innovations may be considered technical or administrative, radical or incremental, and product or process. These and other distinctions are discussed in detail in the extant literature (Damanpour, Szabat, & Evan, 1989; Damanpour, 1991; Swanson, 1994).

The two specific innovations chosen for this research are *electronic commerce* adoption and what we will term *computerized core* adoption. E-commerce adoption is present when a firm engages in any level of sales of products and/or services via the Internet. In the general population such adoption can vary immensely in scope. As we discuss more fully in our measurement section, the type of adoption we expect our sample to engage in is supplementary rather than primary. Computerized core adoption relates to the adoption of computer systems that contribute directly to the firm's primary business activity. As explained below, the differences represented in these two innovations will allow us to explore the extent to which slack-innovation relationships may be moderated by characteristics of the innovation itself.

IT INNOVATION ADOPTION IN SMEs

A substantial amount of research in the information systems literature has been devoted to studying predictors of adoption of new information technologies by SMEs (see Premkumar, 2003; Parker & Castleman, 2007 for reviews of some of this literature). However, organizational slack has received relatively little attention in this research.

The Technology Acceptance Model (TAM) introduced by Davis (1989) is adapted in a number of SME technology adoption studies (e.g., Igbaria et al., 1997; Riemenschneider, Harrison, & Mykytyn, 2003). Others (e.g., Riemenschneider & McKinney, 2001) employ the Theory of Planned Behavior (TPB) which Ajzen (1991) adapted from the Theory of Reasoned Action (Fishbein & Ajzen, 1975). Both of these approaches focus on the perceived characteristics of the particular technology as the key driver of adoption. Hence, this has been termed the "technological" perspective. Others extend this perspective to include characteristics of the organization and of its external environment as further predictors of adoption. This is commonly referred to as the Technology-Organization-Environment (TOE) framework (Tornatzky and Fleischer, 1990; Premkumar and Roberts, 1999; Kuan and Chau, 2001).

The TOE model has been applied to SME adoption of specific technological innovations. Iacovou et al. (1995) developed a model of adoption of Electronic Data Interchange (EDI) by SMEs that proposes *perceived benefits* of the innovation (i.e., the technological context), *organizational readiness* (organizational context) and *external pressure* (environmental context) as the key determinants of the decision to adopt. Of particular interest to the present study is the organizational readiness factor, which is composed of two sub-dimensions: the extent to which the SME possesses (i) the technological resources and (ii) the financial resources necessary to adopt e-commerce. The later may be understood as (or including) financial slack. Iacovou et al.'s (1995) model was

subsequently tested by Chwelos et al. (2001) using a sample of 268 Canadian SMEs, and by Kuan & Chau (2001) using a sample of 575 small trading companies based in Hong Kong. In both cases, the financial dimension of organizational readiness (measured as financial resources in one case and as perceived financial costs of adoption in the other) was found to be an important contributor to the intent to adopt EDI.

The TOE model has also been applied to adoption of internet-based technologies in SMEs. Interestingly, financial considerations have been found to play a lesser role in this context[2]. Mehrtens, Cragg, & Mills (2001) developed a model of internet adoption by SMEs through a multi-case inductive study. Their final model was very similar to Iacovou et al.'s (1995), except that it did not include financial resources as a subcomponent of the organizational readiness factor. Subsequently, survey-based studies of internet adoption in SMEs using the TOE framework have often de-emphasized financial resources (e.g., Premkumar & Roberts, 1999; Beckinsale, Levy & Powell, 2006). Others have included this element but have found it not to be an influencing factor. In particular, in the specific context of e-commerce adoption in SMEs, both Mirchandani & Motwani (2001) and Grandon & Pearson (2004) found financial considerations not to be an important factor.

Overall, most prior SME innovation adoption studies have either paid no attention to financial resources or have modeled this as a sub-dimension of the broader construct of organizational readiness. Most important, when included, the financial component of readiness has been operationalized as something other than financial slack. For example, Chwelos et al. (2001) used a 3-item scale that includes number of employees and annual sales, so that their measure is actually capturing firm size. Similarly, others have used profit levels to proxy for financial resources (e.g., Dembla, Palvia, & Brooks, 2007). Still others have focused on the perceived financial cost of the innovation as opposed to financial resources (Kuan & Chau, 2001; Mirchandani & Motwani, 2001).

The studies by Grandon & Pearson (2004) and by Wang & Cheung (2004) provide exceptions to this and, as such, represent important precedents to the present study. Grandon & Pearson's (2004) single-item measure of financial resources was constructed by asking respondents if they thought they had the "Financial resources to adopt e-commerce" (p. 213). This appears to capture financial slack conditional on perceived costs of adoption (we also suspect this measure is rather capturing *available slack*, as defined below). As noted above, this measure was found not to be an important factor in e-commerce adoption. Wang & Cheung (2004) used a 4-item measure that captures overall (perceived) financial slack of the firm. In a sample of 137 small travel agencies in Taiwan, this measure was found to be negatively related to the intention to adopt e-commerce, but positively related to the degree of e-commerce implementation. The authors argued that the availability of funds facilitates implementation but, at the same time, greater levels of financial slack may result from better past performance and, thus, may be related to resistance to change in the first place.

In sum, taken as a whole, the prior IT innovation adoption literature provides some, but limited, insight into the role of slack on innovation adoption in SMEs. We believe that

further understanding of SME adoption issues will benefit from greater attention to, as well as more precise definition of, organizational slack.

ORGANIZATIONAL SLACK

Organizational slack is defined as resources in excess of what an organization requires to maintain its standard operations (Cyert & March, 1963). Cyert and March (1963) argued that slack is crucial to resolving political conflicts emanating from goal expectations of different coalitions within organizations. Slack has long been held to have a positive effect on various aspects of performance within a firm. Bourgeois (1981) discusses four often cited functions of slack within an organization: as motivation for organizational participants to remain; as a source of resolving conflicts; as workflow buffers; and to aid in the facilitation of creative or innovative processes within the organization. With regard to the latter, it has been suggested that slack allows (i) the exploration of new ideas before they are actually needed, (ii) the purchase of innovations, (iii) the funding of innovation implementation costs, and (iv) the absorption of failure (Rosner, 1968).

Types of Organizational Slack

Singh (1986) suggested two different types of organizational slack. *Absorbed* (or recoverable) slack relates to administrative resources beyond what is necessary for the normal operation of the organization –i.e., excessive organizational overhead. This creates a "cushion" of resources that can be made available either by eliminating costs that are not required or by deploying underutilized staff, facilities, or other assets. By contrast, *unabsorbed* slack is resources that are liquid and uncommitted in the organization, like cash reserves (Singh, 1986). Singh empirically demonstrated that absorbed and unabsorbed slack have different effects on risk-taking behavior. Subsequently, Bourgeois and Singh (1983) suggested further dividing slack into three categories: available (unabsorbed) slack, recoverable (absorbed) slack, and potential slack. *Potential* slack refers to additional financial resources that may be obtained through credit, as indicated by the firm's unused borrowing capacity. Bourgeois and Singh's (1983) typology has been broadly adopted in the prior literature, which has focused on the study of large organizations (Geiger & Cashen, 2002; Greeve, 2003; Herold, Jayaraman, & Narayanaswamy, 2006).

Slack and Innovation

Slack has been argued to allow and, to some extent, promote expenditures associated with creativity and experimentation which, in turn, leads to greater organizational performance (Cyert & March, 1963; Bourgeois, 1981). Other researchers, however, argue that slack promotes wasteful use of resources and, thus, is negatively associated with firm innovation and performance (Simon, 1957; Jensen & Meckling, 1976). The divergence of opinion appears to revolve around how wisely slack resources will be allocated (Herold et al., 2006; Nohria & Gulati, 1996).

Bourgeois (1981) synthesized the competing arguments regarding the role of slack by hypothesizing "that the correlation between 'success' and slack is positive, up to a point, then negative; in other words, the relationship is curvilinear" (p. 31). There are several reasons why excessive slack may lead to inefficiencies: If the number of investment projects increases with additional slack and if projects are funded rationally, it makes sense that the most promising will be funded first and additional projects may have diminishing returns (Herold et al., 2006; Nohria & Gulati, 1996). Moreover, additional slack may lead to less disciplined management of projects in terms of their selection, support, and termination (Herold et al., 2006; Nohria & Gulati, 1996).

Nohria and Gulati (1996) extended this argument to the relationship of organizational slack and innovation (arguably a subset of Bourgeois' (1981) concept of "success"). The authors argued that the relationship between slack and innovation (measured either as total economic impact or as total number of innovations) would be inverse U-shaped, and provided empirical support for this hypothesized relationship. Subsequently, Geiger and Cashen (2002) extended Nohria and Gulati (1996) by taking a multidimensional view of slack. Specifically, they studied possible curvilinear relationships of available, recoverable, and potential slack with innovation. There are few other empirical studies utilizing a multidimensional view of slack and considering non-linear relationships but, apart from Geiger and Cashen (2002), no other study of this sort investigates slack-innovation effects[3].

ORGANIZATIONAL SLACK IN SMEs

As discussed above, the previous slack-innovation literature has focused almost exclusively on the study of larger publicly-traded firms. Only a few studies in the I.S. literature have investigated the role of organizational slack on innovation adoption by SMEs (Grandon & Pearson, 2004; Wang & Cheung, 2004). Moreover, no prior study has pursued a multidimensional view of slack within the SME context. Also, no study has explored the existence of a curvilinear relationship of slack (or dimensions of slack) with innovation in SMEs. Consequently, there is no evidence that current arguments and findings in the slack-innovation literature will hold for small firms. Indeed, there is little reason to expect that they would (Dandridge, 1979; Welsh & White, 1981).

There are fundamental differences between SMEs (defined as firms with fewer than 500 employees) and large firms. The U.S. Small Business Administration reports that the average SME has one location and 10 employees, while the average large employer had 61 locations and 3,300 employees in 2003 (SBA, 2006). Similarly, population estimates with the database used in the present study suggest that more than 80 percent of U.S. SMEs employed fewer than 10 workers in 2004, and more than 70 percent had annual sales of less than $500,000 in 2003 (Mach & Wolken, 2006). Also 59 percent of SMEs were less than 15 years old, and 94 percent were owner-managed (Mach & Wolken, 2006). In short, the large majority of SMEs are very small, rather young, owner-managed firms. There are several important implications that derive from this. First, SMEs are severely undercapitalized (Holtz-Eakin, Joulfaian, & Rosen, 1994a, 1994b) and resource

constrained (Baker & Nelson, 2005; George, 2005; Oviatt & NcDougall, 1994). Second, they tend to have highly centralized structures, where the owner-manager (or owner-manager group) makes most of the firm's decisions. Third, they are afflicted by rather volatile performance (Ekanem, 2005) and high mortality rates that result from their double *liabilities of smallness and newness* (Freeman, Caroll, & Hannan, 1983), which may impact their willingness to take risks. Given these characteristics, it is reasonable to expect that the levels and types of slack, as well as the mechanisms by which slack influences innovation, will differ in the context of SMEs as compared to the context of large and well-established firms.

Dimensions of slack that are relevant for larger firms may be immaterial in the case of SMEs (George, 2005). In particular, the concept of *absorbed* slack seems a contradiction of terms with the size, resource scarcity, and volatility and precariousness that characterize these firms. Even in the case of firms that beat the odds and have protracted periods of above-average returns, the highly centralized ownership structure characteristic of these firms makes it unlikely that surpluses will be "absorbed" throughout the organization in the form of idle or underutilized personnel and facilities. Hence, we do not believe absorbed (or recoverable) slack to be a consequential phenomenon, and thus a meaningful driver of innovativeness, in the context of SMEs.

With regard to *available* slack, it is important to understand that the financial reserves of SMEs will tend to be very limited. SMEs are often "running on fumes" and need to rely on several forms of financial bootstrapping to continue their operations (Winborg & Landstrom, 2000). Given this, the typical SME will not have funds to develop breakthrough innovations internally, and will rather adopt innovations already in existence (Baumol, 2002). Their limited funds also mean that SMEs will tend to seek simpler technologies (Bharati & Choudhury, 2006) and the lowest cost adoption of IT innovations (Thong, 1999).

Finally, in terms of *potential* slack, which refers to an organization's ability to raise external capital, it is important to recognize that since they may have little financial records or collateral, many SMEs represent high-risk borrowers and may not have access to commercial credit at all (i.e., have very little chance to obtain a bank loan), or may be credit constrained by their lenders (i.e., may receive lesser amounts of credit than their business can responsibly carry). Thus, in contrast to the prior literature which has emphasized financial leverage (i.e., debt-to-equity ratio) as the key indicator of potential slack, we believe that the most salient indicator of potential slack for SMEs is access to credit in the first place.

ORGANIZATIONAL SLACK and INNOVATION ADOPTION IN SMEs

Available Slack

As previously discussed, past studies of larger firms have argued and found support for an inverted U-shaped relationship between available slack and innovation (Geiger &

Cashen, 2002; Nohria & Gulati, 1996). Despite a tighter resource environment as well as differences in management processes and the types of innovations that will be pursued, we expect this type of slack to influence innovation in a similar way in SMEs. At low levels of available slack it is unlikely that there are resources for innovation adoption. As financial reserves increase, we expect adoption of e-commerce and computerized core processes to increase. However, for very high levels of cash reserves, which may signal a very successful business model, we expect greater inertial pressure and a lesser willingness to innovate (Wang & Cheung, 2004). Stated formally:

H1: The relationship between available slack and SME adoption of e-commerce will be inverted U-shaped (i.e., positive but declining in strength, and becoming negative beyond an intermediate optimal level).

H2: The relationship between available slack and SME adoption of computerized core will be inverted U-shaped (i.e., positive but declining in strength, and becoming negative beyond an intermediate optimal level).

Potential Slack

Geiger and Cashen (2002) argue that, unlike available and (for larger firms) recoverable slack, potential slack is unlikely to display an inverse U-shaped relationship with innovation. A high level of potential slack simply represents little or no debt rather than current resources. Since greater use of debt generates new (interest) expenses and may prompt increases in other (capital) costs, it is unlikely that greater access to external credit will lead to lesser managerial attention and a laxer use of such resources. Regardless of the level of potential slack, decisions concerning new debt cannot be made carelessly. Consistent with this, Geiger & Cashen (2002) hypothesize and empirically confirm a positive linear relationship between potential slack and innovation.

We believe that discipline in the use of debt may be even more intense in the SME context. SMEs seeking new debt are likely to receive rigorous external scrutiny by would-be creditors at any level of potential slack. Hence, we similarly expect the relationship between potential slack and SME adoption to be linear (i.e., invariant over the range of potential slack values).

In terms of direction, however, specific characteristics of the innovation being considered may moderate how adoption is affected by potential slack (Herold et al., 2006). In particular, the capital-intensity of minimum requirements to adopt a given IT innovation relative to the minimum investment required for alternative processes may determine the role of potential slack in SME contexts. In the case of e-commerce, this innovation offers a low-investment alternative to SME expansion via traditional means such as opening new locations[4]. Hence, SMEs may adopt e-commerce as a way to develop a cost-minimizing marketing channel (Santarelli & D'Altri, 2003). Indeed, for SMEs, e-commerce might be regarded as a form of *bricolage*, or utilizing 'what is at hand' (Baker & Nelson, 2005), in order to be able to grow the business. Consistent with this, we expect

firms that are more credit constrained (i.e., with lower potential slack) to be more likely to adopt this innovation. Formally:

H3: Potential slack will exhibit a linear and negative relationship with SME adoption of e-commerce.

Conversely, process-enhancing technological innovations such as computerizing core activities are likely to require substantial capital investment over and above the no-adoption alternative. Some of this investment may be derived from available slack but this type of innovation is likely to require additional financial resources. Hence, adoption of computerized core innovations is more likely to be pursued by financially healthier SMEs with greater potential slack. This leads to our final hypothesis:

H4: Potential slack will exhibit a linear and positive relationship with SME adoption of computerized core.

DATA and MEASURES

Sample

The data used for this study were obtained from the *2003 Survey of Small Business Finances* (SSBF). The SSBF is a survey conducted every five years by the Federal Reserve Board to gather information about the use of credit and other financial services by SMEs[5]. The so-called 2003 survey was actually administered between June 2004 and January 2005 and gathered data from a nationally representative sample of 4,240 private, nonfinancial, nonfarm firms with fewer than 500 employees. Besides credit use, it contains 2003 financial statement information, as well as other details on the characteristics of these firms and their owners. Both the 1998 and 2003 editions of the SSBF included information about computer use by SMEs. However, the 2003 survey offers greater level of detail regarding firms' adoption of different IT applications.

The sampling frame for 2003 SSBF was about 6.3 million firms listed in the Dun's Market Identifier (DMI) file as of May 2004, and which met the target population definition. The DMI file is thought to be an almost complete listing of all U.S. business establishments (Reynolds, 1994) –although it is likely to under-represent the smallest and newest firms (March & Wolken, 2006). The survey design was a stratified random sample by (i) employment size categories, (ii) broad U.S. Census regions, and (iii) metropolitan versus rural locations. Also, since mid-size firms represent a small percentage of the U.S. population of SMEs, the survey over-sampled larger firms (20-499 employees) –to ensure reliable estimators for this sub-group. As a result, in order to obtain unbiased population estimates from these data, researchers must use techniques that account for the complex structure of the survey (2003 SSBF Technical Codebook: 10-11). Response rate was about 32%.

Prior SSBF editions were released as a complete data set where all missing values (about 2% of data values sought) had been imputed. Imputation of missing data is performed by the Federal Reserve using randomized regressions that model a variable as a function of other survey variables. This practice was often regarded as problematic by prior management authors, and has been cited as a detriment to the use of SSBF data (Cox, Camp & Sexton, 2000)[6]. Interestingly, the 2003 SSBF release provides greater information regarding imputation, and thus greater flexibility in its treatment. The newest data set contains five separate versions of the fully imputed data, referred to as "implicates". This allows researchers to employ statistical techniques that combine estimates from the separate implicates to obtain adjusted standard errors that account for the additional variation due to imputation (Rubin, 1996). The 2003 release also "flags" values that have been imputed. Therefore, researchers have the option to identify and delete observations with imputed values. We conducted analyses under both alternatives and obtained similar results. For simplicity, only results with the reduced sample that contains no imputed values are presented here.

In order to provide a clear demarcation among the two types of IT application of interest, our study was limited to non-retail and non-wholesale firms (i.e., SIC codes 50, 51, 52, 53, 54, 55, 56, 57 & 59). Retailers and wholesalers may regard selling as their primary activity, so that adoption of e-commerce in these firms might be inextricable from adoption of a computerized core. There were 3,101 observations in the 2003 SSBF with non-missing values in the variables used in the present study. Of these, 2,464 observations corresponded to non-distribution firms. We also required that businesses that (i) were not corporate subsidiaries, (ii) had positive sales and positive assets, and (iii) had their three primary owners control more than 50% of the firm's ownership[7]. This resulted in a total of 2, 313 firms that could be used for our analyses. After deleting 17 observations with outlier values of accounting-based available slack (defined below), we were left with a study sample of 2,296 firms.

Dependent variables. *e-Commerce Adoption*. Respondents were asked if their firm used the computer "to sell business products and services via the internet". We coded affirmative responses as 1 and negative responses as zero. There were 711 study firms that had adopted this innovation by the end of 2004. Given their analytical survey weights, adopters are estimated to represent 27.9 percent of the U.S. population of non-retail & non-wholesale SMEs. The survey also asked where did the business primarily sell its products or services, and only two respondents (four respondents for the overall 2003 SSBF), or .08 percent of the population, reported conducting business primarily through the internet or phone. This suggests that practically all adopters used e-commerce as a way to complement their primary sales channel.

There is reason to believe that the vast majority of e-commerce users in our sample are recent adopters. Unfortunately, a precise estimate of the growth of e-commerce adoption in this population is not available. While the 2003 questionnaire distinguished between participation in internet purchases (i.e., e-procurement) and internet sales (i.e., e-commerce), the 1998 SSBF questionnaire merely inquired if the firm used "the computer to purchase or sell business products and services via the Internet". Nevertheless, we can

derive useful information from the available data. First, a comparison of the *1998 SSBF* data (collected in 1999) with the data used in the present study, shows that adoption of the internet for business transactions (either purchases or sales) exploded from 26.9% in 1999 to 66.0% of the population of non-distribution SMEs in 2004. Second, the data shows that almost all SMEs that had adopted the internet for business transactions by 2004 were using it to purchase products/services (94%). By contrast, a minority of those transacting via the internet in 2004 used it to sell their own products/services (41%). Thus, similarly, we would expect that a minority of those reporting to have adopted electronic transactions in 1999 would have been e-commerce firms. Moreover, prior research, as well as the lesser prevalence of e-commerce observed here, suggest a staged adoption of electronic processes, so that it is reasonable to assume an even lesser relative incidence of e-commerce *vis-a-vis* e-procurement in 1999 than in 2004. Prior studies have found SMEs to pass through a set of sequential adoption stages from e-mail use, to a web presence, to e-procurement, and culminating with e-commerce adoption (e.g., Daniel, Wilson, & Myers, 2002; Rao, Metts, & Monge, 2003). E-procurement may precede e-commerce adoption due to the greater involvement and greater commitment of resources needed for the latter. Also, by becoming an on-line purchaser of goods and services first, the business owner gains familiarity and experience with the internet, which may be instrumental to his/her motivation and ability to adopt an on-line store-front later on. In short, we believe that e-commerce adoption among SMEs occurred primarily and progressively in the years after 1999. Since our independent variables are measured at the end of the 2003 fiscal year, we believe to be capturing the relationships of interest at around the time of innovation adoption. Also, as discussed below, our study focuses on dimensions of financial slack that would be more static or slow to adjust after adoption, so that, even if captured several months later, they would still be reflective of conditions present at the time of adoption.

Computerized core. Respondents were asked if their firm used computers "to directly contribute to the firm's primary business activity". We coded affirmative responses as 1 and negative responses as zero. There were 258 firms in our sample that had adopted this innovation. Given their survey weights, we estimate that 9.06 percent of the U.S. population of non-retail & non-wholesale SMEs had computerized their core processes by the end of 2004.

Independent variables. *Available slack*. In prior studies using samples of larger firms, available slack is normally measured using either the quick ratio (Herold et al., 2006; Geiger & Cashen, 2002) or current ratio (Bromiley, 1991; Cheng & Kesner, 1997). These are measures of liquidity or solvency, defined as current assets divided by current liabilities. However, using a measure of this sort proved to be problematic with the present sample of SMEs, as 32 percent of firms in our sample had zero current liabilities. Thus, we opted for using working capital instead, defined as current assets (cash, inventory, account receivables, and other assets that can be converted to cash within one year) minus current liabilities (accounts payable and other debts due within one year). Since this measure was denominated in absolute dollar values, it was important to adjust it for the different operational resource requirements of firms (George, 2005; Greve, 2003). We decided to use working capital over sales as our final measure, as firms with

greater sales need greater amounts of working capital[8]. As opposed to measures used in the prior literature that focus on more ephemeral or high-discretion dimensions of available slack (e.g., George, 2005), our measure captures aspects that are more static or slow to adjust after adoption. In particular, cash reserves, which is the more ephemeral component of current assets, are rather small for firms in our study (31% of non-retail SMEs had $2,000 or less in cash, and the median cash amount was $6,000).

Potential slack. As discussed above, we believe that the most relevant measure of potential slack for SMEs is access to commercial credit. Given recent technological developments in banking leading to broad adoption of automated underwriting technologies (i.e., credit scoring) for small business loans (Frame, Srinivasan & Woosley, 2001; Berger, Frame, & Miller, 2005), we used the firm's credit score as an indicator of its access to credit. Our measure is derived from the Dun & Bradstreet Commercial Credit Score Percentile, as provided in SSBF. The credit score percentile is a measure of credit quality. For example, as of the time of this writing, the D&B customer service website reported that firms that fall in between the 1 and 10 percentiles have an incidence of delinquency of 58.8%; by contrast, firms in the 91 to 100 percentiles have an incidence of delinquency of only 2.5%. The measure available in the SSBF database, is an ordinal index ranging from 1 (worst credit) to 6 (best credit): Firms with a credit score percentile between 1-10 are coded as 1, 11-25 percentiles are coded as 2, 26-50 percentiles are coded as 3, 51-75 percentiles are coded as 4, 76-90 are coded as 5, and firms in the 91-100 percentile are coded as 6. Firms with a high credit score have greater access to credit (i.e., are more likely to be approved for greater amounts of credit) and, thus, have greater potential slack. By contrast, firms with a low credit score will be credit constrained and, thus, have lower potential slack.

Control variables. *Owner(s)' characteristics*. Since it is often difficult to separate small business owners from their firms, we sought to control for characteristics of the owner (or owner-group) that might be related to his/her/their willingness to take risks and/or to their propensity to adopt IT applications. We controlled for *age* and *education* of the owner(s), which prior studies found to be related to computer adoption (e.g., Dickerson & Gentry, 1983). The 2003 SSBF includes demographic information for up to three (largest) owners, and our study selected only firms where three or less owners would represent a majority of ownership. Given this, our measure of owner age is the weighted average age of the dominant owner group in years, using ownership shares as weights. Our measure of owner education is also a weighted average across the dominant owner group. Education was an ordinal variable coded 1 if the person had "less than a high school degree"; 2 for "high school graduate", 3 for "some college but no degree granted", 4 for "associate degree", 5 for "trade school/vocational program", 6 for "college degree (BA, BS, AB, etc.)", and 7 for "post graduate degree". In our analyses we also controlled for the *managerial experience* of owners, which may be related to the level of understanding of business processes as well as to familiarity with business IT applications (Damanpour, 1991). This variable, however, was never significant and it was very strongly correlated with other control variables (owners' age and firm age, in particular). Thus, we decided to drop it from the regression models presented here.

Firm's characteristics. We controlled for *firm age*, which may be related to adoption and which has been found to be related to the effective use of financial slack in private firms (George, 2005). We also controlled for *firm size*, which has been related to IT adoption in SMEs (Bharati & Chaudhury, 2006; Wang & Cheung, 2004), as well as in larger firms (e.g., Tsikriktsis, Lanzolla & Frohlich, 2004). We used the natural log of the number of employees, as well as the number of different sites or locations as proxies for firm size. Albeit related, these measures capture two slightly different aspects of size that may drive adoption. Prior studies have found *centralization* and *professionalism* to be related to innovation (e.g., Damanpour, 1991). We used the ownership share of the primary owner as our proxy for centralization. We added a dummy variable to control for *professionally managed firms* (1=yes). The firm's *legal form* has been related to risk-taking. In particular, because of limited liability, corporations and S-corporations are regarded as more inclined to take risks (e.g., Petersen & Rajan, 1994). Given this, we included a dummy variable coded 1 for corporations and S-corporations. We also added a control for prior performance, which has similarly been found to be related to risk-taking (e.g., Wiseman & Bromiley, 1996) and to innovation adoption (e.g., Greve, 2003). We used *sales growth* during the past 3 years as our measure for prior performance. This variable was coded 1 if sales had increased in comparison to the fiscal-year ended in 2000; 0 if sales were the same; and -1 if sales had declined in comparison to fiscal-year 2000. Finally, to account for possible differences in the propensity to adopt the two technical innovations of interest –over and above industry effects (see below), we controlled for different levels of *fixed asset intensity* across firms. The latter was measured as net fixed assets (i.e., book value of land plus net book value of depreciable assets) divided by sales (Kracaw, Lewellen & Woo, 1992).

Environmental drivers. We controlled for *industry* effects, using dummy variables for each two-digit SIC code that was represented by at least 1 percent of firms in the sample (e.g., Ang, Cole & Lin, 2000). Hence, the reference group for industry effects is the set of minority industries in the U.S. population of non-distribution SMEs (small firms are a lesser presence in industries that are more capital intensive). We also controlled for the firm's *urban versus rural* location of the firm's headquarters office, as this may be related to the need to seek business beyond the local market. Our variable took the value 1 if the firm was located in a Metropolitan Statistical Area (MSA) as designated by the Bureau of the Census, and 0 otherwise. Finally, since our arguments regarding potential slack are based on a firm's access to commercial credit, we decided to control for the level of *concentration in the local banking market*, as prior research with SSBF data has found firms in more concentrated markets to have less access to credit (e.g., Cavalluzzo & Wolken, 2005). The SSBF measure used is an ordinal variable, ranging from 1 to 3, based on the Herfindahl index (HI) of commercial bank deposits at the end of 2003 for the MSA or county where the firm is located. The measure takes value 1 if the local HI is between 0 and 1000; 2 if the HI is between 1000 and 1800; and 3 if the HI is above 1800, indicating high levels of concentration.

METHODS and RESULTS

Statistical Analysis

To test our hypotheses regarding the effects of different types of financial slack on adoption of different IT applications we ran maximum-likelihood logistic regression analyses of our dependent variables. In each case, we fitted a reduced model first, with control variables only, followed by the full model that added the financial slack variables of interest and their quadratic terms. Although we did not hypothesize quadratic effects for potential slack, we included the quadratic term for this variable as well, so as to provide a thorough test of our hypothesis. In order to facilitate interpretation of the quadratic equations, slack variables were mean-centered –i.e., expressed as deviations from their means (Aiken & West, 1991). To produce appropriate population estimates of regression parameters we used the SURVEYLOGISTIC procedure in SAS 9.1, which takes into account the stratified sample design and corrects for the sampling weight of each observation. Therefore, our regression coefficient estimates provide evidence regarding the effect of a change in independent variables on the likelihood of e-commerce (or computerized core processes) adoption by non-retail, non-wholesale U.S.-based SMEs.

Results

Table 1 shows descriptive statistics and correlations among the variables included in the study.

Insert Table 1 about here

Table 2 provides the results of the logistic regression analyses. The columns labeled Model 1 and Model 3 present results for the reduced regression equations that include only control variables, for e-commerce and computerized-core adoption respectively. Both regression equations are strongly significant, due in large part to very strong industry effects. A brief comment on the contrast of these two equations seems warranted. First, in terms of industry effects, the likelihood of e-commerce adoption was found to be greater in some of the capital-intensive industries that SMEs tend to shy away from (e.g., SIC 37-Transportation Equipment; or SIC 38-Measurement and Control Instruments), as well as in hotels (SIC 70) and insurance and brokerage services (SIC 64). By contrast, computerized-core adoption was most likely among SMEs in printing and publishing (SIC 27), machinery and computer equipment (SIC 35), and engineering, accounting, research, and management services (SIC 87). Beyond industry differences, the likelihood of e-commerce adoption was found to increase for larger firms, as well as for younger firms, firms that are incorporated, and firms which have suffered performance declines in the recent past (although the latter effects were only marginally significant). In turn, the likelihood of adoption of computerized core processes was greater for more asset-intensive firms, as well as for older firms with more educated owners (tentatively).

Insert Table 2 about here

Hypothesis 1 predicts an inverted U-shaped relationship between available slack and the likelihood of e-commerce adoption. Consistent with this, we expected to find a negative coefficient for the quadratic available slack term. As shown in Table 2 (Model 2) this coefficient was negative, as expected, but was not statistically significant (β = –.059; p=.439). Hence, Hypothesis 1 was not supported. Indeed, we found no evidence that available slack is related to e-commerce adoption among the population of U.S. SMEs, as the linear available slack term was also non-significant.

Hypothesis 2 predicts an inverted U-shaped relationship between available slack and the likelihood of computerized-core adoption. However, the estimated regression coefficient for the quadratic available slack term in Table 2 (Model 4) was positive (against prediction) and non-significant. Hence, Hypothesis 2 was not supported. As in the case of e-commerce, computerized-core adoption by U.S. SMEs appears not to be related to available slack as the linear effect failed to reach statistical significance as well.

Hypothesis 3 predicts an inverse relationship between potential slack and the likelihood of e-commerce adoption. Consistent with this, the regression coefficient for potential slack in Table 2 (Model 2) was negative and significant (β = –.164; p=.001). Hence, Hypothesis 3 is strongly supported.

Hypothesis 4 predicts a direct relationship between potential slack and the likelihood of adoption of computerized core processes. As expected, the regression coefficient for potential slack in Table 2 (Model 4) was positive and significant (β = .177; p=.009). This result provides strong support for Hypothesis 4.

DISCUSSION

This study sheds light on the relevance of different types of financial slack in SMEs, as well as on the relationships between slack and adoption of different types of IT applications. Our first contribution relates to our characterization of organizational slack in the context of SMEs. We argue that available and potential slack will be the most salient sources of financial slack in the case of SMEs, while absorbed or recoverable slack will tend to be immaterial and, thus, play a negligible role as a driver of innovation. In contrast to larger and well-established firms, SMEs are unlikely to experience lengthy surpluses in returns and cash-flows, and are unlikely to absorb those surpluses in the form of redundant or underutilized firm assets. Rather, SMEs tend to be characterized as operating under severe resource constraints (e.g., Storey, 1994). Furthermore, we argue that the salient dimension of potential slack for SMEs is not the financial leverage capacity implicit in their capital structure (and measured by the debt-to-equity ratio) as professed for larger firms, but rather their ability to access external debt in the first place. Access to commercial credit or other sources of external financing (like venture capital)

are not a given and, rather, tend to be the exception for these firms (e.g, Baker & Nelson, 2005).

Second, this is the first study to investigate relationships between different types of slack and innovation adoption in SMEs. Drawing from the prior literature, we argued for an inverted U-shaped relationship between available slack and innovation adoption in SMEs: We posited that available slack would increase innovation adoption in SMEs up to an optimal point, beyond which greater amounts of slack would provide disincentives to innovation. By contrast, and also based on the prior literature, we argued for a linear relationship between potential slack and adoption. However, as an extension to prior theory, we further espoused that in the SME context this relationship would be moderated by the capital requirements associated with implementing the innovation relative to the no-innovation scenario. We hypothesized that e-commerce would tend to be pursued by SMEs with lesser potential slack, as this innovation may allow the development of a sales channel for considerably less investment than alternative forms of distribution (Santarelli & D'Altri, 2004). By contrast, we argued that computerized-core applications will tend to be more capital intensive than alternative processes and, thus, will tend to be pursued by those with greater potential slack (i.e., greater access to credit). Our test of these hypotheses using a representative sample of non-retail and non-wholesale SMEs in the U.S. produced mixed support for our theoretical model: Hypotheses regarding potential slack were strongly supported. However, we found no support for the hypothesized inverted U-shape relationship between available slack and innovation adoption. Indeed, our findings suggest that available slack plays no meaningful role as a driver of innovation adoption in the SME context. This is in stark contrast to its role as a driver of innovation in the case of larger and better established organizations (Geiger & Cashen, 2002).

The third contribution of the study stems from its characterization of some forms of innovation as "bricolage" –i.e., "make do with what's at hand" (Baker & Nelson, 2005) or, at the very least, as alternative business models that are adopted in an attempt to economize resources when organizational slack is limited. In this view, innovation adoption may be born out of necessity, or may be motivated by a desire to preserve (as opposed to an opportunity to spend) resources. This contrasts with virtually all prior research investigating the relationship between slack and innovation, which has been built on the premise that the latter is germane to greater marginal resource expenditures. As such our work extends emerging research on the positive or 'enabling' aspects of resource constraints with regard to innovation (Katila & Shane, 2005). I also answers a recent call for research that explores how the nature of innovations themselves, and in particular their relative dependency on funding from slack resources, moderates their relationship to organizational slack (Herold et al., 2006).

Consistent with our proposition that e-commerce adoption represents a form of "bricolage" by resource-constrained SMEs, we found adopters to be lesser asset-intensive firms; firms that had experienced performance declines in the recent past; and, most important, firms with lesser potential slack. By contrast, adopters of computerized-core

applications were firms with greater levels of asset intensity and with greater potential slack.

Implications for Research

Our study has important implications for organizational slack research. We have filled a gap in the prior literature by investigating slack-innovation relationships in SMEs. We discuss the relevant dimensions of organizational slack in the context of SMEs, document the challenges of using established measures of financial slack in this context, and advance what we believe are sensible alternative measures for available and potential slack of small firms. We also show that available slack and potential slack play very different roles as drivers of innovation in SMEs as opposed to their roles in larger organizations (Geiger & Cashen, 2002; Nohria & Gulati, 1996). All of this, then, challenges the generalizability of received slack-innovation theory, and underscores the need for further organizational slack research using SME populations.

Indeed the present research raises many new questions that may be answered by future research. In particular, future studies might further investigate the role of available slack in SMEs. After modeling both linear and quadratic effects, the present study suggests that available slack has no influence on innovation adoption by SMEs. Given the observed low levels of working capital among U.S. SMEs, it is possible that business owners don't perceive the latter to be resources "in excess of what an organization requires to maintain its standard operations" (Cyert & March, 1963). Population frequency estimates from the 2003 SSBF indicate that 13 percent of non-distribution SMEs have zero or negative working capital, 36 percent have $5,000 or less of working capital, and the median working capital is $13,928. These marginal amounts may not be regarded as "available" resources to fund investment projects, but rather as necessary buffer to protect operations against cash-flow fluctuations during the normal course of business. Alternatively, our results might be due to a limitation of our research design whereby our measure of available slack may be captured several months after adoption (this limitation is further discussed below). Although we believe that adoption for most firms occurred around the time of the 2003 SSBF survey, and that the aspects of available slack that are more salient in this population (i.e., inventories) are slow to change, if levels of working capital were to decrease significantly after adoption (either because "excess" cash reserves were deployed with adoption, or because the innovation increased the efficiency of internal processes and, thus, reduced inventories) our study would fail to capture the true effects of available slack. Hence, further research is needed to confirm the findings of the present study.

Future research may also explore the relationship between types of slack developed here and performance of SMEs. Also, how are these relationships mediated by innovation adoption? For example, is a firm with low levels of potential slack who adopts e-commerce as a form of bricolage more or less likely to survive and increase performance?

Our study also has implications for research on adoption of new IT innovations by SMEs. First, as far as adoption of e-commerce is concerned, our findings may explain prior mixed results regarding organizational slack. Consistent with our findings, Grandon & Pearson (2004) found a single-item measure that appears to capture available slack not to be a determinant of adoption. By contrast, Wang & Cheung (2004) found a broader measure of organization slack to be marginally significant (p<0.10) and negatively related to the intention to adopt e-commerce. Interestingly, Wang & Cheung's measure includes items that seem related to available slack (e.g., "sufficient slack capital"), as well as others that capture potential slack (e.g., "able to secure necessary funds"). Based on findings from the present study, we would venture that the effect observed in Wang & Cheung's study resulted from the potential slack component of their measure. Second, our study suggests that (potential) slack is an important determinant of adoption. This contrasts with the little attention given to financial slack in the prior SME innovation adoption literature. Interestingly, Wang & Cheung (2004) also found their organizational slack measure to be positively related to the degree of e-commerce implementation after adoption. Their broad measure, however, does not allow concluding if this effect was due to available or potential slack, or both. Others have also applied the TOE framework to explore the extent of implementation of new technologies as opposed to adoption (e.g., Xu, Zhu, & Gibbs, 2004). Hence, this opens an interesting avenue for future investigation as researchers may seek to explore the role of different dimensions of slack on innovation adoption as well as on subsequent implementation. In short, future studies need to include financial slack among organizational drivers of SME innovation and, most importantly, need to discriminate between available and potential slack. This can be done within the confines of the TOE framework or as part of other theoretical schemes. Finally, our review of this literature suggests that it is important to develop more consistent measurement across innovation adoption studies, and to distinguish organizational slack from other concepts like firm size, firm profitability, or perceived cost of adoption.

Implication for Practice and Policy

Using a representative sample of the U.S. population of SMEs, our study shows that the ability to obtain external credit is a strong driver of innovation adoption in this population. Indeed this is the only dimension of organizational slack that is related to SME adoption. In terms of the practical significance of our results, it is important to note the substantial magnitude of the estimated population effects. The odds ratio estimate for the effect of potential slack on e-commerce adoption is 0.849 (p=.0014), indicating that improving the firm's potential slack score from the sample mean of 3.6 to one unit above the mean (which corresponds, approximately, to an increase from the 53rd to the 75th percentiles of the Dun &Bradstreet Commercial Credit Score) decreases the likelihood of e-commerce adoption by 15.1 percent.[9] In turn, the odds ratio estimate for the effect of credit rating on computerized-core adoption is 1.194 (p=.009), which suggests that improving the firm's potential slack by one unit from the mean (i.e., increasing the firm's Credit Score from the 53rd to the 75th percentile) increases the likelihood of computerized-core adoption by 19.4 percent. Hence our results show that improving

SMEs access to credit can indeed have meaningful effects in their ability to adopt capital-intensive technological innovations.

Although a firm's credit rating was used here as only a proxy for its access to external credit, credit ratings have become increasingly important for U.S. SMEs in obtaining external funding so that they may constitute an end in themselves. During the second half of the 1990's most banks (especially large banks) substituted traditional "relationship" lending (based on direct, long-term relationships between local loan officers and business owners) for automated underwriting of small business loans based on business credit scores (Frame et al., 2001; Berger et al., 2005). As credit-scored loans become the norm, the implication for practitioners is that maintenance of a good credit score may become instrumental to be able to adopt new technological innovations.

A related implication is that the recent changes in the banking industry may make it more difficult for young firms to become adopters of capital-intensive innovations. Younger firms have less of a credit record and, as a result, tend to have lower business credit scores. For example, as shown in Table 1, the correlation between firm age and business credit rating was r=.23 in the present study. Also, as shown in Table 2, prior to adding credit rating to our regression model, firm age was negatively related to e-commerce adoption (Model 1) and positively related to computerized-core adoption (Model 3). As a result, capital-intensive innovation adoption by young firms may depend on the availability of relationship-based loans (Ang, 1992; Petersen & Rajan, 1994). The implication for policy makers is that support of small, independent local banks operating under the traditional relationship lending model may contribute to a healthier rate of business innovation.

Limitations

The use of the 2003 SSBF for the purpose of the present study affords the opportunity to draw from a large, representative data set and to derive population estimates of the effects of interest. This benefit, however, comes at the expense of imposing other shortcomings on our analysis.

Results from the present study must be considered in the context of the following limitations: First and foremost, we do not know the time of innovation adoption and, thus, the extent to which our independent variables reflect the organizational context at that time. This concern is most important with regard to available slack, as endogeneity could be more acute in this case. By contrast, our measure of potential slack (i.e., credit score) is both more unchanging and less likely to be affected by technology adoption. Second, while measures of financial slack derived from the SSBF data compare favorably with those used in the prior literature on technology adoption in SMEs, SSBF measures of computer adoption were rather coarse. In particular, as far as our computerized-core variable is concerned, it is not known what specific IT innovations are being adopted. Finally, another aspect that may limit comparison with prior studies is that, as the population of U.S. SMEs is overwhelmingly dominated by micro firms (<10 employees), the population statistics produced in the present study will largely reflect conditions and

relationships characteristic of these firms. Our results need to be interpreted in this context.

Conclusion

The present study fills a gap in the prior literature by investigating how different dimensions of slack relate to innovation adoption in the SME context. It is found that both the dimensions of slack and their relationships to innovation differ in this context as compared to the case of larger and better established firms. This challenges the generalizability of extant slack-innovation theory and underscores the need for further organization-slack research using SME populations. Our study provides a valuable contribution toward this endeavor. Nevertheless, as a first multidimensional examination of slack and its effects within SMEs we leave other questions to be answered.

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TABLE 1
Descriptive Statistics and Pearson Correlation Coefficients[a]

Variables	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 . e-Commerce adoption	0.28	0.46															
2 . Computerized-core adoption	0.09	0.32	0.06														
3 . Average age of owner group	50.56	10.52	-0.03	0.01													
4 . Average education of owner group	4.68	1.88	0.05	0.06	0.09												
5 . Firm age	13.93	11.23	-0.06	0.01	0.53	-0.04											
6 . Number of employees (ln)	1.32	1.60	0.08	0.01	0.02	-0.02	0.08										
7 . Number of sites	1.21	0.98	0.07	0.03	-0.01	0.03	0.01	0.29									
8 . Ownership share of primary owner	83.07	26.09	-0.08	-0.02	-0.01	0.00	0.05	-0.30	-0.15								
9 . Professionally managed firm	0.04	0.26	0.01	-0.02	0.09	-0.04	0.05	0.17	0.03	-0.06							
10 Legal form (incorporated)	0.46	0.49	0.11	0.07	0.00	0.04	-0.04	0.42	0.12	-0.21	0.06						
11 . Sales growth	0.36	0.86	-0.01	-0.01	-0.18	0.04	-0.26	0.08	0.07	-0.06	0.06	0.02					
12 . Fixed asset intensity	0.47	0.95	-0.02	0.02	0.02	-0.08	-0.03	-0.07	0.01	-0.08	-0.02	-0.17	-0.06				
13 . Urban location	0.79	0.41	0.07	0.05	-0.02	0.14	-0.06	0.01	-0.01	0.02	0.04	0.09	0.05	-0.06			
14 . Local banking market concentration	2.43	0.61	-0.04	-0.02	0.01	-0.06	0.02	-0.03	-0.01	-0.01	-0.02	-0.06	-0.02	0.01	-0.36		
15 . Available slack (working capital/sales)	0.25	0.51	0.04	-0.01	0.05	0.04	0.03	-0.06	-0.02	0.01	0.01	-0.06	-0.06	0.14	0.02	-0.01	
16 . Potential slack (credit rating)	3.62	1.44	-0.05	0.06	0.17	0.07	0.23	0.05	-0.02	-0.01	-0.04	0.09	-0.07	-0.04	-0.03	0.04	0.02

[a] n = 2,296. Population estimates (i.e., statistics are adjusted for sampling weights). Correlations greater than |.07| are significant at p<.001.

TABLE 2
Results of Logistic Regression Models Predicting the Likelihood of Innovation Adoption[a]

Variables	E-commerce adoption				Computerized-core adoption			
	Model 1		Model 2		Model 3		Model 4	
Owners' characteristics:								
Average age of owner group	-0.009	(0.007)	-0.008	(0.007)	-0.010	(0.011)	-0.011	(0.011)
Average education of owner group	0.027	(0.039)	0.027	(0.039)	0.112 †	(0.064)	0.108 †	(0.063)
Firm's characteristics:								
Firm age	-0.013 †	(0.008)	-0.009	(0.008)	0.018 †	(0.011)	0.014	(0.011)
Number of employees (ln)	0.173 **	(0.066)	0.192 **	(0.067)	0.118	(0.097)	0.090	(0.100)
Number of sites	0.082	(0.099)	0.082	(0.099)	0.081	(0.185)	0.086	(0.180)
Ownership share of primary owner	-0.002	(0.003)	-0.002	(0.003)	0.000	(0.004)	-0.001	(0.004)
Professionally managed firm	-0.006	(0.347)	-0.055	(0.343)	-0.347	(0.476)	-0.343	(0.493)
Legal form (incorporated)	0.248 †	(0.149)	0.303 *	(0.152)	0.354	(0.238)	0.304	(0.237)
Sales growth	-0.136 †	(0.082)	-0.150 †	(0.083)	-0.006	(0.111)	0.008	(0.112)
Fixed asset intensity	-0.121	(0.075)	-0.133 †	(0.076)	0.332 ***	(0.096)	0.352 ***	(0.099)
Environmental factors:								
Urban location	0.170	(0.177)	0.164	(0.178)	0.178	(0.288)	0.175	(0.290)
Local banking market concentration	-0.088	(0.113)	-0.072	(0.115)	0.103	(0.177)	0.089	(0.179)
Industry: 2-digit SIC code dummies	included ***		included ***		included ***		included ***	
Financial Slack:								
Available slack (working capital/sales)			0.328	(0.235)			-0.295	(0.299)
Available slack squared			-0.059	(0.077)			0.046	(0.080)
Potential slack (credit rating)			-0.164 **	(0.051)			0.177 **	(0.068)
Potential slack squared			-0.050	(0.031)			0.068	(0.042)
Intercept	0.406	(0.575)	0.293	(0.586)	-3.373 **	(1.143)	-3.243 **	(1.188)
Wald χ^2	222.29 ***		236.2829 ***		20,955.01 ***		20,652.43 ***	
d.f.	34		38		34		38	

[a] n= 2,296. Coefficient estimates and their standard errors are adjusted for sampling weights and stratification of the survey design. Standard errors are in parentheses.

Detailed industry dummy estimates not reported. † $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

[1] A notable exception is George (2005) which investigates the relationship between slack and performance in privately held firms.

[2] This is consistent with arguments presented later on in this paper that e-commerce is a form of innovation that allows an SME to economize in the use of financial resources as compared to other alternatives.

[3] Tan (2003) explores curvilinear effects of slack dimensions on the performance of medium to large Chinese state-operated firms, and finds that both absorbed and unabsorbed slack have an inverse U-shaped relationship with firm performance. Another study using the same population of firms found similar results (Tan & Peng, 2003).

[4] Our data shows that most SMEs adopt e-commerce as supplemental sales channels, which suggests that they invest in this innovation at the lower end of the spectrum.

[5] The 1987 and 1993 surveys were called the National Survey of Small Business Finances.

[6] Although the overall SSBF rate of missing values is rather low, missing data problems are widely divergent across variables, and are most acute for items that are financial in nature. Since the present study draws on several of these financial indicators, careful attention to this issue was important.

[7] Since the 2003 SSBF provides demographic information on up to three owners only, this screen was needed to guarantee that our owner-characteristic variables would properly depict the dominant owner group.

[8] Standardizing on the basis of sales volume was preferable here to standardizing on the basis of assets (e.g., Lee & Grewal, 2004), as the latter may change substantially for SMEs upon technology adoption – especially in the case of computerized-core adoption. It is important to note also that we ran additional analyses on the reduced sample for which current ratio could be defined (n=1534, after deleting outliers), and that regression results using either current ratio or working capital over sales were essentially the same. Results for current ratio were also essentially the same as those presented here for working capital over sales using all available data.

[9] Since variables are log-transformed for the logistic regression analysis, the magnitude of effects is nonlinear so that, here, the straightforward interpretation of odds ratios informs about effect sizes for one-unit changes around the sample mean only (Hillman, Shropshire & Cannella, 2007). Odds ratios are not reported in our results table.