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# Technology choice and bank performance with government capital injection under deposit insurance fund protection

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## ABSTRACT

The barrier option theory of corporate security valuation is applied to the two-stage contingent claims of a regulated bank during a financial turmoil. This paper examines the relationships among government capital injection, regulatory deposit insurance fund protection, bank interest margin, and technology choice of investment in human resource relative to information technology. An increase in human resource results in an increased interest margin, and further a decreased default risk when the bank adopts a relatively high level of information technology. We also show a positive effect of government capital injection on human resource investment and a negative effect on bank default risk. Regulatory deposit insurance fund protection weakens the increased human resource investment, but reinforces the decreased default risk. Both the government capital injection and the regulatory deposit insurance fund protection may stabilize the distressed bank explicitly considering technology choice.

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## 1. Introduction

The recent financial crisis raises issues about the roles of government capital injection and regulatory deposit insurance fund protection, particularly from the standpoint of bank performance. A government capital injection program can stabilize banks by providing a source of capital during a financial crisis (Bayazitova & Shivdasani, 2012). Sound funding arrangements are critical to the effectiveness of a deposit insurance system and to the maintenance of public confidence in it as well as in the banking system (Davis & Obasi, 2009). An underlying premise in capital injection and fund protection is that externalities exist due to the safety net provided to banks and, thus, social efficiency can be improved by requiring banks to operate with more sufficient capital (Acharya, Mehran, Schuermann, & Thakor, 2011) and stronger public confidence (Schoenmaker & Gros, 2012). However, these papers ignore the resource costs in technology choice, investment in human resource relative to information technology, incurred in intermediary operations. A growing body of research investigates the impact of human resource investment (e.g., Bartel, 2004; Lengnick-Hall, Lengnick-Hall, Andrade, & Drake, 2009), or information technology investment (e.g., Holden & El-Bannany, 2004; Keramati, Azadeh, Mehran-Gohar, & Afshari-Mofrad, 2012) on bank performance when there are greater environmental changes. Given the related views in the literature, the issue of the effects the investment in human resource relative to information technology

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has on bank performance, the magnitude of these effects, and how they might differ with government capital injections under regulatory deposit insurance fund protection boils down to a question, one that we confront in this paper.<sup>1</sup>

In retail banking, investment in human resource and information technology management are two key technology choice issues. This is visualized that the increasingly competitive environment in the retail banking market has resulted in pressure to develop and utilize alternative delivery channels over the last decade. Delivery channels in retail banking with strategic human resource management can be identified as a backward technology, i.e., a higher marginal administrative cost with a lower fixed cost, while delivery channels with strategic information technology management can be identified as an advanced technology, i.e., a lower marginal administrative cost with a higher fixed cost (Lin & Jou, 2005). Delivery channels related to technology choice are central in strategic long-term decisions and bank spread behavior interacted with alternative delivery channels is also central in strategic short-term decisions made by an individual bank. Knowing how government capital injection and regulatory deposit insurance fund protection affect bank performance is also of paramount importance for regulators contemplating micro- and macro-prudential banking regulation. In particular, comprehending whether higher government capital injection as well as deposit insurance funding arrangement has a significant reduced effect on a bank's default risk and how this effect differs depending on bank spread behavior and the nature of delivery channel in retail banking are important details for regulators who are weighting the levels of regulations to achieve a desired target of retail banking stability during a financial turmoil.

Bank spread and bankruptcy prediction are two important performance issues that concern bank managers. The bank interest margin, i.e., the spread between the loan rate and the deposit rate, is one of the principal elements of bank net cash flows and profits in retail banking. The bank interest margin is often used in the literature as a proxy for the efficiency of financial intermediation (Kasman, Tunc, Vardar, & Okan, 2010; Saunders & Schumacher, 2000). Bank default risk related to the bankruptcy problem is central not only in strategic decisions made by banks, but also in decisions made by regulators about prudential regulation (Berger & Bouwman, 2013). It is well-recognized that bank spread behavior and default risk in the return to retail banking have undergone considerable changes over the last decade in response to technological advance (Hirtle & Stiroh, 2007). To date, evidence on the role played by technology choice in retail banking with regulation during a financial crisis is still scarce and this paper attempts to address some open questions. In conducting these analyses, we propose a two-stage framework for bank equity valuation based on a path-dependent, barrier option model to explicitly address the problem of early bank closure during a financial crisis.<sup>2</sup> The results of this paper show how cost, barrier, and regulation conditions jointly determine the optimal bank interest margin, and then the default risk in the bank's equity return. The results show that an increase in the investment in human resource increases bank interest margin and decreases the default risk in the bank's equity return when the bank adopts an advanced technology. Furthermore, we show that an increase in the government capital injection increases the bank's investment in human resource and then decreases the bank default risk. Regulatory deposit insurance fund protection weakens the increased human resource investment, but reinforces the decreased default risk, thereby contributing to the stability of the banking system.

One immediate application of this paper is to evaluate banking technology arrangements proposed as alternatives for future loans. In particular, one frequent suggestion is for banks to conduct Internet banking with strong human resource management practices of branch banking rather than Internet-only banking. This paper provides one explanation why this should be expected from the standpoints of bank profitability and survival during a financial turmoil. However, we note that there are many aspects of the debate over experience effects from Internet and branch banking (DeYoung, 2005) that we are silent on. Overall, we suggest that banks in distress have adopted a click-and-mortar lending model in which an Internet is used to complement existing brick and mortar branches with government capital injection and deposit insurance fund protection, producing superior performance and greater safety for banks.

The remainder of this paper proceeds as follows. Section 2 discusses related studies as background for the paper. Section 3 constructs a two-stage barrier option model of bank interest margin management with technology choices under government capital injection deposit insurance fund protections. Section 4 derives the two-stage equilibrium solutions and the comparative static results. Section 5 presents numerical exercises to explain the tuition of the comparative static results. Section 6 concludes.

## 2. Related literature

In this section, we review related literature as a base to construct our theoretical model. Ho and Saunders (1981) is a major contributor who proposes a dealership model to examine the relationships between bank interest margin and market competition. Maudos and de Guevara (2004) use an extended dealership model and suggest bank interest margin positively related to operating cost, interest rate and credit risk, and management quality. Wong (1997) uses a firm-theoretical model and also shows bank interest margin positively related to operating cost. However, Kasman et al. (2010) show that managerial efficiency is negatively related to bank interest margin. While we also examine bank interest margin, our focus on an aspect of click-and-mortar technology choice due to becoming more important for banking commerce takes our analysis in a different direction.

Papers have studied the impact of human resource management on performance in the banking industry. For example, Delery and Doty (1996) find a positive correlation between the bank's returns on assets and equity and the existence of profit-sharing and employment security for loan officers. Frei, Harker, and Hunter (2000) show that how well management aligns technology, human resource, and other assets to produce a given level of output plays an important role in the banking industry. Spieker (2004)

<sup>1</sup> Hereafter, the terms "an increase in the investment in human resource" or "a decrease in the investment in information technology" refer to "an increase in the investment in human resource relative to information technology".

<sup>2</sup> Mazumdar (1997), Bhattacharya et al. (2002), Brockman and Turtle (2003), and Episcopos (2008) also employ path-dependent models to address the early closure problem.

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