Available online at www.sciencedirect.com
ScienceDirect
Expert Systems with Applications 34 (2008) 2656–2663
Expert Systems with Applications
www.elsevier.com/locate/eswa

Timing of resources exploration in the behavior of firm – Innovative approach and empirical simulation

Hsiu Fen Tsai [a], Bao Rong Chang [b,*]

[a] Department of International Business, Shu-Te University, 59, Hun Shang Road, Yen Chao, Kaohsiung County 824, Taiwan
[b] Department of Computer Science and Information Engineering, National Taitung University, Taiwan, 684 Chunghua Road, Section 1, Taitung 950, Taiwan

Abstract

We have insight into the importance of resource exploration derived from the quest for sustaining competitive advantage as well as the growth of the firm, which are well-explicated in the resources point of view. However, we really do not know when the firm will seriously commit to this kind of activities. Therefore, this study proposes an innovative approach using quantum minimization (QM) to tune a composite model comprising adaptive neuron-fuzzy inference system (ANFIS) and nonlinear generalized autoregressive conditional heteroscedasticity (NGARCH) such that it constitutes the relationship among five indicators, the growth rate of long-term investment, the firm size, the return on total asset, the return on common equity, and the return on sales. In particularly, this proposed approach outperforms several typical methods such as auto-regressive moving-average regression (ARMAX), back-propagation neural network (BPNN), or adaptive support vector regression (ASVR) for this timing problem in term of comparing their achievement and the goodness-of-fit. Consequently, the preceding methods involved in this problem truly explain the timing of resources exploration in the behavior of firm. Meanwhile, the performance summary among methods is compared quantitatively.

Keywords: Innovative approach; Timing of resources exploration; Quantum minimization; Adaptive neuron-fuzzy inference system; Nonlinear generalized autoregressive conditional heteroscedasticity

1. Introduction

When we think about the firm as a collective of resources (Penrose, 1959), it drives the different aspects of research directions to answer two fundamental strategic questions: the sources of competitive advantage and the growth trajectory of firm. There is fairly general agreement that the accumulation of heterogeneous resources can explain the success of firm for a period of time (Barney, 1986, 1991, 1995; Dierickx & Cool, 1989; Peteraf, 1993; Rumelt, 1984); it also shapes the path of firm's growth (Penrose, 1959; Wernerfelt, 1984). However, resources or capabilities, like product, have life cycles (Helfat & Peteraf, 2003). Thus, researchers always remind us the importance of exploring new resources due to the pressure of external changing environment (March, 1991; Penrose, 1959; Wernerfelt, 1984).

We know the importance of resource exploration derived from the quest for sustaining competitive advantage as well as the growth of the firm that are well-explicated in the resources-based view. It is worth understanding that the idea of balance between exploration and exploitation will be solely achieved under the assumption of calculated rationality. However, we in fact do not know when the firm takes it into account and commits itself to the exploring activities. In each occasion of decision-making, decision makers are constrained by bounded rationality (Cyert & March, 1963; Levinthal & March, 1993; Simon, 1997) which is raised from two facts: (a) managers have limited absorptive capacity and (b) managers acquired finite information subjected to the external changing environment. Therefore, the managers might miss or postpone the exact timing of

* Corresponding author. Tel.: +886 89 318855x6205; fax: +886 89 350214.
E-mail addresses: soenfen@mail.stu.edu.tw (H.F. Tsai), brchang@nttu.edu.tw (B.R. Chang).

0957-4174/$ - see front matter © 2007 Elsevier Ltd. All rights reserved.
doi:10.1016/j.eswa.2007.05.026

exploring activities because of their inability on controlling the future uncertainty under the situation of limited rationality. Accordingly, the reinforcement of the precedent tendency mentioned above will be stressed by the conservative personality of managers. All of these will leads the managers to persist on the exploiting the existing resources rather than exploring new ones.

So, we concern the timing problem, namely when the risky attitude of managers will be shifted from risk-avoiding exploiting activities to relative risk-taking exploring activities. In the basis of the prospect theory (Kahneman & Tversky, 1979), we argue that the turning point will be triggered by the negative prospects. That is, when the firm is framed by positive performance, it will incline the managers to utilize the existing resources and neglect the need of exploring new ones. On the other hand, when the firm suffers from loss or decline in performance, it will reverse the risky attitude of decision makers to approach risk-taking considerably that will ignite more exploring activities. And then, we can observe that the trajectory of the growth of firm is emerging with the exploration and the following exploitation and so on (Penrose, 1959; Rothaermel & Deeds, 2004). In the mean time, we also proposed that large firm holds much more resources than small one (Schumpeter, 1934) in this case that leads to the large firm's 'value function' (Kahneman & Tversky, 1979) is flatter than small firm as shown in Fig. 1 where the value function (S-shape) will exhibit different slope between large firm and small firm. Therefore, large firm has revealed low risk-aversion so as to potentially proceed to higher exploring activities in positive frames; in contrast, small firm with the emergence of high risk-seeking in negative frames will then undertake more exploring activities.

There are five indicators that are the growth rate of long-term investment, the firm size, the return on total asset, the return on common equity, and the return on sales. The relationship among these indicators indeed can be used to analyze the timing of resources exploration in the behavior of firm. Several quantitative methods, such linear time series models with single-output, multi-input structure as AR, MA, ARX, ARMA, and ARMAX (Box, Jenkins, & Reinsel, 1994; Hamilton, 1994), are applicable to the simulation of the dynamics of the interaction between five indicators. Once a trained structure is built, it interprets the timing of resources exploration in the behavior of firm based on the coefficients with respective to explanatory variables. However, a trained ARMAX (Bowerman & O'Connell, 1993) do not get the least mean-absolute-percent-error for the timing problem. Thus, three remarkable nonlinear models, back-propagation neural network (BPNN) (Haykin, 1999), adaptive support vector regression (ASVR) (Chang, 2005), and quantum minimization (Durr & Hoyer, 2005) tuning ANFIS/NGARCH composite model (Chang, 2006) are also provided in this study so that the performance comparison among methods for the timing problem is compared quantitatively.

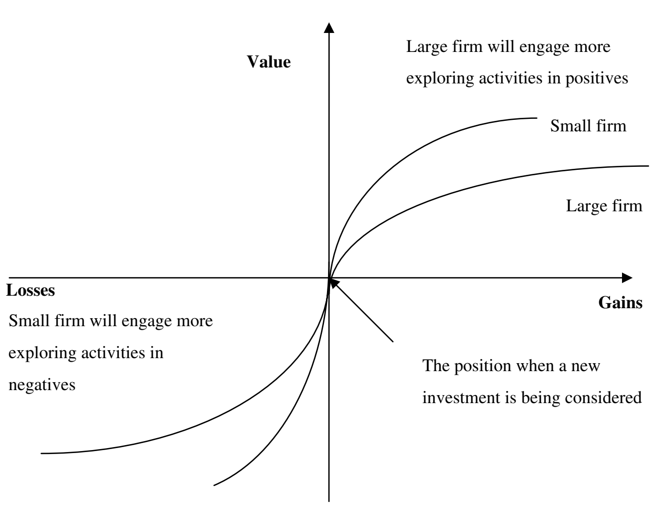

Fig. 1. The value function of large firm and small firm.

2. Methods

Several linear and nonlinear models are described in this section. Autoregressive moving-average regression, back-propagation neural network, adaptive support vector regression, adaptive neuro-fuzzy inference system, and generalized autoregressive conditional heteroscedasticity are introduced below.

2.1. Back-propagation neural network (BPNN)

A well-known intelligent computing machine, three-layer back-propagation neural net (BPNN) (Haykin, 1999) is used for modeling nonlinear structure to analyze the timing of resources exploration in the behavior of firm. For a three-layer BPNN, a structure of $4 \times 10 \times 1$ multi-layer-perceptron is used that the input layer has four input neurons to catch the input patterns, the hidden layer has 10 neurons to propagate the intermediate signals, and the output layer has one neuron to display the computed results (output $y(t)$) as shown in Fig. 2. We arrange the input pattern in the following four input signals: the firm size $u_1(t)$, the return on total asset $u_2(t)$, the return on common equity $u_3(t)$, and the return on sales $u_4(t)$. Only an appropriate growth rate of long-term investment $y(t)$ is designed as output. For more training assignments in this three-layer BPNN, the tangent-sigmoid transfer function is applied as the activations in the hidden layer, the symmetric saturating linear transfer function is employed to the output layer as the activations, and Bayesian regulation derived from Levenberg–Marquardt training method is used as the learning algorithm for three-layer BPNN. Moreover, training epochs is assigned to 1000 as well as training stop criteria is set to be 10^{-6} in this case.

2.2. Adaptive support vector regression (ASVR)

Initially developed for solving classification problems, support vectors machines (SVMs) technology (Vapnik,