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journal homepage: www.elsevier.com/locate/jfecCreative destruction and firm-specific performance heterogeneity[☆]Hyunbae Chun^a, Jung-Wook Kim^b, Randall Morck^{b,c,*}, Bernard Yeung^d^a Sogang University, Seoul 121-742, Republic of Korea^b University of Alberta, Edmonton, Alberta, Canada T6G 2R6^c National Bureau of Economic Research, 1050 Massachusetts Avenue, Cambridge, MA 02138^d Stern School of Management, New York University, New York, NY 10002, USA

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ABSTRACT

Traditional U.S. industries with higher firm-specific stock return and fundamentals performance heterogeneity use information technology (IT) more intensively and post faster productivity growth in the late 20th century. We argue that this mechanically reflects a wave of Schumpeter's creative destruction disrupting a wide swath of industries, with successful IT adopters unpredictably undermining established firms. This validates endogenous growth theory models of creative destruction and suggests intensified creative destruction as explaining findings associating greater firm-specific performance variation with higher per capita GDPs, economy growth rates, accounting standards, financial system development, and property right protection.

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A wave of innovation across a broad range of technologies, combined with considerable deregulation and a further lowering of barriers to trade, fostered a pronounced expansion of competition and creative destruction. The result through the 1990s of all this seeming-heightened instability for individual businesses, somewhat surprisingly, was an apparent reduction in the volatility of output and in the frequency and amplitude of business cycles for the macroeconomy.

Alan Greenspan, Speech on Economic Volatility, 2002.

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* Corresponding author at: University of Alberta, Edmonton, Alberta, Canada T6G 2R6. Tel.: +1 780 492 5683; fax: +1 780 492 9924.

E-mail address: randall.morck@ualberta.ca (R. Morck).

1. Introduction

Elevated heterogeneity in firm-specific stock return and fundamentals performance is significantly correlated with more intensive use of information technology (IT) and faster productivity growth across a panel of traditional U.S. industries from 1971 to 2000. We argue that this suggests IT, at least in the early decades of its absorption into the economy in the late 20th century, induced a tremor of Schumpeter's (1912) *creative destruction* across a wide swath of U.S. industries. New innovators, with abnormally good performance, unpredictably and continually rose to dislodge established firms, abnormally depressing their performance. This suggests intensified creative destruction as a new explanation for the rising firm performance heterogeneity among publicly traded firms in recent decades in the U.S. and other developed economies observed by Morck, Yeung, and Yu (2000), Campbell, Lettau, Malkiel, and Xu (2001), Irvine and Pontiff (2004), Wei and Zhang (2006), and others.

We study publicly traded firms in traditional U.S. manufacturing and nonmanufacturing industries such as lumber and wood products, retail trade, and motion pictures, that is, we abstract from IT-related firms. We do so because this avoids possible noise in dot.com stock returns and, more importantly, because Bresnahan and Trajtenberg (1995), Helpman and Trajtenberg (1998), Jovanovic and Rousseau (2005), and others argue that IT is a *general purpose technology* (GPT), which, like electricity in the early 20th century or steam power early in the industrial revolution, induces process and product innovation across most industries. Bresnahan and Trajtenberg (1995) and Helpman and Trajtenberg (1998) model GPTs driving economic growth, and cite IT as an example. Oliner and Sichel (2000), Jorgenson (2001), Stiroh (2002), and Brynjolfsson and Hitt (2003) also link IT to economy-wide enhanced productivity.

Our findings complement approaches to economic growth theory, such as Pastor and Veronesi (2005), which model an economy absorbing a new technology and consequently exhibiting sustained elevated firm performance heterogeneity. More generally, this paper builds on Aghion and Howitt (1992, 1998), Aghion, Angeletos, Banerjee, and Manova (2004), Aghion, Howitt, and Mayer-Foulkes (2005), Acemoglu (2005), Acemoglu, Aghion, and Zilibotti (2006), and other formalizations of Schumpeter's (1912) concept of creative destruction.

Other research into rising firm-specific performance variation can readily be reinterpreted in light of our findings. Pastor and Veronesi (2003), Fama and French (2004), Fink, Fink, Grullon, and Weston (2005), Bennett and Sias (2006), and Brown and Kapadia (2007) link heterogeneity to small or young firms. Philippon (2003), Irvine and Pontiff (2004), and Gaspar and Massa (2006) stress intensified competition and deregulation. Morck, Yeung, and Yu (2000), Fox, Morck, Yeung, and Durnev (2003), Bris, Goetzmann, and Zhu (2004), Durnev, Li, Morck, and Yeung (2004), Huang (2004), Ozoguz (2004), Biddle and Hilary (2006), and Jin and Myers (2006) link elevated firm performance heterogeneity to financial system development and transparency. Neatly tying all

these findings together, Schumpeter (1912) links creative destruction to intensified competition from new, initially small, upstart firms that need external financing to grow rapidly.¹ Murphy, Shleifer, and Vishny (1991) model regulation repressing creative destruction, and Schumpeter's (1939) theory of business cycles posits that intensified competition trails waves of creative destruction. The link we find between IT and elevated firm performance heterogeneity nonetheless survives controls for all these factors as well as for other relevant industry characteristics, suggesting a robust overarching role for IT.

Our results should comfort financial economists, like Roll (1988), who lament the low R^2 statistics of standard asset pricing models caused by high firm-specific stock return variation in the U.S. and other developed countries. If this reflects faster creative destruction in countries with better institutions, there is no cause for lamentation. Asset pricing models not only retain their basic validity, but may also find a new following among growth theorists as gauges of the intensity of creative destruction and related phenomena. Creative destruction is usually envisioned as creative innovators destroying laggards utterly; however, in practice, the laggards may only be beaten back for a while. Firm-specific performance heterogeneity may thus be a finer and more nuanced metric of the intensity of creative destruction than firm exit rates.

The paper is structured as follows. Section 2 describes our IT intensity, firm performance heterogeneity, and total factor productivity (TFP) measures. Section 3 covers regressions and Section 4 discusses interpretation and statistical robustness issues. Section 5 concludes with a brief discussion of the implications of our results.

2. Variable construction

This section describes our main variables and the data used to construct them. Our results are robust to various alternative constructions, described in detail in Section 4.

2.1. Information technology intensity

Bureau of Economic Analysis (BEA) *Fixed Reproducible Tangible Wealth* (FRTW) data track investment in 61 asset classes from 1971 to 2000 by two-digit industry.² Because we are interested in IT as a GPT in traditional sectors, we drop industries whose primary products are IT goods or services, specifically, industrial machinery (SIC 35), which includes computer manufacturing, and business services (SIC 73), which includes computer-related services and software. We also drop five financial industries (SIC codes in the 60s) whose accounting data are incomparable and five agriculture and mining industries whose IT

¹ King and Levine (1993) provide empirical validation for the dependence of these firms on external financing. Fogel, Morck, and Yeung (2008) empirically link creative destruction to countries' financial development.

² Herman (2000) describes FRTW. Our industries resemble those in Hobijn and Jovanovic (2001) and Stiroh (2002). Fama and French (1997) partition manufacturing more finely and nonmanufacturing more coarsely, with 28 and 20 categories, respectively.

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