Energy Economics 69 (2018) 270–279

Contents lists available at ScienceDirect

Energy Economics

journal homepage: www.elsevier.com/locate/eneeco

Factor market distortion correction, resource reallocation and potential productivity gains: An empirical study on China's heavy industry sector

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ARTICLE INFO

Article history:
Received 12 April 2017
Received in revised form 9 September 2017
Accepted 28 November 2017
Available online 5 December 2017

Jel classification:
O13
O47
P23
P42
Q41
Q43

Keywords:
Factor market distortion
Resource misallocation
Total factor productivity
Price elasticity of factor demands
Heavy industry sector

ABSTRACT

In this study, we develop a novel analysis framework for evaluating the effects of resource reallocation from the correction of factor market distortion (FMD) on total factor productivity (TFP) gains. We first measure FMD in China's heavy industry sector from 1995 to 2012, and then investigate the effects of resource reallocation from FMD correction by using the price elasticity of factor demands as a link, along with its potential TFP gains. The results indicate that: (1) Taking the price of capital as a reference, the prices of labour and energy in the study period were relatively higher to different extents. (2) If current FMD were fully corrected, the labour input in China's heavy industry sector would increase by 25.37%, whereas capital and energy inputs would decrease by 18.51% and 10.57%, respectively. (3) The resource reallocation effects resulting from current FMD correction will bring about significant TFP improvement (by 8.55%) in China's heavy industry sector, and there are evident industrial differences and stage characteristics for these promoting effects.

1. Introduction

Market-oriented reforms have played a key role in promoting China's economic growth ever since the late 1970s, when China adopted the reform and opening-up policies. To date, the Chinese government has made great progress in product market reforms (Zhang and Tan, 2007; Fan et al., 2011). Nevertheless, due to some institutional constraints, the pace of establishing integrated markets for essential productive factors (such as capital, labour, energy, and land) still lags behind, resulting in serious factor market distortion (FMD) among enterprises with different ownerships, within various sectors or regions, and between urban and rural areas (Brandt et al., 2013). Taking the capital market as one case, with a deducted rate for the preferential loan, the actual lending rate for China's state-owned enterprises (SOE) from 2001 to 2007 was only 1.6%, while the lending rate for private enterprises during the same period was up to 5.4% (Liu and Zhou, 2011). As stated by Wei et al. (2016), in regions with higher SOE shares, private firms encounter more difficulties in accessing financing and bear higher financial costs. Significant segmentations also occur in China's labour market (Cai et al., 2002; Knight and Li, 2005; Hertel and Zhai, 2006) and energy market (Ouyang and Sun, 2015; Shi and Sun, 2017; Ju et al., 2017).

FMD refers to the non-optimal allocation of productive factors in a national economy due to market imperfection, i.e., the actual prices of input factors deviate from the theoretical factor prices in a perfectly competitive market. During the past several decades, the relatively lower prices of essential productive factors has created significant cost advantages for investment-driven and export-oriented economic growth in China (Chen et al., 2015). However, this has inevitably resulted in substantial loss for industrial total factor productivity (TFP). On the one hand, lower factor prices would greatly reduce firms' willingness to enhance resource utilisation efficiency through technological innovation, resulting in the stagnation of resource-saving technical progress. On the other hand, the distorted price system fails to reflect the scarcity and opportunity costs of productive factors,

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https://doi.org/10.1016/j.eneco.2017.11.021
0140-9883/

which, in turn, hinders the function of factor markets in optimising resource allocation. Given that efficient allocation of resources is a key source of productivity growth (Kumbhakar et al., 2000; Zhang et al., 2009; Song et al., 2011), the misallocation of productive inputs will inevitably lead to the loss of TFP (Restuccia and Rogerson, 2008; Banerjee and Moll, 2010; Syverson, 2011; Bartelsman et al., 2013), thereby significantly hindering China's economic growth and the transformation of its development mode (Zhu, 2012).

During the last decade, numerous studies have focused on TFP losses resulting from resource misallocation caused by FMD. China, as a country undergoing the transition from a planned economy to a market economy, has naturally become the focus of scholars from home and abroad in recent years. Hsieh and Klenow (2009) examined the aggregate TFP loss from misallocation of inputs across firms in China from 1998 to 2005 and found that the manufacturing industry in this developing country can potentially improve its TFP by 30%–50% when capital and labour are hypothetically reallocated to equalise marginal products to the US level. Gong and Hu (2016) extended the above study by relaxing the assumption of constant returns to scale for differentiated products, and they insist that the extent of resource misallocation in China was overestimated by Hsieh and Klenow (2009). Brandt et al. (2013) examined TFP losses in China's non-agricultural economy associated with labour and capital misallocation across provinces and sectors from 1985 to 2007, and decomposed the overall TFP loss further into FMD within provinces (between state and non-state sectors) and distortions between provinces (within sectors). Du et al. (2014) found strong and consistent evidences of a systematic and worsening resource misallocation within the state sector and/or between the state sectors and private sectors over time. Adamopoulos et al. (2015) used a quantitative framework to measure the extent of resource misallocation in agriculture within villages, across villages, and over time in China and assessed the TFP gains from an efficient reallocation of resources. David et al. (2016) investigated the reduced aggregate productivity and output resulting from the misallocation of factors across heterogeneous firms due to informational frictions in China, India and the US. Focusing on the market distortions and aggregate productivity growth in China's energy sector, Dai and Cheng (2016) insisted that this sector has major potential for productivity gains from resource reallocation through the reduction of market distortions. Domestic studies have also demonstrated increasing interest in this field (Yuan and Xie, 2011; Nie and Jia, 2011; Wang and Wu, 2014; Gai et al., 2015).

Given the great progress in measuring TFP losses resulting from resource misallocation in the context of China's FMD, there are still some issues to be further discussed. On the one hand, most existing studies have focused only on the misallocation of capital and/or labour, while little attention has been paid to another important productive factor, i.e., energy. In the face of severe pressure from the perspectives of energy shortages and climate change in relation to China's current economic growth, incorporating energy market distortion, along with energy misallocation, into the analysis framework and evaluating its impact on China's TFP makes great sense. On the other hand, existing studies have placed their emphasis on the measurements of TFP losses resulting from FMD based on traditional analysis frameworks; however, little attention has been paid to not only the extents to which the productive factors have been misallocated but also how this kind of resource allocation has led to current TFP losses.

In this paper, we aim to investigate the potential TFP gains from the correction of FMD for China's heavy industry sector from 1995 to 2012. There are 18 two-digital industries in China's heavy industry sector including Mining and Washing of Coal (MWC), Extraction of Petroleum and Natural Gas (EPNG), Mining and Processing of Ferrous Metal Ores (MPFMO), Mining and Processing of Non-Ferrous Metal Ores (MPNFMO), Mining and Processing of Nonmetal Ores (MPNO), Processing of Petroleum, Coking and Processing of Nuclear Fuel (PPCPNF), Manufacture of Raw Chemical Materials and Chemical Products (MRCMCP), Manufacture of Non-metallic Mineral Products (MNMP), Smelting and Pressing of Ferrous Metals (SPFM), Smelting and Pressing of Non-ferrous Metals (SPNM), Manufacture of General Purpose Machinery (MGPM), Manufacture of Special Purpose Machinery (MSPM), Manufacture of Transport Equipment (MTE), Manufacture of Electrical Machinery and Apparatus (MEMA), Manufacture of Communication Equipment, Computers and Other Electronic Equipment (MCECOEE), Production and Supply of Electric Power and Heat Power (PSEPHP), Production and Supply of Gas (PSG), and Production and Supply of Water (PSW). As it is known, the heavy industry sector is currently the mainstay of China's economy, with the most serious misallocation of resources. For instance, with the primary target of sustaining rapid economic growth, China's energy sector (involving the four sub-sectors including MWC, EPNG, PPCPNF, and PSEPHP studied in this paper) is currently characterised by rigid governmental interventions and monopolistic SOEs. In this context, this sector is involved in several market distortions, such as monopolies, price regulations, subsidies, entry barriers, biased credit allocations, and the absence of a fully market-based wage determination system in SOEs (Dai and Cheng, 2016), which inevitably trigger resource misallocations and distort firms' entries and exits. Wei and Li (2017) also present quantitative evidence on resource misallocation in the Chinese manufacturing sector, especially the widespread underpaid for labour and the substantial over-use of energy in some energy-intensive sectors, such as Chemical, Non-metallic, Ferrous metals and Non-ferrous metal.

The marginal contributions of this paper lie in the following two aspects: (1) energy input is incorporated into the model when we study the resource misallocation and aggregated TFP losses of China's heavy industry resulting from FMD. (2) The effects of resource reallocation from the full correction of FMD are directly calculated using price elasticities of factor demands as a link, based on which, the potential TFP gains from the full correction of FMD are further evaluated. The remainder of the paper is structured as follows: Section 2 measures the degree of FMD for China's heavy industry sector from 1995 to 2012 and describes the dataset; Section 3 examines the effects of resource reallocation when fully correcting current FMD, using the price elasticities of factor demands as a link; Section 4 evaluates the potential TFP gains from resource reallocation led by FMD correction; and Section 5 concludes the paper and proposes some key issues that are worth studying in the future.

2. Measurement of FMD

2.1. Methodologies

Thus far, there are various conventional approaches for FMD measurement, such as production possibilities frontier technology, shadow price approach, and production function method. The production possibilities frontier technology, put forward by Skoorka (2000), has the main advantage of evaluating the degree of entire market distortions, including the product market and the factor market; but it fails to distinguish different types of distortions among input factors. In addition, relative price distortions cannot be studied by this method. The shadow price approach, developed by Atkinson and Halvorsen (1984), enables measurement of the absolute and relative price distortions of input factors. However, the estimation for the trans-log cost function usually requires quite a large study sample; otherwise the degree of distortion cannot be measured annually. In this paper, the production function method is employed to evaluate the FMD of China's heavy industry sector for two reasons. First, the definitions for absolute and relative distortions of input factors within this analysis are very clear and have very solid theoretical foundations. Second, the flexible function form allows us to measure the absolute price distortion for each factor, along with the relative price distortion between different factors over time.