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Disentangling the effects of endogenous export and innovation on the performance of Chinese manufacturing firms

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ABSTRACT

This paper disentangles the effects of export and innovation on firm-level markup and productivity. Based on a large sample of Chinese manufacturing firms, we explicitly account for firms' endogenous export and innovation decisions, and isolate their impacts on firms' future performance, using a propensity score matching approach with multiple treatments. The results indicate that starting to export alone negatively affects firm-level markup and productivity, while starting to innovate alone has a significant positive impact. There is a complementarity between export and innovation in improving firms' performance. The negative effect of starting to export alone on revenue productivity may reflect the decrease of price-cost markup, rather than a change in physical productivity. Our study contributes to explaining puzzling results of exporter performance for China. The results also suggest that firms should establish domestic market power through innovation before turning to export markets.

1. Introduction

A large body of empirical literature has documented the fact that exporting firms are generally more productive than non-exporters. The productivity advantage of exporting firms can be attributed either to the self-selection of more productive firms into export (i.e. self-selection hypothesis) or to productivity gains through exporting (i.e., learning by exporting hypothesis). While the self-selection hypothesis has been widely supported, mixed evidence has been found regarding the learning by exporting hypothesis (Martins & Yang, 2009). Moreover, some studies even find puzzling results of unexceptional performance of exporting firms for China (Dai, Maitra, & Yu, 2016; Lu, 2010). The inconclusiveness has prompted recent studies to investigate the potential role of firm innovation on the observed relationship between export and productivity.

This study attempts to formally disentangle the effect of export and innovation on the performance of Chinese manufacturing firms. The disentanglement is important, because firms' decisions to export and innovation are interdependent, and they can jointly affect a firm's future performance. Our descriptive analysis shows that > 44.5% of innovating firms also participate in the export markets, and a non-negligible proportion of exporting firms are engaged in innovative activities at the same time. Innovation (export) can act as a confounding factor when we separately evaluate the effect of export (innovation) on firm performance. Though many studies have investigated the role of innovative activities on the export–productivity link, there is still little effort devoted to explicitly disentangling the effects of export and innovation on firm productivity.

In addition to firm productivity, we also investigate the effects of export and innovation on firm-level markup. The price–cost markup captures firms' market power and reflects another important dimension of firm performance. Although many studies has confirmed the positive impacts of firm innovations on measured revenue productivity (Hall, 2011; Hall, Lotti, & Mairesse, 2009),

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there is little evidence on examining how innovative activities affect firm-level markup (Cassiman & Vanormelingen, 2013). In fact, it is difficult to separately identify the two dimensions of firm performance, because firm productivity is always measured as *revenue productivity*, which is estimated from production functions that use firms' sales revenues as output, rather than using physical output, due to lacking data on firm-level prices and output quantities (Brandt, Biesebroeck, Wang, & Zhang, 2017; Syverson, 2011). The measure of revenue productivity differs from firms' *physical productivity*, because revenue productivity contains price and cost-related elements (Foster, Haltiwanger, & Syverson, 2008). Although we do not have detailed data on firm-level prices and output quantities, we are able to construct a measure of firm-level markup under the quantitative framework developed by De Loecker and Warzynski (2012). The inclusion of markup as another dimension of firm performance provides us with additional information to more rigorously evaluate the true impacts of export and innovation.

A major identification challenge of this study is to account for firms' endogenous export and innovation decisions, and disentangle their impacts on firm performance. Export and innovation decisions are endogenous, since firms with better performance may self-select into export and innovation activities, and both choices can also affect firms' future performance. To explicitly account for the self-selection process and isolate the effects of export and innovation, we employ a propensity score matching approach with multiple treatments. Since export and innovation decisions can be firms' mutually exclusive strategies, as well as a joint strategy, we use a multinomial logit model to estimate firms' probability of choosing each of the states. In contrast with the standard matching approach with a binary treatment variable, the generalized matching approach allows for multiple treatments and enables us to isolate the effects of export and innovation on firm performance.

Our paper relates to the literature on examining the heterogeneous characteristics of exporting firms, relative to non-exporters (Bernard & Jensen, 1999, 2004; Chen & Guariglia, 2013). Since the seminal work of Bernard, Jensen, and Lawrence (1995), a growing body of literature has confirmed that exporting firms are generally larger, pay higher wages, are more capital-intensive, and, most importantly, are more productive than are non-exporters (De Loecker, 2007; Van Biesebroeck, 2005). However, the relationship between export and markup is still a fairly unexploited issue in the existing literature (De Loecker, Goldberg, Khandelwal, & Pavcnik, 2016; De Loecker & Warzynski, 2012). For example, theoretical models with productivity heterogeneity in international trade usually assume either a perfectly or a monopolistic competitive market structure with no implications for markup heterogeneity (Melitz, 2003). Empirical studies on the export–markup nexus are also scarce, mainly because rarely available data on firm-level prices and output quantities are required to measure firm-level markups (Choi & Lee, 2013; De Loecker et al., 2016; Lu & Yu, 2015). Until recently, some theoretical models began to relax assumptions on market structure and provide new insights on the relationship between export and firm markups (Melitz & Ottaviano, 2008; Parenti, Ushchev, & Thisse, 2017). Moreover, De Loecker and Warzynski (2012) proposed an empirical framework to measure firm-specific markup by comparing the share of input costs in total revenue with the estimated output elasticities of a variable input. Taking advantage of those new developments, our study tries to empirically evaluate the impact of export and innovation on the price–cost markup of Chinese manufacturing firms.

This study is also closely related to the literature on investigating the role of innovation related activities on the relationship between export and productivity. Many studies have found a positive correlation between firms' decisions to export and firms' decisions to either conduct R&D investment or adopt new technologies that can also endogenously affect firm productivity (Bustos, 2011; Harris & Li, 2008; Parameswaran, 2009). For example, Aw, Roberts, and Yi Xu (2011) estimated a dynamic structural model of a producer's decision to invest in R&D and export, and found that both choices have a positive effect on the plant's future productivity. Investment in R&D enables exporting firms to adapt and assimilate technology from abroad, which in turn leads to productivity improvement (Crisuolo, Haskel, & Slaughter, 2010; Dai & Yu, 2013; Lileeva & Trefler, 2010). Exporting and R&D investment have some complementarity in their impacts on firm productivity (Wang, 2014). Instead of taking export or innovation decisions as binary treatment variables, as in the existing literature, we employ a propensity score matching approach with multiple treatments, which allows us to more explicitly disentangle the effects of export and innovation on firm performance.

It is particularly interesting to conduct our research under the background of China's industrialization (Long & Zhang, 2012). Contrary to the accumulated evidence on the exceptional performance of exporting firms, some studies have found puzzling results for China, i.e., exporting firms being less productive than non-exporters (Lu, 2010; Lu, Lu, & Tao, 2010), especially for exporters in labor-intensive industries. Exporting firms that do not invest in R&D exhibit the worst performance in labor-intensive sectors (Wang, 2014). However, exporters that invest in R&D are the most productive firms in capital-intensive sectors. Domestic firms achieve significant productivity gains after exporting, whereas no learning by exporting effects are found for foreign affiliates (Julan, Yi, Zhigang, & Linhui, 2012). Dai et al. (2016) showed that the puzzling findings of unexceptional exporter performance can be driven by the processing trade in China. However, the measured revenue productivity widely used in the literature contains the confounding factor of price–cost markup changes and does not necessarily reflect physical productivity. Therefore, jointly evaluating the effects of export and innovation on firm-level markup and productivity in our study may provide new insights to help explain the puzzling results for China.

The remainder of the paper is structured as follows. Section 2 describes the quantitative framework to estimate firm-level markup and productivity. Section 3 introduces the empirical strategy to disentangle the effect of export and innovation on firm performance. Section 4 presents the data and estimated results. Section 5 presents empirical findings, and Section 6 concludes.

2. Measuring firm-level markup and productivity

This section describes how to estimate firm-level markup and productivity under the quantitative framework developed by De Loecker and Warzynski (2012). In the spirit of R. E. Hall (1988), the framework recovers a measure of firm-level markup, using the ratio of the output elasticity of a variable input to its share in revenue. The estimation of output elasticity and firm productivity relies

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