

**An Inquiry into the  
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# An Inquiry into the North-South Management Gap in China

## Abstract

We identify a puzzling management practice gap in China. In the South, a one standard deviation increase in firms' management competency is associated with a 7.5 percent improvement in sales productivity and a 29.2 increase in profitability. But such associations are muted for firms located in the North. The southern firms outperformed the northern firms by 8.1 percent in management practices and in all aspects of administration. We conjecture this is partially related to the convenience of accessing a larger export market in the South. The gap persists even after controlling for known sources of heterogeneity such as firm characteristics and resources. After decomposition, a difference of 6.6 percent in management quality remains unexplained. Remarkably, Northern firms' management is correlated with mitigating environmental externalities but not for Southern firms. Our study contributes to the understanding of management that is potentially due to regional differences in social norms and institutional factors.

JEL-Codes: D220, M100, M200, Q400, Q500.

Keywords: management practices, productivity, export.

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# 1 Introduction

In recent years, we have seen a literature that seeks to relate a firm's productivity to its management practices (for instance, Bloom and Van Reenen, 2007; Bloom *et al.*, 2014, 2016, 2019; Bruhn *et al.*, 2018; Cai and Wang, 2022, Giorcelli, 2019). This is an important development because it explicitly links management competency to productivity. Until then, productivity was known to be mainly correlated to innovation, human capital, and natural resources, but its relationship with the internal organization of firms was just a black box. These were just related arbitrarily to some aspects of firm behavior; management practices were never explicitly modeled, despite being recognized as a critical input more than a century ago (Walker, 1887).

It was not until the seminal paper by Bloom and Van Reenen (2007) that resolved the measurement issue and accredited management practices as the focal point of analysis in explaining firm productivity and performance. Along with this development is the initiative by the World Management Survey (WMS) which aims to collect high-quality data on firm management practices, using the innovative survey tool pioneered by Bloom and Van Reenen (henceforth BVR) in their 2007 paper. To date, the WMS has expanded its survey into more than thirty countries that cover both developed and developing economies.

In this paper, we model the behavior of firms in China and relate it to their management practices, using the Chinese dataset from the WMS. Having done so at the aggregate level, we then disaggregate the firm data into two regions - the North and the South - demarcated by the dividing line between the Huai River and the Qinling Mountain. What we find is extremely interesting: management practices are eminently important in the South but not in the North. Specifically, we found that the quality of management practices in the South displays a significant relation with firms' performance. For these firms, a one standard deviation increase in management quality is associated with a 7.5 percent improvement in sales productivity and a 29.2 percent increase in gross profit. In contrast, we do not observe a similar correlation for firms located in the North. Besides the fixed effects attributable to the firm, industry, and location differences, we conjecture

a larger international market is related to higher managerial capital that leads to high earnings performance. Since the southern firms, especially those located along the coastal areas tend to engage in international trade, their share in a larger international market is correlated with better management quality compared to the northern firms.

In a digression, we also investigate the firm management practices and mitigation of environmental externalities. Based on a subset of our data that links with the government ministry data, we obtain a contrasting result between the North-South region. The northern firms display a negative and significant linkage with firms' coal usage intensity, lower COD and SO<sub>2</sub> emissions intensity, and industrial wastewater discharge intensity. On the contrary, the southern firms emit and discharge wastewater more intensively with higher management competence, except for SO<sub>2</sub> intensity. Based on empirical evidence, this is potentially related to the degree of environmental enforcement, policy differential, and the main industrial composition between the two regions.

We also find that management practices that focus on modern lean operations and effective monitoring mechanisms on performance are significantly related to better export sales among firms located in the South, but not for those situated in the North. On average, the management quality of firms located in the southern region is about 8.1 percent higher than firms located in the North. Based on a counterfactual, if we apply the southern firm coefficients to the northern firms, the northern firms' management quality is estimated to increase by 8 percent. A gap of 6.6 percent remains unexplained. We also find that the average management quality of the northern firms could be better than the southern firms if the unobserved firm characteristics are equalized.

This result is unsurprising if we relate it back to the recent history of China's economic development. Since China embarked on its industrialization strategy, the southern part has been a beehive of activity. We say this is unsurprising because in the international trade literature, dynamic firms are seen to be exporting and the less productive firms are seen to be catering to the domestic market. Trading firms require large management overheads that can only be generated by low marginal cost firms. This is supported by empirical observation where the rapid economic development in China is characterized

by largely uneven growth geographically. Partly due to its early reform and opening up policies where the southern region of China has been accorded preferential economic treatment, the region has outstripped the North across multiple economic aspects. According to estimates, the gross regional domestic product of provinces and municipalities in the South was comparable to the North in 1960; however, the south was 57 percent larger in 2017 and was 83 percent larger in 2019, than the North.<sup>1</sup> Some of these differences could be attributed to its industrial mix due to human and natural capital endowments.

The North consists of primarily heavy industries such as steelmakers, chemicals, coal mining, and oil reserves. The South is dominated by modern dynamic industries such as light industries, technology start-ups, and manufacturers of smartphones. Besides the policy variation and industry composition, other factors could also probably affect the division. For instance, the climate and land differences lead to a variation in food, language, and culture between the two regions. These differentials in endowments affect human behavior that could in turn affect the economic conditions between the two locations.<sup>2</sup> Experimental evidence from behavioral science found that Southern China is distinguished by an interconnected society where cooperation and tighter social norms are commonly observed relative to the northern society, and this is attributable to the differences in farming of staples in the South region (Talhelm *et al.*, 2014; Talhelm and English, 2020).<sup>34</sup>

Partially due to its industrial heritage, the local government and businesses in north-

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<sup>1</sup>Issaku Harada, Nikkei staff writer (January 20, 2021) “China’s ‘North-South divide’ to worsen as COVID hits economy.” *NikkeiAsia* (Source: <https://asia.nikkei.com/Economy/China-s-North-South-divide-to-worsen-as-COVID-hits-economy> - Accessed on April 02, 2023)

<sup>2</sup>China’s regional economic performance can also be segregated according to the coastal regions and the more inland areas such as the Northwest region that covers Inner Mongolia, Shaanxi, Gansu, Qinghai, Ningxia and Xinjiang. In this paper, we focus on the North-South division based on the Huai River-Qinling Mountain line to provide a clear division of the nation’s geographical landscape. Moreover, government policies tend to differ based on the North-South division due to the climate differences, such as air pollution policy that targets the Northern Jing-jin-Ji area (the economic region that covers Beijing and Tianjin municipalities, and also the coastal area along the Bohai Sea that belongs to Hebei province).

<sup>3</sup>China is not the only nation with a difference in tradition attributable to rice and wheat farming. Other countries include India, Japan, Vietnam, parts of Italy, South America, etc. (Talhelm and Oishi, 2018; Talhelm, 2020).

<sup>4</sup>Historically, China was also divided between the North-South region during the period between 386 and 581 A.D., and was conventionally known as the Northern Wei and Southern Jin dynasties. The North was under the rule of the Tuoba (Tabgach) clan of the Xianbei while the South was dominated by a series of short-term dynasties ruled by the Han ethnic group.

ern provinces have a strong tendency to operate as a command economy. In the Northern city of Tianjin, when asked by an analyst at a credit-rating agency whether the government would allow more defaults by state-owned firms, an official reportedly answered that “*Market solutions work best in the south.*”<sup>5</sup> In contrast to the North, the regional governments in the South adopted a more *laissez-faire* approach in running the local economy. Some of the most economically advanced cities with international trade are also located in the South, such as Shanghai, Shenzhen, and Hangzhou.<sup>6</sup> In 2020, the southern region recorded a foreign trade surplus of about 7 percent of GDP, while the North ran a 2 percent deficit.

International trade allows a country to reap economies of scale and scope, possibly increase competition, spur technical progress and the diffusion of knowledge. For a developing economy, it can aid and speed up structural transformation. China has benefited from its increased integration with the world economy. This happened at a time when world trade was increasing, with increased trade between the rich industrialized countries and the developing economies. While this increase in world trade was a tide that lifted most boats, Chinese trade grew faster than the world trend. Its measure of trade openness (exports plus imports as a share of GDP) crossed ten percent in 1979. It has and stayed above that number, and increased steadily to reach sixty-four percent in 2006. This integration led to industrialization, with its attendant poverty reduction, and a very quick move up the quality ladder (see Schott 2004, 2008, Rodrik 2006). By any stretch of the imagination, the Chinese growth with its reliance on trade, is an unprecedented event in the world’s economic history. In this study, we look at the broad regional consequences within China of this massive shake-up in its economic structure.

Before providing a conceptual framework, we first present the stylized facts on the differences in North-South regional economic performance of China from 2006 to 2016. Panel A and B in Figure 1 present the macroeconomic performance, namely the gross regional domestic product (GRDP) and the value of net exports of China separately for

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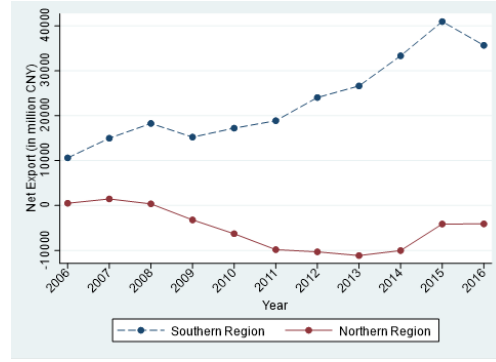
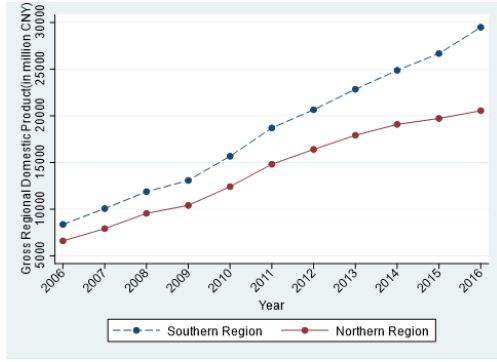
<sup>5</sup>Anonymous (January 20, 2021) “China’s economic centre of gravity is moving south.” The *Economist* Online. (Source: <https://www.economist.com/graphic-detail/2021/01/20/chinas-economic-centre-of-gravity-is-moving-south>)

<sup>6</sup>Hangzhou city is also home to the tech giant Alibaba Group.



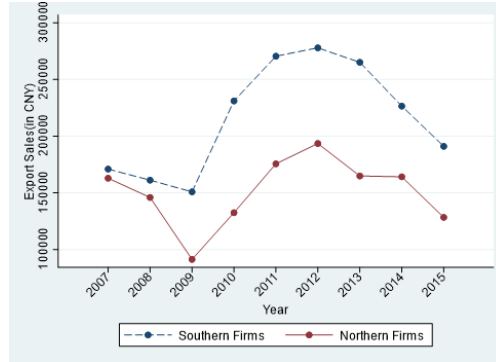
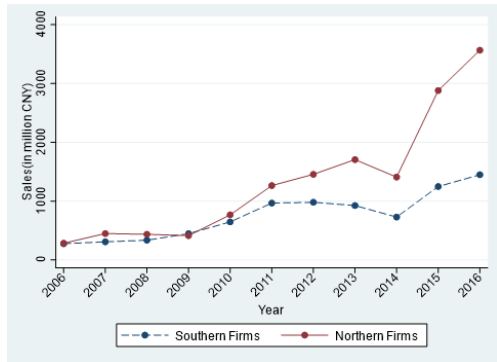
the two regions. Clearly, there is a visibly yawning gap between the North-South region, with the South out-growing the North over the years. The gap was particularly distinct for the net export value displayed in Panel B, with the Northern region continuously decreasing from 2007 to 2014. In contrast, the net export value of the southern region was increasing continuously from 2009 onwards till 2015 and started to taper off in 2016. However, the gap remains distinctively salient. Panel C and D depict the firm-level of sales and export sales in our sample respectively. The sales volume of the northern firms is consistently higher than the southern firms. However, the export sales of the southern firms are persistently higher than the northern firms, indicating that firms in the southern region tend to engage in international trade more than firms located in the North.

Based on the stylized facts, we conceptualize firms in the South have better access to a larger international market than firms located in the North. In corollary, we expect Southern firms to acquire higher management proficiency in order to be competitive in the international market. This leads to better financial returns and export quantity relative to firms located in the Northern region. We provide empirical evidence to support these hypothesis by merging management practice data from the WMS with other sources of firm-level data.



Panel A: Gross Regional Domestic Product

Panel B: Net Export Value



Panel C: Sales of Firms in Sample

Panel D: Export Sales of Firms in Sample\*

Figure 1: North-South Economy of China

\* Note. Firm-level data runs from 2006 to 2015.

Our work contributes to the extant literature on empirical management and organizational economics. In particular, structured management practices that explicitly incorporate formal methods in running a firm and doing it well – such as implementing performance indicators with formal processes to work towards various targets – are essential to firm success in productivity, profitability, and market growth (Ichniowski *et al.*, 1997; Bertrand and Schoar, 2003; Bloom and Van Reenen, 2007; Bloom *et al.*, 2014, 2016, 2019, and Bruhn *et al.*, 2018, etc.). More importantly, recent evidence has shown that the impact of management is not only causal but exerts a lasting impact on firm performance (Bloom *et al.*, 2013; 2020). The effect of management is shown to be consistently essential for performance in other industries such as education (McCormack *et al.*, 2013; Bloom *et al.*, 2015b; Romero *et al.*, 2022) and healthcare sector (Bloom *et al.*, 2015). The results from our paper show that in China, which is the world largest manufacturing base, has a vastly different management capability according to the North-South region, and the difference in management capability has varying associations with different aspects of firm

performance. Our finding that the management differential in the two regions is not fully explained by differences in firms' characteristics has powerful implications for firms and policymakers.

Management practices have also been shown to display spillover benefits in improving energy efficiency (Bloom *et al.*, 2010; Boyd and Curtis, 2014; Schweiger and Stepanov, 2018; Grover and Karplus (2021); Yong and Cao, 2023).<sup>7</sup> This is imperative because energy efficiency is one of the key mechanisms for mitigating environmental damage and climate change. Instead of energy conservation, our study also contributes to this literature by showing that management appears to matter in reducing GHG emissions and effluent discharge, but this is restricted to firms operating in the Northern region.

This paper is organized as follows. Section 2 presents the conceptual framework. Section 3 illustrates how management is measured and differs in location. Section 4 presents the results. Section 5 concludes. Appendix A provides the WMS survey questionnaire. Appendix B provides the detail of the analytical framework. Appendix C presents additional results on management and mitigation of environmental externalities. Additional results are relegated to the Supplementary Materials.

## 2 A Conceptual Framework

While there is a broad consensus among economists that outward orientation is associated with more productive firms, there is some disagreement about the direction of causality i.e. do more productive firms export (see Melitz (2003); Eaton and Kortum (2002)) or does trade and agglomeration cause firm efficiency (papers by Krugman and Venables (1995); Baldwin and Venables (2015)). We do not take a direct position on this debate. Our focus is on comparing the management practices of firms exposed to trade (located mainly in the South) versus firms sheltered from the external competition (located in the North). We find, and this fairly unambiguous, that, in the data, trade-exposed Southern

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<sup>7</sup>Another strand of literature studies firm management that are specifically environmentally and climate-friendly, which relates to practices such as reducing GHG emissions abatement, energy consumption, and investment in low-carbon technologies (Martin *et al.*, 2012; Yong *et al.*, 2021; Adhvaryu *et al.*, 2022; Karplus and Zhang, 2022).

firms have better management practices (these are defined below). We, thus, provide a novel input into their differences. There is a very big and old literature on firms locating near their customers (see Hotelling, 1929 and Steven Salop, 1979).<sup>8</sup> International trade in recent times has become fragmented, and this analysis of trying to locate near the customers is to a first approximation not correct. This is maybe due to the fact that in the last two centuries, since the development of the steam-ships, the cost of transport has fallen significantly, thereby allowing firms to locate at some distance from their customers. This, notwithstanding, transportation costs can be significant and, *ceteris paribus*, firms would like to locate close to their customers to save on transport costs and time. This is a thread that we will weave into our empirical work. It is our belief, and borne out by the data, that southern firms, that supply foreign markets, locate closer to the coast in China, and northern firms, which supply the internal markets, are located inland.

The conceptual framework that we have in mind has two types of firms a high marginal cost firm and a low marginal cost firm. We model the market structure as a monopolistically competitive one (see Appendix B ). This allows for managerial input costs as fixed cost. Assuming a constant elasticity of substitution production function in a Dixit-Stiglitz set-up, the price of each firm's output is a fixed mark-up marginal cost. The elasticity of substitution becomes, *ceteris paribus*, the elasticity of demand facing each producer. As shown in Appendix B, a higher productivity firm (i.e. lower marginal cost) will have a lower price. A lower price gives a high total revenue, and hence a higher ability to finance managerial costs. Thus our, admittedly rudimentary, theoretical structure allows us to generate a scenario where low-cost firms (i.e. the exporting ones) have higher managerial expenditure and profits.

**Proposition 1:** A low cost firm will charge a lower price of and will have a higher surplus (i.e. its ability to support a higher managerial input and profits). More generally, in a dynamic setup where the fixed managerial input has to be committed, we have:  
**Proposition 2:** Given a level of profits, if a firm commits to a higher managerial input, it must be of a low cost type producer.

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<sup>8</sup>Von Thunen (1826) had suggested that this more important for transport-intensive goods.

**Proposition 2:** Given a level of profits, if a firm commits to a higher managerial input, it must be of a low cost type producer.

Our model Bloom shares a family resemblance to Bloom *et al* (2021) in an open economy model. They apply a model with managerial inputs to explain export performance of firms in the US and China. They use a monopolistically competitive framework, with both horizontal and vertical differentiation. Vertical differentiation means that firms can invest in better quality products that may require a higher outlay on inputs, including on management. Our aim, constrained both by the problem that we are tackling and data limitations, is to look at the location of firms and relate it to management practices. We do not venture into explaining vertical differentiation. Our theoretical model is consistent with Bloom *et al*, (2021).

By disaggregating our sample of firms into those in the South and the North, brings in geography in location. We then have a rich story with management, trade, and geography. Our empirical results show that the South is more dynamic compared to the North. This accords with Chinese perception about the characteristics of the two regions, but can be traced to the managerial inputs.

### 3 Measuring Management Quality

To measure firms' management capability, we use the survey data collected by the world management survey (WMS) that captured structured management practices in China. The WMS survey is targeted at a representative sample of manufacturing firms with 150 to 5000 employees to ensure comparable firm scale and size.<sup>9</sup> To collect information on firm management practices, a set of survey questions were carefully designed by the WMS team in collaboration with a top international consultancy firm that has a long history of management consultancy experiences. From the series of survey questions, the WMS are able to assess 18 key components of management practices used by industrial firms. These 18 practices are further categorized into four main sub-components that form the

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<sup>9</sup>In China, the WMS target to interview manufacturing firms with 150 to 5000 employees because their original sample frame uses the Oriana database, which contains only samples firms with over 150 employees (Bloom *et al.*, 2017, Appendix for Online Publication, pp. 34)

crux of modern management practices of a company: (1) Operations (three practices): characterizes the system of lean manufacturing; (2) Monitoring (four practices): the implementation of appropriate plans, rewards, and penalties to track and review workers' performances; (3) Targets (five practices): the setting of comprehensive goals that are realistic and how connected they are in relation to performance; (4) Incentives (six practices): the effectiveness of the firm remuneration system that can retain good workers and removing bad performers. The survey questions and how they are grouped into the four sub-components of management are provided in the Appendix A at the end of the paper.

Using the series of standardized measures, the WMS collected data on management practices from more than 20,000 manufacturing firms across thirty countries starting in 2004 using the BVR method. The survey targets interviews with mid-level managers who are well aware and knowledgeable about the overall management within the companies. At the same time, they are not too senior and high up in the company hierarchy so they are not detached from the firms' daily administrations and operations. As common in survey study, asking people about their perceptions of employers' performance and operations may elicit cognitive bias as highlighted by Bertrand and Mullainathan (2001). To minimize the potential bias, the BVR method require implementing a battery of intensive procedures.

Firstly, the survey questionnaires were designed as open questions. For each sub-component of the management practices, it would involve several questions. This allowed the interviewers to elicit answers from the firm managers starting with fairly broad issues and proceeding with more detailed questions till the interviewers are able to assess the responses with confidence to provide a score. The responses are being ranked by the interviewers on an ordinal scale from 1 to 5, with a higher score representing better managerial performance. Secondly, in order to provide appropriate assessment of the managers' responses, the survey employed mainly graduate students from top US and European business schools as interviewers and they were provided specialized training by the WMS team of researchers. Thirdly, the interview process involved a double-blind procedures, where the interviewers are not provided any prior knowledge about the targeted

firms they interviewed. At the same time, the firm managers interviewed were unaware that their responses were being quantitatively evaluated by the interviewers. To ensure that this double-blind process is being adhered to, all the interviews are conducted using telephones only. Lastly, to ensure consistency in scoring, a subset of the firms was double-scored by another team of trained interviewers who listened quietly to the telephone interview process. Whenever there were discrepancies in opinions, it was resolved through discussion after the interviews. In cases where the firms had multiple establishments, additional interviews were conducted with the different plant managers to check whether the responses were consistent and correlated.<sup>10</sup>

In total, we can match 710 firms from the WMS data to the Orbis database that contains data on the financial variables such as sales, profits, as well as employment and capital assets that can be used as regression controls. We are also able to further matched 483 firms from the WMS data in the Chinese State Administration of Taxes to obtain the export sales of firms. Following Bloom and Van Reenen (2007), we converted each of the practices from its five-point scale into a standardized z-score, and then aggregate them to obtain the overall measure of generic management from the 18 practice scores. The four sub-measures of management practices are also computed in the form of z-score.

Before proceeding to the formal analysis of the data, we conduct a visual examination of the distribution of management quality proxied by the average management scores. Figure 2 illustrates the average management scores across various regions in China, with corresponding alphabetical notations in parenthesis denoting whether the respective location pertains to the North or South of China. The map utilizes a color-coded scheme, with red denoting the highest management scores indicative of superior management quality, and light yellow representing the lowest tier of scores, indicating suboptimal management competency. Upon visual inspection, a discernible pattern emerges, revealing a prevalence of bright orange shades (indicative of the second tier of management scores) in provinces and municipalities in the Southern region, in contrast to the Northern counterpart. Notwithstanding, both regions are home to some firms attaining the highest levels

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<sup>10</sup>Details on the BVR survey methodology can be found at the World Management Survey website (<https://worldmanagementsurvey.org/data/dwms-public-sector/wms-methodology/>).

of managerial competency within China.

### Management Quality of Firms Across China

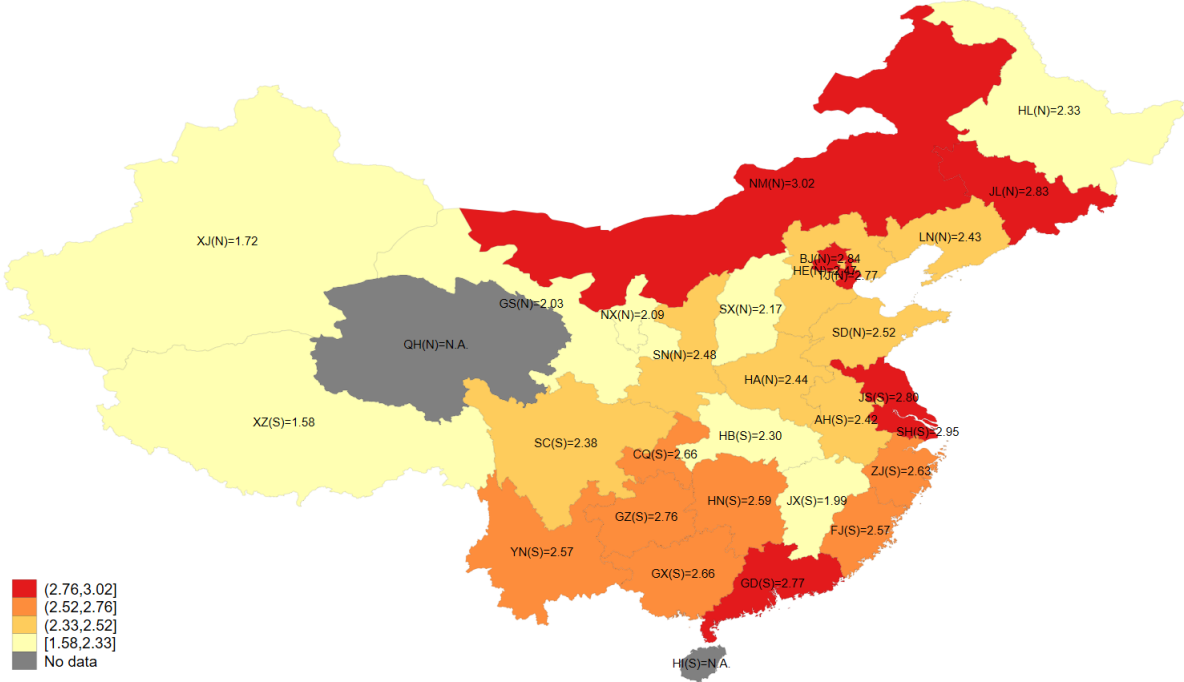


Figure 2: Average Management Practice Score by North-South Region of China

Notes. (1) The range of values shown in the legend are the average management scores of firms in the specific location (province or municipality) in China. Red indicates the highest range of scores representing the highest management capability and light yellow indicates the lowest range of scores representing the lowest tier of management competency. (2) The alphabet in parenthesis indicates whether the location is situated in the North or South of the Huai River and the Qin Mountains, i.e., (N) - Northern region, (S) - Southern region.

Figure 3 displays the kernel density plot of the normalized management scores separated by the firms' location. Clearly, firms located in the South have higher average management scores - indicating higher management capability - than firms located in the North, as the entire distribution is located to the right of the northern firms. Moreover, there are more firms that are well-managed located in the South compared to those in the North, as revealed by the 'fatter' right tail of the distribution. This provides preliminary evidence of the link between the location and management quality in China.



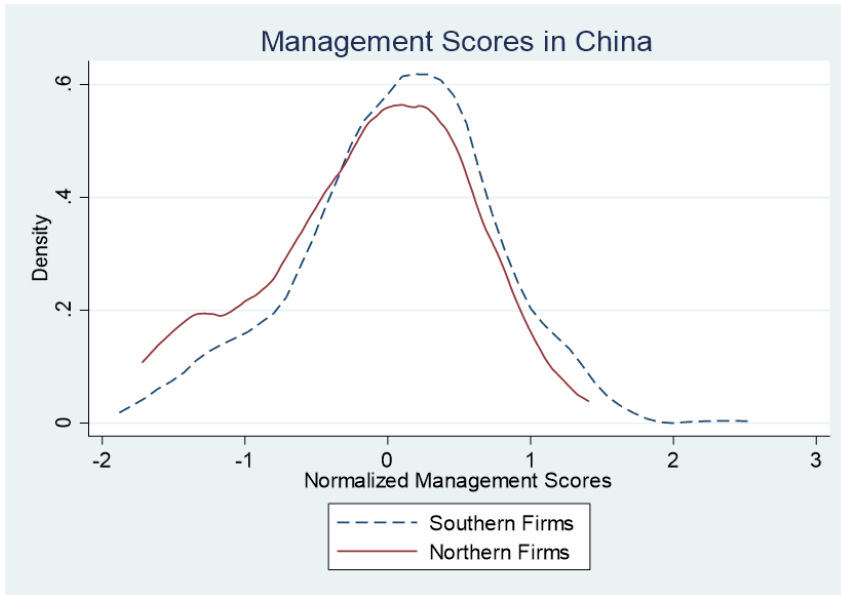


Figure 3: Normalized Management Practice Score by North-South Region

## 4 Results

### 4.1 Firm Characteristics by Locations

In Table 1 we show that there are meaningful differences in the groupings of firms in our sample by the north-south location in China, in which there exists significant differences in the management structures. First, in terms of financial variables, the northern firms dominate the southern firms in terms of financial earnings. The northern firms are also larger than the southern firms in terms of factors of production. However, there are no statistically significant differences. The only exception is export sales, where the value for the southern firms is significantly higher than the northern firms.

Second, the number of state-owned firms in the North is significantly higher than those located in the southern region. State-owned firms are known to be less efficient, and it is likely related to their management competency, given their employment structure such as the immunity to remove inefficient workers – the so-called ‘iron rice bowl’ scheme in Chinese language.<sup>11</sup> While the firm’s age of the southern firms is slightly older than the north, the difference is not significant.

<sup>11</sup>Evidence from the large-scale studies run by the World Management Survey found that government-run manufacturing firms are badly-managed across all the countries in their sample, mainly due to weak management of workers and a lack of modern manufacturing techniques (Bloom and Homkes, 2008).

Lastly, there are sizeable differences in the management scores and sub-practice scores across firms which are statistically significant, after controlling for the different industry types. Firms in the Southern region outperform the firms located in the North in all aspects of management practices. In addition, when we rank the scores of the eighteen management practices, we found that the Chinese firms perform the best in ‘performance review’ and ‘making room for talent’, and they perform the worst in ‘introduction to lean (modern management’, ‘retaining talent’, ‘instilling a talent mindset’, implementing the ‘type of targets’). This is consistent for both the North-South region. However, the southern firms scored strictly higher than the northern firms in all of these dimensions. As in our subsequent analysis, we find there is a strong link between the location of the firms - whether they operates in the north or south - and the quality of management practices.

## 4.2 Earnings Performance and Management Practices

To assess how location impact on the relationship between management practices and firm performances, we resort to using regression analysis. We estimate the following firm-level production function

$$y_{it} = \alpha_0 + \beta M_i + \alpha_1' S_{it} + \lambda_t + \eta_t + \varepsilon_{it} \quad (1)$$

where  $y_{it}$  is the log of the variable that measures earnings’ performance (e.g., sales, gross profit) for the  $it$ h firm in time  $t$ ,  $S_{it}$  is the control for firm sizes or resources, using the logs of employment, capital and the cost of goods sold which are the direct costs of production. . The matrix  $\lambda_t$  contains a number of firm-level controls that includes firms’ age, whether they are listed firms, firm ownership (whether they are state-owned, foreign multinational-own or domestic-own), binary indicators for the year fixed effects, the location of the firms, and a set of binary indicators for the three-digit industry classification to capture the firm-level heterogeneity. For some of the control variables that has missing values in some years, we set the value of these variables equal to zero when it was missing

Table 1: Sample Characteristics by Firm Location

Variables	South	North	p-value	No. of Firms
<b>Financial Variables</b>				
Sales per million CNY	558.37	733.73	0.226	706
Gross Profit in per million CNY	120.73	129.72	0.076	708
Export Sales in CNY	161132.48	105409.90	0.308	483
Capital per million CNY	120.72	158.47	0.848	706
No. of Employees	661.35	787.00	0.514	691
Cost of Goods Sold per million CNY	436.79	601.03	0.364	708
Firm Age in Years	15.37	13.64	0.461	707
State-ownership	0.05	0.14	0.014	708
<b>Management Variables</b>				
Overall Management Score	2.72	2.54	0.000	708
Operations Score	2.64	2.48	0.004	708
Monitor Score	2.86	2.70	0.015	708
Target Score	2.66	2.47	0.001	708
Incentives Score	2.73	2.53	0.000	708
Introduction to Lean (Modern) Manufacturing	2.56	2.40	0.009	708
Rationale for Lean (Modern) Manufacturing	2.63	2.49	0.015	708
Process Documentation	2.73	2.55	0.013	708
Performance Tracking	2.93	2.75	0.087	708
Performance Review	3.03	2.86	0.019	708
Performance Dialogue	2.72	2.64	0.147	708
Consequence Management	2.75	2.55	0.005	707
Type of Targets	2.39	2.15	0.001	708
Interconnection of Goals	2.80	2.58	0.005	708
Time Horizon	2.64	2.47	0.014	708
Goals are Stretching	2.63	2.48	0.019	708
Clarity of Goals and Measurement	2.83	2.68	0.143	708
Instilling a Talent Mindset	2.46	2.28	0.023	708
Building a High-Performance Culture	2.97	2.73	0.001	708
Making Room for Talent	2.99	2.83	0.091	708
Developing Talent	2.66	2.45	0.013	708
Creating a Distinctive EVP	2.84	2.57	0.001	708
Retaining Talent	2.48	2.33	0.006	706

Notes. The  $p$ -value refers to the equality of means between firms in the South and in the North, controlling for its three-digit industrial classification and robust standard error.

and include a dummy variable to indicate this.

To minimize measurement errors, the  $\eta_t$  contains the controls for the survey noise that includes the respondents' identity such as the manager's background, tenure in the company, gender, age, the interviewers' fixed effects (interviewers' identity and interview duration) and also a managers' reliability score. This score was provided by the interviewer on the managers who were being interviewed on their knowledge about the firm and their willingness to participate in the survey. The key variable is the firm-level management practices index denoted by  $M_i$  for each firm  $i$ . This is constructed as an unweighted average of the eighteen management practice scores after normalizing into a z-score. Our modeling approach follows Bloom and Van Reenen (2007) and Bloom *et al.* (2019, 2021) where management practices are viewed as more than reflecting the attributes of the top managers such as the chief executive officers and managing directors; rather, they are embedded within the organizational culture and structure that tend to change slowly over time. Evidence has also supported this conception of persistence in management practices and its long-lasting effect on firm performance (Giorcelli, 2019; Bloom *et al.*, 2020).<sup>12</sup>

Before focusing on the location effect, we first assess the conditional correlation between firm productivity and management competency for the full sample of firms located in China. Table 2 presents the results of the regression of firm performance on management practices based on specification (1) using the full sample of firms. We use sales, profit, and export earnings as measures of firm-level performance, and assess the firm performance in terms of labor productivity and total factor productivity. Columns (1), (3), and (5) present the results for the measure of labor productivity by including the natural logarithm of employment, so that the point estimates on the management z-score reflect the partial relation with labor productivity. Quantitatively, a one-standard-deviation (0.7) increase in the management practices z-score is associated with higher labor pro-

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<sup>12</sup>Based on a follow-up experimental study conducted in 2011 that provided consultancy advice to Indian weaving firms, Bloom *et al.* (2020) found that a substantial fraction of the management practices - 83.5 percent - remain unchanged after nine years. Similarly using observational data, Giorcelli (2019) found that in Italian firms which received managerial training from the US Assistance and Productivity Program (1952–1958), more than 90 percent of them continue to adopt the new American managerial practices after 15 years. The practices include monitoring and tracking sales and orders, which are also part of the operations and monitoring category under the WMS measure of management quality, leading to continuous improvement in firm performance throughout the years.

ductivity in sales, profit, and export sales by 43.4%, 59.6%, and 49.8% respectively.<sup>13</sup> In Columns (2), (4), and (6), we include capital input and cost of goods sold (COGS) which measures all direct costs related to the production of goods and services sold by the firm). With these comprehensive set of controls, a one-standard-deviation rise in the management practices z-score is associated with an increase in total factor productivity of sales, profit, and export sales by 4.8%, 18.2%, and 30.7% respectively. However, the point estimate for the export sales is no longer significance at the conventional level.

Note that our point estimate of sales productivity (0.067) is slightly higher compared to those in the developed countries (0.040) in Bloom and Van Reenen (2007) which include - namely Japan, Germany, the UK, and the US. This is not particularly surprising. As the largest emerging market in the world and also the powerhouse of manufacturing for the world market, the scope for market growth is considerably higher compared to mature economies. Moreover, our data range covers from 2006 to 2016, which is a period of accelerated growth after the country became a member of the World Trade Organization in December 2011.

When analyzed by location, the management relation is different. Table 3 displays the regression result separated by the firm sample in the North-South region. Compared to the southern firms, the management score among northern firms has a smaller size effect on sales and profit. Moreover, the northern firms do not have a significant association with sales and export sales, except on profit at the ten percent significance level. Specifically, for firms located in the Southern region, the point estimate in column (1) - (3) shows that a one standard deviation increase in the management z-score (0.68) is associated with a 7.5 percent increase in sales productivity, a 29.2 percent increase in gross profitability, and a 40.8 percent rise in export sales. By contrast, for firms located in the Northern region, a one standard deviation increase in the management z-score (0.71) is correlated with a 17 percent increase in gross profitability, which is considerably lower than the size of the estimate of southern firms. The point estimates for sales productivity and export sales are statistically insignificant. Hence, as far as possible, these results show a modest

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<sup>13</sup>For example, to compute the labor productivity in sales require:  $\exp(0.7 \times 0.515) - 1 = 0.434$  or 43.4%

Table 2: Firm Performance and Management in China (All firms)

	(1)	(2)	(3)	(4)	(5)	(6)
	Log (Sales)	Log (Sales)	Log (Profit)	Log (Profit)	Log (Export)	Log (Export)
z-Management	0.515*** (0.089)	0.067*** (0.015)	0.668*** (0.094)	0.239*** (0.054)	0.577** (0.272)	0.382 (0.255)
Log(Employment)	0.276*** (0.026)	0.014 (0.009)	0.280*** (0.029)	0.039*** (0.015)	0.082*** (0.028)	-0.007 (0.028)
Log(Capital)		0.012* (0.007)		0.070*** (0.022)		-0.048 (0.065)
Log(Cost of Goods Sold)		0.962*** (0.010)		0.825*** (0.026)		0.592*** (0.064)
Observations	4002	4002	3834	3834	1811	1811
Firms	706	706	701	701	316	316
R-squared	0.581	0.971	0.605	0.838	0.541	0.593

*Notes.* The management index is the un-weighted average score for each of the 18 management questions that was normalized to a zero and one scale. Similarly, the other sub-index comprises of the un-weighted average score for each of the sub-category of the management questions that was normalized. COGS refers to Cost of Goods Sold. The noise controls are a set of variables capturing interview characteristics: respondents' identity such as manager's background, tenure in company, gender, age, and the interviewer fixed effects (interviewers' identity and interview duration) and also a reliability score by the interviewer on the managers' knowledge about the firm and the willingness to participate in the survey. Region controls refer to the location of the firms by province, province-level municipalities (e.g., Beijing, Shanghai), and ethnic autonomous regions (Inner Mongolia, Ningxia). All regressions include the firm age (in logs), the firms' listing status, ownership type, three-digit industry controls, and year dummies. All regressions also include a constant. Robust standard errors in parentheses are clustered on the firm level. \*\*\*, \*\*, and \* denote estimates significant at 1%, 5%, and 10%, respectively.

correlation between management with sales and a contradictory relationship with export earnings, but little can be determined given the size of the standard errors.

As the world management survey sets the firm size to be interviewed between 50 to 5000 employees focusing mainly on manufacturing firms, it has been shown that sampled firms are comparable to each other across the sample of countries (Scur *et al.*, 2021). In our summary statistics in displayed in Table 1, the Chinese firms are also broadly comparable with no significant differences in firm size and resources between the North-South region. Hence, the results are unlikely to be driven by different firm resources and sizes. Nevertheless, in order to address such potential concerns, we applied the coarsened exact matching (CEM) methods proposed by Iacus, King, Porroto (2011, 2012) to match the southern firms with the Northern firms. We applied the CEM algorithm to match the firms based on industry classifications and the average historical value of fixed assets, employment, and cost of goods sold (COGS), which is the direct cost associated with production and sales. Using CEM over other common matching methods such as

Table 3: Firm Performance and Management by North-South Region

	Southern Firms			Northern Firms		
	(1) Log (Sales)	(2) Log (Profit)	(3) Log (Export)	(4) Log (Sales)	(5) Log (Profit)	(6) Log (Export)
z-Management	0.107*** (0.019)	0.377*** (0.064)	0.503* (0.289)	0.015 (0.035)	0.221* (0.129)	-1.107 (0.679)
Log(Capital)	0.006 (0.009)	0.079*** (0.027)	-0.060 (0.071)	0.008 (0.009)	0.042 (0.038)	-0.128 (0.117)
Log(Employment)	0.011 (0.010)	0.036** (0.016)	-0.022 (0.031)	0.018** (0.009)	0.041 (0.030)	0.050 (0.038)
Log(COGS)	0.961*** (0.013)	0.821*** (0.033)	0.557*** (0.072)	0.960*** (0.025)	0.835*** (0.064)	0.320* (0.184)
Industry controls	Yes	Yes	Yes	Yes	Yes	Yes
Year controls	Yes	Yes	Yes	Yes	Yes	Yes
Noise controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2778	2666	1332	1224	1168	479
Firms	485	483	233	221	218	83
R-squared	0.968	0.854	0.621	0.987	0.855	0.798

*Notes.* The management index is the un-weighted average score for each of the 18 management questions that was normalized to a zero and one scale. Similarly, the other sub-index comprises of the un-weighted average score for each of the sub-category of the management questions that was normalized. COGS refers to Cost of Goods Sold. The noise controls are a set of variables capturing interview characteristics: respondents' identity such as manager's background, tenure in company, gender, age, and the interviewer fixed effects (interviewers' identity and interview duration) and also a reliability score by the interviewer on the managers' knowledge about the firm and the willingness to participate in the survey. Region controls refer to the location of the firms by province, province-level municipalities (e.g., Beijing, Shanghai), and ethnic autonomous regions (Inner Mongolia, Ningxia). All regressions include the firm age (in logs), the firms' listing status, ownership type, three-digit industry controls, and year dummies. All regressions also include a constant. Robust standard errors in parentheses are clustered on the firm level. \*\*\*, \*\*, and \* denote estimates significant at 1%, 5%, and 10%, respectively.

Table 4: Firm Performance and Management by North-South Region (Matched Sample)

	Southern Firms			Northern Firms		
	(1)	(2)	(3)	(4)	(5)	(6)
	Log (Sales)	Log (Profit)	Log (Export)	Log (Sales)	Log (Profit)	Log (Export)
z-Management	0.112*** (0.028)	0.377*** (0.107)	0.460* (0.239)	0.022 (0.028)	0.215 (0.135)	-0.566 (0.609)
Log(Capital)	0.012 (0.012)	0.023 (0.039)	0.082 (0.095)	-0.010 (0.008)	0.009 (0.041)	-0.127 (0.145)
Log(Employment)	-0.016 (0.017)	0.023 (0.030)	0.005 (0.027)	0.020* (0.011)	0.037 (0.036)	0.046 (0.055)
Log(COGS)	0.974*** (0.024)	0.791*** (0.049)	0.379*** (0.103)	0.953*** (0.026)	0.820*** (0.067)	0.332* (0.198)
Industry controls	Yes	Yes	Yes	Yes	Yes	Yes
Year controls	Yes	Yes	Yes	Yes	Yes	Yes
Noise controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1193	1153	616	1145	1090	442
Firms	211	211	104	210	207	78
R-squared	0.966	0.830	0.788	0.985	0.832	0.760

Notes. The regressions are run on the matched sample using coarsened exact matching (CEM) with adjustment for sample imbalance. The management index is the un-weighted average score for each of the 18 management questions that was normalized to a zero and one scale. Similarly, the other sub-index comprises of the un-weighted average score for each of the sub-category of the management questions that was normalized. COGS refers to Cost of Goods Sold. The noise controls are a set of variables capturing interview characteristics: respondents' identity such as manager's background, tenure in company, gender, age, and the interviewer fixed effects (interviewers' identity and interview duration) and also a reliability score by the interviewer on the managers' knowledge about the firm and the willingness to participate in the survey. Region controls refer to the location of the firms by province, province-level municipalities (e.g., Beijing, Shanghai), and ethnic autonomous regions (Inner Mongolia, Ningxia). All regressions include the firm age (in logs), the firms' listing status, ownership type, three-digit industry controls, and year dummies. All regressions also include a constant. Robust standard errors in parentheses are clustered on the firm level. \*\*\*, \*\*, and \* denote estimates significant at 1%, 5%, and 10%, respectively.

propensity score technique to produce matching in covariates has several advantages, such as being robust to measurement error and computational speed with large datasets.<sup>14</sup> To alleviate the difference in sample size between the two regions that might affect the statistical analysis, we further adjust for the sample imbalance. The results are similar and they are displayed in Table 4.

In addition, we also conduct a battery of other robustness checks and the results are included in the Supplementary Materials. First, we randomly matched the northern and southern firms with similar industry classifications. The results show that management

<sup>14</sup>A detailed illustration of the advantages of using the CEM over other forms of matching method can be found in Blackwell, Iacus, King, and Porro (2009)



has a positive and significant relationship with sales and profits among the southern firms but not for the northern firms; as for the point estimates for export sales in both regions, they are not significant (Table B1). Second, we conduct CEM matching but without adjusting for firm sample size (Table B2). All the results are consistent with our main analysis. As a counterfactual, we conduct the CEM matching with the similar matching approach in Table 3 (i.e., adjust for sample imbalance) and we match the southern firms' management z-score with those in the North (Table B3). Now the management measure for the southern firms not only has a smaller size effect on sales and profit, but they are no longer significant. Interestingly, the management coefficient on export earnings has a larger estimate with similar significance, which plausibly points to the locational effect in the South. While the CEM methods has its advantages, there are also costs to using it as a matching mechanism for causal inference. For instance, CEM drops more observations than other matching methods and may severely misidentify average treatment effects relative to other methods (Black, Lalkiya, and Lerner, 2021). Hence, as an additional robustness exercise, we apply the Entropy Balance method (Hainmueller, 2012) as a weighting scheme that calibrates unit weights for the key control variables, so that the reweighted data for the firms in the different North-South locations have similar means. We further combine the balancing method with the CEM matched firms adjusted for sample imbalance. These additional results are similar to the main results (table B4 and B5 respectively). Overall, the results show that the quality of management matters for firm performance located in the South – positively with larger size effect - but not for firms located in the North.

### 4.3 Variations in Sub-Category of Management Practices

From a policy perspective, it is of interest to understand what types of management practices in firms located in the South are beneficial to the financial performances that firms in the North lack. To do so, we disentangle the overall management score into its four major dimensions - operations, monitoring, target, and incentives - that characterize modern management for analysis. Recall that these sub-practices represent different as-

pects that are found to be essential to modern-day management. For example, operation practice refers to lean manufacturing practices that have direct implications on production efficiency, while incentive practice reflects the quality of human resource management through implementing appropriate incentives to induce employees' work effort.

In Table 4, we regress each of the four major sub-components of management practices on the firm performance indicators by north-south location. All the management sub-components demonstrated a positive and significant association with firm performance in the South, particularly with sales and gross profit. By contrast, we do not observe similar results for firms located in the Northern region. Most of the coefficient estimates for the sample in the south tend to have a larger size estimate compared to the sample in the North as well. For the southern firms, the target practice emerges as the most important practice for sales productivity while implementing a good incentive system appears quantitatively most important for gross profit. The target practice, which involves setting realistic targets and implementing due process to ensure they are achievable, is the only practice that is positively related to gross profit for the northern firms as well. For export sales, the production operation and monitoring strategies appear most important for the southern firms. On the contrary, these practices are negatively related to export sales for the northern firms.

When we further disaggregate the management scores and run similar regressions on the separate 18 practice scores, we found similar patterns of correlations. Almost all management practices of the southern firms have positive and larger size effects than the northern firms, and they are also significantly correlated with the firm performance outcome. These results are reported in Table B6 in the Supplementary Materials.

#### **4.4 Accounting for Management Variation**

In Table 6, we investigate the relationship between firms' management scores and the north-south location effect. Starting in column (1), we regress the management scores against the dummy to indicate firms located in the north with two other key variables: an indicator for whether the firm export and the degree of market competition. The

Table 5: Sub-Practices and Firm Performance in North-South Region

	Southern Firms			Northern Firms		
	(1) Log (Sales)	(2) Log (Profit)	(3) Log (Export)	(4) Log (Sales)	(5) Log (Profit)	(6) Log (Export)
z-operations	0.064*** (0.015)	0.193*** (0.050)	0.372* (0.217)	-0.004 (0.022)	0.133 (0.090)	-0.446 (0.384)
z-monitor	0.054*** (0.014)	0.185*** (0.050)	0.583*** (0.213)	-0.017 (0.032)	0.045 (0.121)	-2.300*** (0.501)
z-target	0.091*** (0.016)	0.280*** (0.058)	0.303 (0.209)	0.033 (0.026)	0.325*** (0.104)	0.917* (0.494)
z-incentives	0.081*** (0.016)	0.346*** (0.060)	0.145 (0.265)	0.018 (0.032)	0.086 (0.112)	-1.004 (0.647)
Observations	2778	2666	1332	1224	1168	479
Firms	485	483	233	221	218	83

Notes. The four sub-management practice score is the un-weighted average score of different survey questions that was normalized to a zero and one scale. Each row represents separate regressions. The noise controls are a set of variables capturing interview characteristics: respondents' identity such as manager's background, tenure in company, gender, age, and the interviewer fixed effects (interviewers' identity and interview duration) and also a reliability score by the interviewer on the managers' knowledge about the firm and the willingness to participate in the survey. Region controls refers to the location of the firms by province, province-level municipalities (e.g., Beijing, Shanghai) and ethnic autonomous regions (Inner Mongolia, Ningxia). All regressions include the firm age (in logs), the firms' listing status, ownership type, three-digit industry controls, and year dummies. All regressions also include a constant. Robust standard errors in parentheses are clustered on the firm-level. \*\*\*, \*\*, and \* denote estimates significant at 1%, 5%, and 10%, respectively.

measure of competition is the survey response provided by the WMS, which is a question on the number of competitors a firm faces. It was coded as one for “no competitors,” two for “1 to 4 competitors,” three for “5 to 9 competitors,” and four for “10 or more competitors”.<sup>15</sup> We see that firms located in the North are negatively and significantly associated with management quality. Similarly, more intense competition has a depressing effect on management quality while engaging in export has a positive association. In column (2), we include the controls for capital and labor, and this results in a slight increment in the size of the point estimates of the indicator for northern firms. In column (3), we add further controls for the direct cost of production and other standard sets of variables that specifically relate to firms' ownership structure. The indicator for firms located in the North continues to be negative and significant. In column (4), we include the control for the industry fixed effect, and estimates for the northern firm indicator continue to be negative and significant at the 5 percent level.

<sup>15</sup>We also use other formulations to indicate competition such as converting to a z-score and obtained similar results.

Finally, in order to account for possible biases arising from differences in firm sizes, resources, and sample imbalance among firms located in the two different areas in China, we used the CEM to match southern firms' fixed assets, employment, and direct cost of production with adjustment for sample imbalance and re-run the regression using the full specification in column (4). The results in column (5) show a similar size and significant location effect. Finally, we split the sample according to the North-South region in columns (6) and (7). The results indicate that whether a firm engages in export and the degree of market competition is significantly associated with the quality of management among firms located in the south. But such associations are not significantly related to the management quality of firms located in the North.

According to most of the empirical studies (Bloom and Van Reenen, 2007; Bloom *et al.*, 2015; 2019), market competition tends to be positively correlated with better management practices through two main channels: (1) the selection effect where badly-managed firms exit the market faster when competition is intense, and (2) the incentive effect on managers to improve performance and efficiency for fear of losing employment as the threat of firm's liquidation is higher. However, studies have also shown that more intense competition could also reduce profits and dilute the expected return on managerial effort (Hermalin, 1992; Schmidt, 1997). As a consequence, managers may deem it less beneficial to exert effort to improve managerial performance, leading to managerial slack and a negative association between the degree of competition and the quality of management.

Based on the firm sample from China, our results in Table 6 appear to suggest the second channel at work. In particular, higher competition has a negative and significant association with management competence for firms located in the South, but this correlation appears distinctively weaker and statistically insignificant for the Northern firms. While we do not have direct evidence to explain this contrasting phenomenon, studies on the institutional framework in China suggest this could be a complex combination of non-market practices in China that distort managerial incentives. For instance, Young (2000) and Barwick *et al.* (2021) found that many successful firms in China have secured special arrangements with local governments to protect their business by obstructing the entry

of competitors from other locations, both within and outside the country. Hence, when managers are faced with stiffer competition, they re-direct their effort from improving management practices towards rent-seeking endeavors, which is typical of the multitasking agency problem (Holmstrom and Milgrom, 1991; Dewatripont *et al.*, 2000).<sup>16</sup>

## 4.5 Decomposition of Management Variation

In this subsection, we apply the Oaxaca-Blinder decomposition to investigate what proportion of the management gap can be attributed to the differences in the characteristics of firms' locations in the North-South region and what proportion remains unexplained.<sup>17</sup> The upper portion of Table 7 reports the mean predictions by the North-South region and their differences. In our sample of firms, the mean of  $\log(\text{management})$  is 0.972 for southern firms and 0.895 for northern firms, yielding a management gap of 0.078. This is transformed into its original scale to obtain the means of management score: 2.644 for southern firms and 2.447 for northern firms. This amounts to a difference of 8.1 percent.

In the lower part of Table 8, each row represents the regression specification in columns 1 – 4 of Table 7 and presents the results from the decomposition of the log of management scores under each specification. The last row shows the output of regression specification (4) but uses the CEM sample of matched firms on the direct cost of production, employment, and fixed assets. From the range of specifications, the unexplained gap is highly significant and is estimated to be in the range of 5.7 percent and 8.8 percent.

Focusing on the most comprehensive model (specification 4) with the full range of controls and industry fixed effect, the result implies that adjusting the northern firms' endowment levels to the levels of southern firms would increase northern firms' management score by a statistically insignificant level of 1.2 percent. A significant gap of 6.6

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<sup>16</sup>The multitasking problem refers to the organization problem when economic agents concentrate efforts on selected work tasks deemed to reap the highest rewards when they are required to multi-task in a workplace.

<sup>17</sup>The Oaxaca decomposition (Blinder, 1973; Oaxaca, 1973) is an econometric technique commonly used to decompose average differences between two groups of observations in relation to a variable of interest. In our study, the interest variable is the firm-level management practices in the North-South region of China. We applied the technique to identify what proportion of this difference can be accounted for by the available predictors, and what proportion remains unexplained.

Table 6: Explaining Management Practices

	Log (Management Score)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Full Sample	Full Sample	Full Sample	Full Sample	Matched Firms	Southern Firms	Northern Firms
Firm located in the North	-0.072*** (0.023)	-0.084*** (0.025)	-0.057*** (0.022)	-0.066** (0.026)	-0.060* (0.036)		
Firm exports	0.191*** (0.051)	0.138** (0.059)	0.110** (0.052)	0.124** (0.058)	0.062 (0.085)	0.140* (0.074)	0.073 (0.141)
Competition	-0.026* (0.014)	-0.025* (0.015)	-0.020 (0.013)	-0.020 (0.015)	-0.013 (0.025)	-0.034** (0.017)	-0.004 (0.059)
Log(Capital)		0.047*** (0.013)	0.050*** (0.013)	0.034** (0.016)	0.040 (0.024)	0.031 (0.021)	0.019 (0.047)
Log(Employment)		0.013 (0.022)	0.008 (0.020)	0.015 (0.026)	0.018 (0.048)	0.027 (0.034)	0.003 (0.082)
Log(Cost of Goods Sold)			0.013 (0.014)	0.014 (0.018)	0.032 (0.031)	0.007 (0.023)	-0.011 (0.067)
Log(Firm Age)			0.016 (0.020)	-0.019 (0.024)	-0.060 (0.037)	-0.032 (0.030)	0.004 (0.073)
Listed firm			-0.044 (0.034)	-0.078* (0.043)	-0.077 (0.090)	-0.059 (0.054)	-0.096 (0.160)
State-own			-0.033 (0.027)	-0.046 (0.033)	-0.028 (0.050)	-0.061 (0.046)	-0.000 (0.091)
MNC-own			0.033 (0.028)	0.008 (0.035)	-0.015 (0.061)	0.012 (0.044)	0.060 (0.154)
Domestic-own			-0.076*** (0.022)	-0.071** (0.028)	-0.070 (0.053)	-0.063** (0.032)	-0.090 (0.142)
Industry Control	No	No	No	Yes	Yes	Yes	Yes
No. of Firms	708	708	708	708	422	486	222
R-squared	0.056	0.426	0.206	0.452	0.510	0.469	0.640

*Notes.* The dependent variable is the management index which is the unweighted average score for each of the 18 management questions. The sample is a cross-section. All the regressions also include a constant. The coefficient estimates are from OLS regressions with standard errors in parentheses (robust to arbitrary heteroskedasticity). \*\*\*, \*\*, and \* denote estimates significant at 1%, 5%, and 10%, respectively

percent remains unexplained. The log of the management score gap is further divided into three portions. The first portion – the endowments - reflects the mean increase in northern firms' management score if they have the same characteristics as the southern firms. The increase in 0.036 indicates that the differences in the firms' resources (capital, labor, etc.), firm age, competitive environment, export status, whether a firm is listed, firm ownership, and also the industry fixed effect (three-digit SIC) account for slightly less than half the management quality gap ( $0.036/0.078$ ) 0.0460, albeit this is statistically insignificant.

The coefficient term measures the change in the northern firms' management competency when applying the southern firms' coefficients to the northern firms' characteristics. The change in management quality is estimated at 8 percent. Lastly, the interaction term (-0.039) quantifies the overall effect of differences in endowments and coefficients. While this is also insignificant due to the large standard error, it is interesting to note the negative sign, indicating the possibility that the mean of the management score (the management quality) for the northern firms could be higher than the southern firms if these unobserved firm characteristics are equalized.

This unexplained gap could be attributed to unobservable factors that are related to a complex combination of institutional factors and cultural norms. The dramatic growth of China in the past 40 decades started with the reform and opening up policies in 1978 that begins in the Southern coastal regions such as Fujian and Guangdong provinces.<sup>18</sup> Most of the foreign direct investments were attracted to the South because of the preferential policy implemented by the central government and the geographical proximity to Hong Kong, which was the key economic gateway to foreign capital (Cheng and Kwan, 2000). These FDIs have also created three notable metropolitan regions that consist of the Pearl River Delta region, the Yangtze River Delta region, and the Bohai Rim region, with two of the former located in the South (Zhao and Zhang, 2006). Due to historical development

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<sup>18</sup>In August 1980 during the 15th meeting of the Standing Committee of the Fifth National People's Congress, the national legislature officially approved the establishment of the special economic zones in the Southern region of China that includes Shenzhen, Zhuhai, and Shantou in Guangdong Province and Xiamen in Fujian Province (Source: [http://www.xinhuanet.com/english/2020-08/26/c\\_139320084.htm](http://www.xinhuanet.com/english/2020-08/26/c_139320084.htm) - accessed on 15 June 2023).

Table 7: Decomposition of North-South Management Practices

	<b>Southern Firms</b>	<b>Northern Firms</b>	<b>Difference</b>			
Log(Management)	0.972*** (0.012)	0.895*** (0.020)	0.078*** (0.023)			
Management Raw Score	2.644 (0.030)	2.447 (0.048)	1.081 (0.025)			
No. of Firms	486	222				

<b>Log(Management)</b>	<b>explained</b>	<b>unexplained</b>	<b>endowments</b>	<b>coefficients</b>	<b>interaction</b>	<b>Firms</b>
Specification (1)	0.006 (0.005)	0.072*** (0.023)	0.004 (0.006)	0.071*** (0.023)	0.003 (0.007)	708
Specification (2)	-0.006 (0.018)	0.084*** (0.020)	-0.046 (0.044)	0.101*** (0.027)	0.023 (0.045)	708
Specification (3)	0.021** (0.010)	0.057*** (0.021)	0.021 (0.014)	0.056** (0.022)	0.001 (0.012)	708
Specification (4)	0.012 (0.018)	0.066*** (0.021)	0.036 (0.045)	0.080*** (0.028)	-0.039 (0.047)	708
Specification (4) with Matched Firms	0.024 (0.024)	0.060** (0.026)	0.064 (0.043)	0.070 (0.084)	-0.049 (0.091)	422

*Note.* Robust standard errors in parentheses. \*\*\*, \*\*, and \* denote estimates significant at 1%, 5%, and 10%, respectively

over the last 200 years, the Southern Chinese are more exposed and connected to the world outside China, which likely accorded them the absorptive capacity in culture to learn and adopt the best practices in firm management. The general behavioral differences in people due to culture and social norms in the two regions may also contribute to the management gap. Talhelm *et al.*, (2014) found that people from rice-growing Southern China are more interdependent, loyal/nepotistic, and holistic-thinking than the wheat-growing northerners. The interaction of these behavioral attributes and the unique institution in China may have created the latent management gap in firms located in the two different regions.



## 5 Conclusions and Limitations

As a large nation with an estimated population of 1.4 billion, there is a wide disparity in terms of culture, ethnicity, and behavioral characteristics among people in China. This is broadly demarcated by the Huai River and the Qin Mountains that define the North-South region. Moreover, since the reform and opening up of the Chinese economy, various government policies that favor the Southern development have led to a further dichotomy, with the South overtaking the North in various aspects of economic performance. In this paper, we show that there is a significant difference in firm-level management practices correlated with this geographical demarcation.

Using the large-sample Chinese data collected by the World Management Survey that allow for multiyear and cross-sectional comparisons, our study reveals several empirical regularities. Based on various earnings-based measures, we found that the quality of management practices matters for firms located in the southern region of China, but not for those located in the North. To address possible sources of selection, we use coarsen exact matching to match firm-level key covariates and the entropy balance method to preprocess the data to reduce the imbalance in the mean of these covariates. The results from quantitative analysis using these processed data are consistent with the findings from the full sample. We also provide evidence showing that these management practices, despite being non-energy and environmental-centric, are associated with negative production externalities. On this aspect, the northern firms appear to perform better than the southern firms with higher management scores associated with less GHG emissions and industrial wastewater discharge.

In general, firm management in the South is more competent than firms in the North by 8.1 percent. By ranking the 18 practice scores according to their scores separated by the North-South region, firms in both regions perform equally well in performance review and making room for talent, and equally poorly in setting the type of targets, instilling a talent mindset, retaining talent, and introducing modern lean methods of manufacturing. However, firms in the South consistently score better than those in the North on these specific practices. Overall, we find that the southern firms strictly dominate

the northern firms in all aspects of management practices. This management gap cannot be fully explained by differences in the firms' observable characteristics such as firm resources, ownership, export status, and other fixed effects. On average, there is a significant unexplained gap of 6.6 percent in the quality of management practices between the North-South region.

Our findings contribute to the existing literature on empirical management by highlighting the differences in managerial performances for firms located in the North-South regions of China. This empirical dichotomy that cannot be fully explained by firm characteristics has critical implications for corporate firms. Based on the differences in management scores, the northern firms may look for specific areas to improve their management practices. For instance, the largest gap occurs in the "incentive" sub-practices.<sup>19</sup> This implies that there is potential for northern firms to improve human resource management. Specific areas include how to design a system to develop internal staff talent, and also ways to reward and retain the top performers. For some firms, it may require a fundamental change in organizational structure in order to cultivate a high-performance culture that induces productive and creative effort. To capitalize on the current differences in management quality, firms in the Northern region may also invest in designing new executive compensation to attract managerial talent from the South.

There are also important policy implications. As a large nation, there is scope for the Chinese government intervention to elevate the quality of management practices in the northern region. One possibility is to modify the current household registration (known as "hukou" in Chinese) to encourage the migration of managerial talent from the South to the Northern region. Since the system restricts residents' civil rights to their place of birth, there are frictions to labor mobility.<sup>20</sup> While the current policy does allow for skill-based

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<sup>19</sup>From Table 1, the difference in incentive practice score for between southern firms and northern firms is  $2.73 - 2.53 = 0.2$  at one-percent significance level.

<sup>20</sup>The Chinese hukou system was introduced in 1958 for the purpose of population registration. In 1985, the hukou system undergo a major reform through the provision of personal identity cards that classified residents according to rural or urban identity. Currently, its main function includes the control of internal migration, administration of social protection, and maintaining social stability. (Source: <http://fdjpkc.fudan.edu.cn/zggk2015/07/0c/c1570a1804/page.psp>. (in Chinese) Accessed on 18 June 2023) According to Song (2014), while the hukou system did not prohibit the free movement of residents, it excludes migrants without local household registration from the welfare system in the destination regions, which includes limited access to compulsory education, medical resources, and social insurance.

migration, Zhou and Hui (2021) found that this mainly benefits rural-urban migration, but the restrictions remain high for inter-regional migration. Our results suggest there is potential scope to fine-tune the current system facilitating scale migration of managerial talent northwards.

It is well-known that international joint ventures are useful in allowing local firms to gain access to foreign capital, technologies, and managerial skills (Aitken and Harrison, 1999; Beamish, 2008; Beamish and Lupton, 2009).<sup>21</sup> Besides encouraging foreign joint ventures, the authorities may consider preferential policies for cross-regional joint ventures to facilitate bridging the managerial knowledge gap between the two regions. Moreover, educational policies that encourage and facilitate the location of high-quality business schools may also help in building the managerial capital in the Northern cities. Regulatory reform to discourage and remove regional government protection would help to exert competitive pressure on local firms to improve managerial practices.

We recognize some limitations in our study. Our results rely on observational data and are not necessarily causal. While we sought to control for selection using matching techniques, the smaller sample size for the northern firms might underrepresent the region and challenges the estimation results. In addition, our results are mainly restricted to medium-sized firms in China and did not capture the differences in the managerial capacity of larger firms. They are also restricted to the conditions of manufacturing firms but not firms in other sectors. The management associations are also relevant for firms' contemporaneous performance but not for the long-term trajectories such as strategic issues related to innovations and firm survival. Due to the data limitation, our setup of a conceptual model is rather primitive and fails to capture many empirical regularities that affect firm management and performance. These issues could be addressed by future research. For instance, conducting field experiments within firms that set up conditions that vary managerial decision allow for stronger causal identification. Another potential avenue is to conduct lab experiments that use corporate managers as subjects to participate in

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<sup>21</sup>Since embarking on its reform and open-door policy in 1978, the Chinese government has been particularly active in promoting Sino-foreign joint ventures. Some studies on these Sino-foreign joint ventures include Pearson (1991), Yan and Gray (1994), Luo (1997), and Xia *et al.*, (2008).

decision-making games. Such an approach allows to filter out potential confounders such as individual beliefs and values not associated with broader social norms due to regional differences.

## Appendix A: The World Management Survey Questionnaire

<b>OPERATIONS</b>		
<b>Practice Type: Modern manufacturing, introduction</b>		
a) Can you describe the production process for me? b) What kinds of lean (modern) manufacturing processes have you introduced? How long has this practice been in place? Can you give me specific examples? c) How do you manage inventory levels? What is done to balance the line? What is the take time of your manufacturing processes?		
<b>Scoring Grid</b>		
1	3	5
Other than JIT delivery from suppliers few modern manufacturing techniques have been introduced (or have been introduced in an ad-hoc manner).	Some aspects of modern (lean) manufacturing techniques have been introduced, through informal/isolated change programs.	All major aspects of modern/lean manufacturing have been introduced (Just-in-time, automation, flexible manpower, support systems, attitudes and behavior) in a formal way.
<b>OPERATIONS</b>		
<b>Practice Type: Modern manufacturing, rationale</b>		
a) Can you take me through the rationale to introduce these processes? b) What factors led to the adoption of these lean (modern) management practices?		
<b>Scoring Grid</b>		
1	3	5
Modern (lean) manufacturing techniques were introduced because others were using them.	Modern (lean) manufacturing techniques were introduced to reduce costs.	Modern (lean) manufacturing techniques were introduced to enable us to meet our business objectives (including costs).
<b>OPERATIONS</b>		
<b>Practice Type: Process documentation</b>		
a) How do problems typically get exposed and fixed? b) Talk to me through the process for a recent problem. c) How can staff suggest process improvements?		
<b>Scoring Grid</b>		
1	3	5
1) No process improvements are made when problems occur.	Improvements are made in 1 week workshops involving all staff (to improve performance in their area of the plant).	Exposing problems in a structured way is integral to individuals' responsibilities and resolution occurs as a part of normal business processes rather than by extraordinary effort/teams.
<b>MONITORING</b>		
<b>Practice Type: Performance tracking</b>		
a) What kind of KPIs would you use for performance tracking? b) How frequently are these measured? Who gets to see this KPI data? c) If I were to walk through your factory could I tell how you were doing against your KPIs?		
<b>Scoring Grid</b>		
1	3	5
Measures tracked do not indicate directly if overall business objectives are being met. Tracking is an ad-hoc process (certain processes aren't tracked at all).	Most key performance indicators are tracked formally; tracking is overseen by senior management.	Performance is continuously tracked and communicated, both formally and informally, to all staff using a range of visual management tools.
<b>MONITORING</b>		
<b>Practice Type: Performance review</b>		
a) How do you review your KPIs? b) Tell me about a recent meeting. c) Who is involved in these meetings? Who gets to see the results of this review? d) What is the follow-up plan?		
<b>Scoring Grid</b>		
1	3	5
Performance is reviewed infrequently or in an un-meaningful way (e.g. only success or failure is noted).	Performance is reviewed periodically with both successes and failures identified; Results are communicated to senior management; No clear follow-up plan is adopted.	Performance is continually reviewed, based on indicators tracked; All aspects are followed up to ensure continuous improvement.
<b>MONITORING</b>		
<b>Practice Type: Performance dialogue</b>		
a) How are these meetings structured? Tell me about your most recent meeting. b) How would the agenda for the meeting be determined? c) What type of feedback occurs in these meetings? d) For a given problem, how would you identify the root cause?		
<b>Scoring Grid</b>		
1	3	5
The right data or information for a constructive discussion is often not present or conversations overly focus on data that is not meaningful; Clear agenda is not known and purpose is not stated explicitly.	Review conversations are held with the appropriate data and information present; Objectives of meetings are clear to all participating and a clear agenda is present. Conversations do not, as a matter of course, drive to the root causes of the problems.	Regular review/performance conversations focus on problem-solving and addressing root causes; Purpose, agenda and follow-up steps are clear to all. Meetings are an opportunity for constructive feedback and coaching.

<b>MONITORING</b>		
<b>Practice Type: Consequence management</b>		
a) Let's say you've agreed to a follow-up plan at one of your meetings, what would happen if the plan weren't enacted? b) How long is it between when a problem is identified to when it is solved? Can you give me a recent example? c) How do you deal with repeated failures in a specific business segment?		
<b>Scoring Grid</b>		
<b>1</b>	<b>3</b>	<b>5</b>
Failure to achieve agreed objectives does not carry any consequences.	Failure to achieve agreed results is tolerated for a period before action is taken.	A failure to achieve agreed targets drives retraining in identified areas of weakness or moving individuals to where their skills are appropriate.
<b>MONITORING</b>		
<b>Practice Type: Performance clarity and comparability</b>		
a) If I asked your staff directly about individual targets what would they tell me? b) Does anyone complain that the targets are too complex? c) How do people know about their own performance compared to other people's performance?		
<b>Scoring Grid</b>		
<b>1</b>	<b>3</b>	<b>5</b>
1) Performance measures are complex and not clearly understood. Individual performance is not made public.	Performance measures are well-defined communicated; performance is public in all levels but comparisons are discouraged.	Performance measures are well defined, strongly communicated, and reinforced at all reviews; performance and rankings are made public to induce competition.
<b>TARGET</b>		
<b>Practice Type: Type of target</b>		
a) What types of targets are set for the company? What are the goals for your plant? b) Tell me about the non-financial goals?		
<b>Scoring Grid</b>		
<b>1</b>	<b>3</b>	<b>5</b>
Goals are exclusively financial or operational.	Goals include non-financial targets, which form part of the performance appraisal of top management only (they are not reinforced throughout the rest of organization).	Goals are a balance of financial and non-financial targets; Senior managers believe the nonfinancial targets are often more inspiring and challenging than financials alone (e.g. 60% market share by 2003).

## Appendix B: Details of the Conceptual Model

We model the two regions in the economy as being populated by monopolistically competitive firms. This allows the firms to decide on the production plans to maximize profits, recognizing that a higher profitability will allow its size to become larger with higher profits. It will be seen below that a larger market that the international trading set up is associated with, supports a higher managerial input. In a sheltered sector, a firm has less incentives to innovate, even if they start from the same initial size. Our modelling strategy appeals to two major strands of the literature. The first, from the vast literature that efficient firms produce for the external market; and possibly gain from learning by doing. In the earlier literature (based on the Krugman model) all firms are symmetric and hence all of them either export, or do not. This literature emphasizes pricing above marginal cost, and the economy of scale is internal to each firm. The second is the economic geography literature. Since we want to focus on trading firms versus supplying a (smaller) internal market. The dynamic region attracts other firms, capital and labor. And this reduces costs to the industry. There are technological and pecuniary externalities (that are external to each firm). A technological improvement in an intermediate product, for instance, increases the profitability of that sector and the sectors using this as input. This can set in motion a chain of cumulative causation. Moreover, the Government can step in with infrastructure (physical and financial) to help the dynamic sector, further adding to the agglomeration process.<sup>22</sup>

Imagine a region with a representative consumer who consumes many brands of a differentiated good. The brands of the differentiated good are produced in a monopolistically competitive framework. The utility function for the differentiated brands has an elasticity of substitution between brands of  $\sigma > 1$ . Our modelling strategy for empirical implementation, comes from the monopolistic competition literature, although we do not necessarily postulate that these goods are brands of a differentiated good (as in Dixit-Stiglitz). Rather, we use this strategy because our firms in the differentiated goods sector are not monopolies, nor perfect competitors.

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<sup>22</sup>Indeed, such infrastructural support may have motivated firms to set up shop, initially.

Let us first start off with a closed economy.<sup>23</sup> In a partial equilibrium framework (as in Bloom *et al.*, 2021), the economy produces varieties of differentiated goods. Initially think of a static set-up. Each brand has a variable cost component and overhead management requirement—the latter is chosen by the firm. Different firms have different cost structures. The cost structures emanate from differences in the variable cost of production. To save on notation, but without loss of generality, suppose among the firms, there are two types of producers - a high cost producer group (with subscript “H”) and a low cost producer group with a subscript “L”). The number of firms is fixed—although free entry can be incorporated by driving (excess) profits down to zero. The total revenue is lower in “H” (because  $p_H > p_L$ , and the elasticity of demand  $\sigma > 1$ ).

$PX$  is the total expenditure on the differentiated good aggregate, where  $P$  is the price index and  $X$  the “real” consumption (in terms of a numeraire). Within this aggregate  $X$ ,  $x_{Hi}$  and  $x_{Lj}$  are respectively the consumption of the high cost and low-cost brands, with  $n_H$  and  $n_L$  being the number of H and L brands.

$$X \equiv \left( \sum_{i=1}^{n_H} x_{Hi}^{\left(\frac{\sigma}{\sigma-1}\right)} + \sum_{j=1}^{n_L} x_{Lj}^{\left(\frac{\sigma}{\sigma-1}\right)} \right)^{\frac{\sigma-1}{\sigma}}$$

The total expenditure on all brands must add up to the expenditure allocated to X (with price index defined)

$$\sum_{i=1}^{n_H} p_{Hi} x_{Hi} + \sum_{j=1}^{n_L} p_{Lj} x_{Lj} = PX$$

$$P \equiv \left( \sum_{i=1}^{n_H} p_{Hi}^{(1-\sigma)} + \sum_{j=1}^{n_L} p_{Lj}^{(1-\sigma)} \right)^{\frac{1}{\sigma-1}}$$

Maximization gives the demand for  $H$  and  $L$  brands as:

$$x_{Hi} = PX \left( \frac{p_{Hi}^{-\sigma}}{P^{1-\sigma}} \right) \Leftrightarrow p_{Hi} x_{Hi} = PX \left( \frac{p_{Hi}}{P} \right)^{1-\sigma}$$

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<sup>23</sup>The notation is more cumbersome with free trade. This is done in the Online Appendix.



$$x_{Lj} = PX \left( \frac{p_{Lj} p_{Lj}^{-\sigma-\sigma}}{P^{1-\sigma}} \right) \Leftrightarrow p_{Lj} x_{Lj} = PX \left( \frac{p_{Lj}}{P} \right)^{1-\sigma}$$

Note that  $\sigma$  was the elasticity of substitution between brands but now appears as the elasticity of demand (given the aggregates  $X$  and  $P$ ).

**Proposition 1.** A low cost firm will charge a lower price of and will have a higher surplus (i.e. its ability to support a higher managerial input and profits).

**Proof:** A low productivity firm (i.e. one that has a higher marginal cost of producing the good) has a lower total revenue (because the elasticity of demand  $\sigma$  is greater than unity). And since the surplus is  $(1/\sigma)$  of total revenue (since  $(\sigma-1)/\sigma$  covers variable cost), it follows that a lower productivity firm has a lower surplus i.e. the sum of managerial input and profits.

**Proposition 2.** Given a level of profits, if a firm commits to a higher managerial input, it must be of a low cost type producer.

**Proof:** The high cost producer has a mark-up pricing rule:

$$p_H = \left( \frac{\sigma}{\sigma - 1} \right) w$$

Here  $w$  is the wage and labour per unit of output is one. The low cost producer uses less labour per unit of output, with  $\theta > 1$  being the efficiency parameter. Its pricing rule is given by:

$$p_L = \left( \frac{\sigma}{\sigma - 1} \right) \frac{w}{\theta}, \theta > 1$$

(implicitly, for H firms  $\theta=1$ )

Of the total cost a proportion  $\frac{\sigma-1}{\sigma}$  represents variable cost. Of the total revenue (for firm  $i$ ),  $\frac{1}{\sigma} p_i x_i$  covers managerial cost plus profits ( $i = L, H$ ).

$$\text{i.e. } \frac{1}{\sigma} p_i x_i = M_i + \pi_i, i = L, H$$

$$\text{Hence, } \frac{1}{\sigma} p_L x_L > \frac{1}{\sigma} p_H x_H M_H + \pi_H < M_L + \pi_L$$

We can generalize this into a two period set-up, where the managerial cost has to be committed before production i.e.  $M_i = \bar{M}_i$ , it is like a sunk cost. Higher management input raises productivity in the subsequent period(s) and thus lowers the price charged

(with a constant  $\sigma$  and the mark-up  $\frac{\sigma}{\sigma-1}$ ). Of course, in general, given  $\vartheta$ , a higher  $M$  raises the productivity of variable inputs contemporaneously—(inputs are Edgeworth-complementary). Here the labour input is constant in any period but higher  $M$  raises the productivity of labour in the subsequent period(s). In our set-up then,  $\theta = \theta(M)$ , and  $\theta' < 0$ .

If we now allow for many different levels of productivity (with different  $\vartheta$ 's). As the literature on exporting firms has postulated, the more efficient firms are located in the export sector—the less efficient firms produce for the home market, with less onerous price discipline. So for a certain  $\widetilde{M}$ ,  $\bar{M} > \widetilde{M}$ , then the firm locates in the exporting sector. If, per contra,  $M < \widetilde{M}$ , then it serves the domestic market.

In the data, we can think of a steady state where both  $M$  and  $\vartheta$  are constants. The steady state may be with a fixed number of firms, with each firm possessing some monopoly power; or the Chamberlinian “large group case” with free entry. In the latter case  $M = \frac{1}{\vartheta} p_i x_i$ , (with  $\pi_i = 0$ ). A higher  $M$  leads to a lower  $\theta$  in the next period and raises  $\pi$ .

International trade would change both the demand conditions (in a more general set-up change the elasticity of demand), and also give rise to agglomeration (possibly lowering  $\vartheta$  via a sum over individual  $M_i$ 's). We do not pursue these interesting possibilities here (mainly due to data limitations). What we see in the data is that the exporting firms have consistently high management scores.

## Appendix C: Emissions Control and Management Quality

In this section, we explore whether management practices have any relation to reduce firm-level environmental emissions. On one hand, well-managed firms tend to be more productive but generate more greenhouse gas (GHG) emissions as a by-product. On the other hand, well-managed firms may emit less GHG due to being more energy efficient, adopting best practices, and technologies that reduce environmental pollution, which are possible unintended consequences of the spillover effect from good management practices. This relation is particularly important in the context of China, where the nation experienced substantial environmental degradation that are caused by various GHG emissions due to the rapid industrialization process that accompanied its economic development. While the government has been increasing its environmental oversight and implementing various forms of regulations since the 1990s, the effect has been limited due to weak enforcement given the officials' priority of economic development over environmental protection. However, since 2006 when nationalized climate policies have been formally introduced into the macroeconomic system in its 10th Five-Year Plan (2001 - 2005), various environmental policies have been implemented with increasing stringency and enforcement (Zhu, 2021 EAERE Magazine).<sup>24</sup> The government further tightened environmental regulations by aligning the performance of government officers to their duties in fulfilling their mandated emissions targets in the 11th Five-Year Plan period from 2006 - 2010. Hence, with increasing public and regulatory pressure, it is imperative to understand how firms' internal management is responding to these challenges that have serious implications for climate change.

We are able to merge our sample to some firm-level emissions from the China Ministry of Environmental Protection (MEP): chemical oxygen demand (COD), Sulfur dioxide (SO<sub>2</sub>), and industrial wastewater discharge.<sup>25</sup> These chemical emissions and discharge

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<sup>24</sup>For example, the government implemented the "Air Pollution Prevention and Control Action Plan" (2013-2017) and "Blue Sky Defense Battle" (2018-2020) to reduce the concentration of fine particles (PM<sub>2.5</sub>) nationwide. Some of the major efforts are reducing the consumption of coal in end-use sectors, curbing pollutant emissions from vehicles, and optimization of industrial structures (Zhang et al, 2019).

<sup>25</sup>COD is the amount of oxygen required to oxidize the organic matter present in water. It is used as a measure of water and wastewater quality. SO<sub>2</sub> is emitted due to the burning of fossil fuels by power plants and other industrial facilities, and it can directly affect human health and damage the environment by contributing to acid rain. Industrial wastewater discharge may contain pollutants that could negatively

Table A2: Emissions in North-South Region

	Southern Firms	No. of Firms	Northern Firms	No. of Firms	p-value
Coal usage in tons	16435.497	226	1532084.8	133	0.244
COD emissions in kg	47881.405	166	63237.722	90	0.402
SO2 emissions in kg	106951.95	138	483764.86	69	0.346
Ind. waste-water discharge in tons	333736.2	166	343159.12	91	0.986
Coal intensity	1.3500001	192	1.3496112	121	0.383
COD intensity	10.324737	156	10.472572	86	0.094
SO2 intensity	11.057697	117	11.4245	65	0.603
Ind. waste-water intensity	12.899269	159	12.752367	87	0.406

*Notes.* The  $p$ -value refers to the test of equality of means, controlling for industry fixed effects and clustering standard errors.

contribute to environmental degradation as a result of the heightened speed of industrialization in China. These emissions and pollutants are sufficiently important in China that warrants the government response (see for examples, Fan *et al.* (2019) on COD emissions, Chen *et al.* (2018) and Karplus and Wu (2023) on SO2 emissions, and Xing *et al.* (2020) on industrial wastewater discharge). Another main GHG emissions in modern China is carbon dioxide emissions due to its heavy reliance on fossil fuels especially on coal. In fact, China is the world's largest emitter of carbon dioxide, according to data from the Global Carbon Project (2021). But due to a lack of firm-level data access, we use coal usage as a proxy for carbon emissions. To measure efficiency, we focus on the common intensity measurement, which is the ratio of the emissions quantity over the gross output value. We take the natural logarithm of the ratio so that it is unit-free for analysis. Table A2 depicts the various emissions segregated by the firm location between the North-South region.

While the sample of firms in the northern region is higher, both the absolute emissions and their emissions or discharge intensity are higher than the firms operating in the South. This is not surprising because firms in the North tend to be less well-managed compared to the South, based on the management scores shown in Table 1. However, there are no significant differences in the emissions between the two locations, except for affect the quality of receiving waters or interfere with publicly owned treatment works that receive those discharges, causing water pollution.

coal usage intensity. This begs the question whether to what extent management practices, despite non-energy or pollution centric, plays a role in addressing problems related to environmental and climate mitigation. To investigate into this different aspect of firm performance, we run similar regression specification as in equation (1) but now uses the emissions intensity as the dependent variables. Given that we are using a smaller subset of the data that are matched to the emissions data, this may affect the degree of comparability between the North-South location. In particular, the regression estimates can be biased if the firms located in different regions differ significantly in their characteristics due to the merging of data from different sources. Moreover, there are considerable differences in the sample size between the two regions after merging the data with the MEP data. To address these concerns, we resort to employing coarsened exact matching (CEM) on the firm-level covariates with adjustment for sample imbalance.

The results are reported in Table A3. Interestingly, the management associations with GHG emissions and wastewater discharge intensity are uniformly negative and significant among firms located in the North. In contrast, these associations are positive for the firms operating in the south, except for the SO<sub>2</sub> emissions intensity. Clearly, there is a salient difference in managerial efforts in emissions mitigation for firms operating in different parts of China. While we do not have direct micro-evidence to explain this, the difference in emissions mitigation policy and its degree of enforcement between the two regions are possible reasons to explain the difference in managerial efforts to reduce firm-level emissions. This could be attributed to the stricter environmental regulations in the North because of the relative severity of environmental problems in the region. For instance, due to the differences in the heating system between the North and the South - China's Huai River policy - free winter heating was provided to cities north of the Huai River but not to cities in the South. Since heating is provided by boilers using coal, the air quality is particularly poor in Northern China. According to the estimates by Chen *et al.* (2013), air pollution causes the 500 million residents in the North to lose more than 2.5 billion life years of life expectancy.

Moreover, the northern economy is also populated with heavy industries such as steel-

makers, chemicals, shipbuilding, and coal mining that are more polluting than other industries (e.g., Hebei and Liaoning provinces). Hence, the cost-saving from official scrutiny and penalty is likely to be larger compared to the light and service-oriented industries in the South. Probably, this explains why better management in the northern firms is correlated with lower emissions and effluent discharge. In the South, management competency is positively correlated with higher coal, COD, and industrial wastewater intensity, which is directly related to more production. Higher management competency is only negatively associated with SO<sub>2</sub> emissions intensity. This is likely related to the type of enforcement policy initiated by the Chinese government due to the severity of China's ambient air pollution from SO<sub>2</sub> (World Bank, 1997). Hence, in 2005, the Chinese central government impose reductions in SO<sub>2</sub> emissions as the key performance evaluation criterion for prefectural city mayors and Party secretaries. Evidence shows that this policy initiative causes a significant reduction in SO<sub>2</sub> after 2005, but no spillover effects to other pollutants such as carbon dioxide or wastewater (Chen *et al.*, 2018).<sup>26</sup> As a consequence, rational managers may find it in their strategic interest to reduce SO<sub>2</sub> in order to avoid regulatory scrutiny and penalty rather than other pollutants.

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<sup>26</sup>The period of analysis also coincide with our data used in this paper.

Table A3: Management and Emissions in North-South Region (Matched Samples)

	Southern Firms				Northern Firms			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Coal Intensity	COD Intensity	SO2 Intensity	Ind.Wastewater Intensity	Coal Intensity	COD Intensity	SO2 Intensity	Ind.Wastewater Intensity
z-Management	0.087 (0.585)	0.796*** (0.279)	-5.337*** (0.589)	1.960*** (0.183)	-3.653** (1.467)	-5.100** (2.434)	-1.809** (0.902)	-4.841*** (1.414)
Log(Capital)	-0.425 (0.653)	0.175 (0.225)	0.150 (0.332)	-0.007 (0.244)	-0.034 (0.175)	-0.119 (0.256)	-0.148 (0.205)	0.048 (0.211)
Log(Employment)	0.073 (0.336)	0.203 (0.137)	0.002 (0.111)	0.002 (0.057)	-0.156 (0.130)	-0.160 (0.121)	0.042 (0.143)	-0.048 (0.083)
Log(COGS)	0.278 (0.490)	0.175 (0.205)	0.085 (0.213)	0.369** (0.168)	-0.142 (0.165)	0.041 (0.282)	0.091 (0.223)	-0.105 (0.233)
Observations	175	248	177	291	363	268	218	310
Firms	82	60	41	60	112	77	57	78
R-squared	0.691	0.769	0.902	0.822	0.683	0.812	0.882	0.809

Notes. Each of the emissions intensities is measured by the log of emissions in quantities over gross output. The z-management is the unweighted average score for each of the 18 management questions that are normalized to a zero and one scale. COGS refers to Cost of Goods Sold. The noise controls are a set of variables capturing interview characteristics: respondents' identity such as manager's background, tenure in the company, gender, age, and the interviewer fixed effects (interviewers' identity and interview duration) and also a reliability score by the interviewer on the managers' knowledge about the firm and the willingness to participate in the survey. Region controls refer to the location of the firms by province, province-level municipalities (e.g., Beijing, Shanghai), and ethnic autonomous regions (Inner Mongolia, Ningxia). All regressions include the firm age (in logs), the firms' listing status, ownership type, three-digit industry controls, and year dummies. All regressions also include a constant. Robust standard errors in parentheses are clustered on the firm level. \*\*\*, \*\*, and \* denote estimates significant at 1%, 5%, and 10%, respectively.

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