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Does Market Competition Dampen Environmental Performance?
Evidence from China

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Running title: **Does Market Competition Dampen Environmental Performance?**

Research summary: Departing from the extant literature which assumes that firms pursue strong environmental performance as a differentiation strategy, we analyse the general relationship between firms' competitive strategy and their response to heightened market competition. We find that, using a large sample of Chinese manufacturing firms between 2000 and 2005, intensified market competition has an overall negative impact on firms' environmental performance. The negative impact is exacerbated in firms adopting a cost-leadership strategy, but is attenuated in those adopting a differentiation strategy. The results emphasize the importance of including an examination of the particular competitive strategies chosen by firms in seeking to understand the impact of intensified market competition.

Managerial summary: Advocates of corporate social responsibility (CSR) have long argued for the differentiation role of CSR. However, managers may be misguided if the assumed benefits of differentiation critically depend on certain presumptions. In the Chinese context and focusing on the environmental dimension of CSR, our study finds a negative relationship between market competition and corporate environmental performance. It suggests that firms to a large extent can't escape competition via environmental differentiation. Managers should therefore be skeptical of the value of strategic investment in CSR as a viable competitive device.

Key words: Market competition, environmental performance, corporate social responsibility, cost leadership, differentiation.

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Does Market Competition Dampen Environmental Performance? Evidence from China

Introduction

Corporate environmental performance has been the focus of an increasing number of academic studies in recent decades. The literature has evolved through several distinct periods (Marcus and Fremeth, 2009), from creating awareness, exploring ethical mandates and moral responsibility (*e.g.,* Levitt, 1958; Donaldson and Davis, 1991), building a business case for sustainability (*e.g.,* Porter and van der Linde, 1995), to explicitly questioning the financial returns of environmentally responsible business practices (*e.g.,* Russo and Fouts, 1997; King and Lenox, 2002). In this study, we seek to contribute to the literature by probing the relationship between market competition and firms' environmental performance, a relationship that has received limited examination so far.

We are motivated by the current literature which predominantly views firm social or environmental performance as a type of product 'differentiation' device, because it gives the product an additional 'attribute' attractive to some segments of the market (e.g., Bagnoli and Watts, 2003; Conrad, 2005; Fisman, Heal, and Nair, 2006). Relatedly, there is growing interest in 'strategic CSR', which examines corporate actions that appear to advance some social good while allowing a firm to enhance organizational performance, regardless of motives (McWilliams and Siegel, 2001). According to McWilliams, Siegel, and Wright (2006), CSR can be an integral element of a firm's business and corporate-level differentiation strategy. Therefore, it should be considered as a form of strategic investment. Firms can be motivated to adopt proactive strategies, differentiating themselves from competition through CSR. Despite scholars' strong interest in 'strategic CSR',[1] relatively

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[1] From the perspective of the broader literature, strategic CSR is one strand of the 'non-market strategy' research field (Mellahi, Frynas, Sun, and Siegel, 2016; Dorobantu, Kaul, and Zelner, 2017), as well as that of 'corporate political activity'. Both emphasize the importance of augmenting the institutional environment to achieve a better position for future competition as a form of proactive strategy.

little attention has been paid to the role of competition on firms' social and environmental performance.

Among the extant literature, the study closest to ours is Flammer (2015), which finds that responding to competition from foreign rivals, U.S. listed firms increase their engagement in CSR to differentiate themselves from competitors. Similarly, Fernández-Kranz and Santaló (2010) and Hawn and Kang (2015) also find support for the hypothesis that firms use CSR as a differentiation device to escape from competition. However, two other studies fail to find a positive relationship between competition and CSR, using the same dataset (Fisman, Heal and Nair, 2006; Declerck and M'Zali, 2012). In contrast to CSR as a differentiation device, an alternative common view is that heightened competition may compel firms to cut corners in their social or environmental performance (Campbell, 2007; Ioannou and Serafeim, 2012). McWilliams and Siegel (2001) note the possibility that different firms in the same industry may choose different strategies, with the result that it may be difficult to detect consistent responses across even firms that are close competitors.

This in turn leads to a more fundamental point: it has long been recognized that differentiation is not the only strategy that firms deploy to establish a competitive advantage in the marketplace; cost leadership is one well studied and documented alternative (*e.g.,* Porter, 1980). The reaction of a firm that has chosen a cost-leadership strategy to an increase in industry competition may be very different from that of a firm that has chosen a differentiation strategy. This is the key argument that distinguishes our study from the extant literature.

Empirically, we test our hypotheses using longitudinal Chinese firm level data from 2000 to 2005 and exploit the exogenous variations in industry competition stemming from a quasi-natural experiment: China's WTO accession in 2001. The event coupled with the firm-level longitudinal data enable us to apply a difference-in-difference approach to infer the

relationship between market competition and environmental performance. Our indicator of environmental performance also improves upon previous studies: we utilize the World Bank 'Green Watch' data, a comprehensive rating system that includes multiple performance indicators, such as hazardous waste disposal, solid waste recycling, pollution accidents, and public complaints, to yield an unambiguous measure of firms' environmental ratings (see Appendix 1). It enables us not only to understand how the multiple indicators collectively contribute to the rating of the firm but also to differentiate between basic regulatory compliance and voluntary over-compliance.

We find that the exogenous competitive shock stemming from China's accession to the WTO dampens firms' environmental performance in our sample. The negative effect is exacerbated in firms adopting a cost-leadership strategy, but is attenuated in those adopting a differentiation strategy. Our empirical evidence thus suggests the importance of relaxing the assumption prevailing in the current literature that all firms adopt social-performance-based 'differentiation'. Instead, it is important to consider firm heterogeneities, such as firms' strategic position and the overall industrial and institutional context in which they compete with each other. This then allows us to have a more generalized discussion of the relationship between firms' competitive strategy and their social performance, and to explain why in some industrial contexts intensified competition may not foster but can rather dampen firms' social performance. Although our findings are drawn from Chinese data for the early 2000s, where the specific institutional and historical context certainly shapes the results, it is the differences of our findings from others in the literature that provide us with an avenue to seek deeper understanding on the complex relationship between market competition, the social and institutional environment, and corporate social strategies.

We organize the remainder of the paper as follows. In the next section, we review the CSR literature, proceeding from studies that view CSR as a differentiation device to a broader

discussion of how the institutional environment may shape CSR strategies. Hypothesis development is presented based on our critiques of the extant literature. We then explain our research setting, describe our data, and outline our identification strategy before presenting the empirical evidence. Finally, we reflect on the limitations of our research and discuss future research directions.

Literature Review

CSR as a differentiation device

CSR not only represents a way to ''do good'' (while possibly doing well), but also is mainly a strategy through which firms realize their value. By providing an integrative framework of non-market strategy, Dorobantu, Kaul, and Zelner (2017) conceptualize CSR activities as ways in which firms augment the exiting institutional environment by establishing lower-level decentralized institutions either proactively or collectively. Such CSR activities are expected to reward firms for the pursuit of competitive advantage. Relatedly, Kaul and Luo (2018) build an economic model of CSR. They suggest that firms with weak competitive advantages in their core business are more likely to pursue corporate philanthropy, outsourcing the provision of the social good to a non-profit and realizing both modest profits and limited social benefit. In contrast, firms with strong competitive advantages in their core business are more likely to undertake in-house CSR activities, and to realize substantial additional profit from doing so, though the social benefit of their CSR activities is more ambiguous. More recently, Zhang, Wang, and Zhou (2017) focus on the reaction to CSR by securities analysts, and argue that new firms may seek to behave in 'conformity' with the standard CSR practices of their industry, while firms later in their life cycles may seek to deviate to a degree from standard industry CSR practices in order to differentiate themselves for the same audience.

While the above studies inspire us to think deeply and compare the dimensions of CSR, they also remind us of a very relevant question from a 'strategy'' point of view (Chandler, 2014; Zhang, Wang, and Zhou, 2017). It is a fundamental question faced by all firms: which strategy should they select, differentiation or cost leadership? Recent studies have provided evidence supporting the view that CSR can be a differentiation device. For example, Flammer (2015) finds that responding to enhanced import competition, U.S. listed firms increase their engagement in CSR to differentiate themselves from their foreign rivals. In a similar vein, Flammer (2018) also finds that in the U.S. business-to-government context, companies with higher CSR win more government procurement contracts than their peers with lower CSR.

Will firms generally increase their CSR when facing tougher competition in order to 'escape'' from competition? Two more studies provide affirmative answers: Fernández-Kranz and Santaló (2010) and Hawn and Kang (2015). Both use the Herfindahl-Hirschman Index (HHI) as a proxy for market competition and CSR data from Kinder, Lydenberg, Domini Research & Analytics (KLD).[2] However, two other studies fail to find such a relationship using the same datasets. Declerck and M'Zali (2012) find that although competition has a positive relationship with shareholder and employee-related social actions, it has no such relationship with actions affecting other stakeholders. Fisman, Heal, and Nair (2006) focus only on one particular component of CSR, corporate philanthropy, because it is considered more aligned with the 'public' nature of social performance, and find that competition is not statistically associated with corporate philanthropy. Collectively, the

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[2] These studies share a common issue: they all use as their measure of competition the HHI based on Compustat data, which contains a sampling bias due to the listed status of these firms (Ali, *et al.*, 2008). Moreover, using the HHI as a proxy for market competition raises the question of its endogeneity to firm strategies. Flammer (2015) addresses this methodological issue by exploiting U.S. import tariff reductions between 1992 and 1998 as a source of exogenous shock in competitive pressure for U.S. firms, and finds support for a causal positive relationship between competition and firms' CSR.

mixed evidence of the relationship between competition and CSR is intriguing. It motivates a call for a deeper understanding of the institutional context and drivers of CSR.

Institutional context and drivers of CSR

According to Matten and Moon (2008), 'implicit CSR' consists of values, norms, and rules that result in mandatory and customary requirements for corporations to address stakeholder issues and that define proper obligations of corporate actors in collective rather than individual terms. Hence, such CSR activities appear as a social phenomenon and do not exist independent of the firms' institutional context (Wang, *et al.*, 2016). Similarly, Campbell (2007) argues that 'socially responsible corporate behaviour may mean different things in different places to different people and at different times'. In this regard, two strands of research seem particularly relevant.

The first strand of research pays increasing attention to the differences between developed countries and developing ones. For example, Lim and Tsutsui (2012) show that global institutional pressure through nongovernmental linkages encourages CSR adoption, but this pressure leads to ceremonial commitment in developed countries and to substantive commitment in developing countries. Focusing on developing country multinational enterprises (MNEs), Marano, Tashman and Kostova (2017) find that these firms use CSR reporting in response to institutional voids in their *home* country to overcome the liability of origin perceived in their overseas operation. Relatedly, Ghoul, Guedhami, and Kim (2017) find that the value of CSR is greater in *host* developing countries with weaker market institutions and suggest that foreign MNEs can compensate for institutional voids via CSR.

The second strand of research emphasizes that national level institutions matter for corporate social performance. Ioannou and Serafeim (2012) find that in countries where laws and regulations promote higher levels of competition, corporations will score lower on the corporate social performance index. They argue that given high levels of competition, firms

are faced with razor-thin profit margins, to the extent that their very survival may be put at risk. Therefore, they believe social performance will be lower for two reasons. First, firms with minimal or zero profits have fewer, if any, resources to invest in activities that would increase CSR. Second, firms in highly competitive environments would be more likely to cut corners and attempt to save money whenever and however possible. Ioannou and Serafeim's second reason is also noted by Campbell (2007), who asks why corporations behave in socially responsible ways from an institutional perspective. In situations where competition is so extremely intense that profit margins are narrow enough to put shareholder value and firm survival at risk, Campbell (2007) suggests that the incentive to cut corners and save money will cause corporations to act in socially irresponsible ways insofar as they believe that this will help them turn a profit and survive.

In sum, whether CSR can effectively *differentiate* depends on the institutional context and the extent to which resource providers such as consumers and employees appreciate CSR.[3] In developing countries, firms' environmental performance may not translate into higher willingness-to-pay by consumers (or higher willingness-to-supply by employees) as in developed economies. However, this important distinction has not yet received sufficient attention in previous studies.[4]

Hypothesis development

In this research, we define environmental performance as the firms' curtailment of public 'bads' in the form of environmental pollution beyond the level required by the law (Bagnoli and Watts, 2003; Besley and Ghatak, 2007). This definition impliess that to be environmentally responsible firms will incur *additional* costs in their provision of private goods (Jaffe, *et al.*, 1995). We start with a brief discussion of firms' competitive strategies,

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[3]We appreciate the comment from an anonymous reviewer.
[4] Two recent papers emphasize the importance of time in strategy (Crilly, 2017; Hawn, Chatterji and Mitchell, 2018). We would regard this dynamic focus as in line with our perspective here.

which leads to our core hypotheses, namely, how market competition may shape a firm's environmental performance in different ways depending on the strategic choice that the firm pursues.

According to Porter (1985), there are two basic types of competitive advantage: cost leadership and differentiation. While it is conceptually straightforward that a cost leadership strategy attracts consumers by low prices, such as Walmart's 'everyday low price' model, firms may 'differentiate' through various avenues. Two contingent factors are important for the scope of differentiation. One is product characteristics. Any product can be viewed as a bundle of different characters or attributes (Lancaster, 1966). These attributes can be varied in quantity and/or combined in different ways to differentiate a product. Thus, the number of attributes inherent in a product creates scope for differentiation. The other factor important for differentiation is consumer diversity (Hill, 1988; Sharp and Dawes, 2001). Consumer diversity in terms of income, education, aesthetic taste, and social preference creates further scope for differentiation even for a relatively homogenous product (Phillips, Chang, and Buzzell, 1983; Myers and Harvey, 2001; Foellmi and Zweimuller, 2004).

Given that the strategy-performance linkage often generates conflicting results, recent developments suggest that aligning strategy with the social environment is important (Li and Li, 2008). An emphasis on cost leadership is more likely to create superior financial performance for firms operating in some contexts, such as in emerging economies, because firms gain a comparative advantage from their low labour and production costs, and lower price offerings appeal to consumers, given their low level of disposable income. Similarly, some studies suggest that most firms in China adopt a cost-leadership strategy because the value of differentiation is low (Aulakh, Kotabe, and Teegen, 2000; Murray, Kotabe and Zhou, 2005). This is largely driven by the consumers' preference for lower prices and focus on the

physical attributes/function of products, rather than, for example, under what working conditions these products are produced (Lin, 2010).

Apart from consumer behaviour that renders cost leadership a more viable competitive advantage, institutional features in developing countries also make it challenging for firms to pursue 'differentiation'. For instance, marketing research suggests that developing countries have weak intellectual property rights protection, which often jeopardizes the value of 'branding' as a key expression of differentiation. This is both illustrated and complicated by the fact that there is a proliferation of counterfeits, replicas, and unbranded products (Strizhakova, Coulter, and Price, 2008).

More specifically regarding 'green' differentiation, Orsato (2006) theorizes that a lack of reliable information about products' environmental performance is a major barrier for consumer's willingness to pay, hence dampens corporations' willingness to 'go green'. Berrone, *et al.* (2013) model firms' engagement in environmental differentiation as largely influenced by state-level environmental monitoring, with consumer awareness proxied by the number of NGOs, using longitudinal data for 326 publicly traded firms in the U.S. in the period 1997 to 2001. Their findings suggest that when the public attention to environmental protection is low, firms are less inclined to seek environmental differentiation. In a similar vein, Jayachandran, *et al.* (2013) find that although social performance broadly contributes to firms' finance performance, environmental performance in particular does not. More interestingly, in a cross-country qualitative study, Bansal and Roth (2000) find that both Japanese and UK firms consider environmental initiatives only if they enhance their financial performance. Moreover, interviewed Japanese firms so strongly conformed to their industry norm at a time when the prevailing norm of protecting environment was low that the focal firm would not take the lead because exceeding industry expectations would make it persecuted by their industry peers for making them look bad.

In developing countries such as India, Biswas and Roy (2015) find that consumers are highly sensitive to prices, rendering 'green' differentiation a risky strategic choice. Chan (1999) studied consumers' green attitudes in China, and concluded that a green strategy would be hard to implement successfully when consumers are not concerned about protection of the environment. Therefore, we argue that it is important to consider that some firms may not adopt social-performance-based differentiation when various social, cultural, and institutional factors are not strong or stable enough to make it viable. By contrast, a cost-leadership strategy can be an effective alternative because it is less dependent on social and institutional infrastructure. This strategy can be particularly effective in hyper-competitive environments with a dispersed industrial structure, where firms aim to enhance performance and increase market share through a low-cost position relative to their rivals. A cost leadership strategy typically requires large-scale production, rigorous process improvements, learning by doing, cost control, and cost minimization in R&D, advertising, sales, and services (Gao, *et al.*, 2010).

This leads us to argue that when the overall environment is characterized as cost-oriented and hyper-competitive, heightened market competition could have a negative effect on firms' environmental performance. Furthermore, firms explicitly adopting a cost-leadership strategy in this type of environment will face greater pressure on their production costs to maintain their leadership position. This will constrain them from attaining more desirable environmental performance even more than their peers. We sum up the discussion into the following two hypotheses:

H1: An increase in market competition will reduce the environmental performance of all firms operating in a cost-oriented industrial environment.

H2: A firm-level cost-leadership strategy will exacerbate the negative impact of market competition on firms' environmental performance in a cost-oriented industrial environment.

By the same logic, price pressure may be less threatening for firms pursuing a differentiation strategy. Differentiation is the process of distinguishing a product or service from others (Mercer, 1992; Dickson, 1997) and making it more attractive to a particular target audience or market (Dickson and Ginter, 1987). The objective of differentiation is to develop a position that potential customers see as unique, thereby softening price-based competition. There are a variety of avenues through which firms may differentiate themselves in the marketplace, for example, based on their treatment of workers, such as Ben and Jerry's Ice Cream,[5] or on their treatment of animals, such as Chipotle,[6] or use of natural and organic ingredients, such as Burt's Bees and Patagonia,[7] or commitment to clean and sustainable production techniques, such as Starkist, Tyson, and Tim's of Maine,[8] or on their technological innovations, such as Apple, GE, and Nokia, or customer service, such as Amazon, UPS, and FedEx. In addition, a firm's focus on advertising and other marketing activities may serve either to emphasize these and other objective attributes that differentiate it from its competitors or to create subjective differentiating attributes that perform the same differentiating function (Buehler and Halbheer, 2011).

A 'differentiation' strategy will generally soften price-based competition in two complementary ways. First, differentiation may create brand loyalty, reducing demand elasticity (Baker, 1996; Dickson, 1997). Second, differentiation affects performance through reducing the *directness* of competition: as the products become more different, categorisation becomes more difficult and hence there are fewer direct comparisons among rival products

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[5] Catherine Taibi, '9 Reasons to Love Ben and Jerry's That Have Nothing to Do with Ice Cream,' *Huffington Post*, 15 August 2013, https://www.huffingtonpost.com/2013/08/15/ben-and-jerrys-love_n_3726083.html (accessed 8 November 2017).

[6] 'Why Chipotle Insists on Humanely Raised Meat,' *Newsweek*, May 3, 2008, http://www.newsweek.com/why-chipotle-insists-humanely-raised-meat-89691 (accessed 8 November 2017).

[7] David Gianatasio, 'Burt's Bees Tells Two Young Women's Remarkable Stories of Unique Beauty,' *Adweek*, May 13, 2016, http://www.adweek.com/news/advertising-branding/burts-bees-tells-two-young-womens-remarkable-stories-unique-beauty-171461 (accessed 8 November 2017).

[8] Willy Blackmore, 'A major American meat company is going big with antibiotic-free pork,' *Takepart*, February 25, 2016, http://www.takepart.com/article/2016/02/25/tyson-antibiotic-free-pork (accessed 8 November 2017).

(Kotler, *et al.*, 1996; Trout, 2000; Sharp and Dawes, 2001). In terms of the classic model of Hotelling (1931), differentiation strategies increase the distance of a particular product from its competitors in 'product space', making it a more distant substitute for rival products (Salop, 1979). Thus, a successful product differentiation strategy will move the product from competing based primarily on price to competing on non-price factors, which should reduce the negative impact of market competition on firm environmental performance.[9] We state the argument as the following hypothesis:

H3: A firm-level differentiation strategy will positively moderate the negative impact of market competition on firms' environmental performance in a cost-oriented industrial environment.

Having articulated our main hypotheses, we proceed to discuss our empirical context, dataset, and identification strategy.

Empirical Context

Different from the majority of studies that have examined firms' social/environmental performance in the U.S. or other developed economies, we choose China in the early 2000s as our empirical setting for several reasons. First, China represents a vastly different social context from countries such as U.S. (Lyon, Lu, Shi, and, Yin, 2013; Marquis and Bird, 2018), and yet it is important for us to have more understanding of this country given its rising economic and political power. For example, if we consider the 'environmental Kuznets curve' discussion (Grossman and Krueger, 1995), China remains on the left side of the curve, indicating that environmental degradation will be likely to continue to increase with the economic development before the country's income level reaches the turning point predicted

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[9] A recent report suggests the hazards of trying to combine the two strategies: Walmart has apparently encountered resistance from customers of highly differentiated brands that it has acquired because of Walmart's reputation as a low cost rather than high quality retailer. Abha Battarai, 'Walmart bought Bonobos – and the bros aren't happy,' *Washington Post*, May 25, 2018.

by the theory. In addition, being a former socialist economy, China's industrial transformation since the late 1970s is built upon a market-oriented and profit-seeking agenda. Not only is the diversion from profit objectives blamed for the inferior performance of and the justification for the reform of a large number of state owned enterprises, but also stripping away the social objectives of enterprises is ideologically heralded as paramount for efficiency and productivity in modern China (Bo, Li and Toolsema, 2009; Lin, 2010). This has led to severe environmental problems in China.[10] In addition, the legal system in China does not make it easy to protect the natural environment in comparison to that in countries such as the U.S., where the strong legal traditions can facilitate the challenge and punishment of violators at the initiative of citizens and different stakeholders, raising the costs of non-compliance. By contrast, China's legal system remains subdued by the undemocratic political system. The state remains the dominant stakeholder, and whether or not a certain social issue receives due attention depends largely on the state's economic and political agenda.

On a more micro level, publicly traded firms in the U.S. are large, resource abundant, and technologically advanced, and arguably tend to operate in relatively concentrated industrial environments (Chemmanur, He, and Nandy, 2010).[11] By contrast, non–listed Chinese manufacturing firms are relatively small, more labor-intensive, and more resource-constrained, and generally operate in far more dispersed industrial structures. Taking these considerations together, it is plausible that Chinese firms' perception of and engagement in environmental performance could be immensely different from that in the U.S., which makes

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[10] Wu, Deng, Huang, Morck, and Yeung (2013) link the environmental degradation in China with its local governments lacking the incentive to promote environmental policy. Relatedly from the perspective of China's central and local government level, Wang, Wijen and Heugens (2018) point out the bad consequence of 'policy-policy decoupling' between central and local governments.

[11] For example, between 2000 and 2005, the average three digit HHI index based on the SIC is 0.1519 among listed U.S. firms that are simultaneously present in the KLD database and Compustat. This is the sample used in most CSR studies. In the same period, the average four digit HHI index based on the Chinese Industrial Classification of all Chinese manufacturing firms with annual turnover of RMB 5 million or above is only 0.0188. Admittedly, these are not directly comparable due to the differences in industry classification systems, but it is still evident that the former represents a very different industrial structure from the latter. For a recent discussion regarding increasing concentration among U.S. listed firms, see Grullon, Larkin, and Michaely (2016).

it difficult to extrapolate previous findings to this context.

Finally, while Flammer (2015) suggests that heightened import competition will make it harder for U.S. domestic firms to compete with foreign competitors on a 'cost' basis, thus increasing their incentive to engage in CSR-based 'differentiation', we argue that it is plausible the opposite holds true for Chinese firms given their different comparative advantages. For example, Barney and Zhang (2008) argue that 'Made in China' stands for low cost and good value. This country-based image emerged out of the business level strategies pursued by many Chinese firms, namely, a strategy that focused on average quality linked with very low cost manufacturing (Loo and Davies, 2006; Child and Rodrigues, 2005). The success of these strategies has led China to develop the reputation of being the 'world's factory' (Deloitte Research, 2003). Taking these arguments together, our empirical focus on Chinese manufacturing firms justifies the reference to a 'cost oriented industrial environment' that we have made in our hypotheses.

Data Description

We use a sample of Chinese firms monitored by the 'Green Watch' program in Jiangsu Province between 2000 and 2005. Here we outline the background of the program and explain the data choice.

In 1999, China's State Environmental Protection Administration (SEPA) launched its Green Watch Program supported by the World Bank's InfoDev Program. This public disclosure program rates firms' environmental performance from best to worst in five colors—green, blue, yellow, red and black (Wang, *et al.*, 2004), as shown in Appendix 1. The primary benchmarks for ratings are China's emission and discharge standards that specify effluent concentration limits. Firms violating any of these standards are rated red (we code it as 2), and firms violating standards in more than 60 percent of inspections are rated

black (we code it as 1, the worst performance). The secondary benchmarks are China's load-based emission and discharge standards. Firms that satisfy the primary benchmarks but violate the secondary standards are rated yellow (we code it as 3). The rating system also incorporates other performance indicators, such as whether or not the firm received public complaints and whether or not the firm had a China Cleaner Production certificate and/or an ISO14000 certificate. The system specifies a link between each rating (from 1 to 5) to one or multiple indicators that determine it. Our coding follows that in previous research, such as Jin, Wang, and Wheeler (2010) and Bu, Liu and Gao (2011).

The program was extended from Zhenjiang City to all of Jiangsu Province in 2001, and to eight other provinces during 2003-2005. Nationwide implementation of Green Watch has been promoted since 2005. Our data come from the 'Green Watch' program in Jiangsu Province between 2000 and 2005. Jiangsu is geographically next to the commercial center of mainland China, Shanghai. It has thirteen cities and an average GDP per capita of $22,622 (PPP adjusted) in 2012, ranking it the richest province in China. We illustrate the location of Jiangsu in Appendix 2. A detailed map of Jiangsu with its thirteen cities is presented in Appendix 3. Appendix 4 presents the number of firms across the six years, and Appendix 5 presents the two-digit industrial distribution of the sample. All firms are from the industrial sector. We identify these firms' financial and ownership data from the Annual Survey of Industries conducted by China's National Bureau of Statistics (NBS). NBS data have been used in many studies before, including Guariglia, Liu, and Song (2011) and Duanmu (2015).

We should note that there is some discrepancy between the original Green Watch data and the firm level data sought from NBS. Taking 2005 as an example, we have 5823 Green Watch data, but only 2766 can be matched with firm level information. There are two reasons for this large discrepancy. First, the Green Watch data covers organizations

that are not in the manufacturing sector -- for example, restaurants, hospitals, hotels, news agency, utility companies (water suppliers, energy suppliers), and local government agencies. Second, some manufacturing firms' data are not in the NBS firm level dataset, presumably because their annual turnover is less than 5 million RMB. Therefore, our sample is somewhat skewed towards large manufacturing firms in China.

Identification Strategy

Our identification strategy is based on the fact that different industries in China had different levels of output import tariff protection, *i.e.,* protection for end products, before China's WTO accession. Output import tariffs for different industries were then reduced by varying degrees and converged to a unified level to meet China's WTO obligations in the course of 2002 and 2005 (Naughton, 2007; Bas and Straus-Kahn, 2015). Reduced output import tariffs mean *lower* entry barriers of foreign products into the Chinese market, hence indicate stronger competitive pressure on Chinese firms. Thus, we can establish whether changes in firm environmental performance before and after the WTO accession are related to the variations of output import tariff reductions of the industries in which they operate. Despite variation in the exact phase-out process of different industries, we treat all industries equally and exploit only the level of output import tariffs before the WTO accession. Therefore, we use output import tariff rates in 1999 (pre-sample) as the measure of the level of exposure of the industry to import competition. Moreover, to account for the fact that many firms have multiple products, we construct firm level output import tariff rates in 1999 by using the weights of each of the firm's main products. The difference-in-difference approach then captures firm environmental performance resulting from the output import tariff reductions. The baseline estimate can be written as follows:

$EP_{ft}=a_0- \alpha_1 Output\ Import\ Tariff1999*WTO + \sum controls_{ft-1} + \eta_f + d_t + d_t*\varphi_l + \varepsilon_{ft}$ (I)

To consider the possible moderating effect of cost leadership and differentiation strategy, we then add two more interaction terms in the equation, which can be rewritten as follows:

$EP_{ft}=a_0- \alpha_1 Output\ Import\ Tariff1999*WTO - a_2 Output\ Import\ Tariff1999*WTO*Cost\text{-}Leadership_{ft}+$

$a_3 Output\ Import\ Tariff1999*WTO*Differentiation_{ft}+a_4 \sum controls_{ft-1} + \eta_f + d_t + d_t*\varphi_l + \varepsilon_{ft}$ (II)

The data for output import tariff in 1999 was drawn from the World Integrated Trade Solution (WITS) database. We use the rates denoted as 'effectively applied tariffs' in the WITS system. Since China's National Bureau of Statistics uses its own industry classification system, we use a concordance between the NBS system and the WITS system when merging the tariff database with the firm-level information. This method is also used in Hu and Liu (2014). We code WTO as '1' if the year is 2002 and afterwards; otherwise '0'. This is to reflect the fact that China joined WTO in December 2001.

We measure cost-leadership following Gao, *et al.* (2010), but with one modification. While Gao, *et al.* (2010) measure cost strategy by the ratio of production cost to total sales, with *small* values indicating *stronger* cost-leadership, we modify this measurement by using 'total sales - production cost' as the numerator, so that *larger* values indicate *stronger* cost-leadership, which will allow more straightforward interpretation of our results.[12] We also follow the Gao, *et al.* (2010) measure of 'differentiation'. To be more specific, 'differentiation' is proxied by a firm's divergence from the typical level of the ratio of advertising expense to total sales in its three-digit industry.[13]

We include firm fixed effects, η_f, year fixed effects d_t, the interaction terms d_t and φ_l (*i.e.,* location) to account for possible location-specific time trends, and white noise ε_{ft}. $\sum controls_{ft-1}$ is a vector of one period lagged control variables including firm age, size (log

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[12] $Cost\ Leadership\ Competencies_{i,t} = \frac{(CL)_{i,j,t}-median_{-i,j,t}(CL)}{range\{[(CL)_{i,j,t}-median_{-i,j,t}(CL)]\forall i \in j,t\}} \in [-1,1]$

[13] $Differentiation\ Competencies_{i,t} = \frac{(DF)_{i,j,t}-median_{-i,j,t}(DF)}{range\{[(DF)_{i,j,t}-median_{-i,j,t}(DF)]\forall i \in j,t\}} \in [-1,1]$

assets), product diversity, profitability (return on assets), innovation (value added), and debt ratio, based on previous studies of environmental and social performance (*e.g.,* Russo and Fouts, 1997; Fisman, Heal, and Nair, 2006; Fernández-Kranz and Santaló, 2010; Declerck and M'Zali, 2012; Flammer, 2015; Hawn and Kang, 2015). Among these controls, the literature has documented that age tends to be negatively associated with social performance because of organizational inertia. Firm size, product diversity, profitability, and innovation are positively associated with social performance because stronger financial and innovative abilities usually lead to stronger social performance and potential economies of scope of social performance over multiple products. Debt ratio is often argued to reduce the slack resources that managers may divert for social performance, which may lead to a negative association with social performance. We use value added as the proxy of firm innovation because R&D information for non-listed Chinese firms is highly incomplete. We also control for five types of equity in the firm: state; collective; foreign; Hong Kong, Taiwan, and Macao (HTM); and individual equity holdings.

Finally, we include two more control variables and their respective interaction terms with WTO. One is an export dummy. This is to consider the potential market access benefit that exporters may have gained due to WTO accession. The second is the input import tariff in 1999. We include it to consider that its reduction occurred simultaneously with import tariff reductions for output, and firms may benefit from input tariff reductions because of cheaper or higher quality inputs. We adopt the methodology used in Hu and Liu (2014) to compute input import tariff rates. In this method, the input tariff rate of an industry is computed as the weighted average of the output tariff rates of its upstream industries. The Chinese input-output table of 2002 was used as the weight matrix to construct input tariffs.[14] Table 1

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[14] Our identification strategy is similar to that used in several previous studies. For example, Griffith (2001) uses the same difference-in-difference method to examine how UK firms' efficiency increased as result of the Single Market Program (SMP) implemented across Europe. Guadalupe and Wulf (2010) use the method to examine how the

provides the descriptive statistics for the sample data. The correlation matrix of main variables is presented in Table 2.

{Insert Table 1 here}

{Insert Table 2 here}

Data Analysis & Results

Before we present our main results, it is useful to have a look at the trajectory of our dependent variable: firm environmental performance from 2000 to 2005, visualized in Graph 1 in the Appendix. We divide firms into two groups: one is those belonging to industries with higher output import tariffs in 1999, and the other is those belonging to industries with lower output import tariffs in 1999. Graph 1 shows that both groups had similar movement before 2002, the treatment year that we use. But clearly, those firms in industries with higher output import tariff in 1999 experienced a much larger decline in their environmental performance compared to those firms in industries with lower output import tariff in 1999 after 2002. While this alone does not suffice to support our main hypothesis, we proceed to discuss our main results presented in Table 3.

Table 3 reports coefficients, robust standard errors, and p values of all variables included in the estimations. The inclusion of firm fixed effects is supported by the results of a Hausman test across all estimations, which indicates that the fixed effects model is preferable to the random-effects model (for example, in Model 1 of Table 3: $\chi2=80.645$, $p=0.00002$). We cluster our standard errors at the industry level since the tariff movement occurs at this level.

We first discuss our baseline results concerning competition, which is measured by the interaction term of WTO and output import tariff 1999. It is not statistically different from zero as shown in Model (1) where we consider firm and year fixed effects. In Model (2),

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exogenous increase in competition created by the Canada-US Free Trade Agreement of 1989 (FTA) influenced the organizational structure of U.S. firms and their use of incentive pay.

where we add city specific time trends, the interaction term of WTO and output import tariff 1999 becomes statistically significant (robust standard error =0.009, p=0.055), with a negative coefficient of 0.019. This can be interpreted as for one standard deviation increase in competition, firms' environmental performance drops by 16 percent. On a scale of 1 to 5, this is equivalent to approximately 0.76 reduction, a magnitude that is economically significant as well. This result is noteworthy because it indicates the importance of including location-specific time effects where some time-varying characteristics, such as changes in the cities' environmental or economic policies, have an important impact on the results. We will return to this shortly.

{Insert Table 3 here}

In Model (3), we conduct a placebo test. Instead of testing the impact of output import tariff reductions and their interaction with WTO, we test the impact of input import tariff reductions and their interaction with WTO. Input import tariff reductions will benefit Chinese firms in terms of accessing cheaper or higher quality intermediate goods from foreign markets, and there is not a priori reason to expect it to affect firm environmental performance the same way as that of output import tariff reductions. Nevertheless, because of the occurrence of both input and output import tariff reductions associated with WTO accession, we test it to eliminate any confounding effect that may arise from it. The estimation shows that the interaction term of input import tariff 1999 and WTO does not attain a statistically significant result.

We then conduct another placebo test that focuses on exporter's environmental performance before and after WTO in Model (4). In a similar vein, one possible concern is that exporters' environmental performance may have changed after China's accession to WTO. Although the greater access to the global marketplace that exporters gained from China's WTO accession is theoretically different from the competitive pressure attached to

output tariff reductions, it is the timing that raises the concern. In addition, exporters may accelerate their production with better access to the global market, which may also affect their environmental performance negatively, although, if this exists, it would be a different mechanism from competitive pressure. Thus, it is important to have a separate check on exporters. The results are presented in Model (4). The coefficient on the interaction term of WTO and exporter is positive, but not statistically significant. After the two placebo tests, we include the two pairs of interaction terms in the remaining regressions as control variables.

In Model (5) we begin to consider the moderation effect of cost leadership and differentiation strategies. We find that while the main result of competition remains statistically significant -- the coefficient is -0.022 and it is significant at 5% level -- the interaction term of 'cost leadership' and competition attains a negative and statistically significant result, supporting the second hypothesis (coefficient is -0.132 and the p value is 0.054). Meanwhile, the interaction term of 'differentiation' and competition also receives a positive and statistically significant result, supporting our third hypothesis (coefficient is 0.124 and the p value is 0.004). The model has an overall higher explanatory power, indicated in R-squared. We then move to Model (6), which includes observations where the environmental performance exceeds the basic regulatory requirements, namely, those observations whose environmental performance exceed the value of 2. This is more in line with the discussion in CSR literature that to be socially responsible, firms have to exceed basic regulatory compliance. The overall results are unchanged from those in Model (5). More specifically, our key interest, the coefficient of the interaction term WTO and output import tariff 1999, is -0.042, significant at 1% level.

In Model (7) we consider firms with continued presence in the sample for six consecutive years since 2000. Previous models are based on an unbalanced sample, which may

introduce some upwards bias: that is, firms with poor environmental performance may drop out the sample while those with strong performance remain. The coefficient for market competition is now -0.053, indeed larger than those in previous estimates, and remains statistically significant (robust standard error=0.014, p=0.010). This coefficient is equivalent to a 43 percent drop in firms' environmental performance in response to an increase in competition of one standard deviation, equivalent to a reduction of approximately 2 in the scale from 1 to 5. In cases where the firm's starting performance was rated at 5, a reduction of 2 would mean that the performance dropped to 3, which is basic compliance. But in cases where the firm's stating performance is lower than 5, this means that competition reduced its environmental performance to a non-compliance level. The main results with respect to competition and its interaction term with cost leadership and differentiation are visualized in Graphs 2a to 2c in the Appendix.

Having obtained the main results, we conduct several robustness checks to verify our results. First, we use firm clusters and city clusters as a complement to our main analysis, in which we use industry clusters as this is where the tariff movement occurred. The results are presented in Appendix 6, where the first three columns present the results based on firm clusters, and the last three columns present those based on city clusters. By and large, the main results concerning competition and its interactions with cost leadership and differentiation hold. Secondly, we emulate Guadalupe and Wulf (2010) by including firm-specific linear time trends in the estimation.[15] The results are shown in Appendix 7. This inclusion again does not alter our main results.

In our third robustness checks, we turn our attention to the measurement of cost leadership and differentiation. Specifically, we use the ratio of the difference of total sales and selling and administrative cost to total sales as the alternative proxy for cost leadership. This is derived

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[15] We thank an anonymous reviewer for making the suggestion for various robustness checks.

from Gao, *et al.* (2010) with a modification in the numerator to allow for a more straightforward interpretation. We also use new product output as the alternative to the indicator based on advertising. Note that the information on new product output is less complete than that on advertising, which has made our sample sizes smaller. The results are reported in Appendix 8, where we replicate the analysis of Table 3 using these two alterative proxies. The results are overall consistent with those obtained in Table 3. In addition, based on Appendix 8, we then use a dummy variable to indicate firms' cost leadership and differentiation strategy by using the sample mean as the cutoff point. The results are presented in Appendix 9. The overall results are highly consistent with those when the two are measured as continuous variables.

The forth robustness checks concerns state-owned-enterprises (SOEs). In China, SOEs are arguably much less subject to market competition due to political intervention; therefore including them in the sample may underestimate the real impact of competition on environmental performance. We replicate regressions in Table 3 by limiting our sample to firms with less than 50 percent state ownership, and find that our earlier results remain unchanged. The results are presented in Appendix 10.

The fifth check explores how city specific trends may have affected our main results in Model 2 of Table 3. To this end, we evaluate to what extent the city's status in terms of the Two Control Zone (TCZ) program may have some bearings on firms' environmental performance. The TCZ policy, initially adopted by the State Council of China in 1998, is one of the most important policies to tackle air pollution in China. 175 prefectures out of 375 across 27 provinces were designated as TCZ locations due to their exceeding national mandate thresholds for either acid rain or SO_2. The 10th Five-Year Plan (from 2000 to 2005) then set the reduction target for SO_2 by 10% from the 2000 level by 2005 in TCZ locations. Therefore, the TCZ status means more stringent regulations (Hering and Poncet, 2014; Cai, Lu, Wu, and Yu, 2016). Relating the TCZ

policy to firms' response to market competition, we conjecture that it is possible that firms' environmental performance may deteriorate more in TCZ locations because more fierce foreign competition makes it harder for firms to afford the higher level clear-up costs required in TCZ locations. This seems highly likely when local governments prioritize local economic development and employment over environmental protection. By contrast, firms in non-TCZ locations face less stringent regulations, which means that they operate in a 'natural' state with limited policy intervention. Therefore those firms' environmental performance may decline by a smaller margin precisely because of more lax environmental regulations there.

To test the possibility, we replicate the analysis in Model 2 of Table 3 by including the interaction term of TCZ and year to replace the city-specific trends. This way we can capture potentially different trends across cities that are in TCZ locations from those are not. The results are presented in Appendix 11. The results that we obtain in Model (1) of Appendix 11 are highly similar to those results in Model (2) of Table 3, lending some support for the view that there are some divergent trends across the two types of cities that explain firms' response to intensified competition. More specifically, the coefficient is -0.027, which is significant at 1% level, is quite close to the coefficient in Model (2) of Table 3, which is -0.019 and is significant at 5% level. We then extend our analysis by including the interaction term of cost leadership and differentiation in Model (2) in Appendix 11. The results are qualitatively unchanged from what we obtain in Table 3. Last, we limit our sample to those firms that have an over-compliance level in their environmental performance in Model (3), and those with a balanced presence in the sample in Model (4). All our results are highly consistent with those in Table 3. This exercise provides some, not necessarily exhaustive, insights into the sources of city-specific time trends.

Finally, we evaluate how our findings may be related to the 'pollution haven' literature, which argues that multinational firms can 'export pollution' by locating their dirtier operations in developing countries with lax environmental standards (Jaffe, *et al.*, 1995;

Copeland and Taylor, 2004; Bu and Wagner, 2016; Li and Zhou, 2017b). The empirical

support for the 'pollution haven' hypothesis remains mixed (Levinson and Taylor, 2008;

Grether, *et al.*, 2012; Millimet and Roy, 2016), and its vast empirical and theoretical

literature is beyond the scope of our paper. Our empirical setting is also not well equipped

to study this hypothesis given that our focus is on changes in 'competitive pressure' rather

than changes in 'environmental standards'. But it may be interesting to evaluate the

possibility that if industries with high import tariff protections in 1999 also concurrently

attracted higher levels of FDI in our sample, and firms with foreign equity responded more

negatively to competition than their domestic counterparts, then our findings would

resemble the 'pollution haven' notion. Neither speculation is supported in our data. We use

a fixed effects model and find that foreign equity is not positively associated with

'competition''; nor is foreign equity associated with worse environmental performance. The

fact that our balanced sub-sample always generates larger expected coefficients indicates

that it is more of within-firm effect than a between-firm effect that we capture.[16]

Discussion and Conclusions

Solow once characterized a finding of Hotelling as demonstrating that 'the monopolist is the

conservationist's friend' (Solow, 1974; Hotelling, 1929). He was referring specifically to

Hotelling's theoretical prediction that a monopolist would deplete a given stock of natural

resources more slowly than would a competitive firm. We may update this idea by replacing

'conservationist' with 'environmentalist', and note that the output reduction associated with

monopoly can also be expected, all else equal, to be accompanied by lower levels not only of

resource usage but also of the production of negative externalities such as water pollution, air

pollution, and global warming. Modern strategic analysis goes an important step further than

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[16] We thank an anonymous reviewer for the comment that has led to this discussion.

this by incorporating the environmental performance of a firm into the framework of corporate strategy. Following Porter, we divide the broad strategies chosen by firms into two categories, cost leadership and differentiation. We find that apart from an overall negative impact of competition on firms' environmental performance in our sample, a cost-leadership strategy on the part of the firm exacerbates this negative impact. By contrast, a differentiation strategy positively moderates the negative relationship between competition and environmental performance.

We hope that our research makes a first step towards a deeper understanding of the relationship between firms' strategic choices and their environmental performance (Ioannou, Kassinis and Papagiannakis, 2018; Ioannou and Hawn, 2018). We close with some reflections on our findings and their implications for further research in this area.

First, although we do not utilize institutional comparisons in our analysis, our results are clearly institutions-laden in the sense they cannot be detached from China's unique economic and institutional environment in the early 2000s, when a cost-based leadership strategy remained the dominant competitive advantage of manufacturing sectors in China, and that may have compromised their social performance.[17] The contrasting results that we obtain in comparison to those in Flammer (2015) indicate that more theoretical and empirical work is needed to systematically assess to what extent institutional environments such as variations in consumers' care for and willingness to pay for green products, and variations in countries' regulatory and legislative settings, may give arise to divergent competitive advantages which in turn affect corporate social performance in different ways. It is only with cross-country comparisons that such cross-country differences may be revealed. This is an important future research direction, which should provide a more in-depth understanding of how national cultural and institutional environment matter for the theoretical boundary conditions of CSR

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[17] The institutional context in China may have changed or slowly shifted since 2006, the end of our sample period. See relevant discussion in Marquis and Qian (2014).

(Young and Makhija, 2014; Ghoul, Guedhami and Kim, 2017; Makadok, Burton, and Barney, 2018).

Our second reflection is on differentiation. It is worth emphasizing that the third hypothesis regarding the moderating role of differentiation strategy on firms' environmental performance is a general prediction. It is distinct from the innovation literature in the sense that we argue that so long as firms pursue a differentiation strategy, regardless of form or shape, they can reduce the sensitivity of their customers to price, and this in turn should mitigate the negative impact of competition on firms' environmental performance. It does not contradict the key theoretical arguments in the innovation literature. First, if we view 'environmental strategy' as the *only* differentiation device that firms deploy, firms' response to heightened competition may differ depending on the extent to which they adopt their 'environmental' differentiation strategy *ex ante.* For example, Fisman, *et al.* (2006) argue that CSR is more likely to occur in highly competitive markets where CSR is the *only* product differentiation device for an otherwise homogenous product. This theoretical argument is in line with the 'escape competition' argument in the innovation literature (Aghion, *et al.*, 2005), but does not consider the variations of firm distributions in terms of whether they are 'environmental' leaders or laggards, thus ignoring the other prediction (*i.e.,* the Schumpeterian effect with respect to rent dissipation) discussed in the same literature.[18] If we accept the 'environmental' differentiation strategy as one, but not the only, way that firms differentiate themselves, then we may find it appropriate to argue that differentiation in general softens the negative impact of competition on firms' environmental performance.

As noted earlier, the ability of a firm to utilize product differentiation as a competitive strategy depends on the characteristics inherent to the product itself and the heterogeneity of customers. Two additional factors seem likely to increase the incidence and importance of a

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[18] For example, Li and Zhou (2017a) find that, using U.S. listed firms from 1976 to 2005, import competition from high-wage countries increases U.S. firms' innovation because such competition is viewed as 'neck-and-neck'; by contrast, import competition from low-wage countries does not increase U.S. firms' innovation.

strategy of product differentiation going forward. First, corresponding to the importance of a 'hyper-competitive environment' in forcing the adoption of a cost minimization strategy, there is arguably a positive income elasticity of consumer taste for product differentiation. Only if consumers have a certain level of disposable income can they afford to buy sweatshop-free clothing as opposed to the least expensive items on sale. Thus, if the world continues to exhibit both the broad increase in average income and the reduction in the incidence of absolute poverty that have characterized recent decades, consumers' demand for more differentiated products should incentivise companies to move from cost minimization to differentiation as a competitive strategy. Our results suggest that such a move will have a positive side effect of environmental improvements as a result of increased environmental CSR: a global move to the right and down the environmental Kuznets curve.

Second, and related, both global income growth and rapid technological change are likely to lead to an increased growth of the services sector in economies around the world, at the (relative) expense of both the agricultural and manufacturing sectors (Eichengreen and Gupta, 2011). The Googles and Facebooks of the world, and their inevitable successors, are capital-intensive firms without large stocks of physical capital (Haskel and Westlake, 2017), and their billion-dollar revenue streams are accompanied to a large degree by the pollution only from the electricity required to power them. Firms like Google and Facebook mostly offer products that are free to consumers, but in neither case is that related to a cost minimization strategy: for these firms, differentiation is all. Again, to the degree that such firms face increased competition, our results suggest that they are likely to strategically increase their CSR, environmental and otherwise.

A potential limitation of our study is that the market enlargement effect of China's WTO accession could lead to an alternative interpretation of our results. The interpretation could be that the removal of trade barriers makes the competitiveness advantage of China as the world's

factory (*i.e.*, low cost manufacturing coupled with less stringent environmental regulations) more salient. We acknowledge that the market enlargement effect is a possible caveat to our interpretation. The placebo test we conduct in column 4 of Table 3 as well as the fact that we include exporter as a control variable in our estimation may to a great extent reduce this concern, given that the overall results concerning our hypotheses remain supportive.

Finally, we suggest that more research can look into how corporations adjust their social performance when market competition loosens rather than toughens. Are the incentives and results that we have discussed here symmetric? Do corporations become more generous in allocating investment and resources for social causes when market competition softens? How do the competitive strategies chosen by firms increase or moderate tendencies in that direction? The current emerging 'protectionism' might provide such interesting empirical opportunities.

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Table 1: Descriptive statistics

Variable	Measurement	Source	Mean	Std. Dev.	Min	Max
(1) Environmental performance	1-5, higher values indicate better performance	Green Watch Program in Jiangsu	3.58	0.81	1.00	5.00
(2) WTO	=1 if year>=2002; =0 otherwise	This study (NBS)	0.62	0.48	0.00	1.00
(3) Output import tariff rate 1999	Import tariff rates for output in 1999	WITS website	20.29	5.91	6.45	32.47
(4) Export	Dummy variable; exporter is coded as '1', otherwise '0'	This study (NBS)	0.36	0.48	0.00	1.00
(5) Input import tariff rate 1999	Import tariff rates for input in 1999	WITS website	8.89	3.28	3.94	13.27
(6) Age	Number of years in operation	This study (NBS)	13.69	13.88	1.00	109.00
(7) Log assets	Natural log of total assets	This study (NBS)	10.65	1.63	3.82	16.87
(8) Return on assets	Return on assets	This study (NBS)	0.07	0.10	0.00	4.23
(9) Product diversity	Number of main products	This study (NBS)	1.45	0.72	1.00	3.00
(10) Log value added	Natural log of value added	This study (NBS)	10.50	0.98	1.60	15.24
(11) Debt ratio	Long term liability/total assets	This study (NBS)	0.64	0.25	0.00	3.87
(12) State equity %	State equity/total received capital	This study (NBS)	0.06	0.21	0.00	1.00
(13) Collective equity %	Collective capital/total received capital	This study (NBS)	0.07	0.24	0.00	1.00
(14) Foreign equity %	Foreign capital/total received capital	This study (NBS)	0.13	0.31	0.00	1.00
(15) HKTM equity %	HKTM capital/total received capital	This study (NBS)	0.07	0.23	0.00	1.00
(16) Individual equity %	Individual capital/total received capital	This study (NBS)	0.46	0.47	0.00	1.00
(17) Cost leadership	See endnote 12	This study (NBS)	0.18	0.30	-1.00	1.00
(18) Differentiation	See endnote 13	This study (NBS)	0.05	0.32	-1.00	1.00

Table 2: Correlation matrix of main variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
(1) Environmental performance	1																	
(2) WTO	-0.02	1																
(3) Output import tariff rate 1999	-0.04	0.02	1															
(4) Export	0.12*	-0.06*	0.05*	1														
(5) Input import tariff rate 1999	0.01	0.02*	0.81*	0.07*	1													
(6) Age	-0.03	-0.09*	-0.05*	0.10*	-0.02	1												
(7) Log assets	0.24*	-0.08*	-0.07*	0.36*	-0.03*	0.19*	1											
(8) Return on assets	0.03	0.05*	-0.05*	-0.01	-0.07*	-0.11*	-0.12*	1										
(9) Product diversity	0.01	-0.04*	-0.10*	0.04*	-0.12*	0.22*	0.13*	-0.05*	1									
(10) Log value added	0.14*	0.01	-0.13*	0.11*	-0.15*	0.02	0.37*	0.02	0.01	1								
(11) Debt ratio	-0.13*	-0.03*	-0.07*	-0.06*	0.09*	0.13*	-0.11*	-0.16*	0.04*	-0.05*	1							
(12) State equity %	0.02	-0.08*	-0.04*	0.06*	-0.03	0.32*	0.21*	-0.07*	0.14*	0.07*	0.04*	1						
(13) Collective equity %	-0.08*	-0.05*	-0.00	-0.08*	-0.02	0.08*	-0.07*	0.12	0.02	-0.04*	0.05*	-0.08*	1					
(14) Foreign equity %	0.04*	0.01	-0.01	0.31*	-0.01	-0.15*	0.34*	-0.00	-0.07	0.16*	-0.22*	-0.08*	-0.11*	1				
(15) HTM equity %	0.25*	0.00	0.04*	0.14*	0.04*	-0.12*	0.113*	-0.13*	-0.06*	0.06*	-0.09*	-0.07*	-0.07*	-0.13*	1			

(16) Individual equity %	-0.17*	0.05*	0.06*	-0.23*	0.06	-0.03	-0.41*	-0.40*	-0.03	-0.15*	0.16*	-0.25*	-0.26*	-0.40*	-0.28*	1	
(17) Cost leadership	-0.12*	-0.02*	0.03*	-0.21	0.00	-0.08	-0.49	-0.05	-0.06	0.01	0.06	-0.06	0.03	-0.18	0.04	0.17*	1
(18) Differentiation	0.05*	0.02*	-0.02	0.04*	-0.01	0.04*	0.07*	0.01	0.00	-0.01	-0.01	-0.02	0.03*	0.00	-0.03*	0.01	-0.09*	1

Notes: pairwise correlation. *p<0.01

Table 3: The effect of market competition on firms' environmental performance and the role of cost leadership and differentiation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Full sample	Full sample	Full sample (placebo)	Full sample (placebo)	Full sample	Over-compliance	Balanced panel
	Coef. p-value	Coef. p-value	Coef. p-value	Coef. p-value	Coef. p-value	Coef. p-value	Coef. p-value
WTO	0.181 (0.363) [0.201]	0.453 (0.011) [0.179]	0.457 (0.011) [0.181]	0.446 (0.016) [0.176]	0.122 (0.857) [0.672]	0.217 (0.690) [0.544]	0.937 (0.015) [0.384]
Output import tariff 1999	0.006 (0.712) [0.024]	0.016 (0.564) [0.029]			-0.001(0.989) [0.041]	-0.026 (0.444) [0.034]	0.049 (0.028) [0.022]
WTO* Output import tariff 1999	-0.009 (0.417) [0.013]	-0.019 (0.055) [0.009]			-0.022 (0.041) [0.010]	-0.042 (0.008) [0.011]	-0.053 (0.005) [0.014]
WTO* Output import tariff 1999*Cost leadership					-0.132 (0.054) [0.068]	-0.131 (0.042) [0.057]	-0.148 (0.037) [0.059]
Cost leadership					-1.331 (0.269) [1.200]	-1.075 (0.115) [0.791]	-1.159 (0.120) [0.891]
WTO*cost leadership					1.414 (0.293) [1.341]	0.895 (0.254) [1.023]	0.897 (0.221) [1.021]
Output import tariff 1999*cost leadership					0.134 (0.028) [0.061]	0.134 (0.028) [0.061]	0.135 (0.020) [0.058]
WTO* Output import tariff 1999*differentiation					0.124 (0.004) [0.043]	0.096 (0.003) [0.035]	0.097 (0.003) [0.036]
Differentiation					0.038 (0.400) [0.045]	0.041 (0.412) [0.045]	0.085 (0.276) [0.095]
WTO*differentiation					-0.056 (0.466) [0.077]	-0.025 (0.431) [0.075]	-0.024 (0.412) [0.075]
Output import tariff 1999*differentiation					0.018 (0.553) [0.053]	0.021 (0.554) [0.061]	0.020 (0.555) [0.059]
Lagged age	0.002 (0.221) [0.010]	0.004 (0.270) [0.003]	0.004 (0.271) [0.003]	0.004 (0.247) [0.003]	0.001 (0.868) [0.003]	-0.002 (0.551) [0.003]	-0.018 (0.230) [0.015]
Lagged log assets	-0.009 (0.756) [0.033]	-0.020 (0.610) [0.039]	-0.018 (0.603) [0.038]	-0.020 (0.617) [0.040]	-0.056 (0.466) [0.077]	-0.081 (0.172) [0.059]	-0.108 (0.456) [0.117]
Lagged return on assets	-0.065 (0.708)	-0.388 (0.341)	-0.387 (0.341)	-0.388 (0.377)	-0.244 (0.604)	0.252 (0.112)	-0.394 (0.649)

	[0.186]	[0.408]	[0.408]	[0.423]	[0.470]	[0.127]	[0.866]
Lagged product diversity	0.028 (0.331)	0.073 (0.270)	0.057 (0.212)	0.073 (0.270)	0.038 (0.400)	0.019 (0.576)	0.029 (0.190)
	[0.034]	[0.066]	[0.048]	[0.066]	[0.045]	[0.035]	[0.028]
Lagged value added	0.045 (0.799)	0.050 (0.043)	0.051 (0.043)	0.050 (0.041)	0.050 (0.041)	0.050 (0.040)	0.095 (0.120)
	[0.023]	[0.025]	[0.025]	[0.025]	[0.025]	[0.025]	[0.061]
Lagged debt ratio	-0.054 (0.632)	-0.170 (0.345)	-0.170 (0.345)	-0.148 (0.455)	-0.102 (0.517)	-0.238 (0.108)	-0.142 (0.442)
	[0.115]	[0.180]	[0.181]	[0.154]	[0.184]	[0.148]	[0.185]
Lagged state equity %	0.061 (0.508)	0.046 (0.727)	0.049 (0.577)	0.046 (0.720)	0.092 (0.544)	0.085 (0.462)	0.060 (0.767)
	[0.094]	[0.132]	[0.116]	[0.135]	[0.151]	[0.115]	[0.203]
Lagged collective equity %	-0.030 (0.760)	-0.074 (0.616)	-0.074 (0.616)	-0.074 (0.587)	-0.118 (0.475)	-0.128 (0.332)	-0.197 (0.340)
	[0.102]	[0.147]	[0.147]	[0.136]	[0.165]	[0.132]	[0.206]
Lagged foreign equity %	0.082 (0.521)	0.081 (0.669)	0.080 (0.669)	0.081 (0.546)	-0.570 (0.132)	-0.323 (0.299)	0.130 (0.633)
	[0.138]	[0.189]	[0.189]	[0.169]	[0.378]	[0.310]	[0.271]
Lagged HTM equity %	0.070 (0.573)	0.073 (0.554)	0.073 (0.554)	0.088 (0.502)	-0.713 (0.048)	-0.446 (0.118)	0.079 (0.742)
	[0.123]	[0.152]	[0.152]	[0.176]	[0.360]	[0.284]	[0.242]
Lagged individual equity %	-0.097 (0.041)	-0.257 (0.029)	-0.250 (0.028)	-0.226 (0.031)	-0.160 (0.154)	-0.221 (0.009)	-0.056 (0.616)
	[0.042]	[0.114]	[0.116]	[0.117]	[0.112]	[0.084]	[0.111]
Input import tariff 1999			-0.113 (0.336)		-0.240 (0.350)	-0.241 (0.350)	-0.165 (0.311)
			[0.147]		[0.322]	[0.265]	[0.163]
Input import tariff 1999* WTO			-0.029 (0.718)		-0.029 (0.746)	-0.044 (0.205)	-0.115 (0.151)
			[0.085]		[0.091]	[0.035]	[0.080]
Export				-0.238 (0.108)	-0.100 (0.780)	-0.086 (0.190)	-0.502 (0.046)
				[0.148]	[0.359]	[0.066]	[0.252]
Export * WTO				0.140 (0.334)	0.298 (0.433)	0.298 (0.412)	0.231 (0.343)
				[0.145]	[0.380]	[0.376]	[0.243]
Constant	3.361 (0.000)	3.573 (0.000)	3.675 (0.000)	3.836 (0.000)	3.870 (0.001)	4.169 (0.000)	3.889 (0.001)
	[0.428]	[0.482]	[0.464]	[0.497]	[1.144]	[1.022]	[1.176]
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
City*Year effects	No	Yes	Yes	Yes	Yes	Yes	Yes
N	3064	3064	3064	3064	2918	2834	1262
R2	0.4781	0.4815	0.4688	0.4798	0.6089	0.6069	0.6168

Notes: This table reports coefficients from the regression of firm environmental performance on the interaction term of WTO and output import tariff 1999 and its interactions with cost leadership and differentiation. The dependent variable is environmental performance in 2000-2005. Robust standard errors clustered at industry level are in square bracket. P-values are in parentheses.