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ABSTRACT

Collective reputation implies an important externality. Among firms trading internationally, quality shocks about one firm's products could affect the demand of other firms from the same origin country. We study this issue in the context of a large-scale scandal that affected the Chinese dairy industry in 2008. Leveraging rich firm-product level administrative data and official quality inspection reports, we find that the export revenue of contaminated firms dropped by 84% after the scandal, relative to the national industrial trend, and the spillover effect on non-contaminated firms is measured at 64% of the direct effect. Notably, firms deemed innocent by government inspections did not fare any better than noninspected firms. These findings highlight the importance of collective reputation in international trade and the challenges governments might face in signaling quality and restoring trust. Finally, we investigate potential mechanisms that could mediate the strength of the reputation spillover. We find that the spillover effects are smaller in destinations where people have better information about parties involved in the scandal. New firms are more vulnerable to the collective reputation damage than established firms. Supply chain structure matters especially in settings where firms are less vertically integrated and exhibit fragmented upstream-downstream relationships.

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1 Introduction

In markets with information frictions, quality shocks about one firm's products could impose an externality on other firms selling similar products. Tirole (1996) formalizes the theory of collective reputation. In such settings, when an incident spoils the group's reputation, it can be hard for an individual firm to break away from the low-trust-low-quality equilibrium and new firms could be "endowed" with the damaged reputation. Empirically, how important is collective reputation and what are the potential mechanisms that mediate its strength?

In this paper, we study collective reputation in the context of trade and development. When selling on the international markets, producers from the same origin country are often viewed as a "group": for example, "Swiss watches", "French wines", and "Made-in-China". For firms in developing countries that are mostly positioned at the lower end of the value-added chain and export mainly non-branded products, a long international supply chain can make it particularly difficult to trace products to an individual producer within an origin country. As a result, collective reputation becomes especially important in determining firms' exporting performance. In fact, the rising safety and quality concerns regarding goods from developing countries in recent years can significantly hinder firms from penetrating the high-end markets.[1] In a recent survey of over 600 manufacturing firms in China, firms cited lack of reputation and mistrust as one of the main challenges of exporting to global markets.[2] Therefore, understanding how collective reputation spreads within an industry or a geographic area is important for informing trade and development policies.

We exploit a large-scale quality scandal that affected the Chinese dairy industry in 2008. Similar to many industries in developing countries and emerging markets, the Chinese dairy industry was dominated by a large number of small and non-established players that exhibited rapid growth prior to the scandal. Using administrative data on quality inspections conducted by the Chinese government following the scandal, we identify the firms and the products at each firm that failed the inspections (contaminated firm-product pairs) and those products and firms that were never found to be contaminated.[3] We merge the official inspec-

[1] A list of historical and contemporary incidents on food contaminations can be found at https://en.wikipedia.org/wiki/List_of_food_contamination_incidents#2001_to_present. Some of the recent prominent cases include the Chinese dairy scandal in 2008 and the Brazilian meat scandal in June 2017 (see an *Economist* article on the incidence: https://www.economist.com/news/business/21719416-chile-china-and-eu-have-banned-some-or-all-countrys-meat-meat-scandal-brazil).

[2] The survey is led by Jinan Institute for Economic and Social Research (IESR) and Guangzhou General Administration of Quality Supervision, Inspection and Quarantine. We thank IESR for sharing the survey instruments and the data.

[3] We conducted an extensive news search through LexisNexis to cross validate the official inspection reports. See Section 3.3 for more details.

tion lists with firm-product level Chinese Customs data and firm-level Manufacturing Survey data to examine both the direct effects of the scandal on contaminated firm-product pairs, as well as the effects on other products at the contaminated firms (within-firm spillovers) and the effects on innocent and non-inspected firms (across-firm spillovers).

We begin by showing that the scandal had a large impact on the overall export performance of the entire dairy sector in China, thus providing an ideal setting for studying within-sector spillovers. Using a difference-in-differences framework, we find that the average value of dairy exports plummeted by 68% following the scandal and failed to recover ever after five years. This estimate captures both the direct impact on contaminated firm-products and the spillovers on other firms and products. Decomposing the direct versus indirect impacts, we estimate an aggregate spillover effect of 57%, about four fifths of the total effect. Our estimates are robust to various empirical specifications that relax the classical DD assumption. To the extent that products by different dairy firms are imperfect substitutes, the estimates provide a lower bound on the collective reputation effect.

Next, we investigate how the spillover effects are distributed across different firms and products. We leverage the detailed micro data on export activities and inspection outcomes at the firm-product level. Our results suggest that contaminated firms saw a drop of 84% in export revenue after the scandal relative to the national industrial trend. These firms were also 14.2% less likely to export following the scandal. Furthermore, we find that innocent and non-inspected firms experienced an equally significant decline in export revenue that is about 64% of the effect on directly contaminated firms. Moreover, firms deemed innocent by government inspections do not fare any better than non-inspected firms. All together, these findings point to large reputation spillovers and highlight the potential challenges of government actions in helping firms to signal quality and restore trust.

Finally, we investigate potential mechanisms that may underlie the observed spillover effects. Since a firm's reputation is essentially constituted by buyers' beliefs and perception, the ways that consumers gather information and learn crucially matter for the extent of reputation externalities. Specifically, we examine the role of: 1) information accuracy in global media reports, 2) salience of individual (firm) brands, and 3) observability (or traceability) of the supply chain network.

First, to study the role of information accuracy and global media, we construct measures of consumers' knowledge about the scandal across different countries, using Google Trends Search indices for phrases that reflect a more or less accurate depiction of the event. We find that the spillover effects are smaller in countries where people appear to have better

information about the parties directly involved in the scandal, reflected in more targeted internet search behavior. In particular, the across-firm spillover effect is primarily driven by exports to destinations with low information accuracy.

Second, to examine the interaction between collective and individual reputation, we exploit baseline variation in firms' exporting experience and find that young firms are more vulnerable to the collective reputation shock, consistent with the theory outlined in Tirole (1996): a more established individual reputation can (partially) shield firms from the collective damage, whereas newcomers suffer more from the "original sin" of the predecessors.

Third, to examine the role of the supply chain network, we use the Chinese Customs data to identify the major sourcing location for each exporting firm. We find that sourcing the same products from the same location as a contaminated firm hurt export performance. This suggests that production networks matter in transmitting reputation spillovers, especially in settings where firms are less vertically integrated and exhibit fragmented upstream-downstream relationships, as in typical agricultural markets in developing countries.

A growing empirical literature studies firm reputation and quality provision in markets with information frictions (Banerjee and Duflo, 2000; Jin and Leslie, 2009; List, 2006; Macchiavello, 2010; Cabral and Hortacsu, 2010; Björkman-Nyqvist, Svensson, and Yanagizawa-Drott, 2013; Bardhan, Mookherjee, and Tsumagari, 2013; Macchiavello and Morjaria, 2015; Li, Tadelis, and Zhou, 2016). At the same time, prior studies have shown that information frictions play an important role in international trade (Allen, 2014; Macchiavello and Morjaria, 2015; Startz, 2017). We build upon these two bodies of research by examining the role of "group" reputation in trade. Our results demonstrate that collective reputation forces can have important implications on a country's trade pattern, acting as an underlying source of a country's comparative advantage.

Despite earlier works on the theory of collective reputation (Tirole, 1996; Winfree and McCluskey, 2005; Fleckinger, 2007; Levin, 2009; Fishman, Simhon, Finkelshtain, and Yacouel, 2010), empirical studies remain scarce (Freedman, Kearney, and Lederman, 2012; Bai et al., 2016; Zhao, 2018; Bachmann, Ehrlich, Fan, and Ruzic, 2019). Exploiting a natural experiment, our results explicitly identify this important source of externality, and illustrate how it is mediated by various informational and market forces.[4]

Finally, the study relates to the broad literature on firm performance and quality upgrad-

[4]There is also a literature in agricultural and resource economics that studies collective reputation in food and beverage industries, such as Bordeaux wine and regional appellations. Most studies use hedonic price regressions to examine the role of group reputation (e.g., Castriota and Delmastro (2014); Marchini, Riganelli, Diotallevi, and Paffarini (2014); Gergaud, Livat, Rickard, and Warzynski (2017)). We take advantage of a natural experiment that relaxes the identification assumptions.

ing in development and trade (Syverson, 2011; De Loecker and Goldberg, 2014). Previous studies have examined: (1) supply side constraints, including credit access, lack of quality inputs, and managerial constraints (e.g., De Mel, McKenzie, and Woodruff (2008); Harrison and Rodríguez-Clare (2009); Kugler and Verhoogen (2012); Banerjee (2013); Bloom, Eifert, Mahajan, McKenzie, and Roberts (2013)), and (2) demand side factors, including access to high-income markets (e.g., Verhoogen (2008); Park, Yang, Shi, and Jiang (2010); Manova and Zhang (2012); Atkin, Khandelwal, and Osman (2017)). This study highlights information frictions and low collective reputation as another potential barrier.[5]

The remainder of the paper is organized as follows. Section 2 provides background information on the 2008 Chinese dairy scandal and Section 3 describes the data. Section 4 presents motivating evidence on the overall impact of the scandal on the dairy industry. Section 5 analyzes reputation spillovers across firms and products. Section 6 examines mechanisms that could mediate the spillover effects. Section 7 concludes.

2 Background on the 2008 Chinese Dairy Scandal

The Chinese dairy industry exhibited fast growth during the early 2000, both in terms of domestic production and exports. The industry's average annual growth rate was as high as 23.93% prior to 2008. Figure 1 shows that the industry's annual export value increased over 3 times from 2000 to 2007. The number of exporting firms increased from 150 in 2000 to 335 in 2007.[6] Nonetheless, in 2007 dairy exports still constituted a relatively small share of the entire dairy production in China, and accounted for only $300 million of the country's $1.2 trillion exports revenue. Similar to many other industries in developing countries, it was dominated by a large number of small and non-established players.

Over the past decade, there has been an increasing number of quality and safety issues

[5]This paper also speaks to the literature on quality scandals and product recalls. Most of the previous studies have either relied on laboratory experiments to examine consumer reactions to hypothetical product scandals (Ahluwalia, Burnkrant, and Unnava, 2000; Dawar and Pillutla, 2000)), or focused primarily on stock market outcomes using an event-study approach (Davidson and Worrell, 1992; Marcus, Swidler, and Zivney, 1987; Zhao, Lee, Ng, and Flynn, 2009)). Furthermore, most studies focus on losses in own sales and stock market price (Van Heerde, Helsen, and Dekimpe, 2007), rather than across-firm spillovers. The most closely related study is Freedman, Kearney, and Lederman (2012), which examines toy recalls in the US and documents sizable spillover effects.

[6]Figure 1 shows a spike in export growth between 2006 and 2007–the total value of exports increased by about 138%. This spike is mainly driven by new firms entering into the exporting markets. Specifically, 30 firms contributed more than 80% of the growth spike; over 50% of the spike is driven by a single product–milk powder; finally, over 50% of the spike is driven by exports to 6 destinations, namely Thailand, Germany, Bangladesh, Taiwan, UAE and Hong Kong.

regarding Chinese food products. One of the most widely known incidents is the distribution of contaminated baby milk formula in September 2008, hereinafter referred to as "the scandal". The incident led to 4 infant deaths, 51,900 hospitalized children and 700 tons of milk powder recalled nationwide. The infant formula was found to be illegally adulterated with the industrial chemical melamine, which was added to mimic higher protein content in the milk. Melamine is commonly used in the manufacturing of plastics and has been linked to an increased risk of kidney stones (Hau, Kwan, and Li, 2009).

Following the initial outbreak, the Chinese government quickly shut down the supplier of the contaminated milk powder, Sanlu Group, which was one of the largest dairy firms in China. However, further investigations revealed that the adulteration stemmed from malpractices of some upstream milk producers, raising the suspicion that more downstream dairy firms could have been affected.[7] This discovery led to three big rounds of government inspections: the first round targeted firms producing infant formula–175 firms were inspected and 22 were found to have traces of melamine in their products. The subsequent 2 rounds targeted producers of milk powder and liquid milk respectively, and covered most dairy producers in China. We describe the three rounds of inspections in greater detail in Section 3.3. These inspections uncovered contamination in more dairy and dairy-related products, including yogurt, milk, cheese, baby food, and cake. Product recalls were immediately issued. By the end of 2008, the Chinese government issued an official statement that the incidence had been fully addressed and proper measures had been put in place to ensure the safety of the dairy products on the market.[8] Corroborating the Chinese government's statement, data from EU's Rapid Alert System for Food and Feed, which publishes safety notifications and recalls for imported food products, shows that notifications related to melamine contamination in dairy products imported from China surged in the Fall 2008 but quickly subsided a few months after the initial outbreak (see Figure A.1).

Despite the official statement, the scandal triggered widespread fears over food safety in China. Thousands of Chinese dairy-related products were pulled from supermarket shelves across the world. Some countries stepped up inspections for Chinese imports, while others issued explicit import bans for products containing dairy ingredients from China. For instance, the EU authorities stipulated tests for Chinese imports containing more than 15% of milk powder and announced a ban on all products for children coming from China that contained milk; the US Food and Drug Administration restricted imports of all Chinese food

[7] According to the investigation reports, these malpractices were in fact "open secrets" in the industry. See https://www.wsj.com/articles/SB122567367498791713

[8] http://www.telegraph.co.uk/news/worldnews/3079146/China-claims-tainted-milk-scandal-is-over.html

products containing milk; India imposed a temporary ban on import of milk and all milk-related products from China and extended this ban till 2019. Our news search has identified 43 destinations (out of 282) that imposed explicit regulatory bans on certain Chinese dairy imports (see Table B.1).

The scandal has had a long-lasting impact on the dairy industry in China. The General Administration of Quality Supervision, Inspection and Quarantine (GAQSIQ) stopped issuing national exemption status to domestic food producers[9] and tightened inspections on domestically produced food products. Dairy firms also tightened their standards for purchased raw milk and some started to build their own upstream milk farms to better monitor and control quality. Despite these actions, the scandal came as a devastating blow to the industry and almost entirely wiped out the country's dairy exports in the ensuing years. Figure 1 shows that dairy exports sharply collapsed after 2008 and failed to recover even by the end of 2013, the end of our sample period. At the same time, dairy imports in China rose rapidly after the scandal (Figure A.2), suggesting that domestic consumers also switched to foreign dairy products in response to safety concerns surrounding the domestic brands.

3 Data

We assemble three micro-level datasets: the Chinese Customs Database, the Chinese Manufacturing Survey, and the list of inspections conducted by the Chinese government following the scandal. We merge the three datasets using detailed firm and product information.

3.1 Chinese Customs Database (2000-2013)

The Chinese Customs Database provides information on transaction-level trade flows for the universe of China's exports and imports over the time period. The data is collected and made available by the Chinese Customs Office. For the analysis in this study, we focus on exports. For each transaction, we observe the exporting firm name, location, value and quantity of the exports, the HS eight-digit product code, the city in China where the product is sourced from and the final exporting destination. We compute unit prices for exported products by dividing the value of exports by quantity. While the data is available at daily frequency, for our analysis we aggregate the data to firm-product-year level. Figure A.3 plots China's

[9]This was previously known as the "inspection-free" program, which gave exemption status to qualified food producers and waived various quality inspections for these firms.

overall export growth over time. Exports grew rapidly during the early 2000s following the entry into the World Trade Organization (WTO).

We define "dairy industry" using the HS eight-digit product classification. Most of the dairy products fall under the HS two-digit code 04, while infant dairy products fall under 19 and milk protein products extracted from raw milk fall under 35. Table B.2 provides the full list of the HS eight-digit codes and descriptions for dairy products.

3.2 Chinese Manufacturing Survey (2005-2009, 2011-2013)

The Chinese Manufacturing Survey data is compiled from annual surveys conducted by the National Bureau of Statistics (NBS), and includes all industrial firms that are identified as being either state-owned or non-state firms with sales revenue above 5 million RMB. As described in previous studies, even though a large number of small to medium industrial firms (80%) are excluded from the sample, they account for only a small fraction of the total economic and export activities in China. In particular, the excluded firms employ 28.8% of the industrial workforce, but only produce 9.3% of the total output and generate 2.5% of the export revenue (Brandt, Van Biesebroeck, and Zhang, 2012). Our analysis focuses on dairy firms within the manufacturing sector. For each firm-year observation, we observe basic production and financial information, including firms' four-digit industry code, years of operation, total sales, employment, and export revenue.

3.3 Government Inspection Lists

The Chinese government implemented three rounds of inspections after the scandal broke out in late 2008. The three rounds of inspections focused respectively on producers of infant formula, milk powder, and liquid milk. In the first round, the government inspected all 109 infant formula producers in China and found 22 to be contaminated. The second round inspected 154 randomly sampled milk powder producers (together making up over 70% of the market share) out of 290 producers nationwide and found 20 to be contaminated. The third round targeted 466 more established dairy brands with large market shares, and found 9 plants of 3 major brands to be contaminated.

For each round of inspection, the Chinese government released the full list of firm names, the products of each firm being inspected and the corresponding inspection results. We obtained the inspection lists (at the firm-product level) from the official GAQSIQ website. To cross validate the information in the official reports, we conducted an extensive news

search through LexisNexis: all the media-reported cases of contamination we could find were covered in the Chinese official inspection reports.

We merge the firm-product level inspection lists with the Customs data using firm names and product information, and with the Manufacturing Survey data using firm names (since we do not observe product information in the Manufacturing Survey). Based on the firm-product level inspection information, we classify firms into one of the three following categories: contaminated, innocent, and non-inspected firms. The first is defined as firms with at least one product found to be contaminated during one or more rounds of the inspections. The second is defined as firms that passed the tests for all of their inspected products. The third group includes firms that were never inspected. We can classify products into these three categories analogously: for example, contaminated products are those found to be contaminated in at least one of the inspected firms, and innocent products are those that cleared the inspection in all firms inspected.

Using these definitions, we've identified 149 contaminated firm-product pairs in 67 contaminated firms, and 413 innocent firm-product pairs in 95 innocent firms in the Customs data. The Manufacturing Survey data contains 73 contaminated and 352 innocent firms.

3.4 Summary Statistics

Table 1 presents firm-level baseline (2000-2007) summary statistics. It reports the number of non-missing observations, mean and standard deviation for a set of key export performance measures (Panel A), as well as employment and total sales (Panel B), separately for contaminated (Columns 1 and 2), innocent (Columns 3 and 4), and non-inspected firms (Columns 5 and 6). Column 7 calculates the difference in means between the contaminated and non-inspected firms (Column 2 and 6) and Column 8 reports the p-value of the difference. Panel A shows that on average, contaminated firms have larger exporting revenue and are more experienced compared to innocent firms; however, they are not systematically different from the non-inspected firms. Panel B reinforces that observation that contaminated firms are larger in terms both of employment and of sales revenue than innocent firms and non-inspected firms. This is consistent with the fact that the Chinese government targeted larger firms in the third round of inspection.[10]

Table 2 presents product-level baseline summary statistics for the same export performance measures. Panel A shows that on average contaminated products are exported in larger amount and for more years comparing to innocent and non-inspected products. Con-

[10]Table A.1 presents the same baseline summary statistics for non-dairy food industries.

taminated products also appear to be less likely to be exported to countries in the Organization for Economic Cooperation and Development (OECD) although the difference is not significant. Panel B presents the same summary statistics for non-dairy food products.

Figure A.4 plots the number of exporting products and destinations for contaminated, innocent and non-inspected firms before and after the scandal. Many firms exported a single product to a single destination, but some export multiple products to multiple destinations. In Section 5, we discuss in greater detail how these patterns help generate the variation we exploit for the firm-product level analysis.

4 Impact of the Scandal: Industry Level Analysis

This section estimates the overall impact of the scandal on the export performance of the Chinese dairy sector. Section 4.1 discusses our preferred empirical specification, a difference-in-differences (DD) specification, as well as threats to the validity of the DD assumptions and additional tests we perform that relax these assumptions. Section 4.2 presents our DD estimates. Our finding that the scandal decreased the total value of dairy exports by 68% over the course of five years motivates us to further explore the within-sector spillovers across firms and products in Section 5.

4.1 Empirical Specification

Equation (1) presents our baseline difference-in-difference specification, which compares the value of exports of dairy products, the treated industry, to the value of exports of other two-digit level industries before and after 2008, the year of the scandal.

$$Y_{jt} = \beta_{\text{dairy}} \text{Dairy}_j \times \text{Post}_t + \gamma_j + \delta_t + \pi X_{jt} + \epsilon_{jt} \tag{1}$$

Y_{jt} is the natural logarithm of the value of exports for industry j in year t; Dairy_j is an indicator for the dairy industry; X_{jt} include time-varying controls at the industry level, such as the value share exported to different continents at baseline (2000 to 2007) interacted with year indicators. We introduce these covariates to control for differential trends in destination countries that might affect different industries differently. In our preferred specification, we limit the set of control industries to exclude non-dairy food industries. The latter might be affected by the scandal as well, if foreign consumers update their perception about the quality of Chinese food products in general following the scandal. This leaves us with 79

control industries. We cluster standard errors at the industry level allowing for arbitrary correlation in error terms across time for a given industry.

The internal validity of the DD design rests on the assumptions that the treated and control industries would be on parallel trends absent the scandal. The parallel trends assumption might not hold for two reasons. First, as discussed in Section 2, the dairy industry saw a rapid growth in exports prior to the scandal, a growth episode that might not be paralleled by other industries. Second, the global financial crisis in 2008 could have affected different industries differently. If so, we may erroneously attribute to the scandal an export decline in dairy products that was in fact due to the crisis. Perfectly overcoming these concerns is challenging in the current context. We perform a series of robustness checks to address these issues to the best we can. In particular, we show that our estimates of the impact of the crisis are robust to several specifications that relax the parallel trends assumption, such as including a vector of industry-specific linear time trends in Equation (1). We further supplement our DD specification with an interactive fixed effect model (Gobillon and Magnac, 2016) and synthetic control method. Reassuringly, the different methods, despite relying on different identification assumptions, produce qualitatively and quantitatively similar estimates to the DD design. Appendix C presents the alternative empirical strategies and results.

4.2 Results: Difference-in-Differences

Table 3 presents estimates of Equation (1). We focus first on Panel A. The baseline specification in Column 1 includes only year and industry fixed effects, and estimates a decline of 65.5% in the value of dairy exports following the scandal.[11] Columns 3 and 4 build on this specification by adding time-varying controls and industry-specific linear trends. Our preferred specification in Column 4 estimates that the value of dairy exports plummeted by 68% following the scandal. Column 2 expands our sample to include non-dairy food industries. The interaction coefficient between the indicator for food industry and post dummy suggests that the scandal did not affect the non-dairy food industries in an economically and statistically significant way.

Panel A estimates the overall impact of the scandal on the dairy industry, capturing both the direct impact on contaminated firm-products, as well as the spillovers on innocent and non-inspected firms and products. We can gauge the aggregate spillover effect by excluding

[11]Because most of the coefficients we estimates are large in magnitude, in what follows we compute elasticities using the mathematical formula: Elasticity $= (e^{\text{Coeff}} - 1) \times 100$, where Coeff is the estimated coefficient reported in the tables.

the contaminated firm-products from the "treated" (dairy) industry. Panel B shows that the overall spillover effect on the innocent and non-inspected sample appears to be slightly smaller than the total effect, although this difference is only statistically significant in our preferred specification in Column 4. Specifically, we estimate a spillover effect of 57% decrease in exports for the innocent and non-inspected firm-products, about four fifths of the total effect of the scandal on the entire dairy sector.

5 Reputation Spillover: Firm-Product Level Analysis

Motivated by the findings in the previous section, we next zoom into the dairy sector and examine the extent to which the impact of the scandal spilled over across firms and products. Specifically, we are interested in examining both the direct impact on contaminated firm-products, as well as the spillover effects *within* and *across* firms in the industry. To do so, we take advantage of the rich micro-level data on export activities at firm-product level, and merge those with inspection outcomes as described in Section 3 to exploit *within-industry* variation in the involvement in the scandal. Our main regression specification is as follows:

$$\begin{aligned} Y_{fpt} &= \beta_{\text{direct}}\text{CFirm-Product}_{fp} \times \text{Post}_t \\ &+ \beta_{\text{within-firm}}\text{CFirm}_f \times \text{Post}_t \\ &+ \beta_{\text{across-firm}}\text{CProduct}_p \times \text{Post}_t \\ &+ \lambda_1\text{IFirm-Product}_{fp} \times \text{Post}_t \\ &+ \lambda_2\text{IFirm}_f \times \text{Post}_t \\ &+ \gamma_{fp} + \delta_t + \epsilon_{fpt} \end{aligned} \tag{2}$$

We restrict the analysis to the dairy industry. The dependent variable Y_{fpt} is an outcome for firm f product p at year t, including the inverse hyperbolic sine (IHS) transformation of export revenue and export quantity, the natural logarithm of export price, and an indicator for exporting.[12] Except for the price outcome, we first create a balanced panel at firm-product and year level in order to capture extensive margin responses (i.e., entry and exit into exporting). $\text{CFirm-Product}_{fp}$ is an indicator for contaminated firm-product pairs directly involved in the scandal: the indicator equals 1 if a given product of a firm was inspected and failed the quality test. CFirm_f is an indicator for contaminated firms involved in the

[12] We use the IHS transformation for export revenues and quantity to obviate the fact that we have missing firm-product-year cells when exports are zero (Burbidge, Magee, and Robb, 1988).

scandal: the indicator equals 1 if a firm was inspected and *at least one* of its products failed the test. CProduct_p is an indicator for contaminated products involved in the scandal: the indicator equals 1 if at least one of the inspected firms failed the quality test for the given product. $\text{IFirm-Product}_{fp}$ and IFirm_f are defined similarly: $\text{IFirm-Product}_{fp}$ is an indicator for innocent firm-product pairs that were inspected and passed the quality test. IFirm_f is an indicator for innocent firms that passed the quality test for *all* of their inspected products.

Identification relies on the assumption that unobserved firm-product-year specific shocks that affect the outcomes are uncorrelated with the initial inspection status. In other words, absent the scandal, all firm-products would have seen the same growth in export performance over time. However, the Chinese government did not choose which firms to inspect randomly: Table A.3 shows that even for the second round of the inspection, where the inspections were claimed to be random, inspected firms appear to differ from non-inspected firms based on several observable characteristics, including the value of exports in 2007. Overall, inspected firms are on average larger than non-inspected firms (Section 3.4).

To assuage concerns of omitted variable or selection bias, our preferred specification controls for 1) firm-product (γ_{fp}) and 2) year (δ_t) fixed effects, as well as 3) an interaction of baseline firm-product export volume with the post indicator. First, this specification partials out time-invariant firm-product unobservable characteristics, such as quality. Second, it controls for common nationwide dairy industry time trends, such as global demand shocks. Third, we allow for differential trends for firms of different sizes to ensure we account for the fact that firms of different sizes might have been on different growth trajectories during the dairy boom prior to the scandal. Thus, our analysis captures differential changes in performance across firm-products over time. To examine the sensitivity of our results, we also estimate an alternative specification controlling for firm, product and year fixed effects separately (Table A.2). We cluster standard errors two-way at the product-year and firm level allowing for arbitrary correlation in error terms across time for a given firm and for a given product-year across firms.

The omitted category in Equation 2 includes innocent and non-inspected products from non-inspected firms. Therefore, $\beta_{\text{across-firm}}$ identifies the impact of the scandal on non-inspected firms selling one of the contaminated products (i.e., *across-firm* spillovers). $\beta_{\text{within-firm}}$ identifies the overall impact on the contaminated firms (i.e., *within-firm* spillovers) whereas β_{direct} captures the additional impact on their directly involved products. Similarly, λ_1 and λ_2 capture the impact on the innocent firms and innocent firm-products relative to the omitted group. Table A.4 describes the variation in the data in each group that allows us to

identify these various effects.

We first present our baseline estimation results in Section 5.1 and discuss alternative explanations and additional robustness checks in Section 5.3.

5.1 Results: Direct and Spillover Effects on Exports

Table 4 reports the main estimates from Equation (2). Column 1 examines the impact of the scandal on the IHS of export revenue and shows large within-firm and across-firm spillovers. Specifically, we estimate $\hat{\beta}_{\text{within-firm}} = -1.8$, significant at the 1 percent significance level, that is, contaminated firms experienced a drop of 84.1% in export revenue after the scandal relative to the national trend and the firms' average performance. Within contaminated firms, directly involved products are affected more–the estimated coefficient β_{direct} is meaningful (-0.489, or -38.7%) but imprecisely estimated, suggesting that there may be a lot of heterogeneity among the subset of directly contaminated firm-products. Another possibility is that since most products within the contaminated firms are affected, the coefficient is only picking up any *differential* impact of contaminated versus innocent and non-inspected products within those firms.

Next, in line with the industry-level analysis in Section 4, we see a large and negative spillover impact on firms selling contaminated products: the estimate for $\beta_{\text{across-firm}}$ is -0.773 (or -53.8%) and is significant at the 1 percent significance level. Finally, the effects on innocent firms and products are very mixed: while the coefficient on IFirm-Product×Post is large and positive, the overall impact on innocent firms, relative to non-inspected firms, is negative. Both of these estimates are not statistically significant.

Column 2 examines the effects of the scandal on the IHS of export quantity and finds similar results. Comparing the estimates of $\beta_{\text{across-firm}}$ in Column 1 and 2, the decrease in quantity explains 97.9% of the across-firm spillover, after taking into account entry and exit.

Column 3 examines changes in unit price. The regression is estimated on the unbalanced panel of firm-product-year observations with positive export activity. The estimate of $\beta_{\text{across-firm}}$ is -0.157 (-14.5%) and is significant at the 10 percent significance level. The direct impact on contaminated firm-products is -0.122 (-11.5%) but is not statistically significant, whereas the within-firm spillover $\hat{\beta}_{\text{within-firm}}$ is positive at 0.293 (23.2%) with a standard error of 0.051. We speculate that firms, especially contaminated firms, may have lowered prices for products that were found to be contaminated, while at the same time switched production to higher-end products, resulting in an overall increase in the firm-level price.

Column 4 examines the impact of the scandal on the extensive margin, and finds that

contaminated firms are 14.2% less likely to export after the scandal. The estimate for $\beta_{\text{within-firm}}$ is significant at the 1 percent significance level, whereas the one for β_{direct} is non-distinguishable from 0. All Chinese dairy firms carrying contaminated products, regardless of whether innocent, contaminated or not inspected, are 6.2% less likely to export contaminated products, and the estimate of $\beta_{\text{across-firm}}$ is significant at 1 percent significance level. The results on innocent firms and products are again inconclusive.

Finally, we examine how persistent the direct and spillover effects are by fully interacting the firm-product group dummies with year dummies in Equation (2). Figure 2 plots the regression coefficients with standard errors for two outcome variables: log value of exports and exporting indicator. We see that both the within-firm and across-firm spillover effects persist over five years after the scandal and display little sign of recovery.

5.2 Interpretation: The Role of Government Inspections

Overall, the results show large within-firm and across-firm spillovers in export performance: both the non-inspected products of contaminated firms and the contaminated products of non-inspected firms were significantly adversely affected by the scandal. On the other hand, the effects on innocent firms and products are highly mixed. To the extent that inspection outcomes released by the Chinese government can serve as a form of quality signal, these results warrant more investigation. This section discusses two potential explanations for the mixed results on innocent firms and products.

The first explanation is that the public might perceive government inspections as a bad signal for potential quality violations. The fact that a firm went under inspection may indicate that something was not right, even though some of the inspections were claimed to be targeted at random (see discussions in Section 2). An alternative explanation is that any firm that appears in the post-scandal news reports is associated implicitly with the scandal stigma if people do not pay attention to the details of the news. Ma, Wang, and Khanna (2016) discuss this "reminder (salience) effect".

Table 5 examines the impact of the scandal on firms' domestic performance using the manufacturing survey data. Since information on domestic sales is not available at the product level, we conduct the analysis at the firm level and restrict the sample to a balanced panel to control for sample composition changes. The coefficients are less precisely estimated. Qualitatively, we see a negative impact of the scandal on contaminated firms while the innocent firms do not appear to perform better than the non-inspected ones.

Overall, these findings are consistent with the two potential explanations discussed above

and highlight the challenges governments might face in trying to send signals to the market and restore trust via inspection efforts. These results speak broadly to the importance of understanding the process of information acquisition and the resulting information set of consumers. We come back to this point in Section 6 when we discuss the mechanisms underlying the reputation spillovers.

5.3 Alternative Explanations and Robustness Checks

This section considers several alternative explanations that may contribute to the results in Section 5.1 aside from reputation spillovers and presents additional robustness checks.

5.3.1 Differential Time Trends

Different sub-industries within the dairy sector may be on different growth trajectories: in particular, contaminated products may grow faster or slower than other products absent the scandal, leading to biased estimates of the spillover effects. Table A.5 allows for differential time trends across sub-industries at the HS two-digit level. Reassuringly, the results look qualitatively very similar to the results in Table 4.

Contaminated firms and other firms may also be on different growth trajectory. If the contaminated firms were growing faster prior to the scandal, the estimated coefficients would be partly driven by these fast-growing firms mechanically scaling down their production and reducing exports after the scandal. To alleviate this concern, we allow for differential time trends with respect to baseline sales in our baseline specification. In Table A.6, we further exclude firms and destination countries that account for most of the export growth spike between 2006 and 2008 (see more discussion in Section 2). The results are very similar.[13]

5.3.2 Confounding Supply-Side Factors

Collective reputation represents a demand-side force, but there may be supply-side forces changing at the same time that impact Chinese dairy exporters. For example, the scandal may have disrupted the activities of some upstream suppliers; some milk farmers and milk stations exited the market as a result. Similarly, stronger government regulations may exert additional costs on firms, raising their production costs. All these supply-side forces can lead to reductions in export revenue and quantity. However, a pure upward shift of the supply

[13] As discussed in Section 2, a few predominant firms and export destinations drive the growth spike in the pre-scandal period (2006-2007).

curve would have resulted in an unambiguous increase in price (conditioning on exporting), contrary to what is shown in Table 4 Column 3: the coefficient on CProductXPost, the key collective reputation spillover effect, is negative and significant at 10 percent level.[14] This result alone implies that the demand curve must be moving downward and outweigh the supply curve movement. While we cannot completely rule out the effect of all supply-side factors, we can conclude from the analysis that the demand-side force due to collective reputation played an important role in this context.

5.3.3 Confounding Foreign Demand Shocks

Different firms may be subject to idiosyncratic demand shocks depending on the conditions in the destination countries they export to. If contaminated firms are more likely to export to countries that happen to demand more or less imported dairy products after 2008, the estimated $\hat{\beta}_{\text{direct}}$ and $\hat{\beta}_{\text{within-firm}}$ would be biased. To examine this possibility, we construct a measure of firm-specific demand shock using a firm's baseline export value share to each destination country multiplied by each destination country's yearly dairy imports from the rest of the world excluding China and summed over all destinations. Table A.7 shows that our results are robust to including these firm-specific demand shocks as additional controls.

5.3.4 Foreign Import Regulations Due to Protectionist Motives

Import regulations directed to all firms from the same origin-industry can result in similar "spillover" patterns in Table 4. As we discussed in Section 2, after the 2008 scandal, several destinations imposed explicit import bans on Chinese dairy products. Table B.1 list these destinations by their value share of the total dairy exports from China.

One way to think about such trade policy is that foreign governments react on behalf of domestic consumers in light of rising safety concerns about products imported from a particular country. Such blanket-style regulations can be regarded as an underlying channel for the collective reputation effect. However, a different story is that some of these regulatory hurdles may arise from protectionist motives. In other words, foreign countries can take advantage of the scandal to raise import barriers. Empirically distinguishing these two stories is challenging. We perform an additional analysis by looking at the performance of Chinese dairy exporters only to those destinations without explicit import bans. Interestingly, the results, shown in Table A.8, are very similar to the main results. This suggests that while

[14] We can repeat the price regression on a balanced sample of exporters (i.e., firms which exported both before and after the scandal) to account for any sample composition change; the results are robust.

explicit government regulations are present, they cannot explain the spillover effects in full. Market-based forces due to collective reputation do matter.

6 Mechanisms

In this section, we investigate three potential mechanisms that could mediate the strength of the reputation spillover effects documented in Sections 4 and 5. Since a firm's reputation is constituted essentially by buyers' beliefs and perception, the ways that consumers gather information and learn crucially matter for the extent of reputation externalities. Thus, each of the mechanisms we investigate is inherently related to how consumers' information set is formed and shaped. Specifically, we examine the roles of: 1) information accuracy in global media reports, 2) salience of individual (firm) brands, and 3) observability (or traceability) of the supply chain network. In this and other real world contexts, all of these forces can act jointly and interact with one another. Rather than trying to disentangle and quantify the impact of each, our goal is to examine whether a particular force has bite.

6.1 Information Accuracy in Global Media Reports

A vast literature has shown that media influences people's perception, thereby affecting a wide range of social and economic outcomes (DellaVigna and Gentzkow, 2010). In the context of food scares, Adda (2007) and Luong, Shi, and Wang (2019) show that news information alters consumers' perceived risk of encountering low quality products and thereby affects demand. Therefore, the way that media reports an event matters for the event's implications. We investigate an important aspect of media reports: informational accuracy, that is, the level of detail with which media outlets described the involvement of different firms in the scandal. Figure A.6 Panel A shows a typical Chinese media report on the scandal which usually came with a full list of contaminated firms and products. On the other hand, Panel B shows an example from the Western media, the New York Times, which only reported an estimated number of contaminated firms but did not mention any specific name.

Such heterogeneity in media contents across countries can generate different information sets among local consumers. We can imagine two scenarios: one in which consumers perfectly understand the evolution of the scandal and are able to closely keep track of the inspection outcomes, and the other in which consumers have trouble identifying the contaminated firms and begin to worry about Chinese dairy products in general as a result of the scandal. Collective reputation forces would be stronger in the latter scenario compared to the former.

To construct a systematic measure of consumers' information accuracy across different export destinations, we leverage Google Trends data. Google Trends provides public time series indices based on Google Search data, which capture how often a search term is entered relative to the total search volume in a given geographical area. To compare relative popularity across search terms, each data point of Google Trend indices is divided by the total searches of the geographical area and the time range it represents, and scaled on a range of 0 to 100 for any given period. We collect two types of search indices, a web search index and a news search index, for different countries and regions. For each index, we construct the relative search intensity ratio for the two keywords, "Sanlu" versus "2008 Chinese milk scandal". Figure 3 displays the relative search intensity for several regions and countries. It shows that web users on the left panel–China, Hong Kong and New Zealand–search "Sanlu" much more than the generic phrase, suggesting that consumers in these locations may be more informed about the parties directly involved in the scandal. In comparison, information appears to be much less specific in countries on the right panel–the US, Canada and UK.[15]

We collect the web and news search intensity ratios for all rcountries and regions available on Google Trends–there are 31 in total. We classify them into two groups according to the relative search intensity: "high" indicates a higher ratio and thus higher information accuracy. Table B.3 describes the classification.

Table 6 reports the heterogeneous impact of the scandal on export performance to destinations with high and low search intensity ratios, using the news search index. Consistent with the discussion above, the across-firm spillover effect ($\hat{\beta}_{\text{across-firm}}$) is driven by exports to destinations with low information accuracy (-0.617 compared to -0.044). The p-value for testing equality of two coefficients is 0.0616.[16] Results using the web search index are presented in Table A.9 and the qualitative takeaways are very similar.

Overall, the results show that information accuracy plays an important role in mediating the collective reputation force. This may be particularly relevant in the context of international trade as media coverage of events that happen in foreign countries, where information needs to travel far, may be less precise due to the lack of local knowledge.

[15] Figure A.5 shows the search behavior across provinces in China. Not surprisingly, Hebei province, where the headquarter of Sanlu was located, has the highest search intensity for the keyword "Sanlu".

[16] For this test we cluster standard errors at firm level.

6.2 Salience of Individual Brand

A firm's reputation can have both an individual component and a collective component: for example, consumers may observe a noisy signal of the industrial average quality as well as a signal from each firm. In this case, a strong individual reputation can potentially mitigate the impact of a collective reputation shock. As many industries in developing countries, most of the Chinese dairy exporters lack established international brand. However, some had exported for more years than others before 2008. We use a firm's exporting experience as a proxy for its individual reputation stock. Due to our short baseline period, we define "new (young)" firms as those that just entered into exporting in 2008 and define "established" firms as those that had exported for one or more years prior to 2008.

Table 7 shows the heterogeneous impact of the scandal on new and established firms. In line with the above discussion, the across-firm spillover effect is larger for new exporters (again we allow for differential time trends with respect to firm size, which is likely to differ between new and established exporters). A test of equality of $\hat{\beta}_{\text{across-firm}}$ in Column 1 and 2 (or Column 3 and 4), has p-value of 0.0191 (or 0.0734). The test of equality of the spillover effects on the extensive margin, $\hat{\beta}_{\text{across-firm}}$ in Column 5 and 6 (or Column or 7 and 8), has p-value of 0.0335 (or 0.1313).[17] We interpret these findings as evidence that in light of a collective reputation shock, a more established individual reputation can (partially) shield firms from the collective damage, whereas newcomers are more likely to suffer the "original sin" of the predecessors.

6.3 Information on the Supply Chain Structure

The production process and supply chain structure could matter for reputation spillovers. If the root cause of a quality defect is limited to an individual firm, consumers may not be concerned about other firms from the same origin-industry. One example of this is the case of Samsung Galaxy battery fire. By contrast, if the quality defect stems from upstream production processes, such as in the case of the Chinese dairy scandal (see discussion in Section 2), the supply chain structure could become important. Indeed, typical supply chains in agricultural settings in developing countries feature a large number of fragmented upstream producers selling to downstream traders and firms. Quality control by the downstream parties can be very difficult. Therefore, in light of a quality scandal about product quality of one firm, consumers have reasons to worry about the quality of other firms that source

[17] For this test we cluster standard errors at firm level.

from the same upstream sources.

To shed light on this mechanism, we take advantage of the Chinese Customs Data in which firms are required to report the sourcing location for each of their export transactions. We leverage this information to identify a firm's major sourcing city based on the firm's pre-scandal export values from each city. We define an indicator variable called "CSourceCity" if a city hosts at least one contaminated firm. Similarly, we define an indicator variable called "CSourceCity-Product" if a city hosts *at least* one contaminated firm for a given contaminated product.

Table 8 reports the impact of sourcing from a contaminated location, for innocent and non-inspected firms. The coefficients are not estimated precisely, but the point estimates suggest that sourcing the same products from the same location as a contaminated firm can hurt export performance. Note that there is a potential countervailing competition effect: to the extent that firms in one location compete for the same labor market and upstream suppliers, innocent and non-inspected firms may benefit as their rivals were hit by the scandal. Therefore, the negative coefficient on CSourceCity-ProductXPost can be seen as a lower bound of the collective reputation effect.

Summary: This section explores three mechanisms potentially driving collective reputation spillovers. First, information accuracy plays an important role in mediating the strength of collective reputation—the spillover effects are smaller in destinations where people appear to have had better information about parties involved in the scandal Second, individual reputation can mitigate collective reputation damage, and new firms appear to be the most vulnerable to collective reputation shocks. Finally, supply chain structure matters especially in settings where firms are less vertically integrated and exhibit fragmented upstream-downstream relationships.

7 Conclusion

Understanding how reputation spreads within an industry or a geographic area is important for informing trade and development policy as collective reputation implies an important externality. This paper studies this question in the context of Chinese dairy firms' exports following the 2008 scandal. We document strong reputation spillover effects on non-contaminated firms. Surprisingly, firms deemed innocent by formal inspections do not appear to be faring any better than non-inspected firms. These findings highlight the important role of collective reputation in international trade and the challenges governments might face

in trying to signal quality and restore trust. We further investigate potential mechanisms that underlie the spillover effects. All together, the analyses highlight the role of information accuracy, individual reputation and supply chain structure in mediating the strength of the collective reputation effect.

Naturally, the external validity of the results is an empirical question as the exact magnitudes of the spillovers vary across industries and countries. The framework and approach set out here could be used to study similar issues in other contexts. Our study has two broad policy implications concerning 1) the role of government and third-party certifications and 2) the role of market structure.

First, collective reputation may call for government interventions, but government-led inspection efforts may generate counterproductive signals depending on the reputation of the inspection body itself. Private third parties and international certification bodies may act as an effective complement or substitute for government regulations, especially in developing country settings. Yet, based on our interviews with firms in the Chinese dairy industry, third-party certification has not been adopted in this sector. This could be either due to high costs and logistical hurdles of obtaining these certifications, or perceived low returns from certification. Understanding the barriers to adoption as well as the effectiveness of these programs is crucial for designing policies that could assure a high quality standard and break the low-quality-low-reputation equilibrium.

Second, the study takes a first step in investigating various mechanisms that may affect the transmission of reputation spillover. Understanding these mechanisms can help inform policies in light of a collective reputation crisis. In the context of the Chinese dairy industry, one noticeable reaction many firms undertake following the scandal is vertical integration with upstream milk farms. One rationale for this is to enforce stronger quality control (Hansman, Hjort, León, and Teachout, 2017); an equally important rationale is to signal to the market the supplier relationship, so that a firm is better shielded from wrongdoings of other firms' suppliers. By 2018, over 70% Chines raw milk was produced from vertically-integrated milk farms.[18] Future work is needed to understand more about how collective reputation affects firms' quality investment incentives, including endogenous supplier network formation. Acting as an important externality, it could also have rich interactions with other market forces, such as entry and market competition.

[18]News source: http://news.ifeng.com/a/20180611/58672931_0.shtml.

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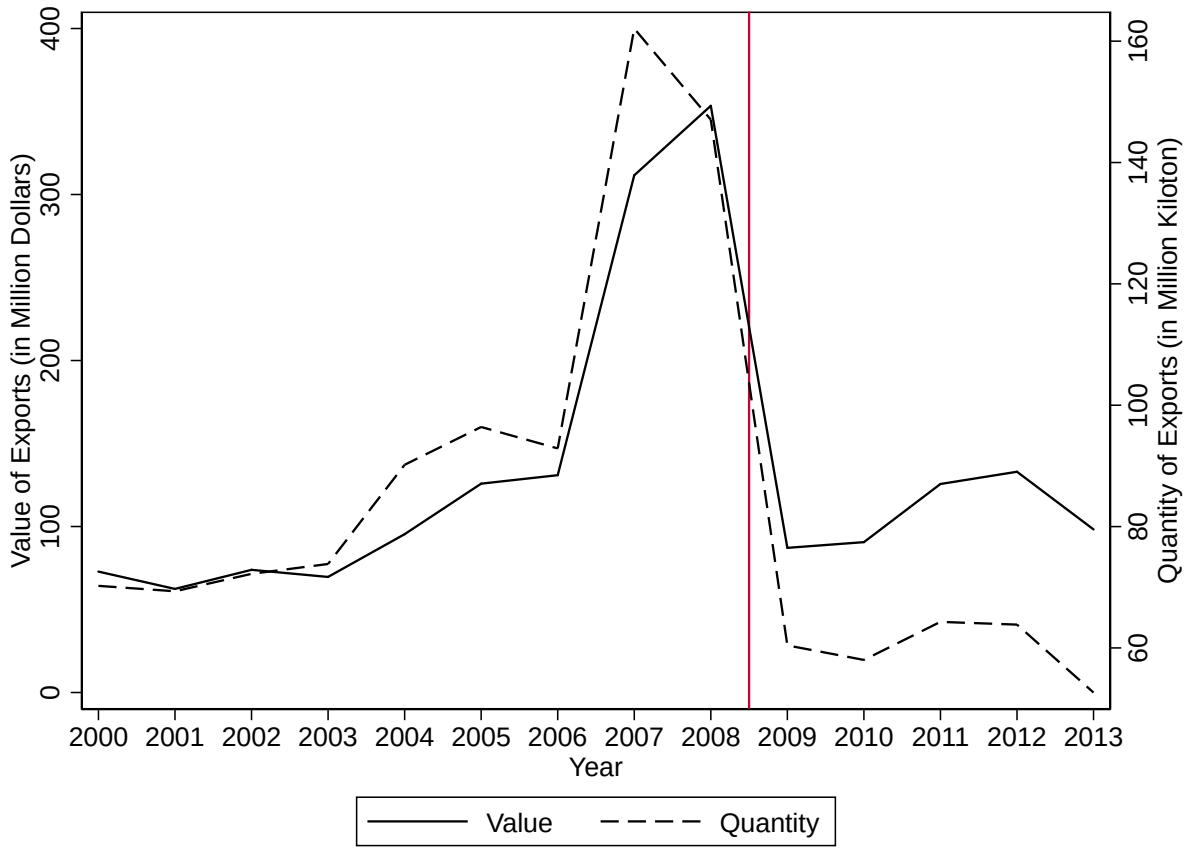
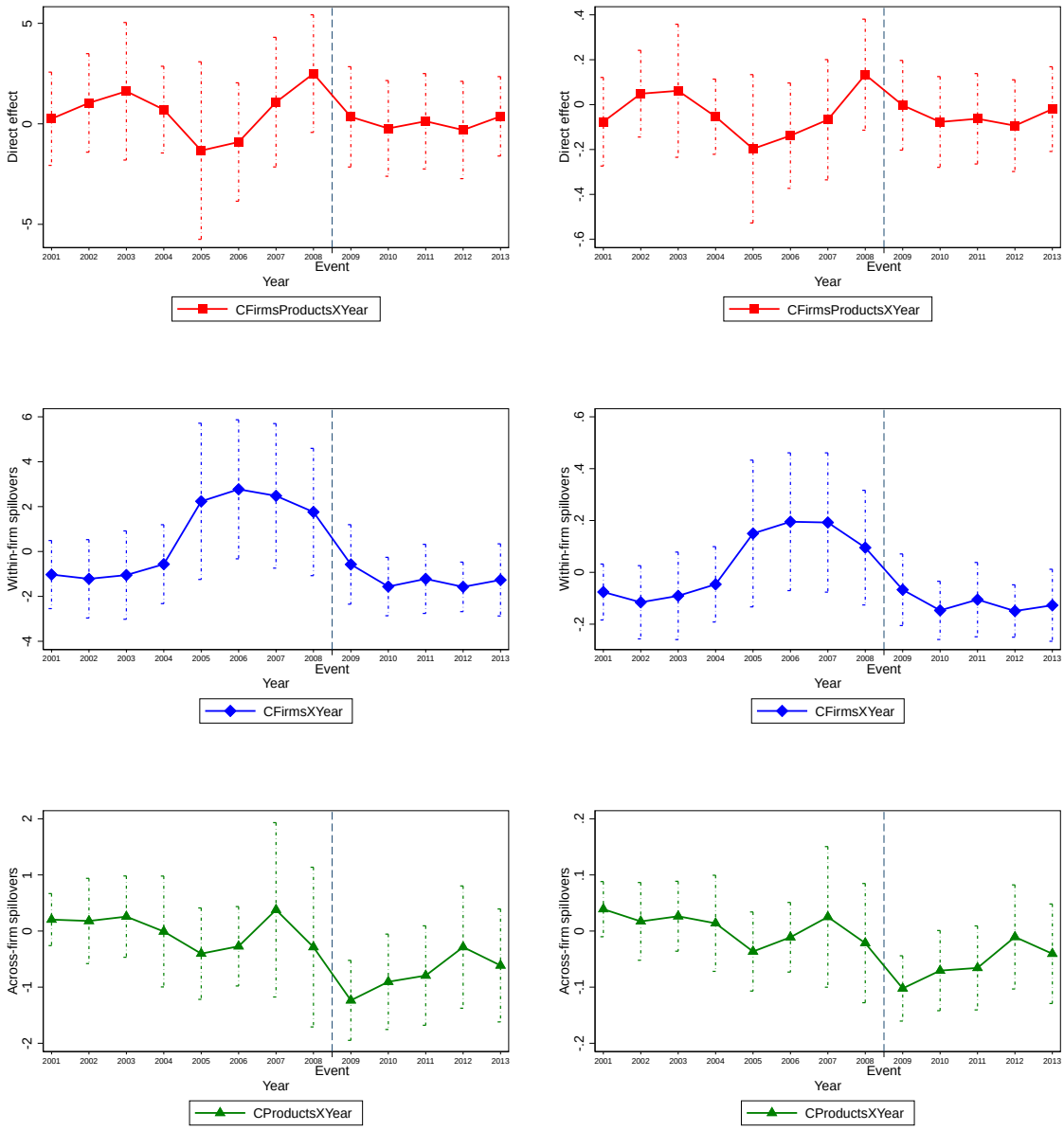
Figure 1: Event Study Graph: China's Dairy Exports



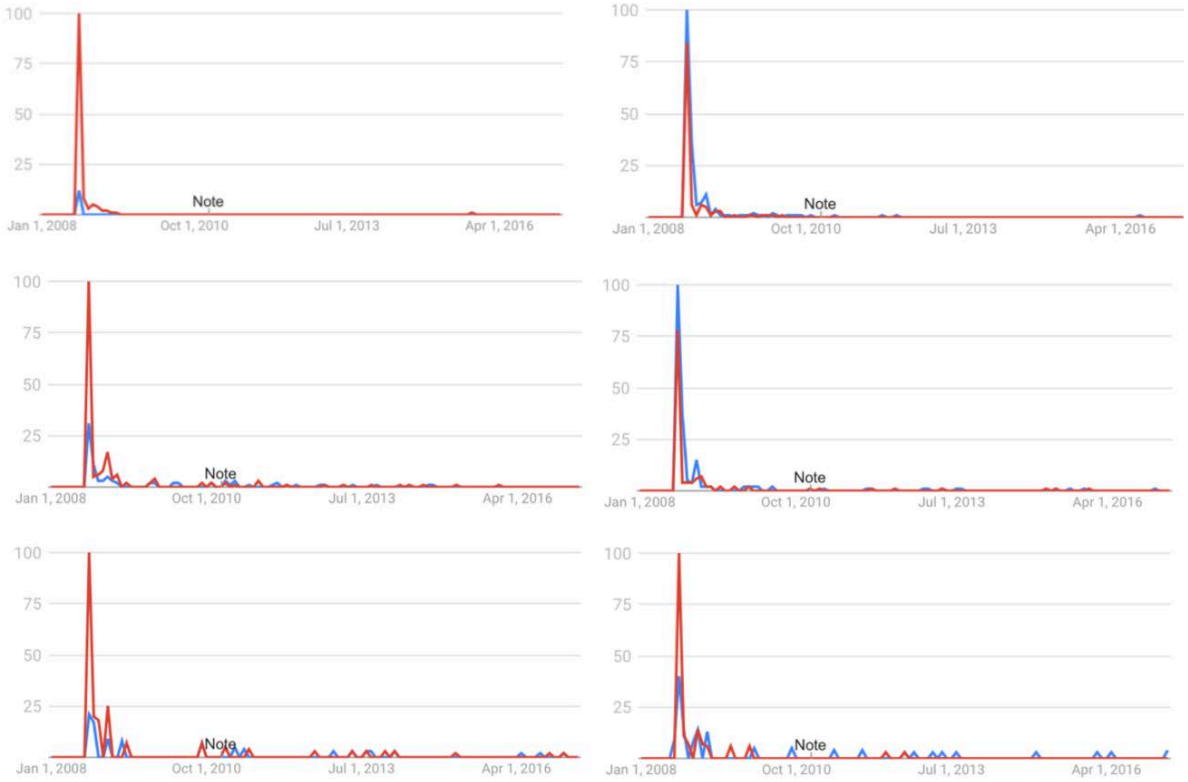
Notes: This figure plots Chinese dairy export value and quantity from 2000 to 2013.

Figure 2: Effects over Time: Export Value (Left) and Export Dummy (Right)



Notes: This figure plots the regression coefficients of the following three group dummies interacted with year dummies: ContaminatedFirm-Product, ContaminatedFirm and ContaminatedProduct. The same regressions also include the interaction terms between year dummies and InnocentFirm-Product as well as InnocentFirm dummies; these coefficients are not plotted. The outcome variable for the left column is the inverse hyperbolic sine transformation (IHS) of export value and that for the right column is the exporting dummy. All regressions control for firm-product and year fixed effects. The dotted lines plot the 95% confidence intervals, based on two-way clustered standard errors at the the firm and product-year level.

Figure 3: News Search Behavior Across Export Destinations



Notes: The figure plots Google Trends news search indices for China, Hong Kong and New Zealand on the left column, and US, Canada and UK on the right column. The red line plots the search index for the keyword "Sanlu" and the blue line plots the search index for the keyword "2008 Chinese milk scandal".

Table 1: Baseline Summary Statistics: Dairy Firms

	Contaminated		Innocent		Non-Inspected		Contaminated vs. Non-Inspected	
	Number	Mean	Number	Mean	Number	Mean	Difference	p-value
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. Customs Database								
Avg. yearly export revenue	15	3.299	23	.496	960	1.846	1.453	.349
(in million dollars)	.	(6.152)	.	(.906)	.	(6.617)	(1.551)	.
Years of exporting	15	4.8	23	3.217	960	4.222	.578	.421
	.	(2.859)	.	(2.315)	.	(2.43)	(.718)	.
% exports to OECD countries	15	.49	23	.389	960	.603	-.113	.299
(conditioning on exporting)	.	(.431)	.	(.422)	.	(.388)	(.108)	.
Panel B. Manufacturing Survey								
Employment	38	954.711	284	279.86	1407	177.244	777.467	.002
	.	(1573.413)	.	(451.327)	.	(294.354)	(252.157)	.
Log (employment)	38	5.732	284	5.043	1393	4.551	1.181	0
	.	(1.449)	.	(.94)	.	(1.053)	(.234)	.
Sales revenue (in million RMB)	36	982.197	264	112.279	880	73.237	908.96	.008
	.	(2073.951)	.	(235.044)	.	(165.395)	(341.242)	.
Log (sales revenue)	36	5.048	263	3.707	867	3.136	1.912	0
	.	(2.006)	.	(1.275)	.	(1.449)	(.334)	.

Notes: For each firm, the sample includes only dairy products. Column 1, 3, and 5 show the number of firms in each category. Columns 2, 4, and 6 show the mean of selected variables in each subsample. For these variables, Column 7 calculates the difference between contaminated firms (Column 2) and non-inspected firms (Column 6), obtained by regressing the outcome variable on a contaminated group dummy. Column 8 presents the p-value of the difference. Standard deviations are in parentheses for Column 2, 4 and 6. For Column 7, robust standard errors are in parentheses.

Table 2: Baseline Summary Statistics: Dairy and Dairy-related Products

	Contaminated		Innocent+Non-Inspected			
	Number	Mean	Number	Mean	Difference	p-value
	(1)	(2)	(3)	(4)	(5)	(6)
			Panel A. Dairy Products			
Avg. yearly export revenue	11	6.358	12	3.989	2.369	.542
(in million dollars)	.	(11.122)	.	(6.409)	(3.825)	.
Number of exporting years	11	7.636	12	6.417	1.22	.086
	.	(1.206)	.	(1.975)	(.677)	.
% to OECD countries	11	.552	12	.648	-.095	.437
	.	(.246)	.	(.328)	(.12)	.
			Panel B. Non-dairy Food Products			
Avg. yearly export revenue	16	38.528	944	21.227	17.301	.168
(in million dollars)	.	(51.01)	.	(67.015)	(12.552)	.
Number of exporting years	16	7.875	944	6.088	1.787	0
	.	(.5)	.	(2.507)	(.146)	.
% to OECD countries	16	.798	944	.758	.04	.204
	.	(.125)	.	(.264)	(.031)	.

Notes: Columns 1 and 3 show the number of products (HS eight-digit) in each category. Columns 2 and 4 show the mean of selected variables in each subsample. Column 5 calculates the difference between contaminated products (Column 2) and innocent plus non-inspected products (Column 4), obtained by regressing the outcome variable on a contaminated group dummy. Column 6 presents the p-value of the difference. Standard deviations are in parentheses for Columns 2 and 4. For Column 5, robust standard errors are in parentheses.

Table 3: Impact of the Scandal on Exports: Industry-Level Analysis

Dep Var: Log (Export Value)	(1)	(2)	(3)	(4)
		Panel A. All Dairy Exports		
DairyXPost	-1.065***	-0.892***	-0.687***	-1.140***
	(0.080)	(0.114)	(0.238)	(0.086)
FoodXPost		-0.174		
		(0.139)		
Observations	1120	1386	1107	1120
		Panel B. Innocent+Non-Inspected Firm-Products Only		
DairyXPost	-0.915***	-0.741***	-0.554**	-0.848***
	(0.080)	(0.114)	(0.233)	(0.086)
FoodXPost		-0.174		
		(0.139)		
Observations	1120	1386	1107	1120
Year, Industry FEs	YES	YES	YES	YES
YearXValue Share to different continents	NO	NO	YES	NO
Industry time trends	NO	NO	NO	YES
Excluding the food sector	YES	NO	YES	YES

Notes: This table shows the regression results for Equation 1. Panel A contains all exporters, collapsed to the industry-year level. Panel B excludes contaminated firm-products in order to quantify the aggregate spillover effect. We create a balanced panel at industry (HS two-digit) and year level. The dependent variable is log annual export value for each industry. The baseline specification in Column 1 includes only year and industry fixed effects. Column 3 and 4 build on this specification by adding time-varying controls, including the value share exported to different continents at baseline (2000-2007) interacted with year indicators and industry-specific linear time trends. Column 1, 3 and 4 exclude non-dairy food industries; Column 2 include all HS two-digit industries. Standard errors clustered at the product (HS two-digit) level. *** implies significance at 0.01 level, ** 0.5, * 0.1.

Table 4: Impact of the Scandal on Exports: Firm-Product Level Analysis

	IHS (Value)	IHS (Quantity)	Log (Price)	Exporting (dummy)
	(1)	(2)	(3)	(4)
CFirm-ProductXPost	-0.489	-0.345	-0.122	-0.019
	(1.180)	(1.157)	(0.091)	(0.078)
CFirmXPost	-1.838***	-1.811***	0.209***	-0.153***
	(0.437)	(0.456)	(0.051)	(0.031)
CProductXPost	-0.773***	-0.757***	-0.157*	-0.064***
	(0.281)	(0.257)	(0.087)	(0.023)
IFirm-ProductXPost	1.083	0.981	-0.211**	0.081
	(0.978)	(0.929)	(0.083)	(0.071)
IFirmXPost	-0.944	-0.847	0.219**	-0.081
	(0.768)	(0.708)	(0.097)	(0.063)
Observations	13775	13775	1519	13775
Firm-product FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
BaselineSizeXPost	YES	YES	YES	YES

Notes: This table shows the regression results for estimating Equation 2. The sample contains all dairy exporters (excluding intermediaries) in the Chinese Customs Data (2000-2013). We rectangularize the data to create a balanced panel at firm-product (HS eight-digit) and year level for outcomes in Column 1, 2 and 4. Columns 1 and 2 present results for the inverse hyperbolic sine transformation (IHS) of the outcome variables of interest, export value and export quantity. The interaction terms are the products of the post-scandal dummy (2009-2013) with the following five group indicators: (C)ontaminatedFirm-Product, (C)ontaminatedFirm, (C)ontaminatedProduct, (I)nnocentFirm-Product, and (I)nnocentFirm. The omitted category includes innocent and non-inspected products from non-inspected firms. All regressions control for firm-product and year fixed effects. Baseline size measures a firm's baseline (2000-2007) total exports volume. Standard errors are two-way clustered at the firm and product-year level. *** implies significance at 0.01 level, ** 0.5, * 0.1.

Table 5: Impact of the Scandal on Domestic Performance

	Log (Total sales revenue)	Log (Domestic sales revenue)	Log (Employment)
	(1)	(2)	(3)
CFirmsXPost	-0.315	-0.311	-0.181
	(0.255)	(0.255)	(0.235)
IFirmsXPost	-0.036	-0.040	-0.099
	(0.089)	(0.089)	(0.067)
Observations	1664	1664	1666
Firm FE	YES	YES	YES
Year FE	YES	YES	YES
BaselineSizeXPost	YES	YES	YES

Notes: This table shows the regression results for the effects of the scandal on firms' sales and employment. The sample includes the balanced sample of dairy firms in the Manufacturing Survey data (2005-2009 & 2011-2013). The interaction terms are the post-scandal indicator (2009-2013) with the following two group indicators: (C)ontaminatedFirm and (I)nnocentFirm. The omitted category includes non-inspected firms. All regressions control for firm and year fixed effects. Baseline size measures a firm's total sales revenue from 2005 to 2007. Standard errors are clustered at the firm level. *** implies significance at 0.01 level, ** 0.5, * 0.1.

Table 6: Information Accuracy: Heterogeneous Impact Based On Google News Search Index

	IHS (Value)			IHS (Quantity)			Exporting (dummy)		
	High	Low	Rest	High	Low	Rest	High	Low	Rest
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
CFirm-ProductXPost	-1.096	-0.284	-0.047	-0.953	-0.226	-0.029	-0.061	-0.011	-0.002
	(1.390)	(0.943)	(0.495)	(1.349)	(0.911)	(0.460)	(0.094)	(0.061)	(0.035)
CFirmXPost	-0.577	-1.480**	-0.890***	-0.656	-1.402**	-0.830***	-0.055	-0.117**	-0.073***
	(0.639)	(0.609)	(0.297)	(0.657)	(0.598)	(0.279)	(0.047)	(0.050)	(0.022)
CProductXPost	-0.044	-0.617***	-0.383***	-0.074	-0.570***	-0.355***	-0.003	-0.052***	-0.032***
	(0.150)	(0.196)	(0.141)	(0.136)	(0.184)	(0.130)	(0.013)	(0.016)	(0.011)
IFirm-ProductXPost	0.470	0.637	0.749	0.444	0.576	0.691	0.031	0.041	0.068
	(0.496)	(0.735)	(0.550)	(0.494)	(0.703)	(0.521)	(0.038)	(0.058)	(0.043)
IFirmXPost	-0.267	-0.343	-0.922	-0.239	-0.306	-0.831	-0.026	-0.027	-0.078
	(0.367)	(0.382)	(0.634)	(0.361)	(0.344)	(0.590)	(0.037)	(0.032)	(0.049)
Observations	13775	13775	13775	13775	13775	13775	13775	13775	13775
Firm-product FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
BaselineSizeXPost	YES	YES	YES	YES	YES	YES	YES	YES	YES

Notes: This table shows the regression results for the heterogeneous effects of the scandal across export destinations with different information accuracy. The sample contains all dairy exporters in the Chinese Customs Data (2000-2013). We create a balanced panel at firm-product (HS eight-digit) and year level. Columns 1-6 present results for the inverse hyperbolic sine transformation (IHS) of the outcome variables of interest, namely export value and export quantity. We categorize export destinations by high and low information accuracy, using the Google news search intensity ratio. "High" information accuracy destinations display high ratio of searches for the word "Sanlu" relative to searches for "2008 Chinese milk scandal". We also include results for countries without Google news search index ("Rest"). The interaction terms are the products of the post-scandal dummy (2009-2013) with the following five group indicators: (C)ontaminatedFirm-Product, (C)ontaminatedFirm, (C)ontaminatedProduct, (I)nnocentFirm-Product, and (I)nnocentFirm. The omitted category includes innocent and non-inspected products from non-inspected firms. All regressions control for firm-product and year fixed effects. Baseline size measures a firm's baseline (2000-2007) total exports revenue. Standard errors are two-way clustered at the firm and product-year level. *** implies significance at 0.01 level, ** 0.5, * 0.1.

Table 7: Individual Reputation: Heterogeneous Impact By Age of Exporting

	IHS (Value)				Exporting (dummy)			
	Established	New	Established	New	Established	New	Established	New
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CFirm-ProductXPost	-0.678	-1.251***	-0.760	-0.943***	-0.032	-0.091***	-0.036	-0.068**
	(1.419)	(0.219)	(1.423)	(0.157)	(0.092)	(0.019)	(0.092)	(0.033)
CFirmXPost	-1.119**	-2.098***	-1.069**	-2.112**	-0.084**	-0.190***	-0.082**	-0.192***
	(0.502)	(0.716)	(0.508)	(0.832)	(0.035)	(0.063)	(0.035)	(0.073)
CProductXPost	-0.390	-1.520***	-0.214	-1.160***	-0.034	-0.115***	-0.026	-0.089***
	(0.358)	(0.464)	(0.411)	(0.398)	(0.028)	(0.036)	(0.033)	(0.030)
IFirm-ProductXPost	-0.456	2.979*	-0.463	2.787	-0.026	0.199*	-0.026	0.185
	(0.831)	(1.765)	(0.821)	(1.843)	(0.061)	(0.120)	(0.060)	(0.126)
IFirmXPost	-0.597	-1.714	-0.583	-1.375	-0.047	-0.147	-0.048	-0.122
	(0.798)	(1.209)	(0.794)	(1.208)	(0.067)	(0.093)	(0.067)	(0.093)
Observations	9830	3945	9830	3945	9830	3945	9830	3945
Firm-product FE	YES	YES	YES	YES	YES	YES	YES	YES
Province-year FE	YES	YES	YES	YES	YES	YES	YES	YES
BaselineSizeXPost	YES	YES	YES	YES	YES	YES	YES	YES
HS2digitXYear	YES	YES	NO	NO	YES	YES	NO	NO
H2digitXPost	NO	NO	YES	YES	NO	NO	YES	YES

Notes: This table shows the regression results for the heterogeneous effects of the scandal on exports across firms of different exporting experiences. The sample contains all dairy exporters in the Chinese Customs Data (2000-2013). We create a balanced panel at firm-product (HS eight-digit) and year level. Columns 1-4 present results for the inverse hyperbolic sine transformation (IHS) of the outcome variable of interest, export value. Column 1,3,5,7 use the subsample of established firms, which are firms that have exported more than 1 year before 2008. Column 2, 4, 6, 8 use the subsample of new firms, which are firms that haven't exported before 2008. The interaction terms are the products of the post-scandal dummy (2009-2013) with the following five group indicators: (C)ontaminatedFirm-Product, (C)ontaminatedFirm, (C)ontaminatedProduct, (I)nnocentFirm-Product, and (I)nnocentFirm. The omitted category includes innocent and non-inspected products from non-inspected firms. All regressions control for firm-product and year fixed effects. Baseline size measures a firm's baseline (2000-2007) total export revenue. Standard errors are two-way clustered at the firm and product-year level. *** implies significance at 0.01 level, ** 0.5, * 0.1.

Table 8: Supply Chain Structure: Heterogeneous Impact By Sourcing Location

	IHS (Value)	IHS (Quantity)	Log (Price)	Exporting (dummy)
	(1)	(2)	(3)	(4)
CProductXPost	-0.735***	-0.725***	-0.106	-0.063***
	(0.277)	(0.255)	(0.087)	(0.023)
CSourceCity-ProductXPost	-1.063	-0.989	-0.130*	-0.072
	(0.659)	(0.607)	(0.070)	(0.052)
CSourceCityXPost	0.015	0.014	0.013	0.003
	(0.283)	(0.258)	(0.045)	(0.024)
Observations	13019	13019	1351	13019
Firm-product FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
BaselineSizeXPost	YES	YES	YES	YES

Notes: This table shows the regression results for the heterogeneous effects of the scandal on exports across firms with different sourcing locations. The sample contains innocent and non-inspected dairy exporters in the Chinese Customs Data (2000-2013). We create a balanced panel at firm-product (HS eight-digit) and year level for outcomes in Column 1, 2, and 4. Columns 1 and 2 present results for the inverse hyperbolic sine transformation (IHS) of the outcome variables of interest, namely export value and export quantity. The interaction terms are the products of the post-scandal dummy (2009-2013) with the following three group indicators: (C)ontaminatedProduct, (C)ontaminatedSourceCity-Product and (C)ontaminatedSourceCity. All regressions control for firm-product and year fixed effects. Baseline size measures a firm's baseline (2000-2007) total export revenue. Standard errors are two-way clustered at the product-year and location (province) level. *** implies significance at 0.01 level, ** 0.5, * 0.1.