Export performance of China's domestic firms: the role of foreign export spillovers*

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Abstract

We investigate how the creation of new export linkages (extensive margin of trade) by domestic firms in China is influenced by their proximity to multinational exporters. Using panel data from Chinese customs for 1997-2007, we show that there is evidence that domestic firms' capacity to start exporting new varieties to new markets positively relates to the export performance of neighboring foreign firms for that same product-country pair. We find that foreign export spillovers are limited to ordinary trade activities. No foreign export spillovers are found for processing trade. More, export spillovers are stronger for sophisticated products indicating that proximity to foreign exporters may help domestic exporters to upgrade their exports. However we observe that foreign export spillovers are weaker when the technology gap between foreign and domestic firms is large, suggesting that upgrading may not occur in locations and sectors where foreign firms have already a strong edge.

Keywords: Export performance, spillovers.

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1 Introduction

There is growing evidence that most of Chinese export rise is due to foreign firms. The share of foreign enterprises in China's exports has increased speedily from 26 percent in 1992 to 57 percent in 2007. This domination is even stronger for high technology products. The share of foreign firms rose from 68 percent to 84 percent over the period. Several studies argue that foreign firms, typically engaged in processing trade, fully drive the skill content upgrading of exports observed in China (Amiti and Freund, 2010; Xu and Lu, 2009).[1] Amiti and Freund (2010) find that the skill content of China's manufacturing exports remained unchanged once processing trade is excluded. However, estimations of growth equations indicate that growth gains from export performance and export upgrading are confined to improvements made by domestic firms. Jarreau and Poncet (2010) find that the positive association between GDP per capita growth and export sophistication at the province level is limited to ordinary export activities undertaken by domestic firms. While there are no direct gains from foreign firms export upgrading, there may still be room for indirect effects of foreign firms on domestic ones through emulation or export spillovers. By favoring the entry of domestic firms on export markets for more sophisticated goods, foreign firms could have an indirect impact on GDP per capita growth in Chinese provinces. In this paper we focus on the possibility that foreign firms act as export catalysts, fostering the creation of new export transactions by domestic firms. We also investigate the heterogeneity of these export spillovers from foreign firms according to the sophistication of exported products.

Since the pioneering study of Caves (1974), the existence of FDI spillovers has been widely investigated (Crespo and Fontoura, 2006). Most studies, whether applied to China or not, have focused on the spillovers from foreign to domestic firms in terms of productivity. The empirical evidence surveyed in Görg and Greenaway (2004) and Blomström and Kokko (1998) is mixed. In the Chinese context, while several articles suggest a significant and positive impact of foreign presence on domestic firms' productivity (Cheung and Lin, 2004; Liu, 2001; Li et al., 2001; Hu and Jefferson, 2002), Hale and Long (2010) argue that the effect disappears when the various sources of estimation biases are controlled for (aggregation bias, selection bias, downward bias in standard errors).

Here, we concentrate on another source of benefits stemming from foreign presence, export

[1] Xu and Lu (2009) find that previous results on the insignificant role of foreign firms and processing trade on Chinese export sophistication (Wang and Wei, 2010) may be due to heterogeneity of Foreign Direct Investment (in terms of origin and contract form). They find that FDI matters for China's exports upgrading when it originates from OECD countries and comes under the form of WFOE.

spillovers. We investigate the presence of foreign export spillovers on the extensive margin of domestic firms, that is their creation of new trade transactions. This focus is coherent with our interest in the determinants of export upgrading of Chinese domestic firms. We seek to understand what is driving the diversification of exports into new (more sophisticated) goods. Our approach is complementary to studies on the export quality of domestic firms (Harding and Smarzynska Javorcik, 2010).[2] Using data on Chinese exports at the city-product level, Chen and Swenson (2009) suggest that proximity to multinational firms is associated with higher quality (unit value) of new export transactions by domestic private Chinese traders. Bloningen and Ma (2010) find nevertheless that the share of foreign firms in Chinese exports by product category and that foreign unit values relative to Chinese unit values are increasing over time, running against the idea that Chinese firms are catching up.

Besides the analysis of the impact of foreign firms on the quality upgrading of domestic firms, growing evidence has emerged on positive export spillovers from foreign to domestic firms. Possible channels are information externalities, cost-sharing opportunities and mutualized actions on export markets. Being close to foreign exporters may facilitate the flow of export-specific information, valuable to domestic firms seeking international outlets for their products. In a pioneer study, Aitken et al. (1997) find that the export decision of local firms in Mexico in the period 1986-1990 is positively influenced by the proximity to multinational exporters, even after controlling for the overall industrial activity in the region and for local export concentration. The role of foreign exporting firms as "catalysts" for domestic exporters has since been confirmed by Kneller and Pisu (2007) on UK data and Kemme et al. (2009) on India.[3] By contrast, Barrios et al. (2003) do not find clear evidence of such export spillovers from foreign firms in Spain, while Ruane and Sutherland (2005) find that the export intensity of foreign-owned enterprises is negatively associated with the export decision and export intensity of domestic firms in Irish manufacturing. They argue that this result suggests that no (and

[2]Harding and Smarzynska Javorcik (2010) find, based on a panel of 116 countries over the period 1984-2000, a positive effect of FDI on unit values of exports in developing countries, but not in developed countries, suggesting that FDI can help bridge the technological gap in production and marketing techniques between developing and high income countries. Our paper is applied to China, the country that everyone has in mind when thinking of the capacity to rapidly upgrade in international markets. Also, contrary to most studies, the Chinese data allow to focus not only on FDI *per se* but on export activities of foreign companies. Since we also have information on exports realized by domestic producers, our analysis can differentiate between the upgrading induced by multinationals themselves and that resulting from the past experience of domestic firms.

[3]Kokko et al. (2001) also investigate the existence of spillovers from MNEs on the export decision of domestic firms in Uruguay, using cross-sectional firm-level data for 1998. However, their measure of spillovers is a simple measure of the presence of multinationals (not export activity) in terms of the output share of MNEs in an industry. The measured impact of multinationals' presence could thus be due to R&D spillovers for example and not to export spillovers.

even negative) export spillover derives from third-country export-platform FDI. This prediction bodes ill for China where foreign firms are mostly engaged in processing trade.

However, it is noteworthy that these papers use rather aggregated industry-level information (2-digit to 4-digit ISIC) instead of fine product level customs nomenclature. Moreover, none of these papers exploit the information on the destination country of exports. Yet, export spillovers have been shown to be stronger when product and destination specific. Based on French firm-level export data, Koenig et al. (2010) show that export spillovers (although they do not distinguish between export activity in MNEs and domestic firms) are stronger when they are product and destination specific, while they are not significant when considered on all products-all destinations.[4] Our study further departs from the previous literature by looking at the decision to start exporting, and not just the export status. Focusing on the creation of new export linkages is consistent with our focus on the impact of FDI as a catalyst for upgrading the export portfolio of domestic firms.

In the context of China, three studies (Ma, 2006; Swenson, 2008; Chen and Swenson, 2009) have investigated export spillovers emanating from foreign firms. Ma (2006) studies how the probability that a province exports in a given 2-digit SITC industry relates to the contemporaneous foreign export activity concentration in this industry. Her probit estimations over the period 1993 to 2000 suggest some positive link. Swenson (2008) focuses on the city-level value (or count) of the new HS2 product trade transactions made by private firms between 1997 and 2003. She finds a positive impact of same HS2 foreign export value (or count) in the previous year. Finally, Chen and Swenson (2009) show that, within a HS2 product-category, the number of new trade transactions, measured a the HS8 level, is positively influenced by the level of exports or the count of export transactions made by multinational firms at the HS2-city level. These papers have two main characteristics in common: while the information is available at a finer product category (HS6), they re-aggregate the data and measure export spillovers at a broader activity level; they moreover do not investigate the specificity of export spillovers according to the destination country of exports.

We thus go further in this direction. In our paper, we use provincial data at a much more disaggregated product dimension (HS 4-digit), and we exploit information on the destination country of exports over the period 1997-2007. We believe that exploitation of the detailed product and destination information provide two benefits. First, it allows to investigate spillovers

[4]Koenig et al. (2010) also find that export spillovers are highly localized and exhibit a spatial decay: the effect of other exporters on the export decision of a given firm declines with distance. This finding is in line with the localized feature of information flows (Jaffe et al., 1993).

at a more adequate level. Indeed, informational flows are likely to be product and country specific. Second, it provides us valuable information to assess the nature of spillovers. We will discriminate between aggregate foreign presence likely to provide direct productivity gains to domestic firms and export spillovers (informational gains) that are likely to be product-destination specific. We believe our study makes three additional contributions. First, we differentiate between ordinary and processing trade in order to see which trade type is more likely to generate and benefit from export spillovers. Second, we study whether export benefits from foreign exporters depend on the technology-content of the exported goods. We aim at verifying that positive information spillovers might be more intense for more sophisticated products. Since Jarreau and Poncet (2010) have shown that the sophistication of domestic exports positively impacts on GDP per capita growth at the province level, this would point at an indirect role of multinational firms on local growth. Third, we investigate the potential conditionality of foreign export spillovers, depending on the technology gap between foreign and domestic firms. Assuming that the capacity to absorb and exploit information on export opportunities depends on the technological distance between the domestic firm and the foreign source of inspiration, foreign export spillovers are expected to be higher when the technological leadership of foreign firms is not too high.

Using panel data from Chinese customs at the province-HS4-destination country level for 1997-2007, we show that there is evidence that domestic firms' capacity to start exporting a given product to a given country positively relates to the export performance of neighboring foreign firms for that same product-country pair. We find that foreign export spillovers are limited to the ordinary trade activities of foreign firms. Processing trade activities do not generate export spillovers. More, export spillovers are stronger for sophisticated products, indicating that proximity to foreign exporters may help domestic exporters to upgrade their exports. However we observe that foreign export spillovers are weaker when the technology gap between foreign and domestic firms is large, suggesting that the enlargement of the export portfolio of domestic Chinese firms may not occur in locations and sectors where foreign firms have already a strong edge.

The rest of the paper is organized as follows. Section 2 describes the data and our measure of export spillovers. Section 3 presents our empirical approach and discusses our results. Section 4 concludes.

2 Data and indicators

We present in this subsection the data we use and the empirical methodology we adopt.

2.1 Trade data sources

The main data source is a database collected by the Chinese Customs. It contains Chinese export flows aggregated by province, year, product and destination country, over the 1997-2007 period.[5] In our estimations, we explain the creation of new export linkages based on a product classification at the 4-digit level. A feature of interest to us in this dataset is that it allows to differentiate between domestic and foreign trading firms, and between processing trade and ordinary trade.[6] Processing trade includes all trade flows by firms operating in the assembly sector, that is, importing inputs to process them in China and re-export the finished products (these producers benefit from a preferential tax regime on imported inputs). We can imagine that firms engaged in this kind of activity are less embedded in their local environment, and consequently generate less (and possibly benefit less from) externalities.

2.2 Explained variable: creation of new export linkages

We investigate the determinants of new export transactions by Chinese domestic firms. We measure the creation of a new export transaction as a dummy which takes the value 1 if domestic firms in a province i start exporting product k at time t to country j and 0 otherwise. We restrict our sample to province-product-country series of zeros followed by a decision to start exporting. For a given province-product-country we can have several starts. For example, the subsequent export statuses 00011001111 become in our sample .001..01..., with . denoting a missing value. Ceasing and continuing export flows are not explained. Note that all our results are robust when we consider "durable starts" only, that is cases corresponding to provinces that start exporting a product to a country for at least two years (coded in the data as a sequence "011").

We construct a specific database, incorporating the set of alternatives faced by each province.

[5]The original data are identified by a 8-digit code. As there were major reclassifications in the international HS 6-digit classifications in 1996 and 2002, we convert them to the same HS 6-digit classifications used in 1992, to avoid problems related to codes reclassification. In order to avoid classifying a product as a new variety just because there has been a new product code or previous codes were split, we drop product lines that changed classification at the 6-digit level over the period due to nomenclature changes.

[6]The data also refer to a third category ("Others") that groups other flows such as aid, border trade and consignment, representing overall less than 1% of total trade value in each year. When considering the processing/ordinary trade distinction, this category is dropped.

For a given province, these are defined as the product-country pairs for which we observe at least one export start over the 1997-2007 period. Indeed, since we are interested in the probability that a province starts exporting a given product to a given country, all province-product-destination country triads for which we observe positive domestic export flows in each year of the period are excluded from our sample by definition. Regarding triads for which we do not observe any positive domestic export flow, they could be, strictly speaking, taken into account. However, two main issues arise: first, from a computational point of view, this would increase dramatically the number of observations so that the database would become hardly tractable. Second, from an economic point of view, it is absolutely not sure that a province can potentially export all the products to all the countries. There can be good reasons why we do not observe any positive domestic export flow for a given province-product-destination country triad over the period, these reasons being not directly linked to export spillovers from foreign firms (provincial specializations, geopolitics etc.). Finally, since we use province-product-country fixed-effects, taking into account a broader definition of possible exported products or destination countries would not change the final sample used for the estimation (see section 2.3).

2.3 Foreign export spillovers and control variables

In our empirical analysis, we explain the probability that domestic firms in province i start exporting product k to country j in year $t+1$ on various characteristics of the province i, product k and country j at time t. The structure and the determinants of international trade flows are now commonly studied using gravity equations. We detail in this section the explanatory variables we take into account in this gravity framework.

Foreign export spillovers

Our focus is on export spillovers, that are supposed to reduce the bilateral fixed export cost. There are two channels through which export spillovers can act: foreign firms can bring specific information on export markets, valuable to domestic firms to pay their fixed export cost (information about the tastes of foreign consumers, on the distribution networks abroad etc.). On the other hand, it could be the case that export spillovers are linked to the mutualization of some fixed export costs (participation to international fares, marketing etc.). In both cases, export spillovers could be linked to the presence of foreign exporters *per se* and/or to the scale of exports by foreign firms. We thus decompose foreign export spillovers into a dummy that identifies the presence of foreign exporters in the province and the log of the value of exports

made by foreign firms in the province. In the sample, 4.36% of the observations have non-null product-country specific foreign export flows, 68.37% have non-null foreign exports of the same product to other countries and 86.63% have non-null foreign exports of other products to the same country.

Moreover, we follow Koenig et al. (2010) and consider different types of spillovers. Indeed, according to the type of information needed to enter successfully on export markets, the export spillovers could be destination specific, product specific or both. For a given triad province-product-destination country ikj, we thus distinguish four types of spillovers: product (HS4) and destination country specific (presence in province i of foreign firms exporting product k to country j and scale of these exports), country specific (presence in province i of foreign firms exporting other products than k to country j and scale of these exports), product specific (presence in province i of foreign firms exporting product k to countries other than j and scale of these exports) and general spillovers (presence in province i of foreign firms exporting other products than k to other countries than j and scale of these exports). Note that the coefficient on these spillovers variables will capture the net effect of the positive externalities described above and some congestions effects, such as the competition exerted by foreign firms on domestic ones on local labor markets (possibly increasing wages), the possible saturation of transport infrastructures etc. Our sample covers 220 countries and 1213 HS4 products..

Time-invariant determinants of exports

Several determinants, invariant across time, can explain the ability of firms in province i to export product k to country j, whether they are domestic or foreign. Not controlling for these determinants would bias our estimation of foreign export spillovers:

- province i can have better transport infrastructure for example, which will impact, all over the period, on the export performance of domestic firms located in province i, whatever their activity and the countries they trade with. It can also influence the attractiveness of the province in terms of FDI and the ability of foreign firms to export.

- province i can have specific relationships with country j, due to distance, to migrants networks, to the presence of a common border, to specific business partnerships between provincial authorities and country j etc. Again, these non-observed determinants, specific to the dyad ij, can impact on the export performance of both domestic and foreign firms.

- province i can have a comparative advantage in product k, due to a specific ability developed across time or to specific development strategies implemented by local authorities. This would affect the export activities of both domestic and foreign firms.

In order to take into account all these unobserved determinants of export performance of domestic and foreign firms at the local level, we introduce a province i-product k-destination country j fixed effect.

This raises some issues about the interpretation of our results on export spillovers. First, given the definition of our dependent variable, the inclusion of the fixed effect means that we are in reality interested in the timing of entry: conditioning on the fact that domestic firms of province i will start exporting product k to country j over the period, we relate the year of entry to the evolution of export activities of foreign firms in the province. Second, our empirical approach exploits the within dimension of our data and is thus focused on short-run determinants of the entry on export markets. Indeed, we study how the creation of export linkages by domestic firms in $t+1$ can be explained by the activity of surrounding foreign exporters in year t, once time-invariant province-product-country fixed effects are controlled for. We believe that this approach is interesting, especially from a public policy point of view, since policy-makers, when implementing strategies based on the attraction of FDI, generally expect quick returns to investment. However, the impact of foreign firms could be different in the long-run: a positive impact of foreign exporters on the probability that domestic firms start exporting in the short-run could become null or negative in the long-run if foreign firms exert a competitive pressure on local wages or on foreign markets, forcing domestic firms to exit export markets more rapidly. Note however that in the case of China, Chen and Swenson (2009) show that the presence of foreign exporters positively impact on the duration of new export flows, casting doubt on the existence of strong negative effects of foreign firms in the long-run.

Time-varying determinants of exports

Other determinants of the entry on export markets vary across time. A first issue relates to the influence of the foreign partner's demand. We need to account for the demand capacity of the destination country at the product level, which may determine simultaneously foreign and domestic export performance. The total import value defined at the 4-digit product level is taken from the BACI world trade dataset.[7] We also add the GDP per capita of the importing

[7]This dataset, which is constructed using COMTRADE original data, provides bilateral trade flows at the 6-digit product level (Gaulier and Zignago, 2008). BACI is downloadable from

country.[8]

Moreover, the province-product-destination country fixed effect controls for specific ability of province i for product k that is fixed over time. However, China has experienced dramatic changes over the period 1997-2007, among which the entry in WTO, that may have reshaped local comparative advantages. To take into account current comparative advantages, we further introduce the log of province total export sales, province-product export sales and China-product export sales in year t. Since we also include year fixed effects that account for the evolution of total Chinese exports, controlling for these variables amounts to introducing the elements of a Balassa index of "revealed comparative advantage" at the province-product level. Indeed, the Balassa index is calculated as follows:

$$B_{ijt} = \frac{X_{ikt}/X_{it}}{X_{China,kt}/X_{China,t}} \tag{1}$$

where X denotes exports. An increase of the Balassa index reflects an increased comparative advantage of province i in product k, with respect to the rest of China. Since we introduce the elements of the Balassa separately, each of them controls for the fact that a potential positive association between the export activity of foreign firms and the probability that domestic firms start exporting simply reflects a specific ability of export activities in the province or in China. We also introduce total exports of province i to country j and total Chinese exports to country j to control for specific relationships between the province/China and the destination country. This is important given the use of business and trade agreement by Chinese authorities to manage their diplomacy. Finally, we also control for province GDP per capita to take into account supply-side determinants of exports such as workers' skills.[9]

We need to make sure that our results are not biased because our measure of multinational presence proxies for omitted unobservable growth in local economic opportunities at the product-level or destination country-level. Indeed, China has grown dramatically over the 1997-2007 period and the entry of domestic firms on foreign markets could be driven not only by current comparative advantages but by specific trends. We thus include the lagged value of all four variables described above (HS4 world demand of country j, total exports of the province, product-level exports of the province, country-level exports of the province). We also include the lagged value of China's exports at the product level and the lagged value of China's exports

http://www.cepii.fr/anglaisgraph/bdd/baci.htm.

[8]World countries real GDP per capita in PPP are taken from the World Development Indicators database (World Bank).

[9]Provincial GDP per capita are taken from the China Statistical yearbooks.

at the destination level to account for overall Chinese dynamics specific to the product and the destination country respectively.

Last, in order to further verify that our foreign export spillovers are not simply proxying for export spillovers between domestic firms or for past experience of domestic firms, we further control for the local export activities undertaken by domestic firms in year t. By construction, since we look at the creation of new linkages at the product-country level, there is no export activity by domestic firms in the previous year for the given product-country pair. We need however to account for export activities in other products for the same country, in other countries for the same product and in other products and other countries respectively. We control for both the presence (through a dummy) and the scale of these export activities (through the log of export value).

We adopt a similar strategy for the foreign export activities when investigating the nature of foreign export spillovers. Checking the specificity of foreign export spillovers is necessary. Indeed, if spillovers from foreign exporters exist at the product level or at the destination country level, not controlling for foreign export activities on these segments could lead to an overestimation of the impact of our measure of product-country specific export spillovers. Finally, note that if larger foreign presence leads to greater congestion effects on the use of local inputs and/or greater competition, this could negatively affect domestic firms' export performance. Our estimation will thus measure the net effect of positive externalities and congestion effects.

3 Estimation of foreign export spillovers

We present here the baseline estimation of the impact of foreign firms' export activities on the creation of new trade linkages by Chinese domestic firms.

3.1 Empirics

The creation of a new linkage (product k/country j) by domestic firms of province i at year $t+1$ is regressed on our proxy of foreign export spillovers in the previous year t and various controls (measured in t and in $t-1$). The relation we finally bring to data is the following:

$$\text{Prob}(\text{start\_dom\_exp}_{ikj,t+1}) = \text{Prob}(\alpha \text{for\_exp\_spill}_{ikjt} + \beta_1 \text{Z}_{jt} + \beta_2 \text{Z}_{jt-1} + \eta_{ikj} + \mu_t + \epsilon_{ikjt} > 0) \quad (2)$$

The identification of foreign export spillovers in China relies on a conditional logit estimation, all regressions including fixed effects at the province-product-country level η_{ikj}. Year fixed effects μ_t are also added. The foreign export spillovers are thus identified based on the within (time) dimension of our data. Time invariant aspects such as bilateral trading distance, product specificity, province geography are hence controlled for.

The conditioning set is made of three categories of variables as displayed in Table 1. First, following the gravity literature, we control for demand side determinants of new export linkages by introducing destination country demand and GDP per capita. Second, we control for supply side determinants by introducing proxies for provincial and Chinese comparative advantages and export intensity. Third, since we are worried that the decision to start exporting by domestic firms captures the intrinsic dynamics at the product level or country level, we include the lag of all the variables described above that aim at capturing local and Chinese export intensity at the product or destination country level.

3.2 Nature of foreign export spillovers

In Table 1, we explore the existence and the nature of foreign export spillovers in China. We first use the value of exports by foreign firms as a proxy for foreign export spillovers. We successively estimate the impact of four different spillover variables, in increasing order of specificity, controlling for the demand in the destination country and for supply-side determinants of exports in the province and in China the year before the entry. In Column 1, we rely on the most aggregated measure of local foreign export activity, the total value of exports by foreign firms (all products-all destinations). This general spillover variable is significant but enters negatively, possibly due to crowding out effect: since we also control for total exports in province i in year t, the more these exports are covered by foreign firms, the less probable is the entry of domestic firms on foreign markets. In Column 2, we focus on country-specific spillovers (all products-same destination), while in Column 3, we rely on a product-specific measure (same product-all destinations). These two spillover variables attract a negative sign but are not significant. In Column 4 we use the most precise measure of foreign spillovers (same product-same destination). Interestingly, the product-country spillover is positive and significant at the 1%

confidence level. Export activities of foreign firms for product k and country j in year t are positively correlated with the entry of domestic firms on export markets for product k and country j in year $t+1$.

To assess further the specificity of export spillovers, for a given province-product-destination country triad ikj, we decompose in Column 5 the overall foreign export value in province i in its four complementary components: exports of the same product k to the same country j, exports of the same product k to other countries, exports of other products to the same country j and exports of other products to other countries. We also control now for the dynamics in demand-side and supply-side determinants of entry on export markets by introducing relevant controls in $t-1$. As can be seen in Column 5, the country/product specific spillover measure is the only one to be positive and significant. Column 6 adds a final category of controls to ensure that the measured impact of foreign export spillovers does not simply reflect past experience of domestic firms on export markets for product k or country j. Indeed, scope economies across destinations or across products may be at work for domestic exports. If the export performance of domestic firms on a destination country j (for other products than k) is correlated to foreign export performance and explains the entry of domestic firms on the product-country pair kj then, our estimation of foreign export spillovers will be biased. We thus include proxies for the domestic export performance on other product-country pairs. We decompose past export performance of domestic firms in province i into three non-overlapping variables: domestic exports of product k to countries other than j, exports of products other than k to country j and exports of other products to other countries. Our main result holds: the coefficient on our foreign product-country specific export spillovers even slightly increases to reach 0.023. Foreign exports of product k to other countries enter with a positive and significant coefficient, but very small in magnitude (0.007).

In Table 2, we investigate further the appropriate way of accounting for foreign export spillovers. Columns 1 and 2 are benchmarks: Column 1 reproduces Column 6 of Table 1 and Column 2 focuses on product-country specific foreign export spillovers, controlling for the overall activity of foreign exporters (all destinations and all products) in the province. In Columns 3 to 6 of Table 2, we address the need to account for the large number of zero foreign presence. Indeed, in only 2.4% of the cases, do we observe positive foreign export flows for the product-country specific spillovers variable. We adopt two strategies to deal with this issue. First, we verify that our results hold when restricting our sample to cases where we observe non zero foreign presence for product k and country j in year t (Columns 3 and 4). In this subsample,

Table 1: Nature of foreign export spillovers

	Explained variable	Domestic new export link in t+1					
		(1)	(2)	(3)	(4)	(5)	(6)
Foreign Spill. Year t	All product-country Foreign export	-0.338^{b}					
		(0.154)					
	Country all products Foreign export		-0.003				
			(0.003)				
	Product all countries Foreign export			-0.003			
				(0.002)			
	Same product-country Foreign export				0. 020^{a}	0.020^{a}	0.023^{a}
					(0.00 2)	(0.002)	(0.001)
	Other product same country Foreign export					-0.000	0.004
						(0.003)	(0.003)
	Same product other country Foreign export					-0.003	0.007^{a}
						(0.002)	(0.002)
	Other product/country Foreign export					-0.331^{b}	-0.313
						(0.147)	(0.202)
Demand Year t	Ln country-product total imports	0.083^{a}	0.083^{a}	0.083^{a}	0.082^{a}	0.080^{a}	0.080^{a}
		(0.007)	(0.007)	(0.007)	(0.00 7)	(0.006)	(0.006)
	Ln country gdp per capita	0.758	0.601	0.606	0.585	0.746	0.784
		(0.718)	(0.912)	(0.915)	(0.91 2)	(0.704)	(0.658)
Supply Year t	Ln Export province	0.690^{a}	0.533^{b}	0.535^{b}	0.530^{b}	0.475^{b}	0.464
		(0.210)	(0.212)	(0.211)	(0.21 1)	(0.192)	(0.740)
	Ln Export province-product	0.178^{a}	0.181^{a}	0.182^{a}	0.179^{a}	0.169^{a}	0.007
		(0.007)	(0.006)	(0.007)	(0.00 6)	(0.007)	(0.009)
	Ln Export province-country	0.143^{a}	0.146^{a}	0.144^{a}	0.143^{a}	0.138^{a}	0.001
		(0.017)	(0.016)	(0.015)	(0.01 5)	(0.016)	(0.041)
	Ln Export China-product	0.418^{a}	0.415^{a}	0.416^{a}	0.413^{a}	0.354^{a}	0.340^{a}
		(0.017)	(0.019)	(0.019)	(0.01 9)	(0.018)	(0.018)
	Ln Export China-country	0.210^{a}	0.208^{a}	0.207^{a}	0.207^{a}	0.197^{a}	0.194^{a}
		(0.030)	(0.031)	(0.032)	(0.03 2)	(0.028)	(0.027)
	Ln Province gdp per capita	-0.540	-0.378	-0.384	-0.365	-0.545	-0.581
		(0.721)	(0.922)	(0.925)	(0.92 3)	(0.708)	(0.663)
Macro lags Year $t-1$	Lag Ln country-product total imports					0.009^{b}	0.009^{b}
						(0.004)	(0.004)
	Lag Ln Export province					0.261^{c}	0.255
						(0.158)	(0.155)
	Lag Ln Export province-product					0.027^{a}	0.027^{a}
						(0.006)	(0.006)
	Lag Ln Export province-country					0.013	0.011
						(0.010)	(0.009)
	Lag Ln Export China-product					0.079^{a}	0.074^{a}
						(0.013)	(0.013)
	Lag Ln Export China-country					0.020	0.019
						(0.015)	(0.016)
Domestic perf. Year t	0/1 other products/same country Domestic export						-1.220^{a}
							(0.391)
	0/1 same product/other countries Domestic export						-1.391^{a}
							(0.087)
	Ln Other countries-same product Domestic export						0.172^{a}
							(0.007)
	Ln Other products-same country Domestic export						0.139^{a}
							(0.038)
	Ln Other country/product Domestic export						-0.014
							(0.611)
	Observations	3575935	3575935	3575935	35759 35	3575935	3575935
	R-squared	0.121	0.120	0.120	0.120	0.122	0.123
	Fixed effects	Fixed effects by province-product (nc4)-country triad & by year					

Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the province level. ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% confidence level.

the average probability of new linkage creation by domestic firms rises from 0.23 to 0.34. Also, the size of the coefficient is increased and is equal now to 0.047 (Column 4).

The second way to deal with the zero foreign export flows, which is used in the rest of the paper, is to keep the full sample but to measure simultaneously the impact of the mere presence of foreign exporters for a given product-country pair and the value of their exports. In columns 5 and 6, foreign export spillovers are apprehended based not only on the foreign export value as previously, but also on a dummy indicating whether foreign exports are strictly positive. This allows us to disentangle what is due to the scale of export activities by foreign firms from the more general effect due to the presence of foreign exporters. In column 6, we use this same approach to study the impact of foreign export spillovers for other products and/or other destinations. As can be seen in Column 6, we find that product-country specific foreign export spillovers are linked to both the presence of foreign firms and the scale of their export activities for the product-country pair kj. For the product-specific spillover and the country-specific one, the dummy enters with a negative and significant coefficient while the value of exports is on the contrary positively correlated to the entry of domestic firms on foreign markets. This means that foreign exports of the same product k (to other countries) or to the same country j (of other products) have a positive impact above a certain threshold only. However, results in column 1 show that the overall average effect is close to zero. Our results on the export spillovers for other products and countries confirm that there is no cross-products or cross-markets benefits from foreign export activities on the creation of a new export linkage.[10]

If we now try to have an idea of the magnitude of these product and destination country spillovers, we can make several thought experiments. Consider a province where there are no firms, neither foreign nor domestic, exporting product k to country j at year t and another province, where there are foreign firms exporting product k to country j, but in negligible quantities: the sole presence of foreign exporting firms makes that the probability that domestic firms start exporting product k to country j in $t+1$ is 6.9% higher in the latter province than in the former.[11] Considering the average probability to start exporting in the sample, equal to 23.3%, as a reference, the presence of foreign firms exporting product k to country j increases the average probability that domestic firms in the province start exporting the same product to the same country in $t+1$ by 1.6 percentage point. The marginal impact of the value of foreign

[10]Note that the dummy 0/1 indicating whether foreign firms export is always 1 for other products and countries, this is why is does not appear in Column 6.

[11]Given the form of the logistic function, the increase in probability generated by the sole presence of foreign firms exporting product k to country j is equal to $[e^{0.067} - 1]\%$.

Table 2: Specification on foreign export spillovers

Explained variable	Domestic new export link in t+1					
	(1)	(2)	(3)	(4)	(5)	(6)
Same product-country Foreign export	0.023[a]	0.023[a]	0.047[a]	0. 047[a]	0.016[a]	0.016[a]
	(0.001)	(0.001)	(0.008)	(0.00 8)	(0.004)	(0.004)
Other product same country Foreign export	0.004		0 .011			0.021[b]
	(0.003)		(0.014)			(0.009)
Same product other country Foreign export	0.007[a]		0 .006			0.016[a]
	(0.002)		(0.006)			(0.004)
Other product/country Foreign export	-0.313		-0.021			-0.321
	(0.202)		(0.331)			(0.200)
All product-country Foreign export		-0.308		-0.018	-0.308	
		(0.207)		(0.37 2)	(0.207)	
0/1 same product-country foreign export					0.072[b]	0.067[c]
					(0.036)	(0.035)
0/1 other prod./same country foreign export						-0.191[c]
						(0.104)
0/1 same prod./other country foreign export						-0.102[b]
						(0.041)
0/1 other prod./same country dom. export	-1.220[a]	-1.088[a]	-1. 797[b]	-1.678[b]	-1.087[a]	-1.486[a]
	(0.391)	(0.374)	(0.745)	(0.75 6)	(0.374)	(0.410)
0/1 same prod./other country dom. export	-1.391[a]	-1.317[a]	-1. 316[a]	-1.302[a]	-1.314[a]	-1.456[a]
	(0.087)	(0.089)	(0.211)	(0.21 3)	(0.090)	(0.101)
Other country same product Domestic export	0.172[a]	0.161[a]	0.156[a]	0.154[a]	0.161[a]	0.179[a]
	(0.007)	(0.007)	(0.018)	(0.01 8)	(0.008)	(0.009)
Other product same country Domestic export	0.139[a]	0.123[a]	0.126[b]	0.113[b]	0.123[a]	0.166[a]
	(0.038)	(0.034)	(0.052)	(0.04 9)	(0.034)	(0.038)
Other country/product Domestic export	-0.014	-0.010	0.203	0.208	-0.010	-0.006
	(0.611)	(0.621)	(0.779)	(0.82 1)	(0.621)	(0.602)
Control for GDPs	yes	yes	yes	yes	yes	yes
Control for Macro export	yes	yes	yes	yes	yes	yes
Control for Macro export lags	yes	yes	yes	yes	yes	yes
Share of domestic starts	0.233		0.384		0.233	
Observations	3575935	3575935	84789	84789	3575935	3575935
R-squared	0.123	0.123	0.169	0.169	0.123	0.123
Fixed effects	by province-product (nc4)-country triad & by year					

Year FE for 1999-2005. Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the province level. [a], [b] and [c] indicate significance at the 1%, 5% and 10% confidence level.

exports is on the other hand much more modest, since a 10% increase in the value of foreign exports of product k to country j raises the probability that domestic firms start exporting the same product to the same country by 0.04 percentage point.[12]

3.3 Ordinary versus processing trade

Our results tend to show so far that domestic Chinese firms benefit from foreign export spillovers, but at a very specific level: the probability that domestic firms start exporting product k to country j is positively associated with surrounding foreign firms' exports of the same product to the same country the year before.

[12]If we consider a reference value $\bar{x}$ for variable x, the increase in probability generated by a 10% increase in x is equal to $(1.1^{\beta_x} - 1)$, β_x being the coefficient on x. The increase expressed in percentage point of probability is equal to $(1.1^{\beta_x} - 1)P_{\bar{x}}$

Table 3: Ordinary versus Processing trade (1999-2007)

Explained variable: new export link in t+1	Domestic		Domestic ODT		Domestic PCS	
	(1)	(2)	(3)	(4)	(5)	(6)
ODT same country/prod. for. export	0.015^a	0.013^a	0.017^a	0. 016^a	-0.017^c	-0.018^c
	(0.004)	(0.004)	(0.004)	(0.00 4)	(0.010)	(0.010)
0/1 ODT same prod/country for. export	0.086^a	0.083^a	0.065 ^{b}	0.063^b	0.279^b	0.274^b
	(0.029)	(0.029)	(0.030)	(0.03 0)	(0.112)	(0.112)
PCS same country/prod. for. export	0.006	0.006	0.007	0. 007	0.009	0.009
	(0.006)	(0.006)	(0.006)	(0.00 6)	(0.015)	(0.015)
0/1 PCS same prod/country for. export	0.080	0.068	0.040	0.028	0.201	0.195
	(0.049)	(0.050)	(0.045)	(0.04 6)	(0.168)	(0.169)
ODT Other country same prod. for. export		0.021^a		0.021^a		0.010
		(0.005)		(0.00 5)		(0.010)
0/1 ODT same prod. other country for. export		-0.132^a		-0.139^a		0.031
		(0.046)		(0.04 5)		(0.088)
ODT same country other prod. for. export		0.021^b		0.021^b		-0.027
		(0.009)		(0.00 9)		(0.021)
0/1 ODT other prod. same country for. export		-0.186^b		-0.185^b		0.382^c
		(0.093)		(0.08 8)		(0.231)
ODT Other country/product for. export		0.025		0.017		0.226
		(0.102)		(0.10 5)		(0.162)
PCS Other country same prod. for. export		0.022^a		0.021^a		0.036^a
		(0.004)		(0.00 5)		(0.010)
0/1 PCS same prod. other country for. export		-0.214^a		-0.207^a		-0.269^a
		(0.040)		(0.04 4)		(0.099)
PCS same country other prod. for. export		0.010		0.007		0.040
		(0.007)		(0.00 7)		(0.026)
0/1 PCS other prod. same country for. export		-0.122		-0.101		-0.341
		(0.084)		(0.08 5)		(0.257)
PCS Other country/product for. export		-0.116		-0.121		-0.198
		(0.118)		(0.12 3)		(0.139)
0/1 PCS other prod./country for. export		2.355^c		2.417^c		2.148
		(1.373)		(1.43 4)		(1.539)
0/1 other prod./same country dom. export	-1.163^a	-1.464^a	-1. 083^b	-1.354^a	-1.168^c	-1.551^b
	(0.430)	(0.448)	(0.453)	(0.46 7)	(0.650)	(0.693)
0/1 same prod./other country dom. export	-1.325^a	-1.543^a	-1. 319^a	-1.534^a	-1.636^a	-1.901^a
	(0.088)	(0.100)	(0.088)	(0.09 9)	(0.267)	(0.292)
Other country same product Domestic export	0.162^a	0.189^a	0.162^a	0.189^a	0.183^a	0.214^a
	(0.008)	(0.010)	(0.007)	(0.00 9)	(0.030)	(0.032)
Other product same country Domestic export	0.130^a	0.163^a	0.127^a	0.157^a	0.128^a	0.170^a
	(0.040)	(0.042)	(0.042)	(0.04 3)	(0.049)	(0.056)
Other country/product Domestic export	0.555	0.460	0.602	0.483	-0.894^a	-0.898^b
	(0.408)	(0.510)	(0.420)	(0.51 1)	(0.313)	(0.439)
Control for GDPs	yes	yes	yes	yes	yes	yes
Control for Macro export	yes	yes	yes	yes	yes	yes
Control for Macro export lags	yes	yes	yes	yes	yes	yes
Average probability of domestic start	0.233		0.235		0.274	
Observations	3575935	3575935	3425094	3425094	222838	222838
R-squared	12.3	12.4	12.3	12.4	13.8	13.9
Fixed effects	Fixed effects by province-product (nc4)-country triad & by year					

Year FE for 1999-2005. Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the province level. ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% confidence level.

Other export activities of foreign firms have overall no significant or very marginal impact. However, one remaining question is whether the results hold when we account for the important role of processing trade. Indeed, since firms engaged in processing trade "simply" import inputs and re-export a transformed product, we can imagine that they are less embedded in their direct environment and consequently generate less externalities. In Table 3, we thus further decompose our foreign export spillovers into the two trade regimes (ordinary and processing). Also, in order to identify whether export spillovers affect differently the creation of new linkages depending on the trade regimes used by domestic firms, we study separately ordinary export creation (Columns 3 and 4) and processing export creation (Columns 5 and 6). Columns 1 and 2 indicate that foreign export spillovers in the assembly sector has no predictive power on the likelihood of domestic firms to create new linkages. The coefficients on both the dummy for the presence of foreign exporters and their export value are insignificant. By contrast, the two measures attract a positive and significant sign when export spillovers emanate from foreign exporters engaged in ordinary trade. More interestingly, the comparison between columns 3 and 4 (restricted to ordinary export flows creation) and 5 and 6 (restricted to processing export new linkages) suggest that foreign export spillovers only derive from ordinary export activities from foreign firms and mainly apply to ordinary export activities of domestic firms. It seems thus that processing trade activities are driven by different determinants. In the end, the presence *per se* of foreign firms exporting product k to country j increases the average probability that domestic firms of the province start exporting this product to this country by 1.52 percentage point[13] while a 10% increase in the value of foreign exports increases the average probability that domestic firms start exporting by 0.04 percentage point[14]. These results are in line with previous findings on the heterogenous impact of export upgrading depending on trade type. Jarreau and Poncet (2010) for example argue that processing exports performance must not be taken as signalling a process of technological adoption in China, but rather as an artefact due to China's participation in the increasing fragmentation of production processes.

4 Heterogeneity of foreign export spillovers

We now investigate potential heterogeneity of export spillovers according to the sophistication of exported products and the sophistication gap between foreign and domestic firms. Given the results obtained in the previous section, we focus on ordinary trade activities.

[13]This figure corresponds to $[exp^{0.063} - 1] \times 0.233$ from column 4.
[14]This figure corresponds to $(1.1^{0.016} - 1) \times 0.233$ from column 4.

4.1 Foreign export spillovers and product sophistication

One argument often advanced by policy-makers to justify policies aiming at attracting FDI is that foreign firms may help domestic ones to improve their processes, to adopt technology and then to increase their productivity and upgrade the quality of their products. Jarreau and Poncet (2010) also show that the export sophistication of domestic exports is favorable to provincial growth, but not the sophistication of foreign exports. However, if the export spillovers generated by foreign firms are stronger for more sophisticated products, we would highlight an indirect impact of foreign firms on local growth. In Table 4, we thus check wether the foreign export spillovers depend on the product sophistication level, focusing on ordinary trade foreign activity. We follow Hausmann, Hwang and Rodrik (2007) and assume that each good k that a country can potentially produce and export has an intrinsic level of sophistication[15] associated to it, $PRODY_k$, that is the weighted average of the income levels of this good k's exporters, where the weights correspond to the revealed comparative advantage of each country j in good k:[16]

$$PRODY_k = \frac{1}{C_k} \sum_j \frac{x_{jk}}{X_j} \times Y_j, \tag{3}$$

where x_{jk} is the value of exports of good k by country j, X_j is the total value of country j's exports and Y_j is the per capita level of income of country j, measured as the real GDP per capita, in PPP. C_k is a normalization term used to have the coefficients sum to 1. The bigger share a given good k weighs in the exports of rich countries, the higher its $PRODY$, the more sophisticated it is. We compute the product(HS4)-level sophistication level for the year 1997, the initial year of our sample. The average sophistication value of goods exported by China across the 1213 exported HS4-products in 1997 is 12813\$ with a minimum of 971 and a maximum of 32000\$.[17]

In Table 4, we use two alternative cut-offs. Columns 1 to 4 rely on the value of 13775\$ which ensures a split in almost two equal subsamples. Columns 5 to 8 use a lower value, equal to 11000\$. Both cut-offs provide a similar message: export spillovers are systematically stronger for higher product sophistication levels.

[15] While Hausmann, Hwang and Rodrik (2007) use the word "productivity" to describe sophistication at the good level, we prefer terms like sophistication, high quality or technological advancement.

[16] The numerator of the weight, x_{jk}/X_j, is the value-share of the commodity in the country j's overall export basket while the denominator of the weight, $C_k = \sum_j (x_{jk}/X_j)$, aggregates the value-shares across all countries exporting the good.

[17] The statistical distribution of sophistication value is reproduced in Figure 1 in the Appendix. Values are in constant 2000 dollars.

Table 4: Heterogeneity impact of foreign export spillovers depending on product sophistication

Explained variable:	Domestic new export link in t+1							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$\geq$ 13775	$<$ 13775	$\geq$ 13775	$<$ 13775	$\geq$ 11000	$<$ 11000	$\geq$ 11000	$<$ 11000
ODT same prod/country for. export	0.012^{b}	0.025^{a}	0.009^{c}	0. 024^{a}	0.015^{a}	0.024^{a}	0.013^{a}	0.023^{a}
	(0.005)	(0.005)	(0.005)	(0.00 5)	(0.004)	(0.008)	(0.004)	(0.008)
0/1 ODT same prod/country for. export	0.095^{b}	0.016	0.100 ^{b}	0.015	0.070^{b}	0.024	0.074^{b}	0.021
	(0.040)	(0.044)	(0.040)	(0.04 4)	(0.030)	(0.071)	(0.030)	(0.071)
All product-country Foreign export	0.042	0.059			0.037	0.074		
	(0.110)	(0.101)			(0.112)	(0.093)		
ODT Other country same prod. for. export			0. 026^{a}	0.016^{a}			0.023^{a}	0.018^{a}
			(0.006)	(0.00 6)			(0.006)	(0.005)
ODT same country other prod. for. export			0. 020^{b}	0.022^{b}			0.019^{b}	0.024^{b}
			(0.010)	(0.00 9)			(0.010)	(0.010)
ODT Other country/product for. export			0.023	0.034			0.017	0.047
			(0.108)	(0.09 9)			(0.110)	(0.091)
0/1 ODT other prod. same country for. export			-0.181^{c}	-0.191^{b}			-0.173^{c}	-0.208^{b}
			(0.097)	(0.09 5)			(0.097)	(0.100)
0/1 ODT same prod. other country for. export			-0.186^{a}	-0.091^{c}			-0.151^{a}	-0.120^{b}
			(0.052)	(0.04 8)			(0.050)	(0.049)
0/1 other prod./same country dom. export	-0.929^{c}	-1.192^{a}	-1. 121^{b}	-1.422^{a}	-1.126^{b}	-0.987^{b}	-1.313^{a}	-1.240^{b}
	(0.501)	(0.434)	(0.521)	(0.44 7)	(0.451)	(0.494)	(0.468)	(0.508)
0/1 same prod./other country dom. export	-1.302^{a}	-1.352^{a}	-1. 430^{a}	-1.461^{a}	-1.295^{a}	-1.361^{a}	-1.416^{a}	-1.486^{a}
	(0.127)	(0.106)	(0.135)	(0.10 8)	(0.108)	(0.113)	(0.114)	(0.117)
Other country same product Domestic export	0.164^{d}	0.161^{d}	0.180^{a}	0.175^{a}	0.160^{a}	0.162^{d}	0.176^{d}	0.178^{d}
	(0.010)	(0.009)	(0.011)	(0.01 0)	(0.008)	(0.010)	(0.009)	(0.011)
Other product same country Domestic export	0.129^{b}	0.127^{a}	0.151^{a}	0.153^{a}	0.139^{a}	0.107^{a}	0.160^{a}	0.136^{a}
	(0.051)	(0.037)	(0.053)	(0.03 9)	(0.045)	(0.039)	(0.047)	(0.042)
Other country/product Domestic export	0.726	0.696	0.737	0.674	0.754	0.641	0.757	0.614
	(0.525)	(0.450)	(0.515)	(0.44 2)	(0.503)	(0.443)	(0.492)	(0.435)
Control for GDPs	yes	yes	yes	yes	yes	yes	yes	yes
Control for Macro export	yes	yes	yes	yes	yes	yes	yes	yes
Control for Macro export lags	yes	yes	yes	yes	yes	yes	yes	yes
Share of domestic starts	0.234	0.236	0.234	0.236	0.234	0.237	0.234	0.237
Observations	1712219	1710931	1712219	17109 31	2352760	1070390	2352760	1070390
R-squared	0.147	0.101	0.147	0.101	0.143	0.084	0.143	0.084
Fixed effects	by province-product (nc4)-country triad & by year							

Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the province level. ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% confidence level.

When we consider results obtained in Columns 3 and 4, the sole presence of foreign exporters increases the probability that domestic firms start exporting sophisticated product k to country j in year $t+1$ by 10.5% with respect to the average productivity to start exporting, i.e. by 2.5 percentage point. Foreign presence has no impact *per se* for less sophisticated products. The difference in the marginal impact of foreign exports value between both samples is negligible (0.02 for sophisticated products and 0.05 for less sophisticated ones). The effect of the presence *per se* of foreign exporters is equal 1.8 percentage point when the sophistication threshold is set at 11000$ (in this case, the marginal impact of foreign exports value is equal to 0.03 percentage point for sophisticated products and 0.05 for the others).

This result is suggestive that foreign export spillovers can be beneficial to the upgrading of Chinese domestic exports. At least the positive impact of foreign exporters is not restricted to products of low sophistication level, which could have resulted in a "low-sophistication" trap for domestic exporters.

4.2 Foreign export spillovers and sophistication gap

We now investigate another source of heterogeneity of foreign export spillovers. In order to benefit from the experience of foreign firms, the activity of domestic firms might need to be quite similar to the one of foreign firms. It is indeed likely that a too large technological distance reduces the capacity for domestic firms to benefit from export spillovers, due to limited absorption capacity. Consistently with the theoretical model of Rodriguez-Clare (1996), Havranek and Irsova (2010) find in a meta-analysis on technology spillovers from FDI that greater positive impact of foreign firms presence on domestic firms' productivity is generated by investors that have a slight technological advantage over local firms. One way to measure the distance between the goods produced by foreign and domestic firms is to compare their degree of sophistication. In Table 5, we thus investigate the potential heterogeneity of the role of foreign export spillovers depending on the sophistication gap between foreign and domestic exporters. We compute the average difference in sophistication level at the province-SH2 level for the year 1997. This average difference is computed as the ratio between the weighted average sophistication of HS4-products exported by foreign firms of province i within a given HS2 category, and this weighted average for domestic firms. The median value of this sophistication gap over the 1715 province-HS2 pairs was 1.008 in 1997.[18] In order to verify that export spillovers are not

[18]The statistical distribution of sophistication gap across the province-HS2 pairs is reported in Figure 2 in the Appendix.

restricted to cases where foreign exporters display no technological advantages over local firms, we split our sample depending on whether the ratio of sophistication level between foreign and domestic entities is lower (Column 1) or higher (Column 2) than one. We find that spillovers are stronger when the HS4-products exported by foreign firms of the province are on average as sophisticated or more sophisticated than the products exported by domestic firms. In this case, the presence of foreign exporters increases the average productivity that domestic firms start exporting a given product k to country j by 5.3% (i.e. 1.25 percentage point). The presence of foreign firms *per se* has no effect when domestic firms of the province export products that are more sophisticated than foreign firms' exported products. In columns 3 and 4, we further split the sample of column 2 depending on the level of the sophistication advance of foreign firms. Interestingly, we find that the export spillovers effect is much higher when foreign exporters have a slight technological advantage over domestic firms. The magnitude of spillovers is greater when the average difference in sophistication is positive but lower than 10%. In this case, presence of foreign exporters in the province increases the probability that domestic firms start exporting product k to country j by around 9% (i.e. 2.26 percentage point). Presence of foreign exporters *per se* has no impact when technological gap in favor of foreign firms if too big. Regarding the marginal impact of foreign exports value, the difference between both samples is again negligible (0.03 percentage point when sophistication gap is small vs 0.05 when it is big).This result is coherent with empirical findings obtained on foreign spillovers on productivity. Consistently with the theoretical model of Rodriguez-Clare (1996), Havranek and Irsova (2010) find in a meta-analysis on technology spillovers from FDI that greater positive impact of foreign firms presence on domestic firms' productivity is generated by investors that have a slight technological advantage over local firms. This last result suggests that the optimistic result obtained previously about the magnification effect of export spillovers with product level sophistication should be qualified. While proximity to foreign exporters can help domestic exporters to create new export linkages, especially for sophisticated products, this is restricted to instances where the technological advantage of foreign firms is not too high.

Table 5: Heterogeneity impact of foreign export spillovers depending on sophistication gap

Explained variable:	Domestic new export link in t+1					
	(1)	(2)	(3)	(4)	(5)	(6)
	Ratio Foreign/Domestic ordinary sophistication (sh2-province 1997)					
	< 1	≥ 1	≥ 1 & < 1.07	≥ 1 & < 1.09	≥ 1.07	≥ 1.09
ODT same prod/country for. export	0.015^{b}	0.017^{a}	0.013^{c}	$0.\ 013^{b}$	0.021^{a}	0.021^{a}
	(0.006)	(0.003)	(0.007)	(0.00 7)	(0.004)	(0.005)
0/1 ODT same prod/country for. export	0.082	0.053^{b}	$0.092^{\ c}$	0.086^{c}	0.010	0.010
	(0.053)	(0.026)	(0.048)	(0.04 9)	(0.042)	(0.048)
ODT Other country same prod. for. export	0.018^{a}	0.024^{a}	$0.\ 036^{a}$	0.035^{a}	0.014^{b}	0.012^{b}
	(0.005)	(0.006)	(0.007)	(0.00 7)	(0.006)	(0.006)
ODT same country other prod. for. export	0.023^{b}	0.020^{b}	$0.\ 027^{a}$	0.029^{a}	0.013	0.010
	(0.011)	(0.009)	(0.009)	(0.00 9)	(0.010)	(0.011)
ODT Other country/product for. export	-0.135	0.074	0.298	0.191	-0.035	-0.005
	(0.230)	(0.123)	(0.223)	(0.25 1)	(0.095)	(0.097)
0/1 ODT other prod. same country for. export	-0.184^{c}	-0.192^{b}	-0.278^{a}	-0.291^{a}	-0.119	-0.090
	(0.111)	(0.090)	(0.095)	(0.09 0)	(0.096)	(0.098)
0/1 ODT same prod. other country for. export	-0.105^{b}	-0.169^{a}	-0.266^{a}	-0.254^{a}	-0.089	-0.081
	(0.047)	(0.057)	(0.068)	(0.06 5)	(0.057)	(0.058)
Control for GDPs	yes	yes	yes	yes	yes	yes
Control for Macro export	yes	yes	yes	yes	yes	yes
Control for Macro export lags	yes	yes	yes	yes	yes	yes
Share of domestic starts	0.233	0.230	0.235	0.234	0.227	0.2265
Observations	1427612	1995538	870664	9837 33	1124874	1011805
R-sq	0.1289	0.1200	0.1329	0.1313	0.1107	0.1097
Fixed effects	by province-product (nc4)-country triad & by year					

Year FE for 1999-2005. Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the province level. ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% confidence level.

5 Conclusion

We investigate how the creation of new export linkages (extensive margin of trade) by domestic firms in China is influenced by their proximity to multinational exporters. Using panel data from Chinese customs for 1997-2007, we show that there is evidence that domestic firms' capacity to start exporting new varieties to new markets positively relates to the export performance of neighboring foreign firms for that same product-country pair. We find that foreign export spillovers are limited to ordinary trade activities. No foreign export spillovers are found for processing trade. More, export spillovers are stronger for sophisticated products, indicating that proximity to foreign exporters may help domestic exporters to upgrade their exports. However we observe that foreign export spillovers are weaker when the technology gap between foreign and domestic firms is large, suggesting that upgrading may not occur in locations and sectors where foreign firms have already a strong edge.

6 Appendix

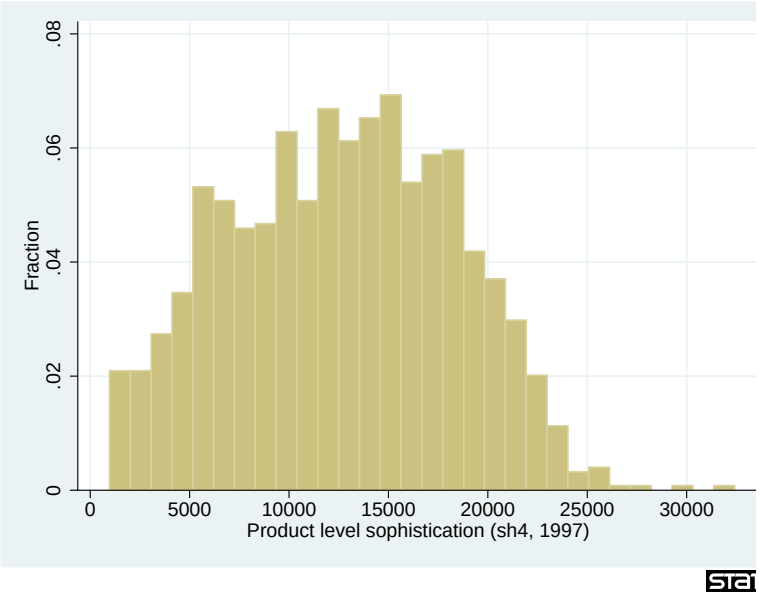

Figure 1: Density of product-level export sophistication, 1997. Source: Authors' computations based on Chinese customs, BACI and WDI.

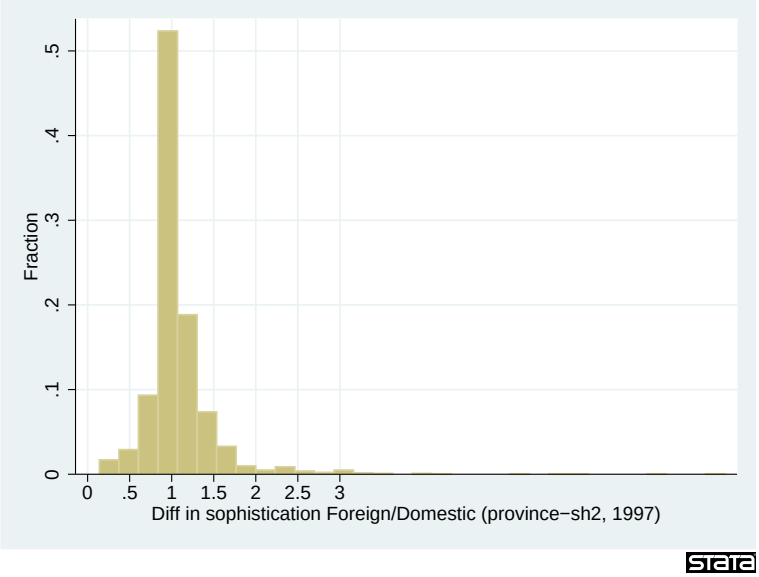

Figure 2: Density of Foreign-Domestic ODT export sophistication, 1997. Source: Authors' computations based on Chinese customs, BACI and WDI.

Table 6: Marginal impact-Summary

	All sample	ODT	PCS	Soph.	Not soph.	Low soph. gap	High soph.gap
Foreign presence *per se*	1.6	1.53	n.s.	2.5	n.s.	2.26	n.s.
Foreign exp. val	0.04	0.04	n.s.	0.03	0.05	0.03	0.05

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