Imitating to Export*

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Abstract

We document Chinese imitation of foreign firms on a large scale. China's export processing zones (EPZs) attract foreign companies. Chinese firms in adjacent cities quickly imitate these companies by increasing exports of the same products. Further, Chinese companies import the same equipment imported by companies in EPZs, suggesting the imitation of technology. Finally, imitating firms leapfrog non-imitating firms in productivity. We conclude that an important element of China's success in trade has been its ability to attract foreign firms and subsequently imitate them. **JEL classification numbers:** F1, F2, O2

After decades of spectacular growth, China became the world's largest trading nation in 2013. While there is little doubt that reform and liberalization have propelled much of this growth, it remains difficult to assess the effectiveness of individual policies. Yet disentangling the contributors to China's incredible success is of fundamental importance to understanding China's rise as well as assessing whether it can be replicated in other countries.

In this paper, we document an important yet previously unaccounted-for contributing factor in China's export machine. Using a broad set of incentives,

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ranging from lower taxes to streamlined customs procedures, China attracts foreign firms to set up operations in export processing zones (EPZs). Exports from these zones, produced almost exclusively by wholly owned foreign enterprises (WOFEs), increased very quickly, ramping up from zero at the beginning of 2001 to about $4 billion per month by 2006.

We find that Chinese companies in adjacent cities quickly export more of the same products exported from EPZs. Moreover, Chinese firms import the same equipment as foreign firms in EPZs, suggesting that they imitate foreign technology. Finally, we find that imitating Chinese companies close to EPZs leapfrog their peers in productivity: they begin with lower starting productivity and their productivity grows faster once they begin to imitate. We conclude that a key ingredient of China's success in trade is its ability to attract foreign firms and subsequently imitate them.

We utilize three layers of variation to identify the effects of EPZs in our study. First, since the placement of EPZs is likely to be endogenous, we study the spillovers from EPZs primarily in cities adjacent to the EPZ, reasoning that imitation is likely to be facilitated by spatial proximity. Second, we use the exact Harmonized System (HS) codes at the 8-digit level for products exported from EPZs, and control for exports of products similar but not identical. Third, we examine the timing of export gains and equipment imports, and find that most of the increase occurs in the year after the year of first export or import from the EPZ.

Our study focuses primarily on cities adjacent to EPZs. The placement of EPZs is endogenous; cities that received EPZs are more populous, have larger economies, and export more than cities which do not. Our assumption is that cities adjacent to the city of the EPZ cannot choose where an EPZ is established or which products are shipped from it. While there are many unobserved factors that could influence the exports of an EPZ and other outcomes in the city of the EPZ, the number of factors that could jointly determine both the exports of an

EPZ and outcomes in adjacent cities is far fewer.

Within each EPZ, we observe the date of first export for each product at the HS8 level. To address the possibility that region-specific comparative advantage explains our results, we include controls for the exports of products that are similar but not identical, reasoning that comparative advantage should extend to a set of products rather than a single HS8 code. Specifically, we control for product exports matching HS6 or HS4 codes but not matching HS8 codes and find very similar results.

Finally, we examine the timing of these gains. Gains in exports occur in the year after the year of first export. Chinese firms with private ownership imitate faster and experience larger increases than state owned enterprises (SOEs). Companies with partial foreign ownership do not imitate and experience no changes coinciding with EPZs.

Reasoning that imitation is likely to occur only when Chinese companies can export under their own brand, we focus on "ordinary trade" exports. In our baseline specification, if a product is exported from an EPZ, ordinary trade exports of the same HS8 product by Chinese companies are 131% larger in the city surrounding the EPZ, and 57% larger in cities bordering the EPZ. These gains in value are accompanied by modestly larger numbers of exporters, suggesting that more Chinese firms enter these markets.

We follow a similar process to provide an important mechanism that suggests that Chinese companies are imitating their foreign counterparts. We observe the HS codes and first import dates of equipment imported by EPZs. We find that imports of this equipment by Chinese companies experience a large, one-time surge in the year following the date of first import by the EPZ. Again, the biggest increases occur in the city of the EPZ, with the next biggest in cities adjacent to the EPZ. Imports are also limited to the exact equipment imports of EPZs, rather than similar types of products. Importing the same equipment suggests that Chinese companies are imitating the technology of foreign ones.

While we cannot directly observe the technology or production processes of Chinese companies or foreign firms, we define "imitation" for the purposes of this paper by suggesting that imitation has occurred when the export patterns and import patterns of foreign companies are duplicated by neighboring Chinese firms. An anecdotal example is illustrative of this definition of imitation.

In 2003, a foreign company began exporting HS code 85445110, "Connector cables between 80V and 1000V," from the EPZ in the city of Hangzhou. In the same year, they also began importing one type of equipment: HS code 84629910, "Other mechanical presses."[1] In the neighboring city of Jiaxing, exports of HS code 85445110 jumped from about $10,000 per year in 2002 and 2003 to more than $100,000 per year in 2004 and 2005. We also observe a surge in imports of HS code 84629910 in 2004, with orders more than quadrupling that year before settling back down to previous levels.

We examine alternative explanations for these patterns. First, we show that the regional agglomeration argument is not the primary driver of our findings. If regional agglomeration were to explain our results, we would expect that wholly owned foreign enterprises (WOFEs), which account for almost all exports in EPZs, might have the greatest potential to benefit from agglomeration effects. However, we find the opposite story: WOFEs in adjacent cities quickly move out of those cities and cut their exports of the products exported from EPZs.

Second, we rule out the possibility that the results are caused by persistent ex ante differences between adjacent cities and non-adjacent cities; we show that expansions in exports and imports by Chinese companies occur after the introduction of those products by EPZs.

Third, we examine our evidence for the presence of area-specific comparative advantage and exogenous product-specific shocks. Some types of firms do not move into EPZs in substantial numbers but are unlikely to be able to imi-

[1] This example was chosen for its simplicity because the foreign firm exported only one good and imported only one type of equipment. In other cases, foreign companies may be exporting multiple types of goods and importing multiple types of equipment.

tate. Joint ventures between foreign companies and Chinese ones and foreign-domestic partnerships are two examples. Exports from these companies show no change when EPZs begin exporting competing products. Our results are robust to including same-city exports by these firms.

Participation in export markets is often viewed as a precursor for economic growth.[2] We examine the implications of our results and find that imitating Chinese companies experience significant gains in operating performance relative to their peers. We compare the growth of productivity between imitating Chinese companies and those firms that export similar but not identical products (products that share the same first 6 digits but differ in the last 2 digits). While the comparison group of Chinese companies starts ahead in terms of productivity, imitating firms exhibit bigger gains in total factor productivity and in profitability. This suggests that imitating foreign technology helps companies to leapfrog their peers.

We believe that our paper is the first to document Chinese imitation of foreign firms on a large scale. As such, it relates to Holmes et al. (2013), who explain the relatively low foreign direct investment (FDI) between China and advanced economies using the existence of quid pro quo arrangements where firms must transfer technology in exchange for access to the Chinese market. Technology transfer in China is also studied by Van Reenen and Yueh (2012), who examine the productivity effect of technology transfer agreements signed at the establishment of international joint ventures.

Recent papers link firm export and production to their imports. Manova and Zhang (2012) show that exporters use higher quality imports to produce higher quality exports. We also integrate export and import behavior into a narrative about the Chinese export machine, complementing their results by showing how certain types of imports, like those selected as equipment by foreign companies,

[2]Park et al. (2010) discuss various pathways for the impact of exports on firm productivity and find supporting evidence from a sample of companies in China.

can lead to increased exports and productivity gains.

In some ways, our paper is similar to that of Fernandes and Tang (2014), who show that when firms begin shipping to a new foreign market, other firms in the same city learn to enter these new markets. Unlike their paper, we focus on Chinese firms learning from foreign ones; this is a different process and has different implications than Chinese firms learning from other Chinese ones. In our paper, Chinese companies imitate which products to ship, rather than which market to enter. Moreover, we provide a mechanism in the form of equipment imports, and we study firms in adjacent cities rather than firms in the same city.

A related strand of literature studies the spillover effects of foreign direct investment (FDI). Empirical evidence thus far has been inconclusive.[3] Our work contributes to the FDI literature in two ways. First, the policy of EPZs provides a natural experiment to test spillovers because we can observe foreign investment in EPZs start from nothing and grow to large levels in geographically concentrated areas. Second, we provide additional insight into how FDI spillover effects take place because we utilize adjacency combined with related products as our key identifying characteristics.

Another strand of related literature evaluates the benefits of place-targeted programs. In the context of China, several papers study special economic zones (SEZs).[4] These papers, which focus on the benefit of SEZs to their own cities, may be subject to endogeneity concerns since zones are not placed randomly. In addition to examining how SEZs impact their own cities, we study how EPZs affect surrounding cities. This approach is close to the approach used in Rajan and Zingales (1998). Since cities are unlikely to be able to influence the establishment of their neighbors' EPZs and cannot pick which products are exported, we believe that our empirical design is close to a causal inference.

[3] See for example, Aitken and Harrison (1999), Pavcnik (2002), Harding and Javorcik (2012), Javorcik and Spatareanu (2008), and Mayneris and Poncet (2013). Head et al. (2014), Swenson and Chen (2014), and Brambilla et al. (2009) study this issue in the context of China.

[4] See for example, Wei (1993), Cheng and Kwan (2000), Démurger et al. (2002), Jones et al. (2003), Alder et al. (2013), and Wang (2013).

1 Institutional Background

The International Labour Organization (ILO) defines an EPZ as "a relatively small, geographically separated area within a country, the purpose of which is to attract export-oriented industries, by offering them favorable investment and trade conditions as compared with the remainder of the host country." According to the ILO, the number of EPZs has increased exponentially from 79 in 25 countries in 1975 to over 3,500 zones in 130 countries in 2006 (ILO 2007).

EPZs in China are dedicated to processing activities, with more than 99% of exports from EPZs classified as processing.[5] The processing trade is the business activity of importing raw materials and components from abroad, and re-exporting the finished product after processing and assembling. Processing requires a signed contract with a foreign partner, who markets the finished products under their own brand. The processing trade is an important component of Chinese trade (Feenstra and Hanson 2005) and accounts for more than 40% of China's exports in our sample period.

EPZs were set up in segregated, fenced-off zones as a way to control smuggling (People's Daily (2000a, 2000b). Because of concerns that the processing trade is vulnerable to smuggling and tax evasion, EPZs helped centralize foreign companies engaging in processing EPZs to locations that were more easily managed by the government. To facilitate the close monitoring of exports and imports, most EPZs take the form of fenced areas between 2 and 3 square kilometers large, placed within SEZs and economic and technological development zones (ETDZs).[6]

China authorized its first batch of 15 EPZs in April 2000, and the first export from these zones occurred in February 2001. The first three EPZs to export were in Chengdu, Hangzhou, and Suzhou. EPZs were scattered throughout China,

[5]The mains forms of trade, apart from processing, are ordinary trade and assembling trade.

[6]The World Bank (2008) describes these policy arrangements as a unique zone-within-zone case as large opened economic zones (ETDZs) hosted smaller zones (EPZs, bonded areas, high-tech development zones) within their territory.

with some provinces receiving several while others had none.[7]

We graph the locations of EPZs in figure 1. Although the bulk of China's international trade emanates from coastal provinces, EPZs are geographically dispersed with many EPZs located in inland China. Three of the first 15 EPZs were in non-coastal provinces, and 12 EPZs eventually appeared in inland provinces over the sample period. We are able to identify 32 EPZs in 29 cities that record positive values of exports in our sample.[8] There are no clear geographical patterns to the phase-in of EPZs, with early and late introductions present in the eastern and southern areas of the country.

In general, cities that receive EPZs are much larger than cities that did not. Table 1 shows the population, GDP, and export levels in 2000 for cities that received EPZs between 2000 and 2006 and cities that did not receive them. This table also contrasts cities that are adjacent to cities with EPZs with those cities that are in the same province but not adjacent. For narrative purposes, we term this group "non-adjacent cities." While these last two groups of cities are similarly sized in terms of population, cities adjacent to EPZs are larger in GDP and exported more. However, the difference between these cities for the specific products exported from EPZs is relatively small.

Compared with ETDZs, EPZs permit fewer business activities inside the zones. Enterprises inside the EPZs may not operate retailing, general trade, or any other business. This focus on processing activities allows the EPZ to offer additional incentives compared to ETDZs. A central feature of EPZs is the property "inside the border, outside customs," which means that goods flowing

[7] A total of 15 export processing zones were first approved in April 2000 by the State Council. Subsequently, 2, 8, 14, and 18 EPZs were approved in 2001, 2002, 2003, and 2005, respectively. During our sample period, 23 provinces had set up at least one EPZ. We list the number of EPZs alongside the name of the province: Shanghai (5), Beijing (1), Jilin (1), Sichuan (2), Yunnan (1), Inner Mongolia (1), Tianjin (1), Anhui (1), Shandong (5), Guangdong (4), Guangxi (1), Xinjiang (1), Jiangsu (14), Jiangxi (1), Hebei (1), Henan (1), Zhejiang (4), Hubei (1), Hunan (1), Fujian (4), Liaoning (3), Chongqing (1), and Shaanxi (1).

[8] Dates between footnote 7 and figure 1 differ because the footnote refers to the dates when EPZs were officially approved, while figure 1 labels EPZs according to their date of first export.

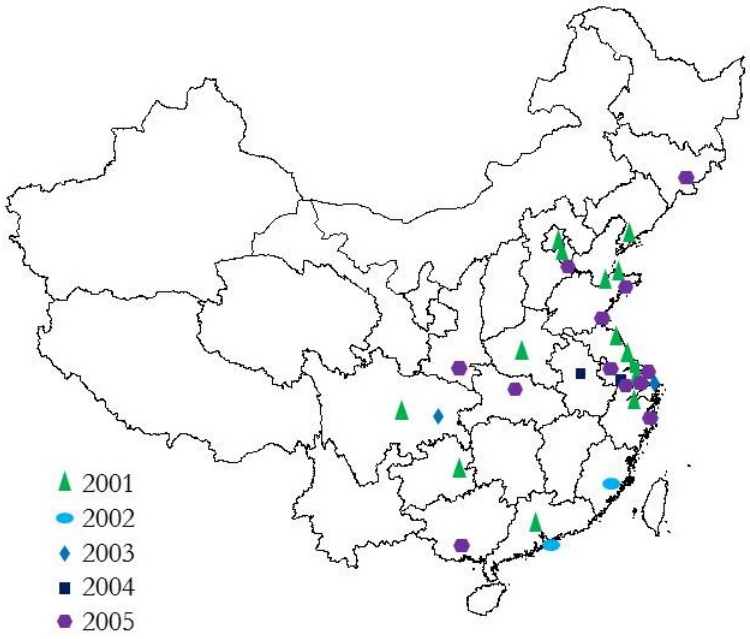

Figure 1: The locations of EPZs in China. The year of first export for each EPZ is labeled.

Table 1: How Cities That Received EPZs Compare with Adjacent Cities and Cities in the Same Province

	Provinces with EPZs			Provinces
	Contains EPZ	Adjacent to EPZ	Not Adjacent	Without EPZs
Number of Cities	29	92	191	131
Avg. Population (M)	2.5	1.5	1.5	2.2
Avg. GDP (B of RMB)	123.4	12.6	9.7	10.4
Average Exports per City (M of $US)				
Exports Matching at HS8	15.7	2.8	2.6	
Exports Matching at HS6	19.5	3.4	2.9	
Exports Matching at HS4	33.9	6.1	4.8	
Exports Matching at HS2	64.2	12.5	9.3	
All Exports	109.1	20.9	14.3	6.3

in and out of the EPZ are treated as exports and imports, respectively.[9] Previous studies like Wei (1993) and Wang (2013), lump different types of economic zones together under the umbrella of development zones.

Although we find no laws restricting EPZs to international companies, the vast majority of exports are attributed to WOFEs, rather than companies with full or partial Chinese ownership. In our data, 96% of exports from EPZs were attributed to WOFEs.[10] Exports from other special zones, such as ETDZs, were much more heterogenous. Once set up, exports from EPZs quickly explode. Figure 2 shows how EPZs grew from inception to account for billions of dollars per month in exports by 2006. Exports from EPZs grow faster than exports from the cities in which they were located until 2005, when they accounted for between 8% and 10% of exports in those cities.

EPZs have several advantages that are attractive to foreign companies. First, they allow duty-free, permit-free, and quota-free imports of raw and intermediate inputs and capital goods (like machinery, equipment, materials) for export production. This could represent a significant savings in cost of goods sold for companies within EPZs. Second, government regulations within EPZs are streamlined. Particularly important is the presence of lowered regulatory burden to clear customs. Third, companies in EPZs are given generous, long-term tax concessions. Outside of the EPZ, companies have to pay the value-added tax (VAT), but are rebated the VAT paid on goods that were exported. Within the EPZ, companies do not have to pay the VAT. Fourth, the infrastructure within EPZs is more advanced than in other parts of the country. Communications services and transportation infrastructure in particular are better within EPZs.

We examine the distribution of HS codes for products exported by export processing zones. Since EPZs are primarily dedicated to the processing trade,

[9]Movements of goods between cities within China and EPZs are not recorded in our data, while movements between EPZs and other countries are recorded.

[10]A further 3% came from joint ventures, with the remainder scattered in miscellaneous company types. Among exports from all areas besides EPZs, WOFEs account for 33% of exports, and joint ventures 19%.

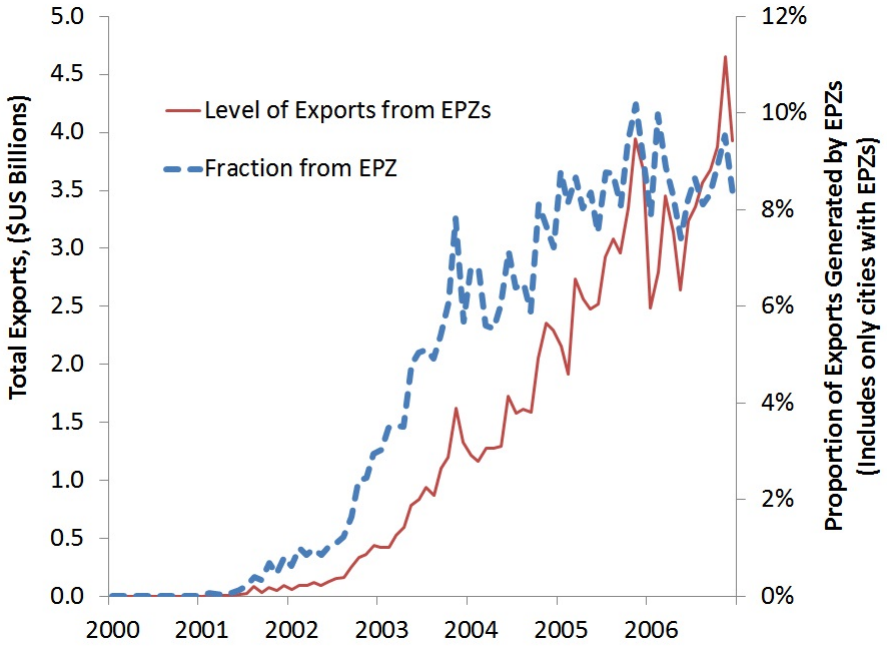

Figure 2: The proportion of exports generated by export processing zones, in cities with EPZs.

it might be expected that the range of HS codes is narrow. However, as we show in table 2, a wide variety of products are exported. EPZs export products with 55 separate HS8 codes on average, with each EPZ seeming to have its own product mix. Barriers to entry appear to be minimal and enterprises across a wide range of industries set up production sites. Anecdotal evidence suggests that, during their early stages, most EPZs did not have a clear plan as to what types of products should be produced. As a result, processing companies from a broad set of industries flocked to EPZs.

In the same table, we examine the range of products imported by EPZs under the customs designation "EPZ equipment," which we explain further when we describe the data. As expected, the largest set of HS codes defined as equipment is in HS Codes 84 and 85, "Machinery and electrical." However, a large variety of other types of goods were also imported under the "EPZ equipment" label, with some entries in almost every product category.

Table 2: Composition of Exports and Equipment Imports for EPZs

		Exports		Equipment Imports	
		Num. Products	Fraction of Value	Num. Products	Fraction of Value
01-05	Animal Products	3	0.05	2	0.00
06-15	Vegetable Products	14	0.01	6	0.00
16-24	Foodstuffs	16	0.05	6	0.00
25-27	Mineral Products	7	0.00	46	0.00
28-38	Chemical Products	107	0.08	213	0.00
39-40	Plastics/Rubbers	55	0.02	144	0.01
41-43	Raw Hides and Furs	13	0.03	19	0.00
44-49	Wood and Wood Products	36	0.01	125	0.00
50-63	Textiles	206	0.18	164	0.00
64-67	Footgear and Headgear	17	0.01	27	0.00
68-71	Stone and Glass	32	0.01	104	0.00
72-83	Metals	89	0.08	403	0.02
84-85	Machinery and Electrical	207	0.29	967	0.81
86-89	Transportation	51	0.09	37	0.00
90-97	Miscellaneous	106	0.08	278	0.15
98-99	Services	0	0	0	0

2 Data

We perform our analysis using the database of the Chinese Customs Trade Statistics (CCTS), compiled and maintained by the General Administration of Customs of China. It records all merchandise transactions passing through Chinese customs from January 1, 2000, to December 31, 2006.[11] In all, 520 cities record exports during our time period.[12] The database includes identifying information on the firm exporting the good (name, address, and ownership status), information on the product being exported (the name of the product, the product code, the quantity and value of the export), and the method of export (means of transportation, transit point, and destination country).

Product codes are recorded using the Chinese version of the HS system.

[11] It includes only transactions between EPZs and other countries, and does not include transactions between other parts of China and EPZs.

[12] We treat districts in four centrally administered cities, Beijing, Tianjin, Shanghai, and Chongqing, as "cities." These districts have populations and economies comparable to cities in other provinces.

Chinese HS codes parallel international codes at the HS 2-digit level but differ at the 4-digit level and 8-digit level. Export and import values are reported in free-on-board terms in US dollars. The corresponding quantities are reported in various units depending on the nature of the good.

The customs data use a special category, "EPZ Equipment," which companies in EPZs employ when they import equipment.[13] Companies in EPZs receive duty-free and quota-free import of both equipment and materials. Hence, they are incentivized to report all imports into these categories, and there is no benefit to mispresenting their imports.

We also supplement the data with the Chinese Annual Survey of Industrial Firms (CASIF) from the National Bureau of Statistics (NBS). The CASIF survey data that we use cover the period 2000 to 2006. Two categories of companies are included in the survey: state-owned companies and companies of other ownership types with annual sales above 5 million Chinese yuan. On average, more than 200,000 companies are included each year and they account for around 95% of total Chinese industrial output and 98% of industrial exports. The NBS collects detailed information on companies' operations, including basic characteristics such as ownership structure, location, and industry.

3 Empirical Analysis

3.1 Imitating the Exports of EPZs

3.1.1 Empirical Setup

Our primary interest is to examine how patterns of Chinese firm export and import behavior are affected by foreign company operations inside EPZs. An obvious focal point is the cities where EPZs are situated. The problem with exclusively studying these cities is that the placement of EPZs is non-random: cities that receive EPZs are much larger, export more, and grow faster than cities

[13] The Pinyin category code is "chu kou jia gong qu jin kou she bei."

that do not receive them.

Our strategy is to primarily focus on cities that are adjacent to EPZs. While the placement of EPZs is endogenous, adjacent cities are not able to pick whether and when their neighbors receive EPZs, nor what products are exported from those EPZs. We reason that geographical proximity and product relatedness should facilitate imitation. One possible mechanism for imitation would be employees who work at foreign enterprises, then leave these firms and start their own companies. These employees may have locational preferences, and cities that are adjacent are more likely to receive these startups than cities that are farther away.

Moreover, our hypothesis includes the idea that the value of products exported from EPZs should grow faster than the value of those that are not exported. We observe the HS codes exported and the first dates of export from each EPZ. We match the exports from a given city with the exports of EPZs near to it using these HS8 code matches. For geographical proximity, we utilize three spatial categories: the city incorporating the EPZ, the cities adjacent to the EPZ, and non-adjacent cities still within the province of the EPZ.

We employ the following equation in our analysis:

$$\begin{aligned} Y_{i,j,t} &= (Contains\,Shipping\,EPZ)_{i,t} * (HS\,of\,Shipping\,EPZ)_{j,t}\beta_1 \\ &+ (Contains\,Shipping\,EPZ)_{i,t}\beta_2 \\ &+ (Adjacent\,to\,Shipping\,EPZ)_{i,t} * (HS\,of\,Shipping\,EPZ)_{j,t}\beta_3 \\ &+ (Adjacent\,to\,Shipping\,EPZ)_{i,t}\beta_4 \\ &+ (HS\,of\,Shipping\,EPZ)_{j,t}\beta_5 \\ &+ \alpha_i + \alpha_j + \alpha_t + \varepsilon_{i,j,t} \end{aligned} \tag{1}$$

In this equation, the index i represents the city from which the export originates, j represents the HS code of the export, and t represents the year of export. In all tests using this specification, we employ fixed effects α_i, α_j, and α_t, corre-

sponding to the city, HS code, and year of export, respectively.[14] $\varepsilon_{i,j,t}$ represents the error term, which is clustered at the city level.

We use value exported as the main dependent variable and examine the number of exporters in some regressions. Since our primary findings are changes in the value exported, we focus on this dependent variable in our text. In this case, $Y_{i,j,t}$ represents the value exported from city i in HS code j in year t.

Our first two explanatory variables help us examine patterns of exports in cities that contain EPZs. Our variable of interest is an interaction term that indicates whether a city containing an EPZ exports a specific product. Each component of the interaction term is included as a control variable. The first control variable differentiates exports of the specific product exported by the EPZ from other exports in the city. The second control variable distinguishes exports of that product from cities with EPZs from cities that do not have an EPZ.

The variable $(Contains\,Shipping\,EPZ)_{i,t} * (HS\,of\,Shipping\,EPZ)_{j,t}$ is a dummy variable indicating whether an EPZ within city i exports HS code j in any year before year t. This variable assumes the value of one when three conditions are met. First, there must be an EPZ in city i. Second, the EPZ must have exported a product with an HS8 code matching j. Third, the EPZ must have exported this product in any year before year t.

The variable $(Contains\,Shipping\,EPZ)_{i,t}$ is a dummy variable indicating whether an EPZ within city i has exported any product before year t. This variable can only assume the value of one after the establishment of an EPZ in city i, and is one only if an export from the EPZ occurs in city i in a year before t.

The variable $(HS\,of\,Shipping\,EPZ)_{j,t}$ is a dummy variable indicating when any EPZ in the province of city i has exported HS code j. Since some provinces

[14] In theory, we would like to control for variation within city-product pairings by adding a full set of city dummies interacted with product dummies, $\alpha_i \times \alpha_j$. In practice, this is computationally infeasible. Instead, we include as a control the mean value of the dependent variable for city i for product j while excluding the value of the export of that product from the mean, $Y_{i,-j,t}$. Tests with this control are presented in the "Related Products" section below.

have more than one EPZ, we use all EPZs in the province of city i to compare adjacent cities and non-adjacent cities. It takes on the value of one under three conditions. First, there is an EPZ in the same province as city i. Second, this EPZ exported HS code j. Third, the export occurs in a year before t.

Our next variables help us examine patterns of exports in cities adjacent to EPZs. The variable $(Adjacent\,to\,Shipping\,EPZ)_{i,t} * (HS\,of\,Shipping\,EPZ)_{j,t}$ is our second variable of interest. It is a dummy indicating whether an EPZ in a city adjacent to city i has exported HS code j in a year before t. It assumes the value of one under three conditions. First, there is an EPZ established in the city next to city i. Second, the EPZ exports product j. Third, the export of product j occurs in a year before t. The estimate of this variable captures how exports in the cities adajcent to the city of the EPZ are affected by the export of goods from the EPZ.

Of its two control variables, we have already explained $(HS\,of\,Shipping\,EPZ)_{j,t}$. Its other component, the variable $(Adjacent\,to\,Shipping\,EPZ)_{i,t}$, is a dummy variable that equals indicates whether an EPZ in a city adjacent to city i has exported in a year before t. It takes on the value of one under two conditions. First, there is an EPZ established in a city adjacent to city i. Second, that EPZ exports any product in a year before t.

Along with the total value of exports, we also examine the total number of exporters. Each exporter in our data is a company or subsidiary or branch of a parent company. These companies are assigned a unique ID number, and we count the number of unique exporters in city i of product j in year t with the variable $log\,(Num\,Exporters)_{i,j,t}$.

3.1.2 Results

We report our baseline estimation results in the first two columns of table 3. In these regressions, the dependent variable is the export value or number of exporters for each city, for each HS8, for each year. All observations from cities

containing EPZs measure only exports from the rest of the city and exclude exports reported from the EPZ. We limit the observations examined to "ordinary trade."[15]

The first row of table 3 reports coefficient β_1, the relation between exports of an EPZ and exports from the city containing that EPZ among the HS8 codes exported by the EPZ. We see a significant and positive relationship for both the value shipped and the number of exporters. The second row of this table reports coefficient β_2, the additional exports realized by the city containing an EPZ for all HS codes. We see that there is a significant positive point estimate, indicating that the cities that contain EPZs also export more of other goods in general.

We show in table 1 that cities with EPZs started with much higher export levels of the goods exported from EPZs in 2000, before any of the EPZs were set up. It is therefore unsurprising that growth in these cities was higher. The placement of EPZs is non-random, and the selection of products is non-random; companies moving into EPZs are likely to select their products to export based on which ones are most profitable in a given area. In the first two rows of table 3, we see strong evidence affirming that cities receiving EPZs grew faster between 2001 and 2006 during the same period for which EPZs were phased in. We emphasize that the coefficients in these rows are likely to represent a correlation rather than a causation.

The third row reports the point estimates for coefficient β_3, our second variable of interest: the impact of exports from an EPZ on exports from adjacent cities. We see that the coefficient on value exported is positive and significantly greater than zero, indicating that companies in adjacent cities exported significantly more in the years after the EPZ began export. Coefficients on the num-

[15] In ordinary trade, a Chinese firm is free to enter new markets under its own brand. This is the type of trade which is most likely to result in the kind of imitation we are most interested in. By contrast, the processing trade and assembly trade in China require proof of a contract with a foreign buyer to whom the firm will export the goods (Manova and Yu 2011). The foreign buyer, who is more likely to be constrained by foreign intellectual property regimes, is responsible for the marketing and distribution of the final product.

Table 3: The Relationship Between Exports of an EPZ and Exports of Cities Around the EPZ

	Chinese		WOFE	
	Value	Num Exporters	Value	Num Exporters
(Contains Shipping EPZ) * (HS of Shipping EPZ)	1.313*** (0.223)	0.686*** (0.171)	1.746*** (0.276)	0.482*** (0.119)
Contains Shipping EPZ	0.389*** (0.142)	0.154*** (0.044)	0.342** (0.148)	0.079*** (0.020)
(Adjacent to Shipping EPZ)* (HS of Shipping EPZ)	0.573** (0.254)	0.083 (0.070)	-0.539** (0.266)	-0.085* (0.051)
Adjacent to Shipping EPZ	0.272** (0.115)	0.055*** (0.020)	0.101 (0.162)	-0.001 (0.017)
HS of Shipping EPZ	1.036*** (0.095)	0.234*** (0.026)	0.799*** (0.101)	0.129*** (0.021)
Year FE	Yes	Yes	Yes	Yes
HS8 FE	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes
N	4,070,360	4,070,360	993,426	993,426
R^2	0.230	0.346	0.197	0.260

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Each dependent variable is the log of that variable. Each observation in these regressions is the export of products with a given HS8 code from a city in a year. Observations exclude exports shipped directlyfrom EPZs. The variable “Contains Shipping EPZ" is a dummy variable indicating whether an EPZ inside that city exported products with any HS code in that year. The variable “HS of Shipping EPZ" is a dummy variable indicating whether any EPZ in the province of the city exported products with a given HS code in that year. The variable “Adjacent to Shipping EPZ" is a dummy variable indicating whether an EPZ in an adjacent city exported products with any HS code that year. Standard errors are clustered at the city level.

ber of exporters are positive but statistically indistinguishable from zero. Some companies enter this marketplace, but not a statistically significant number.

The fourth row reports coefficient estimate of β_4. Again, the point estimate is positive and statistically significant, which indicates that cities that are adjacent export more on average among all product categories.

The fifth row reports coefficient estimate of β_5. Each of the coefficients is positive and statistically significant. The point estimate of β_5 suggests that the exports shipped from EPZs are 104% larger than those that were not shipped throughout the province of the EPZ. This coefficient serves as a baseline estimate for variables β_1 and β_3.

To interpret the economic meaning of our baseline specification, our estimate of coefficient β_3 implies that the export of an HS code from an EPZ boosts exports of that HS code from Chinese companies in neighboring cities by 57.3% relative to non-adjacent cities in the province. Since the variable controlling for HS codes of products shipped from the EPZ is present, this estimate should be interpreted as additional to gains in increases in exports observed throughout the province.

Total exports experience annualized growth rates of 25% between 2000 and 2006 in China. Against this backdrop of rapid export growth, our results suggest that EPZs still have a large effect on exports in adjacent cities. The magnitudes of the coefficients in row 1 are larger than those in row 3, consistent with the narrative that companies in cities that contain EPZs receive the largest gain from close exposure to foreign companies and their technology.

Our coefficient estimates are noisy, with standard errors above 0.2 in row 3 for value, even though we employ millions of observations. We observe 959 distinct HS8 codes exported from EPZs in our data; these exports have a median value exported of \$13,000 and a mean value exported of \$53,084. About 100 of these HS8 codes have a value of less than \$1,000 over the 7-year panel, suggesting that they are not exported very much from EPZs and any imitation

of these of exports would be small in scale. As a result, the standard errors that we observe are likely to reflect a wide variation in imitation, with some products likely receiving large amounts of attention and others receiving little or no attention.

In summary, we find that the value exported by Chinese companies increases more quickly after the product is shipped by an EPZ, with the largest effects occurring in the city of the EPZ and the next largest occurring in the cities adjacent to the EPZ. Exports in these cities increase faster than exports throughout the rest of the province, with exports of the specific products shipped by EPZs growing faster than products not shipped by EPZs.

3.2 Imitating the Technology of EPZs

We proceed to provide evidence of one mechanism driving our finding that Chinese companies imitate foreign firms: Chinese companies purchase the same production equipment as that imported in EPZs. If Chinese companies use the same equipment as foreign companies, they are likely to have imitated the technology introduced by foreign entrants.

We are able to observe the HS codes imported under the customs category "EPZ equipment"[16] and the date of first import for each HS code in each EPZ. There is no corresponding code among Chinese companies outside of EPZs to document the import of equipment. Therefore, we again limit the set of imports in these regressions to "ordinary trade."[17] We analyze whether the import of a given type of equipment by an EPZ is accompanied by increases in imports of that equipment in cities surrounding the EPZ.

We employ a specification that is very similar to equation 1:

[16]Over 99% of imports into EPZs are classified into three categories: "duty-free warehouse goods," "EPZ equipment", and "processing materials". We see from these descriptions that capital equipment imported by EPZs should be registered under the "EPZ equipment" customs code rather than "ordinary trade" or another label.

[17]See footnote 15 for further discussion.

$$
\begin{aligned}
Y_{i,j,t} &= (Contains\,Importing\,EPZ)_{i,t} * (HS\,of\,EPZ\,Import)_{j,t}\gamma_1 \\
&+ (Contains\,Importing\,EPZ)_{i,t}\gamma_2 \\
&+ (Adjacent\,to\,Importing\,EPZ)_{i,t} * (HS\,of\,EPZ\,Import)_{j,t}\gamma_3 \\
&+ (Adjacent\,to\,Importing\,EPZ)_{i,t}\gamma_4 \\
&+ (HS\,of\,EPZ\,Import)_{j,t}\gamma_5 \\
&+ \alpha_i + \alpha_j + \alpha_t + \mu_{i,j,t}
\end{aligned}
\tag{2}
$$

We briefly define each variable below. As before, i, j, and t are dummy variables corresponding to the city, HS8 codes, and year of the observation. This regression employs the same fixed effects[18] and also clusters standard errors at the city level. The key difference between this specification and that of equation 1 is that these dummies indicate whether the EPZ began importing a specific equipment in only the year prior to the observation. Imports of equipment are likely to be short-lived and to appear in bursts as imitating companies build up their capital stock. In contrast with exports, we do not expect increases in eqiupment imports to continue beyond the year of first EPZ import and the year after first EPZ import.

The first variable of interest, $(Contains\,Importing\,EPZ)_{i,t} * (HS\,of\,EPZ\,Import)_{j,t}$, is a dummy variable indicating whether 1) city i contains an EPZ, 2) that EPZ begins import of HS code j, and 3) the import of j began in year $t-1$. Similarly, the variable $(Contains\,Importing\,EPZ)_{i,t}$ is a dummy indicating whether 1) city i contains an EPZ and 2) the EPZ begins importing in year $t-1$.

The second variable of interest, $(Adjacent\,to\,Importing\,EPZ)_{i,t} * (HS\,of\,EPZ\,Import)_{j,t}$, is a dummy variable indicating whether 1) city i is adjacent to an EPZ, 2) that EPZ begins import of HS code j, and 3) the import of j began in year $t-1$. The fourth variable $(Adjacent\,to\,Importing\,EPZ)_{i,t}$ is a dummy indicating whether

[18] Similar to our specifications in exports, we employ additional testing that controls for variation in city:product pairings by adding the additional control $Y_{i,-j,t}$. See footnote 14 for more details.

1) city i is adjacent to an EPZ and 2) the city begins importing any product in year $t-1$.

The fifth variable, $(HS\,of\,EPZ\,Import)_{j,t}$, is used in both interaction terms of the variables of interest. It indicates whether any EPZ in the same province of city i imports HS code j in year $t-1$.

We report estimation results in table 4. Rows 1 and 3 of column 1 report how the value imported by Chinese companies in cities containing EPZs and cities adjacent to EPZs responds after an EPZ begins importing equipment. We see that there is a significant and positive response for each of these types of cities. Moreover, we find that the same pattern of results is observed, with the largest increase in imports occurring in the city surrounding the EPZ, and the next largest occurring in the cities adjacent to the EPZ.

In the same fashion as table 3, we see that imports of equipment are larger throughout the province of the EPZ, although the magnitudes of the coefficients in row 5 are noticeably smaller in table 4. Similarly to table 3, column 2 suggests that the number of importers importing matching equipment in surrounding cities increases, with a positive but noisy number of importers in cities adjacent to the EPZ. In parallel with our results for exporters, the number of Chinese companies importing the same equipment as EPZs is statistically indistinguishable from zero, suggesting that most of the imitation is performed by existing companies rather than new entrants. In general, the pattern of results in table 4 is reassuringly similar to the pattern in table 3.

To summarize, we are able to observe the HS codes and first import dates of the equipment that foreign companies use when they set up in EPZs. We find that imports of matching equipment surge in the year following first import among Chinese companies in the cities surrounding EPZs and the cities adjacent to the EPZs. Chinese companies imitate the equipment of foreign companies in EPZs, suggesting that they are imitating the technology of foreign firms in EPZs.

Table 4: The Relationship Between Imports of Equipment into an EPZ and Imports of Cities Around the EPZ

	Chinese		WOFE	
	Value	Num Importers	Value	Num Importers
(Contains Importing EPZ) * (HS of EPZ Import)	1.397***	0.434***	1.855***	0.596***
	(0.237)	(0.095)	(0.188)	(0.087)
Contains Importing EPZ	0.146	0.040	0.123	0.017
	(0.166)	(0.025)	(0.149)	(0.029)
(Adjacent to Importing EPZ)* (HS of EPZ Import)	0.523***	0.075	0.049	0.006
	(0.193)	(0.047)	(0.209)	(0.048)
Adjacent to Importing EPZ	0.122	0.030*	0.237*	0.025
	(0.126)	(0.017)	(0.138)	(0.019)
HS of EPZ Import	0.190***	0.021	0.266***	0.022**
	(0.071)	(0.016)	(0.079)	(0.019)
Year FE	Yes	Yes	Yes	Yes
HS8 FE	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes
N	3,201,933	3,201,933	1,535,198	1,535,198
R^2	0.212	0.312	0.256	0.347

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Each dependent variable is the log of that variable. Each observation in these regressions is the import of products with a given HS8 code from a city in a year. Observations exclude imports shipped directly from EPZs. The variable “Contains Importing EPZ" is a dummy variable indicating whether an EPZ inside that city imported “EPZ equipment" the year before. The variable “HS of EPZ Import" is a dummy variable indicating whether any EPZ in the province of the city imported “EPZ equipment" with an HS8 code matching the HS8 code of the observation that year or the year before. The variable “Adjacent to Shipping EPZ" is a dummy variable indicating whether an EPZ in an adjacent city imported“EPZ equipment" that year. Standard errors are clustered at the city level.

3.3 Alternative Explanations

In the following section, we examine some alternative explanations for our results. One possibility is that our results occur because of regional agglomeration. Under this explanation, the entrance of foreign companies creates economies of scale for suppliers or regional concentrations of managers with product-specific expertise. These would create surges in exports of particular products in areas surrounding the EPZ and in imports of particular forms of equipment. We address the possibility of regional agglomeration by showing that the value exported by WOFEs and the number of WOFEs in adjacent cities actually drops.

A second possibility is that adjacent cities are different from non-adjacent cities before the introduction of EPZs and such differences persist. We show that the changes presented above coincide with a timing coincident with the introduction of the products from EPZs. Ex ante differences cannot explain the timing of our results.

A third possibility is that region-specific comparative advantages accrue to both cities with EPZs and adjacent cities. We control for the export levels of closely related products to show that related products do not enjoy the same gains. Any comparative advantage would likely adhere to both the specific products shipped from EPZs and closely related products.

Finally, it may be argued that product-specific exogenous shocks such as changes in world prices cause both the introduction of products by EPZs and gains in exports from adjacent cities. We control for the export levels of partnerships and joint ventures. These types of enterprises do not move into EPZs in significant numbers.[19] They would benefit from product-specific exogenous shocks but may be unable to imitate foreign enterprises. Our results show partnerships and joint ventures in adjacent cities are largely unaffected by EPZs. Moreover, Chinese companies export more of the same products and import

[19] See footnote 10.

more of the same equipment in cities adjacent to EPZs, even after controlling for the activity levels of partnerships or joint ventures.

3.3.1 The Behavior of WOFEs

We repeat the regressions from equations 1 and 2, restricting the set of observations to exports and imports by WOFEs. We report these results in columns 3 and 4 of table 3 for exports, and in columns 3 and 4 of table 4 for imports. In both tables, the coefficients are positive in row 1 for foreign companies, just as they are for Chinese ones. Cities with EPZs are different than cities without EPZs; they are larger, wealthier, and grew faster in exports. Since both Chinese and foreign companies are likely to benefit from these advantages, it is unsurprising that the value of exports for both types of companies increased in these endogenously selected cities.

Importantly, exports and imports for foreign companies in adjacent cities differ sharply from Chinese companies in adjacent cities. Coefficients in row 3 are negative for foreign companies in table 3, suggesting that foreign companies situated next to an EPZ export markedly less of the products shipped by the EPZ. Imports of equipment are no different in adjacent cities. To explain this pattern of results, consider that EPZs attract foreign companies to set up, taking advantage of the incentives explained earlier. These benefits create two effects which can hurt exports by WOFEs in adjacent cities. First, foreign companies may move out of adjacent cities into nearby EPZs. Second, companies in EPZs have lower costs and can outcompete similar companies in neighboring cities.

In summary, when foreign companies in EPZs begin exporting a product, foreign companies in adjacent cities are displaced; exports from foreign companies in adjacent cities decline. If agglomeration were a dominant factor, we would expect to see the companies most similar to those in EPZs, other WOFEs, benefit most from the introduction of EPZs.

3.3.2 The Timing of Changes

To show that our results cannot be explained by ex ante differences between adjacent and non-adjacent cities, we provide evidence that changes in both exports and imports are coincident with the first shipment date of the EPZ. We split the within-city, adjacent-city, and within-province dummies from equations 1 and 2 to examine how identical exports from cities surrounding an EPZ are timed with exports from the EPZ. In these regressions, time t refers to the time when an EPZ began exporting a given HS8. Time $t-2$ and time $t-1$ refer to the years before the EPZ begins export, and times $t+1$ and $t+2$ refer to the years after the EPZ begins export.

We perform this regression for each of the major firm types and present the results for exports in table 5. Examining Chinese state-owned enterprises (SOEs) in adjacent cities first, we can see that the coefficients in years $t-1$ and $t-2$, before the EPZ begins to export, are positive but statistically indistinguishable from zero. Then, starting in year $t+1$, the point estimates for exports from adjacent cities turn sharply upward; the export of a good from an EPZ increases exports of that good from SOEs by 30% to 40% in a statistically significant way.

Turning to privately owned Chinese companies in column 2, we can see that the coefficients in years $t-2$ and $t-1$ are negative and insignificant. There is a sharp increase in year t and an even larger increase in year $t+1$ which pushes these coefficients to be statistically significant. Here, the gain in value exported appears to be larger than that of SOEs: the export of a good from an EPZ increases exports from private Chinese companies between 60% and 70%.

In summary, we have found that both SOEs and privately owned Chinese companies increase exports in the years immediately after an EPZ. This may be surprising to some analysts who think that SOEs are inflexible and would not be able to imitate foreign firms. We note here only that SOEs are very heterogenous during this period, with both small SOEs and massive ones observable in

Table 5: The Timing of Changes to Export Value

	SOE	Private	Partner-ships	Joint Ventures	WOFE
(Contains Exporting EPZ) *	1.540***	1.332***	-0.086	1.288***	1.436***
(HS of EPZ Export) ($t-2$)	(0.239)	(0.414)	(0.236)	(0.232)	(0.252)
(Contains Exporting EPZ) *	1.748***	1.599***	-0.040	1.315***	1.695***
(HS of EPZ Export) ($t-1$)	(0.293)	(0.530)	(0.253)	(0.204)	(0.256)
(Contains Exporting EPZ) *	2.047***	1.822***	0.312	1.363***	1.852***
(HS of EPZ Export) (t)	(0.319)	(0.415)	(0.257)	(0.172)	(0.322)
(Contains Exporting EPZ) *	1.991***	1.798***	0.099	1.259***	1.950***
(HS of EPZ Export) ($t+1$)	(0.374)	(0.349)	(0.198)	(0.206)	(0.267)
(Contains Exporting EPZ) *	1.783***	1.499***	-0.091	1.222***	1.848***
(HS of EPZ Export) ($t+2$)	(0.381)	(0.299)	(0.440)	(0.181)	(0.316)
(Adjacent to Exporting EPZ) *	0.363	-0.206	-0.030	0.029	-0.145
(HS of EPZ Export) ($t-2$)	(0.230)	(0.287)	(0.217)	(0.203)	(0.212)
(Adjacent to Exporting EPZ) *	0.435	-0.264	-0.093	0.025	0.0453
(HS of EPZ Export) ($t-1$)	(0.274)	(0.313)	(0.210)	(0.269)	(0.269)
(Adjacent to Exporting EPZ) *	0.508	0.065	-0.185	0.176	-0.174
(HS of EPZ Export) (t)	(0.326)	(0.244)	(0.283)	(0.253)	(0.298)
(Adjacent to Exporting EPZ) *	0.805**	0.450**	-0.173	-0.137	-0.566**
(HS of EPZ Export) ($t+1$)	(0.351)	(0.204)	(0.361)	(0.234)	(0.283)
(Adjacent to Exporting EPZ) *	0.727*	0.496**	-0.377	-0.377	-0.770**
(HS of EPZ Export) ($t+2$)	(0.407)	(0.253)	(0.389)	(0.274)	(0.335)
HS of EPZ Export ($t-2$) *	0.641***	0.398***	0.351***	0.313***	0.200**
	(0.088)	(0.082)	(0.074)	(0.064)	(0.085)
HS of EPZ Export ($t-1$) *	0.840***	0.726***	0.423***	0.613***	0.410***
	(0.091)	(0.083)	(0.101)	(0.069)	(0.095)
HS of EPZ Export (t) *	1.090***	1.117***	0.715***	0.981***	0.840***
	(0.105)	(0.085)	(0.123)	(0.076)	(0.099)
HS of EPZ Export ($t+1$) *	1.013***	1.248***	0.765***	1.053***	0.936***
	(0.112)	(0.087)	(0.132)	(0.083)	(0.107)
HS of EPZ Export ($t+2$) *	0.826***	1.230***	0.704***	0.925***	0.933***
	(0.120)	(0.092)	(0.180)	(0.098)	(0.119)
Year FE	Yes	Yes	Yes	Yes	Yes
HS8 FE	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes
N	3,168,039	2,373,294	173,700	939,624	993,426
R^2	0.204	0.339	0.136	0.132	0.199

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

See table 3 for descriptions of variables in this table. The annotation t refers to the year of first export from an EPZ of the good with an HS8 matching the observation. The descriptions $t-2$ and $t-1$ refer to the year two years and one year before period t, and the description $t+1$ and $t+2$ refer to the years after period t.

our data. We find that SOEs seem to increase their exports later than private firms, and that they register smaller increases, supporting the intuition that private companies are nimbler and would imitate faster than state-owned firms.

The value of exports shipped by WOFEs in adjacent cities, in column 5, appears to follow the opposite pattern. The value of exports is near zero in the years before the export. It turns negative in the year of introduction of the EPZ, and sharply decreases in a statistically significant way in the two years after the introduction of the EPZ. Again, we find that the decrease in exports by WOFEs is coincident with the introduction of the product by the EPZ.

Finally, we examine partnerships and joint ventures. Partnerships have foreign partners in operations while joint ventures are companies with partial foreign ownership. These companies did not move into EPZs in significant numbers, and we would expect that foreign companies cannot imitate WOFEs in EPZs. These companies experience no significant changes from the introduction of EPZs, with all fluctuations statistically insignificant.

We present the timing results for imports in table 6. Turning first to SOEs, we see that there is a statistically significant increase in imports in year $t+1$, affirming our finding above that SOEs begin to export more in period $t+1$. Equipment imports drop off in later periods.

Examining next private Chinese companies, we can see that equipment imports accelerate in the year of first import by EPZs and the year $t+1$. Again, this result is consistent with our earlier finding that private companies increase their exports of the products exported by EPZs in year t and year $t+1$.

In the remaining columns of table 6, we examine patterns of chnages in equipment imports for non-Chinese forms of company ownership. There is no relationship between changes in equipment imports for foreign companies and the import of equipment into EPZs. To understand these results, we should recall that imports of equipment are expansions of firm capital. Firms import equipment when they want to expand capacity; a null result is expected when

Table 6: The Timing of Changes to Import Value

	SOE	Private	Partner-ships	Joint Ventures	WOFE
(Contains Importing EPZ) *	1.353***	0.927**	0.168	1.325***	1.460***
(HS of EPZ Import) ($t-2$)	(0.285)	(0.420)	(0.166)	(0.180)	(0.201)
(Contains Importing EPZ) *	1.357***	0.925**	0.336**	1.538***	1.819***
(HS of EPZ Import) ($t-1$)	(0.282)	(0.438)	(0.167)	(0.218)	(0.256)
(Contains Importing EPZ) *	1.537***	1.077***	0.368**	1.681***	2.105***
(HS of EPZ Import) (t)	(0.249)	(0.387)	(0.180)	(0.188)	(0.271)
(Contains Importing EPZ) *	1.501***	1.290***	0.438**	1.715***	2.141***
(HS of EPZ Import) ($t+1$)	(0.252)	(0.313)	(0.194)	(0.153)	(0.229)
(Contains Importing EPZ) *	1.070***	1.427***	0.400**	1.632***	1.999***
(HS of EPZ Import) ($t+2$)	(0.313)	(0.201)	(0.190)	(0.175)	(0.242)
(Adjacent to Importing EPZ) *	0.262	-0.031	-0.076	-0.047	-0.253
(HS of EPZ Import) ($t-2$)	(0.275)	(0.121)	(0.150)	(0.213)	(0.171)
(Adjacent to Importing EPZ) *	0.243	0.166	0.050	-0.139	-0.128
(HS of EPZ Import) ($t-1$)	(0.261)	(0.133)	(0.188)	(0.199)	(0.190)
(Adjacent to Importing EPZ) *	0.187	0.323**	0.061	-0.074	0.030
(HS of EPZ Import) (t)	(0.271)	(0.153)	(0.278)	(0.223)	(0.211)
(Adjacent to Importing EPZ) *	0.423*	0.458**	0.145	-0.076	0.115
(HS of EPZ Import) ($t+1$)	(0.245)	(0.229)	(0.246)	(0.221)	(0.236)
(Adjacent to Importing EPZ) *	0.112	0.044	0.161	-0.509**	-0.022
(HS of EPZ Import) ($t+2$)	(0.247)	(0.220)	(0.237)	(0.225)	(0.301)
HS of EPZ Import ($t-2$) *	-0.164**	-0.195**	0.013	-0.158**	-0.160**
	(0.075)	(0.073)	(0.086)	(0.064)	(0.076)
HS of EPZ Import ($t-1$) *	-0.046	-0.271**	0.104	0.065	-0.013
	(0.095)	(0.075)	(0.093)	(0.081)	(0.088)
HS of EPZ Import (t) *	0.239**	-0.091	0.264***	0.346***	0.285***
	(0.104)	(0.076)	(0.093)	(0.093)	(0.096)
HS of EPZ Import ($t+1$) *	0.151	-0.055	0.177*	0.356***	0.338***
	(0.104)	(0.101)	(0.109)	(0.092)	(0.102)
HS of EPZ Import ($t+2$) *	0.144	-0.039	0.704***	0.304***	0.312***
	(0.109)	(0.109)	(0.109)	(0.097)	(0.110)
Year FE	Yes	Yes	Yes	Yes	Yes
HS8 FE	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes
N	2,306,997	1,516,032	278,271	1,408,351	1,490,468
R^2	0.190	0.327	0.137	0.178	0.262

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

See table 3 for descriptions of variables in this table. The annotation t refers to the year of first import from an EPZ of the good with an HS8 matching the observation. The descriptions $t-2$ and $t-1$ refer to the year two years and one year before period t, and the description $t+1$ and $t+2$ refer to the years after period t.

operations shrink, since imports cannot be reversed.

In summary, our analysis of timing for both exports and imports strongly supports the idea that Chinese companies imitate companies in EPZs. Private companies respond first, increasing their import of equipment and beginning to increase their exports in the same year as the product is introduced in EPZs. SOEs respond in a somewhat delayed fashion, increasing their imports of equipment and their exports in the year after. Partnerships and joint ventures are unaffected by EPZs, while exports from WOFEs in adjacent cities sharply decrease when exports from EPZs are introduced.

It may be surprising that both private companies and SOEs can imitate WOFEs in EPZs so quickly. Is it really possible for companies to imitate other firms in the years immediately following first export? To explain this, note that nearly all of the export and import activity by EPZs is directly observable in the customs statistics. Customs statistics detail exactly which exports cross the Chinese border and where they are headed. For interested observers, these statistics even helpfully break out which imports are equipment and which imports are materials. To the extent that Chinese firms can observe these customs statistics, all of this detailed information becomes available.

3.3.3 Related Products

To address the possibility that the argument of comparative advantage explains our results, we control for the export levels of related products. Comparative advantage argues that adjacent cities benefit from many of the same strengths as cities with EPZs. For example, an area may have concentrations of skilled workers, such as carpenters or metalworkers, that give a region a comparative advantage in metalworking. Alternatively, it may have natural resource advantages, such as access to low-cost coal or iron ore. While our empirical specification above includes fixed effects for a product for a province, these comparative advantages may be localized within a province and adhere only to cities that

received EPZs and cities that are adjacent to EPZs, confounding our results.

Comparative advantage is likely to apply to a broad product category, such as strength in ironworking or chemicals, rather than to a specific HS8 product category. Hence, controlling for products that match by HS6[20] but not by HS8 allows us to control for comparative advantage. To this end, we include a control variable $Y\left(HS6\right)_{i,j,t}$ in regressions in which we analyze the value exported. This variable is the value of all exports from city i in year t matching HS code j at the 6-digit level. For example, one frequent export from EPZs is HS code 85422129, "Other monolithic digital ic, 018." The variable $Y6_{i,j,t}$ would take on the sum of exports for all products in HS code 854221, "Monolithic integrated circuits, digital," excluding HS code 85422129. In regressions that test the number of exporters, we include the control variable of the number of exporters shipping products with the same HS6 code but not the same HS8 code.

Regressions including HS6 sales controls for Chinese companies are presented in columns 1 and 2 of tables 9 and 10. Including these controls decreases the magnitudes of the coefficients from table 3, but affirms the direction and statistical significance of these results. We can reject the possibility that comparative advantage for adjacent cities explains our results.

3.3.4 Controls from Non-Imitating Firms

Finally, we address the possibility that there are external shocks that are correlated with both the introduction of new products in an EPZ and the sales of those products by companies in surrounding cities. For example, if demand for a particular product increases and its price becomes higher on the world market, companies in EPZs may wish to introduce that product. If companies in adjacent cities are better placed to ramp up production in response to those shocks, they may also increase exports of that product.

To address the possibility of product-specific shocks, we control for types of

[20]We also try the same specifications with controls matching at the HS4 level rather than the HS6 level and obtain the same results.

companies that are likely to be subject to the same product-specific shocks, but are unlikely to imitate foreign companies. The most clear possibilities are partnerships and joint ventures, which should benefit from product-specific shocks such as increased demand for a given product on world markets. Since these firms may be subject to more stringent intellectual property laws than Chinese companies, they cannot imitate. Unlike WOFEs, partnerships and joint ventures do not move in significant numbers into EPZs.[21]

We conduct this portion of our analysis by introducing as a control variable the value of exports and the number of exporters for partnerships and joint ventures in each city for each HS8 code for each year. We present these results in columns 3 through 6 of tables 9 and 10.

Comparing these results to columns 1 and 3 of tables 3 and 4, we can see that our main results for export and import behavior in adjacent cities are affirmed in row 3. Consistent with our hypothesis that learning occurs in adjacent cities, we find that exports from Chinese companies in adjacent cities increase when EPZs are introduced. In adjacent cities, exports from Chinese companies increase much faster than those from partnerships and joint ventures, suggesting that the former companies can gain from imitation while the latter companies do not.

3.4 Gains in Operating Performance of Exporters

We have shown that Chinese companies imitate both the products exported and the equipment imported of foreign companies in nearby EPZs. We now turn to the question of how imitation can affect operating performance. Participation in exporting has widely been viewed as a precursor for performance improvements[22] and more productive companies are more likely to become exporters.

While the correlation between the act of exporting and the improvement of productivity has been well established, the causality is not: Do more productive

[21] See footnote 10.

[22] Park et al. (2010), Lu et al. (2010), Brandt et al. (2012), and Yu (2014) all find supporting evidence from China.

companies choose to export or does exporting improve firm productivity? We provide evidence that the act of imitating the exports of foreign companies has a strong and positive effect on subsequent firm performance, suggesting that the act of exporting can lead to significant gains in productivity.

We first construct the "imitating," or treatment, sample in this study: the set of companies in the city of the EPZ, or in cities adjacent to the EPZ, that export the same goods at the HS8 level as companies in EPZs. Each exporter in the customs data is one company or a subsidiary or branch of a parent company. We match these exporters to their parent companies' accounting information in the CASIF survey, using as our key identifiers the name, address, phone number, and zip code of the firm, following the method suggested in Yu (2014).[23]

To construct a counterfactual to our treatment group, we use companies located in the same cities exporting products that are similar yet not identical to those from EPZs. To be specific, we generate a list of exporters in the city of the EPZ, or in cities adjacent to the EPZ, that export a product matching that exported from the EPZ at the HS6 level but do not export a matching product at the HS8 level. Matching these exporters to parent firm accounting information in the same way, we can then create a "control" sample of firms.[24] Once the sample of treatment and control companies is identified, we study the dynamics of performance before and after the establishment of the EPZ.

We perform the analysis using a differences-in-differences approach with the below specification.

$$Y_{i,t} = After_{i,t}\beta_1 + After_{i,t} * Imitating_i\beta_2 + \alpha_i + \alpha_t + \varepsilon_{i,t} \tag{3}$$

In the above equation, i represents the company and t represents the year. $After_{i,t}$ is a dummy variable that becomes one in years after an EPZ begins

[23]We are able to match around 24% of the exporters to CASIF, a figure very similar to the outcomes in other studies using the same data.

[24]Creating a control sample based on exporting the same product at the HS4 level generates very similar results.

export of the product which matches that exported by the firm at the HS6 or HS8 level. It activates for both treatment and control firms. The interaction term $After_{i,t} * Imitating_i$ is the key variable of interest, and becomes one only in years after an EPZ begins export of a matching product at the HS8 level. It activates only for treatment firms.

Under this setup, the coefficient β_2 on $After_{i,t} * Imitating_i$ estimates the performance differential of imitating companies relative to control firms in the same locations. Similar to our above analysis, we estimate the equation separately for Chinese and foreign companies.

Three main performance outcomes are examined. First, we examine total factor productivity (TFP), the residual of firm output after accounting for labor and capital inputs.[25] Next, we examine a profitability measure, returns on assets (ROA), calculated as total profits divided by total assets. We also examine labor productivity, Ln(Y/L), defined as the logarithm of sales divided by the total number of employees.

We first compare the average performance for imitating companies and control companies before matched products from EPZs begin export. This is average performance when the $After_{i,t}$ dummy is zero. We report the results in table 7. Across all three metrics, control firms outperform imitating ones, suggesting that they start with higher productivity. This also dispels the possible concern that more productive exporters tended to imitate companies in EPZs.

We report the results from equation 3 in table 8. The first three columns report estimation results when we pool Chinese and foreign companies together. Of the 107,378 firm-year observations, 73,847 belong to the imitating group and the remaining 33,531 in the control group. For all three metrics of firm performance, imitating firms experience larger improvements than the control

[25] We use the method suggested by Hsieh and Klenow (2009) with a slight modification. In our reported results, we use the share of labor inputs as is, rather than adjusting the share of labor input in total output. However, our results are qualitatively unchanged if we closely follow Hsieh and Klenow.

Table 7: Performance of Imitating and Control Firms Before EPZ Operations

	TFP	ROA	Ln(Y/L)
Imitating (N=38,743)	7.851	0.062	5.240
Control (N=12,521)	7.881	0.063	5.369
Difference	-0.030**	-0.0016	-0.130***
	(0.013)	(0.001)	(0.010)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Each sample includes only exporters that are located in the city of an EPZ or a city adjacent to the EPZ. The imitating sample includes all companies that export a product matching the HS8 code eventually exported from an EPZ. The control sample includes all companies that export products matching at the HS6 level but not at the HS8 level. Total factor productivity (TFP) is the residual of firm output after labor and capital inputs are accounted for. Return on assets (ROA) is calculated as profit dividedby total assets. Ln(Y/L) is the logarithm of sales divided by the total number of employees.

firms after EPZs begin export.

We estimate the equation for Chinese and foreign companies separately and report the results in the remaining columns. Imitating Chinese companies, exhibit the largest improvements in productivity, greater than those of non-imitating Chinese firms or foreign firms.[26]

The estimated improvements in productivity can seem small in magnitude. In our data, a single parent company may have many exporting subsidiaries; only a subset of these can potentially be affected by EPZs under the mechanisms we describe. In some instances, we see only the effect of one imitating subsidiary on operations of a large parent company.

[26]In these results, foreign firms experience statistically significant increases in productivity, albeit at a much smaller magnitude than Chinese firms. It is possible that we are a form of survivor bias: foreign firms which remain in adjacent cities after new competition from EPZs must be more productive to continue operations.

Table 8: EPZs and the Performance of Imitating Exporters

	All Firms			Chinese			Foreign		
	TFP	ROA	Ln(Y/L)	TFP	ROA	Ln(Y/L)	TFP	ROA	Ln(Y/L)
After	-0.007	0.001	0.006	-0.031**	0.001	0.012	0.008	0.001	0.004
	(0.008)	(0.001)	(0.006)	(0.014)	(0.002)	(0.010)	(0.010)	(0.002)	(0.007)
Imitating*After	0.010*	0.002***	0.012***	0.030***	0.003***	0.019***	0.002	0.002**	0.011***
	(0.005)	(0.001)	(0.004)	(0.010)	(0.001)	(0.007)	(0.006)	(0.001)	(0.004)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	107,378	107,378	107,378	37,683	37,683	37,683	69,695	69,695	69,695
R^2	0.851	0.586	0.843	0.856	0.613	0.813	0.849	0.579	0.856

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The sample includes all exporters who export products with the same HS6 code as an EPZ, and are located in either the city of an EPZ or a city adjacent to the EPZ. These exporters are matched to the CASIF to obtain accounting information between 2000-2006. The variable $After$ is a dummy variable that is one for years that the EPZ exports a product matching at the HS6 level. The variable $Imitating * After$ is a dummy variable that equals one for years that the EPZ exports a product matching at the HS8 level. Total factor productivity (TFP) is the residual of firm output after labor and capital inputs are accounted for. Return on assets (ROA) is calculated as profit divided by total assets. Ln(Y/L) is the logarithm of sales divided by the total number of employees. Standard errors are clustered at the firm level.

Even so, the economic significance of these findings is non-negligible. For instance, estimates in column 5 indicate that imitating Chinese exporters experience a 0.3 percentage point increase in ROA relative to their peers. The median ROA for our control sample is 3%. Therefore, our results imply that Chinese exporters exhibit a 10% improvement in ROA relative to the sample median after they imitate the exporters in EPZs.

One important implication of our finding is that imitation can allow companies to leapfrog closely comparable exporters in productivity. As we saw, companies that did not imitate actually started ahead of imitating companies in terms of productivity, but imitating companies experienced gains from copying relative to non-imitating ones. This is important when considering China's gains from its policies attracting foreign capital.

4 Conclusions

We provide novel empirical evidence that Chinese firms experience real and significant gains from China's EPZs. The value of Chinese exports increased more quickly when Chinese firms imitated foreign ones, bringing also faster productivity growth for imitating firms. We also illustrate one mechanism demonstrating that Chinese firms imitate the production process of foreign firms by showing that imports of the same equipment increased sharply. Imitation of foreign firms was widespread, with 29 EPZs in 23 provinces contributing to our results.

It is unclear whether other developing countries could benefit from using the same mechanisms as China to develop their exports. Setting up EPZs and then imitating the equipment imports of the foreign firms which move in is unlikely to be a successful strategy by itself. We think that our results are more symptomatic of China's intellectual property policies, which are more permissive when Chinese firms copy foreign ones. While we think that equipment imports are indicative that Chinese firms copied the production process and technology

of foreign ones, we cannot directly show this. Future research that can directly examine process or technology would be valuable.

Our results are also important to foreign firms considering moving production to China. The products from entering firms were imitated very quickly, with some occurring in the same year as first export and much occurring in the year after. These foreign firms should expect that their actions will be closely observed, and should consider the possibility that bringing new production into China will allow Chinese competition to strengthen quickly.

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Appendix: For Online Publication

Table 9: Robustness Checks for Exports

	HS6 Control		Partnership Control		JV Control	
	Value	Exporters	Value	Exporters	Value	Exporters
(Contains Shipping EPZ) *	1.201***	0.652***	1.061***	0.625***	0.127	0.288**
(HS of Shipping EPZ)	(0.205)	(0.162)	(0.227)	(0.171)	(0.195)	(0.132)
Contains Shipping EPZ	0.338**	0.137***	0.368***	0.148***	0.271**	0.123***
	(0.133)	(0.039)	(0.140)	(0.044)	(0.135)	(0.044)
(Adjacent to Shipping EPZ)*	0.560**	0.084	0.628**	0.104	0.632***	0.096**
(HS of Shipping EPZ)	(0.237)	(0.067)	(0.243)	(0.069)	(0.212)	(0.050)
Adjacent to Shipping EPZ	0.245**	0.050***	0.267**	0.053***	0.222**	0.043**
	(0.109)	(0.018)	(0.113)	(0.019)	(0.107)	(0.020)
HS of Shipping EPZ	0.973***	0.223***	0.914***	0.200***	0.545***	0.109***
	(0.089)	(0.025)	(0.084)	(0.024)	(0.070)	(0.018)
Value Matching HS6	0.191***					
	(0.005)					
Exporters Matching HS6		0.186***				
		(0.006)				
Log(Val by Partnerships)			0.493***			
			(0.015)			
Log(Num Partnerships)				1.413***		
				(0.127)		
Log(Val by Joint Ventures)					0.531***	
					(0.012)	
Log(Num Joint Ventures)						1.209***
						(0.038)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
HS8 FE	Yes	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes	Yes
N	4,068,990	4,070,360	4,070,500	4,070,500	4,070,500	4,070,500
R^2	0.241	0.360	0.239	0.372	0.285	0.467

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Each dependent variable is the log of that variable. Each observation in these regressions is the export of products with a given HS8 code from a city in a year. Observations exclude exports shipped directlyfrom EPZs. The variable “Contains Shipping EPZ" is a dummy variable indicating whether an EPZ inside that city exported products with any HS code in that year. The variable “HS of Shipping EPZ" is a dummy variable indicating whether any EPZ in the province of the city exported products with a given HS code in that year. The variable “Adjacent to Shipping EPZ" is a dummy variable indicating whether an EPZ in an adjacent city exported products with any HS code that year. Standard errors are clustered at the city level.

Table 10: Robustness Checks for Imports

	HS6 Control		Partnership Control		JV Control	
	Value	Importers	Value	Importers	Value	Importers
(Contains Shipping EPZ) *	1.310***	0.409***	1.100***	0.361***	0.202	0.096**
(HS of Shipping EPZ)	(0.222)	(0.091)	(0.217)	(0.085)	(0.144)	(0.045)
Contains Shipping EPZ	0.137	0.037	0.129	0.036	0.119	0.034*
	(0.159)	(0.024)	(0.159)	(0.024)	(0.138)	(0.020)
(Adjacent to Shipping EPZ)*	0.499***	0.070	0.474***	0.0666	0.378***	0.053**
(HS of Shipping EPZ)	(0.182)	(0.044)	(0.171)	(0.041)	(0.122)	(0.026)
Adjacent to Shipping EPZ	0.111	0.027*	0.106	0.026	0.089	0.025*
	(0.120)	(0.015)	(0.121)	(0.016)	(0.106)	(0.014)
HS of Shipping EPZ	0.200***	0.023	0.172***	0.016***	0.067	-0.003
	(0.068)	(0.015)	(0.066)	(0.015)	(0.044)	(0.009)
Value Matching HS6	0.165***					
	(0.014)					
Importers Matching HS6		0.180***				
		(0.023)				
Log(Val by Partnerships)			0.534***			
			(0.020)			
Log(Num Partnerships)				1.141***		
				(0.115)		
Log(Val by Joint Ventures)					0.585***	
					(0.014)	
Log(Num Joint Ventures)						0.908***
						(0.038)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
HS8 FE	Yes	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes	Yes
N	3,200,550	3,201,933	3,204,222	3,204,222	3,204,222	3,204,222
R^2	0.220	0.328	0.224	0.349	0.287	0.460

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Each dependent variable is the log of that variable. Each observation in these regressions is the import of products with a given HS8 code from a city in a year. Observations exclude imports shipped directly from EPZs. The variable “Contains Importing EPZ" is a dummy variable indicating whether an EPZ inside that city imported “EPZ equipment" the year before. The variable “HS of EPZ Import" is a dummy variable indicating whether any EPZ in the province of the city imported “EPZ equipment" with an HS8 code matching the HS8 code of the observation that year or the year before. The variable “Adjacent to Shipping EPZ" is a dummy variable indicating whether an EPZ in an adjacent city imported“EPZ equipment" that year. Standard errors are clustered at the city level.