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China's Exports in a Protectionist World[1]

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Abstract

Tariffs, currency wars, and protectionism pose risks for Chinese firms. In theory, tariffs and exchange rates exert equivalent effects on export volumes. In practice, tariffs deter trade more than appreciations. This paper estimates exchange rate elasticities for China's four-digit export categories, and uses these to infer lower bounds for the impact of tariffs on exports. The results indicate the China's flagship industries such as electronics and machinery are exposed to exchange rate appreciations and tariffs. The paper then considers how China can promote freer trade to mitigate risks and reduce uncertainty.

Key words: Chinese exports, exchange rate elasticities, tariffs

JEL codes: F10, F14, F13

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1. Introduction

Protectionism is exploding. The U.S. raised tariffs on Chinese products and at one point labeled China a currency manipulator. Other countries are also pursuing beggar-thy-neighbor policies. How do tariffs, exchange rates, and other factors affect China's exports?

In theory, tariffs and exchange rates exert identical effects on export volumes. Fontagné, Martin, and Orefice (2018) demonstrated this equivalence in a model with constant elasticity of substitution (CES) preferences. Krugman (1979) and Eaton and Kortum (2002) also showed this correspondence employing standard models. Because of this relationship, House, Proebsting, and Tesar (2019) used exchange rate elasticities to calculate the effect of Chinese tariffs on the U.S. economy.

In reality, tariffs deter trade more than exchange rate appreciations. Benassy-Queré *et al.* (2018) investigated bilateral trade flows between 110 countries at the Harmonized System (HS) six-digit level. They reported that a 10 percent tariff reduces exports by 14 percent and that a 10 percent exchange rate appreciation reduces exports by 5 percent. Fontagné, Martin, and Orefice (2018) examined exports from 8,500 French firms over the 1996-2010 period. They found that a 10 percent tariff reduces exports by 19 percent and that a 10 percent exchange rate appreciation reduces exports by 6 percent. Fitzgerald and Haller (2014), Ruhl (2008), and others have also reported this effect. It is called the international elasticity puzzle. It could arise because tariffs, as policy instruments, are more persistent than exchange rate changes and thus affect exporters' pricing decisions more than exchange rate fluctuations do (Benassy-Queré *et al.*, 2018). It implies that the response of exports to exchange rates provides a lower bound for the impact of tariffs on exports.

Exchange rate changes are a thorny issue for China and its trading partners. The People's Bank of China only allows the renminbi to fluctuate within a certain band around the U.S. dollar each day. Although the U.S. at one point labeled China a currency manipulator, the International Monetary Fund (IMF) rejected this assessment.

This paper estimates exchange rate elasticities across a wide cross section of Chinese exports. These findings shed light on how factors such as exchange rates and tariffs that influence tradable prices affect exports.

Results from panel dynamic ordinary least squares (DOLS) estimation reveal that price elasticities are greater than one for many sectors including electronics and machinery. Tariffs and exchange rate appreciations thus risk disrupting China's flagship industries.

The next section reviews the literature. Section III discusses our data and methodology. Section IV presents the results. Section V considers how China can mitigate the risks caused by protectionism and concludes.

2. Literature review

Xing (2018) investigated how renminbi appreciations and rising wages affect China's comparative advantage in labor-intensive assembly operations. The growth of processed exports, goods produced using imported parts and components, reflects China's strength in this area. Examining China's exports to more than 100 countries over the 1993-2013 period, he reported that a 10 percent appreciation of the nominal U.S. dollar/renminbi exchange rate would reduce the share of processed exports relative to total exports by 3 percent and that a 10 percent increase in manufacturing wages would reduce this share by 0.8 percent. Xing concluded that stronger exchange rates and higher wages forced many Chinese firms to stop exporting.

Cheung, Chinn, and Qian (2012) used DOLS to investigate China's exports to the world over the 1994Q3-2010Q4 period. They employed the IMF's CPI-deflated real effective exchange rate and deflated exports using the Hong Kong to U.S. re-export unit value index.

They found that a 10 percent appreciation of the renminbi would reduce total exports by between 9 and 16 percent, processed exports by between 9 and 12 percent, and ordinary exports by between 13 and 19 percent. They also reported larger elasticities for manufacturing goods than for primary products and for private firms than for state-owned enterprises.

Baiardi, Bianchi, and Lorenzini (2015) investigated China's clothing exports disaggregated at the Standard Industrial Trade Classification (SITC) 4-digit level over the 1992-2011 period. They sought to explain exports using world real GDP and relative prices. Relative prices were calculated as the ratio of China's export unit value for each 4-digit clothing category at time *t* to the average export unit value of all economies for the same good at time *t*. They found that a 10 percent increase in relative prices would reduce China's clothing exports by 8 percent.

Fatum, Liu, Tong, and Xu (2018) examined firm-level exports and imports between China and the U.S. disaggregated at the Harmonized System (HS) 8 digit level. They investigated the 2000-2011 period. They reported many ordinary least squares regressions and found that a depreciation of the CPI-deflated U.S. dollar/renminbi exchange rate led to an increase in China's exports and an increase in its trade surplus.

Thorbecke (2015) used Johansen maximum likelihood estimation to investigate China's exports to the U.S. over the 1993Q3-2013Q3 period. He employed the CPI-deflated bilateral real exchange rate and deflated exports using the Bureau of Labor Statistics export price index for exports from China. He investigated exports in the SITC 7, 8, and 6 categories. SITC 7 comprised 51 percent of China's exports to the U.S. in 2013, SITC 8 comprised 32%, and SITC 6 comprised 11%. SITC 7 exports are primarily phones, computers, and white goods; SITC 8 exports are mainly labor-intensive products such as clothing, footwear, and toys; and SITC 6 exports are metals, metal products, textiles, and rubber. He reported that a 10 percent renminbi appreciation against the dollar would reduce SITC 7 exports by 16 percent, SITC 8 exports by 8 percent, and SITC 6 exports by 13 percent.

Thorbecke (2015) also reported that China's exports to the US were four times larger than US exports to China and that the US trade deficit with China exceeded the US trade deficit with all other countries combined. He used the workhorse gravity model to investigate whether China's exports to the US were disproportionate. The results indicated that China's exports to the U.S. have been more than $100 billion greater than predicted year after year. This gap could be due to global value chains, since China imports intermediate goods from East Asia and exports finished products to the rest of the world. To investigate this, Thorbecke estimated a gravity model with China's processed and ordinary exports included separately. Processed exports contain parts and components from abroad while ordinary exports contain primarily domestic value-added. China's processed and ordinary exports to the U.S. were both major outliers, exceeding predicted values by more than $100 billion. Parts and components from the two leading suppliers to China (South Korea and Taiwan) were major outliers relative to South Korea and Taiwan's exports to other countries. In addition, China, South Korea, and Taiwan's exports to Asia were much less than predicted. These results suggest that East Asia's export structure is disproportionately focused on the U.S.

3. Data and methodology

We add to this literature by examining China's exports to the world disaggregated at the four-digit International Standard Industrial Classification (ISIC) level. Researchers since Orcutt (1950) have highlighted the advantage of using disaggregated data to estimate trade elasticities. If elasticities differ by sector, aggregate estimates can be biased downwards (see also Bahmani-Oskooee and Ardalani, 2006). In addition, by investigating China's exports to the world rather than China's bilateral exports we avoid misspecification issues that may arise when examining bilateral trade (see, e.g., Ahmet, 2009).

We employ data from 1996 to 2017, but focus on the period beginning in 2003. China joined the WTO at the end of 2001, and by 2003 its exports had exploded. We investigate the 2003-2017 period when China was a major exporter. We also examine the 1996-2017 period as a robustness check.

We estimate standard export functions, with exports depending on price competitiveness and foreign demand. We measure price competitiveness using the bilateral real exchange rate between China and the importing country and foreign demand using GDP in the importing country.

We use data on China's exports to the 83 leading importers. While the renminbi was pegged to the U.S. dollar for part of the sample period, it varied substantially relative to the other 82 currencies. These exchange rate fluctuations, as Chinn (2004) noted, often have a life of their own and remain disconnected from macroeconomic fundamentals (see also Obstfeld and Rogoff, 2000, and Devereux and Engel, 2002). This independent variation both cross-sectionally and over time should help to identify in an econometric sense how exchange rates affect China's exports.

The export data are annual and measured in U.S. dollars. They are available from the CEPII-CHELEM database. We deflate exports using the Bureau of Labor Statistics (BLS) deflator for China's exports. These data are available beginning in 2003. Before 2003, we follow Chinn (2006) by splicing BLS price data for exports of manufacturing goods from non-industrial countries to the price data for exports from China that are available starting in 2003.

Data on the bilateral real exchange rate between China and each importing country *j* ($rmb_{j,t}$) are obtained from the CEPII-CHELEM database. Higher values of rmb represent a stronger renminbi, therefore positive changes in rmb imply an appreciation of the renminbi. Data on real GDP in the importing countries are also obtained from the CEPII-CHELEM database.

A battery of panel unit root tests indicate in most cases that the variables are integrated of order one. Kao residual tests for cointegration indicate that the null hypothesis of no cointegration can be rejected. Mark and Sul (2003) panel dynamic ordinary least squares (DOLS) estimation, a technique for estimating cointegrating relations, is thus used.

The estimated model takes the form:

$$EX_{j,t} = \beta_0 + \beta_1 rmb_{j,t} + \beta_2 y_{j,t}{}^* + \sum_{k=-p}^{p} \alpha_{1,k} \Delta rmb_{j,t-k} + \sum_{k=-p}^{p} \alpha_{2,k} \Delta y_{j,t-k}{}^* + u_{j,t},$$
$$t = 1, \cdots, T; \qquad j = 1, \cdots, N.$$

where $EX_{j,t}$ represents exports from China to country *j* at time *t*, $rmb_{j,t}$ represents the bilateral real exchange rate between China and importing country *j*, $y_{j,t}*$ represents real GDP in country *j*, $u_{j,t}$ is a random error term, and the variables are measured in natural logs. Cross-section specific lags and leads of the first differenced right-hand side variables are included to asymptotically remove endogeneity and serial correlation. The number of lags and leads is determined by the Schwarz Information Criterion. A sandwich estimator is used to allow for heterogeneity in the long-run residual variances. Individual specific fixed effects are included. Because of the persistent increase in China's exports, individual specific time trends are also included.

4. Results

Table 1 presents the results for exports at the four-digit ISIC level over the 2003-2017 period.[2] The products are ordered from the one making up the largest share of China's total exports in 2017 to the one making up the smallest share. Column (2) of the table indicates that four of the five categories with the largest shares are in the electronics industry. They are all sensitive to exchange rates. Column (4) indicates that phones have an exchange rate elasticity of -1.82, implying that a 10 percent renminbi appreciation will reduce phone exports by 18.2 percent. Computers have a price elasticity of -1.47, electronic parts and components an elasticity of -0.99, and televisions an elasticity of -1.12. The electronics sector is thus not only China's largest export category but is also very exposed to exchange rate increases.

Electric motors and generators, motor vehicle parts, and furniture also have high exchange rate elasticities. These range from -1.49 for electric motors and generators to -2.03 for furniture.

On the other hand, prepared textile fibers, electric lamps, games and toys, wearing apparel, footwear, and plastic products have the lowest elasticities in Table 1. These range from -0.33 for textile fibers to -0.92 for plastic products. How can we understand these findings?

Column (6) of Table 1 also presents GDP elasticities. Those products with the lowest price elasticities in column (4) also have the lowest GDP elasticities in column (6). The low GDP elasticities indicate that products such as lamps, apparel, and footwear are necessities. Microeconomic theory teaches that the price elasticities for these goods should be low.

Goods such as phones, computers, and furniture, on the other hand, have higher income elasticities in column (6). Consumers can continue using the phones, computers, and furniture

[2] The results over the 1996-2017 period are similar. The price elasticities tend to be larger though.

that they own, and the latest upgrades are not necessities. Thus the price elasticities for these goods tend to be higher.

Column (3) of Table 1 also shows that China exports 57 percent of the world's electric lamps and 62 percent of its games and toys. Importers depend on China for these goods and have fewer substitute suppliers. This helps to explain why the price elasticities for these goods are low.

Table 2 presents trade elasticities for China's exports disaggregated by industry. The industry classifications come for the CEPII-CHELEM database. Column (2) of the table indicates that 30.9 percent of China's exports in 2017 were in the electronics sector. Column (4) indicates that the exchange rate elasticity in this sector equals -1.56, implying that electronics exports are very sensitive to exchange rates. Column (2) shows that China's second largest export sector is textiles. This includes wearing apparel and knitted fabrics. Reflecting the results in Table 1, column (3) shows that China has a large share of the world's exports in this category and the exchange rate elasticity equals -0.76, much lower than for the other categories.

Column (4) of Table 2 indicates that exchange rate elasticities for the other sectors all exceed unity. They are largest for vehicles. Column (3) of Table 2 shows that China exported only 4.9% of the world's vehicles in 2017. China thus faces a lot of competition from other exporting countries in this category. In addition, purchasing vehicles is a major expenditure for consumers. This implies that these purchases will be more price elastic.

The important implication of these results is that China's exports are very sensitive to exchange rates. This is especially true for flagship industries such as electronics and machinery.

5. Conclusion

Appreciations deter exports by raising prices in importing countries. Tariffs work in a similar way, except that researchers have found that tariffs reduce exports more than equivalent appreciations. The large price elasticities reported in this paper indicate that tariffs threaten China's exports.

The disruption to trade caused by tariffs is multiplied by the uncertainty that accompanies trade wars and protectionism. Bloom (2009) reported that uncertainty hinders investment. Investing in physical capital and in research and development is crucial for the electronics industry, given its short product cycles and volatile consumer demand. By reducing investment, uncertainty jeopardizes the ability of Chinese firms to remain competitive in the electronics industry and in other key sectors.

China could offset these risks and uncertainties by signing free trade agreements (FTAs) with countries other than the U.S. These could strengthen economic cooperation and deepen integration. It could also rechannel China's exports to countries other than the U.S. This could reduce protectionist pressure with the U.S., especially in light of Thorbecke's (2015) finding that China's exports to the U.S. are disproportionate. China has already signed 16 FTAs and is negotiating 24 more throughout the world.

While China has concluded bilateral agreements with Chile, Georgia, New Zealand, Pakistan, Peru, Singapore, Switzerland and others countries, it has also been negotiating the Regional Comprehensive Economic Partnership (RCEP) with multiple Asian partners. These partners include the ten Association of Southeast Asian Nations (ASEAN), China, Japan, South Korea, Australia, and New Zealand. RCEP is important because it is the largest Asian trade deal under consideration and because many of these countries are linked through regional value chains. While the negotiations focus on establishing a region-wide free trade zone, the discussions also address investment, trade in service, technological cooperation and intellectual property (IP) rights.

Ratifying RCEP could be a boon for China. It would grant Chinese firms access to large markets in the region. It would also reduce prices on imports of food, footwear, medicine, and other goods.

In addition to RCEP, the Comprehensive and Progressive TPP (CPTPP) could benefit Chinese companies. The CPTPP sets high standards for labor and environmental rules, competition policy, state-owned enterprise behavior, and IP protection. China would need to do extensive preparatory work before it could join the CPTPP. However, as Chinese firms continue technological upgrading, high quality agreements with strong IP protection would be in their interest.

The Belt and Road Initiative (BRI) offers benefits analogous to a trade agreement. The BRI promotes connectivity by improving infrastructure in the countries involved. This not only increases the scope of potential markets but also reduces transportation costs. Transportation costs are at the heart of trade theory. A simulation exercise found substantial welfare gains for both China and participating countries. For example, a 25 percent reduction in transportation costs caused by BRI would increase the welfare of a representative consumer in China by 1.18 percent, the EU by 0.55 percent, the Middle East & North Africa by 0.15 percent and Sub-Saharan Africa by 0.13 percent. Furthermore, the simulation indicated that the welfare gains could multiply if the countries also negotiated an FTA (Jackson and Shepotylo, 2018). Given the possible gains available through the BRI, contracting nations should work together to realize this potential.

Liberalization would thus benefit China and its trading partners. Global liberalization would generate even greater gains by producing a more efficient allocation of resources based on comparative advantage, as compared to the case of FTAs between a limited number of countries. The world is in danger, however, of breaking up into trading blocs. A likely outcome is one bloc centered on China and a second centered on the U.S. (see Jacks and Novy, 2019).

Trading blocs and trade wars foment uncertainty, misallocate resources, and break up value chains. China and the U.S. should assiduously pursue breakthrough agreements for their mutual benefit and as an example to other countries in the 21st century. China should also hedge against the risk of a failure in these negotiations by signing free trade agreements improving connectivity with other trading partners.

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Table 1. Panel DOLS Estimates for Exports of China's Products to 83 Countries over the 2003–2017 Period

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Product Category (ISIC Code)	Share of China's Total Exports in 2017 (percent)	China's Exports in this Category in 2017 relative to World Exports in this Category (percent)	Exchange Rate Elas-ticity	Standard Error	GDP Elas-ticity	Standard Error
Phones (3220)	11.8%	51.5%	-1.82***	0.14	2.41***	0.34
Computers (3000)	9.4%	44.7%	-1.47***	0.10	2.25***	0.18
Wearing Apparel (1810)	5.0%	36.6%	-0.75***	0.09	1.70***	0.19
Electronic Parts & Components (3210)	3.9%	13.7%	-0.99***	0.14	1.61***	0.32
Televisions (3230)	3.6%	39.5%	-1.12***	0.08	2.15***	0.18
Manufactured Iron & Steel (2710)	2.6%	13.7%	-2.96***	0.17	4.90***	0.46
Plastic Products (2520)	2.5%	20.1%	-0.92***	0.07	1.81***	0.16
Chemicals (2411)	2.4%	13.2%	-0.92***	0.09	1.88***	0.19
Fabricated Metal Products (2899)	2.4%	24.5%	-1.23***	0.07	2.63***	0.17
Footwear (1920)	2.3%	37.0%	-0.91***	0.07	1.46***	0.20
Furniture (3610)	2.2%	30.9%	-2.03***	0.10	3.78***	0.23
Domestic Appliances (2930)	2.1%	37.7%	-1.30***	0.06	2.08***	0.14
Electric Motors & Generators (3110)	2.0%	27.1%	-1.49***	0.08	2.01***	0.20
Knitted Fabrics (1730)	2.0%	36.2%	-1.18***	0.09	1.73***	0.21
Games & Toys (3694)	2.0%	61.5%	-0.73***	0.07	1.83***	0.16
Prepared Textile Fibers (1711)	1.8%	39.3%	-0.33***	0.07	1.55***	0.17
General Purpose Machinery (2919)	1.8%	18.7%	-1.15***	0.09	2.79***	0.21

Electric Lamps & Lighting (3150)	1.7%	57.2%	-0.64***	0.06	1.70***	0.16
Parts for Motor Vehicles (3430)	1.5%	7.7%	-1.89***	0.11	2.55***	0.24

Notes: Lag length for each cross section is selected based on the Schwarz criterion. Cointegrating relationships are determined by Kao residual cointegration tests. An increase of the bilateral real exchange rate implies an appreciation of the renminbi relative to the importing country. The predicted sign of the coefficient is thus negative.
*** denotes the significance at the 1-percent level.

Table 2. Panel DOLS Estimates for Exports by China's Industries to 83 Countries over the 2003–2017 Period

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Industry	Share of China's Total Exports in 2017 (percent)	China's Exports in this Category in 2017 Relative to World Exports in this Category (percent)	Exchange Rate Elas-ticity	Standard Error	GDP Elas-ticity	Standard Error
Electronics	30.9%	30.5%	-1.56***	0.09	1.72***	0.21
Textiles	14.9%	36.2%	-0.76***	0.06	1.72***	0.15
Machinery	12.6%	13.6%	-1.34***	0.08	2.78***	0.20
Electrical	10.9%	26.4%	-1.08***	0.05	2.16***	0.14
Chemical	10.8%	10.3%	-1.04***	0.06	2.03***	0.16
Wood & Paper	8.4%	24.8%	-1.26***	0.06	2.55***	0.15
Vehicles	3.0%	4.9%	-1.96***	0.10	1.99***	0.21

Notes: Lag length for each cross section is selected based on the Schwarz criterion. Cointegrating relationships are determined by Kao residual cointegration tests. An increase of the bilateral real exchange rate implies an appreciation of the renminbi relative to the importing country. The predicted sign of the coefficient is thus negative.
*** denotes the significance at the 1-percent level.