Trade Imbalance as a Source of Comparative Disadvantage: Why Does China Import So Much Waste?*

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Abstract

Recognizing that trade imbalance can generate a difference in the unit shipping cost, we propose a model in which countries with a large trade surplus (deficit) tend to systematically import (export) more of goods that are heavy relative to their value. We report cross-country evidence consistent with this prediction. A particular example of goods that are relatively heavy is solid industrial waste such as scrap metals and scrap glass. We report evidence that countries with a trade surplus such as China systematically import more of such goods. If pollution externality associated with industrial waste is not properly corrected by a tax, a trade surplus is also translated into more health hazard associated with imported waste.

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1 Introduction

This paper explores the implications of trade imbalance for the composition of a country's imports and exports. For example, China is the largest importer of wasted products in the world, with 45 million tons of scrap metal, waste paper, and used plastic, worth over $18 billion in 2016. At the same time, the United States is one of the largest exporters of such solid industrial waste. We study whether such trade patterns are connected to the fact that China consistently runs a large trade surplus, and the United States a large deficit over many years.

Figure 1 plots China's bilateral trade surplus against all its trading partners, and its imports of industrial waste from them(Figure 1). We can see a significantly positive relationship between the two variables. As far as we know, there is no existing theory that explains this pattern. In this paper, we aim to develop a theory and provide empirical tests on whether and how trade imbalance can distort the comparative advantage of a country.

A key insight is that a trade surplus from Country A to Country B makes it more likely for ships returning to A to be under their full carrying capacity(De Palma et al. (2011) and De Oliveira (2014)). This imbalance reduces the unit shipping cost for Country A's imports, making it relatively cost effective for the surplus countries to import goods that are heavy relative to their value (and solid industrial waste happens to be a main item in this category). Conversely, deficit countries have a comparative advantage in exporting relatively heavy goods. (Note that a country's trade balance - a major part of current account balance - is largely determined by its savings and investment balance, and not affected much by shipping costs.) This suggests that the unit shipping cost (per weight or size) is likely to be lower going from a deficit country to a surplus country than in the reverse direction. In Figure 2, we plot the shipping cost of China's imports into Shanghai port from a country relative to the shipping cost of the same route in the reverse direction, against China's bilateral trade surplus with

respect to that country. It is clear that the greater is China's bilateral trade surplus, the lower is the relative shipping cost coming back to China[1]. To our knowledge, this is the first paper that explores its implications for trade patterns and provides empirical evidence.

There is also a possible connection between trade imbalance and imported health hazard. Wasted products often involve more pollution and more associated unsanitary consequences for health than other imports. For example, imported waste products are often dirty, poorly sorted, or contaminated with hazardous substances. Even when they are safely imported, they are not always recycled properly. A film, "Plastic China", examines the environmental damage caused by the country's plastic-recycling industry, which is dominated by thousands of small-scale outfits that often lack proper pollution controls. If the negative externality associated with the industrial waste is not properly addressed by a pollution tax and meaningful enforcement, both of which are often lacking in developing countries, a trade surplus could also turn into an extra source of pollution externality.

We estimate an augmented gravity equation that incorporates trade imbalance and goods features in terms of weight to value ratio. We identify the effect of our mechanism using several methods. First, we identify a good's weight to value ratio from Columbia's import data. Under the assumption that the weight to value ratio is an exogenous physical characteristics that is consistent across countries, we examine whether a country will import more heavy goods from the other country with large trade surplus. The use of the weight to value ratio from Columbia in China's trade equations helps to reduce a endogeneity concern.

Second, we also control for the role of development stages in affecting comparative advantages. For instance, developed countries may export more capital intensive goods that happen to be relatively heavy. This concern is addressed by comparing imports from similar countries. For example, while US has a large trade deficit against China, Germany and Japan have a

[1]See also Wong (2017). Note that the shipping cost could be expressed in terms of either per unit of weight or per unit of volume. Since the trade data we work with to classify HS 6 digit trade can only be done in terms of weight to value ratio, rather than size to value ratio, we will use weight to value ratio in our empirical work.

surplus. We find that a 1% increase in the trade surplus is associated with an increase in the value of of heavy goods imports by about 0.03-0.04%.

As further supportive evidence, we go beyond bilateral trade imbalance and examine trade imbalance at the port level. For example, if Shanghai runs a larger trade surplus against US than Guangzhou, does Shanghai import proportionally more heavy goods from US than Guangzhou? We find that this is indeed the case in the data. Using our estimates, we infer that if the Chinese trade were balanced, the wasted goods import would have declined by 12% to 14%, or around $2.3bn and 5.9m tons.

As additional validation, we search for a shock to a country's trade balance. Mexico's peso depreciation in 1994 might provide a useful case study. After a sharp improvement in Mexico's trade balance (from deficit to surplus) following the depreciation, we find its imports of heave goods rose significantly as well.

To explore the welfare effects of the waste goods import. We estimate the impacts of city waste goods import on the health condition. We find there is a significant correlation between city cancer rate and the waste goods import. We then use the city's closest port trade surplus as an instrument of the waste goods import. We find that if the trade surplus increases by 10%, the cancer rate would increase by 0.08%. That is 8 more people per 10,000 people would get the cancer.

Our paper relates to several streams of literature. First, the existing literature on the welfare effect of the trade imbalance focus almost exclusively on the terms of trade channel (Dekle et al. (2007) and Epifani and Gancia (2017)). Our paper highlights a new channel: a trade imbalance alters the composition of imports towards heavier goods, notably including scrap metals and other industrial waste. If domestic pollution control is weak, a trade surplus can result in welfare cost by increasing the imports of pollution intensive industrial waste.

Second, Hummels and Skiba (2004) and Lashkaripour (2015) already emphasize that unit

weight is an important feature in the international shipping. Djankov et al. (2010) and Hummels and Schaur (2013) study the effect of shipping time on trade cost. But these papers do not consider trade balance as a determinant of shipping cost. An exception is Wong (2017) who studies the round trip effect and transportation costs. We go beyond her point and study the effects on the composition of imports and exports. We also point out a possible interaction between trade balance and environmental standards and enforcement.

Third, the literature on pollution is too large to be summarized comprehensively (Frankel (2009), Kellenberg (2009), Kellenberg (2012) and Lan et al. (2012)). Our novelty is to point out a possible interaction between trade imbalance and weak pollution control: Those developing countries that simultaneously have a weak pollution control regime and a trade surplus might experience especially adverse pollution effects.

The paper is structured as follows. After formalizing our theory in Section 2, extensive empirical tests are provided in Section 3. We then apply the theory to the Chinese waste goods import in section 4 and discuss the welfare effect of an unbalanced trade in section 5. We conclude the paper in Section 6.

2 Model

Consider a shipping company's optimization problem. Let i denote the name of the good. Goods are heterogeneous in terms of weight per unit. Let w_i denote the weight per unit of good i. For simplicity, we assume there are only two countries: home country and foreign country. $c_{i,HF}$ ($c_{i,FH}$) is the price of shipping 1 unit of good i from home (foreign) country to foreign (home) country. $q_{i,HF}$ ($q_{i,FH}$) is the quantity of goods that are sold from home (foreign) country to foreign (home) country. Each carrier faces a downward sloping demand curve $q_{i,HF} = c_{i,HF}^{-\xi} b_{i,HF}$ and $q_{i,FH} = c_{i,FH}^{-\xi} b_{i,FH}$. $\xi > 1$ is the inverse demand elasticity and $b_{i,HF}$ and $b_{i,FH}$ capture the carrier-goods specific demand shifters.

Let $\phi\left(\sum_i q_{i,HF}\right)$ and $\phi\left(\sum_i q_{i,FH}\right)$ be the carrier's operating cost of shipping $\sum_i q_{i,HF}$ units of good from home country to foreign country or shipping $\sum_i q_{i,FH}$ units of good from foreign country to home country.[2] Let $p_{i,HF}$ and $p_{i,FH}$ be the Free On Board (FOB) price for good i of the export and import of home country.

A key assumption is that a ship that leaves from Home to Foreign must come back to home country. Under this assumption, the problem of the carrier is

$$\max_{c_{i,HF},c_{i,HF}} \sum_i c_{i,HF}q_{i,HF} + \sum_i c_{i,FH}q_{i,FH} - \phi\left(\sum_i q_{i,HF}\right) - \phi\left(\sum_i q_{i,FH}\right)$$

$$s.t. \quad \sum_i w_i^{\alpha} p_{i,HF}^{1-\alpha} q_{i,HF} \leq K \tag{1}$$

$$\sum_i w_i^{\alpha} p_{i,FH}^{1-\alpha} q_{i,FH} \leq K \tag{2}$$

$$q_{i,HF} = c_{i,HF}^{-\xi} b_{i,HF}, \quad q_{i,FH} = c_{i,FH}^{-\xi} b_{i,FH} \tag{3}$$

where K is the capacity of the carrier. We assume 1 unit of good i will occupy the capacity of the carrier by $w_i^a p_i^{1-\alpha}$. If $\alpha = 1$, we can interpret the constraints (1) and (2) as the total weight capacity constraints of the carrier. Generally, we assume $\alpha \in [0, 1]$. It captures the fact that more expensive goods may take more careful package and needs more capacity to ship.

Let λ_{FH} be the Lagrangian multiplier of the constraint (2). The optimality condition yields that

$$c_{i,FH} \propto \phi'\left(\sum_i q_{i,FH}\right) + \lambda_{FH} w_i^{\alpha} p_{i,FH}^{1-\alpha} \tag{4}$$

The equation (4) says that to ship 1 unit of good i, the shipping cost has two components: the marginal operating cost to the carrier $\phi'\left(\sum_i q_{i,FH}\right)$ and the shadow cost $\lambda_{FH} w_i^{\alpha} p_{i,FH}^{1-\alpha}$. The

[2] We assume the carrier's operating cost only depends on the total quantities. However, our result still holds for any other convex cost function.

shadow cost part implies that if the carrier has a binding constraint, 1 unit of good i will reduce the carrier's capacity by $w_i^{\alpha} p_{i,FH}^{1-\alpha}$ and results in a shadow cost $\lambda_{FH} w_i^{\alpha} p_{i,FH}^{1-\alpha}$. If the carrier has a non-binding constraint (2), $\lambda_{FH} = 0$.

In the remaining part, we are going to focus on the import of the home country. Denote the trade cost **per value** (iceberg cost) of good i of home country's import as $\tau_{i,FH}$. It has two parts: ad-valorem tariff $(1 + t_{i,FH})$ and per value shipping cost $\left(\frac{c_{i,FH}}{p_{i,FH}}\right)$.

$$\tau_{i,FH} = 1 + t_{i,FH} + \frac{c_{i,FH}}{p_{i,FH}} \tag{5}$$

Let $\bar{\phi}_{i,FH} = \frac{\phi'_{FH}}{p_{i,FH}}$ be the carrier's marginal operating cost per value of good i. From equation (4),

$$\tau_{i,FH} \propto 1 + t_{i,FH} + \bar{\phi}_{i,FH} + \lambda_{FH} \left(\frac{w_i}{p_{i,FH}}\right)^{\alpha} \tag{6}$$

The above equation suggests that the iceberg cost of good i not only depends on the tariff and the carrier's marginal cost $t_{i,FH} + \bar{\phi}_{i,FH}$, but also depends on the shadow cost λ_{FH} times the weight-to-value ratio $\left(\frac{w_i}{p_{i,FH}}\right)$. When the capacity is binding, the shipping cost will be more expensive for high weight-to-value goods (heavy goods) than for low weight-to-value goods (light goods).

When Home runs a large trade surplus against Foreign, more ships tend to have $\lambda_{FH} = 0$. As long as λ_{FH} declines, heavy goods would enjoy a proportionately larger decline in unit trade cost than light goods. Because the trade trade has a negative relationship with the trade cost, our theory implies the following testable proposition:

Proposition The import of heavy goods is higher if the home country runs a larger trade surplus.

3 Empirical Findings

3.1 Main results

To test the theoretical prediction in section 2, we consider an augmented gravity equation:

$$\ln I_{i,ndt} = \beta \ln \text{Imbalance}_{ndt} \times \ln \left(\frac{w_i}{p_i}\right) + \theta_0 \ln GDP_{nt} + \theta_1 \ln GDP_{dt} + \eta_{ind} + \eta_{it} + \varepsilon_{i,ndt} \tag{7}$$

where n and d are the origin and destination countries respectively. $I_{i,ndt}$ is the import good i from country n to country d in year t. Imbalance_{ndt} is the trade surplus country d runs against country n in year t, measured by $\text{Export}_{ndt}/\text{Import}_{ndt}$. $\frac{w_i}{p_i}$ is the weight-to-value ratio of good i. η_{it} is the product-time fixed effect and η_{ind} is the product level origin and destination countries fixed effects. $\varepsilon_{i,ndt}$ is an i.i.d random component with a zero mean.

The gravity equation in the international trade literature suggests that the amount of import from country n to country d will depend on the economic size, measured by GDP, of each country as well as the distance between two countries. Note that the product level origin and destination country fixed effects capture the distance between two countries. We augment this gravity equation by including the trade imbalance interacted with the weight-per-value of good i. According to our theory, we expect $\beta > 0$.

To estimate equation (7), we use the UN trade data from 2002 to 2004. The UN data provides the origin-destination country specific bilateral trade volume, measured by USD, of each HS6 good. By aggregating the bilateral trade volume of each HS6 good, we can also generate origin-destination country specific trade imbalance in a given year. The GDP, measured by 2011 USD, is from Penn World Table.

The weight-to-value ratio may be endogenously determined by the unobserved component $\varepsilon_{i,ndt}$ which affects the import volume of good i. To address this concern, we use the weight-to-value ratio from the transaction level data on Colombian imports in 2007-2013 period. The

data has been collected and made available by the National Tax Agency of Colombia[3]. For each transaction, the data reports the goods FOB value as well as the weight. We assume that the Columbia's weight-to-value ratio is highly correlated with import good i's weight-to-value ratio of a country but is not correlated with other fundamental economic conditions which may affect the country's import value.[4] We exclude all bilateral trade involving Colombia from our main regression.

We show the estimation result of equation (7) in Table 2. Column 1 reports the estimation result of the standard gravity equation with product-year and product-country-pair fixed effects. The import is positively correlated with GDP of the exporter and the importer. The second column reports the main result: the coefficient on trade surplus and a good's weight to value ratio is positive and statistically significant. This means that countries with a larger trade surplus tends to disproportionately import heavier goods. To visualize our result, Figure 3 plots the bin-scatter graph of ln(imbalance)*ln(w/p) against ln(import). There is a very clear positive relation.

One might be concerned with an omitted variable bias. For example, developed countries may sell light but valuable goods to developing countries, while developing countries may sell heavy and low value goods. If our finding is driven by this comparative advantage difference, the pattern should be less pronounced when we only focus on developed (or developing) countries. The third column restricts the sample to those exporters and importers that are both developed countries.[5] In the fourth column further restricts the sample to countries that are WTO members, since the trade tariffs may be quite different between WTO members and non WTO members. We find that the elasticity in fact increases to 0.039 and 0.044 respectively. This suggests that our finding is not likely a spurious result of different comparative advantage

[3]We thank Ahmad Lashkaripour for sharing this data.

[4]Table 1 lists the top 5 and bottom 5 goods in terms of weight-per-value ratio.

[5]Following Djankov et al. (2010), we define developed countries as countries whose GDP per capita are greater than 12,000 USD.

of developed versus developing countries, or WTO members versus non-members.

Finally, we use government expenditure as an IV for the trade imbalance. Since a country's multilateral current balance balance is determined by its savings and investment balance, a shock to savings and investment can be a shock to trade surplus. We consider government expenditure as a measure of fiscal policy shock. The government expenditure can change the trade imbalance but may not be directly be correlated with the composition of imported goods with respect to its weight. An increase in government spending is often said to be spent disproportionately on non-tradable goods (Froot and Rogoff, 1996?), but not on imports of heavy goods. The last column in Table 2 shows that the effect is still significant with the IV approach.

3.2 Persistent Trade Surplus

If a country's trade imbalance switches signs often, and if importing a particular goods requires a fixed cost, our story will not be very strong. To show this intuition, we restricts our sample to countries with persistent trade surplus and expect to see a more pronounced result when estimating the gravity equation.

We first define a country with a persistent surplus as one that runs a surplus against 60% of its trading partners in the sample in all 5 years from 2000 to 2004. Table 3 lists the countries satisfying this definition. The countries are ordered by the percentage of trading partners with positive surplus. In our sample, there are 36 countries satisfying this definition.

Column 1 of Table 5 reports the estimation result using countries listed in the previous table. The estimated elasticity coefficients increases significantly, from 0.026 to 0.044. This confirms the intuition that our story is stronger for countries with a persistent trade imbalance than for those with occasional imbalance. In a similar way, we define a country with a persistent deficit as one that runs a trade deficit against 60% of its trading partners in the sample in

all 5 years from 2000 to 2004.[6] Column 2 shows the estimation result of these countries. The elasticity significantly drops to 0.013.

Another way to define a persistent trade imbalance is to examine statistically estimated persistent coefficient from a country's time series of trade imbalance. In the third column of Table 5, we estimate the auto-correlation of a country's overall trade surplus and define those whose auto-correlation coefficients are above the median as countries with a persistent trade imbalance. When the regressions are done for this set of countries, the elasticity increases from 0.026 to 0.031.

A third approach is to restrict the sample to those country pairs whose auto-correlations of their bilateral trade exceed the median in the sample. In this case, the elasticity, as shown in the last column, increases to 0.0403.

To summarize, the more persistent is the trade imbalance, the stronger is the data pattern that surplus countries tend to import heavy goods. This provides additional validation of the basic story.

3.3 Comparing Similar Countries

In this section, we compare counties in similar developing stages to further alleviate the endogeneity concern. For example, China usually run a large trade surplus against developed countries and the comparative advantage of those developed countries are exporting machines (which may be heavy goods) to China. To handle this concern, we estimate the following country-difference gravity equation

$$\ln\left(\frac{I_{i,ndt}}{I_{i,jdt}}\right) = \beta \ln \frac{\text{Imbalance}_{ndt}}{\text{Imbalance}_{jdt}} \times \left(\frac{w_i}{p_i}\right) + \theta_0 \ln \frac{GDP_{nt}}{GDP_{jt}} + \eta_{it} + \eta_{ind} + \eta_{ijd} + \varepsilon_{i,njdt} \quad (8)$$

[6] Table 4 lists those countries.

where j is another origin country. Equation (8) compares two similar countries. Country d runs different trade surplus against country j and n. The dependent variable of the above equation is the relative import of good i from country j and n. Our model suggests that the heavy good import from these two countries should be positively related to the trade surplus difference. The estimation strategy depends on choosing exporters that are similar. For example, we do not want to compare US with India. Endogeneity is reduced because effects of heavy goods trade volume on trade imbalance are likely to be much smaller between similar countries.

Table 6 shows the estimation of equation (8). We choose US and Vietnam as the benchmark countries for developed countries and developing countries. The first column suggests that if the trade imbalance increases by 1%, the import of a good will increase by 0.03% more than the import of another good whose weight-per-value is 1% lower than the good. The second and third column show the results on restricted sample, similar as column 3 and 4 in table 2. We can see that the results are quite robust.

3.4 Port-level Evidence from China

For a given country, comparative advantage should be similar across different ports. As a robustness check, we use the port-level trade balance data from the Chinese custom database from 2000 to 2006. Besides information on the HS6 code, trade volume, destination or origin countries, we know the exact port used in the transactions. For a given port and HS6 good pair and a given trading partner, we sum up all bilateral imports and bilateral exports in a year, respectively. For example, we know Shanghai port's total exports to the United States by product, and the same port's total imports from the United States by product.

Figure 4 plots the export and import of each port in year 2006.[7] The x-axis and y-axis

[7]Although we use the word port, we are actually meaning a custom city. For instance, Xining is not a coastal city, but there is still export and import by land. Given our story does not only hold for maritime trade, we include those inland cities in the analysis.

are the export and import values in logs. There is a large variation on the export and import values. Shanghai, the largest port in China, is ten times larger in trading volume, than the smallest port in terms of either imports or exports.

The gravity equation to be estimated is as follows

$$\ln I_{i,mnt} = \beta \ln \text{Imbalance}_{mnt} \times \ln \left(\frac{w_i}{p_i}\right) + \theta_0 \ln GDP_{nt} + \eta_{it} + \eta_{imn} + \varepsilon_{i,nt} \tag{9}$$

where m is a port in China. $I_{i,mnt}$ is good i's import of port m from country n. Imbalance_{mnt} is the export from port m to country n divided by the total import of port m from country n. Our model suggests that β should be positive.

We also estimate a equation similar as (8) at the port level.

$$\ln \left(\frac{I_{i,mnt}}{I_{i,hnt}}\right) = \beta \ln \frac{\text{Imbalance}_{mnt}}{\text{Imbalance}_{hnt}} \times \left(\frac{w_i}{p_i}\right) + \theta \ln GDP_{nt} + \eta_{it} + \eta_{imn} + \varepsilon_{i,nt} \tag{10}$$

where m and h are two different ports in China. The dependent variable is the relative import of good i from same country n between two Chinese ports m and h. And the right hand side variable is the relative trade imbalance of ports m and h against country n.

We can interpret the above equation as follows: Suppose ships are more likely to return to the same port when they are back China.[8] If more ships leave for country n from port m than port h, the port m will import more heavy goods from country n than the port h.

Potential endogeneity of trade imbalance is mitigated because the ports are within a common country and the export country is fixed. Trade imbalance across different ports are less likely to be affected by heavy goods trade volume difference.

Table 7 reports the estimation results. Column 1 and 2 show the results of equation (9). We can see that when q port runs a larger trade surplus (as a share of total trade), it also

[8]A ship usually has regular travel routine and takes a few ports as its home ports.

imports disproportionately more heavy goods. This effect is not significantly different between developed and developing countries. Column 3 restricts the sample to countries which China run a persistent trade surplus over all years in our sample. The elasticity increases to 0.024 from 0.023. This is consistent with our previous argument: the effect should be more pronounced in countries with persistent trade surpluses.

Columns 4 and 5 show the results of equation (10). Our results suggest that the trade surplus different between two Chinese ports can predict the import of heavy goods. The elasticity is around 0.004. The elasticity is robust when allowing for heterogeneous effects in different countries. In column 6, we estimate the equation (10) using the restricted sample of column 3. The effect slightly increases by 0.03%, consistent with our theory.

Hummels and Schaur (2013) suggest that we should exclude trade volume by air shipping when we compute the heavy goods trade. The estimation is shown in Table 8. The results are similar to before, suggesting that the results are robust.

3.5 A Shock to Trade Balance: Mexico

Our result holds not only for China but also for other countries. This section shows the estimation results using Mexican import data. Mexico's Peso depreciated over 50% in 1994 causing a large trade surplus. Figure 5 shows the Mexican trade surplus to GDP (solid line) and the exchange rate (dashed line) from 1993 to 1997. As we can see, the trade surplus to GDP ratio increases by 0.5% following the exchange rate depreciation.

We assume that the large exchange rate fluctuation is an exogenous shock to the trade imbalance (will provide more evidence on this). We estimate the following gravity equation

$$\ln\left(\frac{I_{i,nt}}{I_{i,nt-1}}\right) = \beta \ln \frac{\text{Imbalance}_{nt}}{\text{Imbalance}_{nt-1}} \times \left(\frac{w_i}{p_i}\right) + \theta \ln \frac{GDP_{nt}}{GDP_{nt-1}} + \eta_{it} + \eta_{in} + \varepsilon_{i,nt} \tag{11}$$

The right hand side variable is the Mexican import growth rate of good i from country n. The

left hand side is the trade imbalance change due to the exogenous exchange rate shock. The above equation suggests that because of the Peso depreciation, Mexico will export more and run a larger trade surplus. And when the trade surplus increases more, Mexico will import more heavy goods than the light goods.

Table 9 shows the results of the Mexican import data. We use a 5-year window: 1992-1996. So we have 2 years' observations before and after the exchange rate shock. Column 1 and 2 report the estimations of equation (7) and column 2 allows heterogeneous elasticity of developed countries. We find that the trade imbalance will cause the heavy goods import share increases by 0.06%. And this effect is slightly lower in developed countries. The next two columns show the result of equation (11). If the growth rate of the trade surplus increases by 1%, column 3 suggests that the growth rate of heavy goods import share will increase by 0.04% than the growth of light goods import.

3.6 Additional Robustness Checks

Do trade costs affect a country's trade imbalance?

A country's trade imbalance may be affected by the average shipping cost it faces. For example, a lower shipping cost from country j to k causes j to run a trade surplus. To investigate this possibility, we collect port-to-port shipping cost data between Shanghai, China and 46 ports in countries with the largest trade volume with China.[9] We use the 40FT Full Container Load (FCL) price. The data is collected from World Freight Rates in August, 2017.

Figure 2 plots the the relative shipping cost between Shanghai-port to a port (a port-to-Shanghai/Shanghai to the port) and the relative trade volume between China and a county in which the port is located. (China's export to the country/China's import from the country). A negative relationship between two variables are clearly observed. If a lower shipping cost

[9] Among 50 countries with the largest trade volume with China, the port-to-port shipping costs are available for 46 countries.

from a county to China causes the country to run a trade surplus with China, the opposite relationship would have been observed.

Multinational shipping arrangement

So far, we assume that the ship can only travel between two countries. However, a ship might stop by at a few countries to fill up its load before returning to the first exporting country. This might add complications to our interpretations. To investigate its consequence, we group countries according to the number of trade partners that the country runs trade surplus with. If a country runs trade surplus with most of its trade partners, then the ship is difficult to find a route to fill its load. So our story should be more pronounced in this kind of country. The first column of Table 10 reports the regression only using countries whose numbers of positive trade surplus partners are above the median.[10] The elasticity increases from benchmark number to 0.032, consistent with our prediction again.

Volume-per-value analysis

The international carriers may have both a weight capacity constraint and a physical space constraint. We have focused on the weight constraint since only the weight per value information is available for the cross-country data. In the Chinese custom data, some goods are reported in terms of volume, such as the liquid. We now explore this information. By necessity, we can look only a subset of goods for which the information is available.

The result is reported in the column 3 and 4 of Table 10. The column 3 uses the UN data and estimates our main result as the column 1 of Table 2. The column 4 repeats the regression in the column 1 of Table 7. We find significant results in both two specifications.

[10] This exercise is different from the analysis in section 3.2, in which we focus on countries with persistent positive trade surplus. Here we group countries about the number of positive trade surplus.

4 Application: Chinese Waste Goods Import

In this section, we apply our theory to the Chinese import. We first document two stylized facts about the Chinese waste goods import.

Fact 1: Waste goods are heavy goods

Figure 6 plots the the density of weight (kg)/US dollar ratio of each good. The solid line is the weight-to-value ratio of waste goods and the dashed line is the ratio of other goods. On average, the weight-to-value ratio of other goods is very low, about 0.1 kg/USD. However, the wasted good is much heavier. The peak of the density is about 1 kg/USD. Since the wasted goods are much heavier than other goods, our theory predicts that China should import more wasted goods from countries with a large trade surplus.

Fact 2: China imports more waste goods from countries with a larger trade surplus

We already show some of this in figure 1. Here, we provide additional evidence. China runs a larger trade surplus against US than Germany. The first column of Table 11 lists the China's top 10 imported goods (by value) from US. Among them, 5 are wasted goods, and the rest are capital intensive goods.[11] In the second column, we list China's top 10 imported goods from Germany. In this case, nine of them are capital intensive goods, and one is industrial waste.

4.1 Imports of Solid Industrial Waste

In this subsection, we first formally test whether China imports more heavy goods from countries with a large trade deficit by estimating equations (7) and (8). Table 12 reports the results.

[11] Ju et al. (2015) also notice that China imports lots wasted goods from US but they do not link it to trade surplus.

Column 1 includes the interaction term between trade imbalance and weight-to-value ratio and estimates equation (7). The result is consistent with our model prediction. For a pair of goods, if one is 1% heavy (in terms of weight-to-value ratio) than the other, a 1% increase in the trade imbalance will result in an increased import by 0.06% of the heavy good.

In Column 2, the coefficient for developed countries is allowed to be different. We find that the coefficient of the developed countries is significantly higher than the coefficient of the developing countries. So the result suggests that the pattern still holds with-in the developing countries and developed countries groups.

Column 3 shows the estimation result of equation (8). We again choose the United States as the benchmark for the developed group, and Vietnam as the benchmark in the developing country group. We see that China imports more of heavy goods from countries it has larger trade surplus. In Column 4 where different coefficients for developed and developing countries are estimated, the coefficient is around 0.12% for developing countries and 0.09% for developed countries.

We then test whether China imports more waste goods from the large trade deficit countries. We define the dependent variable to be $\text{lnImbalance}_{nt} \times \text{waste\_goods\_indicator}$. The indicator is 1 if good i is waste goods and 0 otherwise and re-estimate equations (7) and (8). Table 13 presents the results. Column 1 reports the estimation of equation (7) and Column 2 allows for different elasticity between two groups of countries. When China bilateral surplus against a country increases by 1%, it will import 0.14% more wasted goods from this country. The elasticity is not significantly different between developed and developing countries. Column 3 shows the first difference regression result of equation ((8). The result implies that when the relative trade imbalance increases 1% between two similar countries, the wasted goods import share will increase by 0.22%. We again allow for different effects between developed and developing countries and find a smaller effect for developed countries. This is consistent

with the result in table 12, and suggests that the heavy good effect is not simply the effect of capital intensive good.

5 Discussion

The import of waste may cause huge welfare loss, especially in the developing countries. In the report by Brigden et al. (2005), they find that when recycling the electronic waste in China and India, substantial quantities of toxic heavy metals are released to the working environment and the surrounding soils and water courses.

To quantify the welfare loss of the waste goods import, we try to estimate whether the waste goods import in a city will significantly change the health of the city. We get the health measure from Charles 2011 data. This is a survey data that covers individual health condition in different cities. We estimate the following equation.

$$R_{ih} = \beta \ln IMP_h + X_i + X_h + \varepsilon_i$$

where i denotes individual i and h denotes the city. R_{ih} is a 0/1 variable meaning whether person i has a cancer or not. $\ln IMP_h$ is the waste goods import per capita of city h in year 2010. X_i are observed characteristics of person i, including age, gender, education level and the household annual consumption (a proxy of income). X_h are observed characteristics of city h. We control the city's GDP per capita to measure the development stage of the city. We also control the city's manufacture sector's GDP per capita because the manufacture sector may generate pollution and affect the health status. Table 14 shows the result. The first column estimates an OLS regression suggesting there is a significant positive correlation between waste goods import and the cancer rate. The second column is our main specification. For each city, we find the closest port of the city and then we instrument the $\ln IMP_h$ using

the trade surplus of the closest port. Because a city mainly imports goods from the closest port in our data. From our previous analysis, the closet port's trade surplus will change the waste goods import cost of the city. However, we believe the port trade surplus condition does not directly correlate with the health status of a city. The result suggests that a 10% increase of the waste goods import in a city will increase the cancer rate by 0.6%. In our previous section, we estimate that a 10% increase of trade surplus can increase the waste goods import by 1.4%. Combine these two numbers, our result suggests that if the trade imbalance increases by 10%, it can increase the cancer rate to increase by 0.08%. In other words, 8 more people per 10,000 people will get cancer if the trade surplus increases by 10%. To further establish the causality, we resorts to the Dif-in-Dif identification strategy. We classify the six diseases that are closely related to pollution of waste recycling, including cancer, stroke and diseases of kidney, liver, heart and blood vessels.[12] We expect that those disease that are related to the waste recycle should have a more pronounced effect when waste import increases. Column 3 of table 14 pools all diseases together. The dependent variable is 1 if individual i gets a certain disease. We control the disease fixed effects and at the same time, we add a interaction term between waste import and a dummy which equals to 1 if individual i gets the above 6 pollution related diseases. We see that the interaction term is significantly positive, meaning that the correlation between waste import and the pollution related disease is stronger than that of waste import and other diseases.

We also estimate a similar equation using cross country data. In the first column of table 15, the dependent variable is the country's cancer rate per 10,000 people and we control for waste goods import per capita, GDP per capita and the manufacture output per capita. The last two controls are meant to capture the development stage and the size of manufacture sector in a country. The result suggests that the waste goods import is significantly correlate with the cancer rate in that country. Surprisingly, the magnitude is very similar to the estimated

[12] The source is https://en.wikipedia.org/wiki/List_of_pollution-related_diseases.

coefficient in China's city level data: a 10% increase of the waste goods import will increase 8 more people per 10,000 people getting cancer. The second column of table 15 uses the trade surplus of that country as the instrument variable. We get a even stronger effect.

However, The pollution induced by import waste recycle is not properly taxed especially in developing countries. To show this point, we use the environmental regulation stringency index (ERS) collected by OECD Stat. The ERS is a country-specific and internationally-comparable measure of the stringency of environmental policy. Stringency is defined as the degree to which environmental policies place an explicit or implicit tax on polluting or environmentally harmful behaviour. The index ranges from 0 (not stringent) to 6 (highest degree of stringency). The index covers 28 OECD and 6 BRIICS countries. The index is based on the degree of stringency of 14 environmental policy instruments, primarily related to climate and air pollution. At the same time, OECD Stat releases in stringency of all these 14 policy instruments as well. [13]

Table 16 lists all countries ERS index. The left panel are indexes of BRIICKS and the right panel are indexes of other OECD countries. The ERS is significantly lower in BRIICKS.

If environmental regulation is strong in countries with a trade surplus, which may import lots waste goods, our mechanism may not result in a significant welfare loss. However, we do not find this pattern in the data. In table 17, we regress different measures of environmental regulation indexes on trade surplus, including the ERS index, environment tax index and the regulation standard index. At the same time, we control for the countries' GDP level, corruption level as well as government efficiency.[14] In all specifications, we do not find a significant correlation between trade surplus and environmental regulation policy.

[13]The BRIICS denote Brazil, Russia, India, Indonesia and China. The details of the data can be found at https://stats.oecd.org/Index.aspx?DataSetCode=EPS.

[14]The corruption index and regulation quality index are collected from World Bank Governance Indicator data set. The data can be found at http://databank.worldbank.org/data/reports.aspx?source=worldwide-governance-indicators.

6 Conclusion

This is the first paper that explores how a trade imbalance can affect import/export compositions. Consistent with our theory, we find that trade surplus countries import more heavy goods, especially scrap metals and other industrial waste. We apply our theory to explain why China imports so much waste goods.

The mechanism we study suggests a concrete channel for a trade surplus to generate a welfare loss, especially in developing countries that have a lax environmental standard.

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Tables and Figures

Table 1: Five Most Heavy and Light Goods

Heavy Goods	Light Goods
Bitumen and asphalt	Diamond
Limestone flux	Precious metal
Wasted Granulated slag from iron	Gold
Ceramic building bricks	Halogenated derivatives
Scrap of glass	Watch

NOTE: This table shows 5 goods which have the highest (lowest) weight-to-value ratio from the transaction level data on Colombian imports in 2007-2013 period.

Table 2: Main Results: Gravity Equation for UN data

	(1) ln(Import)	(2) ln(Import)	(3) ln(Import)	(4) ln(Import)	(5) ln(Import)
ln(Imbalance)$\times \ln\left(\frac{w}{p}\right)$		0.0258***	0.0387***	0.044***	0.101***
		(47.05)	(37.91)	(38.58)	(6.07)
$\ln GDP_{\text{exporter}}$	1.736***	1.764***	0.379***	0.444***	1.730***
	(84.99)	(86.23)	(11.12)	(11.74)	(82.08)
$\ln GDP_{\text{importer}}$	1.412***	1.392***	1.252***	1.325***	1.418***
	(68.69)	(67.63)	(47.13)	(45.23)	(66.36)
Product-year FE	Y	Y	Y	Y	Y
Product-Country-pair FE	Y	Y	Y	Y	Y
Developed Country			Y	Y	
Join WTO				Y	
IV					Y
Obs.	9,909,242	9,890,240	5,884,037	5,227,080	9909242
R-squared	0.83	0.84	0.84	0.84	0.84

Notes: This table shows the estimation results of equation (7) using the world bilateral trade data from 2002 to 2004. "Import" means the import product i from an origin country (exporter) to a destination country (importer) in year t. "Imbalance" means bilateral trade imbalance between a country-pair in year t, measured by the total export of a destination country to a origin country divided by the total import of the destination country to the origin country. "w/p" is the weigh-to-value ratio from the Colombian data. "GDP_{exporter}" ("GDP_{exporter}") is the GDP of exporting county (importing country) in year t. Column 3 restricts sample to countries whose GDP per capita is greater than 12,000 USD and Column 4 further restricts sample to countries joining the WTO. Column 5 uses government expenditure as an IV. T-values are reported in the parenthesis. *** denotes the coefficient is significant at 1% level.

Table 3: Countris with Persistent Trade Surplus

Country	Number of partners with positive surplus	Number of trade partners
Uruguay	68	113
Israel	93	153
Norway	109	179
Singapore	87	142
Sri Lanka	82	132
Viet Nam	102	164
Chile	93	149
Japan	133	213
Germany	135	216
Italy	136	217
Belgium	130	207
France	142	225
Australia	130	204
Russian Federation	122	191
Thailand	136	212
New Zealand	123	189
South Africa	143	219
Ireland	142	216
Austria	148	225
China	132	199
Ukraine	108	160
Korea Rep.	143	211
Netherlands	148	213
Pakistan	119	170
Finland	140	189
Switzerland	161	214
India	149	198
Indonesia	155	204
Brazil	149	195
Denmark	167	215
Malaysia	155	199
Argentina	122	156
Luxembourg	128	160
Sweden	157	190
China, Hong Kong	168	190
United Arab Emirates	15	15

Notes: This table lists the countries who run positive trade surplus with more than 60% of their trade partners from year 2000 to 2004. Countries are ordered by the percentage of countries with positive trade surpluses.

Table 4: Countris with Persistent Trade Deficit

Country	Number of partners with positive surplus	Number of trade partners
Mayotte	1	117
Aruba	1	48
Niger	11	108
Faeroe Isds	17	165
Andorra	14	131
Mozambique	21	132
TFYR of Macedonia	26	141
Iceland	23	124
El Salvador	23	121
Bahrain	23	120
Guatemala	27	137
Algeria	31	155
Zambia	24	117
Croatia	49	196
Greenland	6	24
Lebanon	47	184
Jordan	33	126
Tunisia	47	171
Saudi Arabia	41	148
Bangladesh	46	164
Morocco	41	144
Uganda	41	138
Ecuador	44	146
Madagascar	46	152
Mauritius	48	157
Mexico	57	185
Papua New Guinea	38	120
Bolivia	33	88
Estonia	65	173
Portugal	74	191

Notes: This table lists the countries who run positive trade deficit with more than 60% of their trade partners from year 2000 to 2004. Countries are ordered by the percentage of countries with positive trade surpluses.

Table 5: Gravity Equation for Countries with Persistent Trade Surplus

	(1) ln(Import)	(2) ln(Import)	(3) ln(Import)	(4) ln(Import)
ln(Imbalance)× $\ln\left(\frac{w}{p}\right)$	0.0436***	0.0132***	0.0305***	0.0403***
	(28.72)	(18.68)	(41.66)	(50.05)
$\ln GDP_n$	1.809***	1.672***	1.678***	1.673***
	(52.32)	(39.10)	(65.13)	(61.76)
$\ln GDP_d$	1.368***	1.809***	1.376***	1.3399***
	(42.35)	(42.58)	(56.33)	(52.13)
Product-year FE	Y	Y	Y	Y
Product-exp-imp FE	Y	Y	Y	Y
Obs.	3,750,468	2,518,536	6,141,502	5,178,837
R-squared	0.84	0.80	0.84	0.84

Notes: This table shows the estimation results of equation (7) restricted samples on countries with persistent trade surplus. Each column uses one definition of persistent trade surplus countries. See the paper for the definitions. T-value is reported in the parenthesis. *** denotes the coefficient is significant at 1% level.

Table 6: Gravity Equation for UN data: Comparing Similar Countries

	(1) Δ ln(Import)	(2) Δ ln(Import)	(3) Δ ln(Import)
$\Delta\ln(\text{Imbalance})\times\ln\left(\frac{w}{p}\right)$	0.0301***	0.0468***	0.0530***
	(36.64)	(40.55)	(41.93)
$\Delta\ln GDP_{\text{exporter}}$	1.299***	0.499***	0.631***
	(202.61)	(10.13)	(11.5)
$\Delta\ln GDP_{\text{importer}}$	0.0469	0.416***	0.731***
	(1.37)	(9.94)	(15.36)
Product-year FE	Y	Y	Y
Product-Country-pair FE	Y	Y	Y
Developed Country		Y	Y
Join WTO			Y
Obs.	5,935,824	4,250,645	3,752,765
R-squared	0.83	0.83	0.83

Notes: This table shows the estimation results of equation (8) using the bilateral trade data from 2002 to 2004. The variable definition is similar to Table 2. For developed countries, all the variables are divided by US values. For developing countries, all the variables are divided by Vietnam values. Developed countries are countries whose GDP per capita is above 12,000 USD. Developing countries are countries whose GDP per capita is below 12,000 USD. Column 2 restricts sample to countries whose GDP per capita is greater than 12,000 USD and Column 3 further restricts sample to countries joining the WTO. T-value is reported in the parenthesis. *** denotes the coefficient is significant at 1% level.

Table 7: Gravity Equation of Chinese Ports Imports

	(1) ln(Import)	(2) ln(Import)	(3) ln(Import)	(4) Δ ln(Import)	(5) Δ ln(Import)	(6) Δ ln(Import)
ln(Imbalance)$\times \ln\left(\frac{w}{p}\right)$	0.0200***	0.0194***	0.0237***			
	(48.59)	(43.16)	(39.79)			
{Developed$\times$ln(Imbalance)$\times \ln\left(\frac{w}{p}\right)$}		0.00227				
		(1.3)				
Δln(Imbalance)$\times \ln\left(\frac{w}{p}\right)$				0.00403***	0.00447***	0.00434***
				(3.4)	(3.03)	(3.04)
{Developed$\times\Delta$ln(Imbalance)$\times \ln\left(\frac{w}{p}\right)$}					-0.00121	
					(-0.50)	
$\ln GDP_{\text{exporter}}$	-0.0783	-0.07	-0.116	2.789***	2.789***	4.363***
	(-0.71)	(-0.63)	(-0.77)	(11.35)	(11.35)	(11.17)
Product-year FE	Y	Y	Y	Y	Y	Y
Port-year FE	Y	Y	Y	Y	Y	Y
Port-exporter FE	Y	Y	Y	Y	Y	Y
Port-product FE	Y	Y	Y	Y	Y	Y
Persistent surplus country			Y			Y
Obs.	4,099,227	4,099,227	1,800,473	1,727,032	1,727,032	613,917
R-squared	0.62	0.62	0.62	0.25	0.25	0.29

Notes: This table shows the estimation results of the Chinese port data. Developed=1 if GDP per capita is above 12,000 USD. In the third and last columns, we restrict the samples to countries that China run positive trade surpluses in all years of our sample. T-value is reported in the parenthesis. *** denotes the coefficient is significant at 1% level.

Table 8: Gravity Equation of Chinese Ports Imports: Exclude Trade by Air

	(1) ln(Import)	(2) ln(Import)	(3) Δ ln(Import)	(4) Δ ln(Import)
ln(Imbalance)$\times \ln\left(\frac{w}{p}\right)$	0.0161***	0.0166***		
	(40.25)	(37.75)		
Developed$\times$ln(Imbalance)$\times \ln\left(\frac{w}{p}\right)$		0.0024***		
		(2.48)		
Δln(Imbalance)$\times \ln\left(\frac{w}{p}\right)$			0.00332***	0.00334***
			(2.96)	(2.47)
Developed$\times\Delta$ln(Imbalance)$\times \ln\left(\frac{w}{p}\right)$				-0.0000384
				(-0.02)
$\ln GDP_{\text{exporter}}$	0.215**	0.206**	1.626***	1.626***
	(1.88)	(1.80)	(6.14)	(6.14)
Product-year FE	Y	Y	Y	Y
Port-year FE	Y	Y	Y	Y
Port-exporter FE	Y	Y	Y	Y
Port-product FE	Y	Y	Y	Y
Obs.	4,099,227	4,099,227	1,727,032	1,727,032
R-squared	0.62	0.62	0.25	0.25

Notes: This table shows the estimation results of the Chinese port data exclude the trade by air. Developed=1 if GDP per capita is above 12,000 USD. T-value is reported in the parenthesis. *** denotes the coefficient is significant at 1% level.

Table 9: Gravity Equation of Mexican Imports in Currency Crisis Period

	(1) ln(Import)	(2) ln(Import)	(3) Δ ln(Import)	(4) Δ ln(Import)
ln(Imbalance)$\times \ln\left(\frac{w}{p}\right)$	0.0579***	0.141***		
	(21.25)	(5.25)		
Developed$\times$ln(Imbalance)$\times \ln\left(\frac{w}{p}\right)$		-0.0843**		
		(-3.11)		
Δln(Imbalance)$\times \ln\left(\frac{w}{p}\right)$			0.0420***	0.441***
			(13.57)	(5.19)
Developed$\times\Delta$ln(Imbalance)$\times \ln\left(\frac{w}{p}\right)$				-0.399***
				(-4.70)
$\ln GDP_{\text{exporter}}$	1.646***	1.644***	0.819***	0.827***
	(16.55)	(16.53)	(2.17)	(2.19)
Product-year FE	Y	Y	Y	Y
Product-exporter FE	Y	Y	Y	Y
Obs.	160,781	160,781	119,387	119,387
R-squared	0.79	0.79	0.31	0.31

Notes: This table shows the estimation results of the Mexican data. Developed=1 if GDP per capita is above 12,000 USD. T-value is reported in the parenthesis. *** denotes the coefficient is significant at 1% level.

Table 10: Additional Robustness Checks

	(1) UN data ln(Import)	(2) UN data ln(Import)	(3) Chinese-port data ln(Import)
ln(Imbalance)$\times \ln\left(\frac{w}{p}\right)$	0.0318***	0.0114**	
	(36.69)	(2.46)	
ln(Imbalance)$\times \ln\left(\frac{v}{p}\right)$			0.0219***
			(4.09)
$\ln GDP_{\text{exporter}}$	1.914***	0.567**	0.330***
	(78.91)	(2.08)	(.21)
$\ln GDP_{\text{importer}}$	1.454***	0.989***	
	(55.65)	(2.99)	
Product-year FE	Y	Y	Y
Product-Country-pair FE	Y	Y	
Port-year FE			Y
Port-Country FE			Y
Port-Product FE			Y
Multilateral imbalance	Y		
Obs.	7,195,764	30,332	15,437
R-squared	0.84	0.84	0.68

Notes: This table shows the result with additional robustness checks. "Import" means the import product i from an origin country (exporter) to a destination country (importer) in year t. "Imbalance" means bilateral trade imbalance between a country-pair in year t, measured by the total export of a destination country to a origin country divided by the total import of the destination country to the origin country. "w/p" is the weigh-to-value ratio from the Colombian data. "v/p" is the volume-to-value ratio in the Chinese custom data. "GDP_{exporter}" ("GDP_{exporter}") is the GDP of exporting county (importing country) in year t. Column 1 restricts sample to countries whose numbers of positive trade surplus partners are above median in the UN data. Column 2 and 3 use the goods that have volume-to-value ratio information. T-values are reported in the parenthesis. *** and ** denote the coefficient is significant at 1% and 5% levels.

Table 11: Top 10 imported goods by China

	China-US	China-Germany
1	Monolithic integrated circuit	Bus
2	Soy bean	Transmission
3	Aircraft	Aircraft
4	Car	Electric Sunroof
5	Copper scrap	Coupe
6	Waste cotton	Wine
7	Waste cardboard	Radioactive compactors
8	Brewing residue	Heavy goods vehicles
9	Aluminum scrap	Copper scrap
10	Turbojet engine parts	Antiserum

Notes: This table shows the Chinese top 10 imported goods from US and Germany in 2013.

Table 12: Gravity Equation of Chinese Imports

	(1) ln(Import)	(2) ln(Import)	(3) Δ ln(Import)	(4) Δ ln(Import)
ln(Imbalance)$\times \ln\left(\frac{w}{p}\right)$	0.0641***	0.0017	0.0977***	0.124***
	(26.34)	(.46)	(32.30)	(23.99)
Developed$\times$ln(Imbalance)$\times \ln\left(\frac{w}{p}\right)$		0.0946***		-0.036***
		(22.41)		(6.28)
$\ln GDP_{\text{exporter}}$	0.250***	0.250***	1.521***	1.488***
	(10.70)	(10.70)	(152.81)	(132.05)
Product-year FE	Y	Y	Y	Y
Product-exporter FE	Y	Y	Y	Y
Obs.	1,045,992	1,045,992	872,959	872,959
R-squared	0.77	0.77	0.79	0.79

Notes: Column 1 and 2 show the estimation results of equation (7) using the Chinese import data. Column 3 and 4 show the estimation of equation (8). Developed=1 if GDP per capita is above 12,000 USD. T-value is reported in the parenthesis. *** denotes the coefficient is significant at 1% level.

Table 13: Gravity Equation of Chinese Waste Imports

	(1) ln(Import)	(2) ln(Import)	(3) Δ ln(Import)	(4) Δ ln(Import)
Waste×ln(Imbalance)	0.143***	0.154***	0.221***	0.395***
	(8.21)	(6.41)	(10.48)	(8.99)
Developed×Waste×ln(Imbalance)		-0.0189		-0.226***
		(.63)		(4.51)
$\ln GDP_{\text{exporter}}$	-0.186***	-0.186***	1.608***	1.609***
	(-5.44)	(5.44)	(123.50)	(123.56)
Product-year FE	Y	Y	Y	Y
Product-exporter FE	Y	Y	Y	Y
	0.71	0.71	0.71	0.71
Obs.	1,083,734	1,083,734	905,824	905,824
R-squared	0.76	0.76	0.77	0.77

Notes: This table shows the estimation results of the wasted goods import using the Chinese import data. Developed=1 if GDP per capita is above 12,000 USD. T-value is reported in the parenthesis. *** denotes the coefficient is significant at 1% level.

Table 14: Estimation Result of Health Status in Chinese Cities

	(1)	(2)	(3)	(4)
ln(Waste import per capita)	0.0004***	0.0006*	-0.0014***	-0.0029**
	(2.82)	(1.70)	(-2.52)	(-1.96)
ln(Waste import)*pollution related disease			0.0014***	0.0016*
			(2.69)	(1.92)
ln(Consumption per capita)	0.001*	0.001*	0.0068***	0.0076***
	(1.92)	(1.91)	(8.03)	(8.63)
ln(GDP per capita)	0.00002	-0.00008	-0.00017	0.00024
	(0.14)	(-.54)	(-.51)	(1.40)
ln(Industry output per capita)	-0.135	0.710	1.439	-2.033
	(-.13)	(0.53)	(0.47)	(-.54)
Gender	Y	Y	Y	Y
Education	Y	Y	Y	Y
Age cohort	Y	Y	Y	Y
Disease FE			Y	Y
Obs.	15,599	15,599	195,236	195,236
R-squared	0.01	0.01	0.11	0.11

Notes: This table shows the estimation results of the health status in the 2011 Charles data. Pollution related diseases include cancer, stroke and diseases of kidney, liver, cardiovascular and heart. Dependent variables of column 1 and 2 are the cancer rate. Dependent variables of column 3 and 4 pool all diseases. T-value is reported in the parenthesis. ***, ** and * denote the coefficient is significant at 1%, 5% and 10% level respectively. The instrument variables are trade surplus of the closest port in year 2010.

Table 15: Estimation Results of Global Cancer Rate

	(1)	(2)
ln(Waste import per capita)	0.837***	2.076**
	(-3.43)	(-2.31)
ln(GDP per capita)	-1.256*	-2.516**
	(-1.81)	(-2.49)
ln(Industry output per capita)	0.623	-0.159
	(1.08)	(-0.19)
Obs.	131	131
R-squared	0.17	0.03

Notes: This table shows the estimation results of the cancer rate across countries. T-value is reported in the parenthesis. ***, ** and * denote the coefficient is significant at 1%, 5% and 10% level respectively. The instrument variables are trade surplus of the country.

Table 16: ERS Index

BRIICKS	ERS	OECD	ERS
Brazil	0.42	Turkey	0.88
Indonesia	0.44	USA	1.05
South Africa	0.44	Slovak Republic	1.10
India	0.60	Australia	1.17
Russian Federation	0.65	Poland	1.27
China	0.85	Norway	1.42
		Ireland	1.46
		Italy	1.49
		Canada	1.58
		Czech Republic	1.63
		Switzerland	1.69
		Greece	1.73
		United Kingdom	1.73
		Japan	1.90
		Netherlands	1.90
		Belgium	1.98
		France	2.13
		Portugal	2.13
		Hungary	2.33
		Korea, Rep.	2.33
		Austria	2.40
		Finland	2.48
		Denmark	2.59
		Germany	2.67
		Spain	2.75
		Sweden	2.75

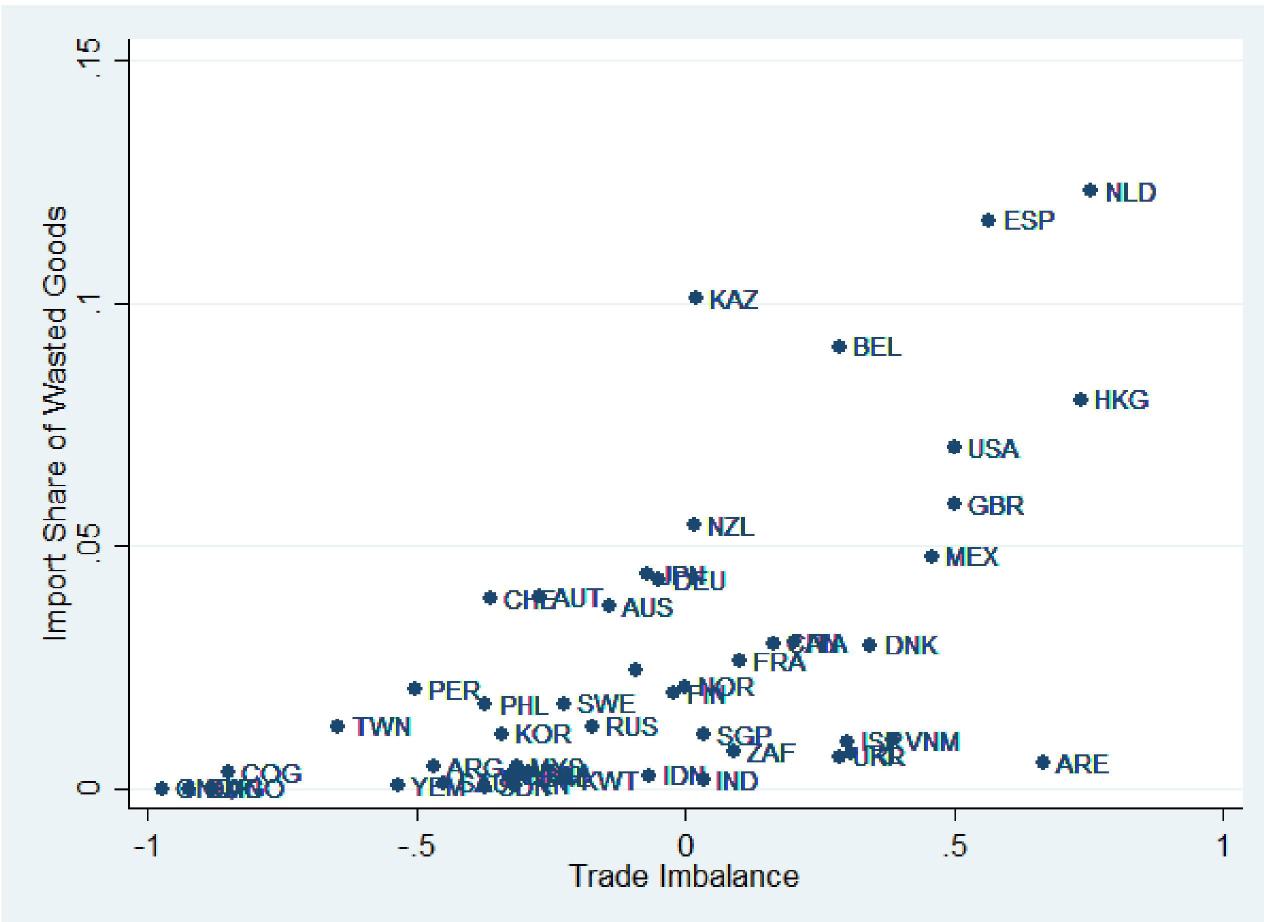
Notes: This table lists the environment regulation stringency index of OECD countries and 6 BRIICKS countries in in 2004. High index denotes high regulation.

Table 17: Results of Regulation and Trade Imbalance

	(1) ERS	(2) Environment tax	(3) Regulation Standard
ln(Imbalance)	-0.191	0.432	-0.177
	(-1.36)	(1.39)	(-1.02)
$\ln GDP$	0.0701	0.163	0.474*
	(0.45)	(0.48)	-2.51
Corruption	0.224	0.1	0.701***
	(1.58)	(0.32)	-4.02
Regulation Quality	0.299	0.857*	-1.050***
	(1.54)	(2.01)	(-4.40)
Year FE	Y	Y	Y
Obs.	89	86	89
R-squared	0.43	0.37	0.18

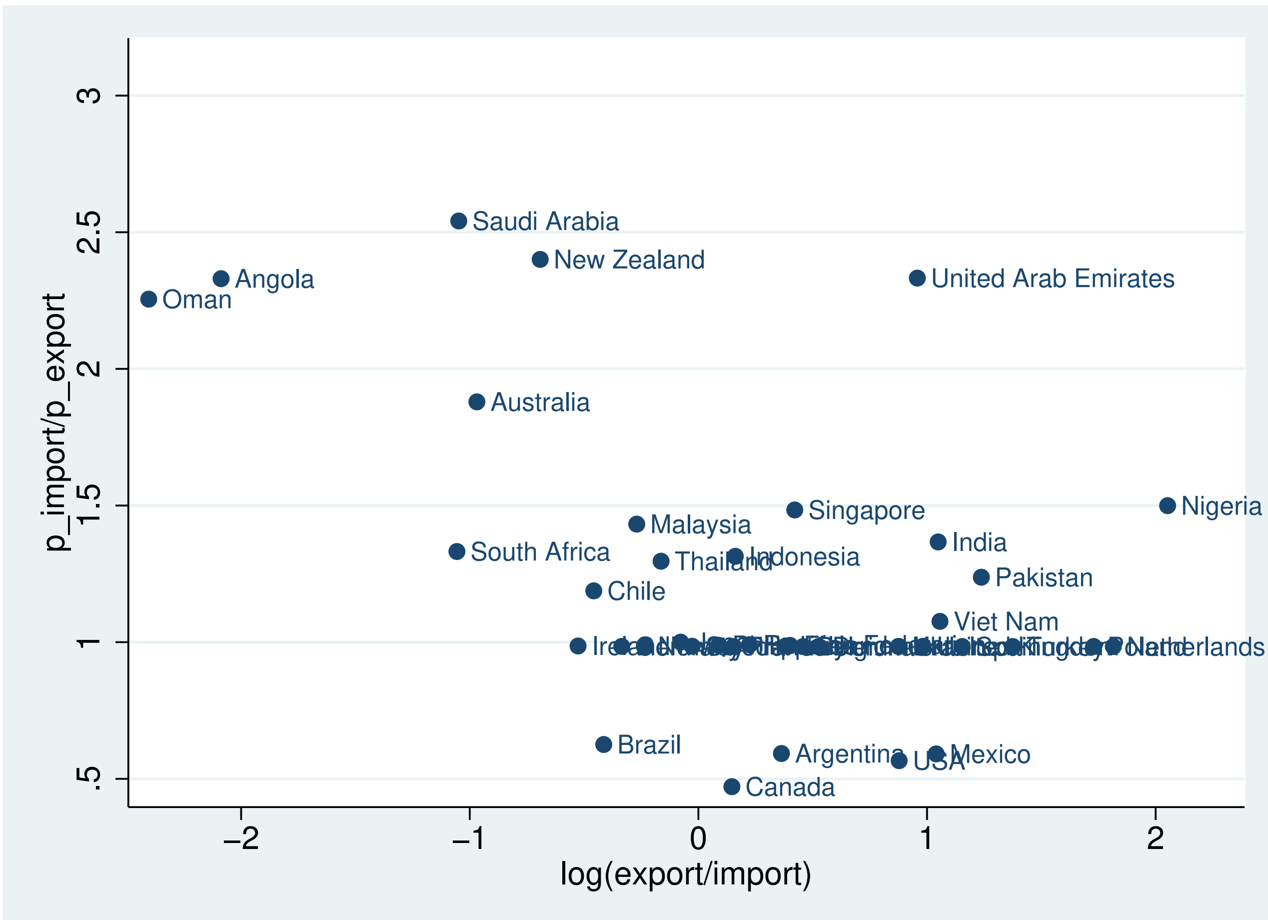
Notes: This table shows the estimation results of the regulation stringency. The three columns use EPS index, environment tax index and pollution regulation standard index as independent variables respectively. *** and * denote the coefficient is significant at 1% and 10% levels.

Figure 1: The Imbalance and Wasted Goods Import Share in China



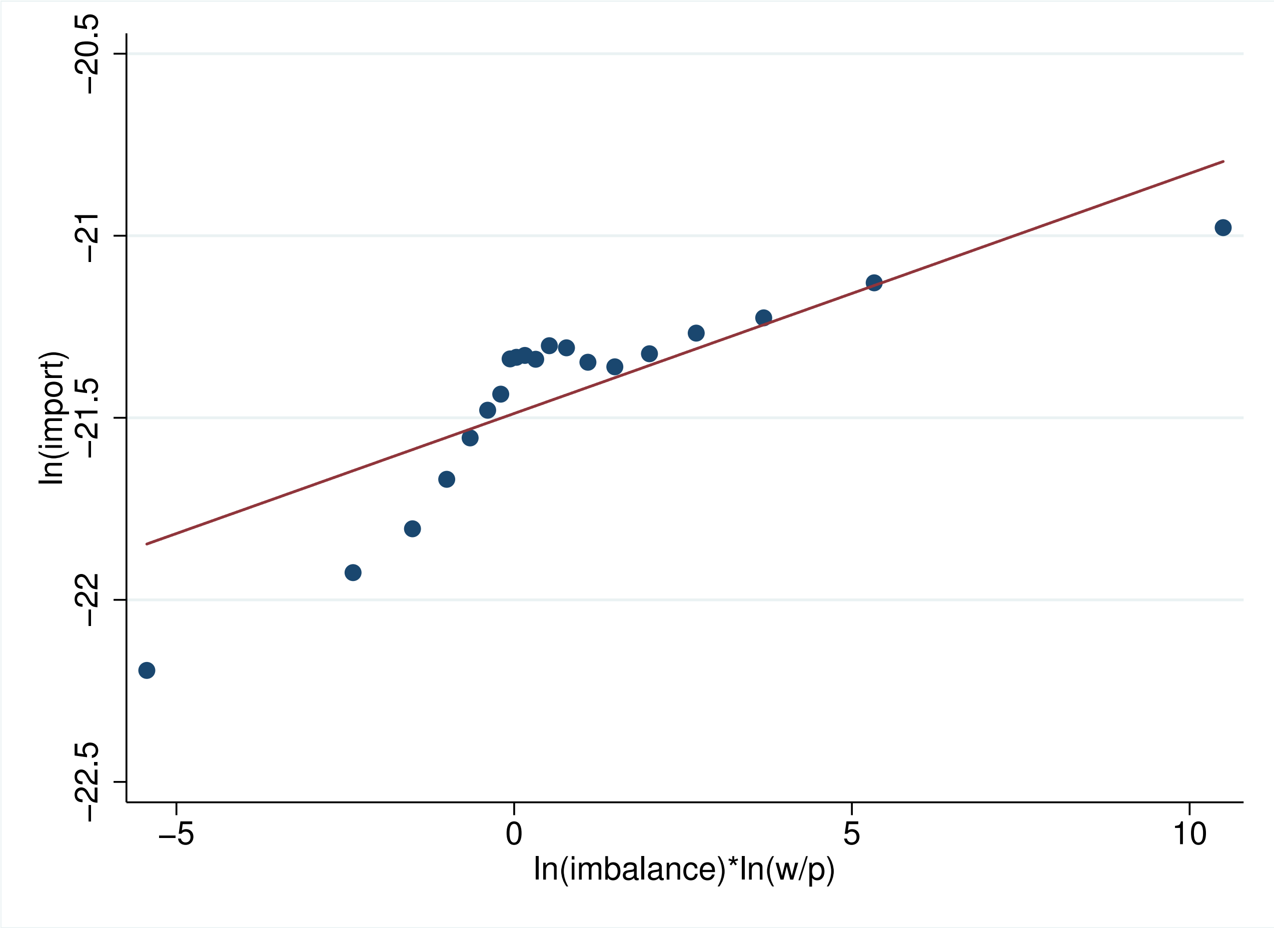
NOTE: This figure shows the trade imbalance and wasted goods import share of China. Trade imbalance is measured by (export-import)/(export+import).

Figure 2: Container Shipping Cost



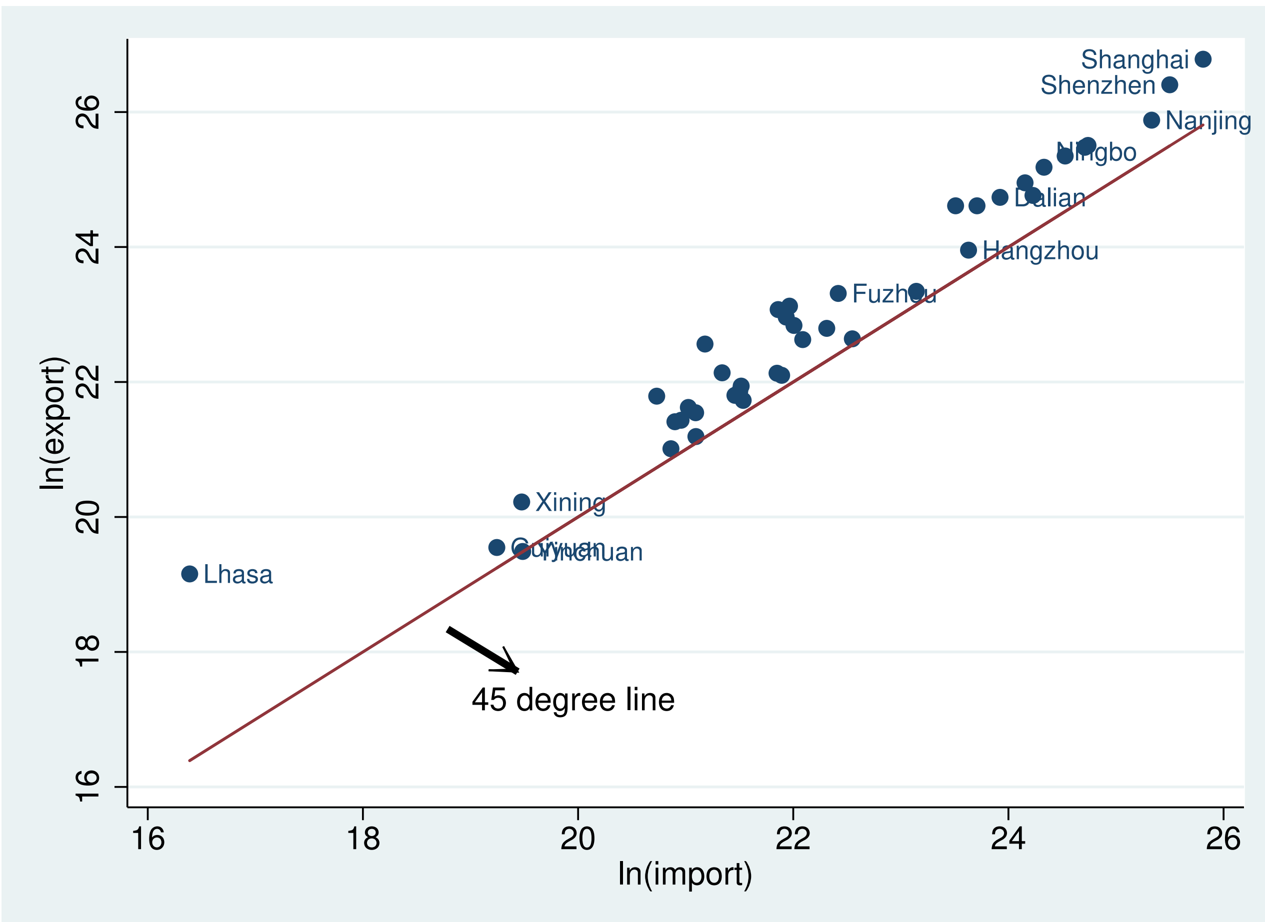
NOTE: This figure shows the ratio of container ship cost from other country to Shanghai and the cost of the opposite direction. The shipping cost information is from World Freight Rates (http://www.worldfreightrates.com).

Figure 3: Conditional Binned Scatter Plots for the Main Regression



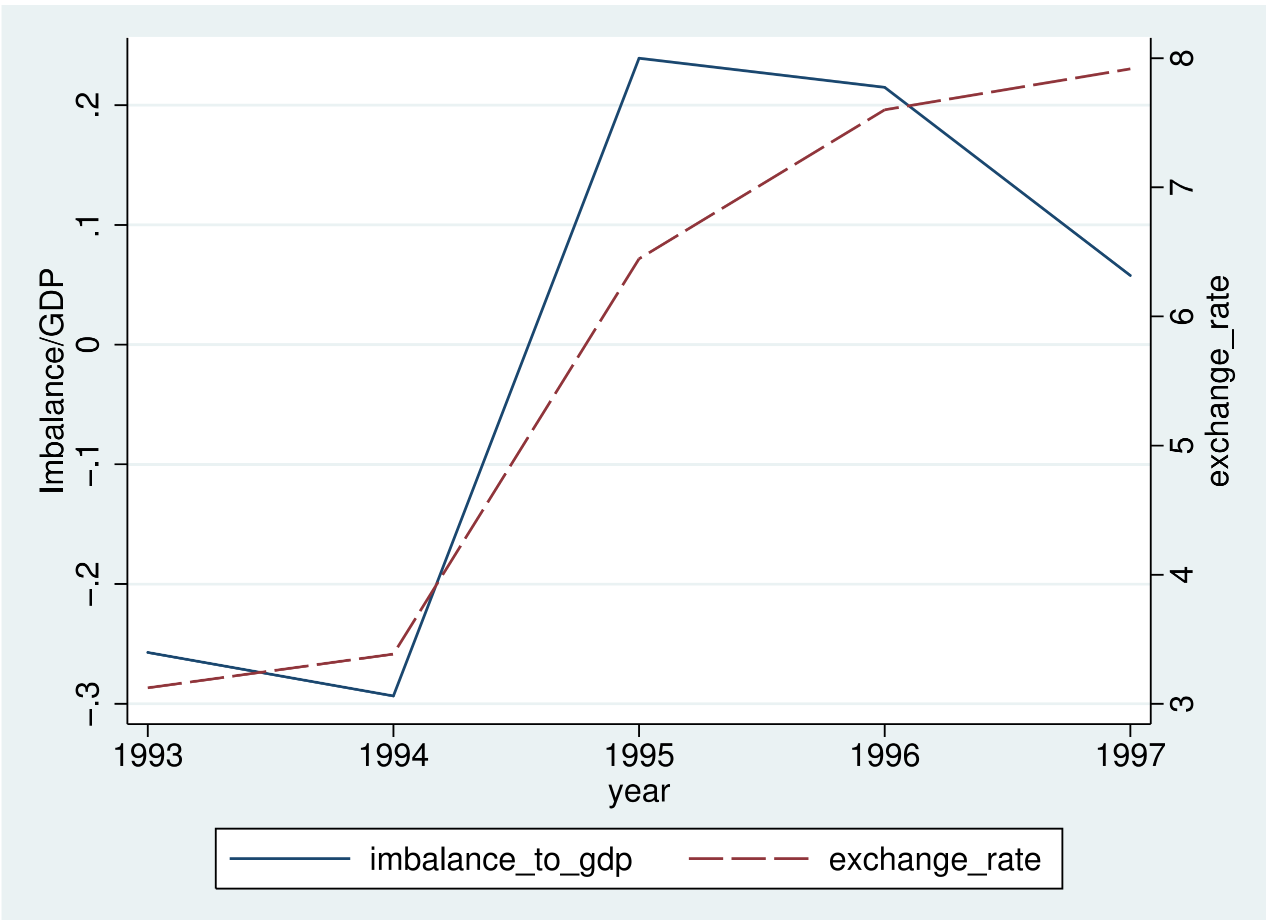
NOTE: This figure shows the conditional binned scatter plots for the regression equation in the second column of Table 2. We first generate the residual from the regression equation without the term $\ln(\text{Imbalance}) \times \ln\left(\frac{w}{p}\right)$. The figure shows the scatter plots for the residual with respect to $\ln(\text{Imbalance}) \times \ln\left(\frac{w}{p}\right)$.

Figure 4: The Export and Import of Chinese Ports



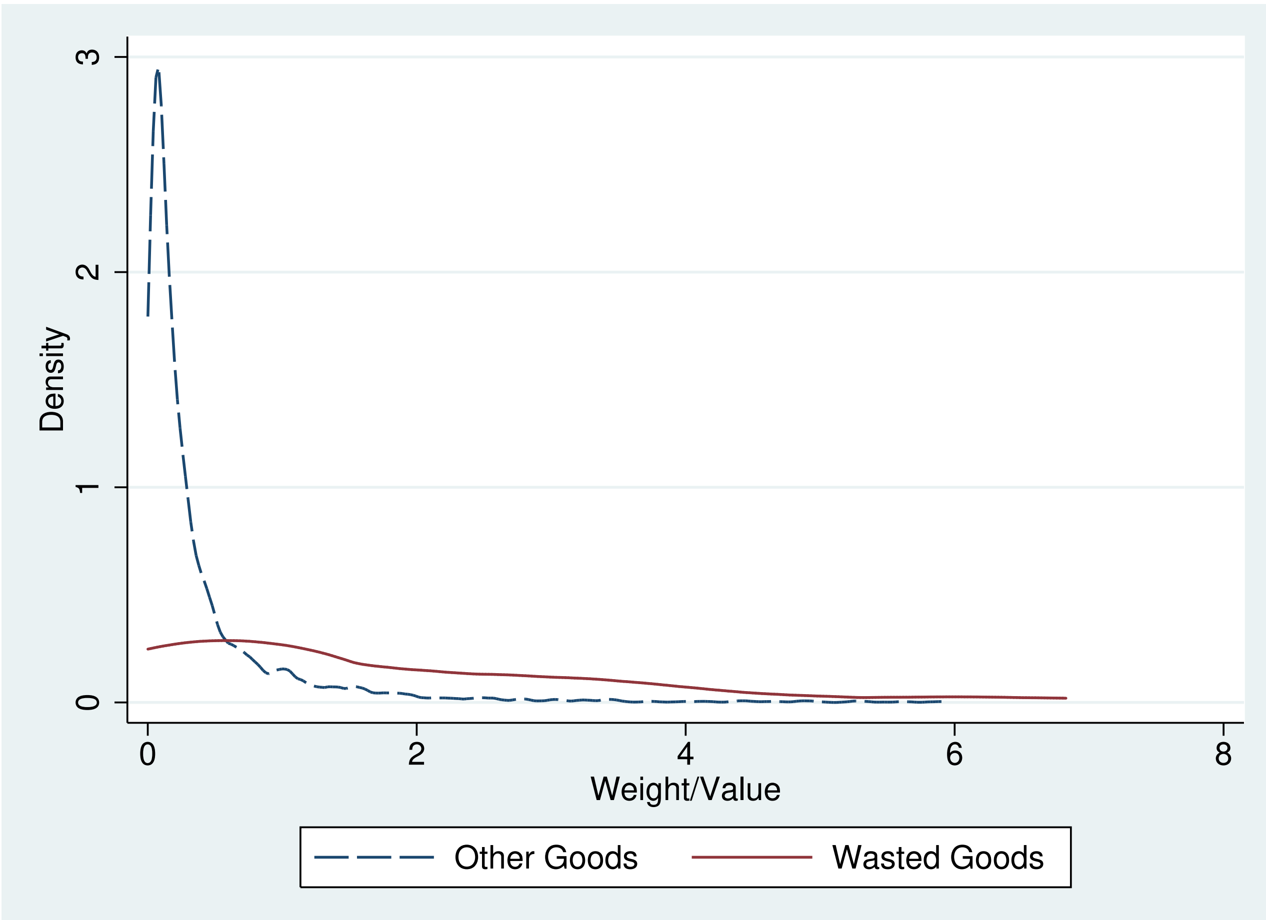
NOTE: This figure shows the ln(export) and ln(import) of each Chinese port in year 2006.

Figure 5: The Imbalance and Exchange rate of Mexico



NOTE: This figure shows the trade imbalance and exchange rate change of Mexico.

Figure 6: The Density of Weight to Value (kg/usd) Ratio



NOTE: This figure shows the density of the weight to value ratio.