Effects of Chinese Retaliatory Tariffs on Chinese Economy

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***Abstract*—During the 2016 presidential campaign, a consistent refrain from then-candidate Trump was to point to U.S. trade with China, and the agreements that enabled it, as primary cause of the loss of U.S. manufacturing jobs and intellectual property. He said China was responsible for "the greatest theft in the history of the world" and lambasted the U.S. trade deficit with China, which in 2016 stood at around $346 billion. The trade war caused economic pain on both sides and led to diversion of trade flows away from both China and the United States. This paper explores the effects of Chinese retaliatory tariffs on the Chinese economy during U.S and China trade war since 2018. Chinese retaliatory tariffs were almost wholly passed through into Chinese domestic prices, so that the entire incidence of the tariffs fell on Chinese consumers and importers, with no impact on the prices received by the U.S. exporters. The cumulative deadweight loss, a reduction in real income from the Chinese tariffs, is approximately $517 million in the whole year of 2018, with an additional cost of $6,321 million to Chinese consumers and importers in the form of tariff revenue transferred to the government.**

***Index Terms*—Trade war, Trump's policy, Chinese retaliatory tariffs, tariff revenue, deadweight loss.**

I. Introduction

The U.S. and China are in the middle of a large-scale "trade war," reversing the decade-long trend of multilateral tariff reductions within the framework of GATT and WTO. Over 2018 and 2019, China and the United States have imposed tariffs on more than $300 billions of goods. Further tariff hikes are actively considered in both countries. While the "trade war" grabbed newspaper headlines, there is not much rigorous economic analysis about its economic effects. We are witnessing such escalation of trade tensions in the global economy for the first time. Mary Amiti, Stephen J. Redding and David Weinstein(citation) are among the first to show how damaging are the tariffs imposed by Trump's administration for the U.S. economy. The authors estimate U.S. losses at $1.4 billion per month, a staggering figure which they argue far exceeds any conceivable losses stemming from China's claimed "unfair trading practices" and "violation of IP rights." They also suggest that other foreign countries that retaliated against the U.S. might have incurred similarly large losses. However, it is really true for China, a developing country that has quite a different industrial and market structure than the U.S. This question has motivated this paper to look into the effects of Chinese retaliatory tariffs on the Chinese own economy.

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What is the damage from China's own retaliatory tariffs? To answer this question, I borrowed the methodology developed by Amiti, Reading and Weinstain [1]. As with any tax or tariff, its cost is either born by domestic consumers or foreign producers besides national government tariff revenue and deadweight loss. They utilize a standard textbook model of trade tariffs and a straightforward regression framework to demonstrate that foreign export supplier, i.e., Chinese producer, are nearly perfectly elastic in the medium term, so that, ironically, all cost of Trump's administration tariffs are born by U.S. consumers and entail massive deadweight loss. Similarly, this paper uses conventional supply and demand model to explore if the same pattern holds for China.

This paper, first of all, makes a conjecture that Chinese imports are supplied perfectly elastically and so the U.S. has a horizontal export supply curve. To check its validity, Chinese import values and quantities from the U.S. are used to calculate the unit prices, the U.S. export prices, before tariffs are applied by dividing Chinese import values by quantities. Chinese import price that includes tariff can be obtained by multiply the U.S. export price by Chinese remedial duty rates. I plotted them in the graph and compare sectors that are subject to retaliatory tariffs and those that are not, as a first step. I interpret any price movements that I observe in protected sectors as evidence of tariff effects. Therefore, I have the conclusion that the imposition of the tariffs had very large relative impacts on the price of U.S. imports into China. In this case, Chinese consumers bear the bulk of Chinese retaliatory tariffs, so that there is no trade gain but only the welfare loss due to the distortion of domestic production and consumption and consumption decisions according to the conventional supply and demand model. Hence, I did a simple calculation to obtain welfare loss and tariff revenue. After the first step, I investigate this issue of tariff incidence in the regression framework. In the end, I found that China is in a situation that its tariff revenue is insufficient to compensate for the losses being born by the consumers of imports.

II. Overview of the Trump Administration's Trade War

Following China's WTO accession in 2001, significant gains from their trade liberalization and expanding bilateral markets are realized for both the United States and China in the past two decades. After President Trump's inauguration, however, the potential for a trade dispute has intensified. In 2018, the U.S. raised import tariffs and as U.S major trade partner, China retaliated, which ended decades of supporting free trade. A large literature studies takes stock on the

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economic effect of the US-China trade war. Because tariffs are the primary policy instrument of the 2018 trade war, I focus on tariffs in particular instead of on trade policy. To study the impacts of trade policy, one approach is to use theoretical models that tried to capture the effect of US-China via simulations (e.g., Meixin *et al*. (2018) [2], Itakura (2020) [3], Amiti *et al*. (2019) [4]). The departing point is Amiti, Redding and Weinstein paper [1], and they did a follow up on using another year of data including significant escalations in the trade war and showed that the response of import values to the tariffs increases in absolute magnitude over time, which is in line with my hypothesizes in this paper. Fajgelbaum *et al*. (2019) [5] supported this strand that there was no decrease in prices of imports targeted by tariffs, implying complete pass-through of tariffs to duty-inclusive prices. Of course, the US-China trade war naturally belongs to the literature on the effects of trade protection (e.g., Miaojie 2015 [6]).

In the empirical literature, a key challenge is to address the economic effect of the US-China trade war from the perspective of China. In quantitative models, the parametrization plays a key role, which is how trade volumes change with trade policy, and I use the observed changes in tariffs to estimate these trade elasticities. My paper is about estimating trade (supply) elasticities. I use the predictions of the model with a log-normal distribution dominate predictions arising with Pareto, which was inspired by Maria *et al*. 2020. Instead of estimating firm-level trade elasticity to tariffs, I utilize the estimation on HTS6 digit level import data in my paper to calculate the trade elasticities. There is a strand of the literature that discusses the impact of the US-China trade war on global value chains, suggesting that welfare losses are actually higher because the trade war disrupted value chains (e.g., Gern *et al*. (2019) [7], Cecilia Bellora & Lionel Fontagné, (2020) [8]). My findings support them by shown that the cumulative deadweight loss, which is also a reduction in real income, from the Chinese tariffs to be approximately $0.517 billion in the whole year of 2018, with an additional cost of $6.321 billion to domestic consumers and importers in the form of tariff revenue transferred to the government.

III. Conventional Price Impacts: Data

Chinese retaliated tariffs had an immediate effect on prices in Chinese economy. To obtain a clear sense of how tariffs are being passed through into domestic prices, I can observe how the prices paid by Chinese importers changes. EPS China data reports the foreign export value and quantities, i.e., the values and quantities of imports by source country at the 8-digit level of harmonized tariff system (HTS10 data). It presents monthly statistics of worldwide import and export of 148,000 kinds of goods with HS8 digits between China and other 200 more countries. I can compute the unit value at a very disaggregated level by dividing the import values by the quantities. Importantly, computed before tariffs are applied, the unit values correspond to foreign export prices. I compute tariff-inclusive import prices when we multiply these unit values by the duty rates available from the Ministry of Finance of the People's Republic of China.

I can have the first hint of what has been happening to the Chinese economy as a result of the Chinese retaliated tariffs from these tariff-inclusive prices. If we denote the unit value (price) of an HTS6 good i in month t by p_{it}, 12-month relative change in price for that good as

$$\hat{p}_{it} \equiv (p_{it}/p_{i,t-12}) \tag{1}$$

To avoid seasonality, we can compute the 12-month relative changes in the unit value. Letting w denote the set of HTS6-country varieties affected by a tariff change, for each wave we compute a price index as following weighted average of these price relatives:

$$\hat{p}_{wt} \equiv \prod_{i \in w} (\hat{p}_{it})^{s_i^w} \tag{2}$$

where s_i^w is the logarithmic mean of the import shares from the United State in sector i in the relevant months from 2015 and 2018 among all HTS6 imports in the categories affected by tariff wave w.

For the constant elasticity of substitution (CES) demand system, to ensure that we weight the price change for each good according to its relative importance in imports, we use the logarithmic mean import shares, which makes this price index corresponds to Sato-Vartia price index. Then, we can have price indexes as proportional changes by subtracting one ($\hat{p}_{wt} - 1$) .Setting the initial month, the month before the tariffs were imposed, as month zero, I compare these price changes relative to month zero. Next, subtracting the average price increase for each wave in month zero from all observations, I eliminate secular trends in price increases, which makes goods in all waves have a price increase of zero in month zero.

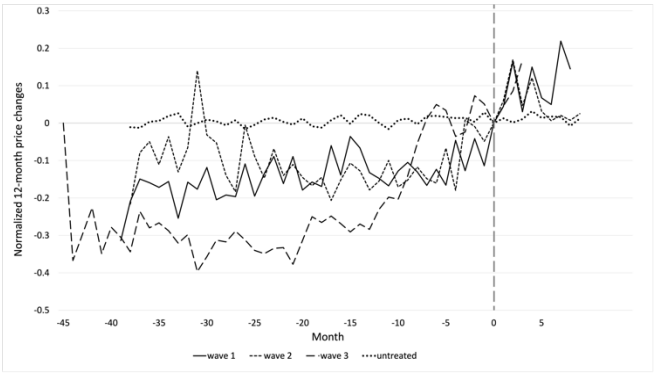

Fig. 1. 12-month proportional change in import price by tariff wave.

Fig. 1 shows the evolution of these prices for the three waves of tariffs. From this figure, a number of important facts. First, as the price for sectors not subject to tariffs are fairly flat, it suggests that whatever price movements I observe in protected sectors are likely due to the tariffs. Second, I see an increase change in prices of goods that were subject to tariffs, with unit values rising from 3 to 15 percent in the wake of the tariffs. Given that these numbers are comparable in magnitude to tariffs that were applied, it suggests that much of the tariffs were passed on to Chinese importers and consumers. Clearly, importers began feeling the full effects of the tariffs in the first month that they were implemented. Finally, although there seems to be some pre-tend in prices for the goods hit in waves 3, there does not appear to be a pre-tend for the goods in any of the other

waves. Therefore, it still indicates that the price increases that I observe are likely due to the face that much of the tariffs have been passed on to importers.

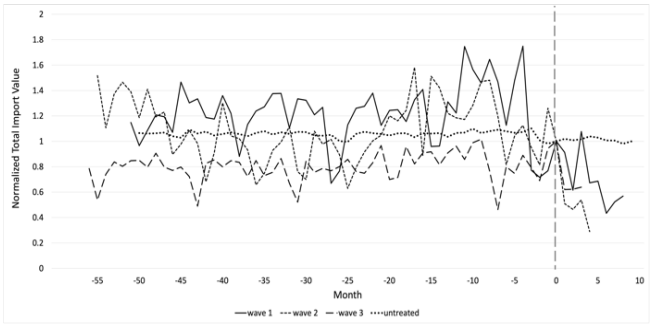

Fig. 2. Total import values by tariff wave.

Fig. 2 repeats the same plot using the total value of imports as the variable in place of unit values. In this plot, I normalize the import value in month zero to be one for all goods, so the import values are all relative to imports in the last month before the tariffs were applied. From the figure we can see that there was an apparent surge in imports in the wave 1 and wave 2 products just before implementation and small surges for the goods in the other sectors. It appears that on average their import levels were rising a little faster that for unaffected goods in months prior to the imposition of the tariffs. However, a steep decline in import value after the imposition of the tariffs can be observed. The drops in imports following the imposition of the tariffs are quite large in magnitude. I can see that import values falling 40 to 70 percent after the imposition of the tariffs. This drop is particularly striking given that the imports of unaffected sector stay still, which could in part reflect some import substitution from affected to unaffected products in response to tariff changes. Above all, these results suggest that the imposition of the tariffs had very large relative impacts on the amount of imports for affected sectors.

IV. Conventional Price Impacts: Theory

Considering the standard model of import tariffs show in Fig. 3, the patterns I observed can be understand. The quantity of home imports (m) is the horizontal axis and import price (p) and foreign exporter prices (p^*) are the vertical axis. As the prices increase, the foreign export supply curve (S^*) rises, which shows that higher prices induce foreign producers to increase production and foreign consumers to decrease consumption. Contractedly, as the prices increase, home import demand (D) falls, which shows that higher prices reduce demand by domestic consumers and increase production by domestic firms. Without the tariffs, markets will be clear with an equilibrium price ($p_0 = p_0^*$), which equalizes import demand and export supply when imports equal m_0.

In this simple framework, an *ad valorem* tariff on imports of τ raises the cost of the imported good in the domestic market from p^* to $p^*(1+\tau)$. This higher price results in that domestic consumers cut back demand for imports to m_1. At this import level, there is a wedge between the price charged by foreign producers (p_1^*) and the prices paid by domestic consumers (p_1) that equals the per-unit tariffs being collected ($p_1^*\tau$). Home consumers lose regions $A+B$, with A reflecting the higher prices paid on the imports purchased, and the triangular region B capturing the deadweight welfare loss (reduction in real income) from the distortion of domestic production and consumption decisions. The home government gains rectangular region $A+C$ in tariff revenue. Rectangle A represents a transfer from consumers to government, like the amount of a tariff's cost are forced to bear. Therefore, whether the tariff benefits the country as a whole depends on the sign of $C-B$. This amount can be thought of as the difference between the gain in a country's "terms of trade", for example, its ability to extract rents from foreign producers by forcing them to drive their prices down in order to continue exporting to the home market, and the deadweight welfare loss given by B. In this setup, the foreign country loses because an amount of their producer surplus equal to C is transferred in the form of tariff revenue to the home government, while the triangular region D constitute the deadweight welfare loss from the distortion of foreign production and consumption decisions at the same time.

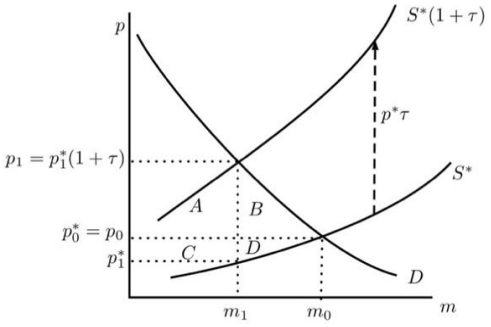

Fig. 3. Impact of a tariff on prices.

The Fig. 4 is an important special case of the impact of tariffs on prices and welfare comes when imports are supplied perfectly elastically and so the foreign country has a horizontal export supply curve. In this case, the imposition of a foreign tariff will have no impact on foreign prices, this means that the home country will necessarily lose because region C is zero and hence there is no terms of trade gain, leaving home only with the welfare loss due to the distortion of domestic production and consumption decisions. To simplify the exposition, I have undertaken all of this analysis starting from zero tariffs, which means free trade, a directly analogous analysis goes through starting from an initial positive value for tariffs.

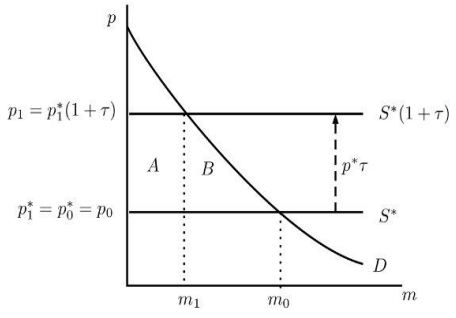

Fig. 4. Impact of a tariff on prices with perfectly elastic export supply.

V. Estimating Price and Welfare Losses

In terms of short-run impacts, whether the price received by foreign exporters (p_1^*) falls in response to a tariff is a critical question. For China, a necessary condition to gain from these tariffs in the classical model is that foreign exporters absorb some of the tariff costs, which in results that they are not fully born by home consumers (Two Figures above). Therefore, it's important to understand how the price received by foreign exporters moves in response to a tariff increase. To test this effect, I run the regression on the change in the log import unit value, which measured without including the tariff change, over a twelve-month period on the change in one plus the applied tariff on imports over the same period (i.e., $\ln(p_t^*/p_{t-12}^*)$ over $\ln[(1+\tau_t)/(1+\tau_{t-12})]$). I treat Chinese retailed tariffs as exogenous and assume that they are uncorrelated with unobserved shocks to unit values, then I know that the estimated coefficient in this regression captures the impact of the tariffs on the prices received by foreign exporters.

TABLE I: Impacts of Chinses Retaliatory Tariffs on Importing

	(1)	(2)	(3)	(4)	(5)
	$\Delta\ln(p_{it})$	$\Delta\ln(m_{it})$	$\Delta\ln(m_{it})$	$\Delta\ln(p_{it}*m_{it})$	$\Delta\ln(p_{it}*m_{it})$
$\Delta\ln(1+Tariff_{it})$	-0.068	-2.702	-6.261	-2.883	-6.636
	(0.929)	(1.548)	(2.899)	(1.316)	(3.684)
N	129,288	129,288	129,288	129,288	129,288
R^2	4.93919E-07	0.00028	0.00042	0.00044	0.00029

Note: Observations are at the HTS6-country-month level for the period January 2017 to December 2018. Variables are in 12 month log change. Standard errors are clustered at the HTS 8-digit level. All columns include HTS10 product fixed effects and country *x* year fixed effects. The dependent variable in column (1) is the log change of prices (before U.S. duties are applied) charged by foreign exporters. The dependent variables in column (2) and (3) are the log change and the change in the inverse hyperbolic sine of U.S. import quantities. The dependent variables in column (5) and (6) are the log change and the change in the inverse hyperbolic sine of U.S. import values. We use the inverse of the hyperbolic sine transformation [log(*x*+(*x*2+1)0.5)] to be able to estimate changes when import quantities or values are zero in t or *t*–12.

The results from this regression are shown in Column (1) of Table I. An estimate of tariffs on unit value is -0.068. It suggests that little-to-no impact on the prices received by foreign exporters is caused by tariff changes. What is more, it also suggests that the Chinese retaliatory tariffs have been almost entirely passed through into domestic prices and leaved exporter prices unchanged. These findings are consistent from a different estimation methodology in Fajgelbaum, Goldberg, Kenedy and Khandelwal (2018) [5]. Therefore, I assume that in the short-run, the supply elasticity of exports is close to perfectly elastic as portrayed above. It means that almost all of the cost of the 2018 Chinese retaliatory tariffs has been born so far by Chinese consumers and importers.

In Column (2) of Table I, I change the dependent variable to the 12-month change in imported quantities. At the same time, I assume that the Chinese retaliatory tariffs are exogenous, and I use the finding that foreign exporters received no offsetting change in the prices. Then, I can interpret that the estimated coefficient on the tariff change as the import demand elasticity. A one percent increase in tariffs will results in a 2.7 percent decrease in imports. This decline is much smaller than the declines we observed in Figure above. It is because that prohibitive tariffs will make zero import quantities which are dropped from the regression. To fix this problem, I rerun the regression replacing the log of the quantity change with the inverse hyperbolic sine, which is defined for cases in which import quantities are zero. Column (3) is the results from this exercise. From this specification, a substantially higher estimate of the impact of tariffs on trade flows is resulted by including the tread flows that go to zero. A one percentage point increase in tariffs is associated with a six percentage point fall in import quantities.

In Columns (4) and (5) of Table I, I repeat this exercise using import values as the dependent variable. The import values are again measured without including the tariff. I find quantitative similar results for values as quantities, which is consistent with earlier finding of no discernible effect on the prices received by foreign exporters.

I use these regression estimates to undertake a simple calculation of the reduction in real income for Chinese consumers as a result of these tariffs. I made the assumption that the import demand curve has a constant slope and approximate region B by a triangle. Under this assumption, the height of this triangle is given by $p_1^*\tau$ and its base is given by $m_0 - m_1$. The deadweight loss is then given by $\frac{1}{2}p_1^*\tau(m_0-m_1) = \frac{1}{2}(p_1^*m_1)\tau(m_0-m_1)/m_1$,
where $p_1^*m_1$ is simply the value of imports after the imposition of tariffs, τ is the tariff rate, and $(m_0-m_1)/m_1$ is the percentage change in the quantity of imports due to the imposition of the tariffs. As I observe both the tariff rate and the value of imports after the tariff, all I need to implement this calculation is an estimate of the percentage change in the quantity of imports.

In principle, the deadweight welfare loss is as $\frac{1}{2}(p_1^*m_0)\tau\beta\ln(\frac{1+\tau_t}{1+\tau_{t-12}})$,
where β is the coefficient in the quantity regression, which would be correct even if $m_1 = 0$, but it is not practical to work with this formulation because trade data often has sectors in which quantities are not reported, which means that m_0 and m_1 are missing. Therefore, I use another approach to obtaining this estimate. I use the quantity regressions we ran earlier. In these regressions, negative one times the coefficient in the quantity regression (β) multiplied by the change in tariff $\ln(\frac{1+\tau_t}{1+\tau_{t-12}})$ tells the percentage change in imports due to the imposition of the tariff and $-\beta\ln(\frac{1+\tau_t}{1+\tau_{t-12}}) = -\ln(m_1/m_0) \approx (m_0-m_1)/m_1$. Thus, the deadweight loss associated with the tariffs is given by $-\frac{1}{2}(p_1^*m_1)\tau\beta\ln(\frac{1+\tau_t}{1+\tau_{t-12}})$.

In Table II, I compute the value of these deadweight losses for each month of 2018 and compare them to the value of the tariff revenue raised. As there's no effect of the tariffs on the prices received by foreign exporters, this tariff revenue is a pure transfer from domestic consumers to the government. I assume that Chinese government uses the tariff revenue to generate social welfare benefits equal to the tax burden, the reduction in welfare from the tariff for the economy as a whole is captured by the deadweight loss, while the cost to the consumer and importer equals the sum of the deadweight welfare loss and the tariff revenue transferred to the government. These losses did not steadily mount over the year, as each wave of tariffs changed affected products. Some affected products in wave one became unaffected products in wave two or three, therefore, there is a zero in deadweight welfare loss in August. By September, these deadweight welfare losses reached $0.118 billion per month. Over the course of the first year of the tariff war, the cumulative deadweight losses amounted to $0.517 billion. If I was instead to assume that Chinese government cannot generate social welfare benefits equal to the tax payments they receive, the losses to taxpayers could rise by as much as the full value of their tariff payments: $6.321 billion through December.

TABLE II: DEADWEIGHT WELFARE LOSS AND TARIFF REVENUE

Month	Deadweight Loss	Tariff Revenue	Total Cost to Importers
Jan	0.002	0.031	0.033
Feb	0.001	0.016	0.017
Mar	0.002	0.026	0.028
Apr	0.32	0.538	0.571
May	0.34	0.549	0.584
Jun	0.022	0.359	0.382
Jul	0.047	0.746	0.794
Aug	0	0.881	0.881
Sep	0.118	1.020	1.139
Oct	0.078	0.724	0.803
Nov	0.109	0.936	1.046
Dec	0.066	0.639	0.706
Total	0.517	6.465	6.982

Note: Deadweight welfare loss and tariff revenue measured in current prices in billions of dollars; see the text for the discussion of these calculations.

There is one potential concern about this approach of using the coefficient β to estimate the percentage change in the quantity of imports due to the tariff is that this coefficient does not capture any effect of the tariffs on imports that is caused by the product category. Therefore, I set up 98 dummy variables based on the first two code of HTS6 and then add them in the regression I have done above. It tunes out that there is little change of the coefficient β. Hence, I can ignore the influence by the product category changes in the trade war.

VI. CONCLUSION

Whether there are real income losses from import protection is a long argument for economists. Using evidence date from the 2018 trade war, empirical support for these arguments are found. The cumulative deadweight loss, which is also reduction in real income, from the Chinese tariffs to be approximately $0.517 billion in the whole year of 2018, with an additional cost of $6.321 billion to domestic consumers and importers in the form of tariff revenue transferred to the government. The deadweight welfare loss alone reached $0.118 billion per month by September of 2018. Chinese retaliatory tariffs were almost completely passed through into Chinese domestic prices, so that the entire incidence of the tariffs fell on domestic consumers and importers up to now, with no impact so far on the prices received by foreign exporters.

While concerning my estimates omit other potentially large costs such as policy uncertainty. Though the effects of trade policy uncertainty are beyond the scope of this study, they are likely to be considerable, and may be reflected on the substantial falls in U.S and Chinese equity markets around the time of the most important trade policy announcements.

CONFLICT OF INTEREST

The author declares no conflict of interest.

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