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The impact of US tariffs against China on US imports: evidence for trade diversion?

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Abstract

In this paper we provide evidence on the existence of short-run trade diversion effects towards third countries as a consequence of tariff shocks. We exploit sudden policy changes in the context of the trade dispute between the US and China. Based on a data set covering monthly product-level information on US imports from 30 countries for the period January 2016 until May 2019, we employ a difference-in-differences estimation framework. Doing so, we (1) can confirm previous findings showing a strong negative direct effect of US tariffs on US imports from China, but (2) do not find evidence for significant short-run trade diversion effects towards third countries. This latter finding holds for product and country subgroups as well as for a variety of robustness checks.

Keywords: Tariffs; US imports; trade diversion; product-level data; difference-in-differences

JEL classification: F13, F14, F61.

Non-technical summary

Research Question

In light of the recent increase of protectionist policies, such as those in the context of the trade dispute between China and the US, interest in quantifying their effects has risen. Besides assessing the direct implications for the trading partners involved in the trade conflict, both researchers and policymakers are also interested in the effects on third countries and the question of whether other countries might even benefit from such actions due to trade diversion effects, replacing the targeted country's exports with own exports. While simulation results suggest that such effects may materialise even within the first year, less is known empirically about the importance of trade diversion effects in the short run.

Contribution

In this paper, we provide ex-post evidence on the short-run effects of the tariffs imposed in the context of the US-China trade conflict with a particular focus on trade diversion effects. To this end, we create a database covering monthly product-level information on US imports from 30 countries for the period January 2016 until May 2019. Importantly, the tariffs imposed on China by the current US administration provide an interesting case for evaluating the effects of trade policies, which we exploit by employing a difference-in-differences estimation framework.

Results

The empirical analysis first of all shows that the tariffs imposed in 2018 had strong negative direct effects on US imports of targeted products from China. In particular, since the tariffs have been implemented, US imports of affected products have grown on average by 30 pp less compared to unaffected products. The results further suggest that trade diversion effects have not been a widespread phenomenon so far, since we do not find evidence for significant trade diversion effects towards third countries in broader estimation samples. Instead, such effects seem to be confined to imports of specific products and from a small number of countries. We therefore conjecture that it may take more time for firms to adjust to the new environment and to find alternative suppliers abroad or relocate production facilities.

1 Introduction

In light of the trade dispute between China and the US, the interest in quantifying the effects of protectionist policies has increased. Besides assessing the direct implications for the trading partners involved, both researchers and policymakers are also interested in the effects on third countries and the question of whether other countries might even benefit from such actions. Indeed, model-based analyses tend to find noticeable positive spillover effects for countries not directly affected by the tariff hikes, which are usually due to trade diversion, i.e. due to those countries' exports to the US replacing US imports from China.[1] For example, using general equilibrium models, Balistreri, Böhringer, and Rutherford (2018) and Bellora and Fontagne (2019) report positive long-run effects for a number of third markets in relation to the trade conflict between the US and China. Moreover, simulation results presented by Bolt, Mavromatis, and van Wijnbergen (2019) and the IMF (2018) suggest that such effects may even occur in the short-run. However, while recent empirical studies already provide evidence for strong direct effects of the US tariffs on imports from China (e.g. Amiti, Redding, and Weinstein, 2019; Fajgelbaum, Goldberg, Khandelwal, and Kennedy, 2020), less is known empirically about potential short-run trade diversion effects.

Trade diversion effects are usually investigated empirically in the context of free trade agreements (FTAs), using gravity style estimation frameworks which tend to feature a long-term perspective.[2] Among such studies, the importance of trade diversion effects varies. For example, in an extensive analysis of trade creation and trade diversion effects of FTAs, Magee (2008) finds only limited evidence for the latter. On the other hand, estimation results by Dai, Yotov, and Zylkin (2014) suggest that FTAs indeed divert trade away from non-participating countries, while they also indicate that such effects are generally stronger for domestic producers. Other recent studies exploit temporary trade policy measures or economic sanctions in order to estimate trade diversion effects from monthly data using a reduced-form difference-in-differences setup (e.g., Carter and Steinbach, 2018; Hinz and Monastyrenko, 2019).[3] While these studies

[1]Some studies also consider other sources of spillover effects such as adverse confidence or uncertainty shocks triggered by the tariffs. In this paper, we focus on the analysis of trade diversion effects.

[2]The concept of trade diversion dates back to Viner (1950), who showed that discriminatory trade policies (such as the formation of free trade agreements) imply that trade is diverted away from more efficient exporters, which are unaffected by the discriminatory policy, to less efficient ones which benefit from the policy change.

[3]Flaaen, Hortaçsu, and Tintelnot (2019) provide another recent study that investigates trade policy measures. The study finds only limited price effects of discriminatory tariffs (i.e., anti-dumping duties) imposed by the US on washing machines imports from individual countries, while tariffs on washing machines imposed against a wide set of countries had significant price effects, which is consistent with relocation of production in response to

present evidence for trade diversion effects, the products affected by these policy changes are typically rather homogeneous goods (such as agricultural products) which may be relatively easy to substitute on the world market also in the short-run. This may be different for the US tariffs imposed against China which cover a broad set of processed intermediate goods.

Against this background, in this paper, we provide ex post evidence on short-run trade diversion effects towards third countries in the context of the trade conflict between the US and China.[4] To this end, we create a database covering monthly product-level information on US imports from 30 countries for the period January 2016 until May 2019. As noted by Amiti et al. (2019), the tariffs imposed by the current US administration provide a natural experiment for evaluating the effects of trade policies, which we exploit by employing a reduced-form difference-in-differences estimation framework to this dataset. To be precise, we consider as evidence for trade diversion if the US increases its imports from third markets of products affected by the newly introduced tariffs (when sourced from China) relative to imports of products unaffected by these tariffs. Moreover, we also estimate a triple DiD setup in the spirit of Romalis (2007), Russ and Swenson (2019) or Frazer and Biesebroeck (2010), which implies that we further account for differences in US imports from non-Chinese third markets to those of the Euro Area from the same set of countries.

Doing so, we (1) can confirm previous findings showing a strong negative direct effect of US tariffs on US imports from China, but (2) do not find evidence for significant trade diversion effects towards third countries. This latter finding holds for product and country subgroups as well as for a variety of robustness checks. The results suggest that, while the trade-destroying direct effect of tariffs has an immediate effect, the trade-creating diversion effect seems to take more time to materialize. Reasons for this lack of trade diversion effects in the short-run could be related to affected products properties, the market power of Chinese producers, spillovers along value chains and domestic substitution effects. In the rest of the paper, we first describe the data used in this paper and present some descriptive evidence in Section 2. We then sketch the empirical framework in Section 3 and present the main results in Section 4, including a series

discriminatory tariffs. Hence, the study provides evidence for trade diversion in the case of a rather standardised consumer good. The production relocation was facilitated by the fact that some of the producers affected by the discriminatory tariffs had also production plants in countries not affected by these tariffs (e.g., Samsung and LG, which had plants in Korea that were affected by the anti-dumping tariffs, and also plants in other Asian countries not affected by these tariffs.)

[4] We do not analyse whether Chinese exports formerly going to the US might now be diverted to third countries. This mechanism is sometimes referred to as trade deflection in the literature and was, for example, analysed by Bown and Crowley (2007) in the context of US anti-dumping duties against Japan.

of robustness checks and a discussion of the results. The last section concludes.

2 Data and Descriptive Evidence

For our empirical analysis, we source monthly US product-level import data for the top 30 US trade partners from the US CENSUS (see Table 1), which together accounted for around 90% of total US import values in 2016. The data cover the period from January 2016 to May 2019 and contain information on import values (excluding tariff duties) and import quantities. Information on products targeted by new tariffs is obtained from the US Trade Representative and the Peterson Institute for International Economics. The analysis is conducted at the HS 6-digit product level. We do so, even though the US applies tariffs to 8-digit product codes, for two main reasons. First, HS product codes are subject to revisions over time, and the UN publishes correspondence tables that link product codes over time at the 6-digit level only. Second, 8-digit product codes identify very specific products, which may imply that trade diversion effects are underestimated if the affected HS 8-digit product is substituted by imports of products from other countries that do not share the exact same 8 digits, but nevertheless belong to the same 6-digit product family.[5] Also note that we exclude products from the sample on which the US imposed tariffs against a variety of countries at the beginning of 2018, since trade diversion effects may only materialise in the case of discriminatory tariffs.[6]

To get a sense of the trade policy measures taken by the Trump administration in the third quarter of 2018, Figure B1 provides an overview of the products affected by new tariffs. It shows that the newly introduced tariffs affected around 50 percent of US imports from China and that the tariffs are spread across all types of products, with a focus on intermediate goods (as compared to capital or consumer goods). In addition, for a first impression of the data and the observed trade patterns, in Table 1 we present the growth rates of imports of affected and unaffected products observed from October 2018 to May 2019 (i.e. after the tariffs went into effect) and from October 2017 to May 2018 (i.e. before the tariffs went into effect) for the countries covered. The table shows that US imports from China (CHN) of affected products grew at deeply negative rates after the tariffs went into effect, while experiencing very positive growth rates in the period before. At the same time, growth of unaffected products also slowed,

[5] In the appendix, we show that our results are not driven by the choice of aggregation since they are similar (both qualitatively and quantitatively) when performing the analysis at the 10-digit or 4-digit product level.

[6] This implies that we remove steel and aluminium products as well as washing machines and solar panel from the sample. We additionally drop energy related products from the sample (i.e. HS 4-digit products 2709-2716).

but to a significantly smaller extent than for the affected ones, which suggests that the tariffs had marked negative effects on US imports from China. By contrast, Table 1 offers only limited evidence for trade diversion effects towards third countries. For example, while US imports from Vietnam (VNM) of affected products have increased significantly since the tariffs went into effect, this holds even more for unaffected products, suggesting that other factors are currently driving the increase in Vietnamese exports to the US more generally. Similarly, there is a large positive growth rate for US imports from Mexico (MEX) of affected products since the tariffs have been in place; but because growth of these products was already strong before the tariffs were implemented, it does not seem appropriate to attribute this growth rate fully to the tariffs. While a simple inspection of this kind suggests that trade diversion may have occurred for a few individual countries such as Brazil (BRA), Indonesia (IDN), Korea (KOR) and Taiwan (TWN), it also indicates that the aggregate effects (Total excluding CHN) of trade diversion are probably limited so far. The sometimes large growth rates of US imports from individual countries depicted in Table 1 further suggest the need to control for country- and product-specific developments in an analysis of trade diversion.

3 Empirical Framework

To investigate this question more rigorously and to control for other factors which potentially affect a country's exports to the US, in a next step we employ a reduced-form difference-in-differences setup to estimate the average effect of the newly introduced tariffs on targeted product categories relative to unaffected products. More specifically, we estimate the following model:

$$\Delta \ln IM^{US}_{p,i,t} = \beta \tau^{CN}_{p,t} + \gamma_{it} + \gamma_{ip} + \gamma_{st} + \epsilon_{p,i,t}, \quad (1)$$

where p denotes a product, i indicates the exporting country, and t is the time period. Δ indicates that the model is estimated in 12-months differences to account for seasonality issues. $\Delta \ln IM^{US}_{p,i,t}$ thus refers to year-on-year growth rates of the value of product p of the US imports from country i at time t.[7] $\tau^{CN}_{p,t}$ is a dummy variable that switches to one in the month of

[7]We only perform a rather mild data cleaning. In particular, we winsorise the distribution of the dependent variable in the case of observations deviating from the median by more than three times the standard deviation. Below, we show that our results are also robust to more rigorous cleaning.

Table 1: List of countries and growth in imports of affected and unaffected products

	Targeted Products		Unaffected Products	
Country	Oct-17 to May-18	Oct-18 to May-19	Oct-17 to May-18	Oct-18 to May-19
AUT	20.8	13.1	-8.4	1.0
BEL	9.2	11.8	7.7	22.8
BRA	4.7	11.0	4.8	-5.2
CAN	3.4	0.6	0.7	3.2
CHE	4.4	6.9	15.3	14.0
CHL	20.7	-10.8	2.1	-5.3
CHN	12.5	-11.3	8.0	1.3
COL	-28.8	-0.6	0.5	9.5
DEU	8.5	0.4	19.2	4.8
ESP	18.0	0.6	42.1	-28.8
FRA	10.2	13.0	22.5	5.2
GBR	7.2	12.2	7.9	3.3
IDN	0.0	6.0	2.4	-2.2
IND	28.4	14.3	2.8	6.1
IRL	-12.7	5.2	10.8	13.4
ISR	4.1	5.4	-4.9	-5.8
ITA	13.1	3.2	19.6	4.6
JPN	2.9	3.8	8.4	13.9
KOR	2.7	15.6	12.3	-1.5
MEX	9.1	8.5	3.3	5.4
MYS	8.6	-2.6	9.7	-10.6
NLD	24.0	9.1	26.7	82.6
PHL	10.1	8.0	6.1	16.4
RUS	19.8	27.3	3.1	-4.1
SAU	53.3	-13.7	-14.0	-15.8
SGP	14.4	-8.5	60.4	27.3
THA	6.8	3.0	5.5	1.5
TWN	6.5	25.7	10.6	2.0
VEN	7.2	-7.3	-2.5	-25.4
VNM	4.2	23.8	4.7	28.2
Total excl. CHN	7.1	6.2	9.5	7.0

2018 in which the US levied a new tariff on product p imported from China.[8] We consider the USD 34 bn, 16 bn, and 200 bn tariff lists implemented by the US in July, August and September 2018. γ_{it} and γ_{ip} are country-time and country-product fixed effects, respectively. The former controls for country-specific aggregate shocks, for instance, in relation to exchange rate movements[9], the latter filters out the average country-product specific growth rate, which can be important if affected and unaffected products are subject to different trends. γ_{ip} also control for other time-constant country-product specific factors, such as unchanged trade policies over the sample period. Finally, γ_{st} account for sector-specific shocks that are common across countries, for example, in relation to price fluctuations of broadly defined commodities.[10] Note that including γ_{st} also implies that we are estimating the effect within sector-years. Standard errors are clustered at the HS 6-digit product level.

We use equation 1 to estimate both the direct effect of the tariffs and the indirect effects in terms of trade diversion. For the direct effect, we restrict the sample to US imports from China, while for the indirect effect, we consider US imports from third markets to assess whether those were impacted by US tariffs imposed against China. This modelling setup is reminiscent of the approaches by Amiti et al. (2019) and Fajgelbaum et al. (2020) who investigate the direct effects of the tariffs on imports from China.[11] In either case, the coefficient of interest (β) informs about the average effect of the newly introduced US tariffs on affected product categories *relative* to unaffected product categories. Hence, we infer trade diversion effects from the relative change in US imports of affected and unaffected products from countries other than China.

In the following analysis, we consider the tariffs that the US implemented against China in the third quarter of 2018 as exogenous. First of all, as also emphasised by Amiti et al. (2019), Trump's election came as a surprise to most observers, suggesting that these tariffs were hardly anticipated in most sectors of the economy. Moreover, the tariffs have gone into effect shortly after the report on unfair trade practices has been published end of March 2018 and the lists of affected products were released even after this date. Hence, firms did not have much time to prepare for the new tariffs. Second, we conduct a number of checks to ensure that affected and

[8]Results based on a specification with actual changes in tariff rates, as opposed to a treatment indicator, are given in the Appendix.

[9]Note that recent evidence suggests that the pass-through of tariffs to import prices is significantly higher as compared to that of exchange rate movements (e.g. Cavallo, Gopinath, Neiman, and Tang, 2019; Fitzgerald and Haller, 2018).

[10]The sector s here refers to HS 2-digit products.

[11]Carter and Steinbach (2018) and Hinz and Monastyrenko (2019) employ comparable setups in the context of trade diversion effects.

unaffected products had not displayed diverging developments already before the tariffs have gone into effect; i.e., to ensure that results are not driven by pre-existing trends. These tests support the notion that the tariffs provide a natural experiment for evaluating the effects of tariff hikes on economic activity.

4 Econometric Results

4.1 Main Findings

Table 2 presents our main results. First, in line with other studies (e.g. Amiti et al., 2019; Fajgelbaum et al., 2020), we find that the tariffs imposed by the US against China in 2018 on average had strong negative direct effects on US imports of targeted products from China. According to our baseline specification, which includes the full set of fixed effects, the growth rate of imports from China of products targeted by new tariffs in 2018 was on average more than 30 pp lower than that of unaffected products (column 1). Note that this result is not driven by the choice of fixed effects structure, since we obtain a coefficient of similar magnitude when estimating a more parsimoniously specified model (column 2). Similarly, this finding is robust to a placebo-type regression shown in column 3, where we estimate the model using data for the year 2017 only (i.e. a time before any tariff was implemented) and move the tariff events one year ahead. We also run weighted regressions to see whether results change when allowing larger trade flows to weigh more in the regressions, with weights referring to 12-months lagged import values. While the coefficient of interest decreases to around 20 pp, suggesting that smaller trade flows have seen larger declines in their growth rates, it remains highly statistically significant. Overall, we can thus conclude that the tariffs strongly impacted US imports of affected products from China.

Table 2: Main results: Direct and diversion effects

	Direct Effect				Indirect Effect			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Tariff Dummy	-0.319***	-0.318***	-0.034	-0.221***	-0.006	-0.006	0.008	-0.019
	(0.030)	(0.020)	(0.028)	(0.074)	(0.011)	(0.007)	(0.010)	(0.019)
Observations	98,668	98,895	40,518	98,668	1,069,201	1,074,874	427,241	1,069,201
R^2	0.143	0.021	0.246	0.453	0.098	0.003	0.242	0.392
Exporter-time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Exporter-product FE	Yes	No	Yes	Yes	Yes	No	Yes	Yes
Sector-time FE	Yes	No	Yes	Yes	Yes	No	Yes	Yes
Specificaton			Placebo	Weighted			Placebo	Weighted

NOTES: The dependent variable is the monthly year-on-year growth rate of US imports from China (columns 1-4) or from other countries (columns 5-8). Tariff Dummy switches to one if a product is affected by a new US tariff when imported from China. Regressions without country-product fixed effects contain a dummy variable which indicates whether a product is affected by new tariffs. Placebo regressions imply that import growth rates for the year 2017 are regressed on the tariff dummy moved one year ahead. In weighted regressions, each obser-vations is weighted according to the 12 months lagged import value. Clustered standard errors (at the HS6-digit product level) in parentheses: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Turning to trade diversion effects in the remaining columns of Table 2, we find no evidence that such effects have occurred on a broad basis. In particular, the coefficient of interest is estimated to be very close to zero and statistically insignificant, irrespective of the chosen fixed effects structure and the weighting scheme applied. Thus, while the trade-destroying direct effect of tariffs seems to have an immediate effect, the trade-creating diversion effect appears to take more time.

This latter point is also supported by Figure 1 where we plot the average treatment effects by quarter over time.[12] While the negative impact on imports from China increases in strength from quarter to quarter, there is no such trend for the diversion effect, i.e there is no evidence, at least in our observation period, that diversion effects increased in significance over time.

It is of course also possible that trade diversion effects are confined to certain products or geographical regions and therefore difficult to detect in a sample comprising many diverse goods and trading partners. In Table 3, we thus present results from a series of regressions using various subsamples. On the one hand, we split the sample along the product dimension and estimate the model separately for intermediate and final goods (columns 1 and 2). On the other hand, we run regressions for certain geographical regions (columns 3 to 7). However, in neither case do we obtain positive and statistically significant coefficients, suggesting that also at this level of aggregation trade diversion is not an important phenomenon.[13]

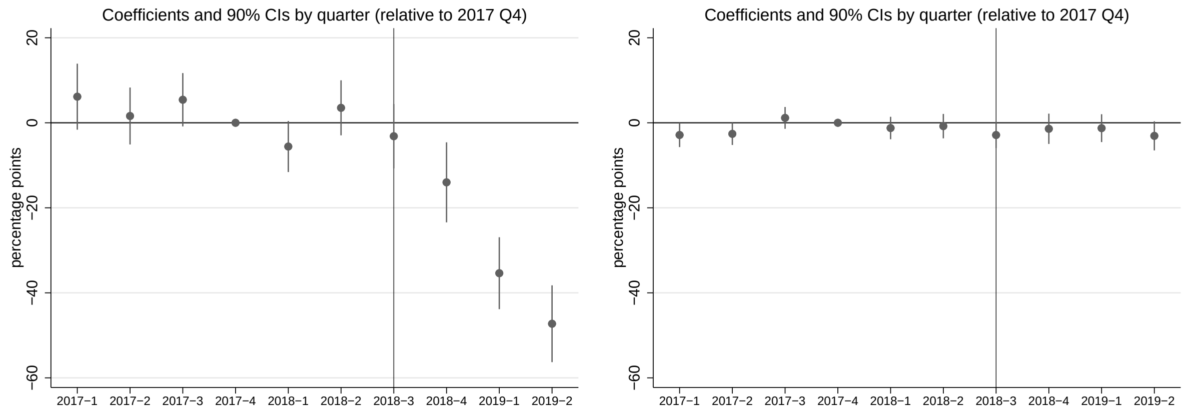
[12]Note that the effects are relative to the fourth quarter of 2017, i.e. the quarter before the report on unfair trade practices under Section 301 of the Trade Act of 1974 was released (end of March 2018).

[13]Note that this conclusion does not change when removing fixed effects from the model or estimating the

Figure 1: Quarterly profile of treatment effects.

(a) US imports from China

(b) US imports from the rest of the world



NOTES: Coefficients and 90% CIs by quarter (relative to 2017 Q4).

Table 3: Subsample regressions: Diversion effects

	By product		By region				
	Interm. (1)	Final (2)	CA, MX (3)	EM Asia (4)	DEV Asia (5)	South Am. (6)	Euro Area (7)
Change in Tariff Rate	0.029	-0.100	0.022	0.153	-0.354**	-0.208	-0.034
	(0.079)	(0.084)	(0.137)	(0.105)	(0.174)	(0.325)	(0.091)
Observations	589,186	479,949	150,554	292,857	82,752	51,389	357,113
R^2	0.105	0.095	0.135	0.115	0.117	0.152	0.093
Exporter-time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Exporter-product FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector-time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

NOTES: The dependent variable is the monthly year-on-year growth rate of US imports from countries other than China. Tariff Dummy switches to one if a product is affected be a new US tariff when imported from China. EM Asia contains emerging economies from Asia, i.e. Indonesia, India, Korea, Malaysia, Philippines, Thailand, Taiwan, and Vietnam. DEV Asia contains developed economies from Asia, i.e. Japan and Singapore. South Am. contains countries from South America; i.e., Brazil, Chile, Colombia and Venezuela. Euro Area includes Austria, Belgium, Germany, Spain, France, Ireland, Italy, and the Netherlands. Clustered standard errors (at the HS6-digit product level) in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

4.2 Robustness Checks

4.2.1 Change in Tariff Rates

To evaluate the robustness of our results, we ran several alternative checks. First, one may wonder whether our results hold if we do not only take into account the information whether a

model by weighted OLS. As shown in the appendix, only when we focus on particular products (Figure B2) and imports from certain countries (Figure B3), we are able to detect some evidence for trade diversion. Yet, these effects are generally not large enough to matter in broader estimation samples.

certain product was affected by new tariffs or not (i.e. the tariff dummy) but also use information by how much the tariff rate has changed. To test this, in Table A1 we use the change in tariffs as an explanatory variable (i.e. $ln((1 + \tau^{CN}_{p,t})/(1 + \tau^{CN}_{p,t-12}))$, where τ is the ad valorem tariff duty) instead of a tariff dummy. Doing so, we obtain qualitatively similar results as with our baseline approach. For none of the specifications, which cover different product groups and regions, we find a positive significant diversion effect.

4.2.2 Product-Exporter-Time Specific Demand Effects

In addition, so far in our specifications we are able to control for exporter-product, exporter-time and sector-time specific effects but it is not possible to control for product-exporter-time specific demand fluctuations. Such demand fluctuations could bias our findings if they would be correlated with the introduction of tariffs. To examine this, we add to our data set information on Euro Area imports which cover the same set of exporter-countries, products and periods as covered by the US import data.[14] Having done so, we can follow Romalis (2007) or Russ and Swenson (2019), who also study trade diversion effects of trade policy measures, in deriving a relative import demand equation (see Appendix A.2). In it, the dependent variable is the monthly year-on-year growth rate of US imports from third countries relative to Euro Area imports from the same set of countries. With this specification we can provide evidence about whether growth in US imports of a product from some exporter varies relative to growth in the Euro Area's imports of the same product from the same exporter, conditional on changes in US tariffs against China. We use two specifications, one with the change in tariffs as the variable of interest (Table A2) and one which is more reminiscent of the triple difference-in-differences approach by Frazer and Biesebroeck (2010) and employs the tariff dummy (Table A3). Both support the view that the tariffs did not induce significant diversion effects in this period. One exception might be Canada and Mexico: If we use the tariff dummy as our explanatory variable we find for this region a positive, albeit only borderline significant coefficient.

4.2.3 Import Prices

Since we are investigating import values, one may ask whether our results are actually driven by changes in import prices. To investigate this, we exploit quantity information in our data

[14] We have chosen the euro area as the control group because it has a relatively similar economic structure to the US, in a global comparison, and could therefore exhibit similar product-specific demand shocks as the US. The data source is Trade Data Monitor.

and compute unit values as a proxy for prices.[15] Table A4 shows that prices measured in this way (i.e. excluding tariff duties and measured in USD) have not responded to the tariff shocks neither for imports from China nor from the rest of the world, which suggests that, so far, the US is carrying the burden of the tariff hikes and that diversion effects measured in quantities are also not significant.[16]

4.2.4 Other robustness checks

In Table B1 in the Extended Appendix we also present regression results using import values which have been cleaned in accordance with the procedure applied to the unit values. As can be seen, we obtain similar results in terms of import responses, suggesting that our main findings are also robust to a more rigourous cleaning procedure. In the Extended Appendix, subsequent tables present further robustness checks. In Table B2, we drop the second quarter of 2018 from the estimation sample to account for potential announcement effects and find that our results are robust in this regard. In Table B3 we show results based on HS 4-digit product level data (instead of the HS 6-digit product level data) which might capture additional diversion effects which occur if importers substituted their treated imports by closely related products outside the treated HS 6-digit category. Moreover, in Tables B4 and B5 we present results obtained from regressions at the HS 10-digit product level. As before, our results are not sensitive to these checks. Finally, Table B6 contains results from placebo regressions corresponding to the results presented in Table 3 to ensure that also for these specifications we are not merely capturing pre-tariff developments.

[15] Note that quantities are only reported at the HS 10-digit product level. We therefore aggregate the price information at the HS 6-digit level by computing the weighted average of the growth rates at the HS 10-digit product level. Ignoring the country dimension to ease notation, we compute the price change at the HS 6-digit level as follows:

$$\Delta \ln(P_{p,t}) = \sum_{k=1}^{K} \bar{h}_{kp,t} \Delta \ln(P_{pk,t}), \tag{2}$$

where p denotes the HS 6-digit product level and k the 10-digit product level. $\Delta\ln(P_{pk,t})$ refers to the year-on-year growth rate, i.e., $\ln(P_{pk,t}) - \ln(P_{pk,t-12})$. The weight $\bar{h}_{kp,t}$ is defined as $\frac{h_{kp,t}+h_{kp,t-12}}{2}$ with $h_{kp,t}$ denoting the share of product k in total imports in period t.

[16] Since unit values are notoriously noisy, we apply a stricter cleaning procedure to their year-on-year change by removing the five upper and lower percentiles of the variable's distribution from the sample.

4.3 Discussion

Our results suggest for the short-run a lack of trade diversion. This may, inter alia, be due to: (1) affected products' properties and a still relatively short treatment period, (2) supply chain disruptions as well as (3) domestic substitution. More than 60% of the products affected by the 2018 US tariffs are processed intermediate goods (see Figure B1). Relative to other types of products, processed intermediate goods tend to be more technologically sophisticated, have a lower elasticity of substitution, and are traded more persistently between firms.[17] Thus, such goods are generally prone to higher switching costs, which might slow down the process of substituting imports and thereby explain why there has been so little trade diversion so far. In addition, given China's high market share in the production of many US import goods, it might be difficult for US companies to find substitutes easily. Both factors may be of particular relevance when considering the relatively short time period that has elapsed since the tariffs went into effect. Moreover, the marked negative direct effect of US tariffs might disrupt global supply chains which itself might reduce demand for imports from third countries. This might hold especially for closely related complements to imports from China which were strongly affected by the newly introduced tariffs and thus might lower the demand for affected products from third countries. Finally, it is important to recall that we do not capture any domestic substitution effects in our main analysis, which could also explain the lack of international substitution effects. To shed some light on this issue, we provide some evidence in the appendix (Section B.4) which, however, also suggests a lack of domestic substitution. Looking at US industrial production, industries for which tariffed imports from the same industry in China have a relatively high weight did not expand more than those industries where such imports have a low weight.[18] Taken together, our findings suggest that tariffs have a fast and strong direct effect which decreases import volumes of tariffed products; whereas it is not obvious that trade diversion effects have occurred, which may be because it takes time for such effects to establish.[19] Overall, the results seem to suggest that domestic consumption of tariffed goods in the US has decreased.

[17] We refer the reader to the appendix for corroborating evidence.

[18] However, keep in mind that it be possible that US producers have shifted some of their sales from foreign markets to domestic ones, which would no necessarily increase their total production but could explain partially the lack of international trade diversion. Such a mechanism would for example be in line with domestic capacity constraints and increasing marginal costs of production as proposed by Ahn and McQuoid (2017) and empirical evidence of a negative relationship between domestic and export sales as found by Vannoorenberghe (2012).

[19] It is also possible that trade diversion effects are masked by industry-time-varying shakeups in supply chains due to the trade war.

5 Conclusion

In this paper we provide evidence on the existence of short-run trade diversion effects as a consequence of tariff shocks. Based on a data set covering monthly product-level information on US imports from 30 countries for the period January 2016 until May 2019, we exploit sudden policy changes in the context of the trade dispute between the US and China, by employing a difference-in-differences estimation framework. The analysis provides evidence for marked negative direct effects of the tariffs on US imports from China, while trade diversion effects do not appear to be a widespread phenomenon. These results illustrate that the direct trade-destroying effects of tariffs are realized very rapidly, while the emergence of trade-creating diversion effects is not obvious according to our analysis, which may be because they take longer to establish. Overall, our results suggest that a bilateral trade war hardly sees any winners, especially, in the short-run.

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A Appendix

A.1 Change in Tariff Rates

Table A1: Diversion effects using change in tariff rates - baseline approach

	All	By product		By region				
		Interm.	Final	CA, MX	EM Asia	DEV Asia	South Am.	Euro Area
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Change in Tariff Rate	-0.054	0.029	-0.100	0.022	0.153	-0.354**	-0.208	-0.034
	(0.058)	(0.079)	(0.084)	(0.137)	(0.105)	(0.174)	(0.325)	(0.091)
Observations	1,069,201	589,186	479,949	150,554	292,857	82,752	51,389	357,113
R^2	0.098	0.105	0.095	0.135	0.115	0.117	0.152	0.093
Exporter-time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Exporter-product FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector-time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

NOTES: The dependent variable is the monthly year-on-year growth rate of US imports from countries other than China. Change in tariffs refers to the (log) change in tariffs that the US imposed on imports from China. EM Asia contains emerging economies from Asia, i.e. Indonesia, India, Korea, Malaysia, Philippines, Thailand, Taiwan, and Vietnam. DEV Asia contains developed economies from Asia, i.e. Japan and Singapore. South Am. contains countries from South America; i.e., Brazil, Chile, Colombia and Venezuela. Euro Area includes Austria, Belgium, Germany, Spain, France, Ireland, Italy, and the Netherlands. Clustered standard errors (at the HS6-digit product level) in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

A.2 Specification based on Romalis (2007)

In this robustness check, we follow Romalis (2007) or Russ and Swenson (2019) who, based on an economy with constant elasticity of demand (CES) preferences, derive a relative import demand equation for US imports relative to those of a reference country (in our case the Euro Area). The demand equation has the following form:

$$\Delta \ln \left(\frac{IM^{US}_{p,i,t}}{IM^{EA}_{p,i,t}} \right) = \beta \tau^{CN}_{p,t} + \gamma_{it} + \gamma_{ip} + \gamma_{st} + \epsilon_{p,i,t}, \tag{3}$$

where the dependent variable is the monthly year-on-year growth rate of US imports from third countries relative to that of the Euro Area imports from the same set of countries. As in our baseline specification, we include exporter-time, exporter-product and sector-time fixed effects.[20] The equation describes how growth in US imports of a product from some exporter varies relative to growth in the Euro Area's imports of the same product from the same exporter, conditional

[20]Note that our empirical setup slightly diverges from the original model proposed by Romalis (2007). Most importantly, we estimate our model based on year-on-year growth rates to account for seasonality of product-level import data. Moreover, we capture US and Euro Area MFN tariffs that appear in the Romalis specification by differencing the data and adding product fixed effects to the model. In light of the relatively short time period of the estimation sample, this should largely capture any time variation in MFN tariffs.

on changes in US tariffs against China.[21] In comparison with our baseline specification, this approach has the advantage that it implicitly controls for product-exporter-time specific effects which are common to US and EA imports. The disadvantage of this approach is that it requires additional assumptions, including the assumption that US tariffs against China have no direct impact on Euro Area imports, which might not hold. To illustrate these two points, imagine US and Euro Area import demand could be described by the following two equations:

$$\begin{aligned}\Delta \ln IM^{US}_{p,i,t} &= \beta\tau^{CN}_{p,t} + \gamma^{US}_{it} + \gamma^{US}_{ip} + \gamma^{US}_{st} + \gamma_{pit} + \epsilon^{US}_{p,i,t}\\ \Delta \ln IM^{EA}_{p,i,t} &= \qquad\quad + \gamma^{EA}_{it} + \gamma^{EA}_{ip} + \gamma^{EA}_{st} + \gamma_{pit} + \epsilon^{EA}_{p,i,t},\end{aligned}$$

where the equation for the US import demand is equal to an expanded version of our baseline specification, to which a term γ_{pit} is added to capture product-exporter-time specific demand shocks which are common to the US and the EA. Assuming EA import demand has the same structure as US demand but US tariffs against China have no impact on it (as outlined in the EA demand equation) one can subtract the EA demand equation from the US demand equation such that one gets:

$$\Delta \ln IM^{US}_{p,i,t} - \Delta \ln IM^{EA}_{p,i,t} = \beta\tau^{CN}_{p,t} + \gamma^{US}_{it} - \gamma^{EA}_{it} + \gamma^{US}_{ip} - \gamma^{EA}_{ip} + \gamma^{US}_{st} - \gamma^{EA}_{st} + \epsilon^{US}_{p,i,t} - \epsilon^{EA}_{p,i,t},$$

which can be rewritten as equation 3. As can bee seen, by subtracting EA demand from US demand one gets rid of common product-exporter-time specific effects. However, it also becomes clear that, if $\tau^{CN}_{p,t}$ would also have an impact on Euro Area demand, an estimate of β would not be unbiased anymore. We implement this approach in two versions, one with the change in tariffs as the variable of interest (Table A2) and one which employs the tariff dummy (Table A3). Both support the view that the tariffs did not induce significant diversion effects in this period.

[21] We consider the Euro Area to be a suitable reference region since it bears some similarities with the US (e.g., a large and advanced economic region with a common exchange rate, which is located far away from China), while it is rather unlikely that it is indirectly affected by the bilateral trade war (e.g., due to trade diversion or trade deflection).

Table A2: Diversion effects using change in tariff rates - Romalis approach

	All	By product		By region			
		Interm.	Final	CA, MX	EM Asia	DEV Asia	South Am.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Change in Tariff Rate	0.033	0.097	-0.041	0.633	0.217	-0.373	-0.100
	(0.113)	(0.162)	(0.168)	(0.469)	(0.161)	(0.282)	(0.583)
Observations	509,652	275,510	233,974	36,159	241,880	71,641	31,709
R^2	0.097	0.107	0.097	0.159	0.106	0.112	0.161
Exporter-time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Exporter-product FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector-time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

NOTES: The dependent variable is the monthly year-on-year growth rate of US imports from countries other than China relative to euro area imports from the same set of countries. Change in tariffs refer to the (log) change in tariffs that the US imposed on imports from China. EM Asia contains emerging economies from Asia, i.e. Indonesia, India, Korea, Malaysia, Philippines, Thailand, Taiwan, and Vietnam. DEV Asia contains developed economies from Asia, i.e. Japan and Singapore. South Am. contains countries from South America; i.e., Brazil, Chile, Colombia and Venezuela. Clustered standard errors (at the HS6-digit product level) in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Table A3: Diversion effects using tariff dummy - Romalis approach

	All	By product		By region			
		Interm.	Final	CA, MX	EM Asia	DEV Asia	South Am.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Tariff Dummy	-0.001	0.001	-0.018	0.158*	0.005	-0.102*	-0.056
	(0.020)	(0.030)	(0.030)	(0.091)	(0.028)	(0.055)	(0.101)
Observations	509,652	275,510	233,974	36,159	241,880	71,641	31,709
R^2	0.097	0.107	0.097	0.159	0.106	0.113	0.161
Exporter-time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Exporter-product FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector-time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

NOTES: The dependent variable is the monthly year-on-year growth rate of US imports from countries other than China relative to euro area imports from the same set of countries. Tariff Dummy switches to one if a product is affected by a new US tariff when imported from China. Regressions. EM Asia contains emerging economies from Asia, i.e. Indonesia, India, Korea, Malaysia, Philippines, Thailand, Taiwan, and Vietnam. DEV Asia contains developed economies from Asia, i.e. Japan and Singapore. South Am. contains countries from South America; i.e., Brazil, Chile, Colombia and Venezuela. Clustered standard errors (at the HS6-digit product level) in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Table A4: Unit Values as dependent variable

	Direct Effect				Indirect Effect			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Tariff Dummy	0.018	0.006	0.025	-0.002	0.001	-0.001	-0.006	0.015
	(0.016)	(0.010)	(0.017)	(0.085)	(0.006)	(0.004)	(0.007)	(0.023)
Observations	80,612	80,888	32,535	80,612	751,552	756,731	292,923	751,541
R^2	0.119	0.002	0.237	0.305	0.093	0.002	0.209	0.224
Exporter-time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Exporter-product FE	Yes	No	Yes	Yes	Yes	No	Yes	Yes
Sector-time FE	Yes	No	Yes	Yes	Yes	No	Yes	Yes
Specificaton			Placebo	Weighted			Placebo	Weighted

NOTES: The dependent variable is the monthly year-on-year growth rate of unit values relate to US imports from China (columns 1-4) or to US imports from other countries (columns 5-8). Tariff Dummy switches to one if a product is affected be a new US tariff when imported from China. Regressions without country-product fixed effects contain a dummy variable which indicates whether a product is affected by new tariffs. Placebo regressions imply that import growth rates for the year 2017 are regressed on the tariff dummy moved one year ahead. In weighted regressions, each observations is weighted according to the 12 months lagged import value. Clustered standard errors (at the HS6-digit product level) in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

B Extended Appendix

In this appendix, we present more information about our data, including some descriptive evidence, and provide additional estimation results and robustness checks.

B.1 Data and Descriptive Evidence

Our data set comprises monthly US product-level import data for the top 30 US trade partners sourced from the US CENSUS, covering the period from January 2016 to May 2019. Information on products targeted by tariffs is obtained from the US Trade Representative and the Peterson Institute for International Economics. Note that the tariffs went into effect on 6 July, 23 August and 24 September. The tariff dummy thus switches to one in July for products on the first list and in September and October for products on the second or third lists.

Figure B1: Properties of products targeted or not targeted by US tariffs

(a) By SITC classification (b) By BEC classification

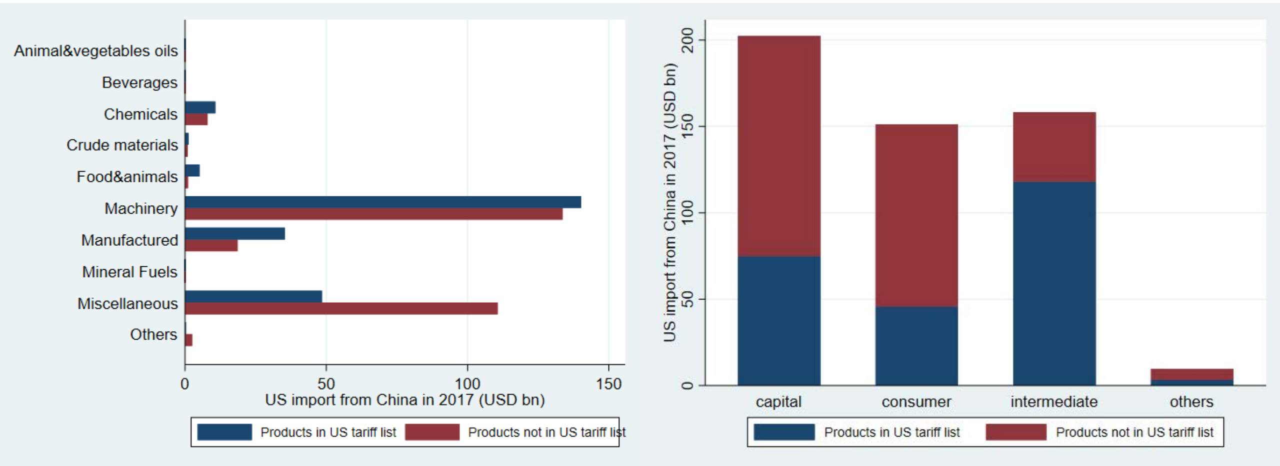
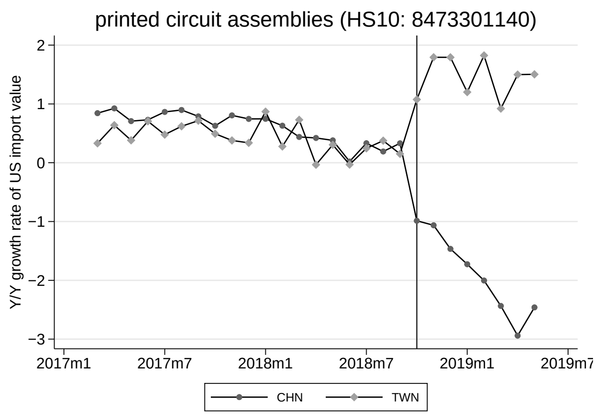
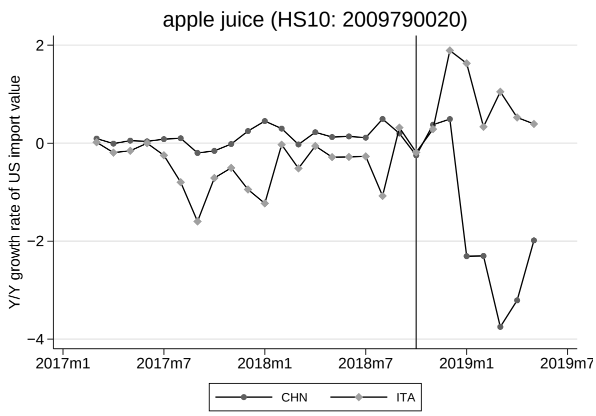


Figure B2: Examples of trade diversion effects for specific products

(a)



(b)



B.2 Additional Estimation Results

Table B1: Import values regressions corresponding to unit value results

	Direct Effect				Indirect Effect			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Tariff Dummy	-0.315***	-0.313***	-0.043	-0.229***	-0.003	-0.014*	0.016	-0.022
	(0.031)	(0.020)	(0.030)	(0.084)	(0.012)	(0.008)	(0.012)	(0.020)
Observations	80,612	80,888	32,535	80,612	751,535	756,714	292,917	751,535
R^2	0.163	0.024	0.276	0.460	0.119	0.004	0.267	0.430
Exporter-time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Exporter-product FE	Yes	No	Yes	Yes	Yes	No	Yes	Yes
Sector-time FE	Yes	No	Yes	Yes	Yes	No	Yes	Yes
Specificaton			Placebo	Weighted			Placebo	Weighted

NOTES: The dependent variable is the monthly year-on-year growth rate of US imports from China (columns 1-4) or from other countries (columns 5-8). Tariff Dummy switches to one if a product is affected by a new US tariff when imported from China. Regressions without country-product fixed effects contain a dummy variable which indicates whether a product is affected by new tariffs. Placebo regressions imply that import growth rates for the year 2017 are regressed on the tariff dummy moved one year ahead. In weighted regressions, each observations is weighted according to the 12 months lagged import value. Clustered standard errors (at the HS6-digit product level) in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Table B2: Robustness check: Announcement effects

	Direct Effect				Indirect Effect			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Tariff Dummy	-0.315***	-0.316***	-0.034	-0.205***	-0.005	-0.007	0.008	-0.017
	(0.030)	(0.020)	(0.028)	(0.076)	(0.011)	(0.007)	(0.010)	(0.021)
Observations	88,319	88,547	40,518	88,319	956,890	962,636	427,241	956,890
R^2	0.148	0.023	0.246	0.465	0.106	0.003	0.242	0.396
Exporter-time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Exporter-product FE	Yes	No	Yes	Yes	Yes	No	Yes	Yes
Sector-time FE	Yes	No	Yes	Yes	Yes	No	Yes	Yes
Specificaton			Placebo	Weighted			Placebo	Weighted

NOTES: The dependent variable is the monthly year-on-year growth rate of US imports from China (columns 1-4) or from other countries (columns 5-8). Tariff Dummy switches to one if a product is affected by a new US tariff when imported from China. Regressions without country-product fixed effects contain a dummy variable which indicates whether a product is affected by new tariffs. Placebo regressions imply that import growth rates for the year 2017 are regressed on the tariff dummy moved one year ahead. In weighted regressions, each observations is weighted according to the 12 months lagged import value. Clustered standard errors (at the HS6-digit product level) in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Table B3: Main results: Direct and diversion effects - HS4 products

	Direct Effect				Indirect Effect			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Tariff Dummy	-0.191***	-0.220***	-0.082	-0.002	-0.019	0.001	0.016	-0.003
	(0.046)	(0.030)	(0.050)	(0.061)	(0.014)	(0.009)	(0.015)	(0.021)
Observations	28,310	28,478	11,655	28,310	437,833	439,144	177,071	437,833
R^2	0.227	0.026	0.313	0.486	0.100	0.006	0.237	0.403
Exporter-time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Exporter-product FE	Yes	No	Yes	Yes	Yes	No	Yes	Yes
Sector-time FE	Yes	No	Yes	Yes	Yes	No	Yes	Yes
Specificaton			Placebo	Weighted			Placebo	Weighted

NOTES: The dependent variable is the monthly year-on-year growth rate of US imports from China (columns 1-4) or from other countries (columns 5-8). Tariff Dummy switches to one if a product is affected by a new US tariff when imported from China. Regressions without country-product fixed effects contain a dummy variable which indicates whether a product is affected by new tariffs. Placebo regressions imply that import growth rates for the year 2017 are regressed on the tariff dummy moved one year ahead. In weighted regressions, each observations is weighted according to the 12 months lagged import value. Clustered standard errors (at the HS4-digit product level) in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Table B4: Subsample regressions for data at 10-digit product level

	Direct Effect				Indirect Effect			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Tariff Dummy	-0.313***	-0.310***	-0.008	-0.407***	-0.008	-0.010*	0.012	-0.015
	(0.022)	(0.017)	(0.018)	(0.106)	(0.008)	(0.006)	(0.008)	(0.019)
Observations	262,140	262,887	101,570	262,140	1,920,772	1,937,791	725,335	1,920,772
R^2	0.126	0.013	0.250	0.440	0.110	0.002	0.257	0.424
Exporter-time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Exporter-product FE	Yes	No	Yes	Yes	Yes	No	Yes	Yes
Sector-time FE	Yes	No	Yes	Yes	Yes	No	Yes	Yes
Specificaton			Placebo	Weighted			Placebo	Weighted

NOTES: The dependent variable is the monthly year-on-year growth rate of US imports from China (columns 1-4) or from other countries (columns 5-8). Tariff Dummy switches to one if a product is affected by a new US tariff when imported from China. Regressions without country-product fixed effects contain a dummy variable which indicates whether a product is affected by new tariffs. Placebo regressions imply that import growth rates for the year 2017 are regressed on the tariff dummy moved one year ahead. In weighted regressions, each observations is weighted according to the 12 months lagged import value. Clustered standard errors (at the HS8-digit product level) in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Table B5: Subsample regressions: Diversion effects

	By product		By region				
	Interm. (1)	Final (2)	CA, MX (3)	EM Asia (4)	DEV Asia (5)	South Am. (6)	Euro Area (7)
Change in Tariff Rate	-0.074	-0.072	-0.011	-0.018	-0.185	-0.169	-0.063
	(0.064)	(0.065)	(0.109)	(0.090)	(0.138)	(0.283)	(0.074)
Observations	1,010,302	910,424	304,432	547,513	151,014	73,715	624,113
R^2	0.114	0.108	0.143	0.120	0.116	0.156	0.101
Exporter-time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Exporter-product FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector-time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

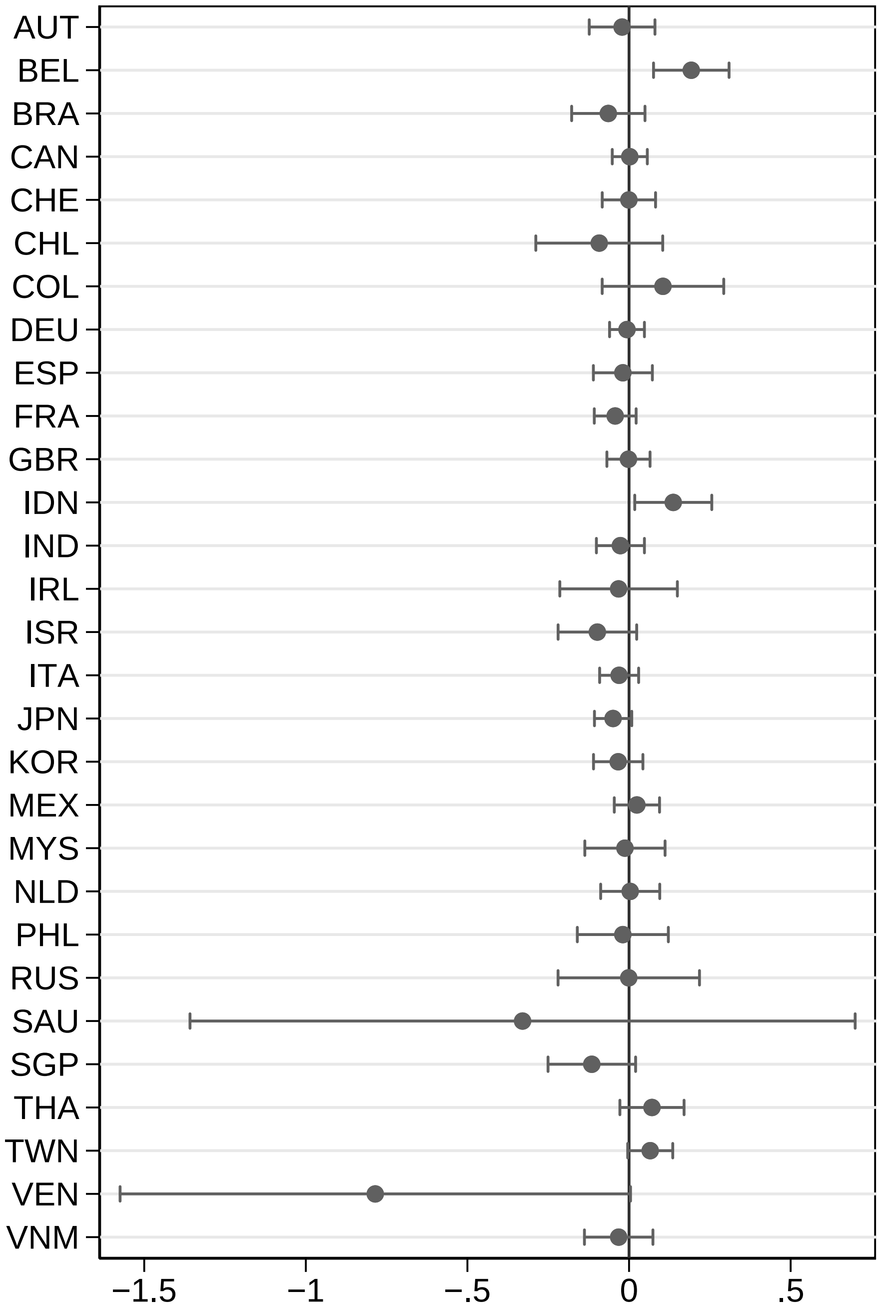
NOTES: The dependent variable is the monthly year-on-year growth rate of US imports from countries other than China. Tariff Dummy switches to one if a product is affected by a new US tariff when imported from China. EM Asia contains emerging economies from Asia, i.e. Indonesia, India, Korea, Malaysia, Philippines, Thailand, Taiwan, and Vietnam. DEV Asia contains developed economies from Asia, i.e. Japan and Singapore. South Am. contains countries from South America; i.e., Brazil, Chile, Colombia and Venezuela. Euro Area includes Austria, Belgium, Germany, Spain, France, Ireland, Italy, and the Netherlands. Clustered standard errors (at the HS8-digit product level) in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Table B6: Placebo results for subsample regressions presented in Table 2: Diversion effects

	By product		By region				
	Interm. (1)	Final (2)	CA, MX (3)	EM Asia (4)	DEV Asia (5)	South Am. (6)	Euro Area (7)
Tariff Dummy	0.019	-0.013	0.005	0.012	0.009	0.031	0.008
	(0.015)	(0.015)	(0.024)	(0.019)	(0.034)	(0.065)	(0.019)
Observations	235,260	191,956	61,196	116,889	33,345	19,952	142,362
R^2	0.256	0.233	0.300	0.263	0.262	0.298	0.228
Exporter-time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Exporter-product FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector-time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

NOTES: The dependent variable is the monthly year-on-year growth rate of US imports from countries other than China. Tariff Dummy switches to one if a product is affected by a new US tariff when imported from China. EM Asia contains emerging economies from Asia, i.e. Indonesia, India, Korea, Malaysia, Philippines, Thailand, Taiwan, and Vietnam. DEV Asia contains developed economies from Asia, i.e. Japan and Singapore. South Am. contains countries from South America; i.e., Brazil, Chile, Colombia and Venezuela. Euro Area includes Austria, Belgium, Germany, Spain, France, Ireland, Italy, and the Netherlands. Clustered standard errors (at the HS6-digit product level) in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Figure B3: Trade Diversion Effects by Country



NOTES: Coefficients and 90% CIs by country, obtained by estimating our baseline specification for each country separately.

B.3 Product Characteristics and Ease of Substitution

Additionally, in Table B7, we present evidence suggesting that processed intermediate goods are subject to higher switching costs. To this end, we consider three different product-specific indicators, namely, an indicator of technological sophistication[22], a measure of the elasticity of substitution[23], and an indicator of relationship stickiness, which alludes to the persistency of trade relationships between firms for specific products.[24] Products that are technologically more sophisticated, have a lower elasticity of substitution (i.e. are more differentiated), and/or are traded more persistently between firms and are likely to be prone to higher switching costs, which may influence the degree and speed of trade diversion. Table B7 shows that relative to other types of product, processed intermediate goods (i.e. those goods that have been targeted quite prominently by US tariffs) do indeed tend to be more technologically sophisticated, have a lower elasticity of substitution, and be traded more persistently between firms. However, results in Table B8 show that interactions between indicators of product characteristics and the tariff dummy do not show up statistically significant. This is either because the coefficients are very small (in case of the elasticity of substitution and the index of relationship stickiness), or because they are estimated somewhat imprecisely, while pointing in the expected direction (in case of the Rauch measure and the index of product sophistication).

[22] This indicator has been proposed by Hausmann, Hwang, and Rodrik (2007) and is designed to capture the level of technological sophistication embodied in a particular good. The intuition of this measure is as follows: if a product is mostly produced by highly developed countries, then it is revealed to be a sophisticated product. The indicator is calculated as the weighted average of GDP per capita of countries that produce a HS 6-digit good. The weights are based on a country's revealed comparative advantage of a specific product. We compute this indicator using export information available from BACI and GDP per capita data from Penn World Tables for the years 2011 to 2017. Obviously, the indicator is prone to a number of caveats. For instance, it can be larger (smaller) simply because several (few) high income countries produce a certain good (e.g. agricultural products which are produced in many developed countries vs. computers which tend to be assembled in less developed countries).

[23] We use the estimates of the elasticity of substitution provided by Broda and Weinstein (2006).

[24] We would like to thank Isabelle Mejean for making this indicator available to us. The indicator is derived from a unique French firm-to-firm export dataset (Martin, Mejan, and Parenti, 2018). The dataset informs about export relationships between French firms and their customers abroad over time. The indicator is calculated using information about the duration of firm-to-firm trade relationships.

Table B7: Product types and indicators of ease of substitution

	Differentiated products (1)	Elasticity of substitution (2)	Relationship stickiness (3)	Product sophistication (4)
Intermediate - processed	-0.116***	-3.718***	0.073***	0.283***
	(0.016)	(1.013)	(0.015)	(0.016)
Intermediate - primary	-0.277***	2.570	-0.171***	-0.167***
	(0.027)	(1.853)	(0.026)	(0.027)
Capital goods	0.355***	4.665***	-0.093***	0.422***
	(0.023)	(1.454)	(0.022)	(0.023)
Observations	4,715	4,214	4,928	4,951
R^2	0.116	0.011	0.029	0.123

NOTES: Indicators informing about a product's ease of substitution are regressed on dummy variable indicating product types. "Differentiated products" is a dummy for differentiated products according to the (Rauch, 1999) classification, "Elasticity of substitution" refers to the measure developed by (Broda and Weinstein, 2006), "Relationship stickiness" to the indicator prepared by (Martin et al., 2018), and "Product sophistication" to the index developed by (Hausmann et al., 2007). Consumer goods are the base category in each regression. *** p<0.01, ** p<0.05, * p<0.1.

Table B8: Search for non-linear effects in relation to product characteristics

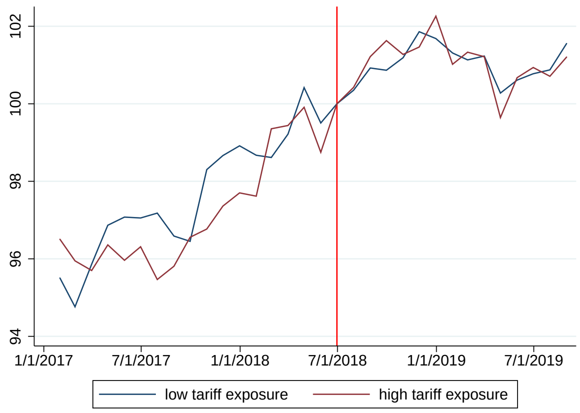
	Differentiated products (1)	Elasticity of substitution (2)	Relationship stickiness (3)	Product sophistication (4)
Tariff Dummy	-0.021	-0.006	-0.005	0.183
	(0.018)	(0.013)	(0.011)	(0.141)
Interaction with Product Attribute	0.023	-0.000	0.005	-0.019
	(0.017)	(0.000)	(0.014)	(0.014)
Observations	998,623	919,703	1,063,475	1,064,972
R^2	0.098	0.099	0.098	0.098
Exporter-time FE	Yes	Yes	Yes	Yes
Exporter-product FE	Yes	Yes	Yes	Yes
Sector-time FE	Yes	Yes	Yes	Yes

NOTES: The dependent variable is the monthly year-on-year growth rate of US imports from other countries. Tariff Dummy switches to one if a product is affected by a new US tariff when imported from China. Interaction with Product Attribute refers to an interaction between the Tariff dummy and the product attribute presented in the first row of the table. "Differentiated products" is a dummy for differentiated products according to the (Rauch, 1999) classification, "Elasticity of substitution" refers to the measure developed by (Broda and Weinstein, 2006), "Relationship stickiness" to the indicator prepared by (Martin et al., 2018), and "Product sophistication" to the index developed by (Hausmann et al., 2007). Clustered standard errors (at the HS4-digit product level) in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

B.4 Domestic Substitution

Domestic substitution effects could explain why there are no significant international substitution effects so far. To provide some suggestive evidence on their existence, we ran an additional analysis. By using information on US industrial production we analyze whether US industries were able to expand their production at the cost of Chinese competitors hit by tariffs. To do so, we compare the relative performance of two groups of US industries: (1) industries for which tariffed imports from the same industry in China have a relatively high weight compared to the size of that US industry and (2) industries for which such imports have a relatively small weight. For it, we allocate the import and tariff data used in our main analysis (in HS classification) to 70 US industries (in NAICS classification) by applying the concordance provided by Pierce and Schott (2009) and updates thereof. Based on this split, we compare the production development of these two groups of industries since the introduction of the tariffs. Our results show no significant difference in their development, suggesting that there has been no significant domestic substitution so far (see Figure B4).[25]

Figure B4: US industrial production by high and low tariff exposure



[25]Note that these results are based on a rather coarse industry definition. For example, at this level of aggregation, it is possible that substitution effects are counteracted by negative output effects in relation to cost push effects due to higher input costs. The results should therefore be interpreted with caution. Moreover, it is possible that US producers shift sales from export markets to US domestic sales, which would not necessarily increase their production but which could explain, at least partially, the lack of international trade diversion effects.

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