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Trade and currency barriers

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Abstract

In this paper, I study the link between trade barriers and currency barriers. Using a detailed gravity model at the product level for 78 countries I find that a 10% appreciation is equivalent to a 5% increase in the power of the tariff. This equivalence varies greatly in time and among countries, depending on their trade specialization. I also find a strong empirical evidence that trade barriers are not independent from exchange rate movements, assuming a link between the so-called "currency wars" and "trade wars". Countries do increase their import protection after facing an exchange rate appreciation: they tend to increase the level of tariffs, but also the number of products under temporary trade barriers as a retaliation.

1 Introduction

In a cooperative environment, countries implement policies to remedy their economic problems taking into account the situation of the rest of the world. In a non-cooperative environment, a country also uses policy instruments to worsen the economic situation of other countries. This is what is called "beggar thy neighbour" policies. This type of policies generally illustrates through trade policies: countries increase trade barriers on each other, as a retaliation for others' trade barriers, sometimes leading to the so-called trade wars. "Beggar thy neighbour" policies can also take the form of competitive devaluations. Indeed, a depreciation of the home currency with respect to the trading partner's currency decreases the price in foreign currency of home exports. Implementing a competitive devaluation, a country devalues its currency to increase its export competitiveness, at the expense of the trading partner. This non-cooperative policy can trigger a whole cycle of competitive devaluations: in response to an appreciation of the home currency, an economy will try to devalue as well to regain trade competitiveness. These tit-for-tat exchange rate policies are sometimes labelled as "currency wars".

The goal of this master thesis is to answer two questions: are trade barriers and currency barriers equivalent, or even substitutes? Do economies use import protection as a retaliation when facing an appreciation of their currency? A positive answer would introduce a new concern in economic policy: currency wars, if they exist, could evolve into trade wars. I start by computing the equivalence between currency barriers and trade barriers. I estimate a gravity model using an extensive dataset: it is defined bilaterally, at the product level, for 78 heterogeneous countries. Standard gravity model do not account for exchange rates movements. Besides, they are generally defined either at the aggregated level for a large number of country, either at the product level considering a small number of countries: the size of the dataset is unusual. On the question of whether trade and currency barriers can be substitutes, one has to compare their impact. I find that on average a 10% appreciation of the exporter's currency is equivalent to a 5% increase in the power of the tariff. This equivalence varies in time

and with countries' characteristics, such as their trade specialization, their level of development, and their level of trade dependence.

Second, I look at whether trade policies are impacted by exchange rate movements. I use two different datasets, to consider tariffs on the one hand and temporary trade barriers on the other one, thus covering a wide range of protectionist instruments. On these two datasets I use the same strategy: regressing the protectionist variable on macroeconomic variables that are supposed to impact import protection decision in a non-cooperative environment. The results show an interesting point: trade barriers and currency barriers are not independent. A country facing an appreciation of the home currency is likely to retaliate with protectionism, whether it is through tariffs or temporary trade barriers. Not all economies are able to use tariff increases as a retaliation, because of their WTO commitments. When they can do so, results show that they use tariff increases on a temporary basis: tariff increases are followed by decreases, and tariff increases are offset by decreases within three years after in 43% of the cases. When they can not use tariffs to retaliate, countries tend to use even more temporary trade barriers such as anti-dumping filings, countervailing duties or safeguards. This pattern does not fit all countries' behaviour: emerging economies seems to be the one that retaliate the most with protectionism to home currency appreciations, as well as non trade dependent economies.

There is an extensive literature on protectionism and its determinants, which highlights two channels for endogenous protection. The first strand of the literature focuses on political pressures, with the cornerstone theoretical paper being [Grossman and Helpman \(1994\)](#). They model the impact of lobbies in deciding the level of protectionism considering a framework with political groups influencing the government prior to an election. [Grossman and Helpman \(1995\)](#) also models the determinants of the structure of protection in cooperative and non-cooperative policy equilibria. These models have been successfully taken to data ([Gawande and Bandyopadhyay, 2000](#); [Ossa, 2014](#)).

The second strand of the literature focuses on the impact of macroeconomic shocks on protectionism. [Knetter and Prusa \(2003\)](#) find that the number of anti-dumping filings depends positively on domestic recession, as well as losses in competitiveness due to appreciation of the real exchange rates for the time period of 1980 to 1998, for four advanced economies. [Bown and Crowley \(2013\)](#) investigate the impact of these macroeconomic variables on a wider range of protectionist measures. They find that the pattern of advanced economies changed during the crisis, showing that the protectionist response was not as high as expected. Advanced economies did respond to domestic recession and domestic appreciations, but they did not increase their import protection when the trading partner was undergoing economic difficulties as well. Using a different database, [Georgiadis and Gräß \(2013\)](#) have the same conclusions. [Bown and Crowley \(2014\)](#) also find that the same variables impact protectionist decisions for fifteen emerging economies.

On the contrary, there is a very poor academic literature on competitive devaluations and still no consensus on whether it can be called "currency wars": not all exchange rate variations comes under currency manipulations. Most literature rely on

the inter-war episode, when economies leaving the Gold Standard started a cycle of competitive devaluations. Besides, [Cline and Williamson \(2010\)](#) show that not all countries with an undervalued currency are to be called manipulators. However, [Gagnon and Bergsten \(2012\)](#) draw a non-exhaustive list of the main manipulators, according to two criteria: the amount of foreign exchange reserve in 2011, and their current account balance in 2012.

This paper contributes to the empirical literature on the determinants of protectionism, and open a new strand on the relationship between trade wars and currency wars. Studies explaining protectionism by macroeconomic variables highlight the link between real exchange rate appreciations and increase in import protection ([Knetter and Prusa, 2003](#); [Bown and Crowley, 2013](#); [Bown and Crowley, 2014](#)). This relationship relates here again to the inter-war period. [Eichengreen and Irwin \(2010\)](#) and [Eichengreen \(2013\)](#) dissects the 1930s crisis. They explain that the protectionist outbreak in the 1930s was not as homogeneous as the history tells it, and was based on a crashing Gold Standard. They also prove that exchange rate appreciation and protectionist surge were linked. [Gagnon and Bergsten \(2012\)](#) also suggest that the USA should respond to currency manipulation with trade policy. An example of this is the agreement of countries signing the Trans-Pacific Trade agreement at the end of 2015 to avoid competitive devaluations.

The paper is organized as follows. Section 2 presents the data. In section 3 I introduce the first estimation strategy and its results, which aims at computing the equivalence between trade and currency barriers. In section 4, I look at whether the relationship between exchange rates and protectionism exists. Section 5 concludes.

2 Data

2.1 Data sources

The dataset is composed of 78 countries, from advanced to developing economies, for the period of 1989 to 2013, with annual data. In 2013 these countries represented 77% of global trade (exports). Bilateral real exchange rates are computed by the USDA from IMF data. I use harmonized bilateral trade data from the BACI database ([Gaulier and Zignago, 2010](#)). Using original data from the COMTRADE database, BACI is constructed by reconciling the declarations of the exporter and the importer, providing a very complete dataset for exports, at the HS 6-digit product disaggregation. Gross domestic product (GDP) data are from the Penn World Tables.

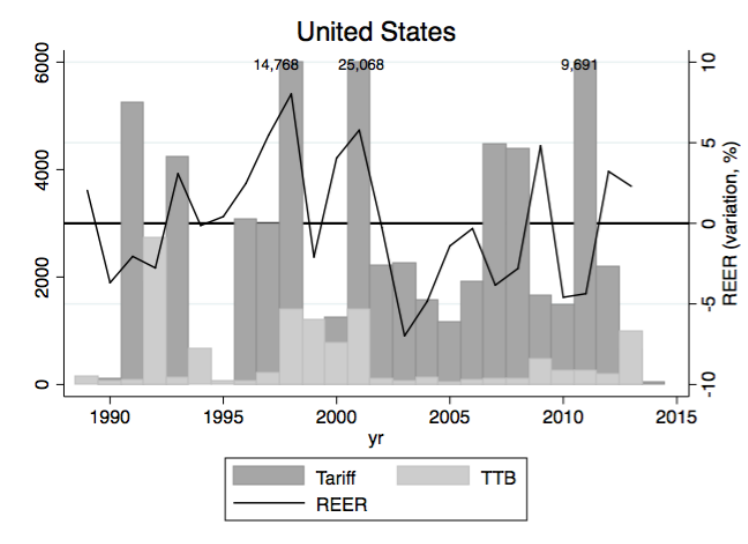
For protectionism two types of data are considered. I look at official tariffs, extracted from TRAINS database (UNCTAD), at the HS 6-digits product level. Within the WTO, there are two types of tariffs. First, tariffs that come under Preferential Trade Agreements (PTA). There are also Most-Favoured Nation tariffs. These are what countries promise to impose on imports from other members of the WTO, unless there is a regional or preferential trade agreement. These MFN tariffs are higher than

those of PTA, but cannot exceed what is negotiated at the WTO, which is the bound tariff. In practice, MFN tariffs are the highest rates that WTO members can charge one another. I use PTA tariffs first, and MFN tariffs if the latter is missing.

But since many WTO members have their tariffs already at the level of bound tariffs, they cannot actually move them. Another way for them to impose trade barriers is through temporary trade barriers, that have become very important and often used in the past decades. Therefore, in a second dataset, I use data on the number of imported product at the HS 6-digit product level subjected to this new type of trade policies. I compile temporary trade barrier data from the World Bank’s *Temporary Trade Barriers Database* (Bown, 2011), for only 40 countries because of data limitation, over the same period of time (1989-2013). This compiled database gives information on the number of products concerned by antidumping filings, countervailing duties, global safeguards, and China-specific safeguard policies. With these two databases, a large range of protectionist measures is covered.

2.2 Descriptive statistics

Figure 1: Exchange rates movements and protectionism surge



The real effective exchange rate comes from the Bruegel Institute (Darvas, 2012). When the REER is positive, it is an appreciation of the \$US. Other variables are from the author’s calculations.

Figure 1 plots the variation in percentage of the real effective exchange rate of the United States (black line). The left axis corresponds to the bilateral count of products that were submitted to import protection through temporary trade barriers (light-grey bars), and to increases in official tariffs at the exporter-product level (dark-grey bars). The graph shows a large protectionist period, at the beginning of the 1990s,

and then again around 2000. After this episodes, the counts of tariff increase is stable, oscillating around 1500 exporter-product specific increases per year¹. Temporary trade barriers were barely used after 2001, but then again with the global financial crisis. This evolution highlights the counter-cyclical use of protectionism in the USA.

Some episodes illustrate the positive link between exchange rate appreciations and protectionism. The steady appreciation of the dollar that started in 1995 is followed in 1996 by a large number of increase in official tariffs, and in 1998 by increases in import protection of another nature. The same pattern is reproduced following the 2000 appreciation. At the end of the period, the dollar appreciated significantly, in 2009 and in 2013, two episodes that are associated with increase in temporary trade barriers, though the number of increase in official tariffs does not rise significantly. These episodes support the hypothesis that protectionism is used as a response to exchange rate appreciations in the case of the USA. However, this is not a systematic relation. At the beginning of the 1990s there was a huge increase in the use of temporary trade barriers, with a peak of products under new import protection. This happening in a period of devaluation of the dollar illustrates a break in the supposed relationship.

This first and succinct analysis gives a preview of the possible relationship between trade and currency barriers. In the next section I start by computing their equivalence.

3 Trade and currency barriers as equivalents

I study here the equivalence between currency barriers and trade barriers. More specifically, I compare the impact on trade of exchange rate and tariff variations. To the extent that there is at least partial pass-through, a depreciation of the exporter's currency decreases the price of exports in foreign currency, and increases the price of imports in domestic currency: this will lead to more exports and less imports. The sizeable impact of exchange rate movements on trade is well known, highlighted by studies on the benefits of currency unions (Rose, 2000; Rose and Wincoop, 2001). In the same way, tariffs impact directly trade flows. Protectionist policies have the initial goal to restrict the degree of import penetration, and protect the domestic industries from foreign competition. Analysing the impact of both exchange rates and tariffs on trade flows is the easiest way to get an equivalent between the two.

I do so by estimating a gravity equation. The gravity equation links bilateral trade between two countries to their respective size (GDPs) and geographical and cultural proximity. Anderson (1979) provides theoretical foundation for such equation adding several controls to the initial framework. The empirical strategy applied in this paper differs from the standard frameworks described in Head and Mayer (2014) in two points. First, standard gravity models do not include exchange rates, because it focuses only on geographical variables and trade costs such as tariffs. Second, the specification is defined at the HS 6-digit product level considering a large number of heterogeneous

¹The total number of products that can be submitted to import protection by one country is 77x6000 (462,000), that this the number of partners in the dataset times the number of products.

economies. Such a level of disaggregation is unusual for gravity models with this number of countries. Gravity equations were theorized at the aggregated level, to take into account country-specific resistance factors. Disaggregated gravity equations are generally applied to one country only. This level of disaggregation is needed here because of the nature of tariffs, as the latter are generally set at the product level, sometimes at the HS 8-digit, or even at the HS 12-digit level². The estimated equation is the following:

$$\begin{aligned} \ln X_{ijkt} = & \alpha + \beta_1 \ln RER_{ijt} + \beta_2 \ln(1 + \tau)_{ijkt} \\ & + \beta_3 \ln GDP_{it} + \beta_4 \ln GDP_{jt} + \alpha_{ijk} + \alpha_t + \epsilon_{ijkt} \quad (1) \end{aligned}$$

The dependent variable $\ln X_{ijkt}$ is the logarithm of the exports of country i to country j in product k in year t , expressed in dollars. The first variable of interest is $\ln RER_{ijt}$, the logarithm of the bilateral real exchange rate. The bilateral real exchange rate is defined here and for the rest of the paper as the number of units of the exporter's currency in one unit of the importer's currency. Thus, an increase in the real exchange rate is a depreciation of the exporter's currency, and an appreciation of the importer's currency. Given the number of free-trade area and of regional trade agreements, there is a large number of zero tariffs. The easiest way to include them in a log-gravity equation is to take the logarithm of one plus the tariff. This is the second variable of interest corresponds to the log of the power of the tariff, $\ln(1 + \tau)_{ijkt}$. To proxy the size effect, which was first identified in gravity frameworks, the practice is to include the log of both exporter and importer GDPs. These two controls expressed in dollars are included in logarithm as $\ln GDP_{it}$ and $\ln GDP_{jt}$. The common strategy then is to include a number of geographical and bilateral gravity controls. The multilateral resistance factors used are exporter-importer dummies covering bilateral distance, colonial status, whether a language is shared, and whether the two countries share a border. To control for product specific sources of variation, I include a three-dimension fixed effect, covering the exporter-importer-product dimension. With this fixed effect the coefficients will report the results of a within estimation. The geographical controls other than the GDPs do not appear in equation (1) because of this fixed effect. All exporter-importer gravity controls will be taken into account in the estimation since they are constant over time. I finally introduce a time fixed effect to take into account time-specific shocks.

One concern is a possible simultaneity bias between exports and the exchange rate. An increase in exports of country i will increase the demand for the exporter's currency. Therefore the exchange rate appreciates, which in turn decreases the exports of country i . But the correlation between the two variables is actually really low (0.04). Besides, the exports are at the HS-06 product level, and the exchange rate is determined at the country-level. It is unlikely that variations in product exports would induce sufficient

²The HS 6-digit product level is the most detailed level at which international comparisons are still possible.

variation in demand to put pressure on the exchange rate. Trade can also respond with a delay, a fact illustrated by the J-curve theory. I focus only on the relationship between exchange rates and exports at the same period though.

3.1 Benchmark results

Table 1: Gravity equation

	Dependent variable: exports (dollars)				
	(1)	(2)	(3)	(4)	(5)
	Exchange rates only	Tariffs only	Whole sample	Pre-crisis 1989-2007	Crisis 2008-2013
RER_{ijt}	0.276*** (217.47)		0.323*** (182.58)	0.393*** (175.58)	-0.0479*** (-6.13)
$1 + \tau_{ijkt}$		-0.582*** (-108.74)	-0.676*** (-124.22)	-0.524*** (-85.63)	-0.657*** (-37.26)
GDP_{it}	0.696*** (711.03)	0.631*** (552.03)	0.739*** (573.11)	0.661*** (309.10)	0.255*** (55.00)
GDP_{jt}	0.397*** (395.96)	0.541*** (445.05)	0.409*** (284.39)	0.369*** (172.78)	0.560*** (112.14)
Country-pair-product FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
N	82,951,590	53,097,221	53,097,221	36,585,070	16,512,151
R^2	0.681	0.726	0.726	0.745	0.828

Notes: robust standard errors. t statistics in parentheses. All variables are in logarithm; all nominal variables are expressed in US dollars. The number of observations varies between specification (1) and (2)-(3) due to the number of missing values in the tariff variable. Level of significance: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

The econometric estimations are presented in table 1. The first column reports the estimates of the gravity model with only the exchange rate as additional variable. Its estimates is positive as expected, and highly significant: an appreciation of the exporter's currency - a decrease of the real exchange rate - is associated to a decrease in its exports. The appreciation makes its exports more expensive relative to others, which induces a shift away of trade flows. The coefficients of both GDPs are positive and significant, though they differ in their magnitude. It appears that domestic GDP has more impact on exports than foreign GDP. The results of the gravity model with

only the tariff variable included are reported in column (2). Its estimates is negative as expected and highly significant. An increase in tariffs imposed by the importer on a specific product is associated with a decrease in this product exports. Since the estimates of both real exchange rate and tariffs are as expected and significant, I include them simultaneously in the regression to get the baseline estimation. The results are presented in column (3). The estimates on the real exchange rate and on tariffs increase, and are significantly different from the previous estimations. At constant tariffs (exchange rates), the impact of exchange rates (tariffs) on trade is greater, implying a possible link between the two variables. The estimates on GDPs change in opposite direction, but nor their sign nor their significance change.

[Kee et al. \(2013\)](#) show that the protectionist response was unusually low during the 2008-2009 crisis. In the same way, exchange rates moved in unexpected ways, mainly due to safe haven and carry trade effects. Given this, and the fact that crisis periods generally illustrated breaks in the macroeconomic relationships, I re-estimate the baseline specification of column (3) without the crisis period (1989-2007). In this specification, the estimate on the real exchange rate is larger, and the one on the tariffs smaller, but they are still both highly significant. The results for the crisis period (2008-2013) are reported in the last column, showing how much the common relationship broke, especially for the exchange rate.

I decide to focus on column (3) to quantify the impact of tariffs and exchange rates on trade flows, in two different ways. On the one hand, a 1% appreciation of the exporter's currency impact trade less than a 1% increase in tariffs. The equivalence between trade and currency barriers is the following: a 10% appreciation of the real exchange rate is equivalent to a 5% increase in the power of the tariff. On the other hand, one standard deviation in the log of the exchange rate (0.19) is associated to a 6.3% decrease in exports, while one standard deviation in the log of one plus the tariff (0.02) is associated to a 1% decrease in exports. The 1% increase interpretation and the standard deviation interpretation differ because exchange rates and tariffs have different pass-through: in theory, the impact on prices of tariffs and exchange rates variations is not equally reported by firms. Exchange rate movements are temporary, implying an incomplete pass-through, while tariffs variations are permanent with a complete pass-through. In practice, the tariff pass-through may not be complete, but is at least greater than the one of exchange rates. This implies that a 1% appreciation impacts trade less than a 1% tariffs increase. The complete pass-through on tariffs also explains why tariffs vary less, and why the standard deviation interpretation differs. Using firm-level data [Fitzgerald and Haller \(2014\)](#) study the elasticity of aggregated exports to exchange rates and tariffs to explore the international elasticity puzzle. They find that export revenue and export participation of long-time market participants respond more strongly to variation in tariffs than to variation in real exchange rates, precisely due to the difference in persistence and volatility of the two variables.

Table 2: Robustness checks

	Dependent variable: exports (dollars)				
	(6) High income	(7) Upper mid. income	(8) Lower mid. income	(9) Agricultural products	(10) Manufactured products
$REER_{ijt}$	0.0631*** (29.33)	0.693*** (166.12)	-0.0356*** (-5.43)	0.188*** (26.23)	0.334*** (176.79)
$1 + \tau_{jikt}$	-0.542*** (-88.57)	-0.914*** (-64.53)	-0.562*** (-28.98)	-0.224*** (-14.91)	-0.728*** (-121.09)
GDP_{it}	0.236*** (111.00)	1.271*** (446.56)	0.0620*** (9.30)	0.275*** (53.48)	0.777*** (559.35)
GDP_{jt}	0.495*** (297.20)	0.336*** (93.72)	0.563*** (99.84)	0.361*** (60.35)	0.435*** (282.51)
Country-pair-product FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
N	39,448,549	9,211,007	4,437,665	3,826,490	45,101,194
R^2	0.731	0.724	0.661	0.726	0.729

Notes: robust standard errors. t statistics in parentheses. All variables are in logarithm; all nominal variables are expressed in US dollars. The product classification excludes the extraction industry. Level of significance: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

3.2 Robustness checks

Using the World Bank classification regarding GDP per capita, I divide the sample into three groups and re-run the previous regression on high income countries, upper middle income countries and lower middle income countries³. The results are presented in table 2. Both exchange rates and tariffs estimates have the same level of significance as before. Looking more closely, their magnitude varies greatly, especially for the exchange rate estimates. The high-income economies' estimates are reported in the first column. The real exchange rate coefficient is much lower than when considering the whole sample: exports at the product level react less to exchange rate movements for high-income economies. This may be due to the fact that these economies generally produce and export differentiated products. The price elasticity of demand of this type of goods is low, which is at the core of the relation between exchange rates and exports. The estimates interpretation is as follows: one standard deviation in the log of

³The classification is reported in appendix.

the exchange rate (0.19) induces a decrease in exports by 1.1% for this country group, while one standard deviation in the log of tariffs (0.02) induces a decrease in exports by 1%. The equivalence between trade and currency barriers is much different from the whole sample: a 10% appreciation is equivalent to 1.1% increase in the power of the tariff for high income countries.

The second column reports the estimates for upper middle income economies. Both exchange rate and tariffs coefficients are higher, illustrating that the exports of these countries are much more sensitive to these variations than the average of the sample. One standard deviation in the log of the exchange rate (0.19) induces a decrease in exports by 13% for this country group, while one standard deviation in the log of tariffs (0.03) induces a decrease in exports by 2.7%. The impact of an increase in tariffs is much greater than previously. For upper middle income economies a 10% appreciation is equivalent to 7.6% increase in the power of the tariff.

The results of the third specification corresponds to lower middle income economies' estimates. The real exchange rate coefficient is unexpected: an appreciation of the exporter's currency is associated to an increase in exports. Though the estimates is actually low, its significance is high. This puzzling result may be explained by the fact that exports are expressed in dollars. An appreciation of the exporter's currency with respect to the importer's currency should have a negative impact on exports expressed in the home currency but not necessarily in dollars. I re-run the regression using exports, and both GDPs expressed in the exporter's currency to avoid this kind of valuation problem. The corresponding tables are reported in appendix. The estimates barely differ from the dollars specifications, except for the one for the lower middle income economies. The coefficients for exchange rate is now 0.052. This change of sign confirms the hypothesis of the valuation problem. However, the coefficient remains lower than for upper middle income countries: one standard deviation of the real exchange rates (0.21) is associated to a fall in exports of 1.1%, while one standard deviation (0.03) is associated to a decrease in exports of 1.7%. Even though the results vary a lot between countries, these specifications do not change the main interpretation. For this country group a 10% appreciation is equivalent to a 8.9% increase in the power of the tariff.

In the last two specifications I consider agricultural and manufactured goods separately. The estimates vary greatly between the two types of products. Agricultural exports are less sensitive to exchange rates or even tariffs variations: their estimates for both variables are much lower than for the manufactured products. This may come from the fact that there is not much tariff variation on agricultural products, preventing the estimation to highlight a sizeable impact.

These results show that the equivalence between exchange rates and tariffs vary among countries, according to their level of development, their trade specialization. Emerging economies' exports are more impacted by exchange rates and tariffs movements than high income economies. This is also true for manufactured products when compared to agricultural products. The key characteristic that can explain these conclusions may be the level of differentiation of products: more differentiated goods will

be less impacted by price variations that can be induced by exchange rates or tariffs movements. Overall, tariff movements impact trade more than exchange rates: they vary less, but these variations are anticipated to be permanent relatively to exchange rates variations.

The next section focuses on the relationship between exchange rate and protectionism, defined as tariffs first, and temporary trade barriers then.

4 Import protection in reaction to exchange rates movements

In this section I assess the causality link between exchange rates and tariffs. The underlying idea is the following: a country facing an appreciation of its currency and being unable to control it will be likely to respond with protectionism. The previous section gives an insight of this response, computing the equivalence of an appreciation and of a tariff increase. There are some historical illustrations of these protectionist retaliations. During the 1930s, the surge in protectionism was coming from countries retaliating against their partner's devaluation ([Eichengreen and Irwin, 2010](#)). Some countries decided to leave the Gold Standard, letting their currency float, and mainly depreciate. Mechanically, the countries who stayed pegged to gold saw their currency appreciate. Being unable to depreciate in order to restore their competitiveness, they ended up retaliating with protectionism, tariffs increasing significantly. The political action taken by the United States with the Currency Reform for Fair Trade⁴ goes in this way as well. The goal here is to assess whether exchange rate appreciations can cause a surge of protectionism, or at least if they precede them. In order to be as complete as possible, I look at both tariffs and what is called temporary trade barriers.

Before starting the estimation, the special case of the European Union needs to be addressed. The European Union has Common Customs Tariffs, but several currencies. When looking at the impact of exchange rate on protectionism, I cannot consider one trade policy for several exchange rates. I would take into account the same change in tariffs several times, introducing a bias in the estimates. Therefore, in this second part of the estimation I consider the EU as a whole. Doing so, I need to compute a composite real exchange rate of the EU. I use the standard real effective exchange rate formula, and construct a trade-weighted real exchange rate of the EU, as follows:

$$RER_{EU,jt} = RER_{EA,jt}^{\alpha_1} * RER_{GB,jt}^{\alpha_2} * RER_{Sweden,jt}^{\alpha_3} \quad (2)$$

where j is the other currency, and α_i the export share of the country in the total exports of the EU. I only take into account the Euro Area, Great Britain and Sweden to compute this European real exchange rate, since they account for more than 90% of the exports of the EU.

⁴Through this law voted in 2015, the USA allow themselves to impose an additional tariff when they think that their trading partner is manipulating its currency.

4.1 Tariffs and exchange rates

I study first the relationship between tariffs and macroeconomic variables. I expect the estimates to be low since only a few countries can still increase their tariffs without violating their WTO commitments. There is an upper bound that tariffs may not cross under the WTO, which is the bound tariff. I am looking at the response of preferential trade agreements and most-favoured nations tariffs: they can increase only if there is "water" in the tariffs, meaning only if they are lower than the bound tariff.

In order to study the relationship between protectionism and exchange rates, I estimate the following equation:

$$\begin{aligned} \text{Tariff}_{ijkt} = & \alpha + \beta_1 \ln RER_{ij,t-1} + \beta_2 \ln GDP_{j,t-1} + \beta_3 \ln GDP_{i,t-1} \\ & + \beta_4 \ln M_{ji,t-1} + \alpha_{ijk} + \alpha_t + \eta_{ijkt} \end{aligned} \quad (3)$$

The dependent variable Tariff_{ijkt} is the level of tariff imposed on country i by country j on product k in year t , expressed in percentage. The explanatory variables are all lagged to take into account the legislative delay that precedes the actual change in the tariffs. The variable of interest is the log of the bilateral real exchange rate between the trading partners from the previous year $\ln RER_{ij,t-1}$. I add controls that are the log of domestic and foreign GDP, $\ln GDP_{j,t-1}$ and $\ln GDP_{i,t-1}$, and the log of imports of country j from country i , $\ln M_{ji,t-1}$. I expect to have negative estimates on growths variables. There is an extensive literature showing that protectionism is a counter-cyclical trade policy, at the exception of [Rose \(2012\)](#). Protectionism should also decrease with the size of trade: I expect a negative estimates on bilateral imports. To control for product-specific variables and get a within estimation, I use an exporter-importer-product fixed effect, and a time fixed effect to control for time-specific shocks.

The results are presented in table 3. The first column reports the coefficients of the baseline regression estimated on the whole sample. The real exchange rate coefficient indicates that a 10% appreciation of the importer's currency is followed by an increase in tariffs by 0.43 percentage points in the next period⁵. The mean tariffs is about 8% for the countries in the sample indicating that the increase in tariffs following an appreciation is not negligible. A 10% increase of the domestic GDP is associated to a decrease in tariffs of 0.6 percentage points. On the contrary, a 10% increase in the foreign GDP of is associated with an increase in tariffs of 0.17 points of percentage. This highlights the strategic use of tariffs from the importing country. Tariffs tend to increase when the importer's economic health worsen, and when the exporter's economic health improves. Controlling for trade, I get that the more the country imports, the less import protection there will be.

⁵One concern that may arise at this point is of econometric order. This first regression show that exchange rates and tariffs are collinear, which could result in biased estimates in the gravity estimation. Multicollinear regressors can induce biased estimated variance, if the correlation is very high, and if the sample is small. Here neither of these two conditions are completed (the correlation between tariffs and exchange rates equals -0.06), thus the estimations of the first section remain unbiased.

Table 3: Tariffs and macroeconomic variables

	Dependent variable: tariffs (%)				
	(1) Whole sample	(2) Pre- crisis (1989-2007)	(3) High income	(4) Upper mid. income	(5) Lower mid. income
$REER_{ijt-1}$	4.283*** (174.16)	5.808*** (160.36)	1.414*** (68.23)	4.137*** (153.60)	4.057*** (43.25)
GDP_{jt-1}	-5.976*** (-189.49)	-6.627*** (-141.19)	-2.417*** (-148.25)	-4.027*** (-135.31)	-3.444*** (-21.57)
GDP_{it-1}	1.702*** (87.23)	3.197*** (82.42)	0.887*** (41.54)	1.090*** (49.44)	1.117*** (14.66)
$Imports_{jit-1}$	-0.111*** (-44.69)	-0.0927*** (-26.05)	-0.0141*** (-4.30)	-0.105*** (-38.45)	-0.294*** (-34.60)
Country-pair- product FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
N	28,709,771	19,198,715	15,016,459	8,250,086	5,443,226
R^2	0.592	0.542	0.485	0.698	0.638

Notes: robust standard errors, t statistics in parentheses. All explanatory variables are in logarithm. The classification of countries is reported in appendix. Level of significance: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

The interesting point of these coefficients is the use of tariffs as a strategic instrument. Tariffs decrease when the trading partner is in recession which comes out as a coordination-based policy. On the opposite, tariffs increase when the domestic growth is deteriorating. The same conclusion arises when considering the real exchange rate coefficient. Indeed, the importer seems to react with protectionism when its currency is appreciating. In a world where most of exchange rates are floating, or pegged to another currency, a country cannot prevent its currency from appreciating. Theory indicates that a way to retaliate, or at least to compensate this loss in export competitiveness is an increase in tariffs: my findings are in line with this theory.

In the following specifications I re-run the first regression on different sub-samples. The goal is to isolate the characteristics that could impact the link between exchange rates and tariffs. I first remove the crisis period from the sample, during which expected relations between macroeconomic variables were not observed. The pre-crisis coefficients do not change in sign nor significance, but their magnitude increases except for the bilateral imports: countries reacted less in term of protectionism during the global crisis than they usually do, which is in line with the findings of [Bown and](#)

Crowley (2013).

Next I do several regressions grouping countries according to their level of GDP per capita. Advanced economies are expected to trade more, to be more integrated, and to hedge more exchange rate risk. Thus, I expect high-income economies protectionism to react less to macroeconomic variables than upper or lower middle income economies. The last three specifications report the results of the estimation run on a three-part divided sample. High income economies react with import protection much less than other countries. A 10% appreciation is followed by an increase in tariffs of 0.14 percentage points when considering high income economies. Gawande et al. (2015) show that there are two forces that can explain such little response to macroeconomic shocks: the WTO rules and the preferential trade agreements on the one hand, and the degree of intra-industry trade. High income countries are generally those that have the least "water" in their tariffs. They also generally belong to one or several free-trade area, which explains why their estimates is lower. Finally, their high level of integration in the global supply chains gives another rationale for so little protectionist response.

The coefficients for upper and lower middle income economies are higher than for high income economies. These countries are indeed the ones that do have water in their tariffs, allowing themselves to respond to macroeconomic shocks with protectionism. The first statement that can be made at this point is that different economies respond to appreciations with protectionism, though the response varies.

Some additional specifications are reported in table 4. Because of free trade areas, a large number of tariffs in the dataset are equal to zero. The dependent variable being left-censored, I run a tobit regression on a randomly drawn subsample which equals 10% of the database⁶. The maximum likelihood estimation prevents me from using high dimension fixed effects: I consider only separated exporter, importer and time fixed effects here. Though the results are lower than in the previous OLS regression, they have the same sign and level of significance. This robustness check passed, I consider other OLS specifications in the following columns.

I look at whether the impact of macroeconomic variables on tariffs is different on agricultural and manufactured goods. On average, it appears that tariffs on manufactured products respond more to macroeconomic shock than tariffs on agricultural products. All estimates of column (3) are greater than those of column (2), but the level of significance does not change. Manufactured tariffs respond more than agricultural tariffs, and more than the average of the sample. A 10% appreciation of the importer's currency in t-1 is associated to an increase in tariffs of 0.44 points of percentage in the next period. For agricultural products, a 10% appreciation is followed by an increase in tariffs of 0.39 points of percentage. The difference is small but significant.

The following specifications consider the degree of openness of the countries considered. This indicator is computed as the sum of exports and imports reported to GDP

⁶A tobit model is identified using maximum likelihood estimation. This estimation does not allow to have a huge dataset as in this model, nor to use the corresponding number of fixed effects. I randomly select 10% of the dataset to be able to run this regression as a robustness check, since it reduces the number of observations and the number of fixed effects included.

Table 4: Robustness checks

	Dependent variable: tariffs (%)				
	(1)	(2)	(3)	(4)	(5)
	Tobit regression	Agricultural products	Manufactured products	Less open economies	More open economies
RER_{ijt-1}	3.278*** (34.50)	3.977*** (46.56)	4.375*** (161.23)	5.515*** (241.19)	2.450*** (51.98)
GDP_{jt-1}	-5.243*** (-62.03)	-4.928*** (-51.46)	-6.081*** (-172.84)	-7.066*** (-393.59)	-4.748*** (-57.08)
GDP_{it-1}	1.554*** (19.78)	1.587*** (17.85)	1.720*** (79.62)	2.063*** (85.07)	1.082*** (34.15)
$Imports_{jit-1}$	-0.573*** (-85.15)	-0.0684*** (-5.99)	-0.113*** (-41.48)	-0.119*** (-34.81)	-0.0824*** (-22.80)
Exporter FE	Yes				
Importer FE	Yes				
Country-pair- product FE		Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
N	2,952,787	1,606,871	24,974,436	15,444,231	13,265,540
R^2		0.733	0.578	0.643	0.513

Notes: robust standard errors, t statistics in parentheses. All explanatory variables are in logarithm. The tobit regression is run on a randomly drawn sub-sample (10%) of the database, with only exporter and importer separated fixed effects. The less open-more open distinction is made from the median of the sample. Level of significance: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

of the importing economy. I separate the sample into two parts at the median, with relatively more open economies on the one hand and relatively less open economies on the other one. The difference between the estimates of these two subsamples is more pronounced than when considering different types of products. The estimates double for less open economies: a 10% appreciation is followed by an increase in tariffs of 0.55 points of percentage for relatively less open economies, and by an increase of 0.25 points of percentage for relatively more open economies. The same goes with the GDPs estimates and for the impact of trade.

It seems counter-intuitive at first: one could expect that open economies would be more impacted by real exchange rate movements, increasing their probability to use tariffs to retaliate. But the degree of openness is also a proxy for the degree of dependence of the economy. The higher this indicator, the more the economy depends on trade. A relatively more dependent economy would be less inclined to respond to

macroeconomic shocks with protectionism. Doing so would increase its trading costs considerably, and would be more damaging than salvaging. The estimates show that the low dependence on trade allow countries to use protectionism strategically.

These several specifications give a clearer view on the conditions in which exchange rates appreciations can induce protectionist retaliations, with tariffs as the instrument. This usually is true for the pre-crisis period, in emerging economies, maybe more on manufactured goods though the difference is thin, and in relatively less trade dependent economies. But it highlights a puzzle in trade policy: a permanent variable, tariffs, react to temporary variations, exchange rates movements. A closer look at the dataset gives the following fact: a large part of increases in tariffs are followed by decreases. In 43% of the cases, the decrease happens the year after, in 8% of the cases it is two years later, and in 6.4% of the cases three years later. In the end, almost 57% of tariff increases are followed by decreases within a window of three years. All of these decreases in tariffs do not entirely corresponds to the preceding increase. Only 42% of increases are offset within a three years period after the rise in protectionism. This partially reconciles the puzzle.

The next section focuses on other types of protectionist measures, temporary trade barriers, since not all countries can use their tariffs as instrument.

4.2 Temporary measures and exchange rates

This section addresses the concern that looking only at tariffs would not be enough to capture the possible protectionist reaction following an appreciation. Following the methodology of [Bown and Crowley \(2013\)](#) and [Bown and Crowley \(2014\)](#), I look at the number of products, defined at the HS 6-digit level, concerned by the application of what is called "temporary trade barriers". Compiling the World Bank's *Temporary Trade Barriers Database* I consider several types of protectionist measures: global safeguards, China-specific safeguards, countervailing duties and anti-dumping fillings. Not all countries have the ability of increasing their tariffs anymore, due to their WTO commitments. I need to account for these alternative trade policy instruments to fully analyse the protectionist response to macroeconomic shocks. Because these measures are not used by all countries, or either because of missing data, I only have data for 40 countries. The dependent variable is a count variable, of the number of products submitted to import protection that is estimated with a negative binomial regression. It is used to model a count dependent variable, when there is over-dispersion of the data, that is when the conditional variance exceeds the conditional mean. Since the dependent variable is a non-negative count and follows a Poisson process, the distribution of counts of products subject to temporary trade barriers given the explanatory variables follows a negative binomial. I estimate the following equation:

$$N_{ijt} = \alpha + \beta_1 \Delta RER_{ijt-1} + \beta_2 \Delta GDP_{jt-1} + \beta_3 \Delta GDP_{it-1} + \beta_4 \Delta M_{jit-1} + \beta_5 TimeTrend + \beta_6 RTA_{jit-1} + \alpha_i + \alpha_j + \nu_{ijt} \quad (4)$$

The dependent variable N_{ijt} counts the number of HS-06 products which investigation started in year t , only when the final decision was to impose import protection on this product. Considering that these investigations are administratively managed, I use lagged explanatory variables, using annual data. The dependent variable is the flow of newly investigated products in year t , therefore I look at the impact of the variation of explanatory variables, not their level. The variable of interest is the variation of bilateral real exchange rates, ΔRER_{ijt-1} . I control for the domestic and foreign growth ΔGDP_{jt-1} and ΔGDP_{it-1} ⁷, and for the bilateral import growth of country j from country i , ΔM_{jit-1} . I include a time trend, and fixed effects. I drop the country-pair when there was not any products submitted to such import protection over the period. The model is identified using maximum likelihood estimation. Table 5 presents the results.

The coefficients reported in the table are the incidence rate ratios (IRR hereafter). An IRR greater than one indicates a positive relationship between the variable considered and the dependent variable. The first specification considers as dependent variable all HS-06 products submitted to investigation, regardless of whether it led to import protection or not. The real exchange rate estimates is greater than one, and significant, indicating that a country will increase the number of investigated products in year t following an appreciation in year $t-1$. The domestic growth IRR is lower than one: as for tariffs, temporary trade barriers are counter-cyclical. The foreign growth IRR is also lower than one: a recession abroad will be followed by an increase in import protection. The bilateral import growth does not seem to have any impact on this type of import protection. Finally, the time trend indicates that on average the number of investigated product increases, probably due to the fact that a growing part of WTO countries have their tariffs equal to their bound tariffs. These first results are consistent with the related literature (see [Knetter and Prusa, 2003](#); [Bown and Crowley, 2014](#)).

The following specifications focus only on the number of products under investigation when it led to actual import protection. The only difference with the previous estimation is that the size differential (away from one) of the IRRs on exchange rates and growth variables increase. The IRR on the time trend is closer to one, indicating that the number of investigated products that are subjected to actual protection increases less rapidly than the sole number of investigated products. I argued earlier that tariffs may not be the most responsive protectionist variable to macroeconomic shocks. I introduce in column (3) a regional trade agreement dummy in the specification, to account for the fact that the two trading partners belong to such agreement. The underlying idea is that if they do, their tariffs are constrained and thus cannot be used as a counter-cyclical instrument. The main IRRs do not change. The IRR on RTA is greater than one, and highly significant: the importer is more likely to impose temporary trade barriers if both countries belong to a trade agreement.

[Bown and Crowley \(2013\)](#) find that the protectionist response with those instruments was less than expected during the crisis. Knowing so, I re-run the estimation

⁷Real growth data come from the IMF.

Table 5: Import protection and macroeconomic variables (negative binomial)

	(1) All TTB	Number of investigated products subjected to import protection		
		(2) Whole sample	(3) Trade agreement	(4) Pre-crisis (1989-2007)
ΔRER_{ijt-1}	1.011*** (5.28)	1.020*** (7.28)	1.020*** (7.28)	1.025*** (7.77)
ΔGDP_{jt-1}	0.943*** (-6.96)	0.907*** (-11.70)	0.905*** (-12.15)	0.887*** (-12.59)
ΔGDP_{it-1}	0.986* (-2.39)	0.980* (-2.47)	0.981* (-2.38)	0.973** (-2.77)
ΔM_{jit-1}	1.000 (-1.53)	1.000 (-0.42)	1.000 (-0.43)	1.000 (0.07)
Time trend	1.107*** (19.27)	1.067*** (10.68)	1.063*** (9.64)	1.142*** (12.26)
RTA_{ijt-1}			1.336*** (4.49)	1.410*** (3.58)
Importer FE	Yes	Yes	Yes	Yes
Exporter FE	Yes	Yes	Yes	Yes
N	54,896	32,984	32,984	23,534

Notes: IRR are reported in lieu of coefficients. Standard errors are clustered at the country-pair level. t stats are in parenthesis. The number of observations differs in the first specification: there are more products investigated than subjected to actual import protection, less country-pair with total products equal to zero were dropped. Level of significance: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

on the pre-crisis sample (1989-2007). I get indeed a greater IRR for the real exchange rate, indicating that countries reacted more with protectionism to appreciations before than during the crisis. The IRR on domestic growth is smaller, as is the IRR on foreign growth. Bilateral import is still non significant. The time trend IRR indicates that countries were more likely to use this type of import protection before than during the crisis.

Using the beta-coefficients that are reported in appendix, I compute the actual impact of the real exchange rate. On the whole period (column 3), one standard deviation of the real exchange rate (20.94) induces a 40.8% increase in the number of investigated products. Considering only the pre-crisis period, one standard deviation of the real exchange rate (24.13) was associated to an increase of 59.4% in import protection. Using quarterly data for five advanced economies [Bown and Crowley \(2013\)](#)

find that one standard deviation increase in the percent change of the bilateral real exchange rate (15%) is associated with a 33% increase in such import protection in the pre-crisis period.

Table 6: Import protection: country-specific characteristics

	Number of investigated products that were subjected to import protection				
	(1) High income	(2) Upper mid. income	(3) Lower mid. income	(4) Less open economies	(5) More open economies
ΔRER_{ijt-1}	1.005 (1.61)	1.047*** (11.40)	1.007*** (3.38)	1.031*** (8.50)	1.001 (0.31)
ΔGDP_{jt-1}	0.893*** (-13.89)	0.900*** (-4.87)	1.026 (1.54)	0.979 (-1.27)	0.876*** (-15.91)
ΔGDP_{it-1}	0.996 (-0.35)	0.994 (-0.40)	0.935*** (-6.22)	0.980 (-1.66)	0.971** (-2.90)
$\Delta Imports_{jit-1}$	1.000* (-2.39)	1.000 (-0.26)	1.000 (-0.61)	1.000 (0.56)	1.000 (-1.32)
Time trend	0.999 (-0.13)	1.082*** (6.76)	1.122*** (18.28)	1.022** (2.59)	1.112*** (11.54)
RTA_{ijt-1}	1.365** (3.03)	1.471*** (3.93)	0.936 (-0.63)	1.305** (2.63)	1.213** (2.78)
Importer FE	Yes	Yes	Yes	Yes	Yes
Exporter FE	Yes	Yes	Yes	Yes	Yes
N	13,680	12,620	6,684	17,511	15,473

Notes: IRR are reported in lieu of coefficients. Standard errors are clustered at the country-pair level, t stats are in parenthesis. The classification of countries is reported in appendix. The less open-more open distinction is made from the median of the sample. Level of significance: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Since the sample is relatively large and heterogeneous, I decide to focus on some country-specific characteristics. Results of the corresponding estimations are reported in table 6. I start by considering countries grouped according to their GDP per capita level, as previously. In column (1) the estimates on real exchange rate is not statistically different from zero: high income countries do not respond to real exchange rate movements. The IRR on domestic growth is lower than one: as it was the case with tariffs, high-income economies do increase their import protection when they are in recession. These countries seem to react more to their own economic health than about the one of their trading partner, since the estimates for the foreign growth is

non significant. Bilateral import is significant, but equal to one. There appear to be no time trend in the protectionist behaviour of high-income economies, as the IRR is not significant. This implies that they use protectionism when they face economic downturns only, and especially if the trading partner belong to the same regional trade agreement.

Countries classified as upper-middle income economies react more than high income economies. Indeed, their IRR on real exchange rate is highly significant and greater than one. More specifically, one standard deviation is the real exchange rate of these countries (19.54) is associated to an increase of 90% of the import protection. They also increase their import protection when they are in recession, but they do not react to their trading partner's economic health, nor to their import growth. The IRR on the time trend indicates that they are using more and more these type of protectionist measures, especially if their tariffs are constrained by regional trade agreements.

Countries classified as lower-middle income economies react less to real exchange rate appreciations, but the estimates is still significant. They increase their import protection when their trading partner is in difficulty and the IRR on the time trend is the greatest when compared to the other specifications. The heterogeneity of this group does not allow to get any import conclusion out of their results.

The last two columns reports the estimates when considering the degree of openness of economies. I find that relatively more open countries respond only to real exchange rate movements or when their tariffs are constrained by a trade agreement, while relatively less open countries respond only to domestic or foreign growths. The IRR on the time trend indicates that both these groups use more and more temporary trade barriers, and this is even more true for open economies.

Temporary trade barriers are a protectionist instrument growingly used, especially when tariffs are constrained by trade agreements or WTO commitments. Results show that they are particularly used in response to exchange rate appreciations by emerging countries, and by relatively less trade dependent economies.

5 Conclusion

Protectionism and competitive devaluations are often used in the context of "beggar thy neighbour" policies. After computing the equivalent between exchange rates and tariffs, I find empirical evidence that the two variables are linked: an appreciation of the importer's currency is followed by an increase in import protection, through tariffs or temporary trade barriers. This is even more true for emerging economies, or for relatively less trade dependent economies.

These results are important if one considers their economic policy implication, particularly when exploring the causality link between currency wars and trade wars. Currency wars are generated by a cycle of competitive devaluations, through which a large number of countries aim at restoring their export competitiveness. My results show that protectionism could be used to retaliate in this context. In a non-cooperative

environment, currency wars through currency manipulation could confer a suitable economic context to a surge of protectionism, and to the development of trade wars.

These findings highlight the need for international policy coordination. The matter of currency manipulation has been avoided by international institutions. Article XV of the WTO states that any conflict to currency manipulation should be the of the IMF resort. On the IMF's side, article IV states that members should "avoid manipulation exchange rates [...] in order [...] to gain an unfair competitive advantage over other members", but the institution has no authority to impose sanctions.

This lack of international coordination or even action is preceded by the lack of research work. There is no consensus on what a currency manipulation really is, or on when it can start a "currency war". The present empirical work highlights the need for such research. Especially, further research should seek to provide a theoretical framework to these empirical findings, to evaluate the probability of currency wars evolving into trade wars, filling in the blank that remains on currency wars themselves.

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Appendix A

Table 7: Classification of the 78 countries

	High income economies	Upper middle income economies	Lower middle income economies
Argentine*	Russian Federation*	Algeria	Bangladesh
Australie*	Saudi Arabia	Brazil*	Benin
Austria	Singapore	China*	Cameroon
Belgium-Luxembourg	Spain	Colombia*	DR. Congo
Canada*	Sweden	Dominican Republic*	Cote d'Ivoire
Chile*	Switzerland	Costa Rica*	El Salvador
Czech Republic*	Trinidad and Tobago*	Ecuador*	Ghana
Denmark	United Kingdom	Jamaica*	Guatemala*
Finland	United States*	Jordan*	Honduras
France	Uruguay*	Malaysia*	India*
Germany	Venezuela*	Mexico*	Indonesia*
Greece	European Union*	Panama*	Kenya
Hong Kong	Ireland	South Africa*	Morocco*
Israel*		Thailand*	Nicaragua*
Italy		Tunisia	Nigeria
Japan*		Turkey*	Pakistan*
Korea*		Peru*	Philippines*
Kuwait		Paraguay*	Senegal
Netherlands			Syrian Arab Rep.
New Zealand*			Zambia
Norway			Egypt*
Poland*			Sri Lanka
Portugal			Tanzania
			Sierra Leone
			Mozambique

* Countries with an asterisk are those that are importers in the negative binomial regression

Appendix B

Table 8: Gravity (exporter's currency)

	Dependent variable: exports				
	(1)	(2)	(3)	(4)	(5)
	Whole sample	Whole sample	Whole sample	Pre-crisis 1989-2007	Crisis 2008-2013
RER_{ijt}	0.277*** (215.61)		0.332*** (184.75)	0.389*** (170.95)	-0.0352*** (-4.35)
$1 + \tau_{ijkt}$		-0.636*** (-118.44)	-0.730*** (-133.75)	-0.525*** (-85.81)	-0.650*** (-36.86)
GDP_{it}	0.652*** (835.08)	0.561*** (625.09)	0.677*** (616.35)	0.652*** (372.53)	0.331*** (72.22)
GDP_{jt}	0.353*** (429.31)	0.464*** (506.38)	0.331*** (277.23)	0.362*** (199.27)	0.637*** (128.25)
Country-pair-product FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
N	82,782,752	52,997,056	52,997,056	36,497,935	16,499,121
R^2	0.818	0.832	0.832	0.846	0.892

Notes: robust standard errors. t statistics in parentheses. All variables are in logarithm; all nominal variables are expressed in the exporter's currency to avoid valuation problems. The number of observations varies between specification (1) and (2)-(3) due to the number of missing values in the tariff variable. Level of significance: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 9: Gravity: robustness check (exporter's currency)

	Exports				
	High income	Upper mid. income	Lower mid. income	Agricultural products	Manufactured products
RER_{ijt}	0.0994*** (45.04)	0.764*** (183.48)	0.0529*** (7.67)	0.201*** (27.37)	0.344*** (179.01)
$1 + \tau_{ijkt}$	-0.521*** (-85.16)	-1.152*** (-78.10)	-0.506*** (-25.89)	-0.182*** (-12.07)	-0.808*** (-133.13)
GDP_{it}	0.332*** (187.32)	1.033*** (384.72)	0.283*** (54.07)	0.424*** (94.88)	0.688*** (582.26)
GDP_{jt}	0.536*** (328.74)	-0.0583*** (-23.08)	0.650*** (122.06)	0.527*** (108.61)	0.328*** (255.50)
Country-pair-product FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
N	39,448,549	9,211,007	4,337,500	3,809,267	45,021,519
R^2	0.812	0.833	0.846	0.836	0.833

Notes: robust standard errors. t statistics in parentheses. All variables are in logarithm; all nominal variables are expressed in the exporter's currency to avoid valuation problems. The product classification excludes the extraction industry. Level of significance: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Appendix C

Table 10: Summary statistics

Variables	Whole sample	Pre-crisis (1989-2007)	High economies	Upper mid. economies	Lower mid. economies
<i>Dependent variables</i>					
Tariff	8.74 (20.23)	9.71 (22.05)	5.20 (16.22)	10.97 (13.36)	13.36 (30.91)
Count of products TTB	1.43 (12.83)	1.54 (14.22)	1.51 (10.99)	0.76 (10.11)	0.92 (3.42)
<i>Explanatory variables</i>					
$\Delta RER_{ijt} - 1$	1.15 (15.06)	1.37 (23.96)	1.85 (16.82)	0.80 (19.43)	0.48 (14.97)
$\Delta GDP_{jt} - 1$	8.90 (13.16)	8.21 (13.67)	8.63 (14.31)	9.53 (13.16)	8.91 (11.24)
$\Delta GDP_{it} - 1$	8.07 (13.94)	7.80 (14.37)	8.02 (13.82)	8.04 (13.93)	8.01 (13.57)

Notes: Mean and standard deviations in parenthesis.

Appendix D

Table 11: Import protection and macroeconomic variables (negative binomial)

	(1) All TTB	Number of investigated products subjected to import protection		
		(2) Whole sample	(3) Trade agreement	(4) Pre-crisis (1989-2007)
ΔRER_{ijt-1}	0.0114*** (5.28)	0.0194*** (7.28)	0.0195*** (7.28)	0.0246*** (7.77)
ΔGDP_{jt-1}	-0.0590*** (-6.86)	-0.0975*** (-11.70)	-0.100*** (-12.15)	-0.120*** (-12.59)
ΔGDP_{it-1}	-0.0144* (-1.53)	-0.0202* (-2.47)	-0.0194* (-2.38)	-0.0277** (-2.77)
$\Delta Imports_{jit-1}$	-0.00000376 (-1.53)	-0.000000639 (-0.42)	-0.000000657 (-0.43)	0.000000133 (0.07)
Time trend	0.102*** (19.27)	0.0650*** (10.68)	0.0608*** (9.64)	0.133*** (12.26)
RTA_{ijt-1}			0.289*** (4.49)	0.343*** (3.58)
Importer FE	Yes	Yes	Yes	Yes
Exporter FE	Yes	Yes	Yes	Yes
N	54,896	32,984	32,984	23,534

Notes: standard errors are clustered at the country-pair level. Beta-coefficients are reported, t stats are in parenthesis. The number of observations differs in the first specification: there are more products investigated than subjected to actual import protection, less country-pair with total products equal to zero were dropped. Level of significance: *** p<0.01, ** p<0.05, * p<0.1

Table 12: Import protection: country-specific characteristics

	Number of investigated products that were subjected to import protection				
	(1) High income	(2) Upper middle income	(3) Lower middle income	(4) Less open economies	(5) More open economies
ΔRER_{ijt-1}	0.00469 (1.61)	0.0463*** (11.40)	0.00649*** (3.38)	0.0307*** (8.50)	0.000680 (0.31)
ΔGDP_{jt-1}	-0.113*** (-13.89)	-0.105*** (-4.87)	0.0256 (1.54)	-0.0209 (-1.27)	-0.133*** (-15.91)
ΔGDP_{it-1}	-0.00438 (-0.35)	-0.00610 (-0.40)	-0.0669*** (-6.22)	-0.0202 (-1.66)	-0.0292** (-2.90)
$\Delta Imports_{jit-1}$	-0.0000712* (-2.39)	-0.00000622 (-0.26)	-0.0000111 (-0.61)	0.00000166 (0.56)	-0.0000165 (-1.32)
Time trend	-0.00128 (-0.13)	0.0790*** (6.76)	0.115*** (18.28)	0.0217** (2.59)	0.107*** (11.54)
RTA_{ijt-1}	0.311** (3.03)	0.386*** (3.93)	-0.0661 (-0.63)	0.266** (2.63)	0.193** (2.78)
Importer FE	Yes	Yes	Yes	Yes	Yes
Exporter FE	Yes	Yes	Yes	Yes	Yes
N	13,680	12,620	6,684	17,511	15,473

Notes: standard errors are clustered at the country-pair level. Beta-coefficients are reported, t stats are in parenthesis. The classification of countries is reported in appendix. The less open-more open distinction is made from the median of the sample. Level of significance: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.