Assessing the impact of the EU-Chile FTA on international trade

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As preferential trade agreements (PTAs) multiply, understanding their impact upon economies in general, and international trade in particular, is increasingly important. Yet, important questions remain open about the magnitude of this impact. Among these, the sensitivity of trade flows to trade barriers is especially important: it determines how given tariff concessions may impact trade flows. As emphasised in the recent literature, these trade elasticities are also important from a theoretical point of view, since they condition the welfare impacts of trade shocks (Arkolakis et al., 2012). In this respect, PTAs can be considered as natural experiments, allowing elasticities to be estimated accurately.

This paper proposes estimates of trade elasticities, focusing on the free trade agreement beteween EU and Chile, in force since February 2003. This Agreement is interesting from the European point of view, because it is among the first signed with a partner which is neither a neighbour nor a former colony. As such, this is an Agreement where trade per se is really a central motivation on both sides, and it can be considered as a blueprint for the Agreement being negotiated or considered. In this regard, policy evaluation is key to improve practices. For Chile, PTAs are especially important –Chile presdently has 22 Agreements in force, with 59 partner countries-, and this Agreement stands out due to the importance of the EU as a trading partner: , the EU was the destination for almost 18% of Chile's exports in 2010, making it the second leading Chilean export market at that time (ranking second to China), and it supplied 14% of its imports (next to China and the US). In addition, this Agreement is to carry out a meaningful ex-post analysis, and detailed, reliable data are available on both sides.

To avoid the bias derived from aggregate trade data, we focus on a product-level analysis. The econometric assessment is then based on the comparison of trade outcomes across products, investigating whether they are meaningfully linked to tariff cuts.

In so doing, it is important to disentangle tariffs from other potential determinants of trade flows, linked to product-specific trends in supply and demand in the EU and in Chile.

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These trends are controlled for by studying, instead of bilateral export flows *per se*, their trend over and above what could have been expected based on exports to and imports from third countries. This "difference-in-differences" approach, applied at the product level, allows an accurate assessment of the link between tariff cuts and bilateral trade between the contracting parties.

We first present the methodology employed and the way it is implemented. Estimation results are then presented, and used in simple simulations to give more specific insights about the nature of the trade impacts of the Agreement.

1 Methodology

Since Aitken (1973), the gravity model has been used in an uncountable number of articles to provide a meaningful benchmark, against which the impact of trade agreements can be assessed. We discuss how such a model can be used in the present case, given the specificities of this ex-post assessment exercise. We argue that assessing the impact of one single agreement requires a radically different approach from the one followed in most of the literature, which aims at assessing the trade impact of FTAs *in general*. For a particular, complex agreement like the one studied here, the assessment must acknowledge the progressive and uneven impact of the agreement, and control, at a detailed level, for changes in supply and demand which are not specifically linked to the EU-Chile FTA. We propose to estimate a difference-in-differences gravity model at the product level: we argue such a model provides not only a detailed and robust assessment of the trade impact of the EU-Chile FTA's tariff clauses, but also an evaluation of the consequences of cross-cutting clauses, like the ones related to trade facilitation.

A. Departing from traditional gravity approaches

Relying on gravity models to assess the trade impact of free trade agreements has become traditional. The extended literature about these models, since Tinbergen's early 1960s work, not only showed that gravity models allow rather accurate representations of trade flows; when duly amended, they are also consistent with a variety of international trade theoretical frameworks (see *inter alia* Anderson 1979 ; Bergstrand 1989 ; Deardorff 1998 ; Anderson et van Wincoop 2003 ; Chaney 2008). Nevertheless, approaches differ widely across studies, resulting in significantly different results (see Baldwin and Taglioni 2006, for a discussion).

Most of this literature focuses upon the statistical analysis of the impact of FTAs *in general*. The basic approach sets a dummy variable equal to one if an agreement is enforced between the two partners, and zero otherwise; it has been used initially in cross-section, and subsequently in panel data analyses (Carrère 2007; Baier and Bergstrand 2007, are two recent examples among numerous others). The ability to jointly analyse a large number of agreements naturally requires simplifications. In particular, three common assumptions are worth mentioning: FTAs are considered as a one-off shock (the "one-off" assumption);[2] the average impact is computed as an average across agreements, implicitly assuming agreement impacts to be identical, even though special cases like custom unions are usually considered separately (the "homogeneity" assumption); the aggregate analysis also overlooks differences across products (the "uniformity" assumption). While these simplifications are natural when a large number of agreements are studied, focusing on a single agreement makes it possible to carry out a more detailed analysis, taking into account the phase-in period, the coverage and preference margin of the agreement, as well as the differences across products.

An additional difficulty in the present case is that other agreements are almost concomitant to the one studied. This is particularly true in the case of the Chile-US agreement, entered into force in January 2004, with potentially important consequences for Chile's foreign trade. This configuration makes it all the more difficult to rely only on the time dimension to identify the impact of the FTA.

Anderson and van Wincoop (2003) were particularly influential in showing the necessity to take into account what they dubbed "multilateral resistance factors", also called remoteness, reflecting in particular the intensity of competition in each country. These factors are difficult to estimate, but omitting them is potentially a source of severe inconsistency. An alternative would be to model remoteness so as to be able to track its evolution over time, as proposed for instance by Baier and Bergstrand (2009). This would require relying on a strong assumption about the underlying model, and it would also ignore the possible impact of other trade agreements signed in parallel by the partners under study, or assume that their impact can be duly identified. As initially suggested by Rose and Van Wincoop (2001) and by Feenstra (2004), this problem can be solved by relying on country fixed effects. When the analysis relies on panel data, these country fixed effects should even be varying over time. A downside of this approach is that the results are difficult to interpret in terms of the impact of the trade agreement, since the fixed effects absorb a large part of the variance. Assume for instance that the EU-Chile trade agreement did increase Chile's export potential as a whole, since its market access to the EU is improved. This effect would be captured by the time-varying, country fixed effects, and could not be identified as such. In addition, this approach has been implemented for aggregate relationships, and it is not clear how it would apply to product-level analyses.

A more promising approach in identifying the trade impact of a given agreement is to take advantage of the multiplicative form of the gravity equation, by transforming the dependent variable. Instead of trade flow x_{ijk} from country i to country j, in product k, the dependent variable is expressed as a ratio with respect to a control exporter i' (or group of exporters): $x_{ijk}/x_{i'jk}$. When the gravity equation is written in logarithm form, this corresponds to a difference gravity equation. This approach was followed by Anderson and Marcouiller (2002), Hanson and Xiang (2004) and more recently Djankov et al. (2010).[3]

[2] Baier and Bergstrand (2007) is an exception: they account for the phase-in period by assuming that the impact spans over ten years, as reflected in the two lags introduced in their analysis based on five-year interval panels.

[3] Head and Mayer (2000) follow a slightly different approach, which they refer to as an odds specification, since they use the importer itself as control exporter.

Differencing with respect to a control exporter allows any unobservable effect linked to the importer—but not specific to any exporter—to be controlled for. Compared to a standard gravity equation, an important advantage of this approach is that it can be applied product by product, or sector by sector, whatever the appropriate definition.

Even in this case, though, changes in the exporter's supply which are not specific to the market under study should be controlled for. This is especially important when a dynamic economy like Chile is concerned. This is why Romalis (2007) differentiates the dependent variable a second time, with respect to a control market. When the equation is expressed in logarithm, this corresponds to a difference-in-differences approach. We now spell out this approach and the changes we plan to introduce, so as to deliver a robust yet specific assessment of the EU-Chile FTA.

B. Specification of estimating equations

A generic gravity model for trade flows between two given partners, for a given product, can be written as follows:

(1) $$x_{ijkt} = G_{kt}S_{ikt}M_{jkt}\phi_{ijkt}$$

where x stand for exports from country i to country j, in product k, at year t. G is a factor invariant across countries (although possibly time-varying), S is an index of the exporter's characteristics, M refers to the importer's characteristics. ϕ is an index of determinants of the bilateral intensity of trade flows. In the simplest form of the gravity model, S and M stand for each country's GDP and ϕ for inverse distance, but such an overly simplistic specification has long been shown to be ill-suited. While more often used at the aggregate level, this equation can also be used at the product level. In such a relationship, the purely bilateral dimension of trade flows is described through ϕ. Accordingly, any impact of trade agreements on partner countries should be looked for in this variable's changes.

Identification is challenged by the difficulty in controlling correctly for multilateral determinants of trade (S and M). As emphasised by Anderson and van Wincoop (2003), these terms, specific respectively to the supplier and the importer, include multilateral resistance factors which are not directly observable and for which assessment raises a number of difficulties. This hurdle can be sidestepped when considering, instead of trade flows, ratios of bilateral trade flows across partners. Dividing equation (1) term-by-term, written for two exporters i and i':

(2)

$$R_{ii'jkt} = \frac{x_{ijkt}}{x_{i'jkt}} = \frac{S_{ikt}}{S_{i'kt}}\frac{\phi_{ijkt}}{\phi_{i'jkt}}$$

where R is the ratio of country j's imports in product k, from provider countries i and i', respectively. This expression washes out both the general term G and the importer-specific index M. If exporter-specific characteristics are assumed constant over time (or varying evenly across products), then this equation allows cross-partner relative changes in ϕ to be identified. Note that the logarithmic version of equation (2) corresponds to a difference specification, since $ln(R_{ii'jkt}) = \ln(x_{ijkt}) - \ln(x_{i'jkt})$.

When exporters’ characteristics are assumed to vary over time (for instance due to demand changes resulting from an FTA), then the changes in these characteristics can be controlled for by focusing on the relative level in markets *j* and *j'* (control importer) of the import ratio from provider countries *i* and *i'*. This "ratio of ratios" (noted BR for bi-ratio) is obtained by dividing equation (2) term-by-term, written for market *j* and *j'*:

(3)

$$BR_{ii'jj'kt} = \frac{R_{ii'jkt}}{R_{ii'j'kt}} = (\frac{x_{ijkt}}{x_{i'jkt}})/(\frac{x_{ij'kt}}{x_{i'j'kt}}) = (\frac{\phi_{ijkt}}{\phi_{ij'kt}})/(\frac{\phi_{i'jkt}}{\phi_{i'j'kt}})$$

Expressed in logarithm, equation (3) corresponds to a difference-in-differences specification. Romalis (2007) shows that this equation allows to identify the impact of a bilateral FTA upon trade flows between partners.[4] Indeed, under standard assumptions (including perfect competition and differentiated goods according to country of origin) and assuming that transport costs can be written as the product of a time- and a product-fixed effect, the bilateral terms of trade flow intensity can be written:[5]

(4) $$\phi_{ijkt} = a_{ijk} b_t c_k \tau_{ijkt}^{\sigma}$$

where τ is equal to one plus the ad valorem custom duty applied by country *j* over imports of good *k* from country *i* at date *t*. The b_t parameters are time fixed effects, including any factor influencing all trade flows in a given year, like for instance, the outbreak of a worldwide economic crisis or a temporary increase in all transport costs. The c_k parameters are product fixed effects, reflecting product-specific differences in the intensity of trade flows, resulting from transportability, distribution of supply and demand across the world, and other structural factors. Parameters a_{ijk} include the determinants of trade intensity specific to a pair of countries, for a given product, which are constant over time; they usually include distance, contiguity, common language and colonial links, among others. σ_k is the elasticity of substitution between product *k*’s varieties. Estimating this elasticity then allows the impact on bilateral trade of a given cut in tariff duties to be assessed, in comparison to trade flows with other partners. Now, substituting (4) into (3):

(5)

$$BR_{ii'jj'kt} = \left[(\frac{a_{ijk}}{a_{i'jk}})/(\frac{a_{ij'k}}{a_{i'j'k}})\right]\left[(\frac{\tau_{ijkt}}{\tau_{ij'kt}})/(\frac{\tau_{i'jkt}}{\tau_{i'j'kt}})\right]^{\sigma}.$$

Following the method applied by Romalis (2007) to the trade-creation effect of NAFTA, equation (5) paves the way for estimating the trade impact of the EU-Chile FTA. In order to do so, let us focus on Chilean exports to the EU (the same analysis, with appropriate alterations, is carried out for EU’s exports to Chile), considering that index j refers to the EU-15 (*j* = *U*),[6] and *i* to Chile (*i* = *C*). j' refers to a control group of importers (*j'* = *M*), a set of

[4] In a different context, Head et al. (2007) apply a comparable method to aggregate trade flows.

[5] Such an expression can for instance be obtained based on Romalis' (2007) model. Here, it is enough to assume that the different components of bilateral trade intensity are combined in a multiplicative form.

[6] To avoid overburdened notations, each index is denoted by single letter.

representative countries whose trade policy with regards to Chile did not change over the period under study. Finally, i' is a control group of exporters ($i' = X$), including partners which did not face, during the period under study, any specific change in the trade policy applied to them by the EU and by the control group of importers. In these conditions, the ratio of tariff duties applied by the control group of importers, M, to the partner, C, and the control group of exporters, X, does not vary over time. Assuming the elasticity of substitution σ to be constant across products, equation (5) can then be re-written as:

$$(6) \qquad BR_{CXUMkt} = \lambda_k \gamma_t \left(\frac{\tau_{CUkt}}{\tau_{XUkt}}\right)^{\sigma}$$

where $\lambda_k = \left[\left(\frac{a_{CUk}}{a_{XUk}}\right)/\left(\frac{a_{CMk}}{a_{XMk}}\right)\right]\left[\left(\frac{\tau_{XMkt_0}}{\tau_{CMkt_0}}\right)\right]^{\sigma}$ and $\gamma_t = \left[\left(\frac{\tau_{XMkt}}{\tau_{CMkt}}\right)/\left(\frac{\tau_{XMkt_0}}{\tau_{CMkt_0}}\right)\right]^{\sigma}$. This type of equation is usually estimated under a log-linear form:

$$(7) \qquad \ln(BR_{CXUMkt}) = \alpha_k + \beta_t + \sigma_g \ln\left(\frac{\tau_{CUkt}}{\tau_{XUkt}}\right) + u_{kt}$$

where $\alpha_k = ln(\lambda_k)$, $\beta_t = \ln(\gamma_t)$, u is the error term and a subscript g, referring to product groups, has been added to σ in order to allow the elasticity of substitution to differ across product groups (see below). The dependent variable here is the difference across importers in differences across exporters, as is clear from the following expression of the dependent variable: $\ln(BR_{CXUMkt}) = [\ln(x_{CUkt}) - \ln(x_{XUkt})] - [\ln(x_{CMkt}) - \ln(x_{XMkt})]$. In this expression, the first term in squared brackets is the difference between EU imports from Chile and those from a control group of exporters; the second term is also the difference between imports from Chile and from a control group of exporters, but this time computed for the control group of importers. In sum, the dependent variable measures the change in EU imports from Chile over and above what is expected given the increase in Chilean exports and EU imports with respect to well-chosen control groups.

Intuitively, the idea is to measure whether EU imports from Chile changed in a way specifically linked to the EU-Chile FTA. These bilateral imports may increase because EU import-demand for a specific product rose. Such an effect would also affect imports from other suppliers, though. Computing EU imports from Chile as a proportion of EU imports from a control group of importers is thus a way to make sure that any trend identified is not linked to changes in EU demand. Still, even when EU imports from Chile are measured through this proportion in comparison to other suppliers, changes may be due to the increasing export capacity of the Chilean economy, independently from the EU-Chile FTA. Would that be the case, however, this dynamism of Chilean exports should materialise in all export markets, not only in the EU. Hence the interest in expressing EU imports from Chile, i.e. Chile's exports to the EU, as a proportion of Chile's exports to a control group of importers. Any remaining trend is not linked to outcomes specific to Chile's export capacity. In sum, the transformation of the dependent variable makes sure that changes analysed are not linked to characteristics specific either to the EU's demand or to Chile's supply, but rather to factors specifically linked to bilateral trade relations between the EU and Chile.

This difference-in-differences specification of the gravity model analyses whether this relative performance of Chilean exporters to the EU market is linked to the relative level of tariffs they face in this market. Identification here only relies on product-by-product changes over time and the specification allows for heterogeneity (i) across years, common to all products (for instance, linked to macroeconomic variables); (ii) across products and years in the competitiveness of Chilean suppliers, since this is controlled through the difference across importers; (iii) across products and years in EU's market demand, since this is controlled through the difference across exporters.

For Poisson and related models, such as the negative binomial model used below, the econometric model is specified in the multiplicative form:

$$(8) \qquad BR_{CXUMkt} = \exp\left(\alpha_k + \beta_t + \sigma\, ln\left(\frac{\tau_{CUkt}}{\tau_{XUkt}}\right)\right) \times v_{kt}.$$

This expression is obtained by taking the exponential of the specification in equation (7), the main difference being that the error term (on which distributional assumption are made) is now $v_{kt} = \ln(u_{kt})$. These estimating equations require trade data not only between the EU and Chile, but also between Chile and the control group of importers, and between the control group of exporters and the two markets (EU, control group of importers). This involves two significant constraints, however. The analysis cannot be fully carried out at the EU's or Chile's tariff-line level (at the 8-digit level), since trade statistics between the two control groups are only available at the 6-digit level. Only those product-year pairs for which the ratio-of-ratios is defined are taken into account which requires exports from the export control group toward both markets, as well as exports from the partner toward the control group of importers, to be non-zero.

The theoretical advantages of analysing difference-in-differences (or ratio-of-ratios, in the multiplicative form) thus go together with practical drawbacks limiting the sample potentially used for estimation purposes. Accordingly, it is also worth carrying out the assessment based on equation (2), where the dependent variable is a simple difference instead of a difference in differences, namely the difference in logarithms of EU imports, from the partner and from the reference group of exporters, respectively:

$$(9) \qquad \ln(R_{CXUkt}) = \alpha'_k + \beta'_t + \sigma \ln\left(\frac{\tau_{CUkt}}{\tau_{XUkt}}\right) + u'_{kt}.$$

Such estimation can be carried out based exclusively on European data. This method does not control for output price changes potentially spurred by the EU-Chile FTA, though. If additional demand on the European market drives the price of Chilean exporters up (either through increased production costs, or through higher margins), then the estimate of the elasticity of substitution σ would be biased downward. Still, these estimates are useful robustness checks of the ones based on difference-in-differences.

Estimating equations (7) and (9) makes it possible to assess how tariff concessions granted in the EU-Chile FTA have impacted Chilean exports to the EU. Inverting the role of Chile and the EU in the above description, the same analysis can be applied to identify the consequences for EU's exports to Chile.

The regressions provide two parameters of interest: the elasticity of substitution σ and time fixed effects βs. σ is the elasticity of substitution between providers. The specification used is actually consistent with demand for imports of product k being drawn from a CES subutility function across products from different origins. This elasticity of substitution, linked to the degree of product differentiation, is likely to differ across groups of products, but assuming it to be common within large enough product groups is necessary to allow accurate identification. To strike a balance between flexibility and robustness, the elasticity of substitution is allowed to differ across sectors.

C. Estimating the impact of non-tariff clauses

The time fixed effects β_t reflect the share of unexplained variance in the dependent variable that is specific to a given year. The estimates may help assess what the effect of the EU-Chile FTA has been over and above what is explained by cross-product differences in tariff cuts.

However, correct identification should recognize the potential cross-product variance in these non-tariff impacts. Trade facilitation, improved data treatment, easier custom clearance and mutual recognition of standards are among the main issues at stake here. The sensitivity of trade to improvement in these areas is likely to differ significantly across products. These different effects can be caught up by allowing time fixed effects to vary across groups of products. The estimating equation would then be

$$(10) \qquad \ln(BR_{CXUMkt}) = \alpha_k + \beta_{tg} + \sigma_g \ln\left(\frac{\tau_{CUkt}}{\tau_{XUkt}}\right) + u_{kt}$$

where β_{tg} measures a yearly, product-specific change in imports, unexplained either by performances of Chilean exporters in other markets or by import demand from other providers (these effects are taken into account in the dependent variable), nor by the evolution of tariffs. Accordingly, if the EU-Chile FTA's non-tariff clauses enhance trade in a given product, the corresponding β_{tg} coefficient should increase over time.

Estimates have been carried out for both EU and Chile imports. Again, groups of products are assumed to be sectors. In each case, the corresponding effects are not significantly different from zero.

D. Implementation

Implementing the methodology described above raises a number of issues, practical and methodological. The main ones are the following.

Control groups

The methodology described above relies on control groups of exporters and importers to control for changes in the importer's demand and in the exporter's supply not specific to the bilateral relation under study. The choice of control groups is important to the success of the proposed estimation strategy. Because these control groups' trade is supposed to reflect changes in market conditions, countries in these control groups should not face significant changes specific to their trade relations with the partners under study, nor with countries of the other control group. Taking again the example of the analysis of Chilean exports to the EU, countries in the control group of exporters should not have signed (or have been phasing in) any trade agreement with neither the EU nor countries of the control group of importers during the period under study. Similarly, countries in the control group of importers should not have signed (or have been phasing in) any trade agreement with neither Chile nor countries of the control group of exporters during the period under study. An additional requirement for these control groups is to be large enough so that they can be considered representative, and that the number of cases where the data is missing for any of the four flows needed to build the dependent variables remains limited.

In practice, when studying Chile's exports to the EU, the control group of exporters is composed of all Latin American countries not belonging to the ACP group, except Mexico (see the full list in Appendix 1). This is a relatively large group of exporters, with a structure of exports comparable to the Chilean one, and no trade agreement with the EU in force over the period considered. The control group of importers is then defined as including all countries, except the EU, Chile and members of the control group of exporters, which do not have any trade agreements in force with either Chile or any member of the control group of exporters during the period under study. This group includes 121 countries. The same control groups are used for the analysis of EU's exports to Chile, inverting their role. Latin American countries thus act in this case as the control group of importers, while other countries form the control group of exports.

Data

The period studied is 2001-2009. The data used to implement the analysis are trade and tariff data at the tariff line (8-digit) level for the EU and Chile. For products covered by an entry price system, only the ad-valorem component is taken into account. This is enough to capture the differential effect of the agreement upon protection faced by each partner, since only the ad-valorem component is cut for such products. The baseline estimations exclude products covered by tariff-rate quotas; as a robustness check, estimates based on inside- and on outside-quota tariff rates have also been carried out. For EU imports, copper and ores are also excluded.[7] Salmon and trout products are also excluded after 2006, since the sanitary crisis strongly blurred trade evolutions afterwards. Preferential and non-preferential suspensions are taken into account. Changes in nomenclatures are corrected for by reconstitution when possible (i.e., when the change was a mere relabeling). When the content of a given nomenclature code changes, it is considered as a different product before and after the break.

Products covered by tariff-rate quotas are excluded from the sample in the estimates presented, because it cannot be asserted systematically whether the binding rate is the inside- or outside-quota tariff rate.[8] Unreported estimates were carried out as robustness checks and they showed that the results are robust to two alternative treatments, namely including quota products using either the inside-quota tariff rate (IQTR) or the outside-quota tariff rate (OQTR). This hardly makes any difference for Chilean imports. For EU imports,

[7] As illustrated in Chapter 1, ores and most of all copper represent a very significant part of EU imports from Chile. However, trade outcomes in these sectors bear little relationship with the Agreement: the corresponding products are not dutiable in the EU, and outcomes are strongly influenced by changes in international prices, which have been very substantial over the period studied, in particular for copper. As a result, these products, if anything, are likely to blur the analysis. Still, we checked that including these products in the econometric estimates does not modify significantly the results.

[8] As mentioned in Chapter 1, TRQs are scheduled in the Agreement for 28 products for Chile imports, and for almost 300 products for the EU.

using the IQTR naturally leads to a lower estimate, since the corresponding impact may be limited for TRQ products by the size of the quota. Using OQTRs makes very little difference to excluding quota products altogether, although it tends to give slightly smaller estimates, presumably because the cut in the OQTR is not relevant when the quota is not filled.

As already mentioned, the analysis based on difference-in-differences ("bi-ratios") also requires data about trade between the two control groups, which cannot be drawn from EU and Chile national sources. These data can be put together at the 6-digit level of the Harmonised System (HS6 level) for the period 2000-2009 using Cepii's BACI database (built as a harmonization of UN's Comtrade database). To limit discrepancies linked to differences across data sources, BACI is also used as the source for imports from Chile of the control group of importers (for which Chile's national customs would have been another source).

To summarize, tariffs and the term x_{CUkt}/x_{XUkt} in the definition of the dependent variable are computed at the 8-digit level, based on national sources, while the term x_{CMkt}/x_{XMkt} is computed based on BACI data, at the HS6 level. The latter term controls for changes across time[9] in the competitiveness of Chile's exporters in comparison to the control group of exporters, based on imports of the control groups of importers. Constrained by the data, these changes are thus assumed to be common to 8-digit subproducts, within each HS6 product. Another solution would be to aggregate EU and Chile imports and tariffs at the HS6 level and to carry out the analysis at this level; however, this would reduce the information available for identification, and raise issues about the right way to aggregate tariffs.

Estimation methods

By default, ordinary-least squares (OLS) estimates are obtained, with standard-errors robust to heteroskedasticity and to clustering. Clustering is performed at the HS6 level when the dependent variable is expressed as a difference-in-differences (since the denominator is then computed at the HS6 level), and at the 8-digit level when the dependent variable is expressed as a simple difference. In the context of heteroskedasticity, however, feasible generalised least squares (FGLS) estimates are more efficient and so they are used as an alternative. A drawback of both estimators is their inability to take into account the fact that a number of trade flows are zero. A first method to account for this is to consider that the observed distribution is censored, because trade flows cannot be less than the level of trade costs. Following Eaton and Kortum (2001) and Crozet et al. (2011), a possible estimation strategy in this context is to use the lowest observed positive trade flow within each category as a maximum likelihood estimate of the censoring point, here the category-specific sunk cost of exporting. We adopt this estimation strategy as an additional robustness check, using HS chapters as the categories within which the sunk cost of exporting is assumed constant.

Santos-Silva and Tenreyro (2006) have pointed out the bias inherent in the standard estimation approach, linked to both heteroskedasticity and to unsuited treatment of zero flows. They find it preferable to estimate gravity models under their multiplicative form,

[9] Heterogeneity in level is accounted for by product fixed effects, defined at the 8-digit level.

using a Poisson quasi-maximum likelihood estimator (QMLE). However, Santos-Silva and Tenreyro's (2006) approach has been in turn criticized for not taking into account zero flows in a satisfactory way. Martin and Pham (2008) show that the Poisson model may be unsuitable if there are too many zero-trade observations. When working at the product-level as we are doing here, zeroes are actually an overwhelming majority, making the suitability of this method dubious.[10] Burger et al. (2009) confirm this sensitivity to zero observations, and emphasize in addition the sensitivity of Poisson estimates to overdispersion; they show that negative binomial estimators are more robust in this context. Compared to the Poisson model, the negative binomial model has the same expected value, but the variance depends upon both the conditional mean and a dispersion parameter. Through differences in this dispersion parameter, an additional degree of freedom is introduced in the model, thus allowing overdispersion to be accommodated.

Negative binomial estimators can thus be used to take Santos-Silva and Tenreyro's (2006) contribution into account, in a framework better suited to the specificity of the present estimations. In the present context, however, the transformation of the dependent variable means that zeros in the flows used as controls, i.e. to and from control groups, also result in missing observations, making it more difficult to account meaningfully for zero flows. In addition, the properties of this method at a very detailed level of aggregation such as the one used here have not been well explored so far. Against this background, we will only use negative binomial estimates as robustness checks.

2 Estimation results

The methodology described above is used to identify the trade impact of the EU-Chile FTA based on product-level information on trade and tariffs. The analysis is carried out from the point of view of the importing party (the EU or Chile), adapting it to the specificities of each country.

2.1 EU imports from Chile

Following the approach described in Appendix 1, we first provide estimates of the elasticity of substitution, on average and sector by sector. Subsequently we attempt an estimation of the effects of non-tariff clauses.

Following the estimation strategy and the mode of implementation described in Appendix 1, we obtain a consistent first set of estimates of the average elasticity of substitution across providers for EU imports from Chile (Table 1). The base estimating equation, used for estimates (1) to (3), is equation (7): $\ln(BR_{CXUMkt}) = \alpha_k + \beta_t + \sigma_g \ln\left(\frac{\tau_{CUkt}}{\tau_{XUkt}}\right) + u_{kt}$. The parameter of interest, σ, is assumed constant in the present case, but it will be assumed variable across good categories (indexed by g) in subsequent estimates. σ is the elasticity of substitution between the products provided by different

[10] Unreported estimates confirmed this concern, with results highly sensitive to specification and sample, sometimes resulting in inconsistent estimated values.

suppliers. It measures the sensitivity of imports from different providers to their relative prices, which has direct implications for the assessed impact of the EU-Chile FTA.

Table 1: Estimates of the average elasticity of substitution for EU15 imports from Chile

	Panel of difference-in-differences				Panel of differences
	(1)	(2)	(3)	(4)	(5)
Sigma (all products)	-6.16 **	-9.02 ***	-5.96 ***	-4.76 ***	-3.52 **
	(-2.01)	(-24.18)	(-2.71)	(-2.67)	(-2.37)
Estimation method	OLS	FGLS	Tobit	Negative binomial	OLS
Product fixed effects	x	x	x	x	x
Year fixed effects	x	x	x	x	x
Observations	6,256	6,256	6,256	9,004	14,789

Scope: All products of the Combined Nomenclature, 8-digit level, years 2001 to 2009, excluding copper and copper products (HS Chapter 74) and ores (HS Chapter 26). Salmon and trout products are also excluded after 2006. Products covered by a tariff-rate quota, either within the EU-Chile FTA or on a non-preferential basis, are excluded.

Notes: OLS estimates based on CIF imports as declared by the importer. Row “Sigma” refers to the estimated value of σ. Estimates (1) to (3) are based on equation (7), estimate (4) on equation (8), and estimate (5) on equation (9). (Cluster-)robust t-statistics reported in parentheses (clustering is assumed at the HS6 level for estimates 1 and 2, and the 8-digit level for estimate 5).[11] Bootstrapped standard-errors used for estimate (3). *, ** and *** denote significance at the 10%, 5% and 1% statistical level.

The estimated elasticity of substitution is significantly different from zero at the 5% or 1% level in each case, with values close to -6 for OLS and Tobit estimates, and to -5 for the negative binomial estimate. The FGLS estimate gives a higher value (-9) while, as expected, estimates based on simple differences give a somewhat lower estimated elasticity.

An elasticity of -6 means that, if the FTA cuts the tariff applied by the EU to Chilean exporters for a given product by 1%,[12] the econometric model predicts that the value of EU imports from Chile would increase by 6%, relative to the value of imports from the control group of importers. Note that this relative increase may be obtained as a result of a

[11] Clustering of standard errors refers to the situation where error terms are correlated over subsets of observations. Not taking this pattern into account typically leads to an overstatement of the precision of the results, hence non-conservative conclusions about the statistical significance of the results. The cluster-robust statistics used here are a standard way to correct for this bias. It accounts for the fact that the error term is likely to be correlated across observations for a given product. Because observations for the control groups are made at the HS6 level for estimates 1 and 2, this is the level at which the correction is applied. Such a correction is not needed when bootstrapped standard errors are used.

[12] This interpretation assumes that a 1% tariff cut implies a 1% decrease in the relative consumer price of Chilean imports in the EU. This is an approximation. If the tariff is cut from τ_0 to τ_1, and assuming the tariff applied to other partners is unchanged, the relative price of imports from Chile is actually cut by $(\tau_0 - \tau_1)/\tau_0$. The logarithm of relative imports values would then be increased by a factor $\sigma \ln(\tau_1/\tau_0)$.

combination of increased imports from Chile and/or decreased imports from other providers. And, obviously, that this percentage may apply to very low initial flows.

The most direct benchmark for our estimates is Romalis (2007), since the methodology used here is partly based on this work. His estimates range between -6.3 and -9.4 for US imports from Canada, between -9.6 and -10.9 for US imports from Mexico, between -2.8 and -5.5 for Canadian imports from the US, between -6.6 and -8.1 for Canadian imports from Mexico, between -2.0 and -2.5 for Mexican imports from the US, and between -0.5 and -0.7, although insignificant, for Mexican imports from Canada. Against these benchmarks, our estimates appear to be consistent, although in the lower range of comparable estimates available.

Other comparable estimates are not widespread in the literature. It is uncommon to carry out such detailed estimates, and a more detailed product breakdown leads to higher elasticities of substitution, because estimation at more aggregated levels involves an aggregation bias (see e.g. Imbs and Méjean 2009, for a discussion). Based on a very different method (elaborating from Feenstra 1994), Broda and Weinstein (2006) find for instance that the simple average of the elasticities of substitution for the US between 1990 and 2001 was around -12.6 for ten-digit (HTS) goods (compared to only 4.0 among three-digit goods), although the median is only -3.1 (-2.2 at the three-digit level). Kee et al. (2008) also provide estimates of import demand elasticities at the six-digit level, which average -3.1 for all HS products, i.e. at a somewhat more aggregated level.

Table 2: Estimates of the elasticity of substitution for EU15 imports from Chile, by sector

	Panel of difference-in-differences				Panel of differences	Average (1)-(3)
	(1)	(2)	(3)	(4)	(5)	
Alcoholic beverages	-14.68 *	-17.43 ***	-13.67 ***	-3.08	-4.24	-15.3
	(-1.83)	(-8.64)	(-3.66)	(-0.50)	(-0.98)	
Fruits	-9.48 **	-1.79 ***	-8.52 **	0.25	-7.91 **	-6.6
	(-2.25)	(-17.65)	(-2.02)	(0.07)	(-2.24)	
Fish, crustaceans & prod.	-8.68	-13.06 ***	-8.39 *	3.43	-3.84	-10.0
	(-1.41)	(-5.64)	(-1.70)	(0.50)	(-1.17)	
Other agric. & food prod.	-0.71	-8.01 ***	-1.46	-3.70	-3.83	-3.4
	(-0.16)	(-38.80)	(-0.46)	(-1.51)	(-1.39)	
Wood & its products	-21.88	-11.24 ***	-16.69 *	-28.57 ***	-12.47	-16.6
	(-1.59)	(-2.59)	(-1.81)	(-2.65)	(-1.42)	
Other manufactured products	-11.87 ***	-9.55 ***	-9.87 ***	-13.67 ***	-0.46	-10.4
	(-2.70)	(-25.06)	(-3.20)	(-3.40)	(-0.22)	
Estimation method	OLS	FGLS	Tobit	Negative binomial	OLS	
Product fixed effects	x	x	x	x	x	
Year fixed effects	x	x	x	x	x	
Observations	6,256	6,256	6,256	9,004	14,789	

Scope: All products of the Combined Nomenclature, 8-digit level, years 2001 to 2009, excluding copper and copper products (HS Chapter 74) and ores (HS Chapter 26). Products covered by a tariff-rate quota, either within the EU-Chile FTA or on a non-preferential basis, are excluded.

Notes: Estimates based on CIF imports as declared by the importer. Rows refer to the estimated value of σ by sector. Estimates (1) to (3) are based on equation (7), estimate (4) on equation (8), and estimate (5) on equation (9). (Cluster-)robust t-statistics reported in parentheses (clustering is assumed at the HS6 level for estimates 1 and 2, and the 8-digit level for estimate 5). Bootstrapped standard-errors used for estimate (3). *, ** and *** denote significance at the 10%, 5% and 1% statistical level.

To gain further insight about the sensitivity of imports to tariffs, the same estimates are carried out allowing the elasticity of substitution to vary across sectors. This is done based on a classification tailored to the pattern of EU imports from Chile. The estimated elasticities of substitution, reported in Table 2, exhibit stronger variability at this level. In particular, the negative binomial estimate and the estimate based on the panel of simple differences fail to provide significant estimates in most sectors. However, the three other estimates provide a rather consistent set of estimates, with a larger estimated elasticity of substitution for alcoholic beverages and for wood and its products, and a smaller elasticity for the sector of other agricultural products. The average of these three estimates, reported in the last column, can be deemed a suitable synthesis of these results.

The relatively low price-sensitivity of bilateral imports for fruits and other agricultural products may seem surprising. However, Chilean exports tend to be concentrated on specific products, like fresh grapes, apples or kiwifruits. In such cases, there is little room for substitution across products when prices change. In addition, most Chilean competitors in the EU market (EU producers, to begin with) are in the Northern hemisphere, meaning that their seasonal cycle is different from the Chilean one. All these elements may explain the relative price insensitivity of Chilean exports in the EU, in particular for fruits and for other agricultural products.

2.2 Chilean imports from the EU

Data on Chilean imports were available up to 2010 when this analysis was carried out, so the analysis covers the period from 2001 to 2010. Based on customs declarations at the 8-digit level, we report for the EU the estimated elasticity of substitution between imports from different providers, and subsequently the estimated trade impact of non-tariff clauses.

Table 3: Estimates of the average elasticity of substitution for Chilean imports from the EU15

	Panel of difference-in-differences			Panel of differences
	(1)	(2)	(3)	(4)
Sigma (all products)	-14.19 ***	-16.31 ***	-15.64 ***	-14.25 ***
	(-10.62)	(-49.79)	(-11.50)	(-12.33)
Estimation method	OLS	FGLS	Tobit	OLS
Product fixed effects	x	x	x	x
Year fixed effects	x	x	x	x
Observations	22,578	22,578	22,578	28,201

Scope: All products of the SACH Nomenclature, 8-digit level, years 2001 to 2010. Products covered by a tariff-rate quota are excluded.

Notes: Estimates based on CIF imports as declared by the importer. Row "Sigma" refers to the estimated value of σ. Estimates (1) to (3) are based on equation (7), and estimate (4) on equation (9). (Cluster-)robust t-statistics reported in parenthesis (clustering is assumed at the HS6 level for estimates 1 and 2, and the 8-digit level for estimate 4). Bootstrapped standard-errors used for estimate (3). *, ** and *** denote significance at the 10%, 5% and 1% statistical level.

Based on the same equation and estimation techniques as those used for EU's imports in Table 1, the EU-Chile FTA's trade impact can be assessed by estimating the elasticity of substitution between imports from the EU and from the control group of importers (Table 3). Since EU exports are far more diversified than those from Chile, far more observations are available when applying the same methodology to Chilean imports from the EU. The results obtained at the aggregate level are very similar across estimation methods. They consistently suggest that the elasticity of substitution faced by EU exports on the Chilean market is very high, with estimated values ranging from -14.2 to -16.3.[13]

Table 4: Estimates of the elasticity of substitution for Chilean imports from the EU15, by sector

	Panel of difference-in-differences			Panel of differences	Average (1)-(3)
	(1)	(2)	(3)	(4)	
Agric. & food	-3.43	-8.72 ***	-9.39 ***	-10.28 ***	-7.2
	(-0.84)	(-9.33)	(-3.82)	(-2.94)	
Mineral prod.	0.06	-15.57 ***	-7.94	-1.86	-7.8
	(0.00)	(-12.33)	(-0.86)	(-0.21)	
Chemical prod.	-15.45 ***	-16.83 ***	-16.67 ***	-14.70 ***	-16.3
	(-6.18)	(-31.46)	(-8.17)	(-7.03)	
Machinery	-16.43 ***	-19.97 ***	-17.79 ***	-15.48 ***	-18.1
	(-9.34)	(-42.81)	(-10.16)	(-10.71)	
Vehicles	-17.27 ***	-15.16 ***	-18.10 ***	-23.60 ***	-16.8
	(-3.39)	(-20.19)	(-5.05)	(-6.33)	
Precision instr.	-10.81 ***	-14.08 ***	-11.91 ***	-11.91 ***	-12.3
	(-4.27)	(-17.52)	(-5.23)	(-5.31)	
Other products	-14.27 ***	-14.74 ***	-15.18 ***	-13.74 ***	-14.7
	(-8.77)	(-34.02)	(-10.62)	(-9.72)	
Estimation method	OLS	FGLS	Tobit	OLS	
Product fixed effects	x	x	x	x	
Year fixed effects	x	x	x	x	
Observations	22,578	22,578	22,578	28,201	

[13] Negative binomial estimates could not be carried out in this case, for computational reasons. This method is computationally very burdensome, and the method requires using around 4,000 dummy variables, making the estimation intractable despite our best efforts.

Scope: All products of the SACH Nomenclature, 8-digit level, years 2001 to 2010. Products covered by a tariff-rate quota are excluded.

Notes: Estimates based on CIF imports as declared by the importer. Rows refer to the estimated value of σ by sector. Estimates (1) to (3) are based on equation (7), and estimate (4) on equation (9). (Cluster-)robust t-statistics reported in parentheses (clustering is assumed at the HS6 level for estimates 1 and 2, and the 8-digit level for estimate 4). Bootstrapped standard-errors used for estimate (3). *, ** and *** denote significance at the 10%, 5% and 1% statistical level.

Sector-level estimates also give fairly precisely estimated elasticities of substitution (Table 4). Mineral products are the only sector where most estimates are not statistically significant, but this is a sector where few observations are available. The estimated elasticity of substitution is comparatively small in agriculture (-7.2), but this sector does not represent a large share of EU exports to Chile. In all other sectors, the estimated elasticity of substitution is very high. This suggests that, although the preferential margin granted to EU exporters was small, as a result of the rather low level of protection in Chile, the trade impacts may have been substantial.

This conclusion may not seem natural based on the descriptive statistics described above. What this suggests is actually that, absent an agreement, EU exports to Chile might well have dropped significantly in relative terms, in a context where Chile signed trade agreements with a large number of other partners.

3 Simulating the trade impact of the EU-Chile FTA

Once elasticities of substitution of bilateral imports between the EU and Chile are estimated, simple counterfactual simulations can be carried out to identify and quantify the trade impact of the FTA. The calculations presented here are first-order approximations, based upon the own-price elasticity of demand for imports from Chile, estimated based on observed import levels. They assume (tax exclusive) producer prices expressed in the importing country currency to remain constant. The budget allocated to each product in total imports is in addition assumed to remain constant (see Appendix 2.3 for details). Less simplistic simulations, for instance using a coputable general equilibrium model, would give more accurate insights about the possible consequences of the Agreement, but this is a useful way to illustrate the implications of the estimations.

3.1 Simulated impact of the EU-Chile FTA on EU imports from Chile

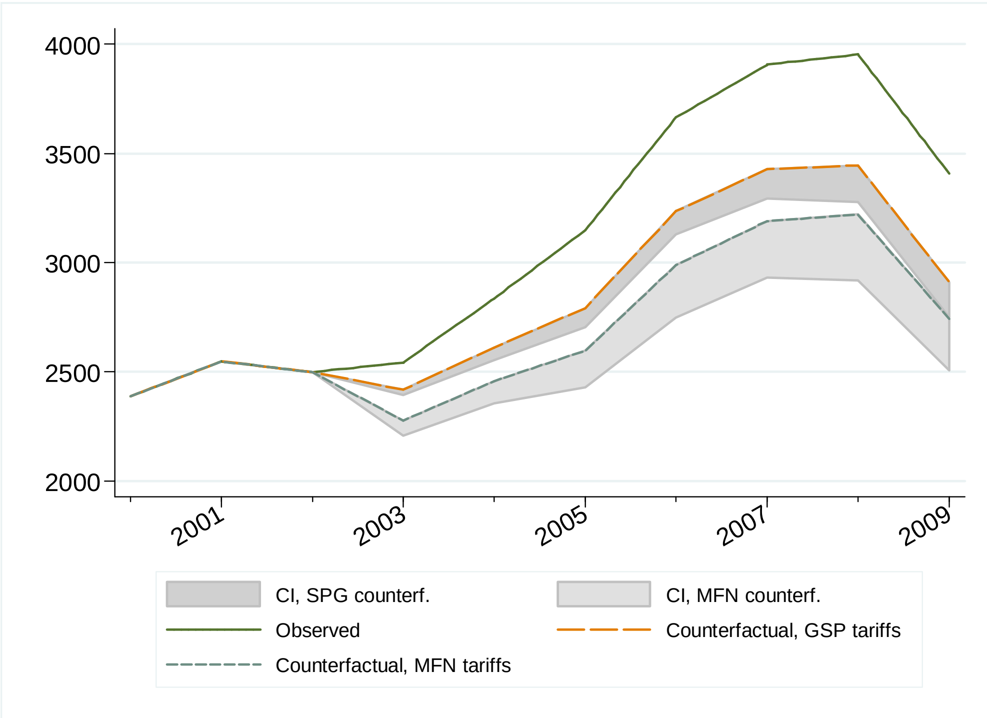
The trade impact of the FTA is simulated here based on the comparison against the MFN and the GSP regimes.[14] The results suggest that the EU-Chile FTA had a significant impact on bilateral trade (Figure 1, Panel A). In 2009, EU imports from Chile would be lower by approximately 500M€ if Chile were applied to the GSP regime instead of the EU-Chile

[14] As before, copper and ores are excluded from these calculations, because the tariff clauses of the EU-Chile FTA are not expected to have an impact on imports of these non-dutiable products. Including them would not change the estimated differences across counterfactual scenarios. For TRQ products, the IQTR is retained as the measure of protection within the EU-Chile FTA when the quota is not filled, while the OQTR is used when the quota is filled (i.e., for meat products and for hake).

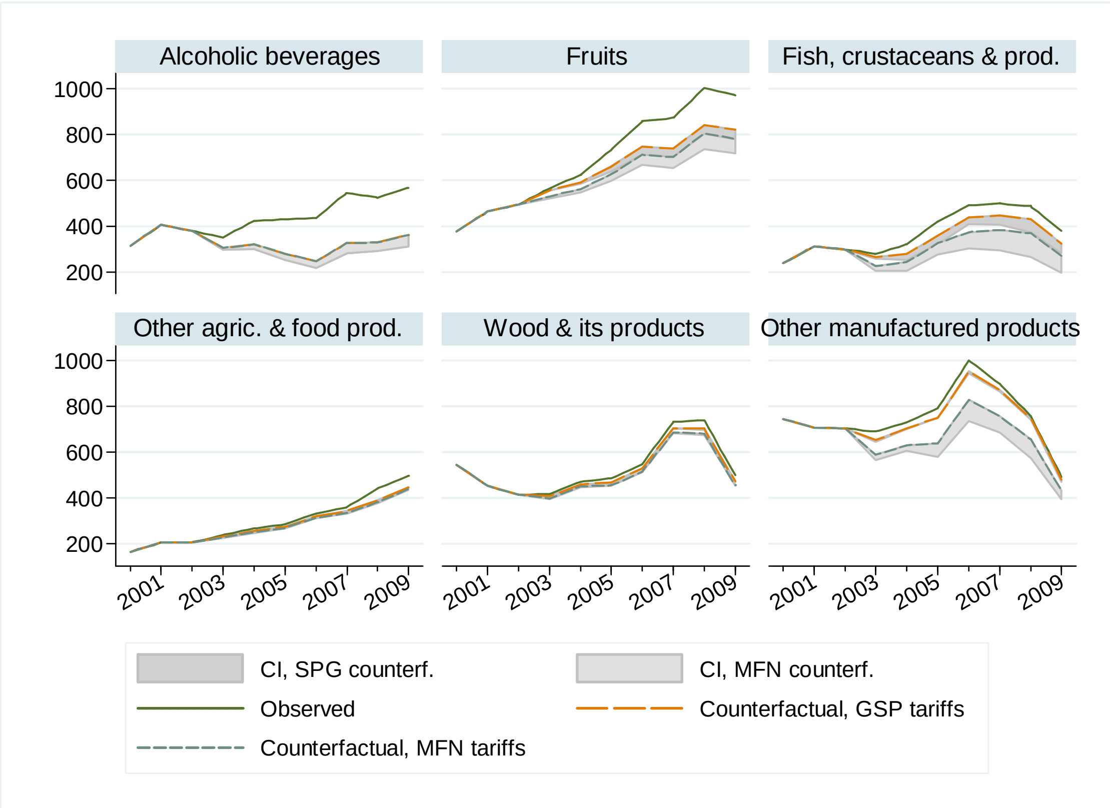
FTA, a decline of about 15% compared to the observed level for non-copper, non-ores products. Switching to the MFN regime would involve a decrease by 665M€, or about 20%. Based on the lower-bound of the confidence interval, the difference with counterfactual imports under the MFN regime reaches 900M€, more than a quarter of observed imports.

Figure 1: Estimated counterfactual levels of EU27 imports from Chile (in million euros)

Panel A: All products, excluding copper and ores



Panel B: By sector



Notes: Counterfactual levels are computed based on equation (12). Confidence intervals, represented as shaded areas, are built with a lower-bound computed using the price elasticity of demand as expressed in (13), instead of (11) in the base case. Copper (HS Chapter 72) and ores (HS Chapter 26) are excluded.

The estimated trade impact of the EU-Chile FTA, in comparison to the GSP, is strongest for alcoholic beverages (in practice, wines), at 206 M€ or 36% of actual imports (switching to the MFN would have the same impact in this case). The increase is also substantial for fruits (151 M€, or 15%, and 191 M€, or 20% in comparison to the MFN regime). The EU-Chile FTA's estimated impact is also substantial for fish (55 M€, 15% in comparison to the GSP, 107M€ or28% in comparison to the MFN), even though it declined after 2006, due the sanitary crisis in salmon cultures. In other sectors, estimated impacts are comparatively small, even though the estimated impact was substantial in 2006-2007 for other manufactured products, due to dutiable copper co-products (in 2006, imports would have been lower by 47M€, or 5%, under the GSP, and by 172M€, or 17%, under the MFN).

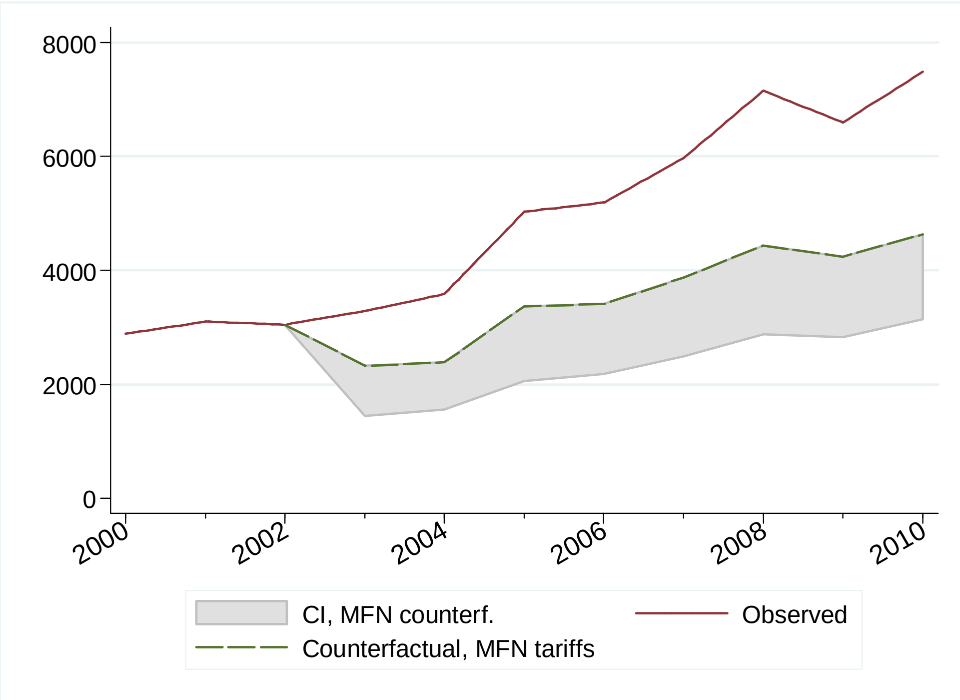
3.2 Simulated impact of the EU-Chile FTA on Chile imports from the EU

As regards Chilean imports from the EU, the relevant counterfactual is the MFN regime. According to our estimates, this would make a powerful difference compared to imports actually registered. Imports would be US$2,850 million lower, or fall by 38% of their observed level (Figure 2). Based on the lower-bound of our confidence interval, the estimates suggest that switching to the MFN regime would cut imports by more than US$4,300 million, or 57% of actual levels.

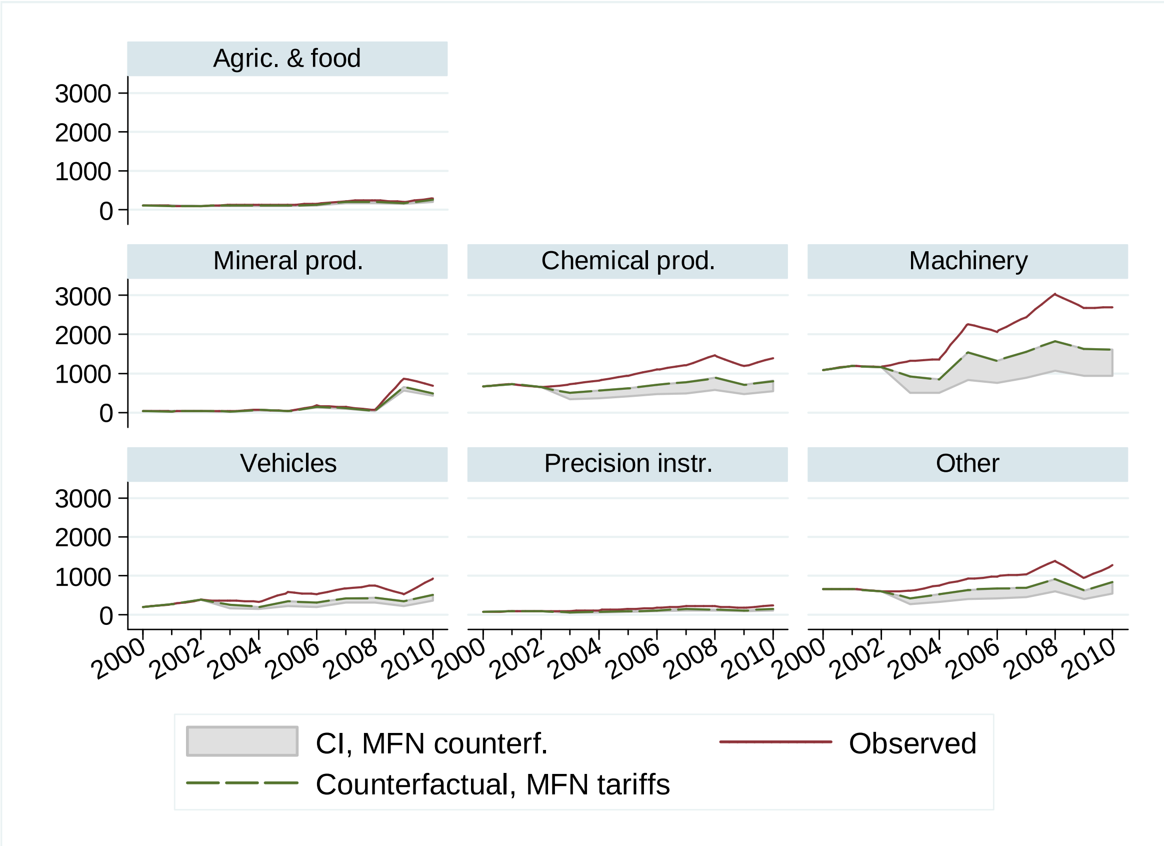
At the sector level, the highest estimated impacts of the EU-Chile FTA are registered for machinery (US$ 1,080 million, 40%), chemical products (US$ 580 million, 42%) and vehicles (US$ 420 million, 45%). The associated confidence interval, linked to the market share of European imports, is especially large for machinery products.

Figure 2: Estimated counterfactual levels of Chilean imports from the EU27 (in millions US$)

Panel A: All products, excluding copper and ores



Panel B: By sector



Notes: Counterfactual levels are computed based on equation (12). Confidence intervals, represented as shaded areas, are built with a lower-bound computed using the price elasticity of demand as expressed in (13), instead of (11) in the base case.

4 Concluding remarks

The comparison across products suggests that a significant positive impact on EU imports from Chile has taken place in specific sectors. As for Chilean imports, the EU's market shares tended to decline since the Agreement was enforced, but this was a period where EU exports were outpaced by a large margin by exports from other regions, and several agreements were being phased-in by Chile.

To assess econometrically the role played by the EU-Chile FTA in these trends, we rely here on a transformed version of the gravity equation. In order to carry out an assessment specific to this agreement, trade impacts are identified out of comparisons across products of import changes, in relation to tariff cuts. Proper estimation requires controlling for several potential competing effects, such as the trends in Chile and the EU's supply and demand, product by product. This is achieved by studying the difference-in-differences of imports, expressed in logarithms. For instance, instead of considering EU imports from Chile properly speaking, econometric estimates are based upon changes in these imports, beyond what could be expected given trends in Chile's exports to other markets, and trends in EU imports from other providers. This specification implies that estimates cannot be directly interpreted as giving the assessed EU-Chile FTA impact. Initial trade levels must be taken into account, as must be the potential consequences on prices, incomes and supplies. Simplified simulations are presented.

Combining these techniques with the most detailed information available (at the tariff-line level) proves useful: robust estimates of the trade impact of tariff cuts are obtained. The results suggest that tariff cuts granted by the EU to Chile had a significant impact on the level of EU imports from Chile, compared to other suppliers. The elasticity of substitution between imports from Chile and from other providers is estimated to be approximately 6 on average, but estimated elasticities larger than 10 are found in several sectors, suggesting that even a 1% tariff cut might result in a more-than-10% increase in imports. The simulations carried out based on these estimates suggest that EU imports from Chile would be 15% lower in 2009, were Chile granted the GSP regime; if the MFN regime were applied to EU imports from Chile, their level would fall by 20%, or 665 M€. Put differently, this means that the EU-Chile FTA is estimated to have increased EU imports from Chile by a quarter. Wines and fruits are the sectors which benefited most.

The estimated elasticities of substitution between imports from different providers are larger for Chilean imports from the EU. The order of magnitude of the average is 15, with estimated elasticities even slightly larger than this in some manufacturing sectors. These are very high levels for elasticities, but they are not inconsistent with the few estimates carried out in other contexts at a comparable level of detail in the product classification. These elasticities must also be put in perspective against a context where Chile's initial protection was low and exhibited variability across products. Simulations based on these estimates suggest that, would Chile apply MFN tariffs to its imports from the EU, their level in 2010 would be lower by 40% to 60%, i.e. by between approximately US$ 3 billion and 4 billion. In other words, the EU-Chile FTA is estimated to have increased EU exports to Chile by between two thirds and four thirds.

This finding might seem at odds with the downward trend observed in the EU's share in Chile's total imports over the 2000s. In fact, it suggests that, absent an agreement, EU exports to Chile might well have dropped significantly in relative terms, in a context where Chile was phasing in trade agreements with a large number of partners.

Appendix 1: Composition of control groups

First control group (exporters for the analysis of Chile’s exports towards the EU, importers for the analysis of EU exports towards Chile): Venezuela, Colombia, Panama, Costa Rica, Nicaragua, El Salvador, Honduras, Guatemala, Ecuador, Peru, Brazil, Bolivia, Paraguay, Uruguay, Argentina.

Second control group (importers for the analysis of Chile’s exports towards the EU, exporters for the analysis of EU exports towards Chile): Afghanistan, Albania, Upper Volta, Angola, Antigua and Barbuda, Netherlands Antilles, Saudi Arabia, Algeria, Armenia, Aruba, Azerbaijan, Bahamas, Bahrain, Bangladesh, Barbados, Belarus, Bermuda, Bhutan, Bosnia Herzegovina, Botswana, Burkina Faso, Burundi , Cape Verde, Cambodia, Cameroon, Chad, Comoros, Congo, North Korea, Ivory Coast, Croatia, Dominica, Egypt, United Arab Emirates, Eritrea, Ethiopia, Fiji, Gabon, Gambia, Georgia, Ghana, Grenada, Guinea, Equatorial Guinea, Guinea-Bissau, Guyana, Haiti, Indonesia, Iraq, Iran, Cayman Islands, Solomon Islands, Israel, Jamaica, Jordan, Kazakhstan, Kenya, Kyrgyzstan, Kiribati, Kuwait, Laos, Lebanon, Lesotho, Liberia , Libya, Macedonia, Madagascar, Malaysia, Malawi, Mali, Mauritius, Morocco, Mauritania, Moldova, Mongolia, Mozambique, Myanmar, Namibia, Nauru, Nepal, Niger, Nigeria, Oman, Pakistan, Papua New Guinea, Qatar, Central African Republic, Dem. Rep. Congo, Republic of Yemen, Russia, St Vincent Grenad., Samoa occ., St. Lucia, Senegal, Seychelles, Sierra Leone, Syria, Sri Lanka, South Africa, Sudan, Swaziland, Tajikistan, Taiwan (Formosa), Tanzania, Thailand, Timor Leste, Togo, Trinidad y Tobago, Tunisia, Turkmenistan, Tuvalu, Uganda, Ukraine, Uzbekistan, Vanuatu, Vietnam, South Yemen, Zambia, Zimbabwe.

Appendix 2: Methodology used to simulate trade impacts

A standard assumption, consistent both with the econometric methodology presented above and with the CGE model used in Chapter 3, is that the elasticity of substitution between imports from different origins is constant. In other words, the bundle of imports for a given product can be represented within consumer preferences through a constant elasticity of substitution (CES) function over imports of different origins. In this case, assuming the budget allocated to each product in total imports is to remain constant, the own-price elasticity of demand for imports from a given country is written:

$$(11) \qquad \nu_{ijk} = \frac{\partial \ln x_{ijk}}{\partial \ln p_{ijk}} = \sigma_k \left(1 - s_{ijk}\right)$$

where x_{ijk} refers to country *j*'s imports of product *k* from country *i*, σ_k is the elasticity of substitution between imports from different providers, and s_{ijk} is the value share of imports from provider *i* in country *j*'s total imports of product *k*.

Let us now assume away any change in producer prices. The only way the EU-Chile FTA changes prices is then through tariff cuts. A first-order approximation of the level of imports that would have prevailed, would the EU-Chile FTA not have been signed, can thus be computed as follows:

(12)

$$\ln \tilde{x}_{ijk} = \ln x_{ijk} + \nu_{ijk} \ln \left(\frac{1 + \tilde{t}_{ijk}}{1 + t_{ijk}} \right)$$

where $\tilde{x}_{ijk}$ refers to the estimated counterfactual level of imports that would have been observed without the EU-Chile FTA, and $\tilde{t}_{ijk}$ is the tariff level that would have prevailed without the EU-Chile FTA. For clarity, let us emphasize again that this counterfactual calculation involves the following assumptions:

- It assumes (tax exclusive) producer prices expressed in the importing country currency remain constant
- It assumes the budget allocated to each product in total imports remains constant
- It is a first-order approximation, since the calculation is based upon the own-price elasticity of demand for imports from Chile, estimated based on observed import levels[15]

The CGE exercise presented in Chapter 3 will allow less simplistic simulations, but this is a useful way to illustrate the implications of the estimations.

An alternative assumption would be the Armington assumption in its initial form, namely the assumption that products are differentiated by country of origin, with domestic products included in the same bundle (i.e., the same CES function) as other imports. In this

[15] Since the own-price elasticity of demand depends upon the market share, it decreases as the level of import increases. Given the orders of magnitude considered here, changes are likely to remain small compared to initial levels, though, hence the assumption that this effect is of second order, and can be neglected.

case, equation (11) would still hold, but replace s_{ijk} by the value share of imports from provider *i* in total domestic demand of product *k*, including demand for domestic products. The corresponding own-price elasticity of demand is higher in this case, but assessing its level requires knowing the level of domestic production of product *k*, a piece of information unavailable at the detailed product level. Still, considering that the share of imports from a given provider in total demand is often low, a useful upper-bound for the price elasticity is obtained assuming this share to be negligible:

(13) $\nu'_{ijk} = \sigma_k.$

In the simulations, this elasticity is used to compute upper-bounds of the trade impact of the EU-Chile FTA, i.e. the lower-bound of the estimated level of trade that would have prevailed without the EU-Chile FTA.

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