When are Tariff Cuts Not Enough? Heterogeneous Effects of Trade Preferences for the Least Developed Countries

Fabien Forge Jason Garred Kyae Lim Kwon

October 6, 2022

Abstract

Poor countries export a remarkably narrow range of products. To what extent have trade preferences targeted to the least developed countries (LDCs) changed this situation? We study a large set of recent reforms to the LDC trade preferences offered by OECD countries. Leveraging trade policy variation by importer, exporter, product and year, we show that tariff reductions have increased the prevalence of positive trade flows. However, new flows have been far more likely to emerge in cases with previous 'export experience', i.e. where countries already exported the same product to another OECD country, or exported a related product to the same importer. So this wave of tariff cuts for LDCs has resulted in an extension of existing patterns of trade rather than wider export diversification.

JEL codes: F13, F14, O24.

We thank Emanuel Ornelas and seminar and conference participants at Insper, the Midwest International Trade Conference, the Centre for the Study of African Economies Conference, the Royal Economic Society Annual Conference, the Annual Meeting of the Canadian Economics Association and the Annual Congress of the Société Canadienne de Science Économique for valuable comments, Keith Head and John Ries for helping to initiate the project, and Lamis Kattan for excellent research assistance. Authors' address: Department of Economics, University of Ottawa, 120 University, Social Sciences Building, Room 9005, Ottawa, Ontario, K1N 6N5, Canada. Email address of corresponding author: Jason.Garred@uottawa.ca.

1 Introduction

The world's poorest countries export a strikingly narrow range of products. From the 48 nations on the UN's list of the least developed countries (LDCs), the United States received imports in an average of 58 six-digit product categories per country in the year 2000. The total of 2,764 LDC-US flows at the country-product level is fewer than the US received from Belgium – a single developed country with a smaller population than the LDC average – in the same year.[1]

Limited trade activity due to low productivity and high trade costs in low-income countries has been a preoccupation of development and trade policies for decades. Some of the best-known policy instruments employed to boost exports from these countries are the unilateral reductions of tariffs and other import barriers provided by importers, such as through the Generalized System of Preferences (GSP). Yet as recently documented by Ornelas (2016), economists know relatively little about the effectiveness of such trade preferences for developing countries.

In this paper, we consider the effects of tariff reductions targeted to the least developed countries, which have been a particular focus of such initiatives. Our outcome of interest is the distribution of nonzero trade flows by exporter, importer and product: in other words, we ask whether these policies have succeeded in fostering the diversification of LDCs' exports across goods and importing countries. Our motivating idea is as follows: when a set of trade preferences are offered in a context where trade is so rare, can this be sufficient to generate new flows?

To investigate this question, we take advantage of a coordinated multilateral policy initative implemented around the turn of the 21st century. In the mid-1990s, the conclusion of the Uruguay Round of trade negotiations included a call for improved trade preferences targeted specifically at LDCs. This was followed by the WTO Plan of Action for the LDCs in 1996, which again advocated for the improvement of market access for LDCs. This push for policy reforms was successful, as the late 1990s and early 2000s saw many wealthy countries initiating or greatly expanding schemes granting LDCs preferential market access. A key component of these reforms was the reduction of tariffs on LDC exports to zero across a large range of products.

However, by the 2010s, many policymakers were expressing concerns about the success of these policies. In a 2013 document notifying the WTO of a revised approach to its

[1] These statements are based on US import data from the UN COMTRADE database and country population data from the World Bank's World Development Indicators.

system of trade preferences, the European Union cited "the disappointing performance of the poorest, both in terms of total export growth and of diversification".[2] Three years earlier, the chairperson of the WTO's subcommittee on LDCs drew a similarly pessimistic picture of LDC export performance over the previous decade, stating that "[w]hile there had been some growth in the LDCs, it was not adequate to make a structural change in LDC economies. The vast majority of LDCs continued to be dependent on a limited number of export products with little value addition. Diversification of their production and export base had not taken place."[3]

We assess the outcomes of the expansion of LDC trade preferences using policy variation by exporter, importer, product and year. For each of 22 waves of tariff reductions by nine OECD countries around the turn of the 21st century, we identify the set of products and exporters for whom tariffs were reduced. We then employ a large dataset, including these nine importers, 100 exporters, more than 4,000 six-digit products and eighteen years between 1996 and 2013, to estimate the effects of the tariff cuts. Our baseline regression includes a full set of three-dimensional fixed effects. This identification strategy thus takes a step further than the exporter-importer-year variation used in standard gravity regressions (e.g. Baier and Bergstrand 2007), and the country-product-year variation that is sometimes used in evaluations of trade policy conducted by a single importer or affecting a single exporter (e.g. Cheong, Kwak and Yuan 2017, Besedes, Kohl and Lake 2020).

In order to minimize measurement error, we build our trade policy data from primary sources whenever feasible. We begin with relevant government documents and WTO notifications from importers, along with raw data by ten-digit tariff line from the WTO Integrated Data Base (IDB) and the EU's TARIC database, and carefully construct a dataset with time-varying preferential program membership and applied tariffs for each observation in the dataset. Details of our coding procedures are provided in a data appendix.

Our findings include both good and bad news about the impacts of the reforms on the distribution of nonzero trade flows, leading us to a nuanced conclusion. First, for our full sample of exporter-importer-product-year observations, we conclude that treatment by a tariff cut increases the probability of a positive trade flow by 0.16 percentage points. Because of the very low prevalence of exports from LDCs at the beginning of the sample period, this is a substantial impact in proportional terms, representing approximately 20% of the initial share of positive trade flows for treated exporters.

[2]See WTO document WT/COMTD/N/4/Add.6.
[3]See WTO document WT/COMTD/LDC/M/56.

However, we observe that the magnitude of the treatment effect depends greatly on the exporter's starting point, a result with important implications for the reforms' actual impact on export diversification. Using a theoretical framework based on Helpman, Melitz and Rubenstein (2008), we make a simple and intuitive prediction: for a particular importer, exporter and product, new trade flows are more likely to emerge in response to tariff cuts in cases that were already on the margin of exporting. These will generally be countries with existing 'adjacent' trade flows: already exporting the same product to another destination (i.e. adjacency on the importer dimension), and/or exporting similar products to the same destination (i.e. adjacency on the product dimension).

We thus divide exporter-importer-product cells into categories depending on their status as of the initial year of the sample period. If adjacent flows existed on at least one of the above dimensions, we label the cell as having relevant 'export experience'. We define product similarity according to the HS product classification. In our baseline definition, we consider flows in the same two-digit product category to be adjacent (e.g. 'Carpets and other textile floor coverings'), but we also consider a narrower definition, and decompose our export experience variable to consider various possible dimensions of experience.

We find an enormous disparity between the estimated treatment effects of tariff cuts on cells with and without relevant export experience. For cells without export experience – which form the large majority of cases – a tariff reduction increases the probability of a trade flow by 0.04 percentage points. Significant impacts are observed only when cuts are unusually large. Above the 90th-percentile tariff reduction (i.e. 19 percentage points or more), the estimated effect for cases without export experience rises to 0.16 percentage points, but for cuts smaller than this, we observe statistically insignificant impacts of 0.02 percentage points.

Meanwhile, in the minority of cells with export experience, the estimated impact of a tariff cut is to boost the export probability by 1.35 percentage points, an impact more than thirty times as large as for cases without export experience. Because we include the small number of existing trade flows in this category, this effect is partly due to increased probability of survival of these existing flows. In cells without exports as of the beginning of the sample period but where adjacent flows existed, the estimated effect is 0.69 percentage points, which is eighteen times as large as for cells without export experience. Moreover, this effect tends to become larger as we impose stricter definitions of export experience. For example, in cases where adjacent flows already existed on both dimensions (by importer and product), the estimated treatment effect rises to 3.73 percentage points.

Our findings therefore show that new trade flows have been generated as a consequence of the reforms we study. But this outcome is best described as an extension of existing patterns of trade rather than wider export diversification, since these new flows have been far more likely to emerge when LDCs had already established closely related trade relationships. In other situations, except in cases of especially large reductions, our results suggest that tariff cuts are not enough.

This study contributes to several branches of the trade policy literature. First, we add to the surprisingly small body of work on the impact of trade preferences for developing countries, recently reviewed in Ornelas (2016). Some of the papers in this literature consider the effects of a single program (or the programs of a single importer) using product-level variation. This includes several papers examining the United States' African Growth and Opportunity Act. While Frazer and Van Biesebroeck (2010) report mostly positive effects of AGOA, the findings of Rotunno, Vézina and Wang (2013) and Fernandes et al. (2020) suggest that these impacts became smaller after the end of the Multifiber Arrangement increased the role of China in the world market for apparel.[4] Other recent contributions using product-level variation include Cheong, Kwak and Yuan (2017) on the effect of EU tariff waivers supporting disaster relief in Pakistan, Hakobyan (2020) on the consequences of the temporary expiration of the United States' GSP program, and Borchert and Di Ubaldo (2020) on the impact of reductions in exporters' uncertainty about their future status in the EU's GSP-plus program.

Some other papers use variation at the country-pair level to simultaneously examine a group of preferential programs. For example, Gil-Pareja, Llorca-Vivero and Martínez-Serrano (2014) examine a wide set of programs targeted to developing countries, including various importers' Generalized System of Preferences (GSP) programs, finding generally positive impacts. Our own work adds an additional dimension to each of the above approaches, by considering several importers' programs affecting multiple exporters, using policy variation by product. This allows us to control simultaneously for confounding factors at the importer-exporter-year, importer-product-year and exporter-product-year levels.[5]

We uncover systematic heterogeneity in the effects of trade preference regimes, in line with

[4]The EU's Everything but Arms program has also been studied by several papers, including Collier and Venables (2007), Thelle et al. (2015), Gradeva and Martínez-Zarzoso (2016) and Persson and Wilhelmsson (2016).

[5]Our paper is also distinct from much of the literature cited here in that our main focus is on the probability of a positive trade flow; i.e. the extensive margin of trade. However, although these other studies have tended to primarily emphasize changes in trade volumes (the intensive margin), most also include results exploring extensive margin effects.

our hypothesis that they encourage new flows disproportionately in cases with particularly favourable initial conditions. Our work is thus also relevant to a set of recent studies of heterogeneity in the impacts of trade agreements, notably Baier, Bergstrand and Clance (2018) and Baier, Yotov and Zylkin (2019). Especially pertinent to our paper is recent work by Ornelas and Ritel (2020), who consider the impacts of all trade preference programs for developing countries from 1950 to 2009, and conclude that their effects differ according to the poverty level and WTO membership status of recipients.[6] All of these studies employ aggregate variation by country pair over time. In contrast, we consider a dimension of heterogeneity that requires a view of the data at the product level.

Finally, our paper also contributes to the literature on 'sequential exporting' (Albornoz et al. 2012, Schmeiser 2012, Chaney 2014, Araujo, Mion and Ornelas 2016, Morales, Sheu and Zahler 2019). Existing work demonstrates that the initiation of exports to one destination can lead to new export flows to additional destinations, i.e. that acquisition of export experience can result in new trade relationships. We find a related result: that tariff cuts for LDCs are much more likely to be effective when relevant export experience is present, so that the impact of these policies is mostly limited to the stimulation of additional episodes of sequential exporting.[7]

The remainder of the paper proceeds as follows. In Section 2, we present the theoretical framework that underpins our predictions regarding the effects of LDC tariff preferences. We next describe our empirical strategy, which is based on this conceptual framework, in Section 3. Section 4 discusses our dataset, as well as providing information on the reforms we study and presenting summary statistics. We discuss our main results in Section 5, and present a number of additional specifications in Section 6. We then offer a brief conclusion in Section 7.

[6] A few other papers have suggested the possibility of heterogeneous effects for specific preferential programs. Soon after the implementation of the EU's Everything But Arms program, Brenton (2003) suggested that it was likely to have limited effects on a group of countries whose exports were concentrated in products for which tariffs were not reduced by the program. Ten years later, de Melo and Portugal-Perez (2013) found that benefits from AGOA's liberalization of apparel trade had flowed disproportionately to just seven African countries. Olarreaga and Özden (2005) find that the size of tariff rents accruing to African firms from AGOA has also been heterogeneous, with exporters in smaller and poorer countries receiving smaller rents. Also, while Cadot et al. (2013) do not study tariff preferences, their results are also related to our study of heterogeneity across exporters: they present firm-level evidence that the probability of survival in export markets upon entry is higher for African firms when more other firms from the same country already export the same product to the same importer.

[7] Similarly, Carrère and Strauss-Kahn (2017) show that prior export experience by developing countries (with non-OECD partners) increases the probability of survival of new export relationships with the OECD. Our results suggest that such survival probabilities may also be enhanced by tariff cuts.

2 Theoretical framework

To motivate the paper's analysis and shape our empirical strategy, we present a theoretical framework based on the model of Helpman, Melitz and Rubenstein (2008). Their model is useful here because it allows for scenarios in which no firm in a country is productive enough to export a certain product to a given importer. This allows us to consider conditions under which importers' tariff reductions are more or less effective in encouraging new products to be exported by a beneficiary country.[8] We accomplish this simply by adding product-level variation to the authors' basic theory.

Say there are a finite number of countries i, a finite set of products p across which a representative consumer in each country i has Cobb-Douglas preferences, and a continuum of varieties v_p of each product for which each consumer has CES preferences with elasticity of substitution σ. That is, the utility function of the representative consumer in country i is (where α_{ip} sums to one across p for each i):

$$U_i = \prod_p \left(\int_{v_p} c_i(v_p)^{\frac{\sigma-1}{\sigma}} dv_p \right)^{\frac{\sigma}{\sigma-1}\alpha_{ip}}$$

Assume that firms each produce a single product, that each firm participating in product market p produces a distinct variety, and that each country i has a potentially different measure N_{ip} of firms producing a given product p. Firms sell under conditions of monopolistic competition. Production of a unit of output requires firms to expend a cost $c_i a$ on inputs, where the country-specific cost c_i is set outside the model, and a is a firm-specific (inverse) productivity parameter. As in Helpman, Melitz and Rubenstein (2008), the distribution $F(a_{ip})$ of a across firms producing product p in country i is bounded, with support $[a_{ip}^L, a_{ip}^H]$. Also, for firms to ship their output to an importer j requires a fixed cost f_{ij} and a product-specific variable cost of the iceberg type, τ_{ijp}.

It is the assumption of bounded productivity that is desirable in our empirical setting, because it allows for situations in which none of the firms active in the domestic market of country i is sufficiently productive to profitably export its output to some (or all) potential importers $j \neq i$. Specifically, a firm in i with productivity a profitably exports to j if the

[8] An alternative approach to modelling potential heterogeneity in the impact of trade policies is provided by Baier, Bergstrand and Clance (2018).

following condition holds:

$$\frac{1}{\sigma}\left(\frac{\sigma P_{jp}}{(\sigma-1)\tau_{ijp}c_i a}\right)^{\sigma-1} E_{jp} - f_{ij} > 0 \tag{1}$$

where P_{jp} is the ideal price index for product p prevailing in importer j and E_{jp} is the total expenditure of country j on product p. If there are no trade imbalances, the latter equals the national income of country j multiplied by the Cobb-Douglas share α_{jp}.

The total value of exports of product p from country i to country j is then:

$$X_{ijp} = \left(\frac{\sigma P_{jp}}{(\sigma-1)\tau_{ijp}c_i}\right)^{\sigma-1} E_{jp} N_{ip} V_{ijp}$$

where V_{ijp} is as follows:

$$V_{ijp} = \begin{cases} \int_{a_{ip}^L}^{a_{ijp}} a^{1-\sigma} dF(a_{ip}) \text{ if } a_{ijp} \geq a_{ip}^L \\ 0 \text{ if } a_{ijp} < a_{ip}^L \end{cases}$$

Here a_{ijp} represents the cutoff productivity for which the profits from exporting product p from i to j equal zero.

A reduction in the tariff on imports of p from i to j corresponds to a fall in τ_{ijp}. It should be clear from the above that if initial imports equal zero, this tariff cut will not necessarily have any effect on trade between i and j. Specifically, if the distance between a_{ip}^L and a_{ijp} is sufficiently large, a given reduction in τ_{ijp} may not be sufficient to bring the most productive firms producing p in country i to the export threshold. However, the larger the tariff cut, the more likely it is to affect this extensive margin.

We can use the model to predict which exporter-importer-product cells are most likely to respond on the extensive margin to a given tariff cut. These are the cases where a_{ip}^L is initially below but sufficiently close to a_{ijp}. We thus rewrite equation (1) in terms of the cutoff productivity level a_{ijp} to clarify the scenario in which there are no firms from i exporting product p to j:

$$\begin{aligned} a_{ip}^L &> a_{ijp} \\ &= \frac{\sigma P_{jp}}{(\sigma-1)\tau_{ijp}c_i}\left(\frac{E_{jp}}{\sigma f_{ij}}\right)^{\frac{1}{\sigma-1}} \end{aligned}$$

Potential exporters responding on the extensive margin to a small cut in τ_{ijp} will initially

satisfy this inequality only marginally for a given product and importer. Other than τ_{ijp}, the inequality varies in three parameters specific to country i – c_i, f_{ij} and a_{ip}^L – all three of which must be sufficiently small for this to be a marginal case.

What is the initial distribution of exports that we are likely to observe in such a case? First, if the fixed cost f_{ij} is sufficiently small, then country i is more likely to already be exporting at least one other product to country j. Moreover, if the productivity bound a_{ip}^L is positively correlated across closely related products within country i, then positive exports by i to j of products similar to p are a potential predictor of an extensive margin response to a cut in τ_{ijp}.[9] In other words, a country that responds to a tariff reduction by a given importer is more likely to be an exporter of similar products to that importer already. Second, if c_i and a_{ip}^L are both relatively small for a given exporter and product, then i is more likely to already be exporting the affected product p to at least one other destination.

These observations suggest that the probability that a tariff cut leads to a new exporter-importer-product flow is related to initial 'export experience', in the sense that the exporting country already sends similar products to that importer, or already sends the same product to another importer. Tariff reductions may therefore be especially likely to encourage new trade flows in cases where such adjacent flows already exist. This suggests that in the absence of sufficiently large cuts, the extensive margin response (by exporter-importer-product cell) to tariff reductions might constitute export diversification only in a limited sense – new flows may appear, but building closely on existing trade relationships.

An alternative way of understanding this prediction is through the lens of the literature on 'granularity'. This concept has previously been employed by Eaton, Kortum and Sotelo (2012) to investigate the prevalence of zero trade flows, and more recently by Gaubert and Itskhoki (2021) in a study of the determinants of comparative advantage. In this literature, the skewness of the distribution of exports (by country and/or sector) is due to the rarity of 'outlier' firms with especially favourable draws from a fat-tailed distribution of potential productivity levels. So instead of positing a gap between a bounded productivity distribution and an export threshold as in Helpman, Melitz and Rubenstein (2008), these studies of granularity suggest that we can conceptualize the extensive margin in terms of the realized productivities of individual firms. Specifically, when we observe an extensive margin response by an LDC to a tariff cut, this might be due to the export behaviour of a single enterprise that is substantially more productive than its local competitors.

[9] Alternatively, the fixed cost might be ijp-specific but correlated across closely related products, producing a similar prediction.

If granularity is important in the context we study, then the potential role of 'export experience' in the link between tariff cuts and new trade flows can also be understood in terms of individual firms. In particular, rather than bringing new firms into exporting, a tariff reduction may be more likely to spur an 'outlier' that was already an exporter to enter a new market that had previously been on the margin of profitability. This could involve the introduction of a new product line in a country and sector where that firm had already been exporting, or sales of an existing export product in a new destination market.

The discussion in this section also relates to the 'sequential exporting' literature, in which export experience makes it more likely for a firm to enter additional markets, for example by allowing the firm to learn about potential export profitability (Albornoz et al. 2012) or by reducing its entry costs into other markets (Morales, Sheu and Zahler 2019). We build on the findings of this literature by considering export experience as a potential factor affecting the impact of a trade policy, rather than discussing its effect on trade dynamics in the absence of policy interventions. However, it should be noted that our dataset is at a higher level of aggregation than would be necessary for us to observe either granularity or sequential exporting at the firm level.

3 Empirical strategy

We now use the theoretical framework presented above, along with our observations regarding the potential relevance of export experience, to construct an empirical strategy. As noted by Helpman, Melitz and Rubenstein (2008), the condition under which the profits from exporting product p to importer j are positive for at least one firm in exporter i (equation (1)) can be rewritten in the following multiplicative way:

$$\frac{1}{\sigma}\left(\frac{\sigma}{\sigma-1}\right)^{\sigma-1} c_i^{-\sigma}\left(a_{ip}^L\right)^{1-\sigma} f_{ij}^{-1} P_{jp}^{\sigma-1} E_{jp} \tau_{ijp}^{1-\sigma} > 1$$

Allowing each of these variables to vary by time t, and defining a variable Z_{ijpt} equal to the left-hand side, gives:

$$\ln Z_{ijpt} = \zeta - \sigma \ln c_{it} + (1-\sigma)\ln a_{ipt}^L - \ln f_{ijt} + (\sigma-1)\ln P_{jpt} + \ln E_{jpt} + (1-\sigma)\ln \tau_{ijpt} \quad (2)$$

In theory, equation (2) captures the extensive margin effect of a tariff cut (which reduces τ_{ijpt}) via a threshold rule: once the right-hand side exceeds zero, i begins exporting product

p to j.

We decompose τ_{ijpt} multiplicatively into an exporter-importer-time-specific component τ_{ijt} (including factors such as time-varying distance effects), an importer-product-time-specific component τ_{jpt} (including factors such as time-varying most-favoured-nation tariffs), and an exporter-importer-product-specific component τ_{ijp} (including factors such as time-invariant preferential tariffs), as well as our treatment variable(s) of interest T_{ijpt} (to be discussed in detail below) and an error component ϵ_{ijpt} absorbing all other variation. This allows us to additively separate the final term of equation (2) into these components, and then express the right-hand side of our estimating equation in terms of our treatment variable(s) and a full set of three-dimensional fixed effects.

At the same time, we replace $\ln Z_{ijpt}$ with a dummy variable W_{ijpt} equal to one if there is a positive trade flow in cell $ijpt$ and zero otherwise. This allows us to estimate a linear probability model using ordinary least squares, a choice we will carefully justify below. Our baseline estimating equation is as follows:

$$W_{ijpt} = T'_{ijpt}\beta + \nu_{ijp} + \phi_{ijt} + \theta_{ipt} + \psi_{jpt} + \epsilon_{ijpt} \tag{3}$$

In the above equation, the parameters ν_{ijp} replace the τ_{ijp} component of the τ_{ijpt} term from equation (2). Similarly, the parameters ϕ_{ijt} replace the f_{ijt} and τ_{ijt} terms; the parameters θ_{ipt} replace the a^L_{ipt} term; and the parameters ψ_{jpt} replace the P_{jpt}, E_{jpt} and τ_{jpt} terms. The term including the cost variable c_{it} is also absorbed by these fixed effects. As noted above, the error component of τ_{ijpt} is represented by ϵ_{ijpt}.

Use of a linear probability model allows us to estimate our extensive margin impact(s) of interest using a fixed effects approach. A probit model is not available to us because the inclusion of high-dimensional fixed effects (and our relatively short time panel) raises the problem of incidental parameters (see e.g. Cameron and Trivedi 2005, Wooldridge 2010, Hansen 2022).[10] Moreover, the logit fixed effects model does not yield easily interpretable parameter estimates, making it an unattractive option (Wooldridge 2010).

The linear probability model has the well-known disadvantage that predicted values of the dependent variable can be outside the $[0, 1]$ interval. In our case, because the predicted values $\hat{W}_{ijpt}$ equal the difference between the observed values W_{ijpt}, which are almost all equal to zero, and the residuals $\hat{\epsilon}_{ijpt}$, which must average to zero, a large share of predicted values

[10] Helpman, Melitz and Rubenstein (2008) estimate a probit model in their first-stage extensive margin regression, but they use a cross-sectional dataset with a relatively small set of fixed effects as compared to the number of observations.

will necessarily be negative. However, this is not necessarily problematic for our objective, which is to identify changes in export behaviour due to tariff cuts, i.e. to identify β rather than to predict W_{ijpt}. Moreover, because we use a fixed effects approach, we accomplish this by exploiting *differences* in export probability across groups, which are much less likely to be estimated to lie outside the intuitive range $[-1, 1]$.

The model's linearity also facilitates a simple approach to assessing treatment effect heterogeneity. We begin by assuming that tariff cuts due to LDC program reforms have a homogeneous effect on all treated observations. Specifically, we define T_{ijpt} as a dummy variable that is equal to 1 for all exporter-importer-product cells experiencing a tariff cut due to one of the reforms we study, in all years after the tariff reduction. Because the model is linear, each fixed effect captures the added probability of exporting for members of a particular three-dimensional category (e.g. for a specific importer-exporter-year). So the parameter β in equation (3) represents the (homogeneous) jump in the probability of exporting due to the treatment, after accounting for all of these group-level differences.[11]

We then allow for treatment effect heterogeneity on specific dimensions, based on theoretical predictions discussed in the previous section. We first allow the effect to vary with the size of the tariff cut, by redefining T_{ijpt} as a set of dummies according to the size of the reduction in tariffs for a given exporter-importer-product cell. We then consider the possible heterogeneity of the treatment effect depending on observed initial 'export experience'. In each case, our model associates each subgroup with a treatment effect parameter representing the rise in the probability of exporting caused by tariff cuts for that subgroup. We also attempt specifications with a continuous variable for the size of the tariff cut, yielding a simple linear impact estimate.

For our export experience regressions, we are interested in the difference in the treatment effect between cases with and without experience, and so we actually employ specifications with appropriate interaction terms. We thus define a dummy variable I_{ijp} that is equal to one for exporter-importer-product cells with export experience, and interact this with our treatment variable T_{ijpt}. We also allow all fixed effects to vary by experience, so as to allow

[11] The assumption of treatment effect homogeneity has been shown to be important for identification in the recent literature exploring the econometrics of two-way fixed effects regressions (e.g. de Chaisemartin and D'Haultfoeuille 2020, Borusyak, Jaravel and Spiess 2022). This literature has shown that when a treatment effect is heterogeneous across treated groups and/or time, a standard specification with group and time fixed effects does not estimate the average treatment effect on the treated. While this result has not yet been extended to the more complex case of a full set of three-dimensional fixed effects, it is likely to be relevant here. We handle this issue by explicitly assuming either a homogeneous treatment effect or heterogeneity on well-defined dimensions – e.g. by allowing for different impacts according to initial export experience – rather than claiming to have estimated average effects.

for differences in the probability of exporting, for every three-dimensional category, between cases with and without export experience. This approach is equivalent to running subsample regressions for each of these two cases and then comparing the estimated coefficients on T_{ijpt}.

We define export experience in terms of observed trade flows in the first year of the sample period (1996). Specifically, $I_{ijp} = 1$ if exports of p by i to any importer in the sample are positive in 1996, and/or if exports of related products by i to j are positive in 1996. As we discuss more carefully below, our product measure is at the six-digit level of the Harmonized System (HS) product classification. We initially define 'related' products to be goods in the same two-digit HS category as p; for example, 'Carpets and other textile floor coverings' or 'Sugars and sugar confectionery'. But we also consider a narrower definition (four-digit HS category), and break down our experience variable I_{ijp} to consider various possible dimensions of experience.

Finally, we ensure that our results are robust to considering other relevant factors that vary by exporter, importer, product and time. This includes the implications of countries' entry into (and exit from) beneficiary status, as well as reforms of other preferential programs and new bilateral trade agreements. We also amend our definition of treatment to consider preference margins, for instance between LDC and GSP tariffs.

Our identification strategy builds naturally on the existing literature. Standard gravity-based estimates of the effects of trade agreements (e.g. Baier and Bergstrand 2007) rely on aggregate trade flows and include exporter-importer, exporter-time and importer-time fixed effects.[12] We augment this strategy here by using variation in the treatment at the product level. Similarly, papers on the policies of a single importer sometimes exploit product-level variation in treatment, but only consider trade flows to the importer being studied (e.g. the study of AGOA by Frazer and Van Biesebroeck (2010)). These papers thus include fixed effects by exporter-time, exporter-product and product-time.[13] We build on this strategy by estimating the effects of multiple program reforms across several importers, allowing us to account for factors potentially correlated to the treatment by importer, product and time (such as the end of the Multifiber Arrangement). Effectively, we identify treatment effects by comparing the same exporter-importer-product before and after treatment, the same importer-exporter-year across treated and untreated products, the same exporter-product-

[12] See also Baier, Bergstrand and Feng (2014), Bergstrand, Larch and Yotov (2015), Anderson and Yotov (2016) and Baier, Yotov and Zylkin (2019) for notable recent examples of such a strategy.

[13] See Besedes, Kohl and Lake (2020) for a recent example of this type of approach. Cheong, Kwak and Yuan (2017) employ the related strategy of considering product-level trade policy variation for a single exporter and including fixed effects by importer-time, importer-product and product-time.

year across importers that treat and do not treat it, and the same importer-product-year across treated and untreated exporters.

Note that this identification strategy captures effects of tariff cuts – since we compare products that are treated by tariff cuts to those that are not – but excludes any impacts of changes in fixed costs or any other aspects of the reforms that vary at the exporter-importer-year level. In our regressions, these impacts are absorbed by fixed effects, and our estimates may thus capture only part of the overall effect of the reforms we study.[14]

A second (more standard) limitation of our strategy is that our estimates may be affected by the presence of trade diversion. For example, new trade preferences may have led beneficiaries to divert exports from one importer in the sample to another, or might alternatively have resulted in relocation of production between exporters in the sample (as suggested by Borchert (2009) in the case of the European GSP scheme). Our estimates might also be influenced in the opposite direction by the effects identified in the sequential exporting literature: the successful initiation of exports to one of the importers in our sample due to tariff cuts might increase the likelihood of nonzero exports of the same product to another destination.

As suggested by Abadie et al. (2017), we cluster standard errors based on correlation in treatment assignment across observations. Specifically, there is correlation in treatment by importer-product, because importers choose the products to treat and apply this across all treated exporters, and also by exporter, based on the LDC status of each country. We thus employ two-way clustering of standard errors on these dimensions in all specifications.

4 Data and summary statistics

4.1 Importers and program reforms

We begin assembling our dataset by identifying reforms of OECD countries' trade preference programs for LDCs during our sample period of 1996 to 2013. This period begins just after the conclusion of the Uruguay Round agreements and the WTO plan of action for LDCs, and

[14]Note that many of these reforms cut product-level import quotas to zero for LDC beneficiaries. Such changes in quantitative restrictions are unlikely to be directly relevant to our main results, given that our primary focus is on effects on the extensive margin, rather than growth in trade volume for existing flows. On the other hand, in cases where product-level changes in rules of origin accompanied tariff cuts, their impacts could be included in our estimated treatment effects.

ends just before another major pivot in EU trade policy towards developing countries.[15] Also, we focus on the programs of OECD members because of the disproportionate importance of these importers in world trade, and because similar preferences offered by some non-OECD members (such as China and Russia) were generally introduced much later than OECD members' reforms. In practice, there was a wave of reforms of OECD countries' trade policy towards LDCs in the first several years after the end of the Uruguay Round.

Of the 26 countries who were members of the OECD as of the beginning of 1996, all but two made significant changes to an LDC trade preference program at least once during our sample period.[16] Fifteen of these countries are European Union members, and thus maintain a unified trade policy; we consider the EU as a single importer throughout the paper so as not to put disproportionate weight on EU trade preferences in our estimates. Also, we exclude Iceland from the analysis because of the unavailability of its product-level tariff schedule for most of the sample period, and its especially small size.[17] This leaves us with nine importers: Australia, Canada, the EU, Japan, New Zealand, Norway, Switzerland, Turkey and the US.

Major reforms to these importers' LDC programs are generally specified in notifications to the WTO Committee on Trade and Development. We compare the timing of reforms according to these notifications with observed waves of reductions in LDC tariffs in the WTO IDB and EU TARIC data. These almost exactly coincide (see the data appendix for details), and so we define our treatment variables using the raw tariff data, as discussed further in Section 4.3 below.[18]

We do not observe WTO notifications with details of the expansion in Turkey's LDC program at the time of harmonization of its preferential tariffs with those of the EU. In a handbook on Turkey's GSP scheme (including its LDC-specific GSP program) published by UNCTAD, this is said to have occurred between 2002 and 2006. Because we observe

[15] As mentioned in the introduction, the EU notified the WTO of significant changes to its trade preference programs in 2013. These took effect in 2014, and included the removal of a large number of countries from its GSP program, in order to increase the preference margin enjoyed by LDCs relative to other developing countries.

[16] The two exceptions are the Czech Republic, which joined the EU later in the sample period, and Mexico.

[17] In 1996, the number of products imported by Iceland from individual exporters in our sample (i.e. nonzero flows by exporter-product) was less than one-third as many as the next smallest of our sample of importers (Norway). While WTO documents indicate that Iceland implemented an LDC trade preference program in 2002, we observe only its MFN tariffs and preferences for the European Economic Area in the WTO IDB tariff data until 2012.

[18] When reforms occur in midyear, the raw tariff data sometimes reflects this in the year of the reform and sometimes in the following year. The tariff cuts due to Norway's reform of July 1 2002 appear in the WTO IDB data in 2004.

large-scale LDC tariff reductions for Turkey in 2002 and 2004 in the WTO IDB data, we consider each of these two years to be reform dates.

We also study the creation and later expansion of the United States' African Growth and Opportunity Act (AGOA), which is not an LDC-specific program, but whose beneficiaries are mainly LDCs because of its focus on Africa.[19] Information on AGOA is available from a WTO notification signalling its creation, as well as several rounds of US legislation. While the tariff reductions available to program beneficiaries appear in the WTO IDB data, preferences specific to the textiles and apparel sector are not present until 2010. We thus adjust the raw tariff data by moving tariff cuts to 2001 for apparel products and to 2007 for textiles, to bring these in line with the timing indicated by US legislation.[20] In total, we study 22 reforms; these are listed in Table 1.

4.2 Exporters

Most of the importers in our sample determine LDC programs' beneficiaries using a list of the least developed countries defined by the United Nations. However, there is some variation in beneficiaries across importers and time. This is both due to importers' adoption of occasional changes in the UN list, and other eligibility decisions made by individual importers.[21] In order to collect data on eligibility for treatment as an LDC by exporter-importer-year, we again refer to WTO notifications and UNCTAD handbooks, and supplement this information with government documents (including amendments to customs laws, regulations and tariff schedules) from the importers in our sample; see the data appendix for details.

In our baseline specifications, we use a reform-specific definition to determine the list of treated exporters: if a country was listed by the importer as a program beneficiary at the time of a given reform, we consider the country to be treated by that reform. Table 1 displays the number of exporters that were defined as beneficiaries by each importer at the time of at least one of its program reforms, while Table A1 provides a full list of these countries for each importer. In some specifications below, we will also take account of entry

[19] We do not include contemporaneous US programs for Caribbean countries in this list because very few of their beneficiaries are defined as LDCs by any LDC-specific program. However, we account for changes in these programs during our sample period in some of our specifications below.

[20] Below, we confirm that our results are robust to using the tariff changes from the raw WTO IDB data.

[21] Among the exporters in our sample, Senegal was added as an LDC, and Cape Verde and the Maldives ceased to be defined as LDCs, by the United Nations during the period of study. Not all of the importers we study immediately adopted these changes. See Table A1 for information on differences in program eligibility by importer.

Table 1: Reforms of OECD importers' programs for LDCs, 1996-2013

Importer	Program	Year(s)	Countries	Products
Australia	GSP-LDC	2003	48	731
Canada	GSP-LDC / MAI	2000, 2003	47	868
European Union	GSP-LDC / EBA	1997, 1998, 2001	48	318
Japan	GSP-LDC	2001, 2003, 2007	48	483
New Zealand	GSP-LDC	2001	48	196
Norway	GSP-LDC	2004, 2008	61	174
Switzerland	GSP-LDC	1998, 2002, 2005, 2008	52	393
Turkey	GSP-LDC / EBA	1998, 2002, 2004	49	1,307
United States	GSP-LDC / AGOA	1998, 2001, 2007	49	1,470

This table displays, by importer, the number of exporters and products whose tariffs were reduced due to 22 reforms (creation or expansion) of trade preference programs for LDCs during the sample period. The list is restricted to sample importers. The column titled 'Year(s)' lists the year of the implementation of each reform by that importer, according to the timing of tariff changes observed in the WTO IDB and EU TARIC data (with the exception of the creation and reform of AGOA, where the timing is based only on official documents). The column titled 'Countries' displays a count of exporters affected by reforms, restricted to countries in the sample used in this paper. The column titled 'Products' displays a count of the number of distinct HS six-digit products whose tariffs were cut by at least one of that importer's reforms, for LDC program beneficiaries at the time of the reform. For Norway, 'Products' refers only to the number of products affected by the reform benefiting 49 countries in 2004, since the admission of 14 additional beneficiaries in 2008 was not accompanied by a product-level program expansion for existing beneficiaries. 'GSP-LDC' refers to the country's Generalized System of Preferences program for the least developed countries. 'EBA' refers to the EU's 'Everything but Arms' program (also adopted by Turkey), and 'MAI' refers to Canada's Market Access Initiative; both of these represented expansions of existing GSP-LDC programs. 'AGOA' refers to the African Growth and Opportunity Act in the US.

of exporters into (or exit from) LDC preference programs between major reforms.[22]

While most of the entries in Table 1 share a very similar list of eligible exporters based on the UN list of LDCs, a few exceptions are notable. First, as previously mentioned, AGOA is targeted to African countries; this includes several countries that are not on the UN LDC list.[23] Second, some importers have slightly deviated from the UN list by including additional countries or excluding certain countries.[24] Third, Norway's 2008 LDC program reform, rather than broadening the range of products covered, instead significantly expanded its list of beneficiaries.[25]

We include all of these countries in our baseline regressions as beneficiaries of these reforms, though we perform robustness checks in which treated countries outside the UN LDC list are dropped from the sample. Also, because individual countries in the South African Customs Union are classified differently by importers (e.g. Lesotho is usually considered an LDC while South Africa is not) but are not separately observed in the trade data we use, we exclude these countries entirely from our sample of exporters.[26] This leaves 69 program beneficiaries in the sample, 48 of which were included in the UN list of LDCs during our sample period.

Because our identification strategy depends on a comparison of reforms' beneficiaries to nonbeneficiaries, we also include additional exporters in our sample. We add only countries that are comparable to treated exporters on two key dimensions: they are developing countries and started the sample period with relatively undiversified exports. The former criterion excludes small but relatively wealthy countries such as Bahrain and Bermuda, while the latter rules out large developing countries such as China, India and Indonesia.

First, we define developing countries as low-income and low-middle-income countries according to the World Bank classification as of 1996. Because the World Bank criteria differ from those of the UN, the LDCs in the UN list span both of these categories (e.g. Burundi is low-income while Djibouti is a low-middle-income country). However, the set of

[22]Countries entering as new beneficiaries in a reform year are classified as treated in our baseline specifications, as discussed below.

[23]These are Cameroon, Gabon, Ghana, Kenya, Mauritius, Nigeria, Republic of Congo and Seychelles.

[24]Switzerland temporarily granted LDC preferences to Albania, Bosnia-Herzegovina, Ivory Coast and Republic of Congo at various times coinciding with program reforms. Tonga was included in the LDC programs of the EU and Turkey in the early years of our sample period. For countries on the UN list but excluded from some LDC preference programs, mostly by the US, see Table A1.

[25]Fourteen additional countries were made eligible for Norway's program in 2008: Cameroon, Ghana, Ivory Coast, Kenya, Kyrgyzstan, Moldova, Mongolia, Nicaragua, North Korea, Papua New Guinea, Republic of Congo, Tajikistan, Uzbekistan and Zimbabwe.

[26]Specifically, we drop Botswana, Lesotho, Namibia, Swaziland and South Africa from the sample.

countries meeting this World Bank definition is wider, including 56 countries that are neither on the UN list nor benefit from AGOA or importer-specific LDC treatment.

Second, we measure export diversification at the beginning of the sample period by counting each of these exporters' positive flows by importer-product in 1996.[27] We then drop any countries whose 1996 level of export diversification, by this measure, was larger than any exporter in our initial sample. That is, in order to be added to the sample, a country cannot have had a wider range of 1996 export flows than the most diversified beneficiary of the LDC program reforms in Table 1. In practice, Bangladesh was the LDC program beneficiary with the largest set of flows by importer-product as of 1996. We therefore drop all countries whose exports were more diversified than those of Bangladesh in 1996. This leaves us with 31 exporters to be added to the sample, for a total of 100 exporters. These are all listed in Table A1, and represented on a map in Figure A1.

While these additional exporters were not treated as LDCs by any of the importers in our dataset at the time of the reforms we study, it is important to note that all were afforded trade preferences as developing countries. In particular, each of the 31 exporters added to our sample received GSP treatment from one or more of our sample importers, and some were also included in other trade preference programs. We will account for time-varying changes in preferential treatment other than LDC program reforms in several of our specifications below.

4.3 Affected products and tariffs

In order to identify the set of products affected by each reform, we use data from the WTO Integrated Data Base (WTO IDB). While the WTO notifications and other primary sources mentioned above include lists of treated products for some (though not all) reforms, WTO IDB gives us additional relevant information. Specifically, it provides each importer's annual tariff schedule, allowing us to match each exporter in our sample to the tariff it faced for each importer, product and year. For the EU, only MFN duties are available in WTO IDB for 1996 to 2009, and preferential tariffs are missing. We thus instead use more detailed information provided by the EU's TARIC database for this period, and WTO IDB for 2010 to 2013 only.[28]

We initially use this information to identify the products whose LDC tariffs fell as a

[27] For this exercise, we only include the nine importers in our sample, and use the extensive margin threshold of one thousand 1996 US dollars discussed below.

[28] Tariffs in the EU TARIC dataset are defined by start and end date rather than by year, so we use tariffs as of July 1 of each year; see the data appendix for details.

consequence of each reform. This allows us to define our baseline treatment variable, which is a dummy variable equal to one in all years after a tariff is reduced due to a reform for a given exporter-importer-product cell. However, in some subsequent specifications, we instead quantify the treatment in terms of the size of the relevant tariff cut or the gap with the importer's GSP or MFN tariff. We also use information on tariffs faced by non-LDCs to quantify other product-level tariff changes due to GSP reforms, trade agreements and fluctuations in MFN rates.[29]

We build on the raw tariff data in several steps in order to generate a panel by exporter-importer-product-year. We briefly outline these steps here, and provide additional information in the data appendix. First, we identify the exporters eligible for programs other than those targeted to LDCs, or participating in preferential trade agreements. As with LDC programs, eligibility for these other preferences may vary over time as well as across importers. We again rely on importers' WTO notifications and government documents, as well as UNCTAD GSP handbooks, to acquire this information.

Because the WTO IDB data does not provide ad valorem equivalents of specific duties (i.e. tariffs set as rates per unit quantity) or tariffs based on more complex formulations (e.g. compound tariffs with both ad valorem and specific components), we calculate these ourselves. This requires us to relate quantity traded to the value of trade by importer and product, which we do using UN Comtrade data on trade flows. Also, for products subject to tariff-rate quotas, we consider only the within-quota tariff, since this is likely to be the relevant tariff for the extensive margin of trade. We thus identify and drop all above-quota tariffs included in the raw data.

Next, we take account of the fact that product classifications evolve over time. All of our tariff data over the sample period is defined using the Harmonized System (HS) classification, for which concordances between versions are available at the six-digit level. Using these, we construct a single concordance that accounts for all changes in six-digit product codes across the 1996, 2002, 2007 and 2012 HS versions. Finally, because most importers' tariffs are set at the eight-digit or ten-digit level, we take a simple average across ten-digit products within the same eight-digit code, and then across eight-digit goods within our (revised) six-digit categories, in order to define product-level tariffs.

We then identify the products that are treated by the tariff reductions associated with each reform. For exporters that are classified as LDCs in the year of the reform, we take

[29]Note that we use the generally applicable GSP tariffs of each importer, disregarding cases in which specific beneficiaries are treated differently for a subset of products, as these are not always specified consistently in the raw data.

the difference between the tariff faced in that year and the previous year. If the tariff facing a given exporter declines between one year and the next for a given product, and also falls relative to the prevailing GSP and MFN tariffs, then we classify that product as treated. We include the second criterion so that cases in which there is no LDC-specific tariff, but the GSP or MFN tariff is reduced, are not mistakenly classified as LDC-specific tariff cuts. Note also that whenever there are new entrants into an LDC program in the year of a reform (such as for the 2008 Norway reform), this procedure captures all product-level tariff preferences gained by that new beneficiary.[30]

We display the number of six-digit products affected by each importer's reforms in the rightmost column of Table 1. Then, in Table 2, we provide more detailed information about the types of products whose tariffs were reduced by these reforms. We first tabulate, across the 69 exporters affected by at least one reform, the share of exporter-importer-product cells experiencing tariff reductions. This proportion, which appears at the bottom of column (1) of Table 2, is approximately 10.4%; the reforms therefore affected a substantial share of tradable goods.

We then tabulate this proportion in the same way for each of the 21 sections of the HS classification. That is, within each section, we calculate the share of treated exporter-importer-product cells. Column (1) of Table 2 shows that there was substantial heterogeneity in the products treated by the reforms; while only 1% of cells in the category 'Mineral products' (where most MFN tariffs were already equal to zero) were treated, 29.2% of cells in the section covering animal and vegetable oils saw their tariffs reduced by a reform.

In column (2), we display the proportion of all treated exporter-importer-product cells falling into each section. This shows that more than 40% of treated cells were textiles and apparel. Note that this is both because of the intensity of treatment within this section, and because this is one of the HS sections with the largest number of six-digit products. In our analysis below, we investigate the extent to which our main results are affected by the importance of tariff cuts for textiles and apparel.

We also separately tabulate these shares for agricultural and nonagricultural products.[31] This shows that a larger share of cells were treated within the agricultural sector: 21.4% as compared to 8.7% of nonagricultural goods. However, because of the larger number of nonagricultural products in the HS classification, nonagricultural goods account for 71.7%

[30] The procedure also allows for potential differences in the set of treated products by exporter. For example, AGOA countries who were also LDCs experienced a narrower range of benefits from the implementation of AGOA in 2001, as compared to non-LDCs.

[31] Throughout the paper, we define agricultural products as in the WTO Agreement on Agriculture.

Table 2: Sectoral distribution of tariff cuts

	Share treated within HS section (1)	Share of HS section in all treated (2)
Animal products	18.6%	6.8%
Vegetable products	19.5%	10.1%
Animal and vegetable oils	29.2%	2.8%
Foods, beverages, tobacco	23.4%	9.2%
Mineral products	1.0%	0.3%
Chemical products	5.5%	7.8%
Plastics and rubber	4.2%	1.6%
Leather and articles	7.3%	0.6%
Wood and articles	2.6%	0.3%
Wood pulp and paper	0.5%	0.1%
Textiles and apparel	26.7%	43.2%
Footwear, headgear, etc.	15.6%	1.6%
Ceramics, glass, etc.	5.9%	1.7%
Precious stones/metals	0.7%	0.1%
Base metals and articles	7.3%	8.6%
Machinery and equipment	1.7%	2.4%
Transport equipment	5.4%	1.5%
Instruments	1.3%	0.5%
Arms and ammunition	1.4%	0.0%
Miscellaneous manufactures	2.7%	0.7%
Works of art	0%	0%
Agriculture	21.4%	28.3%
Nonagriculture	8.7%	71.7%
All sections	10.4%	

This table displays information on the six-digit HS products affected by the reforms of LDC trade preference programs studied in this paper, according to the 21 sections of the HS classification. The first column tabulates, among exporters affected by at least one of these reforms, the share of exporter-importer-product cells for which tariffs were cut by a reform, within each section. The second column tabulates the number of exporter-importer-products in each section for which tariffs were cut by a reform, as a share of the total number of exporter-importer-products for which tariffs were cut by a reform. The same exercises are also performed for agricultural and nonagricultural products, according to the definition of agricultural products in the WTO Agreement on Agriculture.

of treated cells.

In the first panel of Table 3, we summarize the frequency of the main treatment variable used in our analysis below. As discussed above, this is a dummy variable equal to one in all years after a tariff is cut by importer j for exporter i and product p due to an LDC program reform. Because all of the reforms we study occurred after 1996, this variable is equal to zero for all observations in the dataset in 1996. However, by 2013, approximately 7.18% of exporter-importer-product observations in the sample had been treated in this way. As already documented in Table 2, this proportion is 10.4% for exporters treated by at least one of the reforms studied here. Across all years in the sample period, the treatment variable is equal to one for 4.65% of observations (6.74% for treated exporters).

The size of the tariff cuts provided by these reforms is explored in Table A2. This shows the distribution of tariff reductions, in percentage points, across treated exporter-importer-product cells.[32] Three facts about these reductions are notable. First, the cuts are right-skewed, with a mean of 11 and a median of 7 percentage points. Second, there are many large reductions; the 90th percentile of the distribution is 19 percentage points, and the 99th percentile is 93 percentage points. Third, this upper tail of the distribution is occupied almost entirely by agricultural products; the 99th percentile of tariff cuts in the nonagricultural sector is just 20 percentage points.

Because of the existence of some very large tariffs among agricultural goods, we use a winsorized variable in our main analysis so as to avoid the influence of outliers, providing results of regressions that use the raw variable in footnotes. Specifically, we reassign all tariff cuts above the 99.9th percentile to the size of the tariff cut at the 99.9th percentile, based on the distribution of tariff cuts across all treated exporter-importer-product observations. As shown in Table 2, this affects tariff reductions larger than approximately 250 percentage points.[33] Winsorization has little effect on the mean of the tariff cut variable, but reduces its standard deviation by approximately 45%.

4.4 Positive trade flows

We take data on trade flows from the UN Comtrade database. Although the Comtrade data provides us with the value of goods trade as reported by both exporters and importers,

[32] When a cell is affected by more than one reform, for instance because tariffs are reduced in stages, we consider only the size of the initial tariff reduction.

[33] These observations are generally due to large ad valorem equivalents of specific or compound tariffs.

Table 3: Summary statistics

	Treated countries (1)	Full sample (2)
Treatment dummy, all years	6.74%	4.65%
Treatment dummy, 1996	0%	0%
Treatment dummy, 2013	10.41%	7.18%
Positive trade flows, all years	1.10%	1.40%
Positive trade flows, 1996	0.78%	1.00%
Positive trade flows, 2013	1.38%	1.71%
Export experience (baseline definition), 1996	19.15%	22.44%
Of which:		
Existing flows, 1996	0.78%	1.00%
Adjacent flows, 1996	18.37%	21.44%
Of which:		
Both of the below	1.22%	1.70%
Same six-digit product, other importer (only)	3.17%	3.82%
Same two-digit category, same importer (only)	13.98%	15.92%
Of which:		
Same four-digit category	1.76%	2.12%
Other in same two-digit category	12.22%	13.81%
Export experience (four-digit definition), 1996	6.93%	8.64%
Among ever-treated exporter-importer-products:		
Positive trade flows, 1996	0.48%	
Export experience, 1996	13.08%	

This table displays key summary statistics by exporter-importer-product-year observation, for the sample years 1996 to 2013 and for the initial and final year of the sample. Column (1) displays summary statistics for exporters who are subject to at least one of the reforms studied here, while column (2) includes all exporters in the sample. The first panel displays the share of observations equal to one of a dummy variable representing years after a tariff is cut for a particular exporter-importer-product cell. The second panel shows the share of positive trade flows across observations, defined using a threshold of one thousand 1996 US dollars. The first row of the third panel shows the proportion of exporter-importer-product cells with export experience, i.e. in which (i) the same product was exported by the same country to one of the nine importers in the sample in 1996; and/or (ii) a product in the same two-digit HS category was exported by the same country to the same importer in 1996. The next two rows break this down into the proportion of cases where there was a positive flow in 1996 for the exporter-importer-product cell itself, and all other cases. Excluding existing flows, the shares of cells satisfying both (i) and (ii), and only one of (i) and (ii), are shown in the subsequent three rows. Within cases satisfying only (ii), the next two rows show the share of cells where (ii) was satisfied based on the existence of a flow in the same four-digit HS category or not. Subsequently, the share of exporter-importer-products satisfying an amended definition of export experience using four-digit rather than two-digit HS categories is presented. The final panel shows the share of positive trade flows in 1996, and export experience in 1996, among exporter-importer-product cells that are ever treated, i.e. for which the treatment dummy equals one in any year.

we use only import-side information reported by the nine importers in our sample.[34] We observe the value of trade at the level of the importing country, exporting country, six-digit product and year. We calculate aggregate EU imports as the sum of the imports of the fifteen countries who were members of the EU as of 1996. So that very small flows of a given product between a country pair are not counted as breaches of the extensive margin, we define a positive trade flow as a flow greater than or equal to one thousand 1996 US dollars.[35] We also check the robustness of our results to alternative (larger and smaller) thresholds below.

In Table 3, we show summary statistics for positive trade flows, across exporter-importer-product-year observations. This yields a few notable pieces of information about the sample. First, products with positive trade flows between these importers and exporters are rare: among the nearly 70 million observations in the sample, all but 1.40% are zero trade flows. Second, the 69 countries who benefited from at least one of the reforms we study have only slightly less diversified exports than the sample as a whole. Third, there is an upward trend in export diversification across both the treated exporters and the full sample; the initial share of positive trade flows for the full sample was 1.00%, but by 2013, the share of positive observations had expanded to 1.71%.

4.5 Export experience

As discussed in the previous section, we define export experience as a time-invariant characteristic of an exporter-importer-product cell, based on conditions at the beginning of the sample period. In our baseline version of this variable, it is equal to one if either of the following conditions is satisfied: first, if the same product is exported by the same country to one of the nine importers in the sample in 1996; second, if a product in the same two-digit HS category is exported by the same country to the same importer in 1996. As displayed at the third panel of Table 3, such cases constitute around 20% of exporter-importer-product cells: 22.4% as a share of the full sample, and 19.2% among treated countries.

Table 3 also breaks down the frequency of the various possible dimensions of export experience according to our baseline definition. First note that this definition encompasses both existing trade flows (i.e. the product is already traded between that country pair) and cases where only an 'adjacent' flow exists. We will later divide our export experience variable

[34] We do this both because import data is likely to be more closely monitored and thus more reliable, and because this reliability is probably further enhanced by the greater local monitoring capacity in OECD countries.

[35] We use the US import price deflator from the OECD to put all flows into 1996 US dollars.

into cases of existing positive flows and all other cases, in order to separately identify the effects of tariff cuts on trade flow survival and sequential exporting. As noted above, trade occurred in only around 1% of sample cells as of 1996.

Among adjacent flows, initial export experience is most commonly due only to the existence of a product in the same two-digit category that was exported to the same importer. Moreover, this was generally a product outside the same four-digit category. For example, when evaluating the existence of export experience for women's knitted cotton shirts (a six-digit product), we might observe an export of knitted apparel (a two-digit category), but of shirts intended for men rather than women (which are in different four-digit categories). So when we instead use a definition of export experience where relatedness is defined using four-digit rather than two-digit HS categories, the share of cells with experience is reduced to 8.64% for the full sample, and 6.93% for treated countries.

In the last panel of Table 3, we consider the interaction of the treatment variable with the initial distribution of exports and export experience. The reforms we study usually involved reductions of almost all tariffs facing LDCs to zero. So the products whose tariffs were reduced were generally those whose LDC tariffs were initially positive. Unsurprisingly, trade flows were less likely to occur for these products before the reforms took place: of the exporter-importer-product cells that were treated at any time during the sample period, only 0.48% had positive trade flows as of 1996. This is smaller than the share of all cells with positive trade among treated exporters (0.78%). Similarly, the proportion of ever-treated cells with initial export experience is approximately 13%, as compared to a share of cases with export experience for treated countries of around 19%.

5 Main results

5.1 Treatment effects for full sample

We begin our discussion of the results by considering the estimated effect of treatment by a reform for the full sample, assuming in our baseline regression that this impact is homogeneous. Specifically, we estimate equation (3) using a dummy variable for a treated exporter-importer-product-year observation on the right-hand side, as discussed above. In our table of results, we have multiplied the estimated coefficient (and standard error) by 100 so that the estimated effect of the reforms is displayed in percentage points; we will continue this practice in subsequent tables.

Column (1) of Table 4 reveals that treatment by a reform has a positive and statistically

Table 4: Treatment effects for full sample

	(1)	(2)	(3)	(4)	(5)
Treatment dummy	0.1575				
	(0.0701)				
Below-median cut		0.0755	0.0707		
		(0.0421)	(0.0425)		
Above-median cut		0.2347			
		(0.1264)			
p50 to p90 cut			0.1387		
			(0.1140)		
Above p90 cut			0.5340		
			(0.2348)		
Up to 10pp cut				0.0644	
				(0.0465)	
10pp to 20pp cut				0.2355	
				(0.1819)	
20pp to 30pp cut				0.8634	
				(0.3107)	
Above 30pp cut				0.1941	
				(0.0804)	
Size of cut					0.0053
					(0.0019)
Observations	69,676,200	69,676,200	69,676,200	69,676,200	69,676,200

This table displays estimated effects of reforms in OECD countries' trade preference programs for the least developed countries. The dependent variable is a dummy for positive exports, with a threshold of one thousand 1996 US dollars. Each observation is an exporter-importer-product-year, including nine importers, 100 exporters, 4,301 products at the six-digit level of the HS classification, and eighteen years from 1996 to 2013. The variable 'treatment dummy' equals one in years after the import tariff is cut for an exporter-product as part of an LDC trade preference program reform by an importer. The variable 'size of cut' takes a positive value whenever the treatment dummy equals one, and is equal to the size of the tariff cut due to the reform, in percentage points. This variable is winsorized at the 99.9th percentile of tariff cuts by treated exporter-importer-product cell. The regressors in each of columns (2), (3) and (4) are dummy variables based on the size of the tariff cut as indicated, according to the distribution of tariff cuts across treated exporter-importer-products. All specifications include exporter-importer-product, exporter-importer-year, exporter-product-year and importer-product-year fixed effects. All regressions are estimated using ordinary least squares. All estimated coefficients are multiplied by 100. Standard errors (in parentheses) are estimated using two-way clustering by exporter and importer-product.

significant impact on whether a treated exporter sends any goods to the importer in the treated product category. The estimated effect of the reforms is approximately 0.16 percentage points, which is relatively large in terms of the initial average level of the dependent variable for treated exporters. Specifically, it is equal to approximately 20% of the proportion of exporter-importer-product cells in which treated exporters had positive trade flows as of 1996 (see Table 3). The p-value of the estimated coefficient in column (1) is 0.027.

In columns (2) to (5), we begin to allow for treatment effect heterogeneity, by considering whether larger tariff cuts have more substantial impacts. As suggested by the theoretical framework, a larger reduction in tariffs should be more likely to bring infra-marginal cases over the export threshold. We begin by classifying above-median and below-median tariff cuts into separate treatment variables, and estimating equation (3) with both regressors. As previously shown in Table A2, the median tariff reduction across treated exporter-importer-product cells is 7 percentage points. In line with our expectations, we see in Table 4 column (2) that the treatment effect is larger for above-median tariff cuts, by approximately a factor of three. We then further divide the above-median variable into cases above and below the 90th percentile (19 percentage points). Column (3) shows that the estimated effect of the largest 10% of tariff reductions is 7.5 times that of below-median cuts.[36]

Rather than using the distribution of tariff reductions to define our regressors, in column (4) we simply divide tariff cuts into bins of 10 percentage points, with '30 or more percentage points' as the final category. As before, all of these dummy variables equal one only for treated observations, so that the omitted category consists of untreated cells. At first glance, the results are puzzling; although the effect rises steeply until the third bin, it is actually smaller for the highest bin.

However, recall from Table A2 that the upper tail of the distribution of tariff reductions is dominated by agricultural goods. Given constraints on crop diversification due to land suitability, it would not be surprising to find that the responsiveness of the extensive margin to tariff cuts is smaller for the agricultural sector. We first estimate this relationship for the full sample in Table 4 column (5), and find that a ten percentage point reduction in tariffs is associated with an increase of 0.05 percentage points in the export probability. We then run the regressions of columns (1) and (5) separately for agricultural and nonagricultural products in Table A3. The association between the extensive margin and the size of the tariff reduction is indeed much smaller for agricultural products (see Panel B columns (1) and

[36]The slight difference in the estimated coefficient on the below-median dummy between columns (2) and (3) is due to the fact that the estimates of the fixed effects necessarily adjust when a new regressor is added, which in turn affects the other coefficient estimates.

(3)).[37] Nonetheless, the estimated impact of treatment (defined as a dummy variable) in the agricultural sector is approximately 80% of the size of the treatment effect for nonagricultural goods (Panel A columns (1) and (3)).

5.2 Treatment effects by export experience

Table 5 presents results of regressions where all coefficients are separately estimated for exporter-importer-product cells with and without export experience. In this table, we employ our baseline export experience definition, identifying cases where the exporter initially exported the same product to at least one importer in the sample, and/or exported a product in the same two-digit HS category to the same importer. We fully interact our fixed effects with the experience dummy, so that our specifications produce the same results as two sets of subsample regressions. The coefficient on the interaction term represents the difference in the effect of treatment between cells with and without initial export experience.

As shown in column (1) of Table 5, the impact of the reforms on the extensive margin is substantially larger for cells where the export experience dummy equals one. The estimated impact of treatment given initial export experience is approximately 1.35 percentage points (the sum of the two displayed coefficients). At the same time, the estimated size of the effect in cases without initial export experience is just 0.038 percentage points, less than one-quarter as large as the estimate for the full sample in Table 4 column (1), and more than thirty times smaller than the effect conditional on initial export experience.

Our discussion of observed export experience in terms of the theoretical framework proposed that cells with experience tend to represent cases close to the margin of exporting, while other cells tend to be infra-marginal. In column (2), we therefore repeat the specification of Table 4 column (3) dividing the treatment dummy according to the size of the tariff cut, now including a full set of export experience interactions. As expected, movement into exporting for treated cells without experience is driven by cases of large tariff cuts, above the 90th percentile. At the same time, in cells where related flows already existed as of the beginning of the sample period, substantial impacts are observed even for smaller (above-median) tariff reductions. In line with these findings, column (3) suggests a much steeper relationship between positive trade flows and the size of the tariff cut in cases with

[37] As discussed earlier, we winsorize the size of tariff cuts at the 99.9th percentile of treated exporter-importer-product cells because of some very large tariff reductions among agricultural goods. If we instead use the raw variable, the estimated coefficients on 'size of cut' for both the full sample and the agricultural sector become approximately 50% smaller, as these outliers become influential.

Table 5: Treatment effects by export experience

	(1)	(2)	(3)
Treatment dummy	0.0383		
	(0.0231)		
Treatment dummy × export experience	1.3089		
	(0.4502)		
Below-median cut		0.0214	
		(0.0240)	
p50 to p90 cut		0.0205	
		(0.0364)	
Above p90 cut		0.1594	
		(0.0549)	
Below-median cut × export experience		0.3158	
		(0.2788)	
p50 to p90 cut × export experience		1.8251	
		(0.7487)	
Above p90 cut × export experience		2.8594	
		(1.0077)	
Size of cut			0.0013
			(0.0005)
Size of cut × export experience			0.0548
			(0.0207)
Observations	69,676,200	69,676,200	69,676,200

This table displays estimated effects of reforms in OECD countries' trade preference programs for the least developed countries. The dependent variable is a dummy for positive exports, with a threshold of one thousand 1996 US dollars. Each observation is an exporter-importer-product-year, including nine importers, 100 exporters, 4,301 products at the six-digit level of the HS classification, and eighteen years from 1996 to 2013. The variable 'treatment dummy' equals one in years after the import tariff is cut for an exporter-product as part of an LDC trade preference program reform by an importer. The variable 'export experience' is a dummy that equals one for exporter-importer-product cells for which the exporter had at least one positive trade flow to any importer in the sample for the same six-digit product in 1996, and/or the exporter had at least one positive trade flow to the same importer in the same two-digit HS category in 1996. The variable 'size of cut' takes a positive value whenever the treatment dummy equals one, and is equal to the size of the tariff cut due to the reform, in percentage points. This variable is winsorized at the 99.9th percentile of tariff cuts by treated exporter-importer-product cell. The regressors in column (2) are dummy variables based on the size of the tariff cut as indicated, according to the distribution of tariff cuts across treated exporter-importer-products. All specifications include exporter-importer-product, exporter-importer-year, exporter-product-year and importer-product-year fixed effects, and interactions between export experience and these fixed effects. All regressions are estimated using ordinary least squares. All estimated coefficients are multiplied by 100. Standard errors (in parentheses) are estimated using two-way clustering by exporter and importer-product.

export experience.[38]

In Table 6, we break down export experience into various subcategories, in order to better understand what is driving the substantial degree of heterogeneity observed in Table 5. As above, our specifications include a full set of interactions between the fixed effects and each of these subcategories. First, noting that our experience definition includes situations where a trade flow already existed at the exporter-importer-product level as of 1996, we consider these existing flows separately from other cases of initial export experience. In column (1), we see that considering only cases of 'adjacent' flows rather than existing flows is still associated with a large treatment effect of 0.69 percentage points, eighteen times as large as for cells without experience. While the point estimate for existing flows suggests that the reforms we study may also have encouraged trade flow survival, this effect is very imprecisely estimated.

We next further subdivide the export experience variable according to whether the same product was exported to another importer in 1996, a related product was exported to the same importer, or both. The largest treatment effect is apparent in cases where both of these conditions were in place. The occurrence of a tariff cut due to an LDC reform makes the exporter around 3.73 percentage points more likely to breach the extensive margin in such cases, according to the estimates in Table 6 column (2). Tariff cuts are also estimated to have had substantial effects (0.71 percentage points) for cells where the same product had already been exported to another importer in the sample, but no product in the same two-digit HS category was exported to the same importer at the beginning of the sample period.

Both of these results suggest that the reforms have had a substantial impact on the occurrence of sequential exporting across importers, in the sense that treatment of a product already being exported increases the likelihood that the same product is exported to a new destination. We next consider cases where the six-digit product itself was not exported to any importer in the sample as of 1996, but a related product was exported to the importer cutting tariffs. As shown in Table 3, this includes more than two-thirds of the exporter-importer-product cells that we have defined as having export experience. For such cases, the point estimate on the relevant interaction term is much smaller (0.07), and not significantly different from that of cells without export experience.

[38] As noted above, the relationship between the size of the tariff cut and the extensive margin differs by sector (agriculture vs. nonagriculture). In Table A3 columns (2) and (4), we show that in both the agricultural and nonagricultural sectors, effects of tariff reductions are much larger for cells with export experience. This remains true whether treatment is measured as a dummy variable (Panel A) or according to the size of the cut (Panel B). As before, if we do not winsorize the 'size of cut' variable, estimates for the full sample and for agriculture are reduced by approximately 50%.

Table 6: Decomposition of heterogeneous effects

	Two-digit HS categories			Four-digit HS categories	
	(1)	(2)	(3)	(4)	(5)
Treatment dummy	0.0383	0.0383	0.0383	0.0613	0.0613
	(0.0249)	(0.0301)	(0.0345)	(0.0276)	(0.0360)
Treatment dummy × existing flow	2.3347	2.3347	2.3347		2.3117
	(2.3186)	(2.8127)	(3.2175)		(2.8087)
Treatment dummy × adjacent flow only	0.6514				
	(0.3119)				
Treatment dummy × both types of adjacent flow		3.6904	3.6904		4.6867
		(1.5667)	(1.7922)		(3.3478)
Treatment dummy × same product, other importer		0.6759	0.6759		1.0386
		(0.3329)	(0.3808)		(0.4012)
Treatment dummy × same category, same importer		0.0669			
		(0.3353)			
Treatment dummy × same four-digit category, same importer			1.1878		1.1648
			(1.5580)		(1.3562)
Treatment dummy × other in two-digit category, same importer			0.1244		
			(0.2804)		
Treatment dummy × export experience (four-digit)				2.0267	
				(0.6189)	
Observations	69,676,200	69,676,200	69,676,200	69,676,200	69,676,200

This table displays estimated effects of reforms in OECD countries' trade preference programs for the least developed countries. The dependent variable is a dummy for positive exports, with a threshold of one thousand 1996 US dollars. Each observation is an exporter-importer-product-year, including nine importers, 100 exporters, 4,301 products at the six-digit level of the HS classification, and eighteen years from 1996 to 2013. The variable 'treatment dummy' equals one in years after the import tariff is cut for an exporter-product as part of an LDC trade preference program reform by an importer. We define exporter-importer-product cells with 'export experience' as those for which (i) the exporter had at least one positive trade flow to any importer in the sample for the same six-digit product in 1996, and/or (ii) the exporter had at least one positive trade flow to the same importer in the same two-digit HS category in 1996. In column (1), export experience is separated into two dummy variables, for cells with existing trade flows in 1996 ('existing flow') and all other cases of export experience ('adjacent flow only'). In column (2), the latter variable is subdivided into dummies for whether conditions (i) and (ii) are both satisfied, only (i) is satisfied, or only (ii) is satisfied. In column (3), we subdivide the cases where only (ii) is satisfied into dummies for 1996 exports of a product in the same four-digit HS category and all other cases. In column (4), we redefine 'export experience' by allowing only for exports in the same four-digit HS category in condition (ii). In column (5), we redefine the categories used in column (2) according to the revised definition in column (4). All specifications include exporter-importer-product, exporter-importer-year, exporter-product-year and importer-product-year fixed effects, and interactions between the export experience variable(s) and these fixed effects. All regressions are estimated using ordinary least squares. All estimated coefficients are multiplied by 100. Standard errors (in parentheses) are estimated using two-way clustering by exporter and importer-product.

So in column (3), we subdivide this group of cells again, breaking out the narrower set of cases with 1996 exports within the same four-digit category as the product being considered. Among this subset of cells with existing exports of more closely related products, we find a much larger treatment effect of approximately 1.19 percentage points, though this is quite imprecisely estimated and is thus statistically insignificant. Finally, in columns (4) and (5), we reproduce Table 5 column (1) and Table 6 column (2) using a definition of export experience based on four-digit rather than two-digit categories. Using this narrower definition, we unsurprisingly find a somewhat larger treatment effect on exporter-importer-product cells without experience (0.061 rather than 0.038). But the effect is now 2.03 percentage points greater than this for cases with export experience, and 4.69 percentage points larger for cells with both initial exports of the same product to another importer, and exports of a product in the same four-digit category to the same importer.

6 Additional specifications

6.1 Event study evidence

We now present a series of additional specifications, intended both to test the robustness of our main results, and to extend them by exploring other definitions of the treatment effects of interest. We begin by running event study regressions, in which we separately estimate treatment effects for each year preceding or following the implementation of an LDC program reform. Specifically, we expand the specifications of Table 4 column (1) and Table 5 column (1) by replacing our treatment dummy with a set of dummy variables identifying the timing of each treated observation relative to the year of treatment.

Our motivation for running these event studies is twofold. First, one possible concern with our identification strategy is the possibility that tariff reductions could be a consequence of export success rather than vice versa. This might be because the emergence of a new exporter-importer-product trade relationship motivates the exporter of that product to successfully lobby for tariff reductions from the importer.[39] In our setting, this scenario is unlikely, because the wave of LDC reforms we study was based on a multilateral initiative. Moreover, the reforms generally set all remaining nonzero tariffs to zero for LDCs, and defined eligible exporters using the list of LDCs published by the UN, rather than targeting selected subsets of exporters and products. Nonetheless, it is important that we check for

[39]Note that our fixed effects take account of aggregate trends by importer-exporter, exporter-product and importer-product.

pre-trends in the data.

Second, it is possible that the asymmetry we observe between cases with and without export experience is due, at least in part, to the timing of treatment effects. In particular, our baseline estimates might indicate much smaller impacts of tariff cuts on exporter-importer-product cells without export experience because those effects take longer to emerge. If we allow for treatment effect heterogeneity over time, we might observe this phenomenon in the data.

In designing our event study specifications, we follow the advice of Schmidheiny and Siegloch (2020) by including all possible lags and leads (so that no treated observations instead act as controls), but binning some of these together near the endpoints of the window being studied. We thus include dummies for the year of treatment, each of the first four years before treatment (excluding the year immediately preceding treatment) and each of the first nine years after treatment, along with dummies for five or more years before treatment and ten or more years after treatment.[40] In the event study based on the regression of Table 5 column (1), each of these dummy variables is also interacted with export experience.

The results are displayed in Figure 1. In Panel A, we plot the estimated coefficients and 95% confidence intervals from the event study corresponding to the regression of Table 4 column (1). Reassuringly, our point estimates for the years prior to treatment are generally statistically insignificant. A positive effect of around 0.1 percentage points, relative to the year before treatment, is apparent in the initial year of a tariff reduction and the subsequent two years. The estimated impact then gradually rises over time, and exceeds 0.3 percentage points in the eighth year after treatment and beyond.

Panel B shows the heterogeneity in treatment effects over time when these are separately estimated for cells with and without export experience. Again, we see no pre-trends in either case. Our estimates suggest that the effect in cases with export experience is immediate and rises over time. The estimated impact for cells without export experience also increases to around 0.09 percentage points after eight years, which is more than twice as large as the time-invariant estimate in Table 5 column (1). However, a huge gap between cases with and without export experience persists. Ten or more years after treatment, the estimated impact

[40]Binning is motivated by the need for sufficient variation in treatment status to identify each of the coefficients. For example, because most of the LDC program reforms we study fall in the first half of our sample period, estimates of pre-trends far in advance of treatment would need to rely on comparisons involving the relatively small number of observations treated later. To determine which periods should be binned together, we tabulate all treated exporter-importer-product cells according to the year in which they were treated by a reform, and require that at least 50% of the treated cells are used to estimate each of the parameters in our first event study.

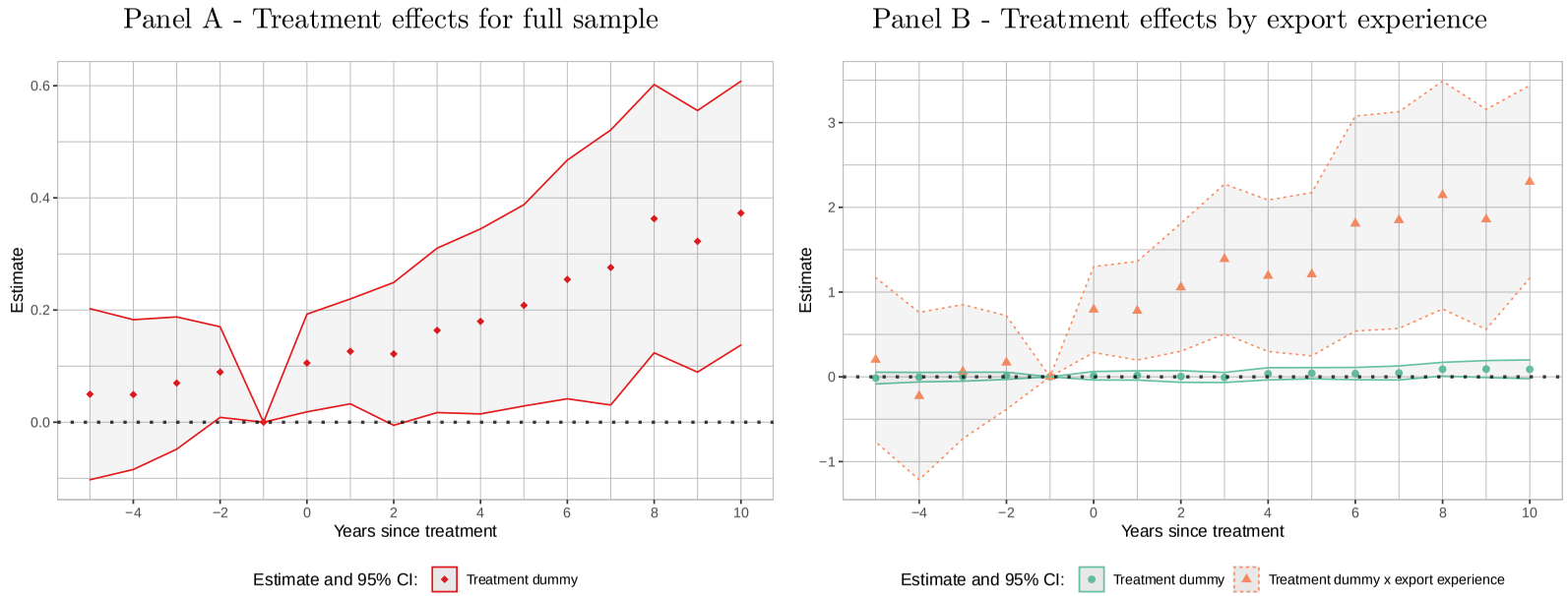

Figure 1: Event studies

This figure depicts estimated coefficients and 95% confidence intervals from two event study regressions. Note that the y-axis of each panel is on a different scale, for greater visibility. The dependent variable is a dummy for positive exports, with a threshold of one thousand 1996 US dollars. Each observation is an exporter-importer-product-year, including nine importers, 100 exporters, 4,301 products at the six-digit level of the HS classification, and eighteen years from 1996 to 2013. Each regression includes a set of dummy variables identifying the timing of each treated observation relative to the year of treatment. This includes dummy variables for the year of treatment, each of the first four years before treatment (excluding the year immediately preceding treatment) and each of the first nine years after treatment, along with dummies for five or more years before treatment and ten or more years after treatment. The regression in Panel B also includes interactions of each of these dummies with a dummy for 'export experience'. We define treatment as occurring when the import tariff is cut for an exporter-product as part of an LDC trade preference program reform by an importer. The export experience dummy equals one for exporter-importer-product cells for which the exporter had at least one positive trade flow to any importer in the sample for the same six-digit product in 1996, and/or the exporter had at least one positive trade flow to the same importer in the same two-digit HS category in 1996. Both specifications include exporter-importer-product, exporter-importer-year, exporter-product-year and importer-product-year fixed effects. The regression in Panel B also includes interactions between export experience and these fixed effects. Both regressions are estimated using ordinary least squares. All estimated coefficients are multiplied by 100. Standard errors are estimated using two-way clustering by exporter and importer-product.

of tariff cuts for cells without export experience remains more than twenty-five times smaller than for cells with experience.[41]

6.2 Alternative country samples

We next consider the possibility that the heterogeneity we have highlighted might be driven by the presence of some very small countries, such as Pacific island nations, in the sample of exporters. These countries' capacity for export diversification may be especially constrained by the simple fact of their size. We thus re-estimate the regressions of Table 4 column (1) and Table 5 column (1) dropping the 21 sample exporters with a population under one million as of 1996.[42] As shown in columns (1) and (2) of Table A4, the estimated impact of LDC program expansion for cells without export experience does rise, but only slightly, from 0.038 to 0.052 percentage points. At the same time, the gap in the estimated effect between cases with and without experience remains of similar size (1.35 percentage points).

In columns (3) and (4) of Table A4, we instead exclude the 21 countries that are treated by at least one reform, but are not on the UN list of the least developed countries. As discussed earlier, most of these countries are either included in AGOA by the US, or are in Norway's 2008 expansion of its LDC trade preferences program. We perform this robustness exercise in order to establish whether the estimated effects remain similar when the treatment group includes only the 48 exporters that are the beneficiaries of most importers' LDC programs. This sample restriction leads to a marginal reduction in our full-sample estimate from 0.16 to 0.14 percentage points, and shrinks the estimated impact for cases without export experience to 0.026 (now statistically insignificant). When both sets of countries are dropped (columns (5) and (6)), the results mostly fall in between these two sets of estimates, due to the offsetting effects of these two refinements to the sample.[43]

[41] As well as these event study regressions, we also run another set of dynamic specifications, in which we instead account for inertia in trade flows. In this robustness check, we add a lagged dependent variable to the specification of Table 4 column (1), and add a lagged dependent variable and its interaction with the export experience dummy to the regression of Table 5 column (1). These regressions produce similar results to our baseline specifications.

[42] We drop Belize, Bhutan, Cape Verde, Comoros, Djibouti, Dominica, Equatorial Guinea, Fiji, Grenada, Guyana, Kiribati, Maldives, Marshall Islands, Micronesia, Samoa, Sao Tome and Principe, Seychelles, Solomon Islands, Suriname, Tuvalu and Vanuatu. Population data is sourced from the World Bank's World Development Indicators.

[43] Our findings are also robust to dropping one importer (and therefore one set of reforms) from the dataset at a time. The results also remain similar when we define the AGOA reforms based on the timing observed in the WTO IDB data; i.e. if we move AGOA tariff reductions for textiles and apparel later in the sample period. Both sets of estimates are available upon request.

6.3 Alternative extensive margin definitions

So far, we have defined the extensive margin in terms of a threshold of one thousand 1996 US dollars, by importer, exporter, product and year. In Table A5, we check whether the results are robust to changing this definition. We first impose a smaller threshold, redefining both our dependent variable and the definition of export experience in line with this new cutoff. Because the UN Comtrade data does not report observations below 500 US dollars until 2001, this is the minimal feasible threshold that allows for consistency across the whole sample period. As shown in columns (1) and (2) of Table A5, using a $500 cutoff makes little difference to our main results.[44]

We next impose a stricter definition, requiring an larger import value in order to qualify as a trade flow. Our baseline threshold of $1000 is close to the 25th percentile of observed flows between sample exporters and importers in years when UN Comtrade has no reporting threshold (2001 onwards). We now instead impose a cutoff around the 75th percentile, at $40,000. Unsurprisingly, this reduces the estimated impact of the reforms: our full-sample treatment effect estimate falls from 0.16 to 0.09 percentage points (see Table A5 column (3)). It also has notable consequences for the estimated heterogeneity of the effect. With the new threshold, only 10.7% of exporter-importer-product cells are classified as having export experience, and these see a treatment effect of around 1.4 percentage points. Meanwhile, the effect of treatment for the other 89.3% of cells is estimated to be 0.011 percentage points – i.e. more than one hundred times smaller – and statistically insignificant.

While the motivation for an extensive margin threshold is to exclude small flows in any given year, the continuation of trade relationships over the years of the sample is also potentially important, given that the reforms we study presumably aimed to generate sustained flows. We thus redefine the extensive margin by removing 'one-off' or 'isolated' flows; i.e. trade of a given product between a country pair that is observed in a certain year, but not in the year before or the year after. So the extensive margin is now defined as all non-isolated flows above $1000. As shown in Table A5 columns (5) and (6), this leads to a modest reduction in our main estimates, but no change in our qualitative conclusions.[45]

[44] Imposing no threshold at all, and thus including all flows observed in the UN Comtrade data, yields similar results. Redefining the baseline threshold of one thousand dollars in terms of current rather than constant US dollars also makes little difference to the size of our estimates.

[45] For the regression in Table A5 column (6), we redefine the dependent variable, but keep our baseline definition of export experience based only on 1996 trade patterns. We do this because the presence of a trade flow in 1997 could be determined by the earliest of the LDC reforms we study.

6.4 Textiles and apparel vs. other nonagricultural products

We have already seen that tariff cuts have a positive effect on the extensive margin in both the agricultural and nonagricultural sectors, concentrated in cells with export experience in both cases. Because more than 40% of exporter-importer-product cells treated by reforms to LDC tariff preference programs are textiles or apparel (see Table 2), we further decompose the impact among nonagricultural goods in Table A6. Specifically, we present results excluding products in the 'Textiles and apparel' section of the HS product classification, as well as results for textiles and apparel products only.

For nonagricultural products excluding textiles and apparel, the estimated impact of a tariff reduction due to a reform is approximately 0.12 percentage points (Panel A column (1)), an effect that is more than fifteen times larger for cells with export experience relative to other cells (Panel A column (2)). Similar patterns are again found when the treatment effect is instead estimated in terms of the size of the relevant tariff cut (Panel B). The results for textiles and apparel (columns (3) and (4)) are less precisely estimated, but remain qualitatively similar; the point estimates again suggest substantially larger impacts for cells with export experience.

6.5 Adding program entry and exit

Next, we fully incorporate exporters' entry into, and exit from, LDC preference programs into our treatment measure. As noted earlier, our baseline treatment dummy already includes cases where countries were newly admitted into these programs in a reform year (such as for Norway's 2008 reform). We now expand this definition to encompass exporters whose tariffs were reduced via entrance into an LDC program at any time during the sample period.[46] This augments the number of treated observations in our sample by approximately 15%, but makes little difference to the size of our main estimates (see Table A7 columns (1) and (2)). We then account for exit from LDC preferences by reassigning our treatment variable to zero whenever an exporter has lost eligibility for these, but this affects only a small share of observations and again does not lead to substantial changes in our results (columns (3) and (4)).[47]

[46] Note that we do not allow for exit and re-entry into an importer's program by an exporter during the sample period to lead to a wider range of products to be coded as treated for that country pair.

[47] Allowing for exit from LDC status, but not considering entry in non-reform years, also yields similar results.

6.6 Adding other trade policy variation

While our empirical models so far have included a full set of three-dimensional fixed effects, we have not yet considered other changes in trade policy that vary by exporter, importer, product and year. These include reforms to other preferential tariff programs, entry and exit from these other programs, and new trade agreements. We now take account of these other policy changes in two different ways: first by controlling for them, and then by redefining our treatment variable in terms of a preference margin relative to the tariffs imposed on non-LDCs.

We begin by adding a control variable that is defined analogously to our treatment dummy, but instead identifies exporters and products affected by reforms to other preferential programs. This mainly encompasses a set of reforms reducing GSP tariffs, enacted at various times during the sample period by Canada, the EU, Norway, Switzerland and Turkey. It also includes the implementation by the EU, Norway and Turkey of 'GSP-plus' programs targeted to a subset of GSP countries, as well as the creation of new US preference programs targeting Caribbean and Andean countries.[48] In practice, the creation and expansion of Turkey's GSP program accounts for more than 60% of cases where this new dummy variable equals one.

We find that our results are robust to controlling for these other cuts to preferential tariffs. Column (1) of Table 7 shows that the estimated coefficient on our LDC treatment variable rises only slightly from 0.16 to 0.19 when we add the 'other improved preferences' variable to our baseline specification. Moreover, interacting both of these regressors with export experience in column (2) again produces heterogeneous effects of LDC reforms that are very similar to our baseline estimates in Table 5.

Of course, these regressions are also informative about the impacts of the non-LDC preferential program reforms. The estimated coefficient on 'other improved preferences' in column (1) suggests an extensive margin effect of a similar size to our estimate for LDC-specific tariff reductions. However, once we allow for heterogeneity and allow our fixed effects to vary for cells with and without export experience (column (2)), our results instead show no statistically significant impact, including for cases with export experience. This may be due to the small size of the tariff reductions we observe in these reforms: across exporter-importer-product cells experiencing a tariff cut due to a non-LDC program reform,

[48] In some cases, reductions of GSP tariffs due to reforms also affect a subset of the least developed countries in our dataset, because of their eligibility for GSP tariffs when no LDC-specific tariff exists. We include such cases in our dummy variable for these other reforms.

Table 7: Controlling for other reforms and improved preferences

	LDC and other preferential reforms		Adding entry into improved treatment	
	(1)	(2)	(3)	(4)
Treatment dummy	0.1887	0.0477	0.1804	0.0382
	(0.0701)	(0.0236)	(0.0687)	(0.0208)
Other improved preferences	0.1843	0.0528	0.1678	0.0498
	(0.1192)	(0.0494)	(0.0822)	(0.0298)
Treatment dummy × export experience		1.3070		1.2310
		(0.4405)		(0.4272)
Other improved preferences × export experience		0.0304		0.2310
		(0.4469)		(0.3142)
Observations	69,676,200	69,676,200	69,676,200	69,676,200

This table displays estimated effects of reforms in OECD countries' trade preference programs for the least developed countries. The dependent variable is a dummy for positive exports, with a threshold of one thousand 1996 US dollars. Each observation is an exporter-importer-product-year, including nine importers, 100 exporters, 4,301 products at the six-digit level of the HS classification, and eighteen years from 1996 to 2013. The variable 'treatment dummy' equals one in years after the import tariff is cut for an exporter-product: in columns (1) and (2), due to an LDC trade preference program reform by an importer, and in columns (3) and (4), due to an LDC trade preference program reform by an importer or entry into an importer's LDC trade preference program in a non-reform year. The variable 'other improved preferences' equals one in years after the import tariff is cut for an exporter-product: in columns (1) and (2), due to a non-LDC trade preference program reform by an importer, and in columns (3) and (4), due to a non-LDC trade preference program reform by an importer or entry into improved preferences in a non-reform year. The variable 'export experience' is a dummy that equals one for exporter-importer-product cells for which the exporter had at least one positive trade flow to any importer in the sample for the same six-digit product in 1996, and/or the exporter had at least one positive trade flow to the same importer in the same two-digit HS category in 1996. All specifications include exporter-importer-product, exporter-importer-year, exporter-product-year and importer-product-year fixed effects. Columns (2) and (4) also include interactions between export experience and these fixed effects. All regressions are estimated using ordinary least squares. All estimated coefficients are multiplied by 100. Standard errors (in parentheses) are estimated using two-way clustering by exporter and importer-product.

the median reduction is 2.4 percentage points and the 95th percentile is approximately 7.5 percentage points. Indeed, in Table 5, we also found a statistically insignificant impact of small tariff cuts (below 7 percentage points) for LDCs, even for cells with export experience.

In columns (3) and (4), we amend our control variable by also incorporating entry into improved tariff treatment other than through program reforms. We add cases of exporters whose tariffs were reduced when they became eligible for GSP or GSP-plus tariffs (in a non-reform year), or were newly granted MFN treatment. We also include tariff cuts due to the entry into force of trade agreements between exporters and importers in the sample. This encompasses various agreements with Canada, the EU, Japan, Norway, Switzerland, Turkey and the US, which generally involve exporters in our dataset other than those eligible for LDC preferences.

To maintain a consistent approach, in the regressions of columns (3) and (4) we use the version of our LDC treatment variable incorporating LDC program entry in non-reform years (from Table A7 columns (1) and (2)). Our findings on the effects of LDC program reforms are again similar to our main results.[49] For other cases of improved tariff treatment, our point estimates now suggest an impact more than five times as large for cells with experience as compared to those without (column (4)), though the estimated difference remains statistically insignificant.[50]

Next, recall from Table 4 that for LDC program reforms, we found an increase in the size of a tariff cut by ten percentage points to be associated with a rise in the probability of exporting by 0.053 percentage points. We now instead consider the effect of preferences for LDCs in terms of the size of the margin between LDC and GSP tariffs, allowing this to vary freely over time. Specifically, whenever we observe an exporter to be classified as an LDC by a particular importer, our regressor captures the (negative) difference between the tariff faced by that exporter and the GSP tariff applied to the same product by the importer. It is otherwise equal to zero. As shown in Table 8 column (1), a preference margin that is ten percentage points larger is associated with a 0.042 percentage point increase in the export probability. Moreover, the results in column (2) indicate that the size of this effect is approximately 0.38 percentage points for cells with initial export experience, but only 0.012 percentage points in cases without experience.

[49] A regression including the augmented control variable but our baseline LDC dummy variable also yields a very similar effect of tariff cuts for LDCs for the full sample. The estimated effect for cells without export experience remains small in magnitude but turns negative, and the difference between the treatment effects for cases with and without export experience rises to approximately 1.82 percentage points.

[50] In the specifications discussed in the previous footnote, the estimated effect of tariff reductions for cells with export experience rises to approximately 0.7 percentage points.

Table 8: Preference margins

	(1)	(2)	(3)	(4)	(5)	(6)
LDC vs. GSP	-0.0042	-0.0012				
	(0.0013)	(0.0005)				
LDC vs. GSP × export experience		-0.0367				
		(0.0133)				
Preferential tariff vs. MFN			-0.0054	-0.0020		
			(0.0018)	(0.0006)		
Preferential tariff vs. MFN × export experience				-0.0252		
				(0.0159)		
Tariff					-0.0069	-0.0021
					(0.0018)	(0.0006)
Tariff × export experience						-0.0422
						(0.0120)
Observations	69,485,362	69,485,362	69,676,200	69,676,200	69,381,562	69,381,562

This table displays estimated effects of preference margins for exporters in the sample. The dependent variable is a dummy for positive exports, with a threshold of one thousand 1996 US dollars. Each observation is an exporter-importer-product-year, including nine importers, 100 exporters, 4,301 products at the six-digit level of the HS classification, and eighteen years from 1996 to 2013. The variable 'LDC vs. GSP' equals the difference between the tariff faced by an exporter who is classified as an LDC by a given importer, and the GSP tariff applied to the same product by that importer. It is equal to zero for nonbeneficiaries of LDC preferences. The variable 'preferential tariff vs. MFN' equals the difference between the tariff faced by an exporter and the MFN tariff applied to the same product by the importer. It is equal to zero when the exporter does not receive better-than-MFN treatment. The variable 'tariff' is equal to the applied tariff. The variable 'export experience' is a dummy that equals one for exporter-importer-product cells for which the exporter had at least one positive trade flow to any importer in the sample for the same six-digit product in 1996, and/or the exporter had at least one positive trade flow to the same importer in the same two-digit HS category in 1996. All specifications include exporter-importer-product, exporter-importer-year, exporter-product-year and importer-product-year fixed effects. Columns (2), (4) and (6) also include interactions between export experience and these fixed effects. All regressions are estimated using ordinary least squares. All estimated coefficients are multiplied by 100. Standard errors (in parentheses) are estimated using two-way clustering by exporter and importer-product.

In columns (3) and (4), we expand the effect of interest beyond LDCs, and instead estimate the impact of preferences relative to MFN tariffs for all exporters in our sample. For any case of better-than-MFN treatment by exporter, importer, product and year, we define our new regressor to be equal to the difference between the applied tariff and the MFN tariff. We again find that larger preference margins are associated with a higher probability of trade (of a magnitude similar to that in column (1)), and that this effect is substantially larger for exporter-importer-product cells with export experience.

Finally, we simply run a regression of our extensive margin dummy on the applied tariff for the entire sample. Table 8 column (5) shows that a ten percentage point rise in the applied tariff is associated with a reduction of 0.069 percentage points in the probability of exporting. As shown in column (6), this effect is also highly heterogeneous according to whether there exists initial export experience. For cells without experience, a tariff that is lower by ten percentage points is estimated to increase the probability of trade by 0.021 percentage points, while the effect is estimated to be approximately 0.44 percentage points in cases with experience.[51]

6.7 Growth in trade value

Throughout this paper, because of our interest in the impact of the LDC program reforms on export diversification, we have focused on the extensive margin of trade. In particular, our dependent variable of interest has been the presence of a trade flow by exporter, importer, product and year. We now instead briefly consider the effect of the reforms on the intensive margin, for the subset of exporter-importer-product cells with existing trade flows as of the beginning of the sample period. This analysis is complementary to our earlier finding in Table 6 that the reforms may have encouraged trade flow survival for these cells, though that result was imprecisely estimated.

We first run a simple OLS specification with the logarithm of trade value, as reported by the importer, as the dependent variable. The right-hand side of the regression includes a dummy variable for a treated exporter-importer-product-year observation, as in our baseline specifications, along with the usual full set of three-dimensional fixed effects. However, our

[51]The results in this table are based on winsorized regressors. The preference margin variables used in columns (1) to (4) are winsorized at the 0.1st percentile of nonzero observations so as to reduce the magnitude of large negative values. Similarly, the tariff variable in columns (5) and (6) is winsorized at the 99.9th percentile of nonzero observations. As with the 'size of cut' regressions above, the results remain qualitatively similar but are approximately 50% smaller in magnitude when the raw variables are used instead, due to some extremely large tariffs in the agricultural sector.

sample is now restricted to exporter-importer-product cells with positive exports as of 1996. As we showed in Table 3, this is approximately 1% of the full sample. Also, because we use the logarithm of trade value in this specification, only positive trade flows are retained in the sample.[52]

The results of this regression are displayed in column (1) of Table 9. The estimated coefficient on the treatment dummy is statistically significant, and implies a treatment effect of approximately 93%. In other words, this estimate suggests that among exporter-importer-product cells with existing trade links as of 1996, the occurrence of a tariff cut due to an LDC reform increased the value of trade of the affected product between that exporter and importer by around 93%.

We next attempt a Poisson pseudo-maximum likelihood (PPML) regression, using the same right-hand side as in the previous specification, but with trade value in levels (including cases of zero trade) as the dependent variable. The results are shown in Table 9 column (2). The estimated treatment effect is again large in magnitude, but of the opposite sign to the OLS estimate in column (1), and very imprecisely estimated.[53]

A possible reason for the large difference between our OLS and PPML estimates is the highly skewed distribution of trade values in the data. While most of the product-level trade flows between the exporters and importers in our sample are small, there are some very large observed flows in the right tail, to which our regression results might be sensitive.[54] Most notably, exports of certain commodities, such as crude oil, occur on a much larger scale than almost all other flows in the sample.

In columns (3) to (6) of Table 9, we therefore exclude some of these very large flows, by restricting the set of products included in the sample. We first simply drop crude oil, which accounts for the several largest trade values we observe. We then remove the five products with the highest observed trade flow values as of 1996 (for any particular exporter-importer-

[52]For the specifications discussed in the main text, we use constant 1996 US dollars and reassign export values under $1000 to zero, in order to remain consistent with our study's baseline definition of the extensive margin. If we retain the same sample but instead use the raw trade value data (so that the dependent variable is measured in current US dollars and we do not reassign any observed trade flows to zero), we obtain similar results.

[53]Note that even though we now include zeroes, the number of observations we use in the PPML regression remains considerably smaller than 1% of the total sample size. This is because this subsample contains many singletons; i.e. groups corresponding to one of our fixed effects (such as an importer-exporter-year) that consist of only one observation. These are dropped from our regressions.

[54]As Eaton, Kortum and Sotelo (2012) note in their study of granularity and zero trade flows, PPML "applies a much greater penalty to a given proportional deviation in a large trade flow than a small one (since a proportional deviation from the mean becomes less likely for a Poisson distributed random variable as the mean is increased)"; see their footnote 25.

Table 9: Intensive margin effects for existing trade flows

	Including all products		Excluding crude oil		Excluding top 5 products	
	OLS	PPML	OLS	PPML	OLS	PPML
	(1)	(2)	(3)	(4)	(5)	(6)
Treatment dummy	0.6853	-1.2544	0.6719	0.9746	0.6719	0.8303
	(0.2410)	(1.2669)	(0.2414)	(0.2806)	(0.2408)	(0.2718)
Implied treatment effect	93.1%	-71.5%	95.8%	165.0%	95.8%	129.4%
Observations	139,101	271,746	138,637	271,098	137,085	269,010

This table displays estimated effects of reforms in OECD countries' trade preference programs for the least developed countries. The dependent variable is the logarithm of trade value in columns (1), (3) and (5), and trade value in columns (2), (4) and (6), as reported by the importer. Trade value is in 1996 US dollars, and reported values under one thousand 1996 US dollars are reassigned to zero. Each observation is an exporter-importer-product-year. The sample in columns (1) and (2) includes all exporter-importer-product cells with positive exports as of 1996, based on a threshold of one thousand 1996 US dollars. The sample in columns (3) and (4) excludes observations for which the traded product is crude oil. The sample in columns (5) and (6) excludes observations for which the traded product is any of the five products with the highest observed trade flow values as of 1996 (for any particular exporter-importer-product observation in that year). These are crude oil, refined oil, liquefied natural gas, cocoa beans and unworked non-industrial diamonds. The variable 'treatment dummy' equals one in years after the import tariff is cut for an exporter-product as part of an LDC trade preference program reform by an importer. The 'implied treatment effect' in percentage terms is calculated as the exponential of the estimated coefficient, minus one, multiplied by one hundred. All specifications include exporter-importer-product, exporter-importer-year, exporter-product-year and importer-product-year fixed effects. The regressions in columns (1), (3) and (5) are estimated using ordinary least squares, and the regressions in columns (2), (4) and (6) are estimated using Poisson pseudo-maximum likelihood. Standard errors (in parentheses) are estimated using two-way clustering by exporter and importer-product.

product observation in that year). Along with crude oil, we drop refined oil, liquefied natural gas, cocoa beans and unworked non-industrial diamonds.

These exclusions have little impact on our OLS estimates (see columns (3) and (5)). However, removing flows of crude oil brings the output of a PPML regression much closer to the corresponding OLS results. The PPML estimate based on a sample without crude oil is positive and statistically significant, as shown in column (4), and corresponds to a treatment effect of 165%. Dropping all five products listed above leads to an estimated treatment effect that is yet closer to the OLS benchmark, calculated at 129% (PPML, column (6)) as compared to 96% (OLS, column (5)). Of course, the OLS and PPML estimates should be interpreted differently from one another, since the PPML estimates also incorporate comparisons of positive trade flows with zeroes.

On balance, our results suggest that exporter-importer-product cells with existing trade flows as of 1996 may have experienced substantial gains in trade value due to the reforms. The estimated magnitudes we observe are in the same range as some other well-known estimates of trade policy impacts, such as the finding of Baier and Bergstrand (2007) that free trade agreements coming into effect between 1960 and 2000 increased bilateral trade by close to 100% after ten years. However, it is important to note that our empirical strategy is designed to identify impacts of LDC program reforms on the extensive margin, and so our estimates might not account for some factors that could be important for growth on the intensive margin.[55]

7 Conclusion

In this paper, we have studied the effects of a set of expansions of LDC trade preference programs by OECD countries in the years following the conclusion of the Uruguay Round. We have explored whether tariff reductions have facilitated the diversification of LDCs' exports across products and importers, starting from a remarkably low base. We have employed a theoretical framework based on Helpman, Melitz and Rubenstein (2008) to predict that on the extensive margin, a subset of importer-exporter-product cells that are close to an export threshold should be much more likely to benefit from reductions in tariffs. These should tend to be cases where 'adjacent' exports already existed: of the same product to a different importer, and/or of a related product to the same importer. Our results confirm

[55] As noted in footnote 14, many of the reforms gave quota-free treatment to LDCs. Our dataset does not include changes in product-level quotas.

that the extensive-margin effect of LDC program reforms has indeed been substantially larger for such cases with previous 'export experience', and small otherwise.

Our results thus suggest that tariff cuts have facilitated incremental expansions in LDCs' export portfolios, building on existing trade relationships, but have not been sufficient to achieve wider gains in export diversification. Further progress may depend on the success of complementary initiatives that bring local firms in untapped sectors closer to the margin of exporting, allowing trade preferences to bring them 'over the top'. In fact, such 'aid for trade' programs – including direct support to trade infrastructure and production – have also long been an important part of the favoured policy approach to fostering export-led growth. The continued prevalence of zero trade flows in LDCs' export portfolios suggest that this approach may still have a long road to travel.

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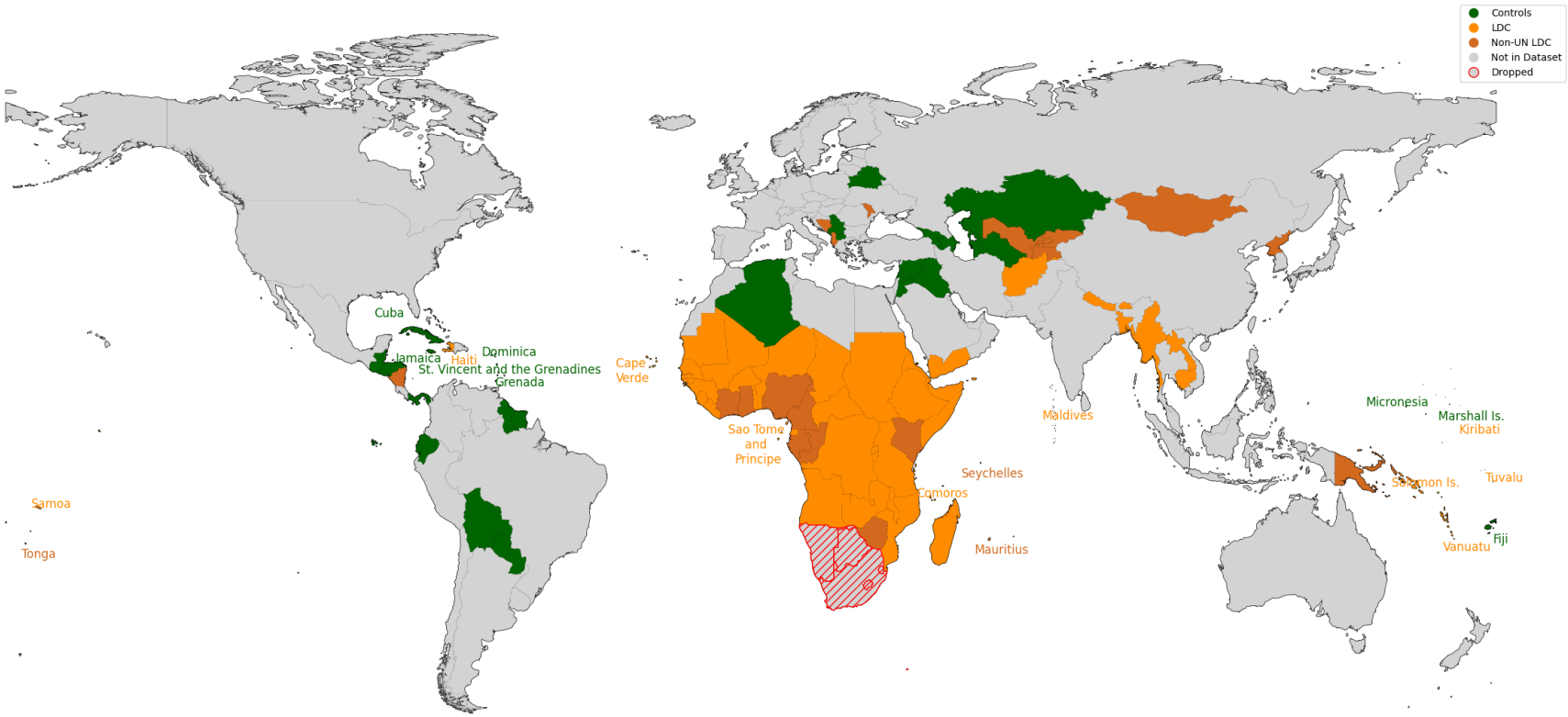

Figure A1: Sample exporters

This figure depicts the set of exporters in the sample. Countries in orange are treated by at least one LDC program reform; this includes 48 countries on the UN LDC list (light yellow) and 21 other LDC program beneficiaries (dark yellow). Countries in the sample that are not treated by any LDC reform, i.e. control countries, are depicted in green. Botswana, Lesotho, Namibia, Swaziland and South Africa are dropped from our sample, since exports from these countries are not separately observed in the UN Comtrade data.

Table A1: Sample exporters and treatment status by importer

	Aus	Can	EU	Jap	NZ	Nor 2004	Nor 2008	Swi	Tur	US LDC	US AGOA
Afghanistan	✓	✓	✓	✓	✓	✓		✓	✓		
Albania								✓			
Algeria											
Angola	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Armenia											
Azerbaijan											
Bangladesh	✓	✓	✓	✓	✓	✓		✓	✓	✓	
Belarus											
Belize											
Benin	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Bhutan	✓	✓	✓	✓	✓	✓		✓	✓	✓	
Bolivia											
Bosnia-Herzegovina								✓			
Burkina Faso	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Burundi	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Cambodia	✓	✓	✓	✓	✓	✓		✓	✓	✓	
Cameroon							✓				✓
Cape Verde	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Central Afr. Rep.	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Chad	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Comoros	✓	✓	✓	✓	✓	✓		✓	✓	✓	
Cuba											
Dem. Rep. Congo	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Djibouti	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Dominica											
Ecuador											
El Salvador											
Eq. Guinea	✓	✓	✓	✓	✓	✓		✓	✓	✓	
Eritrea	✓	✓	✓	✓	✓	✓		✓	✓		✓
Ethiopia	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Fiji											
FYR Macedonia											
Gabon											✓
Gambia	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Georgia											

Table A1: Sample exporters and treatment status by importer (continued)

	Aus	Can	EU	Jap	NZ	Nor 2004	Nor 2008	Swi	Tur	US LDC	US AGOA
Ghana							✓				✓
Grenada											
Guatemala											
Guinea	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Guinea-Bissau	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Guyana											
Haiti	✓	✓	✓	✓	✓	✓		✓	✓	✓	
Honduras											
Iraq											
Ivory Coast							✓	✓			
Jamaica											
Jordan											
Kazakhstan											
Kenya							✓				✓
Kiribati	✓	✓	✓	✓	✓	✓		✓	✓	✓	
Kyrgyzstan							✓				
Laos	✓	✓	✓	✓	✓	✓		✓	✓		
Lebanon											
Liberia	✓	✓	✓	✓	✓	✓		✓	✓		✓
Madagascar	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Malawi	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Maldives	✓	✓	✓	✓	✓	✓		✓	✓		
Mali	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Marshall Islands											
Mauritania	✓	✓	✓	✓	✓	✓		✓	✓		✓
Mauritius											✓
Micronesia											
Moldova							✓				
Mongolia							✓				
Mozambique	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Myanmar	✓		✓	✓	✓			✓	✓		
Nepal	✓	✓	✓	✓	✓	✓		✓	✓	✓	
Nicaragua							✓				
Niger	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Nigeria											✓

Table A1: Sample exporters and treatment status by importer (continued)

	Aus	Can	EU	Jap	NZ	Nor 2004	Nor 2008	Swi	Tur	US LDC	US AGOA
North Korea							✓				
Panama											
Papua N. G.							✓				
Paraguay											
Rep. of Congo							✓	✓			✓
Rwanda	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
St. Vincent & Gr.											
Samoa	✓	✓	✓	✓	✓	✓		✓	✓		
S. T. & Principe	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Senegal	✓	✓		✓	✓	✓		✓	✓		✓
Serbia & Montenegro											
Seychelles											✓
Sierra Leone	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Solomon Islands	✓	✓	✓	✓	✓	✓		✓	✓		
Somalia	✓	✓	✓	✓	✓	✓		✓	✓	✓	
Sudan	✓	✓	✓	✓	✓	✓		✓	✓		
Suriname											
Syria											
Tajikistan							✓				
Tanzania	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Togo	✓	✓	✓	✓	✓	✓		✓	✓	✓	
Tonga			✓						✓		
Turkmenistan											
Tuvalu	✓	✓	✓	✓	✓	✓		✓	✓	✓	
Uganda	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Uzbekistan							✓				
Vanuatu	✓	✓	✓	✓	✓	✓		✓	✓	✓	
Yemen	✓	✓	✓	✓	✓	✓		✓	✓	✓	
Zambia	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Zimbabwe							✓				

This table identifies, for each importer, the set of exporters in the sample that is a beneficiary of at least one of that importer's LDC program reforms. Norway's 2004 product-level program reform is listed separately from its 2008 expansion of the list of beneficiaries. Similarly, 'US LDC' refers to the 1998 US expansion of its GSP-LDC program, while 'US AGOA' refers to the 2001 creation and 2007 reform of the African Growth and Opportunity Act.

Table A2: Distribution of tariff cuts

	All treated (1)	Nonagriculture (2)	Agriculture (3)
Raw variable:			
Mean	11.2	8.2	18.9
Standard deviation	32.9	5.7	60.6
Winsorized variable:			
Mean	10.8	8.2	17.5
Standard deviation	18.0	5.7	31.6
Quartiles:			
25th percentile	4.0	4.3	2.9
50th percentile	7.0	7.0	6.8
75th percentile	12.0	10.1	17.0
Upper tail:			
90th percentile	19.0	17.0	43.1
95th percentile	25.0	19.0	74.9
99th percentile	93.0	20.0	173.4
99.9th percentile	254.6	37.5	398.9

This table tabulates the distribution of tariff cuts, in percentage points, across exporter-importer-product cells affected by at least one LDC program reform. When a cell is treated more than once, we consider only the size of the initial tariff reduction. Column (1) includes the full sample, column (2) includes only nonagricultural products and column (3) includes only agricultural products. Agricultural products are defined as in the WTO Agreement on Agriculture. The second panel shows the mean and standard deviation of a variable that is winsorized at the 99.9th percentile of tariff cuts across all treated exporter-importer-product cells. All other panels display information about the raw (non-winsorized) variable, though note that all of these summary statistics are identical for the winsorized variable with the exception of the 99.9th percentile of tariff cuts across agricultural products.

Table A3: Treatment effects – nonagricultural vs. agricultural products

	Nonagriculture		Agriculture	
	(1)	(2)	(3)	(4)
Panel A				
Treatment dummy	0.1322	0.0156	0.1093	0.0457
	(0.1012)	(0.0266)	(0.0605)	(0.0375)
Treatment dummy × export experience		1.5246		0.5006
		(0.6136)		(0.2925)
Panel B				
Size of cut	0.0209	0.0023	0.0016	0.0003
	(0.0149)	(0.0028)	(0.0009)	(0.0004)
Size of cut × export experience		0.1821		0.0074
		(0.0679)		(0.0065)
Observations	60,085,800	60,085,800	9,590,400	9,590,400

This table displays heterogeneity by sector in the estimated effects of reforms in OECD countries' trade preference programs for the least developed countries. The dependent variable is a dummy for positive exports, with a threshold of one thousand 1996 US dollars. Each observation is an exporter-importer-product-year, including nine importers, 100 exporters, and eighteen years from 1996 to 2013. The sample in columns (1) and (2) includes 3,709 nonagricultural products at the six-digit level of the HS classification, while the sample in columns (3) and (4) includes 592 agricultural products at the same level of aggregation. Agricultural products are defined as in the WTO Agreement on Agriculture. The variable 'treatment dummy' equals one in years after the import tariff is cut for an exporter-product as part of an LDC trade preference program reform by an importer. The variable 'export experience' is a dummy that equals one for exporter-importer-product cells for which the exporter had at least one positive trade flow to any importer in the sample for the same six-digit product in 1996, and/or the exporter had at least one positive trade flow to the same importer in the same two-digit HS category in 1996. The variable 'size of cut' takes a positive value whenever the treatment dummy equals one, and is equal to the size of the tariff cut due to the reform, in percentage points. This variable is winsorized at the 99.9th percentile of tariff cuts (for the full sample) by treated exporter-importer-product cell. All specifications include exporter-importer-product, exporter-importer-year, exporter-product-year and importer-product-year fixed effects. Columns (2) and (4) also include interactions between export experience and these fixed effects. All regressions are estimated using ordinary least squares. All estimated coefficients are multiplied by 100. Standard errors (in parentheses) are estimated using two-way clustering by exporter and importer-product.

Table A4: Alternative country samples

	Excluding small countries		Excluding treated not in UN LDC list		Excluding both sets of countries	
	(1)	(2)	(3)	(4)	(5)	(6)
Treatment dummy	0.2005	0.0517	0.1387	0.0258	0.1826	0.0408
	(0.0884)	(0.0292)	(0.0772)	(0.0292)	(0.1027)	(0.0416)
Treatment dummy × export experience		1.3473		1.4187		1.4490
		(0.4827)		(0.5713)		(0.6346)
Observations	55,044,198	55,044,198	55,044,198	55,044,198	41,108,958	41,108,958

This table displays estimated effects of reforms in OECD countries' trade preference programs for the least developed countries. The dependent variable is a dummy for positive exports, with a threshold of one thousand 1996 US dollars. Each observation is an exporter-importer-product-year; in the full sample, this includes nine importers, 100 exporters, 4,301 products at the six-digit level of the HS classification, and eighteen years from 1996 to 2013. The 21 exporters with 1996 populations smaller than one million are excluded from the sample in columns (1) and (2). The 21 exporters that are beneficiaries of LDC program reforms but are not in the United Nations list of LDCs are excluded from the sample in columns (3) and (4). The 41 exporters that are in both of these categories are excluded from the sample in columns (5) and (6). The variable 'treatment dummy' equals one in years after the import tariff is cut for an exporter-product as part of an LDC trade preference program reform by an importer. The variable 'export experience' is a dummy that equals one for exporter-importer-product cells for which the exporter had at least one positive trade flow to any importer in the sample for the same six-digit product in 1996, and/or the exporter had at least one positive trade flow to the same importer in the same two-digit HS category in 1996. All specifications include exporter-importer-product, exporter-importer-year, exporter-product-year and importer-product-year fixed effects. Columns (2), (4) and (6) also include interactions between export experience and these fixed effects. All regressions are estimated using ordinary least squares. All estimated coefficients are multiplied by 100. Standard errors (in parentheses) are estimated using two-way clustering by exporter and importer-product.

Table A5: Alternative extensive margin definitions

	Threshold of 500 USD		Threshold of 40,000 USD		Two-year definition	
	(1)	(2)	(3)	(4)	(5)	(6)
Treatment dummy	0.1532	0.0353	0.0930	0.0113	0.1327	0.0283
	(0.0722)	(0.0247)	(0.0465)	(0.0097)	(0.0640)	(0.0187)
Treatment dummy × export experience		1.1432		1.3992		1.1810
		(0.4585)		(0.6257)		(0.4275)
Observations	69,676,200	69,676,200	69,676,200	69,676,200	69,676,200	69,676,200

This table displays estimated effects of reforms in OECD countries' trade preference programs for the least developed countries. The dependent variable in columns (1) and (2) is a dummy for positive exports, with a threshold of five hundred 1996 US dollars. The dependent variable in columns (3) and (4) is a dummy for positive exports, with a threshold of forty thousand 1996 US dollars. The dependent variable in columns (5) and (6) is a dummy for positive exports, with a threshold of one thousand 1996 US dollars, but observations where this dummy variable equals zero in the preceding and subsequent year are themselves set to zero. Each observation is an exporter-importer-product-year, including nine importers, 100 exporters, 4,301 products at the six-digit level of the HS classification, and eighteen years from 1996 to 2013. The variable 'treatment dummy' equals one in years after the import tariff is cut for an exporter-product as part of an LDC trade preference program reform by an importer. The variable 'export experience' is a dummy that equals one for exporter-importer-product cells for which the exporter had at least one positive trade flow to any importer in the sample for the same six-digit product in 1996, and/or the exporter had at least one positive trade flow to the same importer in the same two-digit HS category in 1996. For the export experience dummy, a positive trade flow is defined using a threshold of five hundred 1996 US dollars in column (2), a threshold of forty thousand 1996 US dollars in column (4), and a threshold of one thousand 1996 US dollars in column (6). All specifications include exporter-importer-product, exporter-importer-year, exporter-product-year and importer-product-year fixed effects. Columns (2), (4) and (6) also include interactions between export experience and these fixed effects. All regressions are estimated using ordinary least squares. All estimated coefficients are multiplied by 100. Standard errors (in parentheses) are estimated using two-way clustering by exporter and importer-product.

Table A6: Treatment effects – textiles and apparel vs. other nonagricultural products

	Other nonagriculture		Textiles and apparel	
	(1)	(2)	(3)	(4)
Panel A				
Treatment dummy	0.1166	0.0433	0.0027	0.0749
	(0.0525)	(0.0298)	(0.1629)	(0.0651)
Treatment dummy × export experience		0.7315		0.6811
		(0.3396)		(0.7326)
Panel B				
Size of cut	0.0127	0.0064	0.0246	0.0069
	(0.0056)	(0.0038)	(0.0189)	(0.0051)
Size of cut × export experience		0.1091		0.1554
		(0.0410)		(0.0695)
Observations	48,762,000	48,762,000	11,323,800	11,323,800

This table displays heterogeneity by sector in the estimated effects of reforms in OECD countries' trade preference programs for the least developed countries. The dependent variable is a dummy for positive exports, with a threshold of one thousand 1996 US dollars. Each observation is an exporter-importer-product-year, including nine importers, 100 exporters, and eighteen years from 1996 to 2013. The sample in columns (3) and (4) includes the 699 six-digit products in the textiles and apparel section of the HS classification, while the sample in columns (1) and (2) includes the other 3,010 nonagricultural products. Agricultural products are defined as in the WTO Agreement on Agriculture. The variable 'treatment dummy' equals one in years after the import tariff is cut for an exporter-product as part of an LDC trade preference program reform by an importer. The variable 'export experience' is a dummy that equals one for exporter-importer-product cells for which the exporter had at least one positive trade flow to any importer in the sample for the same six-digit product in 1996, and/or the exporter had at least one positive trade flow to the same importer in the same two-digit HS category in 1996. The variable 'size of cut' takes a positive value whenever the treatment dummy equals one, and is equal to the size of the tariff cut due to the reform, in percentage points. This variable is winsorized at the 99.9th percentile of tariff cuts (for the full sample) by treated exporter-importer-product cell. All specifications include exporter-importer-product, exporter-importer-year, exporter-product-year and importer-product-year fixed effects. Columns (2) and (4) also include interactions between export experience and these fixed effects. All regressions are estimated using ordinary least squares. All estimated coefficients are multiplied by 100. Standard errors (in parentheses) are estimated using two-way clustering by exporter and importer-product.

Table A7: Adding program entry and exit

	Adding entry outside reform year		Adding exit from LDC program	
	(1)	(2)	(3)	(4)
Treatment dummy	0.1534	0.0300	0.1473	0.0380
	(0.0695)	(0.0212)	(0.0652)	(0.0235)
Treatment dummy × export experience		1.2095		1.1054
		(0.4362)		(0.4177)
Observations	69,676,200	69,676,200	69,676,200	69,676,200

This table displays estimated effects of reforms in OECD countries' trade preference programs for the least developed countries. The dependent variable is a dummy for positive exports, with a threshold of one thousand 1996 US dollars. Each observation is an exporter-importer-product-year, including nine importers, 100 exporters, 4,301 products at the six-digit level of the HS classification, and eighteen years from 1996 to 2013. In columns (1) and (2), the variable 'treatment dummy' equals one in years after the import tariff is cut for an exporter-product as part of an LDC trade preference program reform by an importer, or due to entry into an importer's LDC trade preference program in a non-reform year. In columns (3) and (4), the variable 'treatment dummy' is as in columns (1) and (2), but set to zero in years after an exporter exits an importer's LDC trade preference program. The variable 'export experience' is a dummy that equals one for exporter-importer-product cells for which the exporter had at least one positive trade flow to any importer in the sample for the same six-digit product in 1996, and/or the exporter had at least one positive trade flow to the same importer in the same two-digit HS category in 1996. All specifications include exporter-importer-product, exporter-importer-year, exporter-product-year and importer-product-year fixed effects. Columns (2) and (4) also include interactions between export experience and these fixed effects. All regressions are estimated using ordinary least squares. All estimated coefficients are multiplied by 100. Standard errors (in parentheses) are estimated using two-way clustering by exporter and importer-product.

A1 Data appendix

A1.1 Defining tariffs by program-product-year

For each importer, we observe one tariff schedule per year through the WTO IDB database, even if the importer published more than one schedule of tariffs in that year due to revisions. This includes tariff information by program (e.g. LDC, GSP, MFN) or trade agreement, for each product according to the product classification used by the importer. For all preferential programs, we use only the generally applicable tariffs, disregarding cases in which specific beneficiaries are treated differently for a subset of products, as such cases are not always specified consistently in the raw data. All relevant preferential tariffs are missing from the EU data from 1996 to 2009, and so we instead use the EU TARIC data for all tariffs in these years, and use the EU data reported in WTO IDB only for 2010 to 2013.

The EU TARIC database provides information on a wider set of product-specific trade policies, and so we first restrict this to observations labelled 'Tariff preference' or 'Third country duty'. Rather than providing a single tariff at the annual level, TARIC specifies specific start and end dates for each tariff. We annualize this data by using the tariffs in place on July 1 of each year. When the same tariff applies to a set of products at a more aggregate level (e.g. all products in a given two-digit category), TARIC does not provide a full list of disaggregated (eight-digit) products. We thus use the set of eight-digit products present in the WTO IDB data for the EU in 1996 to 2009 to define the list of eight-digit products used by the EU in each of these years.

A1.2 Calculating ad valorem equivalents

Many tariffs are not defined in simple ad valorem terms, so we calculate ad valorem equivalents of these tariffs whenever possible. For each importer, we first classify these tariffs into categories (e.g. \$x/unit; \$x/unit + y%; max(min(\$x/unit, y%), \$z/unit)), and separate the various specific and ad valorem components of each category. For specific components, we put units into standard forms found in trade data (e.g. kg rather than 100 kg; number rather than dozen). When a specific component is defined in terms of a part or ingredient of a product rather than the entire product, we assume this part or ingredient constitutes 50% of the product (e.g. of its weight or volume).

Next, we calculate ad valorem equivalents of each specific component. To do this, we use a single unit value for each product over time, so that observed changes in tariffs over

time are due to changes in published tariff rates rather than fluctuations in unit values. We express trade values in the UN Comtrade data in constant 1996 local currency, using US dollar exchange rates from the Federal Reserve Bank of St. Louis FRED database, and import price deflators published by the OECD and the European Central Bank. For each product, we calculate the importer's total value and quantity imported from the rest of the world over the entire sample period, using a consistent set of six-digit product codes (see below for our definition of these). To arrive at a unit value for each product and year, we first divide total value by total quantity, and then put this back into current local currency units using the appropriate import price deflator. We divide specific tariffs by these unit values to arrive at an ad valorem tariff.

Using appropriate calculation rules for each category of tariffs, we translate the various components of each tariff (now all in ad valorem terms) into a single ad valorem equivalent. This sometimes results in missing values, so that by importer-program-product-year, 9.5% of tariffs not defined in ad valorem terms are coded as missing. This occurs for two reasons. In some cases, information on tariffs in the raw data is missing or insufficient (often due to the use of codes representing instructions that are not defined in the raw data). In other cases, there are issues with the linkage between the trade and tariff data; either because quantity information is missing in the trade data, because the units used in specific tariffs are different from the quantity units in the trade data, or because more than one unit is used within a single six-digit product category. Because most tariffs are defined in ad valorem terms in the raw data, tariffs are missing for only 0.4% of observations in the final dataset.

A1.3 Dropping above-quota tariffs

For products subject to tariff-rate quotas, we consider only the within-quota tariff, since this is likely to be the relevant tariff for the extensive margin of trade. For the countries where both within-quota and above-quota tariffs are observed in the raw data, we identify and drop the above-quota tariffs in the following way:

- Canada – We remove observations described as 'over access commitment' in the product description.
- Japan – We remove product codes with the product description 'other', which also share the same first eight digits as a product with description including 'quantity' or 'quota' (these represent the within-quota case).

- Switzerland – We remove product codes that share the same first several digits as a product with description including 'dans les limites du contingent tarifaire' (these represent the within-quota case) and also satisfy certain other conditions identifying them as above-quota tariffs. Depending on whether the within-quota tariff line is specified to seven or eight digits (according to the number of zeroes at the end of the product code), we drop products meeting the following four conditions: (1) has the same first six (or seven) digits; (2) the seventh (or eighth) digit is a higher number; (3) the description begins with the same number of dashes, or more, as the within-quota tariff line; (4) the description does not itself include 'dans les limites du contingent tarifaire'.

- US – Based on the various descriptions of over-quota tariffs in the US data, we remove observations with any of the following in the product description – 'in excess of'; 'ov' and 'quota'; 'after the first'; 'quantity o/'; 'exceed' and 'year'; 'exceed' and 'yr'; 'for over' and 'entered' – as long as these do not include 'outside quota'; 'subject to quota'; 'subj. quota'; 'quota described' 'quota dscrbd'; 'not to exceed'; 'years'.

A1.4 Defining tariffs by exporter

We use information on the status of each exporter for each importer and year (derived from sources discussed below) to match tariffs by program-product-year to specific exporters. We begin by assigning the importer's MFN tariff to all exporters. In some cases, the WTO IDB data provides multiple MFN variables, in which case we impose the temporary MFN tariff if it exists, the (regular) applied MFN tariff if not, and the bound MFN tariff if neither of these are available.

We then assign to each exporter the minimum of the MFN tariff and any other tariffs for which the exporter is potentially eligible (e.g. due to GSP eligibility, membership in another preferential program, existence of a trade agreement, etc.). In doing so, we take account of the fact that for many importers, the raw tariff data might not specify the LDC tariff when it is equal to the GSP tariff. If data on one of the tariffs we compare in this operation is missing, and none of the nonmissing tariffs being compared is equal to zero, we code the resulting tariff variable as missing for that exporter, importer, product and year. Exporters not eligible for MFN treatment are instead assigned the relevant higher-than-MFN tariff.

A1.5 Concording six-digit products across years

The Harmonized System (HS) product classification is agreed internationally at the six-digit level, but differs across countries at more detailed levels. It also changes over time, due to amendments to both shared international codes and country-specific suffixes. We use publicly available concordances at the six-digit level to construct a single concordance that accounts for all changes in six-digit product codes across the 1996, 2002, 2007 and 2012 HS versions.

Whenever multiple products are merged or divided, we consolidate these into a single code. However, because our baseline export experience variable is defined using information on exports within the same two-digit HS category, we drop concorded product codes that span more than one such category. This results in the exclusion of approximately 6% of the six-digit products in the 1996 version of the HS classification. However, because of the large scale of the reclassification of these products (e.g. due to major changes in consumer electronics), our concordance had consolidated these products into just twelve six-digit categories. Their omission is thus of minimal importance to our analysis.

In specifications using a lagged dependent variable, we use trade data from 1995, necessitating a concordance with the 1992 HS version. Because this data is only employed in one robustness check, we take a simpler approach in this case. Specifically, we use a publicly available concordance between the 1992 and 1996 HS versions to assign 1995 trade values equally across all 1996 HS product codes corresponding to each 1992 HS product code.

A1.6 Averaging tariffs by six-digit product

For most of the importers in our sample, tariffs are defined at the eight-digit product level, though also vary according to an additional two-digit code for a subset of products. Using the resulting ten-digit code, we first take a simple average of tariffs at the eight-digit level, and then again take a simple average at the six-digit level (using the products defined by our concordance), for each importer, exporter and year. We define tariffs as missing at the six-digit level when tariff information is missing for any subproduct within that six-digit code.

In a few cases, we deviate slightly from this procedure:

- EU – In the EU TARIC data, tariffs are indicated at the ten-digit level, but an additional four-digit code is occasionally used to distinguish between subcases. We thus first take a simple average of tariffs at the ten-digit level before following the procedure

above.

- Japan – Rather than defining eight-digit products, Japan's classification system employs product codes at the nine-digit level. As with other importers, it also includes an additional two-digit code for a subset of products. We thus first take a simple average of tariffs at the nine-digit level, and then the six-digit level.

- Turkey – Tariffs are defined by ten-digit product in some years, and by twelve-digit product in others, again with an additional two-digit code in some cases. We thus first take a simple average of tariffs at the twelve-digit level, and then at the ten-digit level, before following the procedure above.

A1.7 Imputing missing data

There is no WTO IDB data for Turkey for 2012, and so we use the 2013 data to represent tariffs in this year. In a few other cases, data on a certain program or set of programs is missing in some years, and we impute this as follows. In all cases below, we do this imputation at the six-digit level, using our concorded six-digit product codes, so that it is possible to make comparisons across years.

- Canada – Tariff preferences for Caribbean countries are missing from the data in 1996 and 1997. We instead use the 1998 tariff facing these countries, whenever this is better than the 1998 GSP tariff (since all eligible countries in our sample are also eligible for GSP) and also better than the contemporaneous (1996 or 1997) tariff in the absence of the Caribbean preference program.

- EU – Information on tariffs for countries in African, Caribbean and Pacific Economic Partnership Agreements (ACP EPA) transitional arrangements is missing in 2011, so we instead use 2011 tariffs for the CARIFORUM EPA, since these two sets of tariffs are identical in 2010 and 2012.

- New Zealand – Tariff preferences for SPARTECA countries are missing in 2000. We instead use the 2001 tariff facing these countries, whenever this is better than the 2001 MFN tariff and also better than the 2000 tariff in the absence of the SPARTECA preference program. Also, GSP and LDC tariffs are missing in 2005. We instead use the 2006 GSP or LDC tariff, whenever this is better than the 2006 MFN tariff and also better than the 2005 tariff in the absence of the relevant (GSP or LDC) program.

- Norway – GSP and LDC tariffs are missing from 1996 to 1998. We instead use the 1999 GSP or LDC tariff, whenever this is better than the 1999 MFN tariff and also better than the contemporaneous (1996, 1997 or 1998) tariff in the absence of the relevant (GSP or LDC) program.

- Turkey – Tariff preferences for FYR Macedonia are missing in 2000. We instead use its 2001 tariff, whenever this is better than the 2001 MFN tariff and also better than the 2000 tariff in the absence of these preferences.

- US – Preferential and column 2 tariffs are missing from the 1996 data. We instead use the 1997 tariff when this is both better than the 1997 MFN tariff (or worse in the case of column 2 tariffs) and also better than the 1996 MFN tariff. Also, column 2 tariffs are missing in 1999. We instead use the 2000 column 2 tariff, whenever this is higher than both the 1999 and 2000 MFN tariffs.

A1.8 LDC program reforms

The following are the dates of LDC program reforms as observed in the WTO IDB and EU TARIC data (given the timing of tariff cuts) and in primary sources, along with the source. Most sources listed below are importers' notifications to the WTO Committee on Trade and Development. For Turkey, the UNCTAD source specifies only a period of harmonization between the preferential tariffs of the EU and Turkey. As discussed in the main text, except in the case of the tariff cuts for textiles and apparel due to AGOA, we use the WTO IDB and EU TARIC data to define our treatment variables. Note that the WTO IDB data for New Zealand suggests that four of the 196 treated products first see tariff reductions in 2002 rather than 2001; we include these in the treatment.

- Australia
  - July 1 2003 (WT/COMTD/N/18), 2003 (WTO IDB)
- Canada
  - Sept 1 2000 (WT/COMTD/N/15), 2000 (WTO IDB)
  - Jan 1 2003 (WT/COMTD/N/15/Add.1), 2003 (WTO IDB)
- EU
  - Jan 1 1997 (Council regulation 1256/96), 1997 (EU TARIC)

  - Jan 1 1998 (WT/COMTD/W/41), 1998 (EU TARIC)
  - Mar 5 2001 (WT/COMTD/N/4/Add.2), 2001 (EU TARIC)

- Japan
  - Apr 1 2001 (WT/COMTD/N/2/Add.10), 2001 (WTO IDB)
  - Apr 1 2003 (WT/COMTD/N/2/Add.12), 2003 (WTO IDB)
  - Apr 1 2007 (WT/COMTD/N/2/Add.14), 2007 (WTO IDB)

- New Zealand
  - Jul 1 2001 (WT/COMTD/27), 2001 (WTO IDB)

- Norway
  - Jul 1 2002 (WT/COMTD/N/6/Add.4 (retrospective)), 2004 (WTO IDB)
  - Jan 1 2008 (WT/COMTD/N/6/Add.4), 2008 (WTO IDB)

- Switzerland
  - Mar 1 1997 (WT/COMTD/N/7), 1998 (WTO IDB)
  - Jan 1 2002 (WT/COMTD/N/7/Add.1), 2002 (WTO IDB)
  - Apr 1 2004 (WT/COMTD/N/7/Add.2), 2005 (WTO IDB)
  - Apr 1 2007 (WT/COMTD/N/7/Add.3), 2008 (WTO IDB)

- Turkey
  - Jan 1 1998 (WT/COMTD/W/39), 1998 (WTO IDB)
  - 2002-2006 (UNCTAD GSP Handbook on the Scheme of Turkey, 2017), 2002 and 2004 (WTO IDB)

- US
  - May 30 1997 (WT/COMTD/N/1/Add.2), 1998 (WTO IDB)
  - Dec 21 2000 (WT/COMTD/N/1/Add.3, AGOA legislation), 2001 and 2010 (apparel) (WTO IDB)
  - Dec 20 2006 (AGOA IV legislation), 2010 (WTO IDB)

A1.9 Exporter eligibility for LDC programs

We identify the list of exporters eligible for each importer's LDC program in each year as follows:

- Australia – A list of countries eligible for Australia's LDC program may be found in various (amended) versions of Australia's Customs Tariff Act 1995. According to a comparison of versions of the Customs Tariff Act from 2000, 2001 and 2002, Angola and Madagascar are added to Australia's LDC program in 2001 and Senegal is added in 2002.

- Canada – A list of countries eligible for Canada's LDC program may be found in the UNCTAD GSP Handbook on the Scheme of Canada from 2013. According to WT/COMTD/N/15/Add.1, Senegal is added to Canada's LDC program in 2002.

- EU – A list of countries eligible for the EU's LDC program may be found in periodic Council regulations renewing and updating its GSP program. According to WT/COMTD/W/41, Angola is added to the EU's LDC program, and Botswana and Tonga are removed, in 1998. According to a comparison of the 1998 Council regulation 2820/98 and the 2001 Council regulation 2501/2001 (effective 2002), we assume that Senegal is added to the EU's LDC program in 2002. Myanmar is suspended from LDC preferences in March 1997 and reinstated retroactively to June 2012, according to Council regulation 552/97 and Parliament and Council regulation 607/2013, so we assume it exits the LDC program from 1998 to 2011. According to Commission regulation 1547/2007, Cape Verde exits the EU's LDC program in 2012.

- Japan – A list of countries eligible for Japan's LDC program may be found in the UNCTAD GSP Handbook on the Scheme of Japan from 1999/2000 and several subsequent editions. According to WT/COMTD/N/2/Add.4, Eritrea is added to Japan's LDC program in 1997. According to WT/COMTD/N/2/Add.10, the Democratic Republic of Congo, Kiribati, Tuvalu and Zambia are added to the LDC program, and Comoros and Djibouti may request LDC treatment, as of 2001. However, Zambia appears as an LDC in the 2000 UNCTAD handbook, so we assume it is added to the LDC program in 2000. Comoros and Djibouti are not in a list of LDCs from May 2004 published in the 2006 UNCTAD handbook, but are in the list of LDCs in the 2011 UNCTAD handbook, so we assume these are added to the LDC program in 2005. According to WT/COMTD/N/2/Add.11, Senegal is added to Japan's LDC program in 2002. Cape

Verde is not in in the list of LDCs in the 2011 UNCTAD handbook, so we assume it exits the program upon graduation from the UN LDC list in 2007. The Maldives loses eligibility for LDC preferences in July 2011 according to WT/COMTD/N/2/Add.15, so we classify it as exiting the program in 2012.

- New Zealand – A list of countries eligible for New Zealand's LDC program may be found in the UNCTAD GSP Handbook on the Scheme of New Zealand from 1998 and a subsequent edition in 1999. Angola, Eritrea, Liberia and Senegal are not in the LDC program according to these documents, but the updated list in New Zealand's Tariff (Less Developed Countries and Least Developed Countries) Order of 2005 already includes these four countries. Because the latter document implies that the previous version is from 2001, we assume that these four countries are added to New Zealand's LDC program in 2001.

- Norway – A list of countries eligible for Norway's LDC program may be found in the UNCTAD GSP Handbook on the Scheme of Norway from 1998. The list of LDCs in this document does not include Laos or Senegal. A list of LDCs from 2001 in WT/COMTD/N/6/Add.2 includes Laos, so we assume Laos is added to Norway's LDC program in 2001. The list of LDCs in the 2008 Norwegian tariff schedule (in Norwegian) includes Senegal, so we assume Senegal receives LDC treatment as of 2002 as with other importers who alerted this change to the WTO (Canada and Japan). The document WT/COMTD/N/6/Add.2 specifies that Myanmar is excluded from LDC treatment as of May 1997 (so we classify it as exiting the program in 1998), and a comparison of the Norwegian tariff schedules from 2011 and 2012 suggest that its LDC status is restored in 2012. According to WT/COMTD/N/6/Add.4, fourteen new countries are added to Norway's program in 2008: Cameroon, Ghana, Ivory Coast, Kenya, Kyrgyzstan, Moldova, Mongolia, Nicaragua, North Korea, Papua New Guinea, Republic of Congo, Tajikistan, Uzbekistan and Zimbabwe. According to a comparison of the Norwegian tariff schedules from 2012 and 2013, Cameroon, Cape Verde, Moldova, Mongolia and Nicaragua exit Norway's LDC program in 2013.

- Switzerland – A list of countries eligible for Switzerland's LDC program may be found in the 1997 document WT/COMTD/N/7. This document states that Angola and Eritrea are added to Switzerland's LDC program in 1997. A 2001 amendment to the Swiss government ordinance on preferential tariffs for developing countries temporarily grants LDC preferences to Albania and Bosnia-Herzegovina from April 2001 to March 2004.

According to a 2004 amendment to the same ordinance, Senegal is added to Switzerland's LDC program in 2004. Cape Verde loses eligibility for LDC preferences in July 2011 according to WT/COMTD/N/7/Add.4, so we classify it as exiting the program in 2012. The Maldives loses eligibility for LDC preferences in September 2012 according to WT/COMTD/N/7/Add.5, so we classify it as exiting the program in 2013. According to WT/COMTD/N/7/Add.3, LDC preferences are temporarily granted as of 2007 to two highly indebted poor countries (HIPCs), Ivory Coast and Republic of Congo, until their debt reduction 'completion point'. According to WT/COMTD/N/7/Add.4, Republic of Congo loses eligibility for LDC treatment in July 2011 (so we classify it as exiting the program in 2012), while Kyrgyzstan is added to the list of HIPCs and is given LDC treatment. According to WT/COMTD/N/7/Add.5, Kyrgyzstan loses eligibility for LDC treatment in September 2012, so we classify it as exiting the program in 2013.

- Turkey – A list of countries eligible for Turkey's LDC program at the time of its creation in 1998 may be found in WT/COMTD/W/39. The updated list in the 2007 UNCTAD GSP Handbook on the Scheme of Turkey adds Senegal and drops Tonga. We assume that Tonga exits the LDC program when coordination of preferences with the EU begins in 2002, and that Senegal receives LDC treatment as of 2002 as with other importers who alerted this change to the WTO (Canada and Japan). Cape Verde is listed as an LDC in the 2010 Turkish customs tariff but is listed in the GSP-plus program for 2013 in a Turkish government document listing GSP beneficiaries from 2013 to 2015, so we assume it exits the LDC program in 2012 as with the EU. Because the aforementioned 2007, 2010 and 2013 lists identify Myanmar as suspended from preferences, we assume that Myanmar is suspended when coordination of preferences with the EU begins in 2002 and is reinstated in mid-2013 but retroactively to 2012 as with the EU.

- US – A list of countries eligible for the United States' LDC and AGOA programs may be found in its Harmonized Tariff Schedule. According to versions of this schedule, countries gaining LDC status include Angola, Cambodia, the Democratic Republic of Congo, Ethiopia, Madagascar and Zambia in 1997, Mauritania in 2000, Mauritius in 2001, Afghanistan in 2003, Liberia in 2006, Solomon Islands in 2008, South Sudan in 2012 and Senegal in 2013. Exit from LDC status occurs for Samoa in 1997, Mauritius in 2002, Cape Verde in 2010, Equatorial Guinea in 2011 and Bangladesh in 2013.

Samoa is re-admitted to the LDC program in 2001. AGOA program entrants after its creation include Gambia and Ivory Coast in 2003, Angola and the Democratic Republic of Congo in 2004, Burkina Faso in 2005, Burundi in 2006, Liberia in 2007, Comoros and Togo in 2008 and South Sudan in 2013. Exit from AGOA occurs for Central African Republic and Eritrea in 2004, Ivory Coast in 2005, Mauritania in 2006 and 2009, Guinea, Madagascar and Niger in 2010, the Democratic Republic of Congo 2011, and Guinea-Bissau and Mali in 2013. Some of these countries are re-admitted into AGOA: Mauritania in 2007 and 2010, and Guinea, Ivory Coast and Niger in 2011. South Sudan is combined with Sudan in our sample of exporters, so we count Sudan as entering these programs when South Sudan does so.

A1.10 Other preferential programs and trade agreements

As with our work on LDC programs, we identify major reforms to other preferential programs, along with trade agreements between importers and exporters, using the WTO IDB and EU TARIC data in conjunction with primary sources. Similarly, we identify exporters' eligibility for these programs, including changes over time in eligibility, by consulting WTO notifications, UNCTAD handbooks and government documents, as above. Here we provide a list of sources of information (other than WTO IDB and EU TARIC) used for each importer. Further details of the mapping between these sources and our dataset, along the lines of those provided above for LDC programs, are available upon request.

- Australia – Customs Tariff Act (various years)
- Canada – UNCTAD GSP Handbook on the Scheme of Canada 2001, 2013; Customs Tariff (for general tariff rate); Order in Council SOR/2001-251 (for Albania); Order in Council SOR/2007-174 (for Belarus); WT/COMTD/N/15/Add.2 (for Mongolia); WT/L/175, WT/L/285, WT/L/987 (for CARIBCAN); Canada Border Services Agency Memorandum D11-4-25 (for British Preferential Tariff)
- EU – Council regulations 3281/94, 1256/96, 2820/98, 2501/2001, 980/2005, 732/2008 and Parliament and Council regulation 512/2011 (for GSP, GSP-plus); WT/COMTD/N/4/Add.3, WT/COMTD/N/4/Add.4 (for GSP-plus); Council decision 97/831 (for FYR Macedonia); Council regulations 70/97, 6/2000 and Council decision 2008/474 (for Bosnia-Herzegovina); Council regulation 825/97 and Council decision 2010/36 (for Serbia and Montenegro); Council regulation 552/97 and Parliament and Council regulation 607/2013 (for Myanmar); Council regulation 1763/1999 and Council decision

2006/580 (for Albania); Council regulation 2007/2000 (for Stabilisation and Association Agreements transitional arrangements); Council regulations 1649/2000, 55/2008 (for Moldova); Council decision 2002/357 (for Jordan); Council decisions 2002/761, 2006/356 (for Lebanon); Council decision 2005/690 (for Algeria); Council regulation 1933/2006 (for Belarus); Council regulation 1528/2007 (for ACP Economic Partnership Agreements transitional arrangements); Commission decision 2010/318 (for Panama); Commission decision 2011/830 (for Cape Verde); Council decision 2012/196 (for Eastern and Southern Africa States Economic Partnership Agreement); CARIFORUM Economic Partnership Agreement

- Japan – UNCTAD GSP Handbook on the Scheme of Japan (various years); Japanese tariff schedule (for MFN eligibility); WT/COMTD/N/2/Add.4 (for Marshall Islands)
- New Zealand – UNCTAD GSP Handbook on the Scheme of New Zealand 1998, 1999; Tariff (Less Developed Countries and Least Developed Countries) Order 2005; Working Tariff Document of New Zealand 2017
- Norway – UNCTAD GSP Handbook on the Scheme of Norway 1998; WT/COMTD/N/6/Add.2; WT/COMTD/N/6/Add.4; WT/COMTD/N/6/Add.5; Norwegian tariff schedule 2011, 2012 (for Myanmar); OECD DAC List of ODA Recipients 2006 (for Micronesia)
- Switzerland – WT/COMTD/N/7; WT/COMTD/N/7/Add.3; Swiss government ordinance on preferential tariffs for developing countries (various editions and amendments)
- Turkey – UNCTAD GSP Handbook on the Scheme of Turkey 2007; Turkish Customs Tariff 2010; Turkish government document listing GSP beneficiaries from 2013 to 2015
- US – Harmonized Tariff Schedule (various years)