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Trade tax reforms and poverty in developing countries

Why do some countries benefit and others lose?

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Abstract: This paper studies the relationship between trade tax and domestic tax reforms and poverty in developing countries, and explores whether the role of public goods provision matters in this relationship. Using a sample of 91 developing countries for the 1980–2016 period, I model the trade tax reforms–poverty nexus as heterogeneous across countries with cross-sectionally dependent errors. I find that a shift from taxes on international trade towards domestic taxes under revenue-neutrality reduces poverty in the countries that have consolidated, on average, over time their comparative advantage in agriculture, while it increases poverty in countries that moved from being net exporters to net importers of agricultural products. Public goods, however, do not play a significant role in the relationship.

Key words: common factor model, government spending, taxation and poverty, trade liberalization, trade tax and domestic tax reforms

JEL classification: H2, F13, I38, C23

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1 Introduction

In the early 1980s, many developing countries engaged in trade and tax reforms to initiate trade liberalization processes under the guidance of international institutions such as the World Bank, the International Monetary Fund (IMF), and the World Trade Organization (WTO). This was to allow them to be more integrated into the world trading system. This process consisted of a reduction or a cut in trade taxes considered as distortionary taxes, and their replacement with non-distortionary domestic taxes, such as value-added tax (VAT), necessary for economic growth and development. According to Baier and Bergstrand (2001), 'Tariff reductions still explain almost three times as much trade growth as transport-cost declines'. Accordingly, a reduction in trade taxes is likely to increase the exports of developing countries and contribute to poverty reduction. The neoclassical mainstream international trade theories claim that free trade increases welfare by generating consumption and production efficiency gains. In addition, tariff reduction favours rapid economic growth. There is a consensus that open economies perform better than closed ones due to the exploitation of comparative advantage (Krueger 1985). Nevertheless, the way the welfare gain is redistributed between people remains an important question. Some people benefit while others lose out.

However, recovering revenue loss due to trade liberalization is a major concern of developing countries. Many developing countries rely heavily on trade taxes as a source of government revenue (Easterly and Rebelo 1993; Greenaway and Milner 1991). According to Zee (1996), the average trade taxes as a percentage of total tax revenue of government in Africa was 36.4 per cent over the period 1974–79, 34.8 per cent over 1980–84, and 32.5 per cent over 1985–89, whereas in Asia this share was, respectively, 26.5 per cent, 24.8 per cent, and 23.8 per cent. This share might be high with respect to each individual country. For example, in the early 1990s, the share of trade taxes in total tax revenue was nearly 40 per cent in Pakistan (Lahiri and Nasim 2005). According to the World Bank, import duties over government total tax revenue in 2010 in the Maldives, Ethiopia, Swaziland, and Madagascar were 70 per cent, 52 per cent, 51 per cent, and 47 per cent, respectively. These tax revenues are used by the government to provide good social amenities to its citizens, such as health care and education, good roads, and security, which benefit the poor in particular. Accordingly, decline in trade tax revenues without replacement may be harmful for poor people.

The consequences of trade policies for government revenues have been the subject of considerable interest, but there are controversies about the direction of the effect—that is, whether it is revenue decreasing or increasing. Concerning developing countries, the empirical literature in general concludes that trade liberalization may lead to revenue depletion even though the potential decrease in tariff revenue has been replaced by alternative sources of taxes to offset the loss in trade tax revenue. This loss of tax revenues can worsen the budget deficit and reduce government public spending, which will accordingly reduce the provision of public goods and services. Moreover, this will generate structural macroeconomic instabilities that can be harmful to the economy overall.

Indeed, the structural characteristics of developing countries limit their ability to shift from trade taxes to domestic taxes, then trade liberalization reduces the trade tax ratio to GDP (Khattry and Rao 2002) and total government revenue (Devarajan et al. 1999). According to McCulloch et al. (2001), taxes on foreign trade are administratively easier to collect than taxes on domestic goods. Therefore, trade integration should shift from the tax revenue that is easy to collect—trade taxes—towards that which is hard to collect—taxes on income, production and consumption (Aizenman and Jinjarak 2009). Also, the informal sector accounts for a relatively high share of economic activity, which limits the base for domestic taxes collection.

Baunsgaard and Keen (2010) show that the replacement of trade taxes by other taxes (domestic taxes such as taxes on consumption, income, and profit) does not compensate totally for the loss of trade tax revenue. For these authors, government revenues in most developing countries depend heavily on trade taxes. For every dollar lost due to liberalization, middle-income countries are able to recover 40–60 cents through the implementation of other, internal taxes, whereas low-income countries recover at most 30 cents. The loss in trade tax revenue may exert a downward pressure on some public goods provision (Khattry 2003). School access (education), for example, is a relevant determinant of the well-being and productivity of a country. Yet education can be provided by either the private or public sector. Rich people can acquire it privately while the poor cannot; therefore, this service is a source of inequality if it is not publicly provided. In developing countries, governments are the major stakeholders in education and a large share of the population relies on public education. There is strong empirical evidence that public education expenditure is positively associated with economic growth through favouring human capital accumulation (Blankenau 2005; Blankenau and Simpson 2004; Blankenau et al. 2007; Kaganovich and Zilcha 1999). Consequently, declines in public education provision may lead to an increased poverty.

The effect of the reform of trade taxes and domestic taxes on welfare has received considerable attention, but this attention is more theoretical than empirical. The theoretical predictions on the effects of trade tax and domestic tax reforms on welfare are very mixed (e.g., Emran 2005; Emran and Stiglitz 2005; Falvey 1994; Keen 2008; Keen and Ligthart 2002; Kreickemeier and Raimondos-Møller 2008). To my knowledge, very few papers have paid attention to the effect of trade tax and domestic tax reforms on poverty directly, and particularly in relation to developing countries. While a reduction in trade taxes with an increase in VAT has been at the centre of policies that developing countries implemented in the 1980s and 1990s under the structural adjustment policies of the IMF and the World Bank, as mentioned above, Baunsgaard and Keen (2010) show that developing countries have failed to recover the lost trade tax revenue or to increase government revenue. For instance, Anderson (1996) shows that in South Korea a reduction in trade taxes with a revenue-neutral increase in VAT reduces welfare. Thus, there is doubt about welfare improvement or poverty alleviation elements of reduced trade taxes coupled with an increase in VAT.

In this paper, I investigate the heterogeneity effects of the trade tax and domestic tax reforms on poverty in developing countries, but I also explore the role of public goods in this relationship. This entails investigating how a decrease in trade taxes combined with an increase in domestic taxes affects poverty in developing countries. The literature assumes homogeneity of the effect of trade taxes reforms on poverty. The originality of this paper arises first from the adoption of recent panel time series methods that allow accounting for cross-section dependence and to characterize whether the effect of trade tax reforms on poverty differs substantially across countries. Second, I consider the role of public goods and revenue-neutral reforms of trade taxes and domestic taxes in this relationship.

Using panel data for 91 developing countries over the 1980–2016 period, I at first find that a reduction of trade taxes on average increases poverty significantly, but that this effect varies widely across countries. Second, I show that a reduction in trade taxes combined with an increase in domestic taxes under revenue neutrality increases poverty on average, with considerable cross-countries heterogeneity in parameters. Countries that benefit in terms of poverty reduction are those that have consolidated their comparative advantage in agriculture as their trade balances of agricultural products increase while countries that lose out are those that have moved from net exporters to net importers of agricultural products. Third, when taking into consideration the role of government public education and health expenditures, I find that public goods do not significantly affect poverty when a country moves from trade taxes to domestic taxes under revenue neutrality.

The remainder of this paper is structured as follow: Section 2 presents a short theoretical review on the welfare effects of trade tax and domestic tax reforms. Section 3 discusses the empirical strategy and data, while Section 4 presents the empirical results. Section 5 concludes.

2 Brief synopsis of earlier theoretical work

I present a brief synopsis of the theory of tariff-tax reform effects on income distribution. Mostly, the existing work on tariff-tax reform effects on income distribution in the literature are theoretical. This theoretical literature highlights that trade tax and domestic tax reforms improve welfare under some sufficient conditions, such as lower share of the informal sector in the economy, the presence of non-tradeable goods, revenue-neutral reforms, and perfect competition (e.g., Fujiwara 2013; Hatzipanayotou et al. 1994; Keen 1989; Michael et al. 1993; Naito and Abe 2008).

A reduction in trade taxes combined with an increase in domestic taxes such as VAT or tax on income has been considered in the literature for improving government revenue and welfare in developing countries. The conventional advice prescribed to developing countries under the IMF and World Bank's policy conditionalities consider VAT as a better and non-distortionary tax instrument to raise government revenue and to improve efficiency in resource allocation for better economic performance. Thus, a reduction in trade taxes accompanied by an increase in VAT improves welfare (e.g., Fujiwara 2013; Michael et al. 1993).

Keen and Ligthart (2002), in the case of a small economy in which all goods are tradeable and under perfect competition, show that a tariff cut combined with one-to-one increase in domestic consumption tax—leaving consumer prices unchanged—increases both welfare and government revenue. This occurs because the tariff cut combined with a point-by-point consumption tax increase enables resources to be efficiently allocated, which in turn leads to a production efficiency that drives mostly the rise in welfare. However, in the presence of non-tradeable goods and tradeable intermediate inputs in the model, it is extremely difficult if not impossible to clearly ensure welfare improvement.

Keen and Ligthart (2005) themselves challenge this increase in welfare and public revenue by showing that under imperfect competition a tariff reduction reduces national welfare, using a two-country and two-good (tradeable goods) general equilibrium model. In the model, two identical firms serve and compete in the home market: one domestic firm and one foreign firm. The two firms face the same consumption tax in the home market, but the foreign firm also pays a tariff imposed by the home country. Raising the tariff increases the cost for the foreign firm (and then reduces its production and increases the production of the home country) while an increase in the consumption tax increases both firms' costs and reduces their outputs. Accordingly, a tariff reduction combined with one-for-one increases in consumption tax reduces the production of the domestic firm (and therefore reduces its profits), increases the production of the foreign firm (and increases its profits), and raises the consumer price. Thus, the welfare falls.

Moreover, the positive effects of the shift from trade taxes towards domestic taxes may be undermined by the presence of a higher share of the informal sector in the economy, which is not captured by the VAT net (Emran and Stiglitz 2005; Gordon and Li 2009; Keen 2008; Piggott and Whalley 2001). In fact, in developing countries, according to Schneider and Enste (2000), the average size of the informal sector is 39 per cent of GDP, ranging from 25 to 35 per cent in Colombia, Paraguay, Brazil, Chile, Costa Rica, and Venezuela to 68–76 per cent in Nigeria and Egypt over the 1990–93 period. This higher share of the informal sector shrinks the fiscal base and reduces government revenue, which is harmful in terms of reducing poverty.

Emran and Stiglitz (2005) establish the conditions under which a shift from trade taxes to revenue-neutral increases in VAT is welfare-worsening in the context of developing countries, taking into account the implications of a large informal sector in the economy. Taxes on goods, such as VAT, can only be levied in the formal sector. Therefore, a tax on the formal sector may lower the demand for the goods produced in the formal sector and increase production in the informal sector. VAT is therefore likely to entail a shift from the formal to the informal sector and home production, providing a further distorted source of revenue. Consequently, welfare decreases when moving from trade taxes to domestic taxes.

Furthermore, trade tax and domestic tax reforms affect welfare through public goods provision because the government may use tax revenue to provide public goods. Abe (1992), using a general equilibrium model, shows that tariff reductions can reduce welfare in a small, open economy if public goods are initially under-produced. However, if public goods are over-supplied, tariff reductions increase welfare in this small, open economy.

Given that the share of the informal sector in the economy, public goods provision, sources of government revenue, economic policies, and institutional environment may vary across developing countries, in this paper I investigate empirically heterogeneous effects across developing countries of the trade tax and domestic tax reforms on poverty.

3 Empirical strategy and data

3.1 Empirical strategy

I examine the relationship between trade tax and domestic tax reforms and poverty by adopting a dynamic linear model of poverty assuming heterogeneity across countries. In fact, trade tax reforms may differently affect countries, depending on their economic characteristics and their capacity to respond to the international competition arising from trade liberalization. The replacement of taxes on international trade by domestic taxes is the sort of institutional adjustment used for the implementation of trade agreements. I then consider the differences in the relationship across countries, modelling the relationship between trade tax and domestic tax reforms on poverty as not common but heterogeneous across countries, since the effects of trade tax reforms may depend on countries characteristics and concurrent domestic policy reforms that countries implement. This is the reason that estimating the average effect based on a pooled sample might not result in satisfactory policy prescriptions (Santos-Paulino 2012). I then depart from the conventional panel econometric models that assume homogeneous parameters across all countries by estimating country-specific coefficients. In doing so, I am able to provide policy recommendations to countries to take advantage of trade tax reforms leading to trade liberalization.

The starting model for the empirical analysis is based on Fischer (2001), and I adopt a specification allowing for heterogeneous coefficients drawing on a dynamic common correlated effects estimator (Chudik and Pesaran 2015):

$$\begin{aligned} y_{it} &= \alpha + \beta_0 y_{it-1} + \beta_1 tradetax_{it} + \beta_2 land_{it} + \beta_3 capital_{it} + \beta_4^j X_{it}^j + u_{it} \\ u_{it} &= \gamma_i' f_t + \varepsilon_{it} \end{aligned} \tag{1}$$

where y_{it} is the poverty headcount in country i at time t, y_{it-1} is the lagged value of poverty, $tradetax$ is trade tax revenue as a percentage of GDP, $land$ is agricultural land per capita, $capital$ is capital stock per capita, X is other control variables, f_t is a vector of unobserved common factors, γ_i is the heterogeneous factor loadings, and ε_{it} represents idiosyncratic errors. The heterogeneous coefficients are randomly distributed around a common mean β_{MG}, such that $\beta_i = \beta_{MG} + v_i$, $v_i \sim IID(0, \Omega_v)$ (Pesaran and Smith 1995).

To estimate the model, I am concerned with the cross-section dependence arising from common or global shocks, spatial or spillover effects, or unobserved common factors. The cross-section dependence might occur through commodity price fluctuations, trade or tax agreements (McNabb 2018), currency unions, or world economic or financial crises. To not account for cross-section dependence using conventional panel estimators such as fixed or random effects results econometrically in an inconsistent estimates and misleading inference (Andrews 2005; Phillips and Sul 2003, 2007). This inconsistency in general, occurs when the unobserved factors and the included regressors or observed explanatory variables are correlated (Pesaran 2006).

Many econometric approaches have been developed in the literature to deal with cross-section dependence in panel data (e.g., Bai 2009; Chudik and Pesaran 2015; Coakley et al. 2002; Kapetanios et al. 2011; Pesaran 2006; Pesaran and Tosetti 2011; Robertson and Symons 2000, 2007). For instance, Coakley et al. (2002: hereafter CFS) propose a principal component approach with a two-stage estimation method. The CFS method consists first of extracting principal components from residuals obtained from the first-stage regression of y_{it} on x_{it} for each i. Then, these principal components (one or more) are used to augment the original regression equations to proxy possible omitted variables. However, Pesaran (2006) points out that the CFS estimator is not consistent if the unobserved factors and the included regressors are correlated.

Pesaran's (2006) common correlated effects estimator (henceforth CCE) accounts for unobserved factors through an augmentation of the regression equation with cross-sectional averages of the dependent and independent variables. The CCE estimator is robust to different types of cross-section dependence errors, possible unit roots in independent variables, serial correlation in errors, and slope heterogeneity (Chudik et al. 2011; Kapetanios et al. 2011; Pesaran and Tosetti 2011).[1] However, Chudik and Pesaran (2015) show that the CCE approach is not valid in the case of a dynamic panel and/or in the presence of weakly exogenous dependent variables[2] because the CCE estimator is subject to a small sample bias, in particular when the time-series dimension of the panel is not sufficiently large.[3] Chudik and Pesaran (2015) extend then the CCE approach to allow for a dynamic panel and/or weakly exogenous regressors. In the presence of weakly exogeneous regressors, the CCE estimator provides inconsistent estimates. As a remedy, the authors suggest including further lags of cross-section averages in addition to the cross-section averages of all variables in the model. In this paper, I use Chudik and Pesaran's (2015) estimator to identify trade tax reform effects on poverty in a linear dynamic model because 'many large cross country or cross regional panels tend to be subject to error cross-sectional dependence and slope heterogeneity and are likely to contain weakly exogenous regressors' (Chudik and Pesaran 2015: 394).

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[1] A series has unit roots if it is characterized as non-stationary—that is, has a variable variance and a mean that does not return to a long-run mean over time or fluctuates around a non-constant long-run mean. In the presence of non-stationary series, the estimates from OLS and 2SLS regressions, for instance, are inaccurate or a so-called spurious regression problem (Newbold and Granger 1974).

[2] The weak exogeneity is 'the requirement for conditional estimation to be without loss of information from conditioning' (Ericsson et al. 1998).

[3] The Pesaran (2006) CCE estimator assumes strict exogeneity of the observable regressors. The Chudik and Pesaran (2015) approach relaxes the assumption of strict exogeneity for the regressors and thus allows for the feedback between the dependent variable and regressors.

The CCE estimator has been used in the literature to investigate the economic consequences of tax structure or tax policies (e.g., Arachi et al. 2015; Arnold et al. 2011; McNabb 2018).

The cross-sectionally augmented estimation equation is thus:

$$\begin{aligned} y_{it} &= \alpha + \beta_0 y_{it-1} + \beta_1 tradetax_{it} + \beta_2 land_{it} + \beta_3 capital_{it} + \beta_4'^{j} X_{it}^{j} + \sum_{l=0}^{P_T} \delta_{il}' \overline{z}_{t-l} + \varepsilon_{it} \\ \overline{Z}_t &= (\overline{Y}_t, \overline{Y}_{t-1}, \overline{X}_t) \end{aligned} \tag{2}$$

where $\overline{X}$ includes *tradetax*, *land*, *capital*, and X, and where $\overline{z}_{t-l}$ is cross-sectional (CS) averages of all the dependent and independent variables and p_T is the number of lags of cross-sectional averages.

The mean group estimates $\beta_{MG} = E(\beta_i)$ are given by

$$\hat{\beta}_{MG} = \frac{1}{N} \sum_{i=1}^{N} \hat{\beta}_i$$

$\hat{\beta}_i$ and $\hat{\beta}_{MG}$ are consistently estimated with convergence rate $\sqrt{N}$ if $(N, T, p_T) \to \infty$.

This specification allows slope coefficients to vary across countries—that is, each country has its own set of slope coefficients both on the observed regressors and on the unobserved common factors. In fact, as countries differ in some economic, social, and political characteristics, the effect of tariffs on poverty may differ from one to another.

Chudik and Pesaran (2015)[4] show that the CCE mean group estimator once augmented with sufficient number of lags and cross-sectional averages performs well even in the case of dynamic models with weakly exogenous regressors. To estimate the model, I follow the authors' rule of thumb recommending that $p = int(T^{1/3}) = 3$. This is equivalent to adding up to three lagged differences in my model. Moreover, I add the country-specific linear trend in each model.

3.2 Data

My sample comprises 91 developing countries (see the list of countries in Table A1 in the Appendix) spanning the period 1980–2016. The selection of countries in the sample is based on the availability of the relevant data, notably the availability of data on trade tax revenue. Tax data are collected from the Government Revenue Dataset (GRD) 2018 of ICTD/UNU-WIDER. The GRD offers a 'significantly more complete and accurate source of revenue data than any other single source, particularly for developing countries' (McNabb 2018). I complete some missing values in my data using the OECD Revenue Statistics and Baunsgaard and Keen (2010) datasets.

The poverty indicator used in this paper is the poverty headcount index, which is a measure of absolute poverty. The poverty headcount index measures the proportion of the population whose consumption or income is below a specific poverty line. I consider in this paper the US$1.90-a-day poverty line used by the World Bank. This poverty indicator is often used in the literature (e.g., LeGoff and Singh 2014; Santos-Paulino 2017). The complete definitions of variables and data sources are presented in Table

[4] Chudik and Pesaran's (2015) model is estimated using Ditzen's (2016) ***xtdcce2*** command, version 1.33d, August 2018.

A2. The descriptive statistics of variables used in the empirical analysis are reported in Table 1. The descriptive statistics reveal that trade taxes account for up to 36 per cent of GDP while domestic taxes represent up to 35 per cent.

Table 1: Summary statistics

Variable	Obs.	Mean	Std dev.	Min.	Max.
Headcount	3,302	31.37	26.487	0	96.42
Trade tax (percentage of GDP)	3,096	3.434	3.412	–1.569	36.116
Domestic tax (percentage of GDP)	3,059	10.958	5.655	0.06	35.351
Tax revenue (percentage of GDP)	3,238	14.396	6.552	0.6	53.868
Land pc	3,252	2.304	6.593	0.019	73.737
Capital pc	3,204	0.451	0.538	0.003	3.384
GDP pc	3,347	114.76	854.255	0	15,019.63
Non-tax revenue	2,859	3.715	4.311	0	46.918
Education	1,584	15.352	5.501	0.46	45.883
Health	1,550	127.129	97.681	0.35	797.71
Government expenditure	1,582	25.692	9.671	9.806	100
Population growth	2,250	2.161	1.035	–6.185	7.918

Source: author's compilation based on sources discussed in the text.

4 Empirical results

Before running the regressions, I carry out Pesaran's (2004) cross-sectional dependence test on the raw variables. The results reported in Table A3 suggest that the raw variables are subject to considerable cross-sectional dependence (the presence of common factors in each dataset). The presence of common factors in each dataset validates the common factor model approach.

4.1 Trade taxes effects on poverty

The results (the mean group coefficients) of the effects of trade taxes on poverty are reported in Table 2. I start the estimation using Pesaran and Smith's (1995) mean group estimator (MG) in the first column, which ignores the presence of the cross-sectional dependence, and Pesaran's (2006) CCE estimator in the second column. The estimated coefficient of trade taxes is negative and equal to -0.3 for the MG estimator. However, the CD (cross-sectional dependence) statistic is statistically different from zero, indicating the presence of cross-sectional dependence, implying that my two models were mis-specified. Accordingly, my estimates may be biased due to the presence of the cross-sectional dependence. Using Chudik and Pesaran's (2015) linear dynamic model and including additional lags of the cross-sectional average in the CCE MG model (columns 3–5), the cross-sectional dependence disappears with a CD statistic indicating that the null hypothesis of cross-sectional independence cannot be rejected for the models with two and three lags of cross-sectional average. The coefficients of trade taxes are still negative, equal to -0.14 and -0.3, and significant at the 5 per cent level, respectively for models with two and three lags. The result for the model with one lag is not significant. The negative coefficients of taxes on international trade reveal that an increase in trade taxes reduces poverty on average. Given that the dependent and independent variables are expressed in logarithm, the coefficients of the independent variables are interpreted as elasticities. An increase of 1 per cent in taxes on international trade reduces poverty from 0.14 per cent to 0.3 per cent. My findings are consistent with the literature on tariff revenues and poverty (e.g. Topalova 2007) stating that developing countries rely heavily on trade taxes that allow them to finance public goods necessary for poverty alleviation.

Table 2: Trade taxes incidence on poverty estimation

Dependent variable: poverty headcount ratio (in log)					
	(1)	(2)	(3)	(4)	(5)
	MG	CCEMG	CCEMG with lags		
CA additional lags			First lag	Second lag	Third lag
L. headcount	0.589***	0.388***	0.266***	–0.098	0.254**
	(0.033)	(0.039)	(0.064)	(0.388)	(0.106)
Trade tax	–0.030*	–0.026	–0.032	–0.139**	–0.299**
(percentage of GDP)	(0.017)	(0.019)	(0.053)	(0.063)	(0.135)
Domestic tax	–0.052***	–0.059**	–0.057	–0.053	0.056
(percentage of GDP)	(0.019)	(0.028)	(0.101)	(0.092)	(0.213)
Capital pc	0.145	–0.075	–0.145	0.234	–1.870**
	(0.126)	(0.136)	(0.399)	(0.788)	(0.800)
Land pc	0.052	–0.031	–0.289	0.141	0.197
	(0.139)	(0.168)	(0.615)	(0.759)	(1.046)
GDP pc	–0.437***	–0.691***	–0.624**	–2.172	–2.070**
	(0.097)	(0.129)	(0.297)	(1.403)	(1.034)
Non-tax revenue	–0.002	0.019	0.029	0.025	0.143
	(0.009)	(0.013)	(0.038)	(0.065)	(0.105)
Constant	–0.723	–0.034	–12.060	–13.821	-14.504
	(0.630)	(1.257)	(10.767)	(11.663)	(9.542)
RMSE	0.097	0.067	0.094	0.084	0.087
CD test	9.915	1.68	4.66	0.67	1.47
CD *p*-value	0.000	0.094	0.000	0.506	0.142
Number of countries	81	81	65	63	62
Observations	2,360	2,360	1,979	1,860	1,765

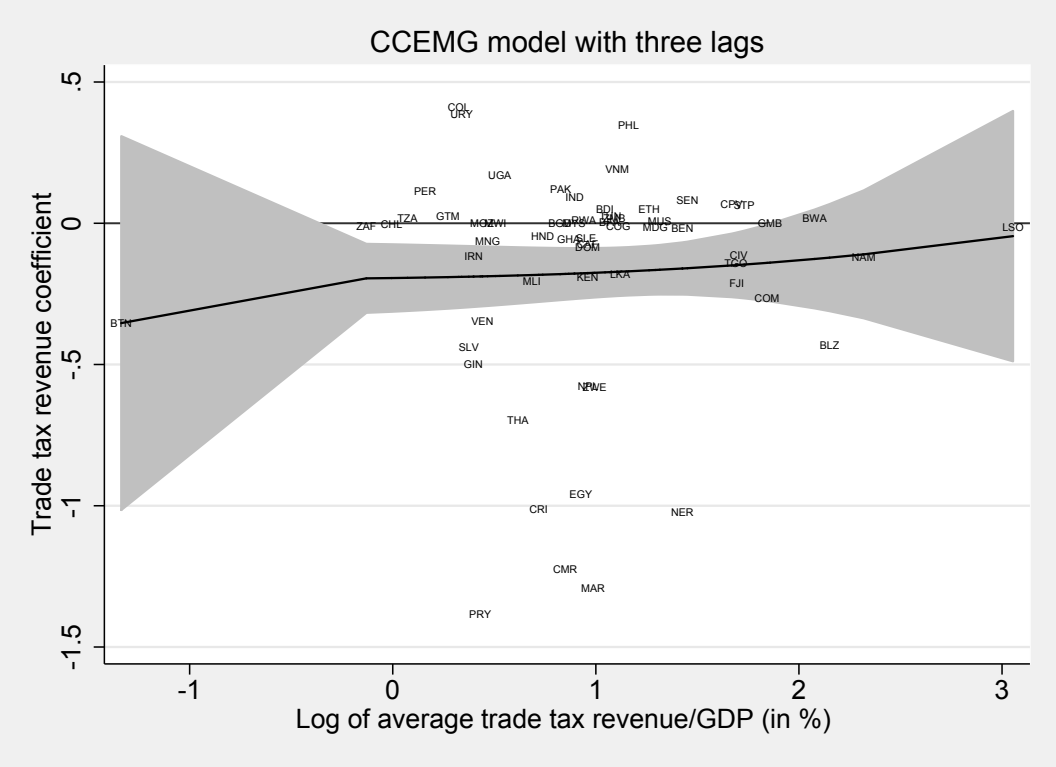
Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard errors in parentheses are constructed non-parametrically following Pesaran and Smith (1995).
All the regressors are in the log. The country-specific linear trend is included in each model.
CD test reports the Pesaran (2015) test for weak cross-sectional dependence; under the null hypothesis of weak cross-sectional dependence of the error term, the CD statistic is distributed $\sim N(0,1)$. RMSE is the root mean squared error.
Source: author's calculations.

Nevertheless, the effects of taxes on international trade vary widely across countries. Figure 1 shows the heterogeneity effect across countries of trade tax revenue on poverty, meaning that a group of countries (36 countries) are beneficiaries, whereas other groups (24 countries) lose out.[5] While most countries in my sample benefit from an increase in trade tax revenue in terms of poverty reduction, the size of the effect varies widely between countries. Figure 1 indicates a non-linearity in the relationship between trade taxes and poverty and a conclusion about the role of trade tax levels in this heterogeneity cannot be drawn. Hence, this heterogeneity may imply that the effects of trade tax revenue are not automatic and may depend on country characteristics and some domestic complementary policies. Countries that experience poverty reduction associated with the increase in taxes on international trade may have a better distribution policy that benefits low-income people, or may be one of those those that take advantage of the protection by reducing the competition for their domestic market and therefore consolidate their comparative advantage. The data show that countries that observe poverty reduction have remained, on average, net exporters of agricultural products over time, while countries in which poverty increases have moved from being net exporters to net importers of agricultural products (see Figure A1). For the

[5] The 36 countries in which an increase in trade taxes reduce poverty are: Belize, Benin, Bhutan Cameroon, Central African Republic, Chile, Comoros, Republic of Congo, Costa Rica, Cote d'Ivoire, Dominican Republic, Egypt, El Salvador, Fiji, Ghana, Guinea, Honduras, Iran, Jordan, Kenya, Lesotho, Madagascar, Mali, Mongolia, Morocco, Namibia, Nepal, Niger, Paraguay, Sierra Leone, South Africa, Sri Lanka, Thailand, Togo, Venezuela, and Zimbabwe. The countries that lose out are: Botswana, Burkina Faso, Burundi, Cabo Verde, Colombia, Ethiopia, Guatemala, India, Malawi, Mauritius, Mozambique, Pakistan, Peru, Philippines, Rwanda, Sao Tome and Principe, Senegal, Tanzania, Tunisia, Uganda, Uruguay, Viet Nam, and Zambia (some countries are dropped from the estimation due to some missing values). The coefficients of trade taxes for Gambia and Malaysia are zero, meaning that trade tax effects on poverty are null in these two countries.

latter groups of countries, imposing taxes on international trade could be detrimental for their exports as their partners may take retaliatory measures that may reduce their access to foreign markets.

Figure 1: Trade tax coefficients heterogeneity



Notes: I plot the country-specific coefficients for trade tax revenues from the Chudik and Pesaran (2015) CCEMG model with three additional lags (column (5) in Table 2). The figure shows that the poverty effect of trade tax revenue varies widely across countries. Thirty-six countries have negative coefficients, meaning that poverty decreases with an increase in trade taxes, while 24 countries have positive coefficients, suggesting that an increase in trade taxes is associated with an increase in poverty. The coefficients for two countries are zero. Jordan has been excluded from the graph sample to ensure homogeneity.

Source: author's creation based on the regression results.

4.2 Revenue-neutral tax policy

I analyse the effects of tax policy consisting of replacing trade taxes with domestic taxes (VAT, income tax, production taxes, etc.) on poverty under revenue-neutral reduction in trade taxes. The revenue-neutral tax reforms involve a reduction in trade taxes offset by an increase in domestic taxes. This implies that one unit loss of trade taxes is totally offset by an increase in domestic taxes. To test empirically the trade taxes decreasing revenue-neutral effects on poverty, I include in my model total tax revenues and domestic tax revenues, but omit trade tax revenues in the regression equation, following McNabb (2018), Arachi et al. (2015), and Arnold et al. (2011). The omitted trade tax revenues are assumed to adjust to absorb changes in domestic tax revenues included in the regression, to maintain revenue neutrality. I transform the domestic taxes data using the share of domestic taxes over the total tax revenue to ensure that the sum of taxes on international trade and the domestic taxes are equal to the total tax revenues.

The results reported in Table 3 indicate that the revenue-neutral shift from trade taxes towards domestic taxes (the mean of coefficients across countries) increases poverty on average by 0.07–0.96, significant at the 10 per cent level. This result is consistent with the findings of Alavuotunki et al. (2017), suggesting that, on average, VAT adoption has led to increased inequality (using a disposable income of inequality).

Table 3: Effects of domestic taxes on poverty under revenue neutrality

Dependent variable: poverty headcount ratio (in log)					
	(1)	(2)	(3)	(4)	(5)
	MG	CCEMG	CCEMG with lags		
CA additional lags			First lag	Second lag	Third lag
L. Headcount	0.589***	0.429***	0.308***	0.321***	0.338***
	(0.034)	(0.042)	(0.054)	(0.073)	(0.121)
Domestic tax	0.036	0.071*	0.261	0.439	0.762
(percentage of total tax)	(0.045)	(0.036)	(0.276)	(0.304)	(0.904)
Tax revenue	–0.037	–0.057	–0.362**	–0.412**	–0.496***
(percentage of GDP)	(0.036)	(0.036)	(0.149)	(0.197)	(0.163)
Capital pc	0.142	–0.037	1.003	–0.067	–1.806**
	(0.134)	(0.155)	(0.613)	(0.948)	(0.754)
Land pc	0.038	0.165	0.119	–0.309	1.029
	(0.137)	(0.146)	(0.433)	(0.845)	(0.985)
GDP pc	–0.461***	–0.614***	–0.644**	–1.742*	–0.826
	(0.095)	(0.118)	(0.325)	(0.964)	(0.740)
Non-tax revenue	0.002	0.012	–0.002	–0.074	–0.062
	(0.008)	(0.014)	(0.044)	(0.094)	(0.073)
Constant	–1.406*	1.375	–1.727	–0.642	–7.209
	(0.760)	(2.003)	(4.448)	(2.223)	(7.889)
RMSE	0.096	0.067	0.091	0.092	0.094
CD test	9.438	2.07	4.59	0.30	1.06
CD *p*-value	0.000	0.038	0.000	0.761	0.290
Number of countries	82	82	65	63	62
Observations	2,377	2,377	1,979	1,860	1,765

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard errors in parentheses are constructed non-parametrically following Pesaran and Smith (1995).
All the regressors are in the log. The country-specific linear trend is included in each model.
CD test reports the Pesaran (2015) test for weak cross-sectional dependence; under the null hypothesis of weak cross-sectional dependence of the error term, the CD statistic is distributed $\sim N(0,1)$. RMSE is the root mean squared error.
Source: author's calculations.

However, the revenue-neutrality effects of domestic taxes on poverty are very heterogeneous when examining the effects individually across countries (see Figure 2). I highlight that a shift from trade taxes towards domestic taxes is associated with poverty reduction in a group of countries (25 countries) while poverty increases in another group of countries (33 countries).[6] Figure 2 reveals that the nexus between the impact of the shift from taxes on international trade towards domestic taxes and the trade taxes-to-GDP ratio is not linear; accordingly, I can't explain the heterogeneity across countries by the level of domestic taxes. I then document the factors that can drive this heterogeneity and point out the role of comparative advantage in agricultural products export. Moreover, Figure 2 shows that most countries that benefit from an increase in trade taxes are those that lost out from the shift from trade taxes towards domestic taxes under revenue neutrality; inversely, most of those that lost out from an increase in trade taxes benefit from an increase in domestic taxes under revenue neutrality.

The data (see Figure A2) show that countries that experienced poverty alleviation have consolidated their comparative advantage in agriculture as their agricultural trade balances have increased on average

[6] The 25 countries that reduce poverty by liberalization trade are: Bangladesh, Botswana, Burkina Faso, Burundi, Cabo Verde, Central African Republic, Costa Rica, Dominican Republic, El Salvador, India, Kenya, Lesotho, Malawi, Mongolia, Morocco, Namibia, Peru, Rwanda, Senegal, Sierra Leone, South Africa, Thailand, Tunisia, Uganda, and Uruguay. The 33 countries in which trade liberalization is harmful for poverty are: Belize, Benin, Bhutan, Cameroon, Chile, Colombia, Comoros, Republic of Congo, Cote d'Ivoire, Egypt, Ethiopia, Fiji, Ghana, Guatemala, Guinea, Iran, Jordan, Madagascar, Mali, Mauritius, Mozambique, Nepal, Niger, Pakistan, Paraguay, Philippines, Sao Tome and Principe, Sri Lanka, Tanzania, Togo, Venezuela, Zambia, and Zimbabwe. Furthermore, the effects of the shift from trade taxes towards domestic taxes under revenue neutrality is null in Gambia, Honduras, Malaysia, and Viet Nam.

over time (overall agricultural trade surpluses have increases). The increase of their exports results from better terms of trade or an increase in the price of agricultural products due to the Stolper–Samuelson theorem. Also, a reduction in trade barriers (for example, within the WTO framework consisting of multilateral reduction in trade barriers under the Doha Round, regional trade agreements, etc.) led them to have greater access to the market and to grow their exports through reducing the fixed cost of trade (e.g. Chaney 2008; Dutt et al. 2013). For instance, Uruguay's accession to Mercosur in 1991 has boosted its export of beef and the country has been able to export to more distant markets such as Japan. McCaig (2011), analysing the effect of US–Viet Nam bilateral trade agreements on poverty in Vietnamese provinces and US market access shows that provinces that were more exposed to the US tariff cuts (greater access to the US market) experienced more rapid decreases in poverty. Likewise, Porto (2003) obtains similar results in Argentina's case by revealing that domestic tariff reduction and better access to foreign markets has decreased poverty. As agriculture is the main source of employment and income in most developing countries, growth in the export of agricultural products is likely to raise employment and income for rural or poor people and therefore to reduce poverty. My findings are also in line with those of Christiaensen et al. (2011), who find that increases in agricultural GDP per capita are five times more powerful in reducing poverty than a similar increase in GDP per capita in non-agricultural sectors.

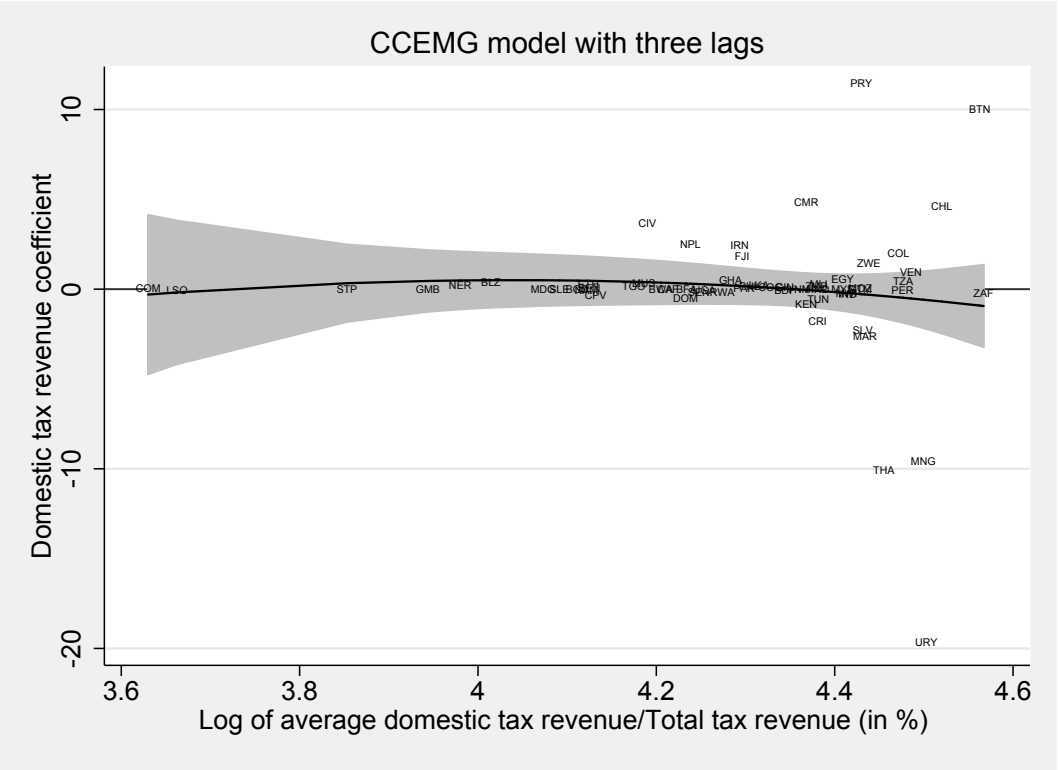
In contrast, the countries in which poverty increases have moved from being net exporters of agricultural products to net importers over time: their agricultural trade balances declined and their agricultural trade deficit has increased after 2010. This could be associated with the fact that trade liberalization has exposed them to international competition, leading to the disappearance of their producers and an increase in domestic taxes doesn't offset the loss due to the production decline. As a large share of the populations in developing countries live in rural areas and depend on agriculture, a decline in agricultural exports reduces their incomes and raises unemployment, with the according poverty increases. As most countries that benefit from an increase in trade taxes are those that lost out due to a shift from trade taxes towards domestic taxes under revenue neutrality, it seems that their firms, especially in the agricultural sector, are less competitive and the protection should be profitable to them in order to maximize domestic welfare over time (Melitz 2005).

Furthermore, my results show that the revenue-neutral shift from trade taxes towards domestic taxes affects poverty through total tax revenue. An increase of 1 per cent in total tax revenue due to an increase in domestic taxes reduces poverty from 0.36 per cent to 0.5 per cent. My results are in line with those of Fujiwara (2013), Keen and Ligthart (2002), Hatzipanayotou et al. (1994), and Michael et al. (1993), who show that a reduction in trade taxes with revenue-neutral increases in indirect taxes (e.g. VAT) increases welfare. There is also a dispersion of total tax revenues effects on poverty across countries.

4.3 Robustness checks

Due to the relevance of China in the world economy, particularly in world trade, it is possible that China drives my results, which could cast doubt on them. Moreover, in my sample, Lesotho has the highest share of trade tax over GDP and can potentially also drive my results as an outlier. Hence, I test the robustness of my results by excluding both China and Lesotho from the sample. The results reported in Tables A4 and A5 reveal that my results are not affected by China and Lesotho and accordingly are consistent.

Figure 2: Domestic tax revenue coefficients heterogeneity



Notes: I plot the country-specific coefficients for domestic tax revenue from the Chudik and Pesaran (2015) CCEMG model with three additional lags (column (3) in Table 3). The figure shows that the poverty effects of domestic tax revenue vary widely across countries. Twenty-five countries have negative coefficients while 33 countries have positive coefficients. The coefficients for four countries are equal to zero. Jordan has been excluded from the graph sample to ensure homogeneity.

Source: author's creation based on the regression results.

4.4 The role of public goods

I am interested in the role of public goods in the relationship between a shift from trade taxes towards domestic taxes under revenue neutrality. Public goods such as public education and public health play an important role in poverty reduction in developing countries. In most developing countries there are regionally significant imbalances in education and health. For instance, rich people can afford private education and health care while poor people rely more on public education and health care. Poor people have worse health status on average than others, and public health spending tends to matter more to the poor (Bidani and Ravallion 1997). Heltberg et al. (2001) find in Mozambique that public expenditures on health and education are likely to have significant poverty-reducing effects.

Most empirical works highlight the negative association between domestic taxation (income tax, VAT, etc.) and human capital (Lin 1998; Lucas 1990; Trostel 1993). A shift from taxes on international trade towards domestic taxes may adversely affect poor people's human capital accumulation and hence their income if there is no safety net to help them profit from public education. Tax revenues may reduce poverty if they are redistributed to benefit people with low earnings. Governments, in order to achieve poverty reduction or to reduce income inequality, might combine taxes and public spending to provide easy access to public goods for poor people. Thus, the government redistributes tax revenues from people who are better off to those who are worse off. Hence, I investigate the role of public goods provision in the relationship between the shift from trade taxes towards domestic taxes under revenue neutrality.

I consider two kinds of public goods. First, government spending on education is used to proxy public goods. It consists of pointing out that government uses total tax revenue to finance public education. In doing so, government favours poor people having access to formal education and consequently accumulation of human capital. There is evidence that countries with higher education expenditures have greater economic performance. The endogenous growth theory provides a link between public education expenditures and long-term economic growth. This theory concludes that public education expenditures promote human capital accumulation and therefore foster economic growth. Consequently, growth and human capital accumulation may reduce poverty.

Second, I use public health expenditures as an alternative proxy for public goods to assess the robustness of my results using public education expenditures.

For the empirical estimation considering the role of public goods, I am constrained by the data availability. I use data on public education and health expenditures from the IMF. These data are available for the 1985–2009 period for a sample of 90 countries. Due to the short temporal dimension of my data (25 years), I am unable to use Chudik and Pesaran's (2015) estimator, which requires a longer temporal dimension. Accordingly, I carry out my estimation using, first, a two-way fixed effects estimator (2FE), second, the Blundell and Bond (1998) system-GMM estimator, and finally, the Pesaran and Smith (1995) MG estimator and Pesaran (2006) CCE MG estimator.

The role of public education and health expenditures is assessed by interacting the government public education and health expenditures with trade tax revenue. The results for all the estimators reported in Tables 4 and 5 indicate that the mean of the coefficient is not significant for both public education and health expenditures interaction terms with total tax revenues. The results hold when controlling for the government total expenditures and population growth. My results are consistent with the non-significant effect of public social spending (public education and public health spending) found by Castro-Leal et al. (1999). Examining the effect of public education and health spending on poverty in a group of African countries, Castro-Leal et al. (1999) show that these programmes favour not the poor, but those who are better-off.

The absence of the significant effects suggests that they may depend on country characteristics, complementary policies such as labour market or employment policies, the pattern of education output, or the structure of labour demand. For instance, a country may invest heavily in public education, but if the unemployment rate is high and individuals cannot find a job after graduation, the poverty level may not be affected. In contrast, a country with a low unemployment rate, by investing more in education, can absorb the new graduates and accordingly may reduce poverty. Furthermore, a country may benefit more from public education expenditures if the type of education financed suits well the patterns of demand in the labour market. For instance, Jung and Thorbecke (2003) show that in Tanzania, to maximize the benefits from education expenditure, complementary factors are needed such as a high level of physical investment, measures that improve the match between the pattern of educational output and the structure of effective demand for labour.

My results may suggest that, to clearly identify the role of public goods in the process of trade liberalization, I should consider the role of the labour market and country socioeconomic characteristics that can play a key role in the poverty–tax reforms nexus.

Table 4: The role of the public education expenditure in the trade tax reforms–poverty nexus

	Dependent variable: poverty headcount ratio (in log)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	2FE		GMM		MG		CCEMG	
L. Headcount (log)	0.860***	0.860***	1.027***	0.928***	0.377***	0.203***	0.323***	0.154
	(0.0466)	(0.0465)	(0.0888)	(0.124)	(0.048)	(0.057)	(0.086)	(0.117)
Tax revenue (log)	–0.0952**	–0.122**	0.146	–0.0396	–0.697	–0.155	–0.228	–0.043
	(0.0438)	(0.0506)	(0.204)	(0.187)	(0.705)	(0.774)	(0.416)	(0.170)
Domestic tax (log)	0.0205	0.0234	–0.0428	–0.0192	–0.002	–0.143*	0.140*	0.059
(percentage of total tax)	(0.0318)	(0.0307)	(0.0503)	(0.0752)	(0.064)	(0.078)	(0.080)	(0.130)
Education (log)	–0.0311	–0.0236	0.171	–0.0532	–0.561	–0.060	–0.124	0.046
(percentage of total expenditure)	(0.0469)	(0.0511)	(0.187)	(0.167)	(0.692)	(0.793)	(0.311)	(0.192)
Education * Tax revenue	0.0245	0.0286	–0.0564	0.0142	0.231	0.072	0.025	–0.011
	(0.0216)	(0.0217)	(0.0655)	(0.0572)	(0.253)	(0.283)	(0.132)	(0.079)
Land pc (log)	0.0857	0.0871	–0.169	–0.243	–0.219	–0.612**	0.120	–0.363**
	(0.102)	(0.102)	(0.198)	(0.505)	(0.224)	(0.277)	(0.205)	(0.153)
Capital pc (log)	0.0616	0.0592	–0.314	–0.0749	0.127	0.108	–0.104	–0.059
	(0.0413)	(0.0418)	(0.438)	(0.297)	(0.233)	(0.274)	(0.206)	(0.075)
GDP pc (log)	–0.240***	–0.234***	0.100	–0.245	–0.607***	–0.724***	–0.397***	0.205
	(0.0725)	(0.0727)	(0.378)	(0.267)	(0.124)	(0.189)	(0.152)	(0.299)
Government expenditure		0.00184		7.90e–05		–0.003		0.010**
(percentage of GDP)		(0.00157)		(0.00231)		(0.002)		(0.005)
Population growth		0.00685		–0.0133		–0.090		–0.071
		(0.00896)		(0.0340)		(0.062)		(0.064)
Constant	–0.776**	–0.803**	–0.235	–1.119	2.871	1.135	0.625	–0.826
	(0.319)	(0.327)	(1.676)	(1.612)	(2.869)	(2.947)	(2.727)	(3.875)
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
RMSE					0.0693	0.0546	0.0252	0.00458
CD test					5.55	2.83	3.47	–1.617
CD *p*-value					0.000	0.005	0.001	0.106
Number of countries	83	83	83	83	70	68	70	68
Observations	1,462	1,462	1,462	1,462	1,371	1,348	1,371	1,348

Notes: Robust standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
CD test reports the Pesaran (2015) test for weak cross-sectional dependence; under the null hypothesis of weak cross-sectional dependence of the error term, the CD statistic is distributed $\sim N(0,1)$. RMSE is the root mean squared error.
Source: author's calculations.

Table 5: The role of public health spending in the trade tax reforms–poverty nexus

	Dependent variable: poverty headcount ratio (in log)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	2FE		GMM		MG		CCEMG
L. Headcount (log)	0.901***	0.900***	1.024***	1.043***	0.381***	0.359***	0.197**
	(0.0236)	(0.0235)	(0.0868)	(0.0823)	(0.054)	(0.070)	(0.082)
Tax revenue (log)	–0.0200	–0.0220	0.0508	0.0479	–0.221	0.218	0.038
	(0.0157)	(0.0155)	(0.0602)	(0.0749)	(0.245)	(0.406)	(0.107)
Domestic tax (log)	0.0307	0.0317	–0.0377	–0.0230	0.005	0.077	–0.041
(percentage of total tax)	(0.0259)	(0.0261)	(0.0581)	(0.0568)	(0.083)	(0.081)	(0.094)
Health	0.0322	0.0364	–0.0182	0.0409	–0.210	0.302	0.065
	(0.0254)	(0.0259)	(0.0481)	(0.0698)	(0.358)	(0.604)	(0.055)
Health * Tax revenue	–0.00406	–0.00466	–0.00233	–0.0195	0.041	–0.104	–0.020
	(0.0124)	(0.0123)	(0.0263)	(0.0309)	(0.150)	(0.226)	(0.046)
Land pc (log)	–0.0235	–0.0160	–0.000913	0.0181	–0.129	–0.193	0.071
	(0.0563)	(0.0555)	(0.0390)	(0.0783)	(0.241)	(0.320)	(0.109)
Capital pc (log)	0.0516	0.0548	0.0311	0.000189	0.246	0.263	–0.078
	(0.0350)	(0.0353)	(0.154)	(0.143)	(0.306)	(0.327)	(0.055)
GDP pc (log)	–0.188***	–0.194***	0.00388	–0.00375	–0.654***	–0.755***	–0.359***
	(0.0534)	(0.0551)	(0.0597)	(0.115)	(0.159)	(0.268)	(0.129)
Government expenditure		0.000699		0.000820		–0.003*	
		(0.000711)		(0.00181)		(0.002)	
Population growth		–0.00212		0.00230		–0.066	
		(0.00505)		(0.0298)		(0.097)	
Constant	–0.844***	–0.885***	–0.0103	–0.254	–0.554	0.186	–0.585
	(0.268)	(0.277)	(0.384)	(0.826)	(2.048)	(2.718)	(2.202)
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
RMSE					0.0564	0.0471	0.0173
CD test					5.31	4.44	–0.88
CD *p*-value					0.000	0.000	0.378
Number of countries	85	85	85	85	81	68	81
Observations	1,443	1,441	1,443	1,441	1,417	1,266	1,417

Notes: Robust standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
CD test reports the Pesaran (2015) test for weak cross-sectional dependence; under the null hypothesis of weak cross-sectional dependence of the error term, the CD statistic is distributed $\sim N(0, 1)$. RMSE is the root mean squared error. Due to missing values in public health spending data, I am unable to implement the Chudik and Pesaran (2015) estimator.

Source: author's calculations.

5 Conclusion

The replacement of taxes on international trade with domestic taxes after trade liberalization policies adopted by developing countries in the 1980s to finance anti-poverty policies necessary to achieve the Millennium Development Goals (MDGs) has been a concern for developing countries these past decades. Trade liberalization is one of these strategies through which poverty could be reduced. Developing countries rely heavily on taxes on international trade that they use for social spending or for public goods financing. Then, switching from taxes on international trade to local taxes may have poverty and inequality implications because this change affects social spending or public goods provision. In this paper, I investigate the effects of reductions in taxes on international trade revenues on poverty in developing countries and the role that public goods can play in this relationship. I adopt empirical specifications that allow for heterogeneity across countries.

I first find evidence that taxes on international trade are negatively associated with poverty, implying that an increase in taxes on international trade reduces poverty on average in developing countries. However, the effect is heterogeneous across countries, indicating that poverty decreases in one group of countries while it increases in another group. Categorizing the two groups of countries (countries in which poverty decreases relatively to those in which poverty increases), I find that countries that benefit from the taxes on international trade are, on average, over time net exporters of agricultural products, while those that lose out have shifted from being net exporters of agricultural products to net importers. Second, I show that a shift from taxes on international trade to domestic taxes under revenue-neutrality increases poverty on average. The effects also vary largely across countries; some countries benefit while others lose out. The group of countries that benefit in terms of poverty reduction are those that have consolidated their comparative advantage in agriculture as agricultural trade balances increase on average over time. In contrast, countries that lose out have moved from being net exporters to net importers of agricultural products on average over time. My results also suggest that the shift from taxes on international trade towards domestic taxes significantly reduces poverty through the total tax revenue on average, but the effect is heterogeneous across countries. Finally, I show that public education and health expenditures do not play a significant role in the relationship between trade tax reforms and poverty under revenue-neutrality.

My results suggest that for developing countries to benefit from tariff liberalization they must implement policies that promote the agricultural sector as well as agricultural export-led policies. In fact, agricultural employment and agricultural share in GDP is higher in developing countries. Also, as it is clearly identified that the poor pay more tax relative to their incomes, my results suggest that developing countries might implement revenue redistribution policies that favour poor people—that is, allow them to benefit more from redistributive policies. Further research in this area would consider the role of income redistribution channels in the relationship between a shift from taxes on international trade towards domestic taxes on poverty to clearly identify the relationship. Moreover, the role of labour market characteristics and the composition of the government's public education expenditures should be explored to clearly investigate the role of public goods provision in the relationship between trade tax reforms and poverty in developing countries.

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Appendix

Table A1: List of countries

Algeria	Cote d'Ivoire	Lesotho	Rwanda
Argentina	Djibouti	Liberia	Sao Tome and Principe
Azerbaijan	Dominican Republic	Madagascar	Senegal
Bangladesh	Ecuador	Malawi	Sierra Leone
Belize	Egypt, Arab Rep.	Malaysia	Solomon Islands
Benin	El Salvador	Maldives	South Africa
Bhutan	Ethiopia	Mali	Sri Lanka
Bolivia	Fiji	Mauritania	St. Lucia
Botswana	Gabon	Mauritius	Suriname
Brazil	Gambia, The	Mexico	Syrian Arab Republic
Burkina Faso	Ghana	Mongolia	Tanzania
Burundi	Guatemala	Morocco	Thailand
Cabo Verde	Guinea	Mozambique	Togo
Cameroon	Guinea-Bissau	Myanmar	Tunisia
Central African Republic	Haiti	Namibia	Turkey
Chad	Honduras	Nepal	Uganda
Chile	India	Nicaragua	Uruguay
China	Indonesia	Niger	Uzbekistan
Colombia	Iran, Islamic Rep.	Nigeria	Venezuela, RB
Comoros	Jamaica	Pakistan	Viet Nam
Congo, Dem. Rep.	Jordan	Paraguay	Zambia
Congo, Rep.	Kenya	Peru	Zimbabwe
Costa Rica	Lao PDR	Philippines	

Table A2: Variable definition and sources

Variable	Description	Source
Headcount	Represents the poverty headcount ratio, which measures the percentage of people living under US$1.90 a day at 2011 international prices (percentage of the population)	World Bank poverty database and WDI (Povcalnet)
Trade tax	Import and export duties (percentage of GDP)	GRD, Baunsgaard and Keen (2010), and OECD
Domestic tax	Measures the total tax revenue excluding trade tax revenue (percentage of GDP)	GRD, Baunsgaard and Keen (2010), and OECD
Total tax	Measures the total tax revenue as the sum of trade tax revenue and domestic revenue (percentage of GDP)	GRD, Baunsgaard and Keen (2010), and OECD
Democracy	Average of political rights and civil liberties of the Gastil index. It ranges from 1 for democracy to 7 for dictatorship (see Paldam and Gundlach 2012)	Freedom House
Land pc	Measures the agricultural area per capita in hectares	FAO statistics
Capital pc	Capital stock per capita at constant 2011 national prices (US$)	IMF
Education	Government expenditure on education as a percentage of government total expenditures	IMF
Health	Government expenditure on health as a percentage of government total expenditures	IMF
Government expenditures	Government total expenditures as a percentage of GDP	IMF
Population growth	Measures the annual population growth rate	WDI

Table A3: Cross-section dependence

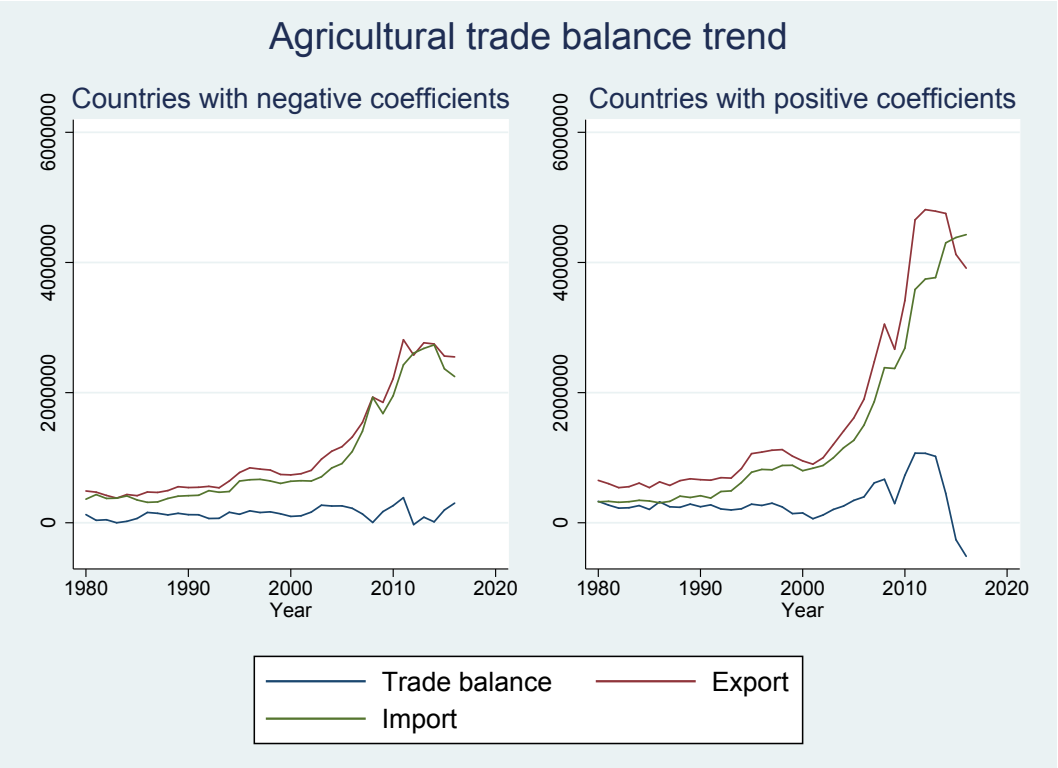
	CD	*p*-value	avg ρ	$\lvert\rho\rvert$
Headcount	87.49	0.00	0.229	0.491
Domestic tax	89.62	0.00	0.243	0.473
Total tax	54.06	0.00	0.142	0.405
Land pc	322.84	0.00	0.847	0.866
Capital pc	53.59	0.00	0.143	0.650
GDP pc	377.72	0.00	0.977	0.977
Population growth	88.04	0.00	0.278	0.568
Health	48.02	0.00	0.204	0.405
Trade tax	202324.52	0.00	0.16	0.37
Non-tax revenue	202324.52	0.05	0.01	0.31
Education	255895.06	0.00	0.05	0.33
Democracy	255895.06	0.00	0.07	0.37
Government expenditure	255895.06	0.00	0.03	0.32

Notes: I use the Stata command *xtcd* which calculates the CD test for cross-sectional dependence of Pesaran (2004) under the null hypothesis of strict cross-sectional independence. I present the average correlation and average absolute correlation coefficients across the $N(N-1)$ correlations between country i and all other countries. The null hypothesis of strict cross-sectional independence is rejected at the 1 per cent level for all variables except for the non-tax revenue variable, for which the null hypothesis is rejected at the 5 per cent level. This suggests the presence of cross-section dependence in each dataset.

For the variables trade tax, non-tax revenue, education expenditures, and government total expenditures, I use Stata routine *xtcdf* to carry out the CD test for cross-sectional dependence due to some missing data leading to an unbalanced panel; accordingly, I cannot use the CD test for cross-sectional dependence *xtcd*.

Source: author's calculations based on sources discussed in the text.

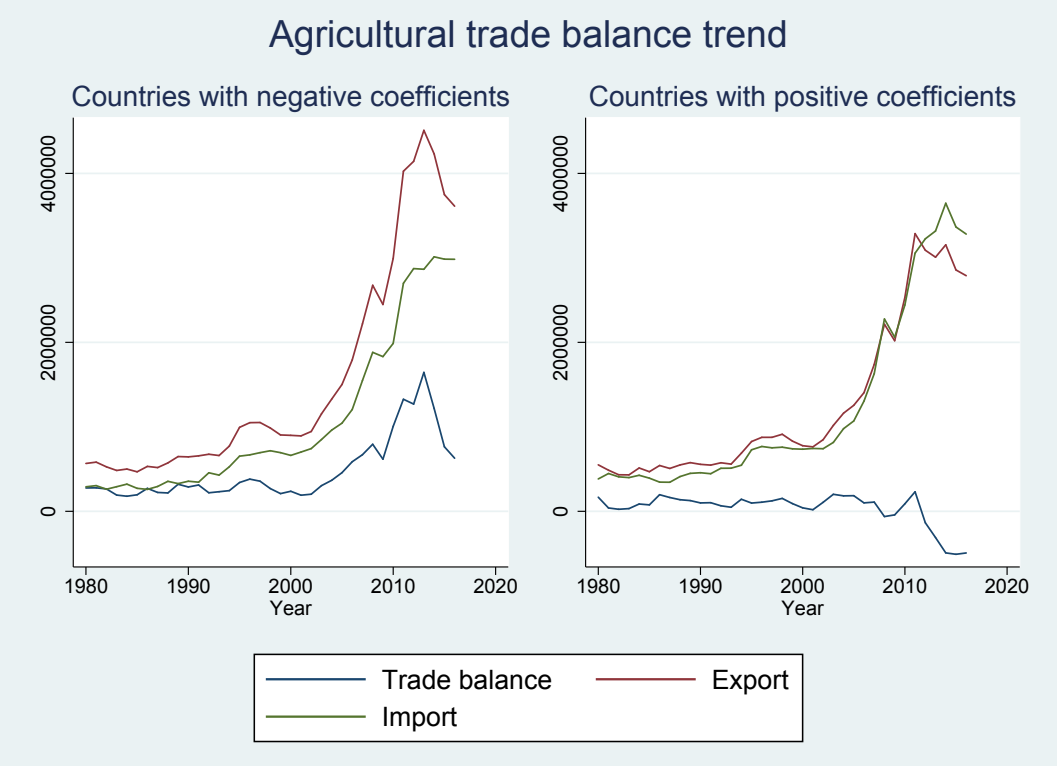
Figure A1: Evolution of agricultural trade balance trend by group of countries: heterogeneity effects of trade tax



Notes: I plot the trend (average) of trade balance of agricultural products over the period 1980–2016 to identify the role of comparative advantage in agriculture in the heterogeneity effects across countries. The countries with negative coefficients refer to those that benefit from an increase in trade taxes in terms of poverty reduction. The countries with positive coefficients are those in which an increase in taxes on international trade is associated with an increase in poverty. The figure shows that countries that experience a poverty-increasing effect of trade taxes have shifted from being net exporters to net importers of agricultural products, while countries in which trade taxes are associated with a reduction in poverty remained, on average, net exporters of agricultural products over time.

Source: author's calculations based on the FAO dataset.

Figure A2: Evolution of agricultural trade balance trend by group of countries: heterogeneity effects of domestic tax



Notes: I plot the trend (average) of the trade balance of agricultural products over the period 1980–2016 to identify the role of comparative advantage in agriculture in the heterogeneity effects across countries of a shift from taxes on international trade towards domestic taxes on poverty. The countries with negative coefficients refer those that benefit from an increase in trade taxes in terms of poverty reduction. The countries with positive coefficients are those in which an increase in taxes on international trade is associated with an increase in poverty. The figure shows that countries that experience a poverty-increasing effect of trade taxes have shifted from being net exporters to net importers of agricultural products, while countries in which trade taxes are associated with a reduction in poverty consolidated their comparative advantage in agriculture as agricultural trade balance increased on average over time.

Source: author's own calculations based on the FAO dataset.

Robustness checks

Table A4: Trade taxes incidence on poverty estimation excluding China and Lesotho from the sample

Dependent variable: poverty headcount ratio (in log)					
	(1)	(2)	(3)	(4)	(5)
	MG	CCEMG	CCEMG with lags		
CA additional lags			First lag	Second lag	Third lag
L. headcount	0.587***	0.363***	0.238***	0.143	0.381***
	(0.034)	(0.044)	(0.067)	(0.169)	(0.142)
Trade tax	–0.032*	–0.034*	–0.023	–0.138**	0.229
(percentage of GDP)	(0.017)	(0.018)	(0.050)	(0.066)	(0.414)
Domestic tax	–0.053***	–0.049**	–0.133	–0.090	–1.193
(percentage of GDP)	(0.020)	(0.025)	(0.116)	(0.086)	(1.039)
Capital pc	0.147	–0.068	–0.735	0.387	–0.646
	(0.129)	(0.147)	(0.599)	(0.573)	(1.635)
Land pc	0.050	–0.089	–0.197	–0.082	–4.199
	(0.142)	(0.162)	(0.609)	(0.705)	(3.315)
GDP pc	–0.442***	–0.673***	–0.794**	–2.084*	4.035
	(0.099)	(0.130)	(0.337)	(1.228)	(5.169)
Non-tax revenue	–0.001	0.010	0.009	0.026	–0.381
	(0.009)	(0.012)	(0.031)	(0.062)	(0.496)
Constant	–0.649	0.876	–14.109	–13.519	45.403
	(0.639)	(1.274)	(10.237)	(10.296)	(52.121)
RMSE	0.0960	0.0682	0.0936	0.0857	0.0880
CD test	9.840	2.304	3.84	1.28	2.24
CD *p*-value	0.000	0.021	0.000	0.202	0.025
Number of groups	79	79	64	62	61
Observations	2,310	2,310	1,945	1,827	1,733

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard errors in parentheses are constructed non-parametrically following Pesaran and Smith (1995).
All the regressors are in the log. The country-specific linear trend is included in each model.
CD test reports the Pesaran (2015) test for weak cross-sectional dependence; under the null hypothesis of weak cross-sectional dependence of the error term, the CD statistic is distributed $\sim N(0, 1)$. RMSE is the root mean squared error.

Source: author's calculations.

Table A5: Domestic taxes incidence on poverty estimation excluding China and Lesotho from the sample

Dependent variable: poverty headcount ratio (in log)					
	(1)	(2)	(3)	(4)	(5)
	MG	CCEMG	CCEMG with lags		
CA additional lags			First lag	Second lag	Third lag
L. headcount	0.582***	0.398***	0.277***	1.036	0.180**
	(0.035)	(0.040)	(0.053)	(0.715)	(0.084)
Domestic tax	0.037	0.029	0.269	0.669*	0.085
(percentage of total tax)	(0.045)	(0.048)	(0.284)	(0.401)	(0.557)
Tax revenue	–0.038	–0.076*	–0.343**	–0.515*	–0.427***
(percentage of GDP)	(0.037)	(0.043)	(0.143)	(0.271)	(0.127)
Capital pc	0.141	–0.094	1.001*	4.055	–2.414**
	(0.137)	(0.149)	(0.586)	(3.484)	(1.107)
Land pc	0.035	0.183	0.360	0.611	0.429
	(0.140)	(0.151)	(0.381)	(1.537)	(0.596)
GDP pc	–0.465***	–0.622***	–0.684**	0.224	–2.044***
	(0.097)	(0.118)	(0.328)	(2.831)	(0.539)
Non-tax revenue	0.003	0.015	0.012	–0.030	–0.073
	(0.008)	(0.015)	(0.040)	(0.167)	(0.104)
Constant	–1.420*	1.055	–2.694	1.762	–4.250
	(0.776)	(2.022)	(4.988)	(3.792)	(6.057)
RMSE	0.0957	0.0683	0.0927	0.0924	0.0956
CD test	9.321	1.659	4.20	1.59	0.65
CD *p*-value	0.000	0.097	0.000	0.112	0.514
Number of countries	80	80	64	62	61
Observations	2,326	2,326	1,945	1,827	1,733

Notes: $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard errors in parentheses are constructed non-parametrically following Pesaran and Smith (1995).
All the regressors are in the log. The country-specific linear trend is included in each model. CD test reports the Pesaran (2015) test for weak cross-sectional dependence; under the null hypothesis of weak cross-sectional dependence of the error term, the CD statistic is distributed $\sim N(0, 1)$. RMSE is the root mean squared error.

Source: author's calculations.