Tax Reform and Trade Openness in Developing Countries

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Abstract Developing countries are confronted with the progressive erosion of their trade tax revenue, which then reduces their total tax revenue. In light of the unavoidable process of trade liberalization, such countries have engaged in tax transition reform to change their tax revenue structure in favor of domestic tax revenue. The current analysis uses a measure of tax transition reform (tax reform) to examine whether countries that engage in tax reform experience greater trade openness. The empirical analysis covers 92 developing countries from 1980 to 2014 and shows that tax reform is positively associated with trade openness. Interestingly, least developed countries (LDCs) appear to enjoy a higher effect of tax reform on trade openness than non-LDCs do. This is confirmed by a more general picture that shows how less advanced developing countries enjoy a higher positive effect of tax reform on trade openness than relatively advanced developing countries do.

Keywords: Tax transition reform, Trade openness, Developing countries

JEL Classifications: F02, F15, O11, I32

I. Introduction

International trade tax revenue still represents an important share of a country's total public revenue. Thus, one reason underlying the adoption of restrictive trade policy measures by policymakers in developing countries is the fear of losing this revenue because of greater trade openness or the liberalization of trade regimes. In fact, several studies have reported evidence of the negative effect of trade liberalization on tax revenue (e.g., Cagé and Gadenne 2018, Hisali 2012, Khattry and Rao 2002). The potential tax revenue losses associated with greater trade liberalization (or trade openness) has led international financial institutions, such as the International Monetary Fund (IMF) and the World Bank, to advise policymakers of developing countries to undertake a tax reform (or "tax transition reform") (e.g., Chambas 2005, Keen

2012). This reform is expected to transform the structure of the tax revenue in these countries from its current high dependence on international trade tax revenue to a greater dependence on domestic tax revenue. Such a tax reform would ultimately lead to a tax structure in developing countries that is similar to the one in developed countries (industrialized nations), where the trade tax revenue is far lower than the domestic tax revenue (Tanzi 1992, Zee 1996, Tanzi and Zee 2000).

The policy advice of the international financial institutions rests on the idea of a tariff-tax reform involving a one-unit reduction in tariff and, concomitantly, a one-unit increase in the consumption tax. As noted by Keen and Ligthart (2002), this proportional tariff-tax reform does not affect consumer prices, but does affect the production sector of the economy. Thus, a reduction of implicit production subsidies (due to declining tariffs) would allow efficient allocation of resources in the production sector, generate welfare gains, and also increase public revenue. The literature on the tariff-tax reform has usually investigated the effect of tariff-tax reform on market access, public revenue, and welfare (e.g., Fujiwara 2013, Hatzipanayotou *et al.* 1994, Keen and Ligthart 2002, 2005, Kreickemeier and Raimondos-Møller 2008, Karakosta and Tsakiris 2014). Specifically, the literature on the effect of tariff-tax reform on market access (defined as the value of import volumes at the world price) has usually focused on one specific tariff-tax reform that involves a one-unit tariff reduction and an increase in consumption tax by one unit, as advised by international financial institutions. Hatzipanayotou *et al.* (1994) showed that this policy reform is welfare-improving for a competitive, small economy. Whereas Keen and Ligthart (2002) generalized this result, they later demonstrated that, in the context of imperfect competition, this result no longer holds (Keen and Ligthart 2005). Kreickemeier and Raimondos-Møller (2008) theoretically proposed that point-by-point policy reform might not increase market access, although it may improve welfare and increase revenue. Fujiwara (2013) theoretically proved that, under decreasing marginal costs, point-by-point policy reform improves market access, welfare, and public revenue.

The current analysis aims to examine the effect of tax reform on trade openness in developing countries. Compared with previous studies on the market access effect of tariff-tax reform, which we highlighted above, the novelty of the current study is twofold. First, it relies on an indicator that captures tax (transition) reform, as defined above, and which is constructed based on the semi-metric Bray-Curtis dissimilarity index (Bray and Curtis 1957). This indicator captures the degree of convergence of a developing country's tax structure toward the tax structure of developed countries. Second, we focus on trade openness and not on market access, although both concepts are interrelated. Thus, to the best of our knowledge, this is the first study on the effect of tax reform on trade openness.

The empirical analysis is conducted using a panel dataset of 92 countries and spans the 1980~2014 period. It shows that tax reform induces greater trade openness. This positive effect

is dependent on the income level of countries (a proxy for their development level), as, among developing countries, less developing ones experience a higher positive effect of tax reform on trade openness than relatively advanced developing countries do.

The remainder of the article is organized as follows: Section 2 presents the indicator of tax reform used in the analysis, whereas section 3 discusses the measure of trade openness. Section 4 discusses how tax reform could influence trade openness. Section 5 presents the model specification that helps address the subject of this article and discusses the appropriate econometric estimator to conduct the empirical analysis. Section 6 presents empirical results, and section 7 concludes the paper.

II. Measure of the Extent of Tax Reform

Following Gnangnon and Brun (2019b), the extent of tax reform is measured by relying on the semi-metric Bray-Curtis dissimilarity index (Bray and Curtis 1957). This index allows us to compare the tax structure of a given developing country to the tax structure of developed countries. It captures the degree of convergence of a developing country's tax structure toward the tax structure of developed countries (qualified as "old industrialized countries"). It is worth noting that the Bray-Curtis index has been used before in natural sciences and social sciences such as international trade (e.g., Finger and Kreinin 1979, De Benedictis and Tajoli 2007, 2008).

The formula of the Bray-Curtis index applied to the tax structure is as follows:

$$d_{it} = \frac{\begin{array}{c}|DIRTAX_{it} - DIRTAXAve_t| + |INDIRTAX_{it} - INDIRTAXAve_t| \\ + |TRTAX_{it} - TRTAXAve_t|\end{array}}{[(DIRTAX_{it} + DIRTAXAve_t) + (INDIRTAX_{it} + INDIRTAXAve_t) + (TRTAX_{it} + TRTAXAve_t)]} \tag{1}$$

where *DIRTAX, INDIRTAX,* and *TRTAX* are, for a given developing country, the ratio of direct tax revenue in its GDP, ratio of indirect tax revenue in its GDP, and ratio of trade tax revenue in its GDP, respectively. *DIRTAXAve, INDIRTAXAve,* and *TRTAXAve* are, for developed countries, the average (over all developed countries, in a given year) of the direct tax revenue to GDP ratio, indirect tax revenue to GDP ratio, and international trade tax revenue to GDP ratio, respectively. Natural resource revenue is excluded from all tax revenue variables to capture a more homogenous indicator of tax reform. In fact, many countries are dependent on natural resources for their tax revenue; including natural resource revenue in the abovementioned tax revenue variables would thus generate a misleading indicator of tax reform. It might even lead to erroneous empirical outcomes and policy conclusions.

The index of tax reform (denoted "*TAXREF*") is then calculated as follows: $TAXREF=$

$(1-d_{it})*100$, where d_{it} is the Bray-Curtis dissimilarity index obtained from formula (1). For a given country in a given year, this index reflects whether the country's tax structure is converging toward (or diverging from) the tax structure of developed countries. The values of this index range between 0 and 100. Higher values indicate a greater extent of tax reform, that is, a convergence of the tax structure of a given developing country toward that of developed countries. Inversely, declining values of this index indicate a lower extent of tax reform, that is, a divergence between the tax structure of a given developing country and of developed countries. We provide in Appendix 1 the list of developed countries that are used as a benchmark to compute the index of tax reform.

As observed by Gnangnon and Brun (2019b), the above index has been computed using tax revenue variables, which themselves depend on countries' structural factors, such as the development level, population size, structure of output, degree of trade openness, and institutional quality (e.g., Baunsgaard and Keen 2010, Crivelli 2016, Gnangnon and Brun 2017, Khattry and Rao 2002). Thus, it could be considered a *de facto* measure of tax reform and not a *de jure* measure, which would better reflect policymakers' decisions concerning the implementation of tax reform. Nevertheless, by controlling for many of these structural factors in the model specification, we could uncover the genuine effect of tax reform, thus reflecting the policymakers' decision on the degree of trade openness.

III. Measure of Trade Openness

In the literature, trade openness has sometimes been used interchangeably with trade policy. However, these two variables reflect different realities[1]. Trade openness is an outcome of several factors, including social, cultural, geographical, and economic factors (which, in turn, include trade, exchange rate, financial, and other policies) as well as international politics (driven by interest groups), which governments cannot control. Therefore, it represents a *de facto* measure of openness to international trade. Trade policy reflects the policymakers' decision to open an economy to international trade. Therefore, it represents a *de jure* measure of openness to international trade. In this respect, *de facto* measures of trade openness contain more exogenous elements than *de jure* measures (also a similar reasoning by Baltagi *et al.* [2009] for the case of financial openness). For example, *de jure* measures of trade openness include incidence-based indicators, such as the average level of tariffs, percentage of imports subject to nontariff restrictions, level of export taxes, a combination of these partial trade policy instruments (e.g., the Sachs and Warner's [1995] indicator, which is a dummy variable capturing trade liberalization),

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1) See Gräbner *et al.* (2018) for a recent literature review on the measure of trade openness.

a measure of "residual openness,"[2] "freedom to trade internationally"[3] indicator, and the *de jure* index of trade globalization, which is a weighted index of trade regulations, trade taxes, tariffs, and trade agreements (see Dreher 2006, Gygli *et al.* 2019).

As noted above, *de facto* measures of trade openness are outcome indicators. They include, for example, price-based indicators such as the Dollar-type index[4] (Dollar 1992) as well as quantity-based indicators such as the trade share (i.e., the ratio of exports plus imports of goods and services in percentage of GDP), which is widely used in the empirical literature. Quantity-based indicators also include the *de facto* index of trade globalization, which is a weighted index of trade in goods as well as in services and partner diversity (see Dreher 2006 and Gygli *et al.* 2019). More recently, Squalli and Wilson (2011) highlighted the limits of the traditional measure of trade openness (i.e., the trade share) and proposed another *de facto* trade openness indicator, calculated as the trade share indicator adjusted by the proportion of a country's trade level relative to the average world trade (see Squalli and Wilson 2011, p. 1758). This indicator has an advantage of providing good indication of a country's level of integration into the global trade market. We primarily use the indicator proposed by Squalli and Wilson (2011). For the robustness check, we use the standard trade openness measure (i.e., the ratio of exports plus imports of goods and services in percentage of GDP).

IV. Discussion on the Effect of Tax Reform on Trade Openness

From a theoretical perspective, we argue that any tax reform would mainly affect trade openness through its effect on public revenue, notably tax revenue. In that respect, we could expect that, by inducing higher tax revenue, tax reform would generate higher trade openness (*hypothesis 1*). However, if tax reform is associated with lower tax revenue (because countries are not able to raise domestic tax revenue to at least compensate for the trade tax revenue losses arising from greater trade openness), then it would be associated with lower level of

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2)   The residual openness index is calculated using a regression of the trade share on the non-policy determinants of trade flows (demographic and geographic factors) to separate "natural openness" (i.e., fitted value of the regression) from "residual openness" (the residual of the regression, which reflects the "man-made choices" shaping a country's trade openness) (e.g., Combes and Saadi-Sedik 2006, Esfahani and Squire 2007).

3)   This is a is a key component of the Economic freedom Index. There are two types of this indicator: one is proposed by the Heritage Foundation with data starting from 1995 onward (for further information, see online at: https://www.heritage.org/index/explore) and another, which is closely related to the previous one, is developed by the Fraser Institute, and covers the period from 1970 onward. Data for this indicator from 1970 to 1999 are provided every five years and data from 2000 are provided annually (for further information, see online at: https://www.fraserinstitute.org/economic-freedom/dataset?geozone=world&year=2016&page=dataset&min-year=2 &max-year=0&filter=0).

4)   The Dollar-type index is calculated as the ratio of the actual real exchange rate relative to its predicted value based on the regression of the real exchange rate on its nonpolicy determinants.

trade openness (*hypothesis 2*). We discuss, in turn, each of these hypotheses.

Concerning hypothesis 1, we argue that, if tax reform allows developing countries to recoup more than the trade tax revenue losses (by substantially increase domestic revenue) and increase their total tax revenue, then policymakers might not fear opening up their economies to international trade. The rise in public revenue would help them promote international trade through investment in all factors that contribute to enhancing international trade flows, notably infrastructure, human capital, and institutional quality (conducive business environment). In this context, tax reform would be associated with greater trade openness.

Recent studies (Baunsgaard and Keen 2010, Crivelli 2016, Moller 2016, and Waglé 2011) have explored whether developing countries have recouped the trade tax revenue losses induced by trade liberalization from other sources, including domestic tax revenue. They report that countries endeavor to recoup the lost trade tax revenue by increasing the domestic tax revenue. For example, Baunsgaard and Keen (2010) provided empirical evidence to show that the replacement rate is low for low-income countries even though the signs of recovery vary across countries. However, middle- and high-income countries have been able to recoup the lost trade tax revenue from other sources. Waglé (2011) found that the tax recovery in low-income countries is much more robust than that shown by Baunsgaard and Keen (2010), although long term replacement is statistically significant only for a few countries. In the same vein, Moller (2016) revealed that low-income countries that have simultaneously initiated a process of democratization are those that have enjoyed a significant tax recovery. Crivelli (2016) provided empirical evidence to show that, for transition economies in Eastern Europe, the former Soviet Union, North Africa, and the Middle East, there is strong revenue replacement of lost trade tax revenue with total domestic tax revenue, notably through the value-added tax and personal income tax.

In addition to its indirect effect on trade openness through tax revenue, tax reform could also influence trade openness through its effect on trade policy. In fact, policymakers should further open up their trade regimes to ensure countries can collect higher domestic tax revenue during the tax reform process. This is because higher value addition to domestic production is an important determinant of tax revenue (e.g., Baunsgaard and Keen 2010, Crivelli 2016, Gnangnon and Brun 2017, Khattry and Rao 2002). Further, trade policy liberalization is essential to encourage domestic firms to add value to their production by reducing their production costs, notably the costs of imported intermediate inputs used in their production process. Hence, greater trade policy (*de jure* trade policy) liberalization during the tax transition reform process could lead to greater *de facto* trade openness. Along this line, studies have reported a positive effect of trade liberalization on exports (e.g., Ahmed 2000, Bleaney 1999, Santos-Paulino 2002a, Ju *et al.* 2010, Zakaria 2014) and imports (e.g., Bertola and Faini 1991, Ju *et al.* 2010, Santos-Paulino 2002b, Santos-Paulino 2004, Santos-Paulino and Thirlwall 2004, Zakaria 2014), which could

suggest a positive effect on trade openness (as defined above).

As for the second hypothesis, countries (for example, very poor countries) could lack the capacity—including human resources in the tax and revenue administrations—to effectively design the tax reform (tax policy as well as tax and revenue administration reforms) that would help undertake tax reform successfully, such as by raising the level of total tax revenue in the context of declining trade tax revenue. In this scenario, the tax reform would be negatively associated with trade openness. However, development aid could help countries that are facing difficulties in successfully undertaking the tax reform through, for example, technical assistance to help them design tax policy as well as tax and revenue administrations reforms, or by affecting the distribution of the costs and benefits of the reform. That is to say—in the latter case, by targeting groups (including firms and households) that would be adversely affected by the implementation of the reform. (e.g., Attila *et al.* 2009, Gnangnon 2019a). In this specific case, tax reform would be associated with greater trade openness.

V. Empirical Analysis

This section presents the model specification that would help empirically test the effect of tax reform on trade openness. It then discusses the econometric estimator to estimate this model.

A. Model specification

To empirically examine the effect of tax reform on trade openness, we draw on certain extant studies (e.g., Fukumoto and Kinugasa 2017, Goswami 2013, Guttmann and Richards 2006) on the determinants of trade openness[5] (i.e., *de facto* trade openness). In addition to the main variable of interest, which is the *de facto* measure of trade openness, we use control variables that could affect the effect of tax reform on trade openness. These control variables include a *de jure* trade openness indicator (trade policy) ("*TRJURE*"); development aid flows ("*NAT*"); real per capita income ("*GDPC*"), which captures countries' development level; depth of financial development ("*FINDEV*"); institutional quality proxied by the democratization level of countries ("*POLITY2*"); current account balance ("*CAGDP*"); inflation rate (whose transformation is denoted "*INFL*"; see Appendix 1); and countries' size, measured by the population size ("*POP*").

We expect restrictive trade policies to result in lower import flows. Restrictive trade measures would also adversely affect export flows if they increase the costs of intermediate inputs used by exporting firms in their production processes of exportable goods and services. Likewise,

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5) It is worth highlighting that, in their respective studies, Milner and Kutoba (2005) as well as Svaleryd and Vlachos (2002) have used both *de jure* and *de facto* measures of trade openness in their analysis.

we expect a rise in the development level to result in lower barriers to trade (e.g., Easterly and Rebelo 1993, Rodrik 1995, Svaleryd and Vlachos 2002, Milner and Kutoba 2005), and hence induce greater trade openness. At the same time, an increase in the population size could lead governments to adopt restrict trade policies (e.g., Rodrik 1997) to encourage production for the domestic market at the expense of international trade. This would result in lower trade openness. However, countries characterized by an important share of the working-age population would experience greater trade openness (e.g., Fukumoto and Kinugasa 2017).

Let us consider the effect of development aid flows on trade openness. Development aid could induce the Dutch Disease effect (i.e., an appreciation of the real effective exchange rate) by shifting resources from the tradable sector to the non-tradable sector, thereby hurting recipient-countries' export competitiveness (e.g., Collier 2007, Munemo 2011) and lowering their exports. At the same time, such appreciation of the real effective exchange rate would result in higher imports. In this context, the combined effect of development aid flows on trade openness through the Dutch Disease effect is *a priori* unknown, given that trade openness includes the sum of exports and imports of goods and services. Part of this aid could also be used by recipient-countries to further liberalize their trade regimes (this was the case in the context of the structural adjustment programs; e.g., Ancharaz 2003, Borgatti 2007, La Ferrara 1996), which could contribute to greater trade openness. Part of the development aid flows called "aid for trade policy and regulation" also helps developing countries implement WTO agreements, which, through the liberalization of domestic trade regimes, could contribute to promoting trade openness. Development aid flows could also positively influence trade openness through their positive effect on human capital accumulation, including educational outcomes[6] (e.g., Dreher *et al.* 2008, Birchler and Michaelowa 2016) and health outcomes[7] (Pickbourn and Ndikumana 2016, Kotsadam *et al.* 2018). This is because better human capital is associated with higher export performance[8] (Hausmann *et al.* 2007, Farok and Mudambi 2008, Andersson and Johansson 2010, Agosin *et al.* 2012), and hence higher participation in international trade. This, turn, would lead to greater trade openness. Further, as development aid targeted to the financial sector promotes financial development (Maruta 2018) and financial development could positively influence trade openness (Svaleryd and Vlachos 2002, Kim *et al.* 2010), we infer that development aid for the financial sector could result in higher trade openness.

Summing up, development aid could positively or negatively influence trade openness depending on whether the aforementioned positive effects dominate its eventual negative effect on exports through the appreciation of the real exchange rate.

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6) See a literature review on the subject matter in Abby and Nio-Zarazua (2016).

7) A comprehensive literature review on the effect of development aid on health outcomes could be found in Kotsadam *et al.* (2018).

8) This is because, in general, better quality products require quality control procedures and better technology, with both requiring better educated workers (Fafchamps 2009).

With respect to the effect of financial development on trade openness, a number of authors have shown that countries that are financially developed and have well-functioning financial institutions (i.e., where restrictions in the credit market are low) would specialize in financially intensive goods and services, which would promote trade, particularly exports (Kletzer and Bardhan 1987, Rajan and Zingales 1998, Chaney 2005, Manova 2005). Along the same lines, Svaleryd and Vlachos (2002) argued that a developed financial system helps diversify the private sector's risks, and thus promotes trade openness. They provided empirical support for the positive effect of financial development on trade openness. In the same vein, Kim *et al.* (2010) empirically demonstrated that financial development exerts a positive effect on trade openness in countries that are not members of the Organisation for Economic Cooperation and Development (OECD). Incidentally, an improvement in the institutional quality is expected to enhance trade openness (e.g., Jansen and Nordås 2004, Wu *et al.* 2012), whereas a lower inflation rate (which reflects higher macroeconomic stability) is expected to lead to higher trade openness.

In countries that experience a deterioration of their current account, governments might be willing to promote trade, including by reducing trade barriers and implementing export promotion policies. This would drive import flows, especially if trading firms extensively use imported intermediate inputs for producing final goods. We therefore expect deterioration in the current account to be positively associated with trade openness.

Against this background, we postulate the following model (1):

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\begin{aligned}
Log(TROPEN)_{it} = {} & \alpha_0 + \alpha_1 Log(TROPEN)_{it-1} + \alpha_2 Log(TAXREF)_{it} + \alpha_3 Log(TRJURE)_{it} \\
& + \alpha_4 Log(GDPC)_{it} + \alpha_5 Log(NAT)_{it} + \alpha_6 Log(FINDEV)_{it} + \alpha_7 INFL_{it} \\
& + \alpha_8 CAGDP_{it} + \alpha_9 POLITY2_{it} + \alpha_{10} Log(POP)_{it} + \gamma_t + \mu_i + \omega_{it}, \quad (2)
\end{aligned}
$$

where the subscript i represents a given country's index, and t represents the time-period. Based on available data, we construct an unbalanced panel dataset comprising 92 developing countries (which excludes countries classified by the World Bank as "High-Income Countries") spanning the period 1980~2014. We use non-overlapping five-year sub-periods of average data to smooth out the effect of business cycles on the variables. These sub-periods are 1980~1984, 1985~1989, 1990~1994, 1995~1999, 2000~2004, 2005~2009, and 2010~2014. α_0 to α_{11} are the coefficients to be estimated. μ_i represents countries' fixed effects; ω_{it} is an idiosyncratic error-term. γ_t represent global shocks that simultaneously affect all countries' trade openness.

The descriptions and source of variables used in model (2) are provided in Appendix 1. The descriptive statistics on these variables are displayed in Appendix 2. The list of countries contained in the full sample are reported in Appendix 3.

Note that do not apply the natural logarithm to the variables *CAGDP* and *POLITY2*, because

they contain zero values and/or negative values. The variable capturing inflation is transformed using the method proscribed by Yeyati *et al.* (2007) (see Appendix 1).

The dependent variable "*TROPEN*" represents the measure of the *de facto* trade openness. As noted above, it is primarily measured by the trade openness indicator proposed by Squalli and Wilson (2011), which is denoted as "*OPENSW*." For the robustness check, the standard measure of trade openness ("*OPEN*") is employed. The one-period lag of *TROPEN* is introduced in model (1) to capture the state-dependence nature of the trade openness variable to be persistent over time.

To obtain initial insight into the correlation pattern between tax reform and trade openness in developing countries, Figure 1 illustrates the cross-plot between each of the two measures of trade openness and our indicator of tax reform. It appears from the two graphs in this figure that tax reform is positively correlated with trade openness.

B. Econometric methodology

The dynamic nature of model (2) (as it contains the one-period lag of the dependent variable as a regressor) precludes us from using standard econometric estimators, such as the fixed effects or random effects estimators, to obtain reliable estimates. This is because, in a panel with a small time dimension and large cross-section (such as ours), the one-period lag of the dependent variable is likely correlated with the specific effects, thereby generating an endogeneity bias (the so-called Nickell bias; see Nickell 1981) when standard econometric estimators are used. Furthermore, several regressors contained in model (2) are likely endogenous, particularly due to the bidirectional causality problem. These include the trade policy indicator, development aid, financial development, institutional quality, current account, and real per capita income. To address these endogeneity concerns in the estimation of model (2), we employ the two-step system Generalized Methods of Moments (GMM) estimator (see Arellano and Bover 1995, Blundell and Bond 1998). This estimator entails the estimation of a system of equations that includes an equation in differences and an equation in levels. The lagged first differences are used as instruments for the level equation, whereas the lagged levels are used as instruments for the first-difference equation. This estimator is suitable for dynamic panels (including unbalanced panels), where the series exhibit a strong persistence over time.

Overall, our main econometric estimator is the two-step system GMM estimator. However, for the sake of comparison, we also report the outcomes of the estimation of a static version of model (2) (that is, model (2) from which we exclude the one-period lag of the dependent variable, and where the dependent variable is OPENSW). For this purpose, we use two standard estimators: the fixed effects estimator (denoted "FE-DK"), where standard errors have been corrected using the Driscoll and Kraay (1998) technique. This technique addresses heteroscedasticity,

serial correlation, and contemporaneous cross-sectional dependence in the error term. The second estimator is the feasible generalized least squares (FGLS). The results of the estimations of the static version of model (2) using these estimators are displayed in Table 1.

The results in Table 2 are based on the estimation of model (2) as well as some variants of this model, by means of the two-step system GMM estimator. We report the outcome of the estimation of dynamic model (2) in column [1] of this table. Column [2] of the table reports the estimates arising from the estimation of dynamic model (2), where *OPEN* is used (for a robustness check) as the measure of trade openness. In column [3], we display the outcome of the estimation of a specification of model (2) that allows us to examine whether there is a differentiated effect of tax reform on trade openness in poor countries versus nonpoor countries. We follow the United Nations definition and consider "Least Developed Countries" (LDCs) as the poorest countries. In fact, based on several criteria,[9] the United Nations has identified a set of countries (LDCs) qualified as the poorest and most vulnerable (in the world) to environmental and external shocks. The list of LDCs used in the analysis is provided in Appendix 3. To perform the analysis, we create a dummy variable "LDC," which takes the value 1 for LDCs and is 0 otherwise. This dummy variable is then made to interact with the *TAXREF* variable. Both variables are included in the model specification, which is estimated using the two-step system GMM approach. In column [4] of Table 2, we present the results of the estimation of the variant of model (2) that includes a variable capturing the interaction between the indicator of tax reform and the real per capita income. This variant would allow us to assess whether (and if so, how) the effect of tax reform on trade openness varies across countries in the full sample.

VI. Empirical Results

The results reported in the two columns of Table 1 suggest a positive and significant effect of tax reform on trade openness, although the magnitude of the effect in the two columns are slightly different (the coefficient is 0.4 for the results based on the FE-DK estimator and 0.6 for the result based on the FGLS estimator).

We note from the control variables that the results are not necessarily similar in the two columns of Table 1. In particular, from column [1], we find that, at the 10% level of statistical significance, trade openness is positively driven by trade policy liberalization, higher real per capita income, improvement in the current account balance, lower population size, higher depth of financial development, and better institutional quality. In column [2], real per capita income,

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9) These criteria as well as other information concerning the group of LDCs can be obtained online at: http://unohrlls.org/about-ldcs/

current account balance, a rise in the population size, and financial development are positively associated with trade openness, while development aid flows, inflation, and the institutional quality are negatively associated with trade openness. As indicated in the previous section, these results are likely biased. Therefore, we turn to Table 2, which contains the results based on the two-step system GMM estimator. First, we note that across the three columns of this table, the coefficient of the one-period lag of the dependent variable is positive and statistically significant at the 1% level. Thus, there exists persistence of the two trade openness variables

Table 1: Impact of tax reform on trade openness
Estimators: FE-DK and FGLS

VARIABLES	FE-DK	FGLS with panel-specific AR1 autocorrelation structure
	Log(OPENSW)	Log(OPENSW)
	(1)	(2)
Log(TAXREF)	0.404***	0.592***
	(0.0853)	(0.0683)
Log(TRJURE)	0.182*	0.0420
	(0.104)	(0.0557)
Log(GDPC)	0.800***	0.995***
	(0.0803)	(0.0292)
Log(NAT)	0.00694	-0.0408**
	(0.0143)	(0.0207)
Log(FINDEV)	0.137***	0.193***
	(0.0165)	(0.0289)
INFL	0.0138	-0.0221*
	(0.0103)	(0.0123)
CAGDP	0.00541**	0.00340***
	(0.00218)	(0.000880)
POLITY2	0.00518**	-0.00784***
	(0.00247)	(0.00302)
Log(POP)	-0.433*	0.597***
	(0.241)	(0.0186)
Constant	-10.01***	-26.88***
	(3.083)	(0.410)
Observations	405	399
Number of groups	92	86
Within *R*-squared	0.3802	
Pseudo *R*-squared		0.9133

(Note) *p-value<0.1; **p-value<0.05; ***p-value<0.01. Robust Standard Errors are in parenthesis. The Pseudo R^2 has been calculated for the regression based on the FGLS estimator as the correlation coefficient between the dependent variable and its predicted values. Time dummies have been included in the regressions based on the FGLS estimator.

(*OPENSW* and *OPEN*) over time. The bottom part of Table 2 reports the results of the three tests that allows us to check the appropriateness of the two-step system GMM estimator in estimating model (1) and its variants highlighted above. These tests include the Arellano-Bond

Table 2: Impact of tax reform on trade openness
Estimator: Two-step System GMM

VARIABLES	Log(OPENSW) (1)	Log(OPEN) (2)	Log(OPENSW) (3)	Log(OPENSW) (4)
One-Period Lag of the dependent variable	0.617***	0.695***	0.656***	0.626***
	(0.0209)	(0.0174)	(0.0259)	(0.0209)
Log(TAXREF)	0.497***	0.356***	0.463***	1.784***
	(0.0647)	(0.0305)	(0.0904)	(0.316)
LDC*[Log(TAXREF)]			0.516***	
			(0.101)	
LDC			-1.838***	
			(0.418)	
[Log(TAXREF)]*[Log(GDPC)]				-0.165***
				(0.0403)
Log(TRJURE)	0.173***	0.0531**	0.283***	0.184***
	(0.0437)	(0.0255)	(0.0426)	(0.0411)
Log(GDPC)	0.287***	-0.00285	0.258***	0.956***
	(0.0248)	(0.0108)	(0.0507)	(0.163)
Log(NAT)	-0.0887***	-0.0427***	-0.0660***	-0.0983***
	(0.0260)	(0.00883)	(0.0241)	(0.0277)
Log(FINDEV)	0.116***	0.0194**	0.0889***	0.106***
	(0.0201)	(0.00756)	(0.0219)	(0.0191)
INFL	-0.0911***	0.0216***	-0.0960***	-0.0883***
	(0.0115)	(0.00575)	(0.0122)	(0.0116)
CAGDP	0.00359**	0.00268***	0.0113***	0.00334**
	(0.00152)	(0.00101)	(0.00212)	(0.00160)
POLITY2	0.00928***	0.00203*	0.0113***	0.00899***
	(0.00184)	(0.00116)	(0.00235)	(0.00218)
Log(POP)	0.328***	-0.0279***	0.318***	0.321***
	(0.0225)	(0.00677)	(0.0213)	(0.0224)
Constant	-11.56***	0.784***	-11.48***	-16.39***
	(0.839)	(0.220)	(1.071)	(1.286)
Observations-Countries	368-92	368-92	368-92	368-92
Number of Instruments	88	88	89	89
AR1 (*P*-Value)	0.0015	0.0003	0.0004	0.0009
AR2 (*P*-Value)	0.9069	0.6335	0.9526	0.9638
AR3 (*P*-Value)	0.2510	0.7204	0.2148	0.2345
OID (*P*-Value)	0.4396	0.6164	0.7504	0.4670

(Note) *p-value<0.1; **p-value<0.05; ***p-value<0.01. Robust Standard Errors are in parenthesis. In the two-step system GMM estimations, the variables *TAXREF, TRJURE, NATCST, FINDEV, POLITY2, CAGDP,* and *GDPC* are considered endogenous. The other variables are considered exogenous. Time dummies are included in the regressions.

test of first-order serial correlation (AR(1)) in the error term; the Arellano-Bond test of no second-order autocorrelation (AR(2)) in the error term; and the standard Sargan test of over-identifying restrictions (OID), which assesses the validity of the instruments used in the estimations. The test of the no third-order autocorrelation (AR(3)) in the error term is also reported to show that there is no serial correlation at the third order, which might indicate that there is no omitted variable bias. As the number of instruments should be lower than the number of countries to ensure the tests are reliable (e.g., Roodman 2009), we also report the number of instruments used in the regressions. The outcomes of the tests show that the *p*-values of the statistics related to the AR(1) are lower than 0.01, whereas those of the statistics related to the AR(2) and AR(3) are all higher than 0.01. Furthermore, the *p*-values related to the OID test are higher than 0.10. Taken together, all these results confirm the suitability of the two-step system GMM estimator for the empirical exercise.

Turning to the estimates provided in column [1] of Table 2, we note that the effect of tax reform on trade openness (measured by *OPENSW*) is positive and statistically significant at the 1% level. A 1% increase in the index of tax reform is associated with a 0.5% increase in the level of trade openness. This result is similar in magnitude to the ones obtained in columns [1] and [2] of Table 1. Moreover, this result is confirmed in column [2] of the same table, that is, with the trade share as the measure of trade openness. However, the coefficient of the variable *OPEN* reported in Table 2 amounts to 0.36, which is slightly lower than the one of column [1].

Based on these two results, we can conclude that tax reform is positively associated with trade openness. This finding validates hypothesis 1 set out in section 2. The estimates of the control variables have few differences in columns [1] and [2] of Table 2. In particular, column [1] shows that trade openness is positively driven by greater trade policy liberalization, higher real per capita income, lower amount of development aid flows, higher level of financial development, improvement in the current account balance, better institutional quality, a rise in the population size, and lower inflation rates. The results for the control variables in column [2] are also similar to those in column [1], although with different magnitudes of the coefficients. However, in column [2], the real per capita income exerts no significant effect (at the 10% level) on trade openness, though inflation exerts a positive effect on trade openness (here, trade share). This is different from the results in column [1] of the same table.

We now consider results in column [3] of Table 2. We find that the coefficient of both the *TAXREF* variable and the interaction (associated with the variable "*LDC*[Log(TAXREF)]*") are positive and statistically significant at the 1% level. The positive interaction term suggests that tax reform exerts a higher effect on trade openness in LDCs than in non-LDCs (countries of the full sample that are not classified as LDCs). These two results reveal that the magnitude of the net effect of tax reform on trade openness in LDCs is 0.979 (=0.463+0.516), whereas

it is 0.463 for non-LDCs. In other words, a 1% increase in the index of tax reform is associated with a 0.98% increase in the level of trade openness in LDCs and a 0.46% increase in the level of trade openness in non-LDCs. With few exceptions, the results of the control variables in column [3] of Table 2 are similar to those in column [1].

Let us now examine results in column [4] of Table 2. Note that these results aim to investigate the extent to which the effect of tax reform on trade openness (*OPENSW*) depends on countries' development level proxied by their real per capita income. Two coefficients are important to respond to this question: the coefficient of the variable *TAXREF* and the coefficient associated with the interaction variable *[Log(TAXREF)]*[Log(GDPC)]*. Specifically, we observe that *TAXREF* is positive and statistically significant at the 1% level, and the interaction term is negative and statistically significant at the 1% level. The combination of these two results suggests that there is a turning point of the real per capita income above which the effect of tax reform on trade openness becomes negative; otherwise, it is positive. This turning point amounts to 49618.6 US dollars [= exponential (0.0440/0.00608)]. This threshold of the real per capita income is far higher than the maximum value of countries' real per capita in the full sample (i.e., 14018.6 US dollars). Thus, irrespective of the development level of countries, tax reform always induces higher degree of trade openness. Further, the lower the development level, the higher is the magnitude of the positive effect of tax reform on trade openness. In other words, less advanced developing countries (including the poorest countries) experience a higher positive effect of tax reform on trade openness than relatively advanced developing countries do. Figure 2 confirms this finding by illustrating the developments of the marginal impact of tax reform on trade openness for different countries' development levels at the 95% confidence intervals. This marginal impact is always positive and statistically significant, but it decreases as the real per capita income increases. This signifies that less developed countries enjoy a higher positive effect of tax reform on trade openness than relatively advanced developing countries do.

VII. Conclusion

This article examined the effect of tax reform on trade openness using an unbalanced panel dataset containing 92 developing countries, covering 1980 to 2014. The empirical analysis was conducted using an indicator of tax reform that captures the extent to which a developing country's tax structure converges toward developed countries' tax structure.

Over the full sample, the results suggest that tax reform is positively associated with trade openness. In addition, less advanced developing countries (such as poor countries) experience a higher positive effect of tax reform on trade openness than relatively advanced developing

countries do. Overall, these findings suggest the tax (transition) reform in developing countries, including in poor countries, would increase their level of trade openness. The benefits of trade openness, including when accompanied by complementarity policies, have been well established in the literature (e.g., Chang *et al.* 2009). Therefore, measures that contribute to greater trade openness, while also mitigating its adverse effects on the economy, should be promoted. Governments in developing countries should pursue tax transition reforms, especially with the assistance of relevant international institutions, such as the IMF, the World Bank, and the United Nations. An avenue for future research could be to propose another indicator of tax "transition" reform, which would accurately reflect the governments' will to implement tax transition reform (*de jure* tax reform) and the extent of such tax reform. We note that this would be a challenging task.

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Appendix 1. Definition and source of variables

Variables	Definition	Sources
OPENSW	Measure of trade openness suggested by Squalli and Wilson (2011). It is calculated as the measure of trade openness (the variable "*OPEN*" previously described) adjusted by the proportion of a country's trade level relative to the average world trade (see Wilson 2011, p1758).	Authors' calculation based on data extracted from the WDI
OPEN	Measure of trade openness (de facto trade openness). It is calculated as the sum of exports and imports, in % GDP	WDI
TAXREF	This is the index of tax (transition) reform. Higher values of this indicator reflect greater extent of tax reform, while lower values of this index indicate lower extent of tax reform.	See the description of this indicator in Section
TRJURE	Measure of De jure trade openness. It is in fact an indicator of De Jure measure of trade globalization, which has been calculated as a weighted index of trade regulations, trade taxes, tariffs, and trade agreements developed (see Dreher 2006 and Gygli *et al.* 2019).	See the database and other information online at: https://www.kof.ethz.ch/en/forecasts-and-indicators/indicators/kof-globalisation-index.html
GDPC	GDP per capita (constant 2010 US dollars)	WDI
NAT	Net Aid Transfers (*NAT*), in Constant 2015 US dollars prices. This is the net Official Development Assistance (ODA), from which are subtracted principal payments are received on ODA loans, interest received on such loans and debt relief.	*NAT* data (in current prices) are extracted from the database compiled by David Roodman (see online: http://davidroodman.com/data/)
FINDEV	Proxy for financial development. It is measured by the domestic credit to private sector by banks (% of GDP).	WDI
CAGDP	Current account balance (% of GDP)	WDI
INFL	The variable "*INFL*" has been calculated using the following formula (e.g., Yeyati *et al.* 2007): $INFL = sign(INFLATION) * \log(1 + |INFLATION|)$ (2), where $|INFLATION|$ refers to the absolute value of the annual inflation rate (%), denoted "*INFLATION*". The annual inflation rate (%) is based on Consumer Price Index -CPI- (annual %) where missing values has been replaced with values of the GDP Deflator (annual %).	Authors' calculation based on data from the WDI.
Proxy for the Institutional Quality (POLITY2)	Index extracted from the Polity IV Database (Marshall and Jaggers 2009). It represents the degree of democracy based on competitiveness of political participation, the openness and competitiveness of executive recruitment and constraints on the chief executive. Its values range between -10 and +10, with lower values reflecting autocratic regimes, and greater values indicating democratic regimes.	Polity IV Database (Marshall and Jaggers, 2009)
POP	Total Population	WDI

Appendix 2. Standard descriptive statistics on the variables used in the analysis

Variable	Observations	Mean	Standard deviation	Minimum	Maximum
OPENSW	581	0.001	0.003	0.000	0.038
OPEN	584	71.906	34.248	9.106	229.638
TAXREF	479	59.264	15.077	8.838	96.854
TRJURE	610	40.401	16.291	8.283	88.762
GDPC	599	2609.250	2632.648	151.102	14018.550
NAT	599	4.79e+08	5.07e+08	30000	3.83e+09
FINDEV	573	24.634	21.079	0.335	146.545
POLITY2	597	1.277	6.129	-10.000	10.000
CAGDP	531	-4.514	8.554	-46.448	39.207
INFLATION	602	74.106	447.608	-3.016	6424.987
POP	629	4.25e+07	1.57e+08	297661.8	1.32e+09

Appendix 3. List of countries in the full sample

Full Sample				LDCs	
Albania	Dominican Republic	Lebanon	Paraguay	Angola	Niger
Algeria	Ecuador	Lesotho	Peru	Bangladesh	Rwanda
Angola	El Salvador	Liberia	Philippines	Benin	Senegal
Armenia	Fiji	Madagascar	Romania	Bhutan	Sierra Leone
Azerbaijan	Gabon	Malawi	Rwanda	Burkina Faso	Tanzania
Bangladesh	Gambia, The	Malaysia	Senegal	Burundi	Timor-Leste
Benin	Georgia	Mali	Serbia	Cambodia	Uganda
Bhutan	Ghana	Mauritania	Sierra Leone	Central African Republic	Zambia
Bolivia	Guatemala	Mauritius	South Africa	Chad	
Botswana	Guinea	Mexico	Sri Lanka	Congo, Dem. Rep.	
Brazil	Guinea-Bissau	Moldova	Suriname	Gambia, The	
Bulgaria	Guyana	Mongolia	Swaziland	Guinea	
Burkina Faso	Haiti	Montenegro	Tajikistan	Guinea-Bissau	
Burundi	Honduras	Morocco	Tanzania	Haiti	
Cambodia	India	Mozambique	Thailand	Lao PDR	
Cameroon	Indonesia	Namibia	Timor-Leste	Lesotho	
Cape Verde	Iran, Islamic Rep.	Nepal	Tunisia	Liberia	
Central African Republic	Jamaica	Nicaragua	Turkey	Madagascar	
Chad	Jordan	Niger	Uganda	Malawi	
China	Kazakhstan	Nigeria	Ukraine	Mali	
Congo, Dem. Rep.	Kenya	Pakistan	Venezuela, RB	Mauritania	
Congo, Rep.	Kyrgyz Republic	Panama	Zambia	Mozambique	
Costa Rica	Lao PDR	Papua New Guinea	Zimbabwe	Nepal	