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Taxation and Income Inequality in Developing Countries: An Empirical Investigation

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Abstract

This paper studies the relationship between taxation and income inequality in 46 Developing countries. The research takes an empirical approach to analyze the effects of taxes revenue, taxes on goods and services, taxes on income, profits, and capital gains and taxes on international trade on income inequality. Mobilizing a dynamic panel data over the period 2000–2012 and using the system GMM estimator to address endogeneity issues, the econometric results yield that (i) there is a negative and robust relationship between taxes revenue and income inequality (ii) there is a positive and robust relationship between taxes on goods and services and taxes on income, profits, and capital gains and income inequality (iii) there is a positive relationship between taxes on international trade and income inequality. To allow the marginal effect of one explanatory variable to depend upon the level of another explanatory variable, the study further incorporates interaction terms of taxes and governance variables in the model and analyses there effect on income inequality.

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1. Introduction

There is growing consensus that assessments of economic performance should not focus solely on overall income growth, but also take into account income distribution. Some see poverty as the relevant concern while others are concerned with income inequality more generally. Following Musgrave (1959), taxation plays various roles as stabilization, allocation, and distribution. Particularly, taxation is relevant for addressing economic inequalities… (Stewart and Venugopal, 2009).

Sure enough, taxes can affect the income distribution in two ways: first, through the government budget whereby the government imposes taxes on people via income resources inserted in the annual budget and spends the tax revenues derived in accordance with the relevant laws and regulations; second, through taxation of economic performance resulting in changes in the income of owners of production factors via changes in the transaction relations among various production sectors. However, the impact of various tax categories on the income distribution depends on the extent to which tax burden may be transferred.

Theoretically, a direct taxation system with progressive rates has more impacts on income redistribution while an indirect taxation system, due to its direct influence on the household consumption, can affect the income distribution and the income transfer from higher classes to lower ones providing that: first there is a complete awareness about the process of indirect tax transfer and the extent to which various factors are affected by it, and second the consumers of any particular product and the individuals' levels of income are clearly identified. Nevertheless, it is worth mentioning that a progressive income tax system may impose a heavier tax burden on high-income individuals and decrease inequality in the income distribution, but if the final tax rate is very high, it may even give rise to inequality due to the impacts of taxes on production, goods supply, work supply, savings, etc. In addition, for many Developing countries, inequality is a structural problem and in many cases, taxes neither affect substantially income redistribution, nor play any roles in income generation.

Following Prasad (2008), there are four major reasons why Developing countries rely more heavily on indirect taxes than direct taxes. First, given their low income levels, the tax base is relatively small, and therefore indirect taxes represent an easier way to collect government revenue. Second, the efficiency of tax collection in Developing countries is often poor. Third, tax evasion is high. And fourth, Developing countries have a large informal sector which does not pay income taxes. Together these reasons often make indirect taxation more attractive for Developing countries.

Generally speaking, the existing empirical evidence both in Developed and Developing countries indicate that overall impacts of taxes on income distribution are generally limited and that even fundamental changes in the tax structures have little distributive impacts. On the contrary, distributive impacts of public expenses especially targeted social costs may have positive major impacts on justice and as such, they can decrease poverty (Chu et *al*., 2002). Nevertheless, the distributive impact of taxes on income distribution is a tax-relevant question, especially in the areas of tax occurrence and tax justice. As Bird (2005) suggests, the issues related to income distribution not only are relevant to tax policy, but also they affect the minds of policy makers in this regard (vertical and horizontal justice). In fact, a proper understanding of distributive impacts of ordinary taxes and their different dimensions can be helpful in moving towards justice-oriented tax systems, without sacrificing the efficiency (Askari, 2011).

Taxation is one of the few ways in which the wealthy may be made less wealthy, short of outright confiscation. But taxes have likely had only moderate success in reducing income inequality in Developed countries and appear to have had even less success in reducing income inequality in Developing countries. The major tax instruments for achieving progressivity are the individual income tax and various wealth taxes (such as taxes on real property, taxes on personal assets, and inheritance taxes). None of these taxes has been particularly effective in Developing countries in reducing income inequality.

Several reasons exist why Developing countries are less capable of using the tax system to redistribute income. First, income and wealth taxes play a relatively small role in the tax structure of Developing countries as compared to Developed countries. In those Latin American countries for which data are available, for example, personal income taxes collect much less than 1 percent of GDP. Second, the

individual income tax in Developing countries is often merely a wage withholding tax. In many countries, taxes on labor in the formal sector comprise over 90 percent of the total individual income tax revenue. In some countries, the tax law does not reach some forms of income from capital, such as capital gains. In other countries, the limitations of tax administrations may effectively exempt certain types of income from tax (for example, income from passive assets held outside the country). The limited ability of the individual income tax to tax effectively income from most forms of capital means that it is unlikely that the very rich bear significant tax liability. Third, it may of course be politically difficult to impose effective income tax and wealth taxes in many countries. It may be acceptable to pass tax legislation that is in theory progressive but in practice does not impose significant tax liability on the upper classes. The appearance of progressivity may be necessary for the tax system to be politically acceptable even if the reality of effective progressivity is not, in the end, acceptable.

The study of impacts of macroeconomic variables on income distribution through reviewing the impact of economic growth on income is founded by Kuznets (1955)[1]. Sure enough, his studies show that in initial stages of economic growth, income distribution is unequal but in the long-run, this inequality decreases as the economic growth keeps increasing. This finding was later on supported or rejected by many researchers and finally, following the extension of the research literature, the role of governments was highlighted. Following Jarjarzadeh and Eqbali (2005), the governments can give rise to the difference between income classes by accepting various expenses or may affect income distribution through their revenues in the form of taxes or transfer payments; the arguments for the role of taxes in income redistribution have been raised due to this issue.

The political economy literature has long established a reverse relationship between income inequality and taxes (Meltzer and Richard 1981; Persson and Tabellini 2002). Also, much of the empirical work that examines the effect of income inequality on economic growth argues that inequality affects growth through its effect on taxes and redistribution, (Barro 2000; Milanovic 2000; Perotti 1992; Persson and Tabellini 1994). The general argument, based on the median voter hypothesis, is that as the ratio of median income to mean income falls (that is-to-say inequality increase), the median voter will vote for higher taxes and greater redistribution. Therefore, greater income inequality should lead to greater progressivity. Duncan and Sabirianova (2008) as for them look at the effect of the structural progressivity of national income tax system on income inequality by using a detailed personal income tax schedules for a large panel of countries over 1981-2005. By developing an estimate comprehensive time varying measures of structural progressivity of national income tax systems they found that while progressivity reduced observed disparity in reported gross and net income, it had a statistically significant smaller effect on the correct inequality estimated by consumer based measures of Gini coefficient. Furthermore, the study suggests also that under some certain conditions, tax productivity may improve actual income inequality mostly in countries with weak law and order and large informal non taxable sector. Martinez-Vazquez et *al*. (2010) study the impact of direct versus indirect taxes on income inequality for 116 Developed, Developing and Transitional countries over the period 1972-2005. By using the two stages least square procedure in the data estimation to control for potential reverse causality of some of the variables, the results yield that the effect of tax ratio to income inequality is a function of the size of the taxation system. , there was positive effect on income inequality. The results also suggest a positive effect on income inequality in countries with small tax system, but a negative effect in countries with larger size taxation system. However, for the full sample studied, the tax mix had negative effect on the Gini coefficient thereby reducing income inequality in countries with share of total tax to GDP larger than (0.29). Furthermore, for the sub-sample of Developing countries, there was no statistically significant effect of tax mix on income inequality. In sum and according to them, the result conformed to existing evidence of low impact of tax systems on distribution of income for Developing countries. Krever and Zhang (2011) as for them investigate progressive income taxation and urban individual income inequality in China. Their study suggests that China had not been able to use personal income tax to effectively redistribute income. For them, it would be likely that significant reform of the personal income tax law and administration would be required for income tax to be meaningful on income redistribution in China. Moreover, Askari (2011) studies the impacts of tax revenues on income

[1] Cevik and Correa-Caro (2015) find evidence supporting the hypothesis of the existence of a Kuznets curve—an inverted Ushaped relationship between income inequality and economic development—in China and the panel of BRIC+ countries.

distribution in Iran over the period 1971-2010 by employing an Auto Regressive Distributed Lag (ARDL) methodology. The results obtained suggest that direct taxes affect income distribution negatively due to tax evasion issues while indirect taxes have a positive impact on income distribution. In a more recent study, Giovanni (2012) investigates inequality trends and their determinants using data from Latin America from 1990 to 2010. The least square dummy variable estimator was employed in the study. It was observed in the model that changes in the explanatory variables accounted for 64% variation in the inequality over 2002 to 2009 while in the GMM, it reduced to 35%. In the LSDV model, it was observed that GDP per capital had a negative but non-significant effect on inequality. The ratio of direct to indirect tax revenue was found to be strongly significant and negatively related to income inequality in all the models considered.

In this paper, we seek to determine, empirically, the relationship between taxes (taxes revenue, taxes on goods and services, taxes on income, profits, and capital gains and finally taxes on international trade) and income inequality in 46 Developing countries by mobilizing a dynamic panel data over the period 2000–2012 and using the system GMM estimator to address endogeneity issues. We also analyze the combined effects of these taxes to the governance control variables (voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law and control of corruption) on income inequality.

The paper is organized as follow. The next section presents the model of this study. Section 3 presents the data while section 4 describes the estimation method. Section 5 presents the estimation results and section 6 concludes the paper.

2. Model

We use dynamic panel data model to capture the effects of taxes on income inequality in 46 Developing countries. Thus, we develop an econometric model in which the characteristics of each country are modeled as specific effects which are here unobservable variables, constants in time and expected to affect their behavior. Taking into account the sources of unobserved heterogeneity allows completing heterogeneity carried by the observable variables included in the model. The regression model which we estimate can be written as follows:

$$\begin{aligned} Giniindex_{it} = {} & \alpha Giniindex_{it-1} + \gamma_1 Taxrev_{it} + \gamma_2 Taxrev_{it}^2 + \delta_1 Taxgs_{it} + \delta_2 Taxgs_{it}^2 \\ & + \psi_1 Taxipc_{it} + \psi_2 Taxipc_{it}^2 + \phi_1 Taxit_{it} + \phi_2 Taxit_{it}^2 + \beta x_{it} + \mu_i + \lambda_t + \varepsilon_{it} \end{aligned} \quad (1)$$

where $Giniindex_{it}$ is the variable of income inequality, $Taxrev_{it}$ the taxes revenue, $Taxgs_{it}$ the taxes on goods and services, $Taxipcg_{it}$ the taxes on income, profits and capital gains, $Taxit_{it}$ the taxes on international trade, x_{it} the vector of explanatory variables. The μ_i terms are fixed country effects (unmeasured shocks). The λ_t terms are sample-wide period effects (temporal specific effect). The error ε_{it} terms are idiosyncratic distributions which vary by country and over time and are assumed to be *iid* (independent and identically distributed) with zero mean and a variance equal to σ_ε^2. As already noted *i* and *t* respectively represent the country index and the time index. α, γ_1, γ_2, δ_1, δ_2, ψ_1, ψ_2, ϕ_1, ϕ_2 and β are the parameters to be estimated.

3. Data

We use available dynamic panel data of 46 Developing countries observed over the period 2000-2012 to analyze the effects of taxation on income inequality. The data are annual and come from the *Worldwide Governance Indicators* of the World Bank and the statistics tables of the World Bank. Table 1 in appendix A shows a summary description of the variables. Appendix A contains also a variable description with their sources (table 2). Figures 1 to 4 in appendix B present the plots as descriptions of the data. Further, a list of the 46 Developing countries (18 of Africa, 14 of Asia, 8 of Europe and 6 of America) included in this study is presented in appendix D.

The GINI coefficient which is the dependent variable in this study is a widely used statistic for measuring inequality. It is derived from the Lorenz curve and defined as the ratio of the area between the Lorenz curve and the perfect equality line. The Lorenz curve plots the relation between the cumulative percentage of the population and the proportion of total income earned by each cumulative percentage. The dependent variable is the GINI coefficient; a common measure of inequality that varies from 0 to 1, where 0 presents perfect equality and 1 perfect inequality. As it is stated in Duro (2004) "the GINI coefficient is more sensitive to the income changes occurred at the middle of the income distribution, treating symmetrically the lower and the upper tails of the incomes ranking" (Thalassinos et *al*., 2012). The GINI coefficient data are mostly sparse for a number of the countries in our sample. Some countries either have one income base or they have both but only for some years. Furthermore, there are a number of countries for which GINI index data is only available for few years.

The explanatory variables include the interest variables of this study and the control variables. The CPI inflation and its squared and lagged represent the interest variables of this study and others variables are the control variables namely GDP per capita, unemployment, trade openness, voice and accountability, political stability, governance effectiveness, regulatory quality, rule of law and corruption.

4. Estimation methods

The econometric methodology used in this paper to assess the empirical link between taxes and income inequality is those of the dynamic panel data like in Nantob (2015). The lagged levels of the regressors sometimes are poor instruments for the first-differenced regressors. Thus, to derive more general conclusions about the relationship between taxes and income inequality in Developing countries, we use the system GMM approach of Blundell-Bond. The Blundell-Bond methodology specifies a dynamic model which allows for time-invariant country-specific effects, which is plausible in the case of inequality analysis, given that many variables outside the analysis exhibit minimal variation over time. This methodology allows controlling individual and temporal specifics effects with short-term dynamics and solving variables endogeneity bias, simultaneous bias, inverse causality and omitted variables problems and provides more precise estimates of the effects of taxes on income inequality in Developing countries.

The system GMM estimator uses the level equation (for example equation (1)) to obtain a system of two equations: one differenced (see equation (2) below) and one in level. By adding the second equation, additional instruments can be obtained. Thus, the variables in levels in the second equation are instrumented with their own first differences. This usually increases efficiency.

$$\begin{aligned} Giniindex_{it} - Giniindex_{it-1} = {} & \alpha\left(Giniindex_{it-1} - Giniindex_{it-2}\right) + \gamma_1\left(Taxrev_{it} - Taxrev_{it-1}\right) \\ & + \gamma_2\left(Taxrev_{it}^2 - Taxrev_{it-1}^2\right) + \delta_1\left(Taxgs_{it} - Taxgs_{it-1}\right) \\ & + \delta_2\left(Taxgs_{it}^2 - Taxgs_{it-1}^2\right) + \psi_1\left(Taxipc_{it} - Taxipc_{it-1}\right) \\ & + \psi_2\left(Taxipc_{it}^2 - Taxipc_{it-1}^2\right) + \phi_1\left(Taxit_{it} - Taxit_{it-1}\right) \\ & + \phi_2\left(Taxit_{it}^2 - Taxit_{it-1}^2\right) + \beta\left(x_{it} - x_{it-1}\right) + \left(\lambda_t - \lambda_{t-1}\right) + \left(\varepsilon_{it} - \varepsilon_{it-1}\right) \end{aligned} \quad (2)$$

The first difference eliminates countries specific effect and consequently the bias of time invariant omitted variables. By construction, the term $\left(\varepsilon_{it} - \varepsilon_{it-1}\right)$ is correlated with the lagged variable in difference $\left(Giniindex_{it-1} - Giniindex_{it-2}\right)$. The first differences of the explanatory variables are instrumented by the lagged values (in level) of those same variables. The objective is to reduce the simultaneous bias and the bias due to presence of the lagged dependent variable in difference at the left of equation (2). There are some statistical shortcomings to a straightforward instrumental variables estimation of the above equation, namely that in a small sample with some persistent explanatory variables, lagged levels make weak instruments for the regression when run in differences. Asymptotically, the variance of the coefficients would rise and coefficients could be biased. To address this weakness, Blundell and Bond (1998) developed the system GMM dynamic model, which combines the regression in first differences above with an estimation run in levels, using both lagged levels and lagged differences as instruments. It was shown that

using the system GMM would substantially gain efficiency under certain conditions. Thus, Blundell and Bond (1998) showed using Monte Carlo simulations that the system GMM estimator is more efficient than in first differences, it gives biased results in finished samples when the instruments are weak. OLS results are presented alongside fixed- and random-effects GLS estimations, as well as the Blundell-Bond GMM results.

Equation in first difference (equation 2) is estimated simultaneously with equation in level (equation 1) by the GMM. In the equation in level, the variables are instrumented by their first differences. At this level, only the more recent first difference is used. Using other lagged firsts differences result in redundancy of moments' conditions (Arellano and Bover, 1995). Blundell and Bond (1998) tested this method with the simulations of Monte Carlo. They found that the GMM estimator in system is more efficient than GMM estimator in differences. The latter produces the biased coefficients for small samples. Bias is as much more important than the variables are persistent in time, the specific effects are important and the temporal dimension of the panel is weak.

For equation in level, one uses additional moments' conditions supposing that the explanatory variables are stationary.

$$\mathbb{E}\left[\left(Giniindex_{it-\tau} - Giniindex_{it-\tau-1}\right)\cdot\left(\mu_i + \varepsilon_{it}\right)\right] = 0 \quad \text{for} \quad \tau = 1 \tag{3}$$

$$\mathbb{E}\left[\left(Taxrev_{it-\tau} - Taxrev_{it-\tau-1}\right)\cdot\left(\mu_i + \varepsilon_{it}\right)\right] = 0 \quad \text{for} \quad \tau = 1 \tag{4}$$

$$\mathbb{E}\left[\left(Taxrev^2_{it-\tau} - Taxrev^2_{it-\tau-1}\right)\cdot\left(\mu_i + \varepsilon_{it}\right)\right] = 0 \quad \text{for} \quad \tau = 1 \tag{5}$$

$$\mathbb{E}\left[\left(Taxgs_{it-\tau} - Taxgs_{it-\tau-1}\right)\cdot\left(\mu_i + \varepsilon_{it}\right)\right] = 0 \quad \text{for} \quad \tau = 1 \tag{6}$$

$$\mathbb{E}\left[\left(Taxgs^2_{it-\tau} - Taxgs^2_{it-\tau-1}\right)\cdot\left(\mu_i + \varepsilon_{it}\right)\right] = 0 \quad \text{for} \quad \tau = 1 \tag{7}$$

$$\mathbb{E}\left[\left(Taxipc_{it-\tau} - Taxipc_{it-\tau-1}\right)\cdot\left(\mu_i + \varepsilon_{it}\right)\right] = 0 \quad \text{for} \quad \tau = 1 \tag{8}$$

$$\mathbb{E}\left[\left(Taxipc^2_{it-\tau} - Taxipc^2_{it-\tau-1}\right)\cdot\left(\mu_i + \varepsilon_{it}\right)\right] = 0 \quad \text{for} \quad \tau = 1 \tag{9}$$

$$\mathbb{E}\left[\left(Taxit_{it-\tau} - Taxit_{it-\tau-1}\right)\cdot\left(\mu_i + \varepsilon_{it}\right)\right] = 0 \quad \text{for} \quad \tau = 1 \tag{10}$$

$$\mathbb{E}\left[\left(Taxit^2_{it-\tau} - Taxit^2_{it-\tau-1}\right)\cdot\left(\mu_i + \varepsilon_{it}\right)\right] = 0 \quad \text{for} \quad \tau = 1 \tag{11}$$

$$\mathbb{E}\left[\left(x_{it-\tau} - x_{it-\tau-1}\right)\cdot\left(\mu_i + \varepsilon_{it}\right)\right] = 0 \quad \text{for} \quad \tau = 1 \tag{12}$$

Moments' conditions above (equations 3 to 12) associate with GMM allow estimating the coefficients of the model. To test the validity of the lagged variables as instruments, Arellano and Bond (1991), Arellano and Bover (1995), and Blundel and Bond (1998) suggest overidentified test of Sargent/Hansen. By construction, the error term in first difference is correlated yields first order conditions, but it must not been to the second order. To test this hypothesis, these same authors suggest a second order autocorrelation test.

Further, we used different approaches to test the robustness of the results. Indeed, the hypothesis of non autocorrelation in the regression model of the errors terms is essential so that the GMM estimator is efficient. Arellano and Bond (1991) proposed a test which allows verifying the absence of first and second order autocorrelation. Thus, if there is absence of autocorrelation in the distribution of errors terms, this test gives a negative and significant value of the differentiated residues in the first order and non significant in the second order. This test which is based on auto-covariance standardized average residues follows a normal law under the null hypothesis. By another way, the authors proposed the instruments validity test of Sargent. Thus, if the weighting matrix is optimally selected for a given instrument matrix, Sargent test statistics follows asymptotically a law of chi2 under the null hypothesis of the validities instruments. Hansen tests and the second order autocorrelation tests of Arellano and Bond in general, do not allow rejecting the hypothesis of the validity of lagged variables in level and in differences as instrument, and the hypothesis non autocorrelation in second order (see table 3 and 4 of appendix A). In general, the results of our estimations are robust to eliminate rigorously all bias due to the non observed individual heterogeneity and offer, consequently, a better efficiency of our estimations results.

5. Estimation results and interpretation

Table 5 in appendix A reports the results from the regression of the taxes and the income inequality of 46 Developing countries (see country list in appendix C). In this table, we have done eight (8) estimations. In table 6 of appendix A, we do the same thing as in table 5 but by adding the governance variables of the *Worldwide Governance Indicators* of the World Bank (voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law and control of corruption).

The level of the taxes revenue is negative and statistically significant in columns (3), (5), (6) and (7) of table 5 and in columns (1), (2), (6) and (7) of table 6. This suggests that there is a negative relationship between taxes revenue and income inequality. However, the level of the taxes on goods and services is positive and statistically significant in columns (1), (3), (4), (6) and (7) in table 5 and in columns (1), (2), (3), (6) and (7) in table 6. Moreover, the level of the taxes on income, profits, and capital gains is positive and statistically significant in columns (1) to (7) in table 5 and 6. The level of the taxes on international trade is positive and statistically significant in columns (6) and (8) in table 5 and in columns (1), (2) and (7) in table 6. This suggests that there is a positive relationship between taxes on goods and services, taxes on income, profits, and capital gains, taxes on international trade and income inequality. The squared terms of taxes revenue and taxes on international trade have negative, although insignificant coefficients in columns (8) of tables 5 and 6. However, the squared term of taxes on income, profits, and capital gains have positive, although insignificant coefficient in columns (8) of tables 5 and 6. The squared term of taxes on goods and services have negative, although insignificant coefficient in columns (8) of tables 5 and have positive, although insignificant coefficient in columns (8) of tables 6. The results suggest that at short and long runs the taxes revenue lower income inequality in Developing countries as these taxes increase. However, the results suggest also that at short and long runs the taxes on goods and services, the taxes on income, profits, and capital gains, the taxes on international trade increase income inequality in Developing countries as these taxes increase.

Concerning the control variables, the results suggest that there is a positive relationship between savings, government expenditures and income inequality in Developing countries. However, the results suggest that there is a negative relationship between investment, openness and income inequality in Developing countries. For the governance control variables, the results suggest that there is a positive relationship between political stability, corruption and income inequality in Developing countries. However, the results suggest that there is a negative relationship between rule of law and income inequality in Developing countries. Sure enough, the political stability and the corruption increase income inequality in Developing countries as these governance variables increases. The rule of law however lowers income inequality in Developing countries as this governance variable increase. Further, the study analyzes interaction between the governance control variables and taxes on income inequality[2]. Sur enough, the interaction between voice and accountability and taxes revenue contribute to reduce income inequality in Developing countries. However voice and accountability and taxes on goods and services increase income inequality in Developing countries. The interactions between political stability and taxes on income, profits and capital gains on the one hand and between taxes on international trade on the other hand both contribute to increase income inequality in Developing countries. The interaction between governance effectiveness and taxes revenue contribute to reduce income inequality in Developing countries. The interaction between rule of law and taxes revenue contribute to reduce income inequality in Developing countries. The interaction between corruption and taxes revenue contribute to reduce income inequality in Developing countries. The interactions between corruption and taxes on income, profits and capital gains contribute to increase income inequality in Developing countries. In general, the magnitude of the coefficients in columns (1) to (8) of the tables 5 and 6 is fairly stable across the different specifications.

6. Conclusion

Inequality can be addressed through taxation. This paper aims to provide some insights into the relationship between taxation of different sources of income and income inequality. We do so by study the effects of

[2] Models with interactions allow the marginal effect of one explanatory variable to depend upon the level of another explanatory variable (See Wooldridge, 2004).

four categories taxes namely taxes revenue, taxes on goods and services, taxes on income, profits, and capital gains and finally taxes on international trade on income inequality of 46 Developing countries by mobilizing a dynamic panel data over the period 2000–2012 and using the system GMM estimator to address endogeneity issues. Unlike many previous studies, we test a non-linear effect between taxes and income inequality by introducing in the model the squared terms of taxes and the results suggest and confirm a linear relationship between taxes and income inequality. Thus, at short and long runs the taxes revenue lower income inequality as these taxes increase. However, the taxes on goods and services, the taxes on income, profits, and capital gains, and the taxes on international trade increase income inequality at short and long runs as these taxes increase. Moreover, the results suggest a positive relationship between savings, government expenditures and income inequality. However, the results suggest a negative relationship between investment, openness and income inequality. Further, for the governance control variables, the results suggest a positive relationship between political stability, corruption and income inequality. Thus, the political stability and the corruption increase income inequality these governance variables increases. However, the results suggest a negative relationship between rule of law and income inequality. Thus, the rule of law however lowers income inequality as this governance variable increase. The study also suggests that the interaction between voice and accountability and taxes revenue contribute to reduce income inequality. However voice and accountability and taxes on goods and services increase income inequality. The interactions between political stability and taxes on income, profits and capital gains on the one hand and between taxes on international trade on the other hand both contribute to increase income inequality. The interaction between governance effectiveness and taxes revenue contribute to reduce income inequality. The interaction between rule of law and taxes revenue contribute to reduce income inequality. The interaction between corruption and taxes revenue contribute to reduce income inequality. The interactions between corruption and taxes on income, profits and capital gains contribute to increase income inequality.

Appendix

Appendix A: Tables

Table 1: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Gini index	181	40.08227	9.519379	24.24	67.4
Taxes revenue	181	15.58029	4.431435	6.90244	39.6604
Taxes on goods and services	181	35.40731	9.982875	10.6438	60.9443
Taxes on income, profits and capital gains	181	20.17919	11.61008	1.37515	54.7613
Taxes on international trade	181	8.371238	7.921301	-.002055	37.9768
GDP per capita	181	3590.028	3244.441	159.8314	15694.08
Inflation	181	10.51042	27.28686	-.845716	324.997
Savings	181	17.41432	10.04064	-7.61607	43.4219
Unemployment	181	8.634489	5.435561	1	32.3
Government expenditures	181	14.30729	5.334734	4.48365	42.5058
Investment	181	21.80168	5.317722	10.1411	39.7616
Openness	181	78.56446	35.94989	13.5026	210.374
Labor force growth	181	-.0119992	.0201968	-.077116	.109499
Initial level of gini index	181	40.16608	9.32156	27.32	63.9
Voice and accountability	181	-.177446	.7273322	-1.77032	1.15981
Political Stability and Absence of Violence	181	-.3454212	.8031049	-2.57102	1.18038
Governance effectiveness	181	-.2325859	.5545417	-1.65271	1.24741
Regulatory Quality	181	-.0822956	.5977503	-1.82574	1.31016
Rule of Law	181	-.383871	.5703964	-1.63315	.929167
Control of Corruption	181	-.3490496	.5591615	-1.5167	1.24467

Table 2: The sources of variables

Variable	Description	Source
Gini index	GINI index	WDI
Taxes revenue	Tax revenue (% of GDP)	WDI
Taxes on goods and services	Taxes on goods and services (% of revenue). These taxes include general sales and turnover or value added taxes, selective excises on goods, selective taxes on services, taxes on the use of goods or property, taxes on extraction and production of minerals, and profits of fiscal monopolies.	WDI
Taxes on income, profits and capital gains	Taxes on income, profits and capital gains (% of revenue). These taxes are levied on the actual or presumptive net income of individuals, on the profits of corporations and enterprises, and on capital gains, whether realized or not, on land, securities, and other assets.	WDI
Taxes on international trade	Taxes on international trade (% of revenue). These taxes include import duties, export duties, profits of export or import monopolies, exchange profits, and exchange taxes.	WDI
GDP per capita	GDP per capita (current US$)	WDI
Inflation (CPI)	Annual inflation (in %)	WDI
Savings	Gross domestic savings as a share of GDP, current prices (in %)	WDI
Unemployment	Unemployment, total (% of total labor force)	WDI
Government expenditures	General government final consumption expenditure as a share of GDP, current prices (in %)	WDI
Investment	Gross fixed capital formation as a share of GDP, current prices (in %)	WDI
Openness	Export and import as a share of GDP (in %)	WDI
Labor force growth	Labor force growth (in %)	WDI

Initial level of gini index	GINI index for the initial year of each subperiod	WDI
Voice and accountability	Reflects perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media.	WGI
Political Stability and Absence of Violence	Reflects perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including politically-motivated violence and terrorism.	WGI
Governance effectiveness	Reflects perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.	WGI
Regulatory Quality	Reflects perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.	WGI
Rule of Law	Reflects perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.	WGI
Control of Corruption	Reflects perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests.	WGI

Note: WDI and WGI are defining respectively as World Data Indicator and *Worldwide Governance Indicators* of the World Bank.

Table 3: Estimations robustness tests for Table 5

	Obs.	Test on AR(1)	Test on AR(2)	Sargent Test	Hansen Test
(1)	180	Z= -2.27 [0.023]	Z= -1.46 [0.145]	chi2(54)= 30.24 [0.996]	chi2(54)= 9.24 [1.000]
(2)	180	Z= -1.47 [0.141]	Z= -1.24 [0.216]	chi2(61)= 42.86 [0.962]	chi2(61)= 12.12 [1.000]
(3)	180	Z= -1.75 [0.080]	Z= -1.36 [0.172]	chi2(61)= 37.10 [0.993]	chi2(61)= 13.38 [1.000]
(4)	180	Z= -1.68 [0.092]	Z= -1.15 [0.248]	chi2(54)= 37.97 [0.952]	chi2(54)= 9.43 [1.000]
(5)	180	Z= -1.75 [0.081]	Z= -1.39 [0.166]	chi2(63)= 34.93 [0.998]	chi2(63)= 10.38[1.000]
(6)	180	Z= -0.33 [0.744]	Z= -1.09 [0.275]	chi2(65)= 66.10 [0.439]	chi2(65)= 8.68 [1.000]
(7)	180	Z= -1.73 [0.084]	Z= -1.26 [0.206]	chi2(63)= 36.94 [0.996]	chi2(63)= 10.75 [1.000]
(8)	180	Z= -1.95 [0.051]	Z= -1.20 [0.229]	chi2(78)= 72.52 [0.654]	chi2(78)= 3.75 [1.000]

Source: Author, based on the estimations.

Table 4: Estimations robustness tests for Table 6.

	Obs.	Test on AR(1)	Test on AR(2)	Sargent Test	Hansen Test
(1)	180	Z= -1.70 [0.090]	Z= -1.68 [0.092]	chi2(84)= 154.46 [0.000]	chi2(84)= 5.28 [1.000]
(2)	180	Z= -2.53 [0.011]	Z= -1.86 [0.063]	chi2(84)= 133.03 [0.001]	chi2(84)= 2.11 [1.000]
(3)	180	Z= -2.32 [0.020]	Z= -1.73 [0.083]	chi2(84)= 136.65 [0.000]	chi2(84)= 2.30 [1.000]
(4)	180	Z= -2.13 [0.033]	Z= -1.62 [0.104]	chi2(84)= 139.57 [0.000]	chi2(84)= 4.08 [1.000]
(5)	180	Z= -2.23 [0.026]	Z= -1.41 [0.160]	chi2(84)= 143.80 [0.000]	chi2(84)= 1.70 [1.000]
(6)	180	Z= -2.46 [0.014]	Z= -2.40 [0.016]	chi2(84)= 132.23 [0.001]	chi2(84)= 1.83 [1.000]
(7)	180	Z= -2.59 [0.010]	Z= -1.36 [0.172]	chi2(82)= 119.69 [0.004]	chi2(82)= 3.55 [1.000]
(8)	180	Z= -2.55 [0.011]	Z= -1.15 [0.249]	chi2(84)= 144.73 [0.000]	chi2(99)= 0.00 [1.000]

Source : Author, based on the estimations.

Table 5: Taxation and income inequality, one-step GMM estimates.

Gini index	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Gini index lagged (-1)	0.634	0.640	0.654	0.595	0.694	0.289	0.664	0.682
	(6.42)***	(5.47)***	(5.92)***	(6.17)***	(5.93)***	(2.25)**	(6.13)***	(7.40)***
Taxes revenue	**-0.290**	**-0.332**	**-0.357**	**-0.248**	**-0.389**	**-0.414**	**-0.362**	**0.286**
	(1.59)	**(1.52)**	**(2.02)****	**(1.65)**	**(2.19)****	**(2.08)****	**(2.12)****	**(0.42)**
Taxes revenue squared								**-0.011**
								(0.60)
Taxes on goods and services	**0.163**	**0.125**	**0.160**	**0.168**	**0.137**	**0.126**	**0.159**	**-0.214**
	(1.99)*	**(1.48)**	**(1.79)***	**(1.82)***	**(1.32)**	**(1.83)***	**(1.79)***	**(0.46)**
Taxes on goods and services squared								**0.004**
								(0.61)
Taxes on income, profits and capital gains	**0.205**	**0.224**	**0.200**	**0.217**	**0.193**	**0.174**	**0.201**	**0.091**
	(2.68)**	**(2.88)*****	**(2.75)*****	**(2.59)****	**(2.40)****	**(2.47)****	**(2.89)*****	**(0.30)**
Taxes on income, profits and capital gains squared								**0.002**
								(0.28)
Taxes on international trade	**0.082**	**0.134**	**0.113**	**0.182**	**0.035**	**0.207**	**0.120**	**0.516**
	(0.73)	**(1.07)**	**(0.88)**	**(1.41)**	**(0.23)**	**(2.29)****	**(0.96)**	**(1.76)***
Taxes on international trade squared								**-0.017**
								(1.37)
GDP per capita	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.61)	(1.10)	(0.44)	(1.19)	(0.02)	(1.60)	(0.60)	(1.68)*
Inflation		-0.091	-0.087	-0.093	-0.068	-0.087	-0.088	-0.037
		(1.43)	(1.51)	(1.61)	(1.12)	(1.83)*	(1.49)	(0.54)
Savings	0.144		0.123	0.105	0.105	0.107	0.127	0.009
	(2.67)**		(2.06)**	(1.46)	(1.62)	(2.10)**	(2.14)**	(0.14)
Unemployment	-0.023	0.011		-0.009	0.042	0.280	0.054	0.185
	(0.11)	(0.07)		(0.04)	(0.31)	(1.69)*	(0.41)	(1.50)
Government expenditures	0.141	0.277	0.249		0.378	0.192	0.239	-0.025
	(1.00)	(1.72)*	(1.97)*		(2.70)***	(1.89)*	(1.93)*	(0.18)
Investment	-0.254	-0.162	-0.203	-0.250		-0.202	-0.213	-0.251
	(1.81)*	(1.22)	(1.60)	(2.03)**		(2.04)**	(1.57)	(1.99)*
Openness	-0.043	-0.037	-0.037	-0.036	-0.047	-0.012	-0.036	-0.043
	(2.41)**	(1.76)*	(1.94)*	(1.60)	(2.04)**	(0.65)	(1.78)*	(2.24)**
Labor force growth	-11.460	-3.653	-8.780	-8.499	-14.429	1.841	-9.578	-14.471
	(0.49)	(0.16)	(0.39)	(0.33)	(0.57)	(0.09)	(0.39)	(0.67)
Initial level of gini index						0.499		
						(2.89)***		
Constant	12.689	11.981	10.815	14.716	5.799	3.587	10.124	15.502
	(1.67)	(1.51)	(1.39)	(2.49)**	(0.91)	(0.79)	(1.28)	(1.65)
F statistic	21.76	25.28	14.66	35.51	14.79	73.07	16.23	56.10
Observation	180	180	180	180	180	180	180	180
Number of countries	46	46	46	46	46	46	46	46

Notes: Significant levels: *** $p<0.01$; ** $p<0.05$; * $p<0.1$. Robust standards errors are in the brackets.

Table 6: Taxes and economic growth, accounting for various indicators of governance, one-step GMM estimates

Gini index	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Giniindex lagged (-1)	0.440	0.451	0.441	0.526	0.489	0.369	0.405	0.403
	(3.39)***	(4.83)***	(3.89)***	(5.13)***	(4.37)***	(3.72)***	(4.72)***	(4.46)***
Taxes revenue	**-0.601**	**-0.512**	**-0.391**	**-0.112**	**-0.458**	**-0.889**	**-0.579**	**-0.346**
	(1.89)*	**(1.68)***	**(1.35)**	**(0.39)**	**(1.20)**	**(2.47)****	**(2.39)****	**(0.40)**
Taxes revenue squared								**-0.013**
								(0.60)
Taxes on goods and services	**0.298**	**0.269**	**0.213**	**0.115**	**0.181**	**0.228**	**0.200**	**0.522**
	(3.61)***	**(2.03)****	**(1.69)***	**(1.28)**	**(1.28)**	**(2.29)****	**(2.88)*****	**(1.63)**
Taxes on goods and services squared								**-0.004**
								(1.06)
Taxes on income, profits and capital gains	**0.371**	**0.474**	**0.278**	**0.240**	**0.306**	**0.430**	**0.394**	**0.254**
	(2.94)***	**(3.29)*****	**(2.30)****	**(2.62)****	**(2.35)****	**(3.65)*****	**(3.84)*****	**(0.94)**
Taxes on income, profits and capital gains squared								**0.003**
								(0.62)
Taxes on international trade	**0.361**	**0.666**	**0.167**	**0.188**	**0.532**	**0.187**	**0.341**	**0.441**
	(1.79)*	**(3.70)*****	**(0.91)**	**(1.43)**	**(1.34)**	**(0.62)**	**(2.75)*****	**(1.44)**
Taxes on international trade squared								**-0.003**
								(0.25)
GDP per capita	0.000	-0.000	0.000	0.000	0.001	-0.000	0.000	0.000
	(1.31)	(0.24)	(0.75)	(0.30)	(1.50)	(0.58)	(0.09)	(0.15)
Inflation	-0.017	0.004	0.075	0.118	0.031	-0.032	0.057	0.024
	(0.29)	(0.07)	(1.20)	(1.93)*	(0.57)	(0.69)	(0.78)	(0.37)
Savings	0.063	0.115	0.062	0.067	0.075	0.109	0.099	0.069
	(0.91)	(1.68)*	(0.73)	(0.78)	(1.02)	(1.71)*	(1.53)	(1.26)
Unemployment	0.129	-0.054	-0.102	-0.083	0.059	-0.012	0.085	0.020
	(1.33)	(0.39)	(0.60)	(0.61)	(0.47)	(0.07)	(0.68)	(0.15)
Government expenditures	0.040	0.268	-0.056	0.122	-0.092	0.112	0.177	0.347
	(0.20)	(1.50)	(0.26)	(0.78)	(0.51)	(0.58)	(0.89)	(1.72)*
Investment	-0.392	-0.289	-0.389	-0.315	-0.510	-0.323	-0.286	-0.237
	(2.51)**	(2.21)**	(2.43)**	(2.61)**	(3.32)***	(2.15)**	(2.09)**	(1.58)

Openness	-0.025	-0.088	-0.080	-0.075	-0.047	-0.056	-0.063	-0.062
	(1.17)	(4.07)***	(2.31)**	(3.80)***	(1.47)	(2.37)**	(2.96)***	(2.86)***
Labor force growth	-11.240	-4.648	-20.017	-11.972	-23.517	1.055	20.277	33.088
	(0.49)	(0.27)	(0.94)	(0.58)	(0.82)	(0.06)	(1.03)	(1.72)*
Voice and accountability	**-0.645**						**-1.124**	**-1.467**
	(0.11)						**(0.63)**	**(0.88)**
Voice and accountability* Taxes revenue	**-0.450**							
	(2.30)**							
Voice and accountability* Taxes on goods and services	**0.165**							
	(1.75)*							
Voice and accountability* Taxes on income, profits	**0.189**							
	(1.51)							
Voice and accountability* Taxes on international trade	**0.080**							
	(0.41)							
Political Stability		**-3.289**					**3.067**	**2.737**
		(0.48)					**(1.82)***	**(1.76)***
Political Stability*Taxes revenue		**-0.219**						
		(1.22)						
Political Stability*Taxes on goods and services		**0.082**						
		(0.58)						
Political Stability*Taxes on income, profits		**0.284**						
		(2.05)**						
Political Stability*Taxes on international trade		**0.515**						
		(2.89)***						
Governance effectiveness			**11.254**				**2.361**	**1.406**
			(1.04)				**(0.58)**	**(0.45)**
Governance effectiveness* Taxes revenue			**-0.698**					
			(2.81)***					
Governance effectiveness* Taxes on goods and services			**-0.093**					
			(0.43)					
Governance effectiveness* Taxes on income, profits			**0.276**					
			(1.26)					
Governance effectiveness* Taxes on international trade			**0.014**					
			(0.05)					
Regulatory Quality				**9.658**			**0.972**	**1.877**
				(1.15)			**(0.42)**	**(0.89)**
Regulatory Quality* Taxes revenue				**-0.378**				
				(1.45)				
Regulatory Quality*Taxes on goods and services				**-0.179**				
				(1.19)				
Regulatory Quality*Taxes on income, profits				**0.214**				
				(1.42)				
Regulatory Quality* Taxes on international trade				**0.138**				
				(0.63)				
Rule of Law					**6.024**		**-8.192**	**-8.247**
					(0.70)		**(2.57)****	**(3.31)*****
Rule of Law*Taxes revenue					**-0.536**			
					(1.78)*			
Rule of Law*Taxes on goods and services					**-0.092**			
					(0.49)			
Rule of Law*Taxes on income, profits					**0.202**			
					(1.07)			
Rule of Law*Taxes on international trade					**0.481**			
					(1.07)			
Control of Corruption						**22.508**	**7.376**	**8.301**
						(2.10)**	**(2.62)****	**(3.20)*****
Control of Corruption* Taxes revenue						**-1.077**		
						(2.68)**		
Control of Corruption* Taxes on goods and services						**-0.094**		
						(0.79)		
Control of Corruption* Taxes on income, profits						**0.309**		
						(1.74)*		
Control of Corruption* Taxes on international trade						**-0.308**		
						(0.79)		
Constant	17.646	17.402	28.529	20.142	24.624	32.254	21.676	14.388
	(2.36)**	(2.19)**	(3.04)***	(2.44)**	(2.42)**	(3.22)***	(2.98)***	(1.35)
F statistic	66.10	185.14	475.80	400.42	233.46	148.46	655.37	358.96
Observation	180	180	180	180	180	180	180	180
Number of countries	46	46	46	46	46	46	46	46

Notes: Significant levels: *** $p<0.01$; ** $p<0.05$; * $p<0.1$. Robust standards errors are in the brackets.

Appendix B: Income inequality versus taxes in Developing countries

Figure 1: Income inequality versus taxes revenue in Developing countries

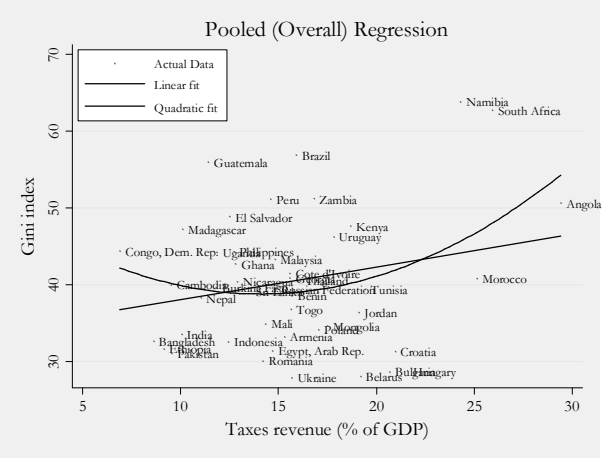


Figure 2: Income inequality versus taxes on goods and service in Developing countries

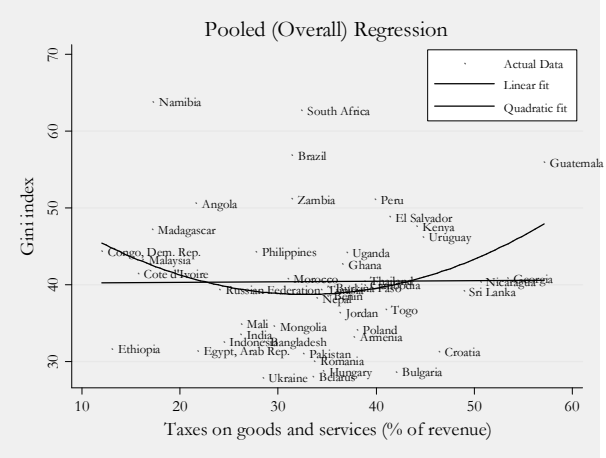


Figure 3: Income inequality versus taxes on income, profits and capital gains in Developing countries

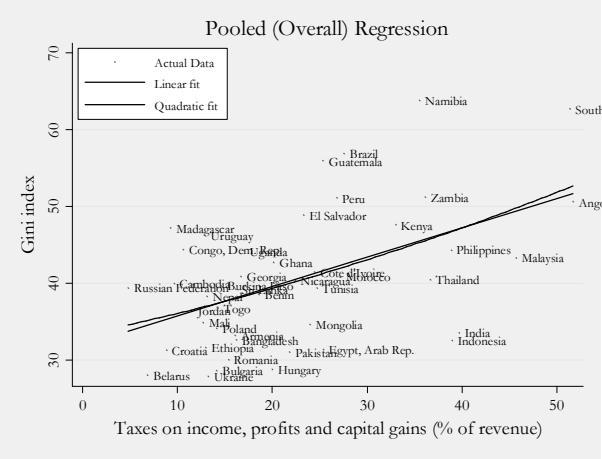
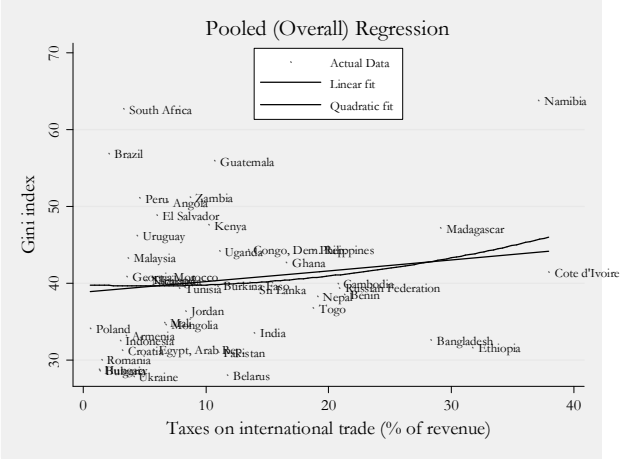


Figure 4: Income inequality versus taxes on international trade in Developing countries



Appendix D: Country list

Country	Number of observations	Percentage of the sample	Years included
Angola	2	1.10	2000, 2009
Armenia	7	3.87	2003-2008, 2010
Bangladesh	2	1.10	2005, 2010
Belarus	10	5.52	2000, 2002, 2004-2011
Benin	1	0.55	2003
Brazil	8	4.42	2002-2009
Bulgaria	2	1.10	2003, 2007
Burkina Faso	2	1.10	2003, 2009
Cambodia	4	2.21	2004, 2007-2009
Congo, Dem. Rep.	1	0.55	2006
Cote d'Ivoire	1	0.55	2008
Croatia	3	1.66	2000, 2004, 2008
Egypt, Arab Rep.	2	1.10	2005, 2008
El Salvador	8	4.42	2002-2009
Ethiopia	2	1.10	2005, 2011
Georgia	8	4.42	2000, 2002, 2003, 2006-2010
Ghana	1	0.55	2006
Guatemala	5	2.76	2000, 2002-2004, 2006
Hungary	4	2.21	2000, 2002, 2004, 2007
India	2	1.10	2005, 2010
Indonesia	3	1.66	2002, 2005, 2008
Jordan	4	2.21	2003, 2006, 2008, 2010
Kenya	1	0.55	2005
Madagascar	1	0.55	2005
Malaysia	3	1.66	2004, 2007, 2009
Mali	2	1.10	2006, 2010
Mongolia	2	1.10	2002, 2008
Morocco	1	0.55	2007
Namibia	1	0.55	2004
Nepal	2	1.10	2003, 2010
Nicaragua	1	0.55	2005
Pakistan	4	2.21	2002, 2005, 2006, 2008
Peru	10	5.52	2000, 2002-2010
Philippines	4	2.21	2000, 2003, 2006,2009
Poland	9	4.97	2002, 2004-2011
Romania	9	4.97	2002-2004, 2006-2011
Russian Federation	8	4.42	2002-2009
South Africa	3	1.66	2000, 2006, 2009
Sri Lanka	3	1.66	2002, 2007, 2010
Thailand	4	2.21	2006, 2008-2010
Togo	2	1.10	2006, 2011
Tunisia	3	1.66	2000, 2005, 2010
Uganda	3	1.66	2000, 2006, 2009
Ukraine	9	4.97	2002-2010
Uruguay	10	5.52	2000, 2002-2010
Zambia	4	2.21	2003, 2004, 2006, 2010

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