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The consequences of the value-added tax on inequality

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Abstract: The adoption of the value-added tax has arguably been one of the most important tax policy measures worldwide, but is also one of the most heatedly debated. While some argue that the VAT has served as a useful tool to boost government revenue, others claim that it is also a regressive tax, contributing to increased inequality within the developing world. Using newly released high-quality macro data, this paper offers updated estimates of the revenue impacts of the VAT and the first estimates on its consequences on inequality at the macro level. The results from instrumental variable estimations reveal that the revenue consequences of the VAT have not been positive, contrasting results from earlier work. VAT adoption has not led to increased inequality, suggesting that the move to the VAT has not undermined equitable development.

Keywords: tax policy, value-added tax, inequality, developing countries
JEL classification: H23, O23

Figures and tables: Provided at the end of the paper.

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1 Introduction

After the introduction of the personal income tax and income tax withholding, the value-added tax (VAT) stands out as one of the most important tax policy innovations.[1] The VAT has spread to a great majority of countries. The expansion of the VAT-club membership was strikingly fast in the developing world in the 1990s (see Figures 1 and 2). In many cases, the introduction of the VAT was accompanied by a reduction in customs duties and tariffs.

The benefits of the VAT can be manifold: cascading of indirect taxes is avoided, it is perhaps harder to evade than other forms of taxation, and it can easily be made compatible with international trade. In an empirical macro study by Keen and Lockwood (2010), it is found that the VAT is also a 'money machine': it has helped countries generate more revenues than they would have had without the VAT in place.

However, the suitability of the VAT for developing countries has been hotly debated. Emran and Stiglitz (2005) argue that with a large informal sector, the VAT could be inferior to border taxes, although Keen (2008) points out that this finding is subject to a major qualification that, in practice, the VAT is also collected on imports, and hence it operates in much the same way as import duties. In addition to this debate, the VAT is often seen as an inherently regressive tax. This view is especially prevalent among the representatives of NGOs. For example, a recent Oxfam report writes in its abstract: 'Tax policy in developing countries has been heavily influenced by the IMF and national elites. This has had a negative impact in many cases, with a focus on indirect regressive taxation like VAT, and extensive tax incentives for companies' (Itriago 2011).

Similar arguments have also been made by academics. Emran and Stiglitz (2007) argue that the tax reform policies that have reduced tariffs and shifted the burden towards the VAT have been undesirable from the equity point of view. According to them, the evidence points to the direction that the emphasis on uniform VAT is especially regressive. However, others have been more sceptical, including Bird and Zolt (2005) and Gemmell and Morrissey (2005), who point out that the border taxes that the VAT has replaced could well have been more regressive.[2]

Clearly, arguments made for both points of view can be valid: a strong reliance on the VAT is relatively regressive, if the alternative is to have a well-functioning progressive income tax. On the other hand, if the VAT indeed serves as a money machine and provides the government with more revenues, these revenues can also be used for financing transfers and the provision of (public) goods that can reduce inequality. The overall impacts of the VAT on inequality are, therefore, ambiguous in theory.

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[1] See Ebrill et al. (2001) for a broad overview of the VAT.

[2] They both survey incidence analyses of VAT and some excises and tariffs in individual developing countries. In Bird and Gendron (2007, Table 5.1), VAT is regressive in some countries and progressive in others. Unlike our paper, these studies do not examine the causal impact of VAT adoption on realized inequality.

The purpose of this paper is to shed light on this question, which is ultimately an empirical one, by estimating the causal impact of VAT adoption on inequality. We use newly released and high-quality data on taxation at the macro level, available from the ICTD Government Revenue Dataset (see Prichard et al. 2014). The data on inequality come from the World Income Inequality Database,[3] which is seen as providing a reliable database for cross-country income inequality comparisons (Jenkins 2015). In addition to explaining the impact of VAT adoption on inequality, we also update the analysis of the revenue consequences of the VAT in Keen and Lockwood (2010), using new data (where some problematic observations are replaced), corrected specifications, and observations for more than ten more years. While this is interesting in its own right, it is also closely linked with the inequality analysis. If it is indeed the case that the VAT leads to increased revenues, the government could use these revenues to improve public services, which would have an impact on people's wellbeing, but this would not be captured in the Gini index as the value of publicly provided goods is typically not included in the Gini measures.

We present both conventional fixed effect regressions and IV estimates. The idea in the latter is that VAT adoption has proceeded in waves (see again Figure 2), and therefore we can use the neighbouring countries' decision to adopt VAT as an instrument for the VAT in the country in question. This instrument is a strong determinant of VAT adoption in the first stage, whereas it hardly has any direct impact on inequality.[4]

The paper attempts to contribute to the surprisingly small body of academic economics research examining the VAT.[5] Related papers include Ebeke and Ehrhart (2011) who examine the impacts of the tax arrangement on the volatility of tax revenues in Africa, showing how a relatively large share of domestic indirect taxes have a stabilizing role in tax revenue collection. Ahlerup et al. (2015), also for African countries, continue this work and examine the impacts of VAT adoption on revenues. They find that the presence of a VAT has not increased revenues in African countries. In turn, Lee et al. (2013), using data on OECD countries, examine the impacts of the presence of a VAT on government revenues and the size of the government, demonstrating that the government size is hardly positively affected by the VAT. Finally, using worldwide data, Ufier (2014) investigates the impact of VAT adoption on a number of outcomes using a matching approach. He finds that the presence of the VAT has led to lower inflation and government spending and increased investment and growth.[6]

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[3] UNU-WIDER, World Income Inequality Database (WIID3.0b), September 2014.

[4] Lee and Gordon (2005) use a very similar instrument, the weighted averages of other countries' tax rates, in their analysis of the impacts of taxes on growth. A similar strategy is used in subsequent papers in the field of research on the macroeconomic effects of tax policy, see e.g. Gemmell et al. (2014) and Liu and Feng (2015). We also discuss potential threats for the identification strategy below.

[5] A search for 'value-added tax' in the title, abstract, or keywords in the top field journal, Journal of Public Economics, only found five hits for the period from the year 2000 to the present.

[6] Ufier (2014) uses a hazard model to predict the propensity score for the matching analysis. Such an approach is not feasible in our context: For the main analysis, we use five-year averaged data, which, combined with the practice in his paper where the match is not necessarily from the same year, implies that the time series we have is not sufficient for

More broadly speaking, our paper is related to the empirical analysis of tax systems in developing countries (for recent surveys, see Keen (2013) and Besley and Persson (2013)). Another strand of literature the paper is linked with is the cross-sectional analysis of the determinants of within-country inequality. The UNDP (2013) offers a broad overview and Hassine (2015) is an example of recent analysis, which also contains more references.

The paper proceeds as follows. Section 2 discusses the data and provides some descriptive evidence on tax policies, revenues, and inequality. Section 3 introduces the empirical methods. Section 4 presents the results on the impacts of the VAT on inequality, whereas Section 5 is devoted to the estimates of the revenue impacts of the VAT. Section 6 concludes.

2 Data and descriptive evidence

To maintain some degree of comparability between the Keen and Lockwood (2010) setting and ours, we keep the same country sample. This means exclusion of former Soviet Union countries which were left out from the Keen and Lockwood study due to the poor data quality and the fact that the VAT reform took place at the same time as wider structural reforms, which reduced the size of the public sector and most likely had an negative influence on governments' own revenue levels.

2.1 Data on measurement of inequality

The source of the data for inequality is the latest release of the World Income Inequality Database, the WIID. In constructing the WIID, much emphasis has been placed on making the data comparable across countries, and it is also based on actual observations, rather than imputations, which are used in some of the competing datasets. As the WIID gives researchers the possibility to select those inequality measures that best suit the research question at hand, Jenkins (2015) concludes that the WIID can be seen as a reliable source for cross-country information on inequality. We also follow the requirement by Jenkins and report our data selection algorithm in the Appendix (Table A1).

One of the main issues in working with inequality data is that in the developed world, inequality measures are typically income-based, whereas in most developing countries (apart from Latin America), Gini coefficients and other inequality measures refer to consumption inequality. Another issue is the fact that in developing countries, household surveys are not conducted every year. For this reason, using annual observations in a panel setting is not really feasible, and in all of the inequality analysis in this paper, we use data that is based on five-year averages. As usual, Gini values take values between 0-100.

What kind of inequality impacts can we measure with the data available? When measuring the share of indirect taxes paid out of total income, a common finding is that indirect taxation is seen as regressive, as the share of disposable income used for consumption (the base for indirect taxation) is

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building hazard models. Keeping the econometric approach fairly similar to that of Keen and Lockwood (2010) also has the virtue that our results are more easily comparable with that key paper in the literature.

greater for low-income households, i.e. the savings rate of high-income households is higher. This effect we cannot take into account, as the Gini index that is disposable income-based, is typically calculated in the underlying data as referring to direct taxes and transfers, whereas the consumption-based Gini takes into account the burden of indirect taxes out of consumption, not income.

What we can capture by the WIID data is the tax mix: if countries, when moving to a VAT, start to have a tax system that is more dependent on flat rate indirect taxes and less dependent on progressive direct taxes, this will be reflected as greater disposable-income inequality because of a smaller share of direct, progressive, taxes.[7] In the consumption-based Gini analysis, with sufficiently strong behavioural responses we can also detect some of the impacts of the differentiated VAT schedules. This can happen for instance if lower VAT rates on necessities are associated with a relative larger increase in the overall demand among low-income households. While not being able to measure the differences in tax incidence that arise from different savings rates is an important caveat to our analysis, one can also argue that the consumption based inequality measures give a better picture of long-term, lifetime differences in wellbeing.

The differences in ways of inequality measurement are taken into account by us by using constant within-country definition of inequality. When we combine the series for regression analysis, we control for the type of inequality index we use.[8] For a robustness check, we run both separate regressions for countries where inequality is measured using consumption and for countries for which inequality measures are based on income. For the latter, we choose to use the disposable income inequality figures.

2.2 Data on measurement of government revenues

Our main dataset regarding tax variables, such as overall tax revenues, is the Government Revenue Dataset, compiled by the International Centre for Taxation and Development (Prichard et al. 2014).[9] The main aim in developing the database was the need to unify the concepts used in cross-sectional data on fiscal issues, and expand the coverage of countries and tax instruments used. The main sources of the database are the IMF's Government Finance Statistics and the OECD tax statistics, as well as several regional organizations' data and IMF Article IV reports. The exact variables used in the analysis are described in Table A1 in the Appendix.

2.3 Control variables

Following Keen and Lockwood (2010), we add controls that are standard in models explaining aggregate government revenue. These include GDP per capita (YPC), the share of agriculture of GDP (AGR), and the share of the sum of imports and export of GDP (OPEN, measuring the

[7] Clearly the implications of the VAT on inequality also depend on what other taxes it replaces. If direct taxes are not an option, and the VAT only replaces other indirect taxes, then this channel is shut down.

[8] The within-country definition of inequality stays the same.

[9] Since we also have access to the original data used by Keen and Lockwood (2010), we check the robustness of our results for the years those data cover using the original revenue data.

openness of the trade). In addition, we control for the size of the country in population (POP), demographic variables (DEPOLD, DEPYOUNG), and an external pressure to increase government revenue which comes through being part of IMF crisis or non-crisis programmes. These variables are also one way to try to capture the impacts of other contemporaneous reforms that could also influence revenues and inequality. Further, a federal state dummy from Treisman (2002) is used to control for special issues which federal states are addressing with the adoption of the VAT. With the exception of index variables for VAT adoption and for IMF crisis and non-crisis countries the data for the control variables are extracted from the World Bank's World Development Indicators Database. Data for VAT adoption and IMF crisis/non-crisis countries come from IMF.

For inequality estimations, we apply some of the same controls (YPC, AG, OPEN, POP) used in the revenue estimations. In a developing country context, a smaller share of agriculture is expected to reduce income disparities. It might, however, work in a different direction when a country passes a certain development phase. This is shown in Asteriou et al. (2014) in an EU setting—the higher the share of agriculture, the lower the observed inequality of incomes. In standard trade theory (as the Stolper-Samuelson theorem points out), trade openness should lead to a reduction of income equality by reducing the wage gap between skilled and unskilled workers in countries with abundant unskilled labour. Using cross-section evidence, Wu and Hsu (2012) find an indication that international trade has an equalizing effect on income distribution. On the other hand, openness works also towards increasing wage gaps by increasing the differences in returns to education and skills. Kraay (2006) and Goldberg-Koujanou and Pavcnik (2007) found a strong positive link between trade openness and inequality. Population size is used to control for the size of the country.

We add some additional controls used in the literature, such as the share of urban population (URBAN) to capture the impact of urbanization on income inequality and variable capturing the depth of financial market (quasi-money M2/GDP) to account for the effects of the level of financial development on the Gini coefficient. Milanovic (2005) and Batuo et al. (2010) report a negative relationship between the depth of financial markets and inequality. Further, we also add a control for foreign direct investments (FDI) to capture the effect of financial globalization. The results in Asteriou et al. (2014) suggest that a high FDI/GDP ratio is associated with higher Gini coefficients in the EU context.

2.4 Some descriptive evidence

The development of the VAT adoption was already described in Figures 1 and 2. Here, we describe the evolution of other tax variables and developments regarding inequality.

Figure 3 reveals that while in some geographical areas within-country inequality has risen (notably in developing Asia), in others (notably in Latin America) it has fallen during the period we study. In Figure 4, the vertical line depicts the time of VAT adoption for each country. The chart suggests that, again, the picture is mixed. Inequality seems to have fallen in the time periods after the introduction of the VAT in most areas, but it has trended upwards in Asia and Latin America. This chart also suggests that there does not appear to be a clear break in the level of inequality series around the time of VAT adoption.

Turning to the development of government revenue, Figure 5 depicts the history of overall general government revenues in different regions of the world. The figure shows how developing countries have been able to raise their tax take from the 1990s to 2000 and 2010. Interestingly, the share of indirect taxation out of total government tax revenue has remained fairly stable (Figure 6).

Figure 7, which plots the revenue developments before and after VAT adoption, reveals that while the total government revenues have been on the rise throughout the period, the rise in the revenues was perhaps faster in some areas after the adoption of the VAT. Clearly this can happen also for other reasons than the presence of the VAT. Figures 8 and 9 provide similar graphs for the share of the indirect taxes out of total tax revenue. This share is, somewhat surprisingly, not consistently higher after the adoption of the VAT. The main reason for this is that the VAT has probably mainly replaced tariff revenue and import duties.

3 Empirical specifications

In the main equation, the dependent variable ($y_{i,t}$) is either the central government revenue (logged) or inequality, measured by the Gini coefficient. The model includes country fixed effects (α_i) and a set of control variables, $\boldsymbol{X}_{i,t}$. The main interest is on the coefficient of the VAT variable[10], β. Therefore, the regression equation is of the form

$$y_{i,t} = \alpha_i + \beta V_{i,t} + \gamma \boldsymbol{X}_{i,t} + \delta year_t + \varepsilon_{i,t}, \quad (1)$$

Where $year_t$ refer to a set of year dummies and $\varepsilon_{i,t}$ is the error term. Heteroscedasticity consistent standard errors are used throughout the study. In the case of Gini estimations, year dummies refer to dummies for the five-year periods.

The equation is estimated as LSDV model as well as fixed effects instrumental variables with the VAT variable instrumented, to take into account possibilities such as countries which will otherwise also invest in revenue raising are those that are most likely to introduce the VAT. As mentioned in the introduction, we use the presence of the VAT in the geographical neighbour countries as an instrument and construct two alternative ways to measure it. The first alternative instrument uses the annual share of countries in the region with the VAT in place ('NEIGHBOUR') the previous year. The second alternative is to use presence of the VAT in the neighbouring countries weighed by inverse distance from country in question ('DISTANCE'), also lagged by one year to avoid possible simultaneity problems. Both instruments yield similar results; however, they both have different strengths. Using NEIGHBOUR results in a stronger first stage while DISTANCE contains more variation between countries of the same region in a given year.

[10] In the case of annual data (as in our revenue regressions), the VAT variable is a simple indicator variable. When taking five-year averages for the Gini analysis, it varies between 0 and 1, depending on the number of years a country has had a VAT within a period. As very few countries have actually abandoned the VAT, those countries that have a strictly positive but smaller than unity value for V have adopted it in the later years towards the five-year period.

As the VAT has proceeded in waves, both instruments are strong predictors of the adoption of the VAT in the country in question.[11] The validity of the instruments will require that neighbours' adoption of the VAT does not have an impact on revenue raising or inequality directly. A threat to this identification would arise if the presence of the VAT in the neighbouring country were to affect the examined country circumstances directly via e.g. foreign trade. Regarding inequality, one could perhaps envisage that the VAT adoption among a region takes place at the same time that other policies (such as social programmes) are undertaken. While we regard such threats as fairly unlikely (for instance the social protection systems in developing countries have tended to take place later than VAT adoption[12]), in the case of the DISTANCE instrument we can also include region*year fixed effects, which will pick up all region-specific common unobservables in a given year.

In some specifications, we also allow for a lagged dependent variable. Hence, the regression equation is written as

$$y_{i,t} = \alpha_i + \beta V_{i,t} + \gamma \boldsymbol{X}_{i,t} + \delta year_t + \eta y_{i,t-1} + \varepsilon_{i,t}, \qquad (2)$$

where, to avoid the Nickell bias, the lagged dependent variable is instrumented with the second and the third lags of the dependent variable.

As in Keen and Lockwood (2010), we are also interested in the interaction between the VAT and some of the control variables, such as the level of economic development (measured by GDP per capita), openness, and the share of agriculture. If these are added, in the IV estimates these are also instrumented with the interaction of the control variable in question and the neighbouring countries' VAT variable. The instruments for the VAT and its interactions are always exactly identified, whereas for the instruments for the lagged dependent variable, we also report the Sargan test of the over-identifying restrictions.

In the Keen and Lockwood (2010) study, the authors also use a selection model approach. The difference is that they run a separate adoption equation using Probit and use it to predict a selection correction (lambda) term, which is then included in the revenue equation. The neighbouring countries' VAT variable is included in the adoption equation, but it is not used as an excluded instrument as in our study. For completeness, we also report the results for the revenue equation using our IV strategy.

4 Results on inequality

In this section, we present our main results, the inequality implications of VAT adoption. We first estimate the direct impact of the VAT, followed by adding first controls and then VAT interactions with low- and middle-income countries. We then instrument the VAT with the VAT adoption rate

[11] The first stage regression naturally includes all the same covariates that are used at the second stage.

[12] They proliferated in Latin America in the late 1990s and early 2000s and in Africa still later, whereas VAT adoption took place mostly in the 1980s and 1990s.

of the neighbouring countries in order to avoid the bias created by the possible endogeneity of VAT adoption. Instrumentation is needed if there is a reason to believe that countries with higher Gini coefficients have a lower or higher tendency to implement the VAT. That would be the case, for example, when a government which puts less weight on poverty-reducing activities (such as income transfers) also has less interest in reforming its tax system. This would lead to downward biased estimates for the VAT.

Table 1 presents the results for the shorter period 1975–2000. In the specifications without the interaction terms (Columns (1)–(2) and (5)–(6)), the VAT does not have any or only a marginally significant direct effect on the Gini coefficient. This result holds for the IV specifications when the dataset is extended to cover years until 2010 (Table 2). Even though the variation in VAT adoption took place typically before the year 2000, there are still countries, especially in Sub-Saharan Africa and the North Africa Middle East region, introducing the VAT after 2000 (see Appendix Table A2). On average, VAT adoption has had benign impacts on inequality, which can be seen as our main result.

However, there is some heterogeneity in the impacts, which is revealed by the specifications that include interaction terms. In the instrumented specification with extended dataset together with the VAT and income level interaction terms (LICV and MICV, Table 2, Column (7)), we can see that while the direct impact of the VAT on inequality is positive, the effect in low-income countries has been, on the contrary, significantly negative.

Further, the interaction between trade openness and the VAT (OPENV) has a statistically significant negative effect on inequality (Tables 1 and 2, Column (8)—although in the former only at the 10 per cent level). While in general, trade openness seems to have a neutral or increasing effect on inequality, its interaction term with VAT adoption is negative, indicating that VAT reform implemented in countries with more open trade policies is associated with lower levels of inequality. One interpretation of this finding is that the border taxes that the VAT has replaced were more regressive than the VAT. Adding other interactions does not change this result. This result needs to be interpreted with some caution, however, as the openness variable can be correlated with tax policy (reductions in tariffs associated with the introduction of the VAT can boost trade volumes).[13]

Using our alternative IV specification (regional adoption weighed by the inverse distance from the country in question, 'DISTANCE', see Columns (1)–(4) of Tables A3 and A4 in the Appendix) only weakens the impact of the VAT on inequality. However, the negative impact of the VAT on inequality in low-income countries and in countries with more open economies remains significant in the period 1975–2010 (Table A4, Column (4)).

Columns (5)–(8) of Tables A3 and A4 report the same specification with the DISTANCE instrument but also control for year times region fixed effects to account for potential common

[13] In order to try to evaluate the longer-run impacts of the VAT, we also ran models with the lagged dependent variable of Gini included as an additional control. Quite a few years are lost in that exercise since we already use five-year averages. In the results from this analysis, available upon request, the sign of the VAT and its interactions remain the same with strong significances.

patterns during certain times within a region that can also influence inequality. The results for the earlier time period stay the same, whereas in the period ending 2010, the direct impacts of the VAT change sign, but the negative coefficient for the interaction with openness remains. As we discussed above, the longer time period is likely to produce more unstable results as the extent of variation in the VAT variable is less. While controlling for year*region fixed effects is a useful robustness check, including these additional controls also takes away some of the remaining variation. Since it is unclear how strong a concern the year-specific regional unobservable effects are, we would tend to favour the results with country and year fixed effects only.

Out of the other controls, the depth of financial markets (M2/GDP) is quite consistently positive and significant while the financial globalization measure (FDI) is positive and significant only for time period 1975–2000.

Adding years to our observation period increases marginally the statistical significance of the income per capita (lnYPC), as seen in Table 2. The share of agriculture of GDP remains insignificant which can be due to the findings in the previous literature that the size of the agriculture sector seems to affect income inequality differently in low-income and high-income economies.

An important question is also through which channels an adoption of the VAT potentially has an impact on inequality. Alternative mechanisms could, for example, be a change in government revenues, a change in the share of indirect tax revenue of total tax, or different levels of reduced (or zero) VAT rates targeted to benefit the poor. Table 3 shows the associations between government revenue and indirect taxation on income inequality. As we see, a high indirect tax share of total tax revenues is positively and significantly associated with higher inequality rates in all the specification. However, causal relationships are not clear—a higher share of indirect (flat rate) tax could result in higher inequality but it can also be a signal of a government not being concerned about reduction of inequality. Table 3 also indicates that government revenues are negatively associated with inequality (the higher the government revenues, the lower the inequality) but the significance of this connection vanishes with the longer time period.

In the main analysis, we combine both consumption-based and disposable income-based measurement of Gini coefficients. To test if the measurement type matters, we run the analysis for both types separately (Appendix Tables A5 and A6). The results from these exercises reveal that the positive impact of the VAT on inequality is greater when measured using income-based Gini only. Clearly, the result is influenced by the fact that low-income countries' inequality is rarely measured using income-based analysis. Therefore, one needs to be cautious regarding these differences: the VAT can have led to higher inequality in higher income countries or in countries with income-based measurement.[14]

[14] Appendix Table A7 also provides an analysis where the ex-Soviet Union countries are included. Since the introduction of the VAT there coincided with a large structural change, one cannot draw strong conclusions about the positive impact of the VAT on inequality when these countries are included.

5 Results on revenue consequences

We now turn to the analysis of the impacts of VAT adoption on government revenue. If having the VAT in place leads to an increase in overall government revenues, part of these revenues can be used in a way (as increased spending in basic public services) that benefits also or especially the poor households. Examining the impacts of VAT adoption is also of interest, as the new ICTD Government revenue dataset is arguably an improvement in terms of comparability of time series across countries over earlier available datasets.

First, we replicate the Keen and Lockwood (2010) estimations with our updated dataset, using the two preferred specifications (Keen and Lockwood 2010, Table 2, Columns (2) and (4)). We also make small adjustments to their empirical setting, mainly adding year dummies (which Keen and Lockwood have in their model specification but are not used in the empirical part) and removing some inconsistencies from the data on population.[15] The third difference is that the data we use comes from the ICTD (as we also want to examine the longer time period which the earlier data does not cover). The implications of our updated data and other adjustments on the original results of Keen and Lockwood (2010) are discussed below.

The coefficient for V is significant and negative in our two first specifications (Table 4 Columns (1) and (2)), signalling that the introduction of the VAT has both a short- and long-term direct negative effect on revenue ratio.[16] However, the effect of the VAT is more complex than that and one has to consider the various interaction terms through which the VAT influences to obtain the final direction of the effect. The interaction of the VAT with income per capita is positive and consistent with the Keen and Lockwood (2010) findings which, in turn, is aligned with the common belief that higher income countries are better equipped to deal with the administrative and compliance requirements of a VAT system. The interaction term with the FED dummy is insignificant in both our and Keen and Lockwood's (2010) estimations.[17]

One difference between Keen and Lockwood (2010) and our results concerns the interaction terms with openness and agriculture (Column (2) in Table 4). While Keen and Lockwood (2010) report OPEN*V to be significant at 5 per cent level and AGR*V not at all, our results indicate that both OPEN*V and AGR*V are negative and significant.

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[15] For example, in their data Sudan's population stays around 0.4 million (in reality it has grown to 27 million), Sri Lanka's population stays around 50,000, and Switzerland's population growth is wrong (15 million inhabitants in the data whereas the real figure is around half of that). However, it turned out that errors in the population data did not have impacts on signs or significance of results.

[16] Keen and Lockwood (2010) reported a direct positive effect of the VAT. However, adding interaction terms and controls, this effect also turns negative.

[17] Also belonging to the IMF crisis country programmes is associated with higher revenue ratio (around 3 per cent higher), but contrary to Keen and Lockwood's (2010) results, belonging to the non-crisis IMF programmes has no significant effect on the tax ratio.

The VAT variable and its interaction terms are jointly significant at 10 per cent level; however, the size and sign of the effect need further analysis and cannot simply be drawn from the estimation results. The joint effect is examined below in the next sub-section.

We now turn to the results when the VAT is instrumented with the degree of VAT adoption by its neighbours (variable 'NEIGHBOUR'). There is a possibility that the level of the revenue ratio can influence the decision of VAT adoption: on the one hand, countries more dedicated to domestic revenue mobilization could be more willing to implement the VAT (hence leading to an upwards bias of the VAT adoption); on the other hand it might be precisely those countries most in need of revenues that are eager to move to a VAT system. Thus, the bias could go either way, and an instrumentation strategy is implemented to deal with this bias. All the interaction terms are also instrumented by replacing VAT with the NEIGHBOUR variable. First stage F-statistics reported at the end of the table are strong in both of the specifications and, in addition, the Column (4) specification also passes the Sargan test for instrument validity. Columns (3) and (4) of Table 1 present the IV estimation results.

In Column (3) of Table 4, the direct short-term effect of the VAT on the revenue ratio loses its significance but in column (4) with added lagged revenue ratio, interaction terms, and control variables, the sign of the VAT coefficient is positive and significant at 1 per cent level. This could indicate that countries with low levels of revenue ratio (and perhaps with a strong need to increase revenue ratio) are more likely to implement VAT reform. Once this endogeneity is removed, the direct effect of the VAT becomes positive. However, the full effect of the VAT on revenue is a formula of direct and interaction effects which all need to be taken into consideration.

A negative and statistically significant (at 1 per cent level) coefficient of the interaction between VAT and OPEN is somewhat surprising and in a sharp contrast with the results of Keen and Lockwood (2010). They conclude that one would expect (all else equal) that the VAT functions better in more open economies since they can use their borders as tax collection points—especially in developing countries where the majority of the VAT revenue is collected at borders. Perhaps the VAT in practice in developing countries has not fully compensated for the lost revenue of tariff and custom duties' reductions.

The size of the agricultural sector has a significant and negative effect on revenue if the VAT is adopted. This is aligned with the notion that the VAT as a tax instrument has difficulties in reaching the agriculture sector.

The VAT and its interaction terms are jointly significant at 1 per cent level but, again, the size and sign of the joint effect is analysed in more detail in the next sub-section.

Before turning to examine the joint revenue consequences of the VAT and its interactions, we look at what happens when extending the observation period to cover also the most recent available years of data, now covering 1975–2010. The results of the longer time period, reported in Table 5, seem to put less emphasis on the VAT's ability to influence the revenue ratio (directly or indirectly) and the results from the IV estimations do not change this finding. A potential reason for this is that the countries that have adopted the VAT fairly late can have less conducive institutions for revenue collection for other reasons. The only interaction term that remains significant is the negative

association between the interaction of the VAT variable and the openness ratio. Despite the insignificant coefficients of V and its interaction terms, in the IV specification the VAT and its interaction are jointly significant at 1 per cent level. Our first stage F-values are fairly strong and all IV specifications pass the Sargan test for instrument validity.

5.1 The overall revenue consequences

When considering the overall effect of the VAT on revenue ratio, we follow again the Keen and Lockwood (2010) framework for calculating cumulative gains since the introduction of the VAT.

To calculate the overall gain or loss of revenues for a country that has adopted the VAT we need to sum up annual gains and losses since the introduction of the VAT. First, to calculate short-term gains we use the specifications from Column (2) and Column (4) from Table 4

$$\Delta r_{it} = \hat{\beta}_V + \hat{\beta}_{YPC*V} lnYPCV_{it} + \hat{\beta}_{OPEN*V} OPEN_{it} + \hat{\beta}_{ARG*V} AGR_{it} + \hat{\beta}_{FED*V} FED_{it} \qquad (3)$$

Each $\hat{\beta}$ is an estimated coefficient of V and its interaction terms. From the short-term effect, we calculate the long-term effect at the end of the period by taking into account the cumulative gains through the lagged revenue coefficient, λ, as follows

$$\Delta r_{i2000} + \lambda \Delta r_{i2000-1} + \cdots + \lambda^{2000-\tau} \Delta r_{i\tau} \qquad (4)$$

where τ is the year a country adopted the VAT.

For countries without the VAT by the end of observation period, we simply calculate a short-term effect from an annual average of the last 10 years of the period. The long-term effect is calculated by multiplying this by $1/(1-\lambda)$.

The results depend on the specification used and are prone to change if specifications change and they are based on the point estimates, thus not reflecting the statistical significance of the estimates. This approach, however, helps us get a more comprehensive picture of the total effect of the VAT, including the direct effect and its interactions with other variables.

Table 6 presents revenue consequences for the period 1975–2000. The results stemming from conventional fixed effects specifications (the upper panel) indicate that for approximately half of the countries that adopted the VAT the effect has been positive, and almost two-thirds of countries without the VAT would have had positive revenue gains from adopting it.

When using the IV specification (the lower panel), the cumulative gains from the VAT are still positive for more than half of the countries with VAT in place. For countries without the VAT, removing endogeneity between V and the revenue ratio reveals that countries which did not adopt a VAT by the end of the observation would have not gained but rather, on average, lost revenue in adoption. The predicted revenue gain might be negative for countries without the VAT since they have, on average, a higher trade openness index and a higher share of agricultural value added, which both combined with the existence of the VAT affect negatively the revenue ratio in this specification. Thus, even if the direct effect of the VAT is positive, the overall predicted gain (the direct impact combined with indirect interaction effects) is in many cases negative.

The revenue consequences, when extending the observation period to 2010, are reported in Table 7. The upper panel reports results from the specification in Table 5, Column (2). As more than three-quarters of the countries have adopted the VAT in 2010, the cumulative gains since the adoption are, on average, negative for all the other regions but Europe. Similarly, the predicted gains for regions without the VAT are, on average, negative. The IV specification yields quite similar results; however, the positive cumulative gains for Europe are now negative while Sub-Saharan Africa is, in turn, the only region with positive cumulative gains. As discussed above, since the variation in VAT adoption during the additional years is of minor importance, these results should be dealt with cautiously.

For robustness testing, we run the same regressions with the alternative IV strategy where the presence of the VAT in the neighbouring countries is weighed by inverse distance from the country in question. The estimation results do not diverge dramatically from our original results, and the overall revenue consequences of the VAT remain more negative than in Keen and Lockwood's (2010) original article.[18]

6 Conclusions

Using recently released, high-quality macro data, this paper examined the consequences of the introduction of the VAT on government revenue and inequality. Earlier work has demonstrated that the VAT has served well as a revenue raising device, but the VAT has also been subject to considerable criticism because of its alleged negative influences on distributional equity.

Our analysis can cover those impacts of the VAT on inequality that stem from the possible tax mix changes (if the introduction of the VAT has led to a lower reliance of progressive tax instrument) and, in cases where inequality measurement is consumption-based, the mean effects from differentiated VAT rates. An important caveat is that with the available country-level inequality data one cannot measure those tax incidence impacts that could arise from differences in savings rates across people with different income levels. Nor do the data allow the analysis of the impacts of changes in the revenue side on expenditure composition (one could envisage that if VAT adoption increases revenues, part of the revenues could be directed to pro-poor social policies). In addition,

[18] These estimation results are not included here but are available upon request.

the impacts of the VAT have been captured here with a simple indicator variable for the simple reason that information on the effectiveness and rates of the VAT are not available for such a large set of countries. We believe that despite these reservations, the importance of the VAT as a fiscal tool and the debate surrounding it justify examining its inequality impacts as well as one can.

Our results, stemming from instrumental variable regressions, suggest that the direct impact of VAT adoption has had a benign impact on inequality, especially in the period up until the year 2000. The results from this period are arguably the most reliable ones, since later periods saw fewer changes in the set of countries having a VAT. However, there appear to be some interesting differences in the impacts of the VAT across countries. In particular, VAT adoption has led to lower income differences in more open economies. The likely reason for this finding is that the VAT has been a less regressive tax instrument than the trade taxes it has replaced.

While these results suggest that the criticism levelled against the VAT is partly misplaced, the picture is a more nuanced one. This is so because, our analysis with updated data and an alternative identification strategy suggests that VAT adoption has not led to increased government revenues. This finding is in contrast with earlier work in the area.

The macro-level analysis offered by this paper should ideally be combined with careful country-level studies and country comparisons between similar countries adopting and not adopting a VAT, using more detailed incidence data. Such an analysis is likely to shed more light on the interesting country differences which the results in this paper already point to.

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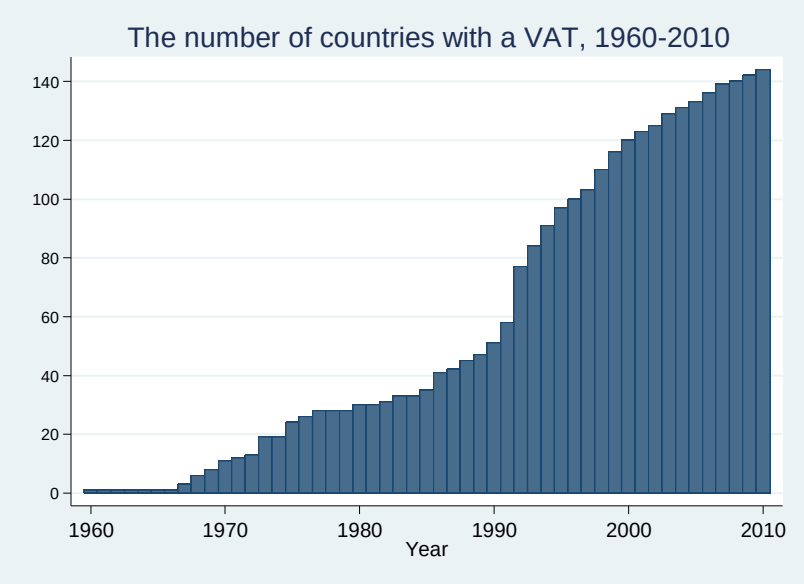
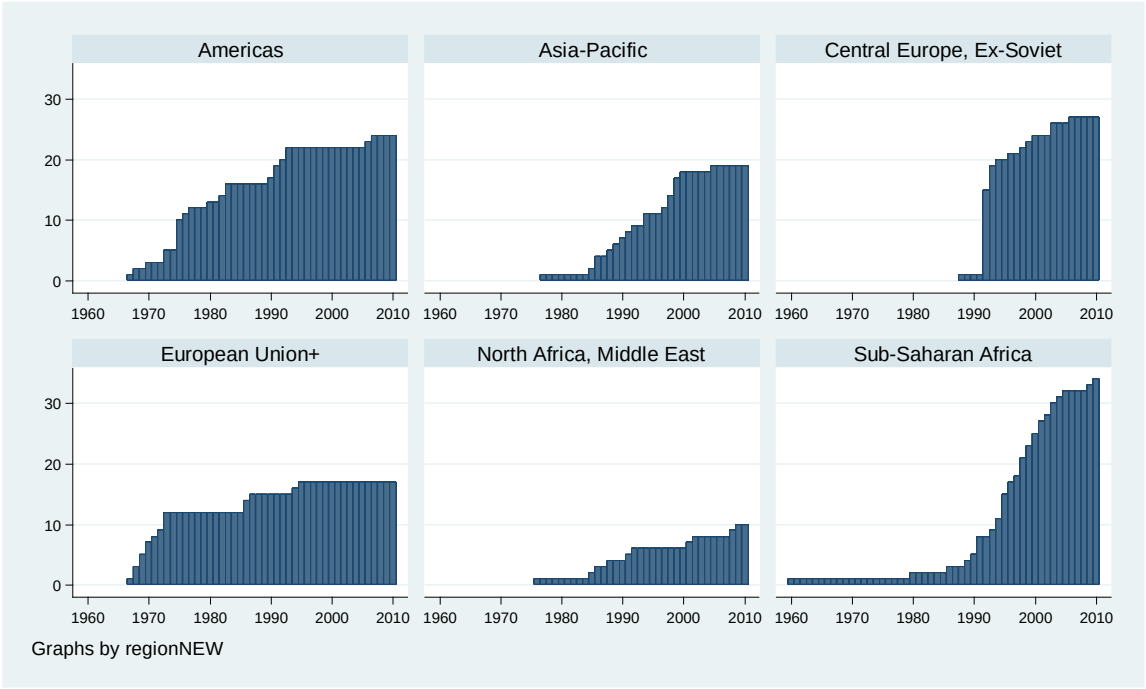
FIGURES

Figure 1: The adoption of the VAT worldwide



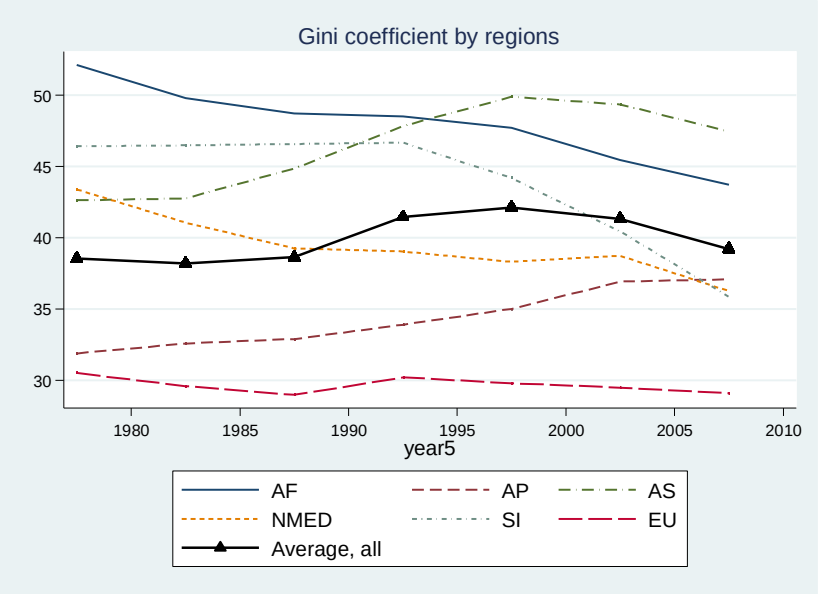
Source: IMF (2014).

Figure 2: The adoption of the VAT by region



Notes: AF = Sub-Saharan Africa, AP = Asia-Pacific, AS = South America, CBRO = Central Europe and the ex-Soviet Union, EU = European Union, NMED = North Africa and the Middle East, and SI= Small Islands.
Source: Authors' calculations based on IMF (2014) data.

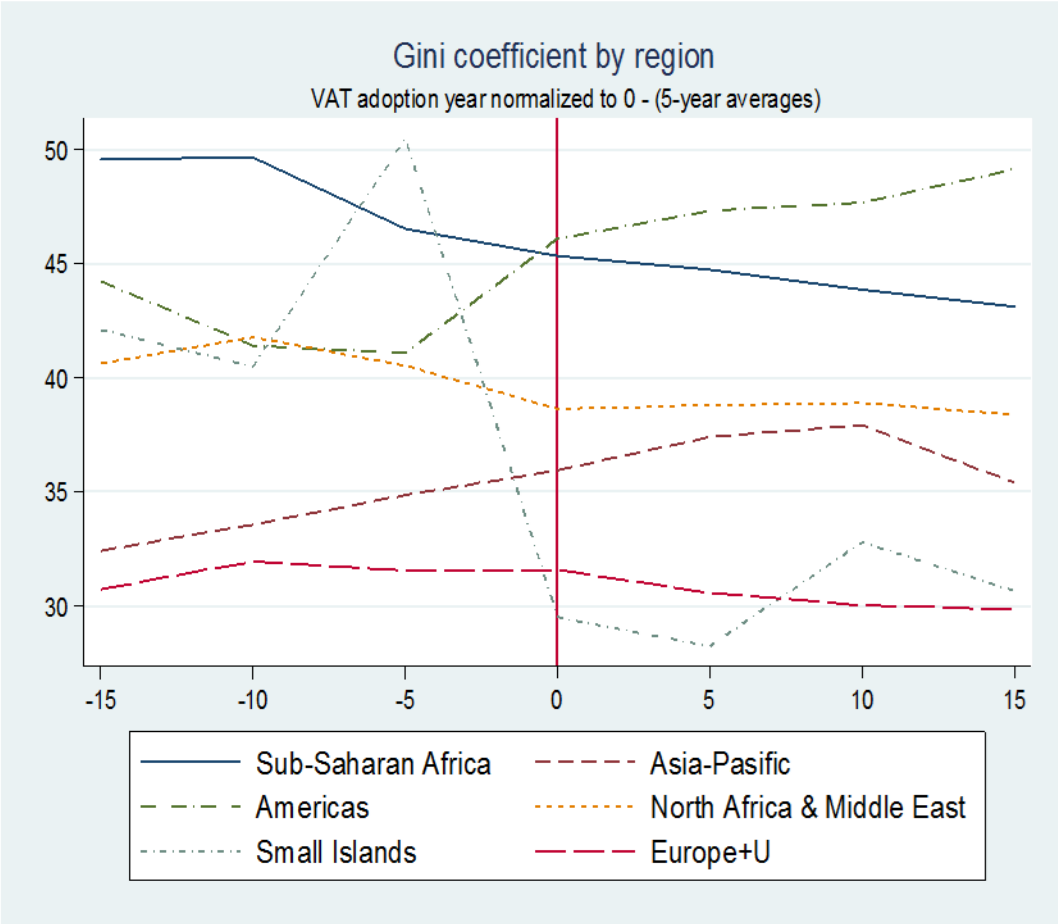
Figure 3: The evolution of inequality as measured by the Gini coefficient (for consumption or disposable income)



Notes: AF = Sub-Saharan Africa, AP = Asia-Pacific, AS = South America, CBRO = Central Europe and the ex-Soviet Union, EU = European Union + Norway and Switzerland, NMED = North Africa and the Middle East, and SI= Small Islands.

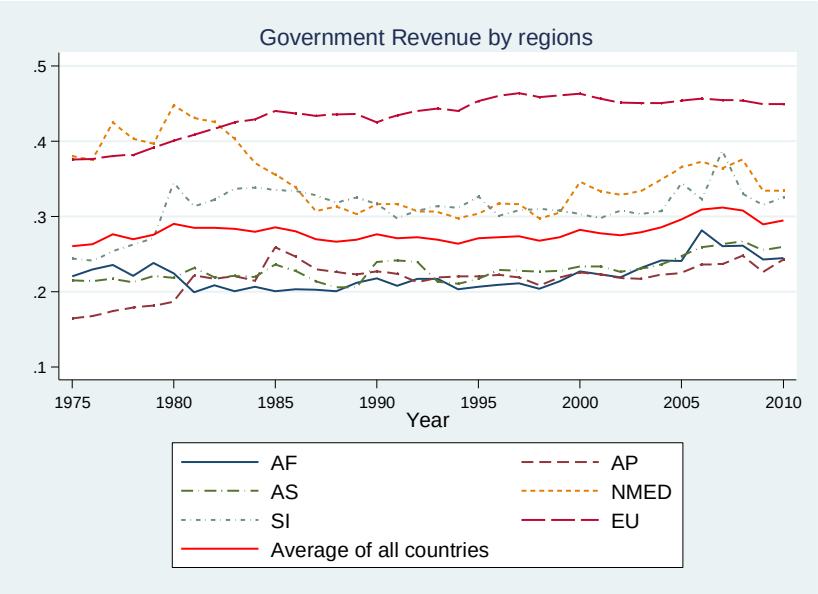
Source: Authors' calculations based on UNU-WIDER, World Income Inequality Database (WIID3.0b) (2014).

Figure 4: Inequality measured by the Gini coefficient before and after the adoption of the VAT



Source: Authors' calculations based on UNU-WIDER, World Income Inequality Database (WIID3.0b) (2014).

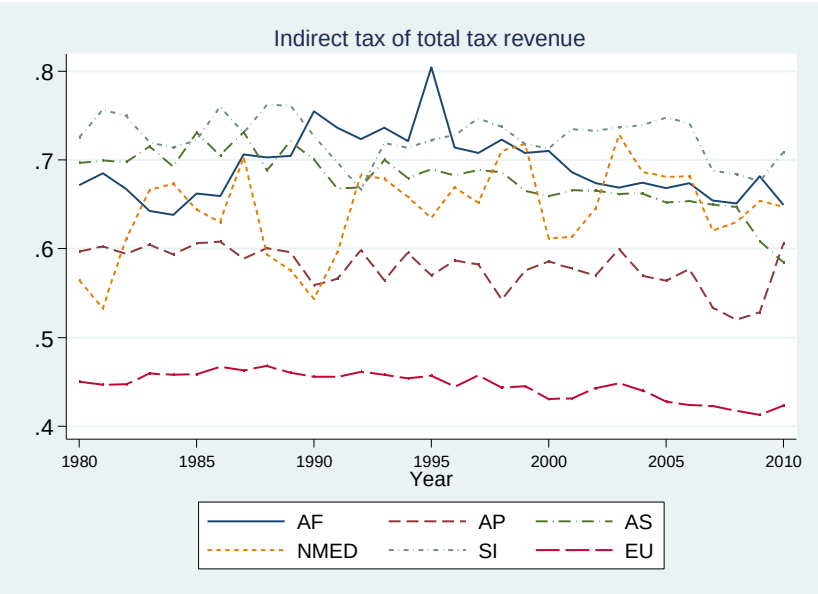
Figure 5: Overall government revenue per GDP in different regions



Notes: AF = Sub-Saharan Africa, AP = Asia-Pacific, AS = South America, CBRO = Central Europe and the ex-Soviet Union, EU = European Union + Norway and Switzerland, NMED = North Africa and the Middle East, and SI= Small Islands.

Source: Authors' calculations based on Government Revenue Dataset (Prichard et al. 2014).

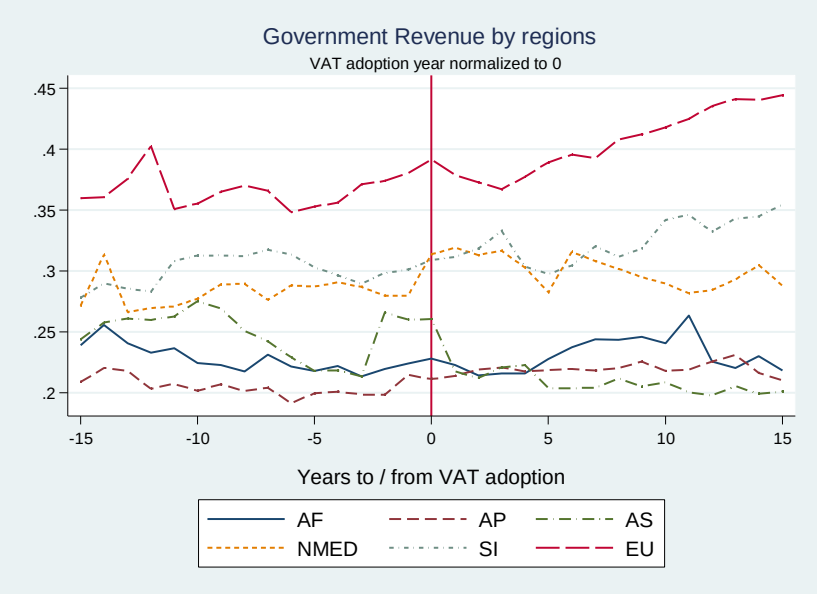
Figure 6: The tax mix by regions



Notes: AF = Sub-Saharan Africa, AP = Asia-Pacific, AS = South America, CBRO = Central Europe and the ex-Soviet Union, EU = European Union + Norway and Switzerland, NMED = North Africa and the Middle East, and SI= Small Islands.

Source: Authors' calculations based on Government Revenue Dataset (Prichard et al. 2014).

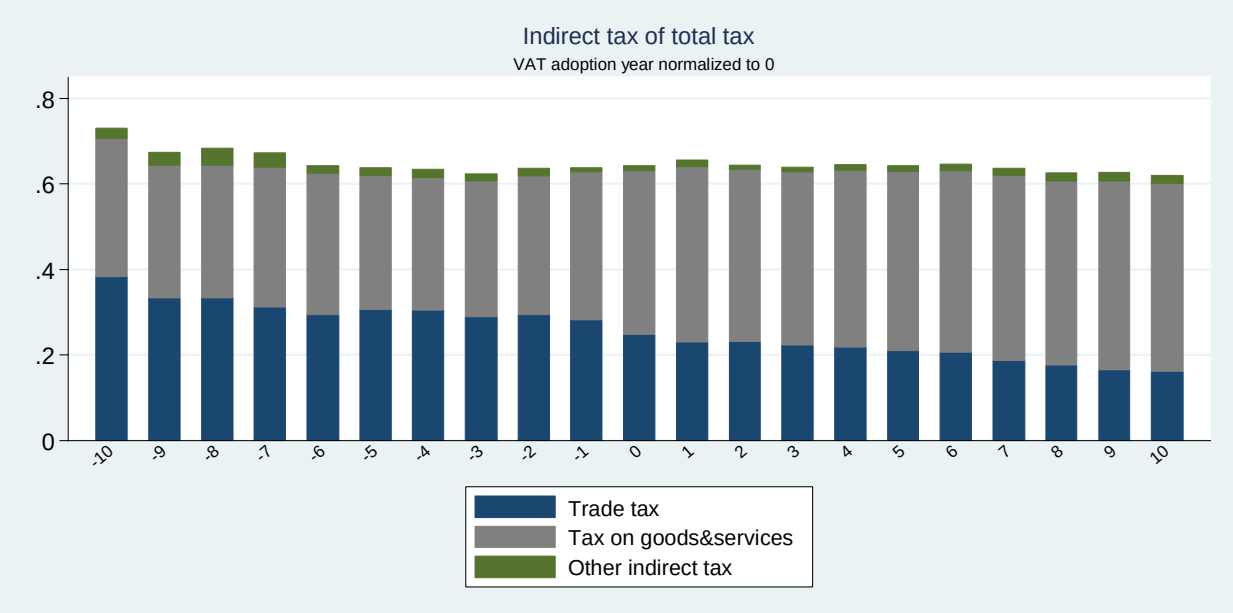
Figure 7: Government revenue before and after the adoption of the VAT by regions



Notes: AF = Sub-Saharan Africa, AP = Asia-Pacific, AS = South America, EU = European Union + Norway and Switzerland, NMED = North Africa and the Middle East, and SI= Small Islands.

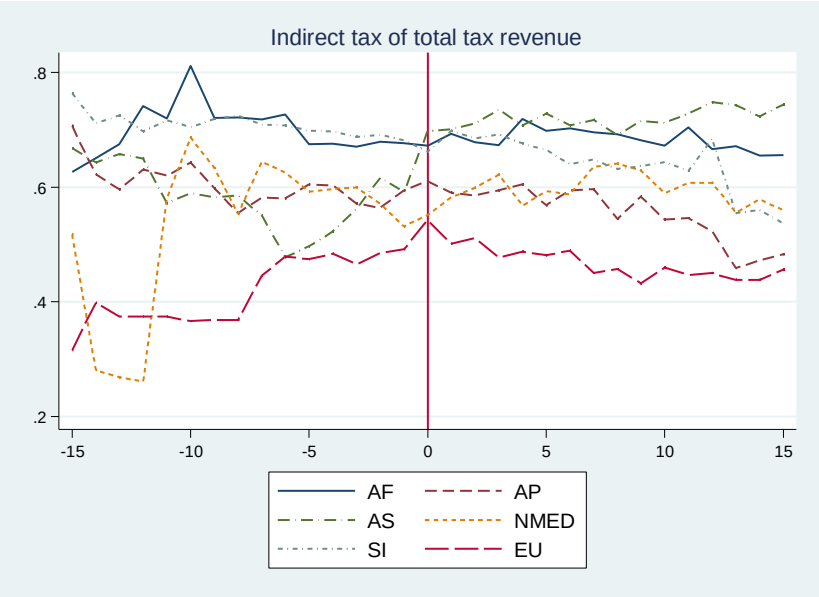
Source: Authors' calculations based on Government Revenue Dataset (Prichard et al. 2014).

Figure 8: Government indirect tax revenue before and after the adoption of the VAT



Source: Authors' calculations based on Government Revenue Dataset (Prichard et al. 2014).

Figure 9: The tax mix before and after the adoption of the VAT



Notes: AF = Sub-Saharan Africa, AP = Asia-Pacific, AS = South America, CBRO = Central Europe and the ex-Soviet Union, EU = European Union + Norway and Switzerland, NMED = North Africa and the Middle East, and SI= Small Islands.

Source: Authors' calculations based on Government Revenue Dataset (Prichard et al. 2014).

TABLES

Table 1: Gini coefficient, period 1975–2000

	OLS				IV			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
V	1.07	1.63*	0.04	1.02	3.98	2.57	8.72	14.30*
	[1.27]	[1.66]	[0.02]	[0.40]	[1.63]	[0.93]	[1.27]	[1.75]
LICV			1.93	1.68			-8.88	-10.68
			[0.70]	[0.59]			[-1.42]	[-1.60]
MICV			2	1.9			-4.66	-5.37
			[0.96]	[0.90]			[-0.93]	[-1.03]
OPENV				-1.59				-8.38*
				[-0.59]				[-1.92]
lnYPC		-0.68	-0.83	-0.76		-0.58	-1.32	-0.97
		[-0.29]	[-0.33]	[-0.30]		[-0.24]	[-0.47]	[-0.34]
OPEN		3.3	3.16	3.78		3.11	2.47	5.66
		[1.23]	[1.16]	[1.29]		[1.13]	[0.81]	[1.62]
AG		-0.17	1.11	2.36		1.32	-5.1	1.41
		[-0.01]	[0.09]	[0.18]		[0.10]	[-0.35]	[0.09]
M2ofgdp		4.92*	5.38**	5.43**		4.75*	3.44	3.6
		[1.91]	[2.04]	[2.06]		[1.80]	[1.07]	[1.09]
FDI		0.26**	0.27**	0.27**		0.28**	0.30**	0.31**
		[2.30]	[2.33]	[2.34]		[2.29]	[2.26]	[2.27]
Period FE	yes	yes	yes	yes	yes	yes	yes	yes
Country FE	yes	yes	yes	yes	yes	yes	yes	yes
Observations	293	247	247	247	293	247	247	247
R-squared	0.08	0.18	0.19	0.19				
First stage FV					27.1	21.0	8.5	6.4
First stage FLICV							80.1	59.9
First stage FMICV							18.5	13.8
First stage FOPEN								12.7

Notes: Dependent variable: Gini index. Columns (1)-(4) are OLS estimation, Columns (5)-(8) are IV-estimations; both use 5-year averaged data. V and its interaction terms (LICV, MICV, OPENV) are instrumented with NEIGHBOUR and its interactions correspondingly. T-values are reported in brackets. All regressions are with fixed effects. First stage F-values show F-statistic test variable for each first stage regression separately.

Source: Authors' own calculations.

Table 2: Gini coefficient, period 1975–2010

	OLS				IV			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
V	1.17	1.93**	1.56	3.50*	-0.41	1.72	10.64**	16.84***
	[1.51]	[2.28]	[0.92]	[1.71]	[-0.22]	[0.73]	[2.00]	[2.95]
LICV			-1.34	-1.83			-17.38***	-19.96***
			[-0.57]	[-0.78]			[-3.32]	[-3.70]
MICV			0.99	1.2			-6.21	-6.23
			[0.54]	[0.66]			[-1.45]	[-1.43]
OPENV				-3.40*				-10.47***
				[-1.68]				[-3.30]
lnYPC		1.67**	1.52*	1.40*		1.63*	0.47	-0.08
		[2.21]	[1.94]	[1.78]		[1.84]	[0.49]	[-0.08]
OPEN		1.77	1.85	4.02*		1.79	2.64	9.39***
		[1.04]	[1.08]	[1.88]		[1.04]	[1.41]	[3.35]
AG		-9.68	-9.93	-8.44		-9.89	-15.38**	-11.7
		[-1.49]	[-1.51]	[-1.27]		[-1.44]	[-2.05]	[-1.51]
M2ofgdp		3.79***	3.78***	4.05***		3.81***	2.62	3.43**
		[2.64]	[2.62]	[2.80]		[2.63]	[1.59]	[2.01]
FDI		0.03	0.03	0.04		0.03	0.05	0.07
		[0.64]	[0.68]	[0.87]		[0.63]	[0.83]	[1.31]
Period FE	yes	yes	yes	yes	yes	yes	yes	yes
Country FE	yes	yes	yes	yes	yes	yes	yes	yes
Observations	478	423	423	423	478	423	423	423
R-squared	0.07	0.15	0.15	0.16				
First stage FV					78.9	44.2	17.7	13.2
First stage FLICV							90.3	67.9
First stage FMICV							59.8	44.9
First stage FOPEN								27.1

Notes: Dependent variable: Gini index. Columns (1)-(4) are OLS estimation, Columns (5)-(8) are IV-estimations; both use 5-year averaged data. V and its interaction terms (LICV, MICV, OPENV) are instrumented with NEIGHBOUR and its interactions correspondingly. T-values are reported in brackets. All regressions are with year and country fixed effects. First stage F- values show F-statistic test variable for each first stage regression separately.

Source: Authors' own calculations.

Table 3: Gini coefficient, government revenue and tax mix, 1975–2000 and 1975–2010

	Period 1975-2000			Period 1975–2010		
	(1)	(2)	(3)	(4)	(5)	(6)
Revenue	-8.30	-15.63*	13.60**	-7.53	-13.25	0.95
	[-0.91]	[-1.69]	[2.04]	[-0.90]	[-1.53]	[0.17]
Indirect tax	14.05***	8.99*	9.21*	13.32***	11.43***	6.59*
	[3.25]	[1.94]	[1.81]	[3.28]	[2.76]	[1.69]
lnYPC		-3.18	-0.32		-1.12	1.49*
		[-1.59]	[-0.11]		[-1.11]	[1.95]
OPEN		2.14*	4.63		2.40**	1.95
		[1.94]	[1.54]		[2.15]	[1.11]
AG		-15.90*	6.03		-14.27**	-7.09
		[-1.76]	[0.35]		[-2.03]	[-0.98]
M2		-1.06	3.34		-1.24	2.65*
		[-0.60]	[1.11]		[-1.49]	[1.78]
FDI		0.47***	0.16		0.010	0.020
		[3.08]	[1.33]		[0.10]	[0.40]
Period dummies	yes	yes	yes	yes	yes	yes
Region dummies	yes	yes	no	yes	yes	no
Country dummies	no	no	yes	no	no	yes
Observations	249	207	207	418	370	370
R2	0.63	0.68	0.17	0.59	0.61	0.12

Notes: Dependent variable: Gini index. All estimations are ordinary least squares estimations using 5-year averaged data.. Robust T-values are reported in brackets.

Source: Authors' own calculations.

Table 4: Revenue, period 1975–2000

	KL		IV	
	(1)	(2)	(3)	(4)
	xtreg	ivxtreg	ivxtreg	ivxtreg
V	-0.04**	-0.15**	0.07	0.32***
	[-2.01]	[-2.51]	[0.75]	[3.09]
lnYPCV		0.06***		-0.04
		[3.02]		[-0.66]
OPENV		0.01		-0.14***
		[0.44]		[-2.98]
AGRV		0.35**		-0.80**
		[2.37]		[-2.39]
FEDV		-0.01		-0.05
		[-0.24]		[-0.58]
lnYPC	-0.10***	-0.13***	-0.10***	-0.05
	[-3.08]	[-3.73]	[-2.71]	[-1.36]
OPEN	0.07**	0.05**	0.07*	0.07***
	[2.05]	[2.17]	[1.93]	[2.70]
AG	-1.54***	-0.95***	-1.50***	-0.48**
	[-10.26]	[-4.72]	[-9.16]	[-2.57]
Lagged Revenue		0.57***		0.63***
		[6.18]		[7.11]
DEPOLD		0.06		-0.15
		[0.06]		[-0.10]
DEPYOUNG		0.19		0.66**
		[0.67]		[2.03]
IMFCR		0.03***		0.02**
		[2.69]		[2.13]
IMFNCR		0.02		0.02
		[1.33]		[1.05]
lnPOP		-0.06		
		[-0.83]		[0.00]
Observations	2,620	1,950	2,567	1,950
Serial Correlation test	302.20	0.34	311.20	0.00
Sargan		0.47		0.54
Sargan - p		0.49		0.46
Joint sign.of V		9.40		13.14
P-value		0.09		0.02
First stage FR		34.84		15.13
First stage FV			128.10	22.24
First stage FYPCV				13.92
First stage FOPENV				61.59
First stage FAGRV				40.30
First stage FFEDV				63.26

Notes: Dependent variable: log revenue. Column (1) is an ordinary OLS regression, Column (2) is a IV-instruments lagged revenue with its own lags. Column (3) instruments V with NEIGHBOUR. Column (4) adds instruments to V and all of its interaction terms, also lagged revenue is instrumented with its lags. t-statistics are reported in brackets. All regressions are with fixed effects. First stage F- values show F-statistic test variable for each first stage regression separately.

Source: Authors' own calculations.

Table 5: Revenue, period 1975–2013

	KL		IV	
	(1)	(2)	(3)	(4)
	xtreg	ivxtreg	ivxtreg	ivxtreg
V	-0.05***	-0.03	0.06	0.06
	[-3.15]	[-1.17]	[1.25]	[1.11]
lnYPCV		0.02**		-0.01
		[2.48]		[-0.81]
OPENV		-0.02		-0.06***
		[-1.52]		[-3.01]
AGRV		0.12		0.00
		[1.59]		[-0.01]
FEDV		-0.01		-0.04
		[-0.66]		[-1.03]
lnYPC	-0.05***	-0.04***	-0.04***	0.00
	[-4.26]	[-3.31]	[-2.77]	[-0.13]
OPEN	0.09***	0.06***	0.08***	0.06***
	[3.74]	[3.45]	[3.61]	[3.38]
AG	-1.23***	-0.47***	-1.18***	-0.35***
	[-12.74]	[-5.42]	[-11.62]	[-3.74]
Lagged Revenue		0.75***		0.75***
		[20.57]		[20.25]
DEPOLD		0.19		0.44
		[0.42]		[0.93]
DEPYOUNG		0.14		0.13
		[0.98]		[0.87]
IMFCR		0.02**		0.02***
		[2.54]		[2.70]
IMFNCR				-0.01
		[-0.29]		[-0.64]
lnPOP		0.05		0.05
		[1.13]		[1.04]
Observations	3,896	3,188	3,843	3,188
Serial Correlation test	284.30	7.80	286.00	6.19
Sargan		1.01		0.64
Sargan - p		0.32		0.43
Joint sign.of V		9.07		14.97
P-value		0.11		0.01
First stage FR		204.30		65.82
First stage FV			382.40	51.13
First stage FYPCV				77.50
First stage FOPENV				201.70
First stage FAGRV				120.60
First stage FFEDV				234.60

Notes: Dependent variable: log revenue. Column (1) is an ordinary OLS regression, Column (2) is a IV-instruments lagged revenue with its own lags. Column (3) instruments V with NEIGHBOUR. Column (4) adds instruments to V and all of its interaction terms, also lagged revenue is instrumented with its lags. T-values are reported in brackets. All regressions are with fixed effects.

First stage F- values show F-statistic test variable for each first stage regression separately.

Source: Authors' own calculations.

Table 6: Revenue consequences, period 1975-2000

Specification: Table 1, Column (2)	ALL	AP	AS	EU	NMED	SI	AF
Countries with VAT							
Mean	0.01	0.02	-0.01	0.14	0.00	0.04	-0.05
Number with Δr>0	37	7	9	11	2	2	6
Number with Δr<0	36	4	12	0	2	0	18
Countries without VAT							
Mean	0.02	0.08	0.12	-	-0.01	0.04	-0.01
Number with Δr>0	27	3	3	-	7	8	6
Number with Δr<0	14	1	0	-	4	2	7

Specification: Table 1, Column (4)	ALL	AP	AS	EU	NMED	SI	AF
Countries with VAT							
Mean	0.04	-0.09	0.17	0.08	0.16	-0.12	-0.03
Number with Δr>0	45	3	20	9	4	0	9
Number with Δr<0	28	8	1	2	0	2	15
Countries without VAT							
Mean	-0.10	-0.40	-0.25	.	0.14	-0.07	-0.19
Number with Δr>0	17	0	1	.	9	3	4
Number with Δr<0	24	4	2	.	2	7	9

Note: Total numbers of countries in any region may be less than actual amount of countries due to missing data.

Source: Authors' own calculations.

Table 7: Revenue consequences, period 1975–2010

Specification: Table 2, Column (2)	ALL	AP	AS	EU	NMED	SI	AF
Countries with VAT							
Mean	-0.06	-0.07	-0.06	0.04	-0.06	-0.03	-0.13
Number with Δr>0	25	4	1	15	1	4	0
Number with Δr<0	72	12	18	2	5	7	28
Countries without VAT							
Mean	-0.05	-0.09	0.02	-	-0.02	-0.03	-0.09
Number with Δr>0	8	1	1	-	4	1	1
Number with Δr<0	20	4	1	-	3	6	6
Specification: Table 2, Column (4)	ALL	AP	AS	EU	NMED	SI	AF
Countries with VAT							
Mean	-0.09	-0.10	-0.06	-0.30	-0.06	-0.13	0.04
Number with Δr>0	32	6	5	0	1	0	20
Number with Δr<0	65	10	14	17	5	11	8
Countries without VAT							
Mean	-0.11	-0.32	-0.10	.	-0.12	-0.09	0.03
Number with Δr>0	10	1	1	.	2	1	5
Number with Δr<0	18	4	1	.	5	6	2

Note: Total numbers of countries in any region may be less than actual amount of countries due to missing data.

Source: Authors' own calculations.

APPENDIX

Table A1: The list of variables and their sources

	OBS	MEAN	MIN	MAX	Source
Revenue	5097	0.28	0.00	1.64	Government revenue, GRD and IMF
Gini_a	1299	37.95	15.0	74.3	Combination of income and consumption-based GINI, WIID3b
Gini_i	969	37.20	15.80	66.00	Income-based GINI, WIID3b
Gini_c	405	40.55	16.60	74.30	Consumption-based GINI, WIID3b
V	5616	0.46	0.00	1.00	Adoption of VAT, IMF
NEIGHBOUR	5616	0.46	0	1	Adoption of VAT by region, IMF
lnYPC	4961	1.31	-2.11	4.10	log of GDP per cap (constant 2000 US dollars), WDI
OPEN	5024	0.82	0.00	4.58	Imports+Exports of GDP, WDI
AG	4810	0.18	0	1	Agriculture, value added (% of GDP), WDI
FED	5616	0.15	0.00	1.00	Treisman (2002) Table 12
DEPOLD	5338	0.06	0.00	0.25	Population 65 or older (% of total population), WDI
DEPYOUNG	5338	0.35	0	1	Population 14 or younger (% of total population), WDI
IMFCR	5303	0.12	0	1	Dummy equal to 1 if country was a crisis IMF country, IMF
IMFNCR	5303	0.11	0.00	1.00	Dummy equal to 1 if country was a non-crisis IMF country, IMF
POP	5603	33.88	0.04	1357.38	Total Population, millions (WDI)
M2 per GDP	4860	0.61	0.01	74.14	Financial development indicator ; Financial depth: Money and quasi money (M2) per GDP, WDI
URBAN	5577	50.50	3.53	100.00	Urban population (% of total), WDI
FDI	4959	3.39	-82.9	430.7	Foreign direct investments, net inflows of GDP, WDI

Notes: GRD=Government Revenue Dataset of the International Centre for Taxation and Development, WIID=World Income Inequality Database of the UNU-WIDER, WDI= World Development Indicators of the World Bank.

The series for the Gini_i is chosen by taking observations for which the variable welfaredefn in the WIID data set is either 'Monetary Income, Disposable' or 'Disposable Income' or 'Income,Net'. Gini_c is based on observations where the welfaredefn is 'consumption' or 'income/consumption' for countries in the developing world outside of Latin America. In case of duplicate observations, we keep those which are reported for the value 'all' in area, population and age coverage.

Source: Authors' own calculations.

Table A2: Countries and introduction year of VAT

Asia-Pacific		Americas		Sub-Saharan Africa		Europe	
1977	Korea, Republic of	1967	Brazil	1960	Côte d'Ivoire	1967	Denmark
1985	Indonesia	1968	Uruguay	1980	Senegal	1968	France
1986	New Zealand	1970	Ecuador	1986	Niger	1968	Germany
1986	Taiwan Prov.of China	1973	Bolivia	1989	Malawi	1969	Netherlands
1988	Philippines	1973	Peru	1990	Kenya	1969	Sweden
1989	Japan	1975	Argentina	1991	Benin	1970	Luxembourg
1990	Pakistan	1975	Chile	1991	Mali	1970	Norway
1991	Bangladesh	1975	Colombia	1991	South Africa	1971	Belgium
1992	Thailand	1975	Costa Rica	1993	Burkina Faso	1972	Ireland
1994	China,P.R.: Mainland	1975	Nicaragua	1994	Madagascar	1973	Austria
1994	Singapore	1976	Honduras	1994	Nigeria	1973	Italy
1997	Nepal	1977	Panama	1995	Gabon	1973	United Kingdom
1998	Mongolia	1980	Mexico	1995	Mauritania	1986	Portugal
1998	Sri Lanka	1982	Haiti	1995	Togo	1986	Spain
1999	Cambodia	1983	Dominican Republic	1995	Zambia	1987	Greece
1999	Papua New Guinea	1983	Guatemala	1996	Guinea	1994	Finland
1999	Vietnam	1990	Trinidad and Tobago	1996	Uganda	1995	Switzerland
2000	Australia	1991	Canada	1997	Congo, Republic of		
2005	India	1991	Jamaica	1998	Ghana	**Central Europe and the ex-Soviet**	
no VAT	Brunei Darussalam	1992	El Salvador	1998	Mauritius	1988	Hungary
no VAT	China,P.R.:Hong Kong	1993	Paraguay	1998	Tanzania	1992	Armenia
no VAT	Lao People's Dem.Rep	1993	Venezuela, Rep. Bol.	1999	Cameroon	1992	Belarus
no VAT	Malaysia	2006	Belize	1999	Mozambique	1992	Estonia
no VAT	Myanmar	2007	Guyana	2000	Chad	1992	Georgia
		no VAT	United States	2000	Namibia	1992	Kazakhstan
Small Islands				2001	Central African Rep.	1992	Kyrgyz Republic
1973	San Marino	**North Africa and Middle East**		2001	Rwanda	1992	Latvia
1990	Iceland	1976	Israel	2002	Botswana	1992	Lithuania
1992	Cyprus	1985	Turkey	2003	Ethiopia	1992	Moldova
1992	Fiji	1986	Morocco	2003	Lesotho	1992	Russian Federation
1994	Samoa	1988	Tunisia	2004	Zimbabwe	1992	Tajikistan
1995	Malta	1991	Egypt	2009	Burundi	1992	Turkmenistan
1997	Barbados	1992	Algeria	2010	Eritrea	1992	Ukraine
1998	Vanuatu	2001	Jordan	2013	Swaziland	1992	Uzbekistan
2004	Cape Verde	2002	Lebanon	no VAT	Angola	1993	Czech Republic
2007	Antigua and Barbuda	2008	Iran, I.R. of	no VAT	Gambia, The	1993	Poland
2007	St. Vincent & Grens.	2009	Djibouti	no VAT	Guinea-Bissau	1993	Romania
2010	St. Kitts and Nevis	no VAT	Afghanistan, I.R. of	no VAT	Liberia	1993	Slovak Republic
2012	St. Lucia	no VAT	Bahrain, Kingdom of	no VAT	Sierra Leone	1994	Bulgaria
2013	Seychelles	no VAT	Iraq	no VAT	South Sudan	1996	Albania
no VAT	Bahamas, The	no VAT	Kuwait			1998	Croatia
no VAT	Comoros	no VAT	Libya			1999	Slovenia
no VAT	Grenada	no VAT	Oman			2000	Macedonia, FYR
no VAT	Maldives	no VAT	Saudi Arabia			2003	Montenegro
no VAT	Solomon Islands	no VAT	Syrian Arab Republic			2003	Serbia, Republic of
no VAT	São Tomé & Príncipe	no VAT	United Arab Emirates			2006	Bosnia & Herzegovina
no VAT	Timor-Leste	no VAT	Yemen, Republic of			no VAT	Kosovo, Republic of
no VAT	Tonga						
no VAT	Tuvalu						

Source: IMF (2014).

Table A3: Gini coefficient with alternative IV strategy, period 1975–2000

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
V	1.60	0.84	16.24	29.14	0.97	1.84	0.71	4.45
	[0.40]	[0.22]	[0.75]	[0.91]	[0.85]	[1.42]	[0.19]	[0.91]
LICV			-15.3	-22.13			0.21	-2.02
			[-0.87]	[-0.92]			[0.04]	[-0.32]
MICV			-9	-12.59			2.07	1.57
			[-0.73]	[-0.77]			[0.44]	[0.33]
OPENV				-10.83				-6.4
				[-1.42]				[-1.60]
lnYPC		-0.77	-1.23	-0.78		-3.34	-3.97	-3.47
		[-0.33]	[-0.39]	[-0.20]		[-1.21]	[-1.35]	[-1.15]
OPEN		3.46	1.71	5.08		3.65	3.28	6.22*
		[1.28]	[0.42]	[1.06]		[1.39]	[1.23]	[1.88]
AG		-1.43	-5.13	4.04		-0.03	-0.69	4.75
		[-0.11]	[-0.31]	[0.19]		[-0.00]	[-0.05]	[0.33]
M2ofgdp		5.07*	1.79	0.8		6.70***	7.34***	7.62***
		[1.96]	[0.31]	[0.11]		[2.66]	[2.67]	[2.72]
FDI		0.25**	0.35*	0.41		0.26**	0.26**	0.24**
		[2.04]	[1.68]	[1.52]		[2.22]	[2.22]	[1.97]
Period FE	yes	yes	yes	yes	yes	yes	yes	yes
Country FE	yes	yes	yes	yes	yes	yes	yes	yes
Region*period FE	no	no	no	no	yes	yes	yes	yes
Observations	276	225	225	225	276	225	225	225
First stage FV	8.397	9.636	5.048	3.771	232.5	192.5	66.02	50.1
First stage FLICV			60.96	45.62			41.51	31.1
First stage FMICV				9.45			35.35	26.46
First stage FOPEN				9.414				33.21

Notes: Dependent variable: Gini index. Columns (1)-(4) are with year and country fixed effects and Columns (5)-(8) add region-year fixed effects. All estimations are IV estimations using 5-year averaged data. V and its interaction terms (LICV, MICV, OPENV, YPCV, AGRV) are instrumented with VAT adoption share of neighbouring countries weighted by inverse distances and its interactions correspondently. T-values are reported in brackets. First stage F- values show F-statistic test variable for each first stage regression separately.

Source: Authors' own calculations.

Table A4: Gini coefficient with alternative IV strategy, period 1975–2010

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
V	-5.34**	-3.88	8.4	16.29**	2.21*	3.58***	5.18	12.73***
	[-2.13]	[-1.14]	[1.14]	[2.08]	[1.96]	[2.87]	[1.36]	[2.68]
LICV			-17.13***	-20.45***			-8.48	-13.34**
			[-2.69]	[-3.06]			[-1.43]	[-2.05]
MICV			-5.36	-5.34			1.1	0.55
			[-1.03]	[-0.99]			[0.25]	[0.12]
OPENV				-11.52***				-11.11***
				[-3.32]				[-3.29]
lnYPC		0.46	0.13	-0.32		0.84	0.29	-0.13
		[0.44]	[0.13]	[-0.29]		[0.90]	[0.28]	[-0.12]
OPEN		2.26	2.76	10.14***		0.55	1.19	9.01***
		[1.24]	[1.51]	[3.43]		[0.33]	[0.66]	[2.93]
AG		-15.53**	-16.78**	-11.88		-3.48	-7.82	-5.03
		[-2.04]	[-2.22]	[-1.51]		[-0.54]	[-1.02]	[-0.63]
M2ofgdp		4.32***	2.82*	3.60**		3.46**	3.26**	4.20**
		[2.80]	[1.67]	[2.04]		[2.35]	[2.06]	[2.52]
FDI		0.02	0.04	0.08		0.05	0.05	0.07
		[0.44]	[0.81]	[1.38]		[1.12]	[1.09]	[1.41]
Period fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Country fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Region*period FE	no	no	no	no	yes	yes	yes	yes
Observations	467	410	410	410	467	410	410	410
Autocorrelation	2.39	1.67	0.44	0.16	1.38	0.39	0.14	0.02
First stage FV	44.3	22.1	8.6	6.6	315.9	262.0	97.3	72.7
First stage FLICV			69.1	52.3			62.7	47.7
First stage FMICV				29.5			68.6	51.4
First stage FOPEN				17.0				58.8

Notes: Dependent variable: Gini index. Columns (1)-(3) are with year and country fixed effects and Columns (4)-(6) add region-year fixed effects. All estimations are IV-estimations using 5-year averaged data. V and its interaction terms (LICV, MICV, OPENV, YPCV, AGRV) are instrumented with VAT adoption share of neighbouring countries weighted by inverse distances and its interactions correspondingly. T-values are reported in brackets. First stage F- values show F-statistic test variable for each first stage regression separately.

Source: Authors' own calculations.

Table A5: Gini coefficient with only income-based Gini, periods 1975–2000 and 1975–2010

	Period 1975–2000				Period 1975–2010			
	OLS		IV		OLS		IV	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
V	2.63*	0.18	9.42**	7.88	3.77***	1.24	11.81***	11.15***
	[1.99]	[0.10]	[1.98]	[1.51]	[3.55]	[0.84]	[4.13]	[2.64]
MICV		4.37*		2.62		4.53**		0.95
		[1.95]		[0.64]		[2.47]		[0.25]
lnYPC	3.48	2.39	6.28	5.6	-0.70	-0.42	0.28	0.32
	[1.07]	[0.74]	[1.51]	[1.38]	[-0.62]	[-0.37]	[0.21]	[0.25]
OPEN	2.44	2.07	0.69	0.49	2.08	1.86	2.86	2.8
	[0.59]	[0.51]	[0.14]	[0.11]	[0.82]	[0.75]	[0.97]	[0.99]
AG	5.33	11.19	31.52	34.73	2.91	9.17	13.93	15.07
	[0.30]	[0.62]	[1.17]	[1.37]	[0.27]	[0.85]	[1.08]	[1.18]
M2ofgdp	2.75	3.95	-0.22	0.53	3.68**	4.02***	2.90*	2.99*
	[0.89]	[1.28]	[-0.06]	[0.13]	[2.56]	[2.82]	[1.73]	[1.80]
FDI	0.09	0.08	0.28	0.27	0.01	0.01	0.02	0.02
	[0.44]	[0.38]	[1.02]	[1.05]	[0.19]	[0.17]	[0.27]	[0.27]
Observations	146	146	146	136	284	240	240	233
First stage FV			9.57	4.77			38.47	20.69
First stage FMICV					14.21			

Notes: Dependent variable: Gini index. V and its interaction are instrumented with NEIGHBOUR and its interactions correspondingly. T-values are reported in brackets. All regressions are with fixed effects and period dummies using 5-year averaged data. First stage F- values show F-statistic test variable for first stage regression.

Source: Authors' own calculations.

Table A6: Gini coefficient with only consumption-based Gini, periods 1975–2000 and 1975–2010

	Period 1975–2000				Period 1975–2010			
	OLS		IV		OLS		IV	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
V	-0.27	2.16	1.58	-0.42	0.54	0.26	-4.56	-8.43
	[-0.19]	[0.81]	[0.34]	[-0.08]	[0.38]	[0.13]	[-0.49]	[-1.01]
MICV		-1.12		4.68		0.34		9.06**
		[-0.38]		[1.04]		[0.15]		[2.14]
lnYPC		-5.14		-7.83*		1.59		-0.13
		[-1.26]		[-1.70]		[0.90]		[-0.07]
OPEN		3.65		2.51		1.87		3.05
		[0.92]		[0.64]		[0.70]		[0.92]
AG		-4.52		-15.58		-8.95		-16.12
		[-0.22]		[-0.73]		[-0.96]		[-1.55]
M2ofgdp		3.33		4.18		7.44*		5.69
		[0.57]		[0.75]		[1.75]		[1.24]
FDI		0.30*		0.35**		0.12		0.16
		[1.91]		[2.17]		[0.88]		[1.18]
Observations	146	132	146	108	244	224	244	205
First stage FV			7.40	2.92			3.98	2.53
First stage FMICV				5.21				14.14

Notes: Dependent variable: Gini index. V is instrumented with NEIGHBOUR and its interactions correspondingly. T-values are reported in brackets. All regressions are with fixed effects and period dummies using 5-year averaged data. First stage F- values show F-statistic test variable for first stage regression.

Source: Authors' own calculations.

Table A7: Gini coefficient with ex-Soviet states and Eastern European countries, period 1975–2010

	OLS				IV			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
V	1.97***	2.25***	2.55*	4.19**	3.46**	5.20**	10.55***	17.20***
	[2.79]	[2.88]	[1.78]	[2.24]	[2.35]	[2.55]	[3.37]	[4.55]
LICV			-3.18	-3.77*			-17.11***	-20.65***
			[-1.53]	[-1.78]			[-4.96]	[-5.56]
MICV			0.34	0.35			-5.21**	-6.25**
			[0.22]	[0.22]			[-1.96]	[-2.29]
OPENV				-2.52				-8.85***
				[-1.36]				[-3.06]
lnYPC		1.38*	1.1	1.02		1.95**	0.28	-0.11
		[1.96]	[1.51]	[1.41]		[2.42]	[0.32]	[-0.12]
OPEN		3.66**	3.72**	5.49***		3.40**	3.81**	10.06***
		[2.46]	[2.50]	[2.78]		[2.22]	[2.37]	[3.83]
AG		-7.35	-8.22	-7.29		-5.56	-11.59*	-8.9
		[-1.32]	[-1.47]	[-1.29]		[-0.96]	[-1.88]	[-1.39]
M2ofgdp		2.66*	2.62*	2.73**		2.48*	2.04	2.35
		[1.95]	[1.93]	[2.00]		[1.78]	[1.38]	[1.55]
FDI		0.03	0.03	0.04		0.04	0.03	0.06
		[0.65]	[0.68]	[0.83]		[0.71]	[0.67]	[1.13]
Year FE	yes	yes	yes	yes	yes	yes	yes	yes
Country FE	yes	yes	yes	yes	yes	yes	yes	yes
Observations	582	506	506	506	582	506	506	506
R-squared	0.08	0.13	0.14	0.15				
First stage FV					127.8	63.8	24.0	18.0
First stage FLICV							115.8	87.1
First stage FMICV							70.1	52.6
First stage FOPEN								34.1

Notes: Dependent variable: Gini Index. V is instrumented with NEIGHBOUR and its interactions correspondingly. T-values are reported in brackets. All regressions are with fixed effects and period dummies using 5-year averaged data. First stage F- values show F-statistic test variable for first stage regression.

Source: Authors' own calculations.