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Are taxes good for your health?

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Abstract: The global framework for financing development, adopted in 2015, places great emphasis on mobilizing domestic resources to finance the Sustainable Development Goals, which include universal healthcare. In a recent paper Reeves et al. (2015) attribute progress towards universal healthcare to higher levels of taxation, but report a negative association between taxes on goods and services (indirect taxes) and health outcomes, which they hypothesise arises from the impact such taxes have on the real incomes of the poor. This paper revisits the relationship between tax types and health outcomes using the ICTD Government Revenue Dataset, which, crucially, isolates taxes from resource industries. As expected, we confirm increases in revenue are associated with increased public health expenditure; we find some weak evidence that greater reliance on direct taxes is associated with higher health spending and better outcomes, but no evidence that indirect taxes are deleterious to health. We argue these relationships cannot bear the weight of causal interpretation but that they offer some guidance on what to expect from increased domestic revenue mobilization.

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1 Introduction

One of the major differences between the Millennium Development Goals framework which ran from 2000-2015, and the successor framework of the Sustainable Development Goals (2016-2030), is the emphasis on domestic resource mobilization, or taxation. This was also reflected in the Addis Ababa Action Agenda, adopted by world governments at the Third International Conference on Financing for Development in July 2015, which positioned domestic resource mobilization (taxation) as the first item on its "action agenda". Raising tax revenues is widely recognised as critical to achieving the Sustainable Development Goals, and following many years of civil society activism and campaigning has now become an established priority for international development cooperation.[1]

The strengthening of domestic resource mobilisation is the first of 19 SDG targets labelled as 'means of implementation'. A further target within the SDGs requires a reduction in the related phenomenon of illicit financial flows (cross-border movements of capital which are deliberately hidden because the transactions and/or the source of the capital is forbidden - e.g. individual or corporate tax evasion, the theft of state assets and the laundering of the proceeds of crime). This emphasis, and the public attention to the taxation of multinational corporations and of undeclared offshore wealth, reflects both the changed political climate since the global financial crisis of 2008 and also the work of a growing number of academics and civil society organisations - with the point made, often explicitly, that higher (direct) tax revenue will support better development outcomes.[2]

In light of this policy emphasis, the empirical relationships between taxation, development-oriented government expenditure, and development outcomes are of great interest: do the data support the idea that higher tax revenues will help deliver global development goals? The case of health seems a particularly clear one on the face of it. Additional domestic resource mobilisation can fund additional expenditure and so contribute to improved outcomes. As Gupta et al. (2015) note, the debate on universal health care has shifted from whether to pursue it, to how to achieve it - with growing support for public, pooled financing over private insurance or out-of-pocket spending.

The limited analysis to date of the question of whether curtailing illicit financial flows would support health progress has relied either on relatively mechanical use of historical relationships between tax revenues or GDP and mortality (O'Hare et al., 2014); or on simple correlations between illicit flow volumes and development outcomes (Spanjers and Foss, 2015).

[1] See, for example, the OECD Task Force on Tax and Development; From Billions To Trillions: Transforming Development Finance, a joint statement issued by the IMF and multilateral development banks; and the Addis Tax Initiative in which aid donors committed to doubling their assistance for domestic resource mobilization. Civil society emphasis dates largely to the establishment of the Tax Justice Network in 2003, related in Seabrooke and Wigan (2015b,a)

[2] See for example Oxfam's Africa: Rising for the few or Action Aid Ebola-affected countries lose more in corporate tax dodging than they spend on health. Some estimates of forgone revenues are presented in Zucman (2014), Nitsch (2015), Crivelli et al. (2015) and Cobham and Janský (2015). A good overview of policy questions is provided in Reuter (2012)

However, in a recent paper Reeves et al. (2015) investigate the relationships between revenue sources and health in developing countries and conclude that "tax revenue was a major statistical determinant of progress towards universal health coverage". They also report the striking result that whilst higher revenues from income taxes are associated with better health outcomes, there is a negative association between taxes on goods and services and health outcomes, which the authors attribute to these taxes reducing the real incomes of the poor.

There are other potential mechanisms via which inequality may affect health outcomes (Truesdale and Jencks, 2016), but regarding the relationship between tax types and inequality Lustig et al. (2011) show that the 'conventional wisdom' about the relative progressivity of direct vs indirect taxes should not always be taken for granted - countries vary substantially. On the other hand, taxes can have a material impact on inequality and the real incomes of the poor (Piketty et al., 2014).

A further mechanism via which taxes may affect health spending and outcomes is the political economy argument that taxes lead to political representation and better governance. Prichard et al. (2014) confirm the average relationship between greater government reliance on tax, and stronger governance, which some studies (Mahon, 2005; Di John, 2006) have suggested is most powerful for direct taxes. If a more representative government might be thought more likely to spend a larger share of its revenues on health, then again higher levels of (direct) taxation might be more likely to support improved health outcomes, for a given level of national income.

This paper revisits these relationships in low-and-middle income countries using the ICTD Government Revenue Dataset, which provides improved coverage and accuracy in comparison to taxation data drawn from the World Development Indicators used by Reeves et al. (2015).[3] An important attribute of the ICTD GRD data is that, where possible, it distinguishes between resource and non-resource taxes and other revenues. This is potentially important. Edwards (2016) uses natural geological variation to instrument for the relative size of the mining sector in an economy and finds that countries with larger mining shares tend to have poorer health and education outcomes than countries with similar per capita incomes, geographic characteristics, and institutional quality. We also refine the empirical model along some dimensions and elaborate on difficulties in the interpretation of statistical associations between taxation and other fiscal variables. In particular we draw attention to the problem of omitted variable bias when estimating the relationships between variables that form part of a budget constraint, as shown by Kneller et al. (1999) among others.

These data confirm that there is a positive association between health expenditure and taxes of all varieties. But in most countries taxes are the largest component of government revenue and this statistical association merely tells us that on average governments spend a share of their marginal revenues, from each component of revenue, on health. A

[3] Available at http://www.ictd.ac/dataset. Prichard et al. (2014) describes the construction of the ICTD GRD and how it compares to other widely used datasets.

potentially more interesting question is whether governments who make greater or lesser use of different tax types tend to spend more on health than would be predicted by their total level of taxation and other country characteristics. Following Reeves et al. (2015) we focus on direct and indirect taxes. We find weak evidence that greater use of direct taxes is associated with higher levels of public health spending.

Regarding the relationships between tax types and health outcomes, we find some fragile evidence that direct taxes are associated with better health outcomes, when controlling for a set of government and country characteristics. But we also find some evidence that taxes on goods and services are associated with better health outcomes, in sharp contrast to Reeves et al. (2015), although again these relationships do not survive in all model specifications. We find no support for the idea that indirect taxes have a deleterious effect on health.

2 The interpretation of statistical associations in this context

In most empirical work, the possibility that explanatory variables are endogenous, perhaps because causality runs in both directions or perhaps because both the dependent and the explanatory variable of interest are driven by some omitted third factor, is usually of great concern. Much effort is often expended to identify sources of exogenous variation in the explanatory variable of interest, to permit causal inference.

It is possible to think of exogenous variation in revenues from various tax types, perhaps driven by external macroeconomic shocks or even international efforts to curtail tax avoidance by multinational corporations, and, for example, researchers might pursue an instrumental variables or natural experiment approach to isolate exogenous variation in revenues from different tax types and trace their average impact on health expenditure across countries. Otherwise the interpretation of statistical relationships between fiscal variables in empirical models that have been estimated on observational data must account for the fact taxation is a policy decision, and hence that a causal interpretation of estimated effects is usually unwarranted. The best that can be said of estimated statistical associations in observational data, between fiscal variables, is that they restrict the set of plausible hypotheses concerning government behaviour.

Obtaining estimates of how public health expenditure tends to respond to an exogenous increase in taxes on corporate profits, for example, would not tell us what mix of taxes governments tend to choose to finance desired increases in health expenditure, nor how revenues would be spent if a policy decision was taken to raise corporate tax revenues (which would depend on the motivation behind that decision). In the context of policy debates around health financing, the estimated average historical response of public health expenditure to exogenous changes in tax revenues across countries would reveal something about the preferences of the average government, which might give us some indication of how governments may be expected to spend the fruits of domestic mobilization efforts, if the past is any guide to the future. It would not tell us how governments who have made progress towards universal health coverage have tended to finance it, for example. This paper confines itself to revisiting and expanding on the relationships estimated in Reeves et al. (2015) but in general research in this area would benefit from more precisely articulated research questions coupled with an empirical strategy suited to identifying the effect in question.

An obvious likelihood in this context is that both expenditure and revenue choices are explained by third factors, such as government and country characteristics. For example, as countries get richer and their formal economies grow and informal economies shrink, direct taxes tend to account for a larger share of tax revenues and public health expenditure also tends to rise somewhat as a share of GDP, although in isolation income levels explains only a tiny fraction of health spending levels across countries (see Figure 1).

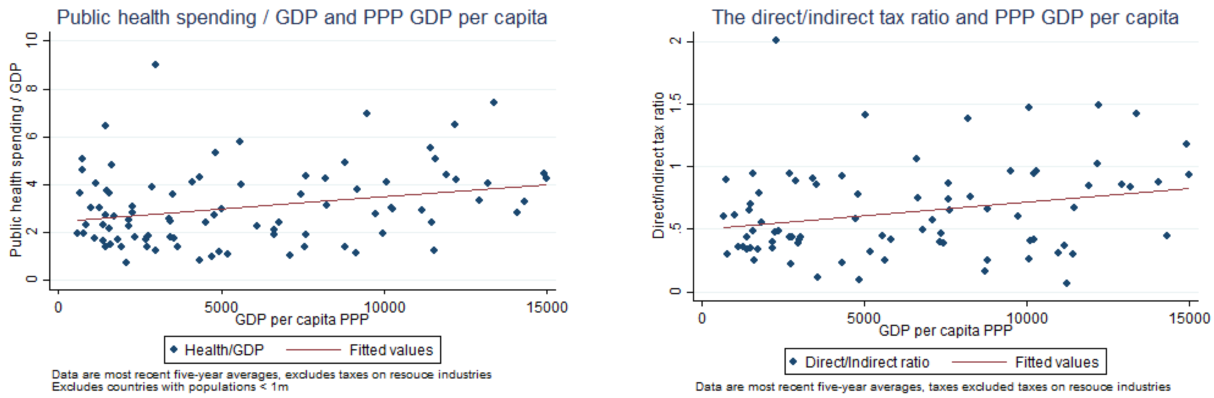


Figure 1: Direct taxes and health spending rise with GDP

In addition, both health spending levels and tax composition are likely to be affected by shifting international consensus positions - especially in developing countries. Since the 1990s, and seen most clearly in the Millennium Development Goals, there has been a growing prioritisation of health. At the same times, the 'tax consensus' that held sway through much of the last three decades (Cobham, 2007; Marshall, 2009; Baunsgaard and Keen, 2010; Bird, 2014) has promoted a switch from trade taxes to taxes on goods and services, and encouraged the relative neglect of direct taxes.

Another third factor that may drive both expenditures and revenues is business cycle frequency changes in economic activity. Fiscal policy is particularly pro-cyclical in developing countries: government expenditure rises during good times whilst overall taxes fall, as a share of GDP, although components such as taxes on profits may be more likely to be counter-cyclical (Talvi and Végh, 2005; Vegh and Vuletin, 2012). These regularities may drive estimated relationships between taxation and expenditure, particularly when based on within-country variation in panel data, as in fixed-effects estimators.

As will be explained below, an empirical model of the relationship between tax types and health *outcomes*, estimated on observational data, must include control variables such as health expenditures and income per capita, to avoid omitted variable bias. The estimated coefficient on a tax type, capturing the relationship between that form of taxation and health outcomes holding health expenditure constant, would be of potential interest to a government that wishes to raise revenues to fund health spending and is considering alternative choices of tax type because, at the margin, it may be that certain taxes do themselves have an impact on health outcomes. But we should be careful not to misinterpret the estimated coefficient on a tax type in a health outcomes regression as summarising the estimated impact on health outcomes of using that tax type to finance higher health expenditures, because that entails increasing health expenditure, not holding it constant.

2.1 The importance of the government budget constraint

Taxation and expenditure variables form part of the government budget constraint. In the absence of measurement error, total expenditures must equal total revenues. Revenues include taxes, grants, various non-tax revenues (revenues from state-owned enterprises, licence fees etc.) and also net borrowing and seigniorage (or revenues from printing money). Over any given period of time:

$$\sum E_i = \sum T_j + \sum R_k + \Delta B + \Delta M$$

where different categories of expenditure E are indexed by i, tax types T by j, non-tax revenues R by k and ΔB denotes changes in bonds and ΔM change in base money. If one expenditure category is regressed on all other elements of the budget constraint, the estimated coefficients would be 1 for revenues and -1 for other expenditures. Holding all else constant, a 1 unit change in any revenue component *must* be associated with a 1 unit change in the expenditure component in question (barring measurement error). At least one element of the budget constraint must be omitted from the estimating equation, to allow the coefficients to differ from 1.

However, interpretation of estimated coefficients is complicated because a number of different causal explanations, or data generating processes, may be consistent with the same set of estimated coefficients. Suppose, for the sake of illustration, total expenditure E (equal to total revenue R) is exogenously determined and all governments spend half of their revenues on health $e_1 = 0.5 * E$. Further suppose there are three categories of revenue, which all governments set in proportions $r_1 = 0.2 * R, r_2 = 0.3 * R, r_3 = 0.5 * R$. In such a world, an econometrician investigating the relationship between revenues and health spending by running an ordinary least squares regression would estimate coefficients that solve the following equation:

$$0.5 = \beta_1 0.2 + \beta_2 0.3 + \beta_3 0.5$$

That equation has infinite solutions, but when some well-behaved statistical noise is added to simulated data, standard estimating procedures recover estimated coefficients of (approximately) $\beta_1 = 0.25$, $\beta_2 = 0.45\, \beta_3 = 0.65$.[4] Interpretations along the lines of 'all else constant, an additional dollar of r_3 on average raises e_1 by 0.65 dollars' or 'countries that make more use of $r3$ tend to have higher levels of e_1' are not warranted. Here the relatively high coefficient on r_3 merely reflects its proportionately greater use in the revenue mix. However, it is possible to generate similar estimates by assuming a data generating process in which countries tend to make proportionately *less* use of r_3, but where countries with relatively high r_3 also tend to spend a higher share of total revenues on health.[5] So similar estimated coefficients are consistent with quite different processes for determining taxation and spending.

Statistical associations between taxes and expenditures, based on levels data, may also be a poor guide to marginal spending decisions. Countries with high levels of health expenditure and a certain mix of revenues, may have other priorities for the marginal tax dollar.

Because the existence of the budget constraint implies that changes in one component must be associated with changes in at least one other component, ignoring the existence of budget constraints when modelling the impact of fiscal variables on *outcomes* can lead to omitted variables bias, as shown by Kneller et al. (1999) among others.

Suppose an empirical model is estimated in which health outcomes are regressed on tax types, to investigate the hypothesis that regressive taxes have a negative impact on health by reducing the incomes of the poor, but health expenditure is omitted from the estimated model. The fact that taxes partially fund health expenditures will muddle the positive impact of health expenditure with the estimated impacts of the taxes. If regressive taxes do in fact have a negative impact on health, the estimated coefficient on those taxes would be biased upwards by the omitted (and correlated) positive impact of health expenditures.

However, if health expenditures are included in the model to avoid omitted variable bias, then estimating the impact of increasing one tax type whilst holding health expenditures constant implies either reducing some other source of revenue or increasing some other form of expenditure (because budget constraints have to add up). So estimates reflect the joint impact of the tax increase and these omitted offsetting changes. There is no way around this - it is the nature of budget constraints. As Kneller et al. (1999) show, ideally the components of the budget constraint which are excluded from the estimating equation should have no impact on the outcome being modelled, with the result that the estimated coefficients on the variable of interest are not contaminated by the omitted variable(s), which have zero impact by assumption. In this context, the model of health outcomes estimated by Reeves et al. (2015) excludes all other items of government expenditure (education, defence etc.) and other sources of government revenue (such as seignorage and borrowing). Some of these may be safely assumed to have no impact on health outcomes,

[4] The simulation involves $N = 3000$ countries with randomly generated total revenues (and expenditures), divided between e_1, e_2 and r_1, r_2, r_3 as described, with a zero-mean, independent and normally distributed error added to every variable.

[5] This point is also confirmed by regressions run on simulated data, available on request.

but in other cases there are plausible effects on health outcomes. For example education spending may improve health outcomes whilst seigniorage may reduce the real incomes of the poor by creating inflation. However, it is only in cases where the omitted offsetting increase in expenditure, or decrease in other source of government revenue, has a negative impact on health that the model would be biased towards finding a negative impact of increasing any particular tax type, as reported by Reeves et al. (2015). That does not seem very likely - it is it easier to believe the estimated coefficient on taxes are biased upwards.

3 Taxes and health expenditure

This section investigates two questions concerning health expenditure and taxation choices: how is public health expenditure financed? And, does the choice of tax types have any relationship with the chosen level of health spending?

To address the first question, we regress health expenditure on revenue variables, starting with total government revenues and then progressively disaggregating. All revenue variables are mutually exclusive, or non-overlapping, in the sense that it is possible change one variable whilst holding others constant. The variable 'other revenues' is a residual computed by subtracting the other included revenue variables from total revenues, so its constituents change from model to model. We take advantage of the ICTD GRD differentiating between resource and non-resource taxes and other revenues, and focus on the non-resource components of taxes. The goods and services tax data used by Reeves et al. (2015), taken from the World Development Indicators, includes taxes on the extraction and production of minerals. Resource rents are dramatically different from other taxes on goods and services, both in terms of their incidence and in related political economy considerations that are likely to shape government behavior.

As discussed previously, the estimated coefficients on individual tax types in expenditure regressions must be interpreted carefully. A positive coefficient on direct taxes, for example, does not mean that countries with higher direct taxes tend to have higher levels of public health expenditure. The interesting null test is whether the coefficients on various tax types are statistically significantly different from each other, not whether they are non-zero, even if there are various possible explanations for differing estimated coefficients on tax types. If one regards revenue and expenditure decisions as separable, then governments will spend revenues in line with their preferences, whatever the source happens to be.

Table 1 reports ordinary least squares estimates based on data averaged over five year periods. Although fixed-effects estimates would be feasible on these data, cross-section regressions are widely regarded as better suited to capturing average long-run relationships (Pesaran et al., 1996) and may also be more robust to measurement error the estimates based on within-country variation (Hauk and Wacziarg, 2009). The specification of dynamic models, which include lagged values of the dependent variable to generate convergence dynamics, can be difficult, especially in the presence of heterogeneity across countries (Pesaran et al., 1999). Although we will report estimates from static fixed-effects models in following sections, further investigation of the dynamics of the relationships between taxes, health expenditure and health outcomes, may be a valuable avenue for future research (but is beyond the scope of this paper).

Table 1: Public Health Expenditure regressions

	M1	M2	M3	M4	M5
Total revenue	0.114***				
	(6.08)				
Taxes (non resource)		0.125***			
		(8.30)			
Resource revenues		0.0210**		0.0222*	
		(2.31)		(2.20)	
Grants		0.165***	0.182***	0.125***	0.122***
		(10.88)	(4.23)	(5.33)	(4.27)
Other revenues		0.110**	0.0140	0.144***	0.0286***
		(2.28)	(1.56)	(3.44)	(2.89)
Direct taxes (non resource)			0.157***	0.128***	0.140***
			(5.53)	(4.05)	(3.85)
Indirect taxes (non resource)			0.0798***	0.127***	0.136***
			(3.79)	(5.81)	(5.60)
Constant	0.143	0.0447	0.549**	0.0371	0.0620
	(0.34)	(0.18)	(2.91)	(0.14)	(0.23)
Observations	465	134	396	106	106
Countries	128	46	118	41	41

t statistics in parentheses

Tax variables include social security contributions.

Constituents of residual Other Revenues varies

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

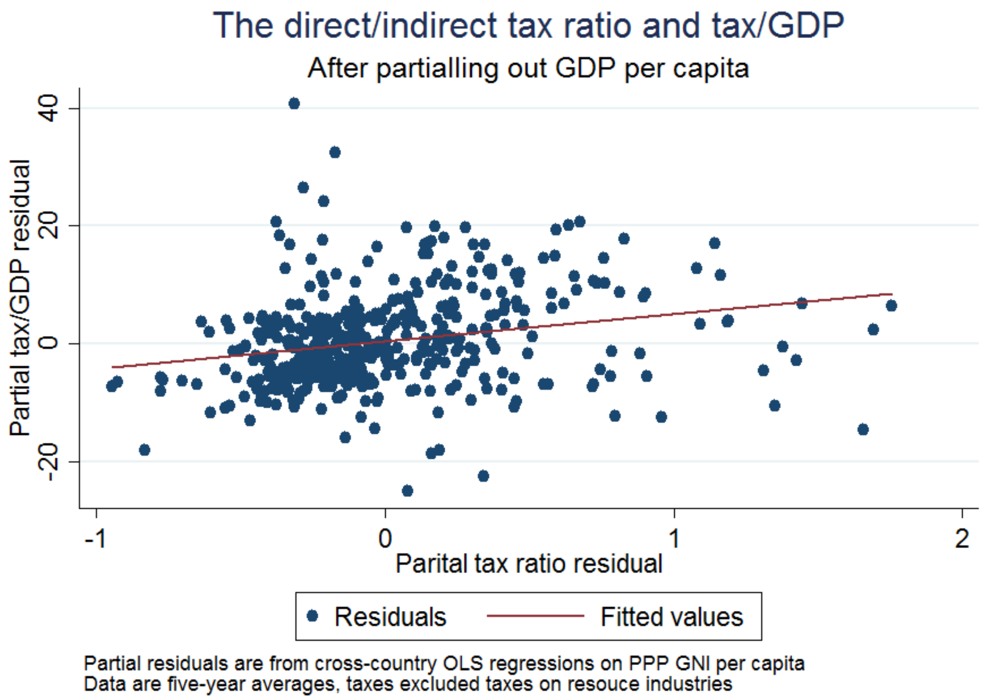
The estimates in the first column of table 1 suggest that on average that a one percentage point increase in government revenues as a percentage of GDP (excluding borrowing and seigniorage) is associated with a 0.12 percentage point increase in public health expenditure. Column 2 splits revenues into non-resource taxes, total resource revenues (including taxes on resource industries) and grants. The estimates suggest that increases in resource revenues are associated with a much smaller change in public health expenditure whilst a greater proportion of grants tends to feed through into health (although the estimates also reflect the average share of resource revenues in total revenue). Note that total resource revenue data are only available for a small number of countries - column 1 was estimated on data from 128 countries, column 2 from 46 countries. Columns 3 and 4 disaggregate taxes into direct and indirect components. Column 3, which does not use the total resource revenue variable and hence is estimated on more countries, finds that a higher proportion of direct taxes are spent on health than indirect, and the difference between the two coefficients is statistically significant at the 1 per cent level. In column 4, which separates out resource revenues and grants, but is estimated on a smaller sample, the coefficients on direct and indirect taxes are statistically indistinguishable. Column 5 uses the same sample as column 4 but estimates the model in column 3; the results show that the contrast between columns 3 and 4, is explained by the sample not the choice of controls. The larger sample in column 3 contains many more poorer countries and some smaller middle-income countries.

Table 1 does not shed light on the question of whether governments who make greater use of direct taxes tend to spend more on health than would otherwise be expected, because it estimates the relationship between revenue types and public health expenditure, as shares of GDP, at all levels of public health expenditure. The relationships between taxation and expenditure might depend on the overall level of expenditure (and revenue) as a share of GDP. Perhaps countries that manage to achieve the highest levels of expenditure tend to do so by raising direct taxes, whereas at lower level of expenditure gains tend to come from indirect taxes, and perhaps spending preferences for the marginal tax dollar also tend to change at different levels of expenditure. Again more careful analysis of heterogeneity could be a fruitful avenue for research, but it beyond the scope of this paper.

To investigate whether relatively high levels of health expenditure are associated with different revenue sources, we run regressions intended to ask whether countries that make relatively more use of direct taxes tend to spend more on public health than would be predicted by their total level of taxation, controlling for other country characteristics. Our variable of interest is the *ratio* of direct to indirect taxes, controlling for total tax revenue. Although it remains to be tested, these specifications were chosen in hope of evading the problems with interpreting regressions of budget line items, either in absolute levels or as shares of GDP, as discussed above.

An alternative strategy would be to exclude total tax revenues and model the level of public health expenditure using a set of non-revenue variables (such as GDP per capita or indices of government quality) and introduce this ratio to such a regression. However the interpretation of the coefficients on these variables would be unclear, because they would undoubtedly be correlated with omitted revenue variables. There is a strong positive correlation between the ratio of direct to indirect taxes and the overall tax to GDP ratio: countries that make greater use of direct taxes tend to have higher tax to GDP ratios. In part this is because they tend to be richer, and richer countries tend to have higher tax takes. However the correlation remains even after controlling for real income per capita. Figure 2 shows the correlation between the direct/indirect tax ratio and taxes as a share of GDP, after controlling for the level of real GDP per capita. Hence we include the level of total taxes as a share of GDP in our regressions.

Figure 2: Direct taxes are associated with higher levels of taxation



The first column of table 2 shows regressions of public health expenditure on total revenues, disaggregated into non-resource taxes, grants and other revenues, much like the first columns in table 1. The residuals in such a regression could reflect the extent to which governments are spending more (or less) than average on health, given these revenue variables. Columns M2 then introduces non-revenue variables to explain this deviation from average health spending given revenues. It should be emphasized that this is not the same thing as explaining the level of expenditure, which is in great part determined by the level of revenues. The results indicate that there is a positive correlation between the direct/indirect ratio and higher than predicted levels of public health expenditure, but it is only statistically significant at the 10 per cent level. One hypothesis for how tax choices may influence spending decisions is by making government more accountable to citizens. Column M3 introduces variables from the World Government Indicators, and the voice and accountability index is positively associated with higher than predicted health spending, but the introduction of that variable does not much change the coefficient on the direct/indirect tax ratio. The final two columns introduce measures of inequality, which are potential candidates for a country characteristic that may partially explain both revenues and health expenditure levels. Column 4 uses the Gini coefficient for which data are more readily available, and the estimated coefficient on the direct/indirect tax ratio reduces in magnitude and loses statistical significance, consistent with the idea inequality explains both revenues and expenditures, but Column 5 uses the Palma ratio, a measure designed to better capture inequality between the rich and poor.[6] Here the direct/indirect ratio regains statistical significance at the 10 per cent level, despite the markedly smaller sample size.[7] So although statistical significance is low and fragile, there is weak evidence in cross-section that countries which make relatively more use of direct taxes also tend to have higher levels of public health expenditure, after controlling for total revenues and a set of country characteristics.

Table 2: Health Expenditure level regressions: cross-section

	M1	M2	M3	M4	M5
Taxes (non resource)	0.127***	0.0957***	0.0837***	0.0811***	0.0520**
	(11.62)	(7.20)	(6.51)	(4.98)	(2.10)
Grants	0.199***	0.196***	0.217***	0.180***	0.172**
	(6.63)	(3.69)	(5.75)	(5.38)	(2.60)
Other revenues	0.0348*	0.00643	0.0171	0.0422*	0.112**
	(1.82)	(0.32)	(0.91)	(1.81)	(2.54)
Mining share		-0.00229	-0.00151	-0.0215	-0.0509**
		(-0.20)	(-0.14)	(-1.60)	(-2.40)
Direct/Indirect ratio		0.591*	0.517*	0.323	0.608*
		(1.89)	(1.98)	(1.07)	(1.74)
GNI/Cap PPP		0.0000465	0.0000444*	0.0000517	0.0000670
		(1.60)	(1.68)	(1.47)	(1.46)
Voice and accountability			0.580***	0.590***	0.924**
			(3.36)	(2.84)	(2.66)
Govt effectiveness			-0.268*	-0.372*	-0.756**
			(-1.75)	(-1.88)	(-2.62)
Gini				0.00786	
				(0.76)	
Palma ratio					-0.0344
					(-0.70)
Constant	0.112	0.152	0.342	0.208	0.607
	(0.42)	(0.52)	(1.30)	(0.36)	(1.34)
Observations	451	278	275	190	90
Countries	127	105	105	94	55

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

[6]The Palma ratio is a concentration ratio of the incomes of the top 10 per cent to those of the bottom 40 per cent, motivated by the observation that the income share of the omitted 50 per cent is very stable (Palma, 2011; Cobham and Sumner, 2013).

[7] Inequality data are taken from UNU-WIDER (2015), 'World Income Inequality Database (WIID3c)'

This association in cross-section may be driven by unobserved country characteristics, and within-country variation can be exploited to control for such characteristics, providing these are time-invariant. Table 3 reports estimates from fixed-effects regressions, including country-specific time trends, in which the estimated coefficients on the direct to indirect tax ratio are no longer statistically significant at the 10 per cent level, although they remain positive.[8] But note that in some of these regressions even the level of taxation is found to have no statistically significant relationship with health expenditures, so despite using data averaged over five-year periods it may be that expenditure levels are not responsive to much in the short-run and that these associations only emerge over the long-run.

Table 3: Health Expenditure level regressions: fixed effects

	M1	M2	M3	M4	M5
Taxes (non resource)	0.0338	0.0725*	0.0704**	0.121	0.134
	(0.90)	(1.88)	(2.18)	(1.43)	(0.54)
Other revenues	-0.0229	0.0169	0.00953	0.109	-0.0120
	(-0.98)	(0.34)	(0.18)	(1.09)	(-0.11)
Mining		-0.0451	-0.0443	-0.0383	0.0112
		(-1.42)	(-1.39)	(-0.79)	(0.12)
Direct/Indirect ratio		0.326	0.398	0.349	2.366
		(0.63)	(0.76)	(0.45)	(1.48)
Voice and accountability			0.327	0.465	-0.424
			(1.14)	(1.19)	(-0.64)
Govt effectiveness			0.150	-0.146	0.179
			(0.32)	(-0.18)	(0.10)
Gini				0.00437	
				(0.23)	
Palma ratio					0.0773
					(0.15)
Constant	2.021***	1.577**	1.788***	-0.225	-0.950
	(3.75)	(2.43)	(3.14)	(-0.12)	(-0.23)
Observations	451	278	275	190	90
Countries	127	105	105	94	55

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Regressions include country-specific linear time trends

[8] Statistical significance is actually even lower in fixed-effects regressions excluding country-specific linear time trends (not reported.)

4 Taxes and health outcomes

Tax experts, as exemplified by the UK's Mirrlees Review (Mirrlees and Adam, 2011), emphasise that the system of taxation and expenditure must be considered as a whole, and that efficiency considerations suggest that progressive goals may sometimes be best served by a system that includes some regressive elements, for example consumption taxes that fund progressive expenditures (Mabugu et al., 2015). Taxation is a dynamic problem. There is a strong positive association between real incomes and health outcomes, which suggests that a tax system conducive to economic growth may be instrumental to the achievement of healthcare goals.

It could be that consumption taxes can have a negative impact on health outcomes by reducing the real incomes of the poor at any point in time, whilst at the same time being more conducive to economic growth and hence health improvements over the long run. If so, policymakers would face a difficult trade-off. Single-equation empirical models, as employed in this paper and by Reeves et al. (2015), cannot tease out these relationships. Such questions are beyond the scope of the present paper, and it should not be presumed that orthodox thinking on the growth impact of taxes is correct. The point of this paragraph is merely that the relationship between taxes and health is complex and differs from short-run to long-run.

There are many links in the chain between domestic resource mobilization, health expenditure and health outcomes (Filmer et al., 2000). The efficacy of public health systems is the subject of much research (Wagstaff and Claeson, 2004; Rajkumar and Swaroop, 2008; Das and Hammer, 2014) and is beyond the scope of this paper, which concerns solely the possibility that taxes themselves may have a direct impact on health outcomes.

Reeves et al. (2015) investigate various dimensions of universal health coverage. The first concerns the breadth of coverage, as measured by International Labour Organization (ILO) data on health coverage as a percentage of the population. Coverage is closely related to the level of public health expenditure, but differs because a government may, for example, deliver low coverage relative to spending levels by concentrating spending in better-off urban areas.[9]

Column 1 of Table 4 shows that there is strong bivariate correlation between health coverage and public health expenditures, suggesting that on average a 1 percentage point increase in public health expenditure as a share of GDP is associated with health coverage being extended to 7 per cent of the population. Column 2 shows that conditional on the share of public health expenditure in GDP, more effective governments in wealthier countries tend to have higher levels of health coverage. The negative coefficient on the WGI index for voice and accountability is a puzzle. Column 3 shows that controlling for these variables, the ratio of direct to indirect taxes has a positive association with health coverage. There is no obvious direct channel whereby revenue choices would affect health coverage,

[9] In these regression ILO coverage data is taken for the most recent available year whilst other variables are the most recent available five-year average.

Table 4: Health Coverage regressions

	M1	M2	M3	M4
Public Health Exp.	10.06***	5.206***	3.923**	4.224*
	(5.54)	(2.98)	(2.28)	(1.91)
GNI/Cap PPP		0.00276***	0.00209***	0.00219**
		(5.23)	(3.48)	(2.48)
Govt effectiveness		25.45***	24.73***	22.84***
		(5.11)	(4.55)	(3.33)
Voice and accountability		-12.31**	-13.38***	-9.475*
		(-2.60)	(-3.14)	(-1.74)
Direct/indirect ratio			25.47***	21.89***
			(3.54)	(2.71)
Gini				-0.392
				(-1.30)
Constant	20.52***	23.40***	12.84	32.74*
	(3.20)	(3.38)	(1.61)	(1.72)
Observations	461	445	372	254
Countries	116	114	105	98

t statistics in parentheses

Dependent variable is ILO health coverage (pct population)

Tax variables include social security contributions.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

but possible explanations include both variables having something to do with the size of the formal economy or the extent of urbanization. Column 4 shows that adding inequality to the set of control variables does not alter this result.[10] Unfortunately sufficiently long time-series of coverage data are not available, to permit the use of fixed-effects regressions to control for time-invariant country characteristics.

Table 5: Health Access regressions

	M1	M2	M3	M4
Public Health Exp.	3.407	3.888	4.427***	3.932**
	(1.46)	(1.59)	(3.64)	(2.60)
GNI/Cap PPP	0.00405***	0.00427***	0.00306***	0.00272***
	(7.37)	(5.09)	(7.62)	(6.24)
Govt effectiveness	-6.343	-8.689	3.391	0.208
	(-1.14)	(-1.38)	(0.88)	(0.05)
Voice and accountability	6.432	6.306	0.556	2.640
	(1.52)	(1.30)	(0.15)	(0.70)
Gini	0.434*	0.428	-0.0179	-0.0000928
	(1.79)	(1.66)	(-0.09)	(-0.00)
Direct/indirect ratio		-0.215		8.778**
		(-0.04)		(2.09)
Constant	11.94	8.698	46.51***	42.65***
	(0.90)	(0.60)	(3.77)	(2.79)
Observations	154	129	282	247
Countries	76	69	114	106

t statistics in parentheses

Dependent variable: M1 M2 antenatal visits M3 M4 births attended

Tax variables include social security contributions.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5 investigates access to healthcare, as proxied by the proportion of pregnant women who receive at least 4 antenatal visits (columns 1 and 2) and the proportion of births attended by a skilled health professional (columns 3 and 4), both taken from the World Development Indicators dataset. Data are averaged over 5-year periods.[11] For reasons of space, results are presented in each case with the full set of controls used previously, first without revenue variables and then with. The ratio of direct to indirect taxes bears no relationship to antenatal visits but there is a positive statistically significant relationship with birth attendance. These same relationship are evident when estimated using within-country variation to control for time-invariant country characteristics (results not shown)

[10] Alternatively, following Reeves et al. (2015), regressions could include revenues from different sources as a share of GDP. If so the estimated coefficients on direct taxes are positive and statistically significant. Results not shown, available on request.

[11] Health access data are from period surveys, so the five-year averages ignore missing values.

but they do not survive the inclusion of country-specific linear time trends, shown in table 6.

Table 6: Health Access regressions: fixed effects with time trends

	M1	M2	M3	M4
Public Health Exp.	-0.657	-1.456	0.761	-0.712
	(-0.20)	(-0.35)	(0.43)	(-0.44)
Govt effectiveness	-6.229	-2.518	-8.331	-6.910
	(-1.08)	(-0.39)	(-1.61)	(-1.45)
Voice and accountability	9.715	11.05	0.246	2.525
	(1.34)	(1.26)	(0.06)	(0.71)
Gini	-0.208	-0.404	-0.0164	0.0130
	(-0.93)	(-1.57)	(-0.09)	(0.07)
Direct/indirect ratio		-21.33		3.126
		(-1.17)		(0.61)
Constant	46.90***	69.70***	61.17***	63.47***
	(3.40)	(3.55)	(7.01)	(6.23)
Observations	154	129	282	247
Countries	76	69	114	106

t statistics in parentheses
Dependent variable: M1 M2 antenatal visits M3 M4 births attended
Tax variables include social security contributions. Regressions include time trends
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Finally, we turn to the relationships between taxes and health outcomes, where Reeves et al. (2015) report the striking result that indirect taxes - taxes on trade, goods and services - have a negative relationship with health outcomes, which they attribute to the regressive nature of these taxes. Table 7 shows that in cross section the direct/indirect tax ratio is associated with better health outcomes (the coefficients are negative) but the relationships are not statistically significant. We use data that excludes taxes on the extractive industries, which may explain why our findings differ from those in Reeves et al. (2015).

Data on health outcomes are available from 1995 and Reeves et al. (2015) base their estimates on within-country variation, using the fixed-effects estimator with clustered standard errors and including country-specific linear time trends. These have the advantage of controlling for time-invariant unobserved country characteristics which may explain health outcomes and be correlated with included variables, and the time trends may capture such things and technological improvements which may also be correlated with trends in tax types over time. The interpretation of these estimates is potentially complicated by business-cycle frequency changes in economic activity, taxes and health outcomes, although using 5-year averages and controlling for GDP per capita may mitigate such concerns.

Table 8 reports results from fixed-effects health outcomes regressions, without the in-

Table 7: Health Outcomes cross-section regressions

	M1	M2	M3
Public Health Exp.	-3.855*	-2.200***	-2.968**
	(-1.82)	(-3.16)	(-2.20)
GNI/Cap PPP	-0.00500***	-0.00150***	-0.00317***
	(-6.50)	(-8.90)	(-7.10)
Govt effectiveness	-9.197	-1.119	-5.950
	(-1.27)	(-0.59)	(-1.37)
Voice and accountability	-8.230	-1.984	-5.070
	(-1.51)	(-1.39)	(-1.63)
Gini	0.846**	0.0278	0.471**
	(2.24)	(0.25)	(2.10)
Direct/indirect ratio	-7.731	-1.894	-3.187
	(-1.26)	(-1.19)	(-0.84)
Constant	64.19***	36.71***	48.05***
	(3.24)	(5.18)	(3.98)
Observations	269	269	269
Countries			

t statistics in parentheses

Dependent variables: M1 under 5 mortality ; M2 neonatal ; M3 infant

Tax variables include social security contributions.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

clusion of time trends, and shows that periods where direct taxes are relatively high are associated with better health outcomes (the estimated coefficient is negative) but these results are potentially explained by time trends in the data. Table 9 shows estimates when country-specific time trends are included in the model, and the direct/indirect ratio no longer has any explanatory power. The interpretation of these results is unclear. It could be that both direct taxes as a share of revenues has tended to rise over time whilst medical technology has improved, but it could also be that the inclusion of time trends demands too much of too few data points, and it could just be that we have insufficient data - notice that all almost variables lose statistical significance in these regressions and public health expenditure is sometimes estimated to be associated with worse health outcomes, which may be implausible.

Table 8: Health Outcomes fixed-effects regressions

	M1	M2	M3
Public Health Exp.	-9.276***	-1.675***	-4.847***
	(-2.80)	(-3.03)	(-2.77)
GNI/Cap PPP	-0.00149***	-0.000693***	-0.00123***
	(-3.16)	(-6.77)	(-4.45)
Govt effectiveness	1.162	1.175	1.035
	(0.14)	(0.75)	(0.23)
Voice and accountability	-9.878	-0.934	-5.361
	(-1.41)	(-0.74)	(-1.37)
Direct/Indirect ratio	-20.08**	-4.533***	-11.99**
	(-2.38)	(-2.87)	(-2.57)
Constant	110.1***	34.94***	72.15***
	(11.28)	(17.99)	(13.49)
Observations	434	434	434
Countries	124	124	124

t statistics in parentheses
Dependent variables: M1 under 5 mortality ; M2 neonatal ; M3 infant
Tax variables include social security contributions.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

It is possible that we find no effect of tax types on health outcomes because we are using a ratio of aggregated measures of total direct and indirect taxes, whereas Reeves et al. (2015) use revenues at a more disaggregated level (the problematic inclusion of resource revenues notwithstanding). In table 10 we disaggregate direct taxes into taxes on non-resource corporate profits and individuals' income taxes, and indirect taxes into goods and services, imports and exports. Grants are includes separately, and 'other revenues' is a residual calculated by subtracting all separately included revenue categories from total revenues. Other revenues should include resource revenues. However data on taxes on

Table 9: Health Outcomes including time trends

	M1	M2	M3
Public Health Exp.	0.186	0.258	-0.0157
	(0.11)	(1.16)	(-0.02)
Govt effectiveness	-5.206	-0.479	-2.535
	(-1.27)	(-0.72)	(-1.18)
Voice and accountability	-0.286	0.534	-0.157
	(-0.08)	(0.87)	(-0.08)
Direct/indirect ratio	0.540	-0.122	0.395
	(0.11)	(-0.17)	(0.16)
Constant	86.34***	28.91***	58.67***
	(18.91)	(44.00)	(23.84)
Observations	434	434	434
Countries	124	124	124

t statistics in parentheses
Dependent variables: M1 under 5 mortality ; M2 neonatal ; M3 infant
Tax variables include social security contributions.
Regressions include country-specific linear time trends.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

individuals and trade are sparse, so to maximise sample size in odd-numbered columns these are left in the residual other revenues variable. Table 10 shows that in cross-section taxes on goods and services are consistently associated with better health outcomes, and taxes on individuals' incomes with worse. These results are diametrically opposed to the hypothesised mechanism in Reeves et al. (2015) whereby regressive goods and sales taxes reduce the incomes of the poor to the detriment of their health whilst direct taxes on relatively wealthy individuals have no such effect. We do not proposal any causal mechanism to explain these results but interpret them as correlates of omitted variables.

Table 11 shows estimates based on within-country variation, but not including country-specific time trends. The association between goods and sales taxes and better health outcomes survives, and the relationship with individual incomes taxes has switched signs so that these are now also associated with better health outcomes. But again, these relationships do not survive the inclusion of country-specific time trends, as reported in table 12, which is consistent with the view that time trends in health outcomes are associated wiht trends in revenues from goods and services, as a result of 'tax consensus' policy reforms.

Table 10: Health Outcomes cross-section regressions

	M1	M2	M3	M4	M5	M6
Pub Hlth Exp.	-5.068**	2.817	-2.426***	-1.104	-3.557**	0.456
	(-2.02)	(0.74)	(-3.46)	(-0.92)	(-2.45)	(0.20)
GNI/Cap PPP	-0.004***	-0.005***	-0.001***	-0.002***	-0.003***	-0.003***
	(-5.10)	(-3.73)	(-7.04)	(-5.26)	(-5.77)	(-4.49)
Govt effect	-12.13	-16.12*	-1.453	-2.536	-7.800*	-9.813*
	(-1.51)	(-1.82)	(-0.84)	(-1.17)	(-1.77)	(-1.97)
Voice & accnt	-0.448	-0.0978	-0.0782	-0.241	-0.672	0.165
	(-0.07)	(-0.01)	(-0.05)	(-0.13)	(-0.21)	(0.04)
Gini	0.438	-0.294	-0.0647	-0.219	0.207	-0.158
	(1.05)	(-0.49)	(-0.51)	(-1.48)	(0.87)	(-0.50)
Grants	5.303***	2.991	0.965***	0.463	2.838***	1.617
	(2.75)	(1.57)	(2.65)	(1.12)	(2.88)	(1.59)
Profits	0.682	-3.006	-0.0677	-0.831	0.678	-1.489
	(0.47)	(-1.16)	(-0.21)	(-1.26)	(0.74)	(-1.00)
Goods & Sales	-3.581***	-3.664**	-0.942***	-1.067**	-2.069***	-2.145**
	(-4.17)	(-2.43)	(-3.60)	(-2.23)	(-4.05)	(-2.33)
Other revs	0.735	-2.130*	0.341**	-0.136	0.474	-1.010
	(1.02)	(-1.83)	(2.33)	(-0.47)	(1.25)	(-1.53)
Individ inc		7.733*		1.930**		4.833**
		(1.97)		(2.10)		(2.26)
Imports		0.0439		0.181		0.188
		(0.05)		(0.72)		(0.31)
Exports		8.699*		1.460		4.644*
		(1.91)		(1.32)		(1.83)
Constant	80.52***	112.3***	41.39***	49.43***	57.75***	74.13***
	(3.49)	(4.11)	(4.85)	(4.99)	(4.08)	(4.49)
Observations	225	126	225	126	225	126
Countries	101	66	101	66	101	66

t statistics in parentheses

Dependent variables: M1 M2 under 5 mortality ; M3 M4 neonatal ; M5 M6 infant

Tax variables include social security contributions.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 11: Health Outcomes fixed-effects regressions

	M1	M2	M3	M4	M5	M6
Pub Hlth Exp.	-6.529**	-2.957	-1.087*	-0.582	-3.261**	-1.320
	(-2.25)	(-1.14)	(-1.98)	(-0.95)	(-2.04)	(-0.93)
GNI/Cap PPP	-0.002**	-0.002***	-0.001***	-0.001***	-0.001***	-0.001***
	(-2.60)	(-3.19)	(-5.74)	(-5.79)	(-3.79)	(-4.63)
Govt effect	4.563	1.607	1.573	1.232	2.689	0.619
	(0.64)	(0.18)	(1.10)	(0.64)	(0.67)	(0.13)
Voice & acc	-10.57	-9.326	-0.724	-0.804	-5.471	-4.346
	(-1.48)	(-1.31)	(-0.55)	(-0.60)	(-1.38)	(-1.14)
Profits	-3.719***	-0.889	-0.835***	-0.301	-2.281***	-0.660
	(-2.65)	(-0.78)	(-2.94)	(-1.02)	(-2.73)	(-0.99)
Goods & Sales	-1.873***	-2.422**	-0.422**	-0.636**	-1.046**	-1.369**
	(-2.62)	(-2.53)	(-2.44)	(-2.59)	(-2.38)	(-2.47)
Individ inc		-3.666**		-0.807*		-1.833**
		(-2.10)		(-1.70)		(-2.14)
Constant	116.3***	106.6***	36.26***	35.93***	75.70***	69.77***
	(11.80)	(11.20)	(18.28)	(15.60)	(13.87)	(14.40)
Observations	429	332	429	332	429	332
Countries	126	112	126	112	126	112

t statistics in parentheses

Dependent variables: M1 M2 under 5 mortality ; M3 M4 neonatal ; M5 M6 infant

Tax variables include social security contributions.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 12: Health Outcomes fixed-effects regressions inc. time trends

	M1	M2	M3	M4	M5	M6
Pub Hlth Exp.	0.0483	-0.386	0.185	0.469*	0.0555	-0.0244
	(0.03)	(-0.18)	(0.87)	(1.89)	(0.07)	(-0.02)
Govt effect	-1.650	2.288	-0.00370	0.455	-0.676	1.379
	(-0.45)	(1.01)	(-0.01)	(0.72)	(-0.34)	(1.07)
Voice & acc	-0.216	2.947	0.483	0.634	-0.0325	1.630
	(-0.07)	(0.95)	(0.84)	(1.24)	(-0.02)	(0.96)
Profits	0.985	0.725	0.0393	0.0256	0.487	0.278
	(0.94)	(0.84)	(0.22)	(0.23)	(0.83)	(0.66)
Goods & Sales	-0.0189	-0.213	0.0444	-0.0212	-0.0385	-0.149
	(-0.05)	(-0.68)	(0.62)	(-0.27)	(-0.19)	(-0.86)
Individ inc		-2.682		-0.163		-1.178
		(-1.41)		(-0.82)		(-1.33)
Constant	87.24***	95.73***	28.80***	29.36***	58.79***	62.61***
	(12.01)	(11.36)	(28.02)	(27.02)	(14.74)	(13.77)
Observations	429	332	429	332	429	332
Countries	126	112	126	112	126	112

t statistics in parentheses

Dependent variables: M1 M2 under 5 mortality ; M3 M4 neonatal ; M5 M6 infant

Tax variables include social security contributions.

Country specific linear time trends included but not reported

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

5 Conclusion

This paper has revisited the relationships between tax types, health expenditure and health outcomes as investigated in a recent paper by Reeves et al. (2015). As expected, we confirm that higher tax revenues are associated with higher public health expenditures, and higher public health expenditure with better health outcomes. We find some evidence that greater reliance on direct taxes is associated with higher health spending than would be expected on the basis of total public revenues, and better health coverage and outcomes, but - contrary to Reeves et al. (2015) - no evidence that indirect taxes are deleterious to health. In fact, we find a positive association between goods and sales taxes and better health outcomes (although the estimates do not survive the introduction of time trends).

We first considered the relationships between public health expenditure and various revenue components of the budget constraint, although the interpretation of these relationships is unclear and whilst they could reflect different propensities to spend on health related to revenue choices, they may also reflect revenue choices with no connection to spending choices. We find that a larger statistical association between direct taxes and public health expenditure than between indirect taxes and health spending, although the result depends on the sample used (table 1).

Next we explored whether spending more on public health, conditional on total tax revenues, is associated with different sources of revenue, and show that in cross-section countries that make relatively more use of direct taxes also tend to have higher levels of public expenditure (table 2); although the estimated coefficients lose statistical significance once controlling for unobserved time-invariant country effects (table 3).

We then turn to aspects of universal health care. There is a positive association in cross section between health system coverage and greater use of direct taxes (table 4) and with measures of health access (table 5) although the positive association with health access disappears once controlling for unobserved country characteristics (table 6).

Finally, we looked at the relationship between revenue components and health outcomes. In cross section (table 7), the direct/indirect tax ratio is associated with better health outcomes, but the relationships are not statistically significant. In fixed-effects regressions (table 8), the direct/indirect tax ratio is associated with better health outcomes, and the estimates are statistically significant; but the result is not robust to the inclusion of country-specific time trends (table 9). Similarly, taxes on goods and services are associated with better health outcomes, although the result is again not robust to the inclusion of time trends (tables 10-12).

Our differing results from Reeves et al. (2015) may in part be explained by our use of ICTD GRD data which allows us to separate out taxes on the extractive industries and other resource revenues, and has stronger coverage and greater international comparability than other sources.

We do not propose causal mechanisms behind the results reported in this paper, which have many potential explanations. Statistical associations in observational data, such as those reported in this paper, cannot bear the weight of causal interpretations and hence only tentative policy conclusions can be drawn. The relationships we report offer some guidance to what may be expected from increased domestic revenue mobilization, in the sense that observed patterns are a point of reference. Had we found, for example, a negative correlation between greater use of direct taxes and public health expenditure, it would be harder to argue increasing direct taxes will contribute to the expansion of universal healthcare. The results therefore provide reasons to be cautiously optimistic about the benefits of greater international attention to the obstacles to raising direct taxes in developing countries, such as addressing the challenges of corporate taxation in the globalized economy. There is also nothing in the results we report to suggest that indirect taxes are inimicable to healthcare objectives.

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