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## **The tax elasticity of formal work in African countries**

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**Abstract:** A key policy problem in most developing countries is the size of the informal sector and its persistence over time. In need to increase their tax revenues, policy makers face a trade-off between decreasing tax rates (making formalizing potentially more attractive) and alternatively raising tax rates (potentially slowing down the formalization of the economy if people prefer informal employment or self-employment). Evidence on formal versus informal wages and job characteristics in different sectors and the impact of tax changes on the extent of informality in developing countries is, however, very limited. This paper estimates the tax responsiveness of the extensive margin of formality, that is the propensity to be a formal rather than informal worker, for four sub-Saharan African countries. Using repeated cross-sections of household data and applying grouping estimator techniques, this paper does not find robust effects of taxes on the extent of formal work, although in a pooled sample taxes appear to lower the share of formal workers in some specifications.

**Keywords:** developing countries, informality, labour supply, sub-Saharan Africa, taxation

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## 1 Introduction

In most developing countries the informal sector is substantial in size, even though precise estimates vary by definition of the informal sector and informal employment. A survey by Charmes (2012) provides comparable information about the size of the informal sector in different countries. According to his numbers, the share of the informal sector in non-agricultural employment was on average 58 per cent in Latin America in 2005–10, whereas it was larger in sub-Saharan Africa (approximately around 66 per cent). In addition to its large size, the informal economy shows no clear declining trend. In sub-Saharan Africa, according to Charmes (2012), the informal employment share was around the same in 2005–10 as it was in the 1980s. More recently, the World Bank estimates informality rates in some sub-Saharan African countries of over 90 per cent (World Bank 2019).

Almost by definition, the informal sector falls outside the tax base available to governments, who are under pressure—internally and from donors—to raise their tax revenues. Domestic tax revenue mobilization is also one of the Sustainable Development Goals (SDGs).<sup>1</sup> This high degree of informality makes it much more difficult for developing countries to collect direct taxes such as personal income tax on employees and corporate income tax on firm profit, making them much more reliant on indirect taxes. This is unfortunate because progressive income taxes may be one of the most effective ways of reducing the high and sometimes rising inequalities in Africa. While countries in Africa have been able to increase their tax take since the early 2000s, with some heterogeneity (see Figure 1, which provides information about the tax revenue to GDP ratio for selected African countries and for sub-Saharan Africa on average), Figure 2 shows that they generally obtain much less revenue using direct taxes on labour income than developed countries do. That said, one should also note that the labour income tax receipts in the African countries are no smaller than the revenues from corporate taxes, which stood around 1–1.5 per cent at the same time.<sup>2</sup>

There remains a strong need for more revenues to finance necessary developmental spending and to enable redistribution. But there is also likely to be a trade-off between the two needs, the desire to generate more jobs within the formal sector and the goal of raising more revenues—perhaps especially using labour income tax—which may create a disincentive to formalize. Productive enterprises may choose whether to operate in the formal or informal sector in terms of registration, and can also choose whether to employ workers on a formal or informal basis. Workers can also choose between work in the formal or informal sector (the latter often self-employment). It is highly likely that one of the most important margins of response of economic behaviour to changes in tax and transfer policies in developing countries is the extent of formal work. Besley and Persson (2013) note that this elasticity is also a quantitatively important ingredient of the elasticity of taxable income, which is a sufficient statistic that determines the size of the distortions the tax system creates in the presence of informality. The severity of these distortions can then be weighed against the distributional gains that can be achieved by the tax system.<sup>3</sup>

How large is the potential trade-off? To be able to answer this question, one would need to obtain credible information about the responsiveness of the share of the formal sector to changes in the net labour income differential from working in the formal and informal sectors. From the outset it is, however, not even clear that an individual would necessarily prefer working in the formal sector or

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<sup>1</sup> SDG 17.1: ‘Strengthen domestic resource mobilization, including through international support to developing countries, to improve domestic capacity for tax and other revenue collection’ (<https://sustainabledevelopment.un.org/sdg17>).

<sup>2</sup> According to own calculations based on GRD data.

<sup>3</sup> This approach has proven very valuable in modern empirical public finance—see Piketty and Saez (2013).

that formal-sector jobs would even be available. While much of the traditional literature (e.g. Fields 1975) suggests that formally employed people earn more and informal employment is an escape from unemployment while looking for formal employment, this view has recently been challenged by many studies which provide evidence for voluntary informal employment (Bargain and Kwenda 2011; Bruhn and McKenzie 2013; Henley et al. 2009; Maloney 1999, 2004; see Bargain and Kwenda 2011 for a more detailed discussion). Findings by Günther and Launov (2012) from urban Cote d'Ivoire even show that only less than half of the informal sector and employment is involuntary, as there is a segment of individuals for whom informality represent an opportunity. Moreover, Badaoui et al. (2008) do not find evidence for a wage gap between the two sectors when controlling for other characteristics. Related to this question, Bargain and Kwenda (2010) pointed out that the specific type of informal employment (e.g. informal self-employment or informal salaried work) has an impact on the formal–informal earnings gap and that this gap is also affected by the individual's position along the income distribution, but that the effect of these two aspects differs across countries. Hence, the sensitivity of the decision to work in the formal sector may additionally be moderated by the varying pay premium for formal-sector work by country, type of work, and income level.<sup>4</sup>

Recent quasi-experimental econometric work on tax elasticity exists, especially for Latin American countries, though largely considering changes in payroll rather than income tax changes, thus targeting firm rather than individual behaviour. However, we are not aware of any studies on this matter for low- or lower-middle-income African countries, where the trade-off could be even more severe than in Latin America. In Latin America, larger social protection systems are already in place, whereas similar programmes are being scaled up in African countries. Therefore, the needed increase in the tax base to finance such programmes may well be greater in Africa. At the same time, the different scale and type of available benefits for formal workers and different tax systems may affect the incentives of workers to formalize and thus the elasticity of formal work. Apart from that, also the share of the working-age population earning a monetary income differs.

The purpose of this paper is, therefore, to provide new evidence of the elasticity of formal work using representative household data from four sub-Saharan African countries.<sup>5</sup> Building on the approach developed by Blundell et al. (1998), the idea is to utilize a number of tax reforms that treat different groups of individuals differently. These provide exogenous variation to the relative attractiveness of working in the formal sector, which is needed for reliable causal estimates of the impacts of fiscal policies on formality. Our analysis here is based on four African countries for which the necessary data to address this question is available; but we also complement it with a pooled analysis which can enable more precise estimates.

To the best of our knowledge, this paper offers the first estimates of the impacts of taxes on formal-sector work for African countries—with the exception of South Africa—that are based on a modern, credible, estimation strategy.<sup>6</sup> Given the very different state and nature of social benefits and tax systems in

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<sup>4</sup> Falco et al. (2011) further show that size of the firm is an important determining factor of wages in urban Ghana and Tanzania, irrespective of wage or self-employment or formal or informal sector. In line with this and opposing the view of self-employment as a last resort option, Falco and Haywood (2016) estimate that rising returns to productive characteristics between 2004 and 2011 in Ghana have attracted in particular skilled labour into self-employment. Falco (2014) finds in Ghana evidence for the theoretically modelled hypothesis that more risk-averse workers are more likely to aim for the scarce but more secure formal-sector jobs, rather than aiming for the higher income variability in informal-sector jobs.

<sup>5</sup> Related work by Bruhn and McKenzie (2014), Rocha et al. (2018) and Benhassine et al. (2018) examines whether interventions lowering the costs to formalize a business, targeted at informal businesses in developing countries, are effective in raising the share of formal firms. In contrast, our study investigates the impact of tax policy changes on the share of formal-sector workers.

<sup>6</sup> While high-quality data for South Africa would be available, we left South Africa outside of the sample because of the large institutional differences between South Africa and poorer sub-Saharan African countries. In South Africa, unemployment is close to 30 per cent, there are unemployment benefits, and the formal sector is fairly large, whereas in other African countries

African countries compared to those in South America, this study can provide important evidence from a different geographic area and countries in a different stage of development, which can inform about the external validity of earlier results from South America. An additional important contribution of this paper is that we provide a considerable amount of descriptive material about the differences (with special reference to their earnings) between formal- and informal-sector workers in Africa. Perhaps somewhat surprisingly, there is not much earlier empirical work on this matter.

The paper proceeds as follows. In Section 2 we provide a review of earlier relevant work, which, as was mentioned above, largely focuses on Latin America. Section 3 provides the theoretical background and the econometric strategy of the paper. Section 4 presents the data and some descriptive statistics. The results are presented in Section 5. Section 6 concludes.

## 2 Literature review

Even focusing on formality from an employee point of view, as here, formality status as such is a debated term. The literature has defined it in multiple ways, resulting in different levels of formality and different people being classified as either formal or informal, which do not necessarily overlap (Henley et al. 2009). While the terms ‘informal sector’ and ‘informal workers’ are often used interchangeably, the literature distinguishes, according to Henley et al. (2009), between three main alternative definitions of formality status: the first purely relies on a contract status for whether a worker is formally or informally employed; the second is based on whether an individual contributes to social security; and the third distinguishes between salaried employees in firms with more than five employees as being formal and self-employed or own-account workers, who are not professionals, as being informal. If an individual is self-employed but contributes to social security, the person would, according to the first definition, be classified as informally employed. According to the third definition, they would be working in the informal sector, whereas according to the second definition they would be a formal worker. Hence, the definition of formality status matters and consistency in its definition over time and across countries is highly important for comparisons.

While there is an extensive literature comparing the characteristics of the formal and informal sectors in developing countries, the literature looking at the impact of changes in taxes and transfers on choices of workers (or sometimes firms) to participate in the formal sector is much smaller. Some of this takes the form of calibration models, of which an important example is the work of Albrecht et al. (2009). These authors look at the choices of workers to be in the formal sector, in the informal sector, or to move between the two, and simulate what would be the effect of changes in payroll taxes and severance payments on the size of the informal sector. Not surprisingly, a rise in severance tax encourages workers to leave the formal sector and join the informal sector, and a reduction in payroll tax has the reverse effect, that is people joining the formal sector. Other calibration models include those by Bosch and Esteban-Pretel (2013), who look at the effect of changes in taxes and transfers (especially unemployment insurance) on the size of the informal sector, and Alonso-Ortiz and Leal (2013), who use a calibration model to consider the responsiveness of informality to taxes and transfers in Mexico. Feltenstein and Shamloo (2013), in turn, simulate the effect of tax reform in Russia on the size of the underground economy there.

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unemployment rates are low, unemployment insurance benefits are largely non-existent, and people typically work in the informal sector. See Bhorat et al. (2014) and Tondini et al. (2017) for recent quasi-experimental evidence regarding the employment effects of wage costs in South Africa.

In terms of empirical studies, the only study we are aware of for African countries is that of Auriol and Warlters (2012), who develop a simple general equilibrium model for 38 African countries. The paper does not contain estimates or quasi-experimental evidence about the impacts of the tax burden on the extent of formal work, but rather provides a simulation analysis and calculates the marginal cost of public funds for various tax instruments.

These issues have been studied in much greater detail in Latin America, and to a lesser extent in transition countries or in other parts of the world. Lora and Fajardo-González (2016) have examined the effects of payroll taxes, value-added taxes, and corporate income taxes on a number of labour market indices, such as the participation, employment and informality rates, and wages in 15 Latin American countries using macro-level panel data. These authors found that each type of tax affects labour market outcomes very differently, and that the effect is moderated by the characteristic of labour market and tax institutions.

Many other studies have taken a micro approach. Using plant-level data for Colombia, Kugler and Kugler (2009) find that a 10 per cent increase in payroll taxes leads to reduction in formal employment of 4–5 per cent. Antón (2014), also for Colombia, finds that a fall in payroll taxes increased employment overall and formal employment in particular. Using a panel of administrative records of employees, Morales and Medina (2017) estimate a significant increase in formal-sector employment as a result of a 13.5 per cent reduction in payroll taxes in Colombia. This finding is confirmed by Fernandez and Villar (2017), who estimate a 4.8 per cent reduction in informality of the same reform using household survey data. Gorodnichenko et al. (2009) and Zarković-Rakić et al. (2016) looked at the effect of tax reforms on the size of the informal economy in Russia and Serbia, respectively.

Ulyssea (2018) notes that an important margin of formality is that formal firms can still use casual, informal workers, and the impacts of taxation for this decision can be marked. Our analysis, where the unit of observation is an individual, captures similar individuals as informal workers. Waseem (2018) provides compelling evidence about a Pakistani tax reform that increased the taxes on partnerships relative to other firms and encouraged these firms to move to the informal sector.

Other studies have considered the effect of transfers on participation in the formal sector. Bergolo and Cruces (2014a) look at the effect of social insurance reform in Uruguay, extending healthcare coverage to dependants of registered workers, and find that the reform increased the number of those working in registered employment significantly. In another paper, also on Uruguay, Bergolo and Cruces (2014b) study the incentive effects of the social security programme on labour supply using a regression discontinuity design. In particular, they examine in detail the anatomy of behavioural responses—responses along different margins and the heterogeneity within the outcomes. Their results indicate that a 1 percentage point increase in net income implies an about 1.7 per cent increase in registered employment. Garganta and Gasparini (2015) have studied how the Universal Child Allowance (AUH) programme (an income maintenance programme in Argentina) affects the incentives of informal workers to transition to the formal-sector labour market using a difference-in-differences strategy. According to their results, eligible and ineligible groups' formalization rates, defined as entry rate into registered jobs, had been almost the same until the end of 2009, after which their formalization rates significantly diverged, coinciding in timing with the implementation of the AUH. They found that the programme has a disincentivizing effect (in contrast, there is no evidence that registered employment becomes informal). These effects concern self-employed workers, informal salaried employees, and the unemployed, and are especially pronounced for poor workers in large households with young children.

Other studies on the subject include, for example, that by Bosch and Campos-Vazquez (2014). They estimate that the implementation of Mexico's Popular Health Insurance programme reduced the stock of registered employers by 3.8 per cent and employees by 2.4 per cent. Alzúa et al. (2012) study the effect of welfare programmes on work incentives and the adult labour supply in Mexico, Nicaragua, and

Honduras in a difference-in-differences fashion. Their evidence suggests that the welfare programmes neither brought along notable disincentives to work nor significantly affected the intensive or extensive margin of labour supply of individuals or households in treatment localities.

### 3 Theory and estimation

#### 3.1 Conceptual framework

This section presents a highly stylized model of occupational choice, inspired by the literature on the extensive margin of labour markets in public economics; for recent examples, see Jacquet et al. (2013) and Kroft et al. (2019). An individual  $i$  can either seek work in the formal sector or work in the informal sector. Conditional on searching, they find a job in the formal sector with a probability  $p$ . When working in the formal sector, the individual receives earnings equal to  $y_f$ , pays taxes equal to  $T(y_f)$ , and receives benefits (e.g. future pension rights)  $B(y_f)$ . Working in the formal sector also incurs a cost of  $d_i$ , which can be negative. Workers can therefore work for the informal sector either voluntarily or involuntarily (when they are unsuccessful in finding a formal-sector job).

How realistic is this set-up? As discussed in Section 1, the more modern view of the informal sector sees it as a sector in which some choose to work. This view is corroborated by the findings of McKay et al. (2018), reported in Table 1. In a survey questionnaire, a substantial fraction of the self-employed in similar African countries to those we have in our sample report to work informally because it is their choice to do so, not because of necessity—although the latter group is large as well.

If the individual works in the informal sector, they receive income equal to  $y_n$  and receive benefits  $B(y_n)$ . Denote the net income from the formal sector as  $x_f = y_f - T(y_f) + B(y_f)$  and that from the informal sector as  $x_n = y_n + B(y_n)$ . Assume for simplicity that utility is linear (or log linear) in income. The individual searches for a job in the formal sector if

$$p(x_f - d_i) + (1 - p)x_n - \psi_i \geq x_n, \quad (1)$$

where  $\psi$  stands for the cost of searching for a formal-sector job, which varies according to the individual. The condition for searching for work in the formal sector can also be written as

$$x_f - x_n \geq d_i + \frac{\psi_i}{p}, \quad (2)$$

which makes it clear that the probability of working for the formal sector is positively related to the difference in net pay between the two states. Consumption taxes would not alter this relationship if the net consumption taxes paid do not depend on the sector of work. In both formal- and informal-sector work, consumption taxes  $\tau x_i$ , where  $\tau$  is the consumption tax rate and  $x_i$  refers to consumption, would need to be financed from disposable income from either formal- or informal-sector work. The payroll taxes paid by the employer are, on the other hand, already reflected in the gross salary for formal-sector workers. Denoting the payroll tax rate by  $s$ , the labour cost for the employer is  $z = (1 + s)y_f$ , hence  $y_f = z/(1 + s)$ .

To reiterate, the model can capture the response in the share of the formal sector to labour taxes when working for the informal sector is (partly) a choice. Changes in the tax burden on formal-sector labour

can also influence the pre-tax wage rate, via tax incidence. A higher labour income tax may lead workers to ask for a higher wage, which reduces labour demand when the labour demand function is downwards sloping. This channel is shut down when, because of, for example, a binding minimum wage, the wage rate is fixed. This implies that our preferred specification is one in which we exclude individuals whose formal-sector wage would be below or equal to the minimum wage.

### 3.2 Estimation

Based on the discussion above, the share of workers working for the formal sector increases when the tax rate decreases or  $x_f - x_n$  increases (or becomes less negative) through other circumstances, such as bracket creep, provided that  $p$  is strictly positive. Hence, the sign of the coefficient  $\beta$  is expected to be positive. If  $p = 0$ , because, for example, of a binding minimum wage, implying that employment in the formal sector is determined by labour demand alone, changes in net pay are not associated with increases in the size of the formal sector.<sup>7</sup> Drawing on equation 2, the share of the population with a formal-sector job with a strictly positive income  $P(y_f > 0)_{i,t}$  for an individual of type  $i$  at period  $t$  can be represented empirically by a linear probability model as<sup>8</sup>

$$P(y_f > 0)_{it} = \alpha + \beta [x_f - x_n]_{it} + \varepsilon_{it}, \quad (3)$$

where  $x_f - x_n$  stands for the net wage differential between the formal and informal sectors.  $P(y_f > 0)$  is defined to be 1 if the individual is earning strictly positive formal sector income.<sup>9</sup>

However, estimating equation 2 brings a number of challenges. There can be unobservable characteristics that affect both the individual's pay in the case of formal-sector work and his/her probability to work for the sector. At any given point in time, each individual can only be observed earning either informal or formal income, so the income that could be earned in the respective other sector needs to be imputed.

We address these challenges by using the data as a repeated cross-section, which allows us to compare *groups* of individuals over time in the form of a pseudo-panel. Thereby, it addresses this endogeneity problem by constructing instruments. We follow Blundell et al. (1998), and group our sample into separate cells  $g$  based on country, gender, age, and education level. Based on the difference-in-difference idea that tax reforms differently affect otherwise similar individuals depending on whether they are working in the informal or formal sector, the grouping estimators allow us to estimate the structurally meaningful parameter of the elasticity of formality.

Suppose that  $\varepsilon_{it} = \alpha_g + \mu_t + \eta_{it}$ , where  $E[\eta_{it} | y_{it} > 0, g, t] = 0$ . Under this assumption, unobserved heterogeneity, conditional on  $g$  and  $t$  and the strictly positive annual wage  $y$ , can be captured by a permanent demographic group effect  $\alpha_g$ , which stands for a vector of interacted dummy variables and a time fixed effect  $\mu_t$ . The term  $\omega_{gt}$  represents a vector that contains the full set of interactions between group dummies and time, which are by assumption uncorrelated with  $\eta_{it}$ . This is the central exclusion restriction for identification of our model. This leads us to then estimate

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<sup>7</sup> See Kroft et al. (2019) for a discussion of labour market models and their implications for job-finding rates in the context of a similar model (with the exception that, in their case, the informal sector is replaced by unemployment).

<sup>8</sup> Formally, this derivation assumes that  $\psi$  is uniformly distributed. Ideally, one would perhaps want to assume a normal distribution and, hence, arrive at a probit model. This would lead to the so-called incidental parameters problem, rendering the empirical estimations unfeasible.

<sup>9</sup> The discussion in this section draws on Jäntti et al. (2015).

$$P(y_f > 0)_{it} = \alpha + \beta[x_f - x_n]_{it} + \alpha_g + \mu_t + \eta_{it}, \quad (4)$$

by two-stage least squares (2SLS) using  $\omega_{gt}$  as excluded instruments for  $(x_f - x_n)$ . Here, it is crucial that both the order and the rank condition for identification hold. The order condition requires the inclusion of at least as many instruments as endogenous regressors. The rank condition requires that net income changes at different rates for different groups over time. As the variation in the second-stage equation is entirely at the group level, equation 4 can alternatively be estimated by collapsing the data into time-specific group means, which yields identical results.<sup>10</sup> Hence, this paper estimates

$$\overline{P(y_f > 0)}_{gt} = \alpha + \beta \overline{(x_f - x_n)}_{gt} + \alpha_g + \mu_t + \eta_{it}, \quad (5)$$

by GLS, using group cell size as weights and heteroscedasticity-robust standard errors. By taking group means, the dummy variable of formality status becomes a continuous variable, which at the same time represents the group's probability of being formal and the share of formal workers.

To combat the challenge of missing income in either of the states, we thus use the cell means and average over individuals with formal earnings  $y_f - T(y_f) + B(y_f)$  and individuals with informal earnings  $y_n + B(y_n)$  to get estimates for the net income in both formal and informal jobs, respectively. While it would be conceptually optimal to include the benefits that both types of workers receive  $B(y_f)$  and  $B(y_n)$ , we unfortunately need to proxy the net wage differential without accounting for benefits as we are limited by the available data. In the individual country models, group cells are in the main specification of the regression analysis constructed using survey wave, sex, educational category, and age group. In the pooled specification, they are formed on the basis of means over several years.

Our main approach is to utilize a regression equation of the form of equation 5, since each individual is observed in only one state, and the wage in the counterfactual state would need to be imputed also in individual-level regressions. However, imputing incomes allows one to run the 2SLS estimates, which can be utilized to test the predictive power of the group\*time interaction instruments in the first stage.

The extensive margin of formality elasticity, that is the percentage change in the probability of having a formal job with respect to a percentage change in the net earnings differential of working in the formal and informal sector, can be calculated as  $\beta \times [\overline{(x_f - x_n)}_{gt} / P(y_f > 0)]$ , where  $\beta$  is the regression coefficient  $\beta$  from equation 4 and  $\overline{(x_f - x_n)}_{gt}$  stands for the mean net wage differential of a particular group  $g$  in a given time  $t$ . However, the estimation of the probability of being a formal-sector worker does not only rely on tax and benefit reforms, but is also identified from shocks affecting the gross pay in both sectors, meaning, for example, bracket creep. This occurs as a result of inflation, wherein salaries are inflation-adjusted and formal income may therefore cross into another tax bracket and thereby affect the net pay differential, as tax brackets are less frequently adjusted and at a different rate.

Based on the above discussed conceptual framework and estimation approach, we estimate country-specific elasticities and an aggregate elasticity of formal work.

### *Individual country model*

We first estimate the elasticity of formal work separately for each country  $c$ . This means we run separate regressions for each country of the mean net wage differential on the probability of being a formal worker, whereby we group observations by age group, gender, educational category, and survey

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<sup>10</sup> See Angrist and Pischke (2009) for an elaborate discussion about IV estimation on grouped data.

wave. For this purpose we identify three age groups, three educational groups, and males and females—therefore up to 18 groups. The basic model is estimated without any fixed effect. This is then adapted to include group and year fixed effects and moreover estimated separately on a sample of only male and only female observations. The group fixed effect  $a_g$  can be decomposed into the product of the age group, gender, and educational category fixed effects as in equation 5:

$$\overline{P(y_f > 0)}_{gt} = \alpha + \beta_1 \overline{(x_f - x_n)}_{gt} + \beta_2 (age_{gt} * sex_{gt} * educ_{gt}) + \mu_t + \eta_{gt}, \quad (6)$$

In this model  $\mu_t$  represents the survey wave fixed effect. This results in 18 group observations per wave, if group cell size allows the existence of each group. Using the respective country's  $\beta_1$  from equation 5, we then calculate as explained earlier the elasticities for each country.

### *Pooled model*

Second, we estimate the aggregate elasticity of formal work across countries. For this we pool all countries and survey waves together and separate them by year groups covering multi-year time periods to increase the number of observations per group cells as we in some instances combine several survey waves into one year-group period. As in the individual country model, observations are grouped by age group, gender, and educational category, but instead of by survey wave by year group and additionally by country, as presented in equation 6:

$$\overline{P(y_f > 0)}_{gtc} = \alpha + \beta_1 \overline{(x_f - x_n)}_{gtc} + \beta_2 (age_{gtc} * sex_{gtc} * educ_{gtc}) + \mu_t + \theta_c + \eta_{gtc}. \quad (7)$$

Here,  $\theta_c$  represents the country fixed effect, whereas  $\mu_t$  stands for the year-group fixed effect. The advantage of this approach is that it gives us 18 group observations per year group and country and thus in total results in more group observations. The larger number of degrees of freedom also allows a wider set of controls to be introduced into the analysis.

## 4 Data and descriptive information

This section first discusses the data used for this analysis and thereafter presents some descriptive statistics.

### 4.1 Country selection

This study is based on Labour Force Survey data or labour force modules of Living Standard Household Surveys from four sub-Saharan African countries: Ghana<sup>11</sup>, Rwanda<sup>12</sup>, Tanzania<sup>13</sup>, and Uganda<sup>14</sup>

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<sup>11</sup> Ghana: Ghana Living Standards Survey (GLSS) 3 (1991/92), GLSS 4 (1998/99), GLSS 5 (2005/06), and GLSS 6 (2012/13).

<sup>12</sup> Rwanda: Enquête Intégrale sur les Conditions de Vie des ménages (EICV; in English this is the Integrated Household Living Conditions Survey) 1 (2000/01), EICV 2 (2005/06), and EICV 3 (2010/11).

<sup>13</sup> Tanzania: Integrated Labour Force Survey (ILFS) (2006) and ILFS (2014).

<sup>14</sup> Uganda: Uganda National Panel Survey (NPL) (2009/10), NPL (2010/11), NPL (2011/12), and NPL (2013/14).

over a time period from 1991 to 2014. The individual country model estimations consider each survey wave as a time period, whereas in the pooled model the different survey waves are grouped into more aggregate year groups as presented in Table 2. The choice of countries is geographically limited to countries in sub-Saharan Africa. Furthermore, it is based on the size of the economy in terms of GDP, the availability of at least two recent waves of a nationally representative survey with individual income data, information regarding the individuals' demographic characteristics, and either direct or indirect information concerning the individuals' formality status.<sup>15</sup> South Africa is left out because its labour market is vastly different to those of other African countries. Nigeria would have data with sufficient information, but the data source has so few workers reporting receiving a monetary income that regressions cannot really be carried out in the absence of a sufficient number of formal and informal workers in each group, hence reducing the number of usable groups.<sup>16</sup> This study also uses information on the minimum wage, tax rate, and tax bracket information obtained from the local tax authorities and big-four accounting firms. Annual income data<sup>17</sup> is inflation adjusted and rebased to the year 2014 for each country. Subsequently, incomes are converted into US dollar equivalent of 2014 using PPP exchange rates.

## 4.2 Sample selection

Figures 3–6 report the share of individuals who have monetary income in the underpinning datasets. In all these countries, a large majority do not receive earnings in monetary terms. We only include individuals working and reporting strictly positive cash income, whereas in-kind income is not taken into consideration; both wage employment and self-employment are considered here. Unless in wage employment, agricultural income is excluded from the analysis as this is assumed to be largely coming from informal subsistence farming and data on agricultural revenues and costs are relatively noisy. Moreover, those working in the public sector, which represents 3–26 per cent<sup>18</sup> of all non-subsistence agricultural workers, are excluded. Public-sector workers are by assumption formal workers and are assumed to have a lower incentive to change their jobs in order to change their formality status as the tax wedge does not necessarily have the same importance for the public sector. Quasi-public sector workers consisting of mainly state-owned enterprise employees are, however, included. While many individuals may engage in more than one job, this study only considers the income and formality status of the main job, or if such indication is not available, the income from the job with the highest salary is considered. Income levels above the 99th percentile of the distribution are considered outliers and replaced by the cut-off value.<sup>19</sup>

Following Henley et al. (2009), who suggest that in the absence of information regarding formality status based on contracts one should use information concerning social security contributions as the prime alternative, we use social security contributions as the main defining indicator for formality and subsequently use the terms (in)formal sector, (in)formal workers, and (in)formally employed interchange-

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<sup>15</sup> We excluded countries with periods of major conflict around the time of the survey.

<sup>16</sup> We have all results also for Nigeria but choose not to report those; the number of groups was as low as seven due to very few respondents reporting earning positive monetary income.

<sup>17</sup> Income is reported in different frequencies (e.g. daily, weekly, monthly) and scaled to the annual level, irrespective of the actual tenure and annual income of the job. For surveys with income questions for the past 12 month and the past 7 days, the most recent information is considered leading and complemented when missing with the information from the past 12 months to minimize the recall bias as well as missing information in the income data.

<sup>18</sup> These shares differ slightly between waves for each country: Ghana 18, 12, 12, and 10 per cent; Rwanda 13, 11, and 3 per cent; Tanzania 11 and 10 per cent; and Uganda 26, 18, 24, and 18 per cent.

<sup>19</sup> Income data from Tanzania ILFS 2006 does not distinguish between main and secondary job income. In this case, the sum of income from both main and secondary job is used in both waves, but the formality status is based on that of the main job.

ably. Additionally, those people receiving medical care and retirement benefits from their employer are considered formal workers, as well as those who claim that their employers withhold taxes from their income. Those who claim to have a formal private-sector job and for whom the preceding information is missing are considered formal workers. All remaining workers are classified as informal workers, under the assumption that those individuals who are formal workers would have answered to be identified as such through any of the preceding questions.

Figures 7–10 describe, in turn, the shares of formal and informal workers in the estimation sample. Based on this information, for the individuals working in the non-public and non-subsistence agriculture sector, around 20 per cent are formal workers, with no clear trend over time in any country.

Identifying formality status allows the calculation of a net real annual wage for the formal and informal sectors. For all those who report that taxes have already been deducted, the reported income is considered the net income. In other formal-sector cases, the reported wage is adjusted by the appropriate tax rate.

We further restrict the sample to only those observations for which information regarding age, gender, region (rural/urban<sup>20</sup>), relationship to household head, marital status, and occupation exist. These are characteristics previously shown to moderate the probability to work in the formal sector. As respondents have no incentive to not report their educational level and are likely to remember the achievement of a particular level if completed, individuals who do not report their education level are assumed to have no or less than primary education. We distinguish between three categories of completed educational levels: none or less than primary and primary education; junior secondary education; senior secondary education and above. In robustness checks the last category is split into senior secondary and post-secondary/tertiary education. Further, the analysis restricts itself to three age groups between 15 and 60 years, considering the compulsory education, legal minimum working, and retirement age, but uses open-ended age ranges for robustness checks. Some descriptives are presented with more disaggregated age groups and educational categories.

### 4.3 Descriptive statistics

Summary statistics, presented in Tables 3–6, report the aggregated distribution of individuals across sectors, occupations, age groups, and other demographic characteristics, as well as how these individuals are divided between the formal and informal sectors. In all countries the quasi-public sector, consisting of state-owned enterprises, NGOs, and international organizations, represents at most 6 per cent of employment and is thus a rather small sector. Around 70 per cent of individuals gain their main income from self-employment or working in their family business, and around 30 per cent through private-sector salaried employment. Only in Uganda are the latter two shares slightly more balanced. In terms of occupations, the large majority of people hold sales and shop worker and elementary jobs; in Ghana and Tanzania they also hold craft positions, and in Rwanda clerical jobs.

For all countries, men, household heads, and middle-aged individuals (25–44 years) are more likely to be formal workers. Moreover, the share of individuals working in the formal sector rises with education. Professionals, technicians, and associate professionals are occupations most likely to be formal, whereas clerks, sales, and shop workers are most likely to be informal. Probit model estimations of the determinants of the formality status (not reported) confirm these aggregate findings and further suggest that men, household heads, women, employees, and those living in urban areas are more likely to have a

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<sup>20</sup> As the surveys for Ghana do not distinguish between rural and urban status, we use non-capital and capital region as the closest proxy.

formal job. In addition, having children increases in all countries except Ghana the likelihood of being a formal worker.

Whereas the distribution of characteristics across individuals and the distribution of formality status have, as revealed in separate analyses (not shown), been rather stable across waves, the annual net mean income in the formal sector is not in all waves larger than the mean income in the informal sector, as is the case for the aggregate. According to the first survey in Ghana and the first survey in Tanzania, informal workers earn in aggregate terms more than formal workers.

Density plots of aggregate formal net income and informal income show very little difference in mean income (Figures 11–14). In terms of the shape of the distributions in Figures 11–14, one observes mainly two distinct patterns. The first is especially visible for Uganda and the later waves for Ghana, in which the distribution largely overlaps with the exception of a much longer tail of low informal incomes. The second contains distributions with similar means but a larger variance of informal incomes, as clearly visible in the tighter distribution of formal income around its mean in the case of Tanzania and the first round of Ghana. Separate analyses of mean annual income by urban/rural status, employment type, or occupation<sup>21</sup> reveal that in aggregate terms the formal-sector incomes are generally higher, but there are some exceptions where the reverse holds. Overall, there is a lot of heterogeneity between the specific groups, without a clear pattern across countries of which sector pays more in a particular subgroup. This finding links to the debate in the literature regarding the direction of the pay gap between these two sectors.<sup>22</sup> The fact that we find higher informal than formal mean wages for some subgroup samples, such as Ghana 1991 and Tanzania 2006, is not too surprising and is supported by recent findings from Brazil. These show that for the first quarter of 2014 the mean informal income exceeded formal income for women aged 25–55 (Matos and Portela Souza 2016). Based on previous research findings one should not necessarily expect a net pay premium in the formal sector nor an increase in the premium over time as a country develops. Therefore, the observed distributions do not challenge previous evidence.

#### 4.4 Variation in economic incentives

Figure 15 provides information about the actual tax rate variation that formal-sector workers have encountered. For this chart, wages from earlier rounds have been uprated into the latest survey year level using an index based on mean wage growth. The graph shows that, for the case of Ghana and Rwanda, there is quite substantial variation in the average tax rate in the cell-level data across the income distribution. Since there has been little variation in the marginal tax rates, these changes mainly occur due to ‘bracket creep’ (or fiscal drag)—that is, tax schedules have not been adjusted in a one-to-one relation with wage growth. The extent of variation in Tanzania and Uganda is more muted.

As explained above, the difference in the net pay between formal and informal work is also influenced by the pre-tax earnings levels. To capture the overall variation which we use when estimating equations 6 and 7, we use the cell-level data in a panel format (that is, following the same group over the years) and compute the difference across the survey wage in our key regressor,  $x_f - x_n$ , for the four countries. The extent of the variation is depicted in Figure 16. Based on this, there is in fact quite a lot of variation in our key right-hand side variable, which is necessary for precise estimates.

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<sup>21</sup> Results available from the authors upon request.

<sup>22</sup> For references on this debate, see Badaoui et al. (2008).

## 5 Results

### 5.1 Individual country-level models

Table 7 presents the elasticity of formal work for each country, based on individual country models using the grouped estimator. The sample consists of people aged 15–60, working in the quasi-public and private sectors or as self-employed workers. Groups are created by survey wave using gender, three educational categories, and three age groups, as discussed in Section 3. The first column shows the cross-sectional correlation, whereas the second includes the full set of indicator variables. In this case these are a survey wave fixed effect and the interaction of educational category dummies, age category dummies, and gender dummies. In the third column, all observations below the minimum wage are discarded, whereas in the fourth column we only consider observations for which earnings are greater than the first tax threshold, meaning that people in these income groups would have to pay the income tax. Finally, in column (5) the impacts are only measured for the wage workers, excluding those working in self-employment with earnings above the minimum wage.

While there appears to be a positive cross-sectional correlation in these models (outside of Rwanda), the impacts remain statistically insignificant. In particular, according to the results from model 4, this also holds when restricting the sample to only those observations with annual income above the lowest tax payment threshold. This is important as one could argue that only those workers with income levels that would require them to pay taxes if formally employed are affected and thus potentially reacting to tax rate changes. The additional results presented in the Appendix (separate estimates for men and women, using four instead of three educational categories to create cells, using other characteristics than education to create cells, or measuring the difference in earnings in levels rather than logs; see Table A1) do not change this conclusion. Therefore, there does not appear to be a clear link between the net pay in the sector and the share of formal work based on the country-level estimates.

Apart from the grouped estimations, we also estimate individual-level regressions based on imputed income, as discussed in the last paragraph of Section 2. In this way we can obtain an F-statistic for the excluded variables presented in Table 8. For all countries, F-statistics are 10 or above. There is thus significant evidence for the validity of the group\*time interactions as instruments in the first stage.

Finally, grouping estimators have been shown to be sensitive to small-sample bias (Deaton 1985). For this reason, we condition the inclusion of a group on a minimum cell size of 20 and a minimum of 30 or 10 observations in robustness checks, to ensure representativeness. Apart from minimum overall cell size, we condition cell size to include at least 5 formal and 5 informal observations and, respectively, 15 and 5 of each kind in the robustness checks. The results are robust to these changes.<sup>23</sup>

### 5.2 Pooled model

The results of the pooled model with country and year-group fixed effects confirm the result of the individual country models' estimates (Table 9, column (2)). However, when restricting the sample to those above the minimum wage or above the first tax bracket level, the estimates become greater and statistically significant (columns (3) and (4), respectively). As the pooled model has a larger number of cells, more control variables may be added to the model. In column (5) we have added country-specific

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<sup>23</sup> These results are available upon request.

linear trends for those countries for which we have more than two periods (we could have added linear trends also for Uganda, but since its observations are aggregated to just two periods, the present model does not do so). With country-specific trends added to model (4), the positive and significant coefficient disappears.

The additional results, available in Table A2 in the Appendix, suggest that the positive impact of the pay difference, when it is measured in levels as opposed to logs, does not remain valid. This implies that while the pooled models give support to some evidence of a negative formality impact of taxes, the evidence cannot be claimed to be robust.

Another interesting point is that when the sample is restricted to wage earners only, the estimate is negative. This could be related to the observation discussed above that while staying informal is a result of a choice for many of the self-employed, being an informal wage worker is much less of a choice in that this may be the only work available. If wage earners prefer, for other reasons, always formal jobs over informal jobs, then they may accept formal jobs even if they pay less. This result disappears when adding linear country trends to the model.

### 5.3 Overall discussion and limitations

Taken together the findings suggest that changes in the formal–informal wage gap have either no significant effect on the probability to be a formal worker for the population as a whole, or there could be an impact among subgroups. In our alternative specification restricting the sample to individuals with earnings above the first tax bracket and using a model pooling all countries (Table 9), there is weak evidence that the probability to engage in formal work rises with tax reductions. Finding some formality effect above the first tax bracket would also be consistent with findings of Rocha et al. (2018) in that the impact of a tax reduction on formality is larger for high-income entrepreneurs. Moreover, the fact that we observe some positive and significant elasticities in certain specifications, while Rocha et al. (2018) find that the formality impact of a tax cut fades away completely after around six months, may highlight the importance of bracket creep from which most of the tax variation in our case stems, apart from the generally considered tax reforms. Using the default specification in the country-specific model (Table A1) also for Ugandan and Rwandan women, the results suggest weak significant evidence for a small but positive elasticity to work in the formal sector. The significant result for a particular demographic group may indicate that country-specific tax and benefit systems might play an important role in incentivizing different demographic groups to formalize. However, the obtained positive significant results are to be treated with caution and are only indicative, as standard errors are large and the findings are not robust to changes in the model specification.

Generally, the overall finding of non-robust elasticities or zero impact for all other cases means that changes in the tax rate and resulting changes in the sectoral wage differential do not significantly change the probability to have a formal job. In our sample countries the tax variation mostly originates from changes in the tax bracket threshold income levels and the abolishing of additional tax brackets at the upper end of the distribution. Variation in the formal–informal income difference thus mainly stems from bracket creep, which workers may not necessarily notice. Nonetheless, there is, as the density plots depict, a substantial share of workers earning less than the basic allowance level in income taxation, meaning they are located to the left of the rising green dotted line, and hence tax changes do not necessarily influence their formality status choices. We also do not consider choices to formalize to be affected in either direction by changes in payroll taxes as these have remained largely constant over time.

The lack of sensitivity may be a result of a lack of advantages or little awareness concerning the advantages of a formal job, apart from potentially a minimal wage premium. This would be in line with

findings by Bargain and Kwenda (2011) that the formal sector wage premium is higher in South Africa due to larger legal benefits of a formal job than in Mexico and Brazil, with fewer benefits from formal jobs.

The findings might be attributed to a lack of knowledge and capacity, related to low levels of education, on how to formalize, or imagined or actual bureaucratic costs of formalizing not outweighing the minimal pay and/or benefit differential. This view is, however, challenged by McKenzie and Sakho's (2010) findings from Bolivia, where among large firms it is mainly high-ability entrepreneurs who stay informal, and formalizing is not beneficial in terms of firm profits over all firm sizes. Alternatively, land ownership issues have been found to be important hindrances to formalizing business, even when building capacity and eliminating formalization costs, as in the field experiment by De Mel et al. (2013) in Sri Lanka. These issues may also play a role for entrepreneurs in African countries.

Apart from these potential explanations for our findings, there are several aspects directly related to the study design that should be considered when interpreting the results. The number of survey waves and the time frames they span vary across countries. This is especially a concern for countries such as Tanzania, with just two survey waves, and Uganda, with four survey waves but conducted in consecutive years. Also, survey sample sizes vary by country and survey wave, and sample sizes (i.e. at least 20 observations per group cell, or 30 in robustness checks, with proportional formal/informal requirements of at least 5 (15) observations per group cells) may not be large enough to capture the mean wage premium of working in the formal sector of the respective group, and reduces the number of group observations that are included in the model. Finally, as stated earlier, income data for developing countries is quite noisy,<sup>24</sup> making it more difficult to obtain precise results.

## 6 Conclusion

In need of raising domestic revenues, developing countries are challenged by partly missing the underlying precondition to collect taxes—namely the existence of a base for collecting direct taxes—due to the persistently large informal sector and a limited share of the working population earning a monetary income. A key policy question is therefore the elasticity of formal work, meaning to what extent increases in the tax rate incentivize people to move from a formal job into informal employment to avoid the tax burden, or a decrease in the tax rate may make working in a formal job more attractive and induce informal workers to formalize. In addition, a greater tax burden may lead to higher equilibrium wages, reducing labour demand.

While there is evidence for an effect of tax rate changes on intensive margin of labour supply for developed countries and there is some evidence from Latin America that tax reductions may increase the incentives for individuals to work in the formal sector, evidence from developing countries in other parts of the world, in particular from African countries, characterized by an even larger informal sector, is still missing. Individuals in African countries may, however, react very differently to tax rate changes due to their less developed benefit and tax systems. This paper therefore sought to investigate this question for four countries in sub-Saharan Africa: Ghana, Rwanda, Tanzania, and Uganda. Household survey data over a period from 1999 to 2014 are used to construct pseudo-panels, consisting of 2–4 survey waves for each country. By applying grouping estimator techniques, this study subsequently estimates the effect of

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<sup>24</sup> For this reason, many studies and surveys, in particular in Africa, with large shares of the population living on subsistence farming use household budget questions, consumption, or expenditure to proxy for income.

an exogenously induced change in the mean wage difference between the formal and informal sectors, on the probability to work in the formal sector.

While survey estimates of household income are always imprecise, the results based on these data give, we would argue, the currently best possible estimates for these countries. The descriptive analysis shows a significant overlap between earnings in the non-public formal and informal sector, though with greater heterogeneity in the latter in almost all cases. The regression analysis, based on the expected differential between earnings in formal and informal work, indicates that there is no robust significant impact of this differential on the probability of being a formal worker. However, when examining only those employees whose income exceeds the minimum wage or the basic tax allowance using pooled data across countries, the share of formality appears to depend on the financial gain from working for the formal instead of the informal sector. This result does not survive adding country-specific linear trends to the model and thus cannot be regarded as robust.

Different explanations for the finding of a largely non-elastic formality status can be considered. The low wage differential between the formal and informal sectors in all four countries is likely to be a major factor. In addition, there is likely to be limited availability of formal-sector jobs for those living in rural areas and those without or with only low educational qualifications. This is also reflected in the very low employment rates in monetary income-earning employment. Workers currently in the informal sector, who might have the skills needed for formal jobs, may not be well informed about such vacancies and advantages of formal-sector jobs. Moreover, there might be a general lack of information regarding the functioning of the tax system, tax rate changes, and how to formalize in practice, which is relevant for the self-employed. Considering that the likelihood of working informally has been shown to be higher for those with lower education, there may be a general lack of capacity to formalize. Workers may also have, irrespective of the wage differential between the two sectors, other reasons for preferring to work in the informal sector, such as the proximity or flexibility of the informal job, or the perceived benefits of the formal sector not outweighing the perceived costs of paying taxes and the bureaucracy involved in formalizing. Furthermore, the country-specific design of the taxation system could have important effects on the elasticity of formal work due to differing incentives to formalize as a result of varying benefits of formalizing in different countries by different demographic groups. Lastly, the tax rate changes during the sample period and the bracket creep, caused by inflation-adjusted wages falling into different tax brackets, may not have resulted in sufficiently salient variation in the sectoral wage gap to initiate notable response.

While there are obviously reasons to be cautious in interpreting the results, the evidence this study gathered, which is robust to a variety of specifications, is not consistent with the notion of the existence of a severe trade-off between the share of formal work and taxation. This study adds to the literature in terms of external validity regarding tax-induced extensive margin labour supply decisions in developing countries.

The findings of this study have two important policy implications: first, it may be that raising tax rates mildly does not necessarily lead to a greater share of the informal sector. Second, the findings relate to Chetty et al.'s (2009) argument that in order to observe behavioural sensitivity to policy changes, such as changes in the tax rate, those policies need to be salient. This pertains especially to tax incentives given to small businesses. They would need to be well communicated to potential taxpayers in order to induce behavioural changes.

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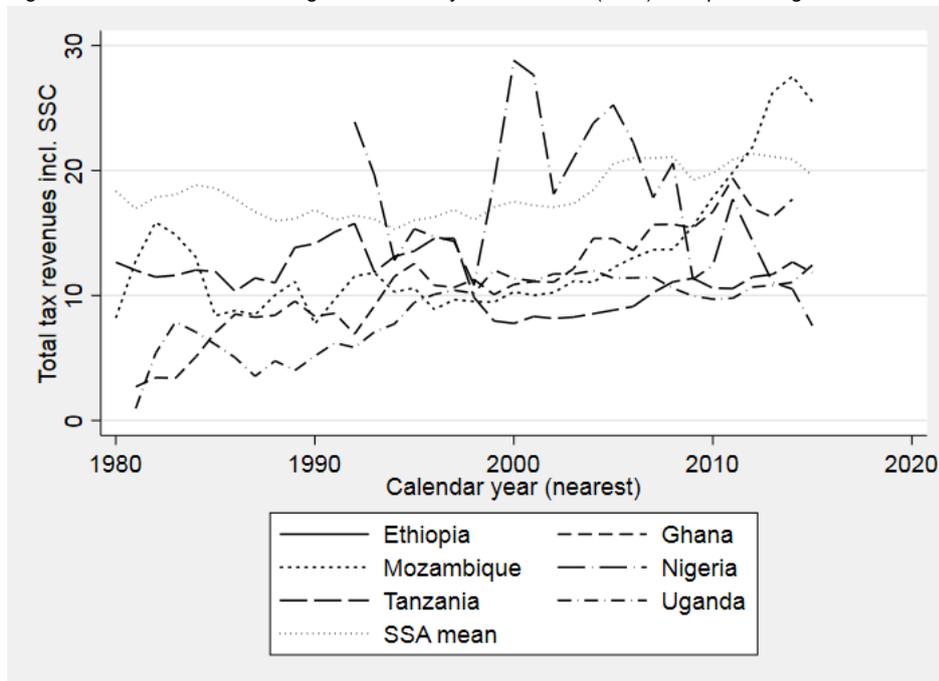
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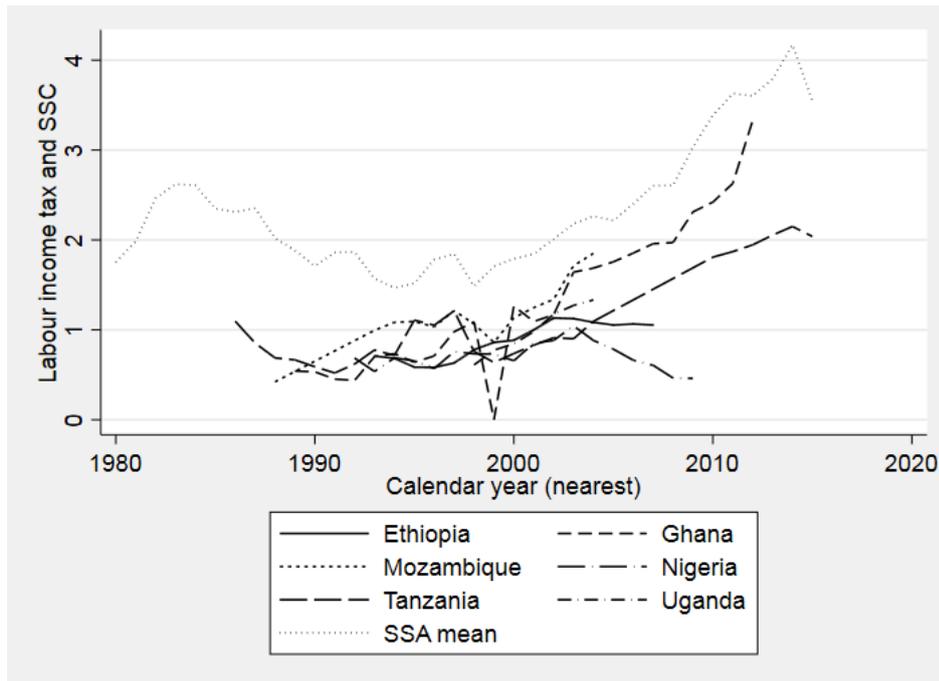
## Figures

Figure 1: Tax revenues including social security contributions (SSC) as a percentage of GDP in selected African countries



Source: authors' calculations based on UNU-WIDER-ICTD Government Revenue Dataset.

Figure 2: Labour income tax revenue including social security contributions (SSC) as percentage of GDP in selected African countries



Source: authors' calculations on the basis of the ICTD/UNU-WIDER Government Revenue Dataset..

Figure 3: Share of workers with monetary income across survey waves, Ghana

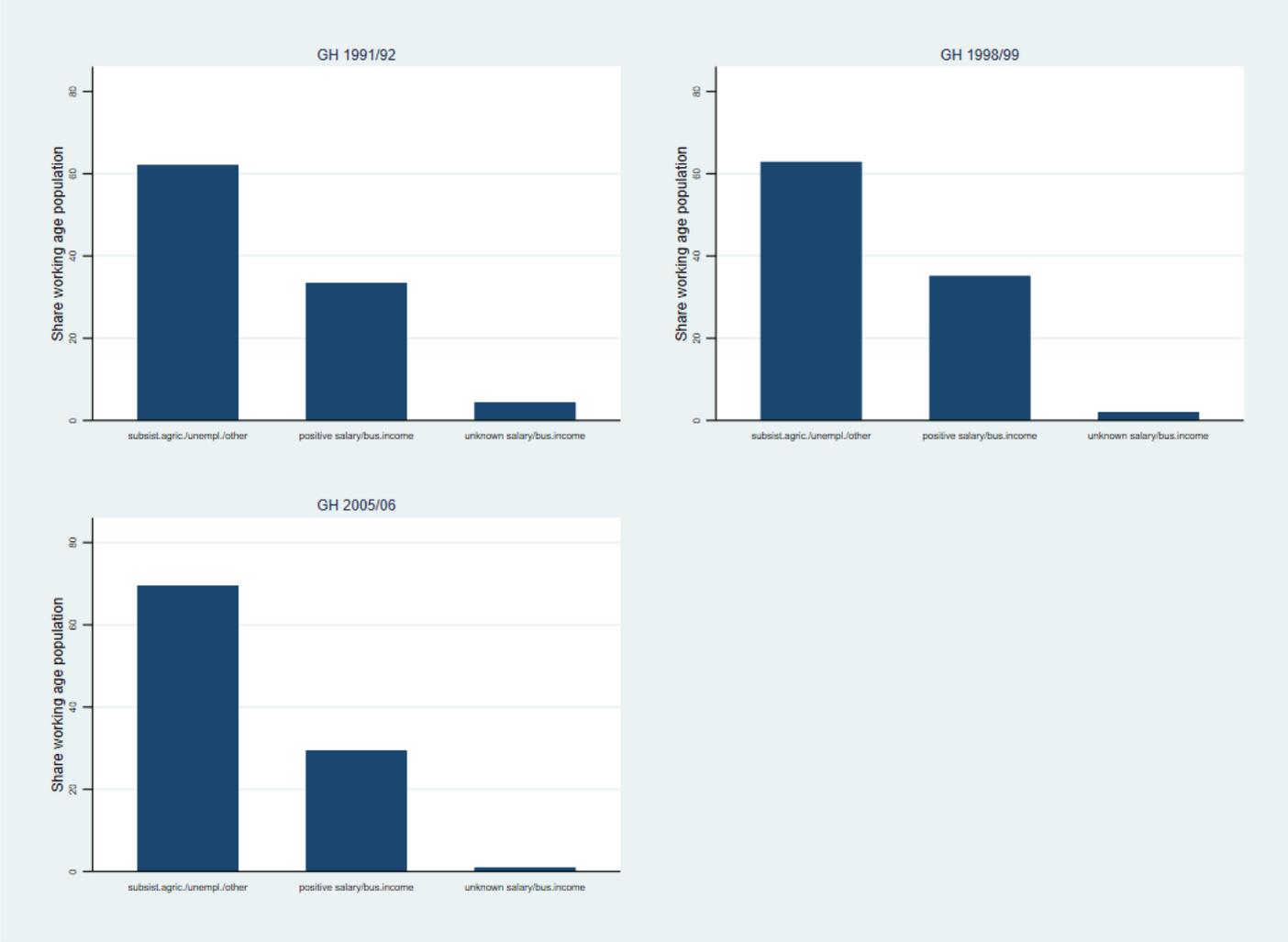


Figure 4: Share of workers with monetary income across survey waves, Rwanda

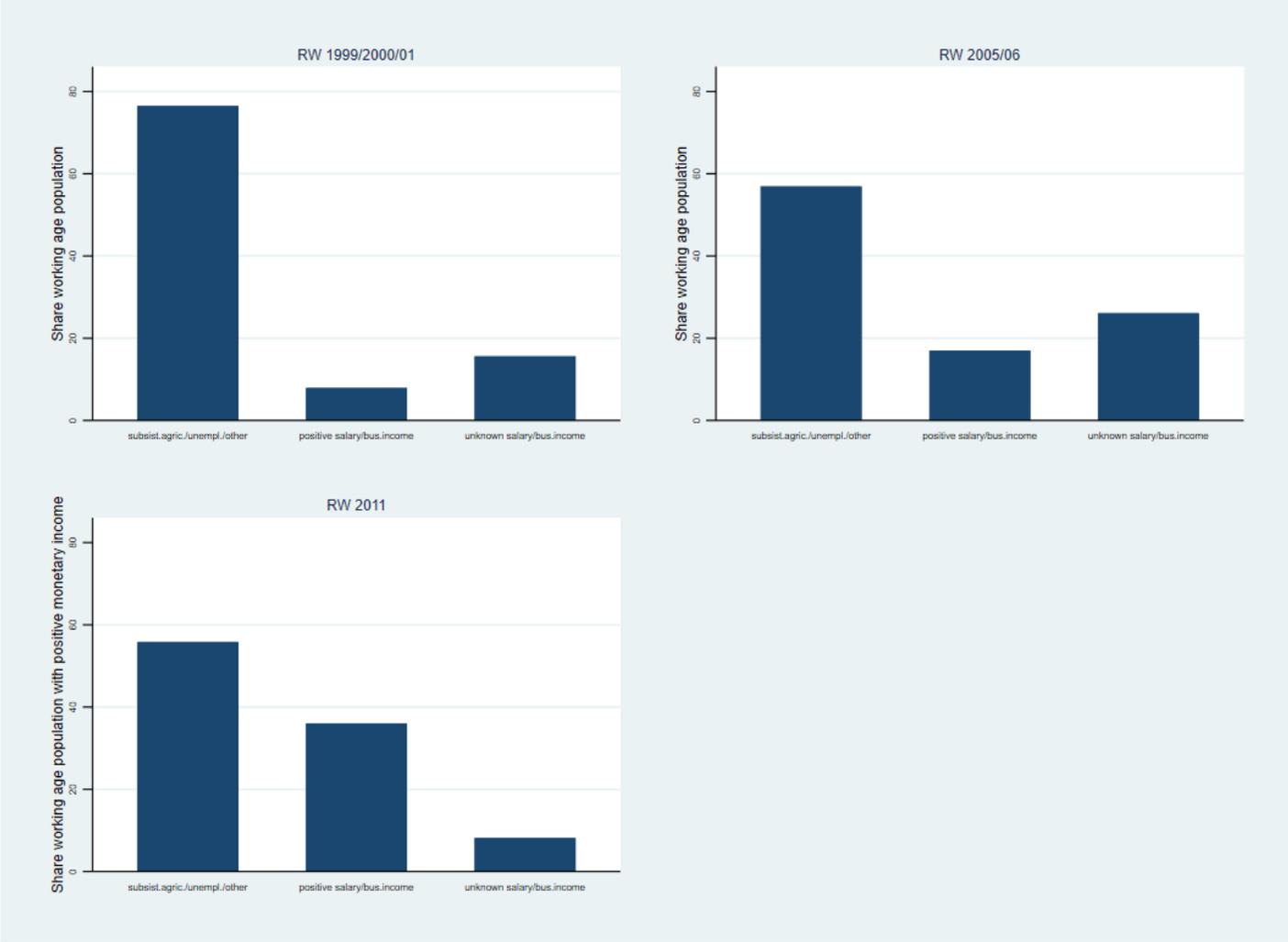


Figure 5: Share of workers with monetary income across survey waves, Tanzania

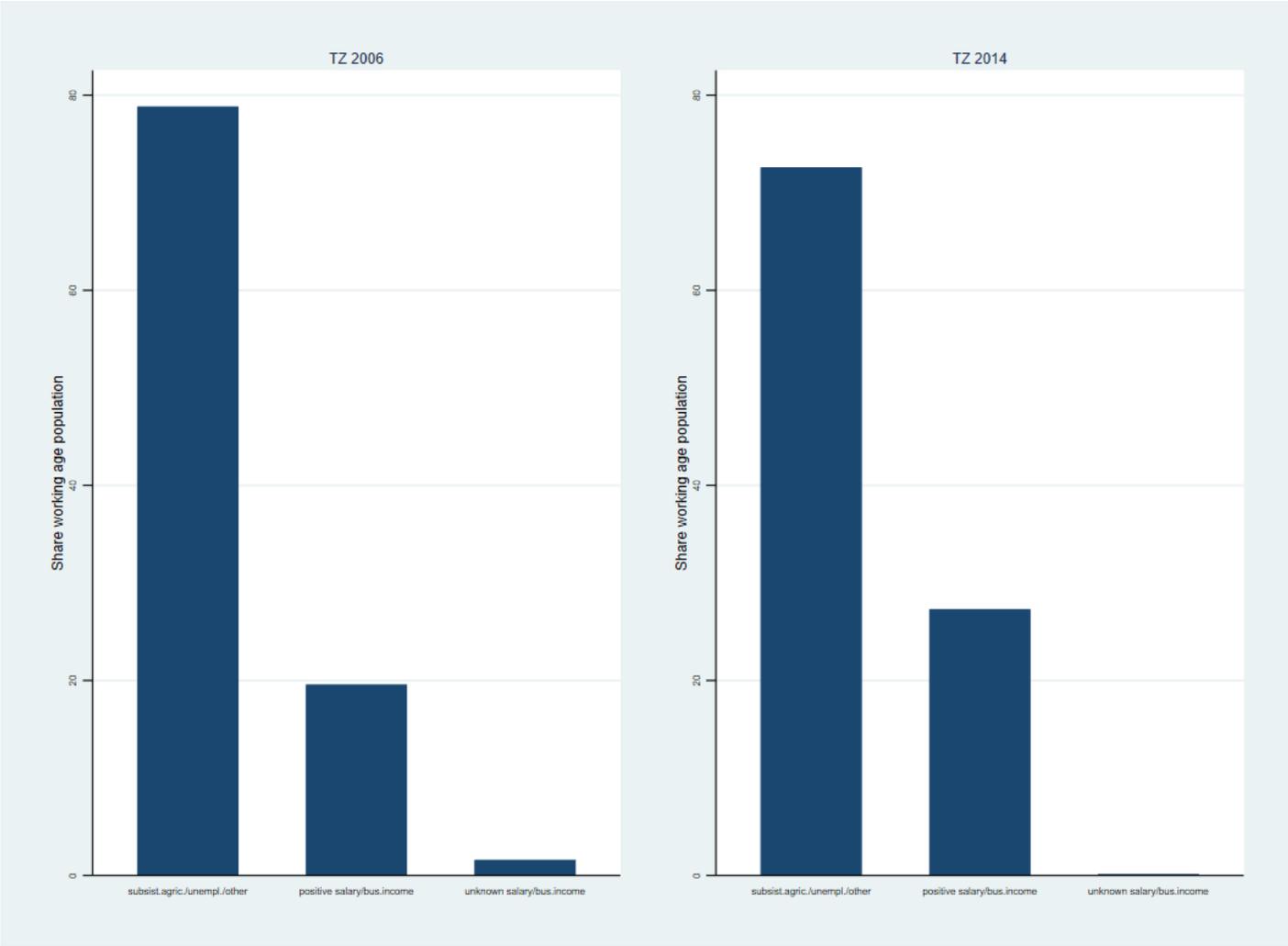


Figure 6: Share of workers with monetary income across survey waves, Uganda

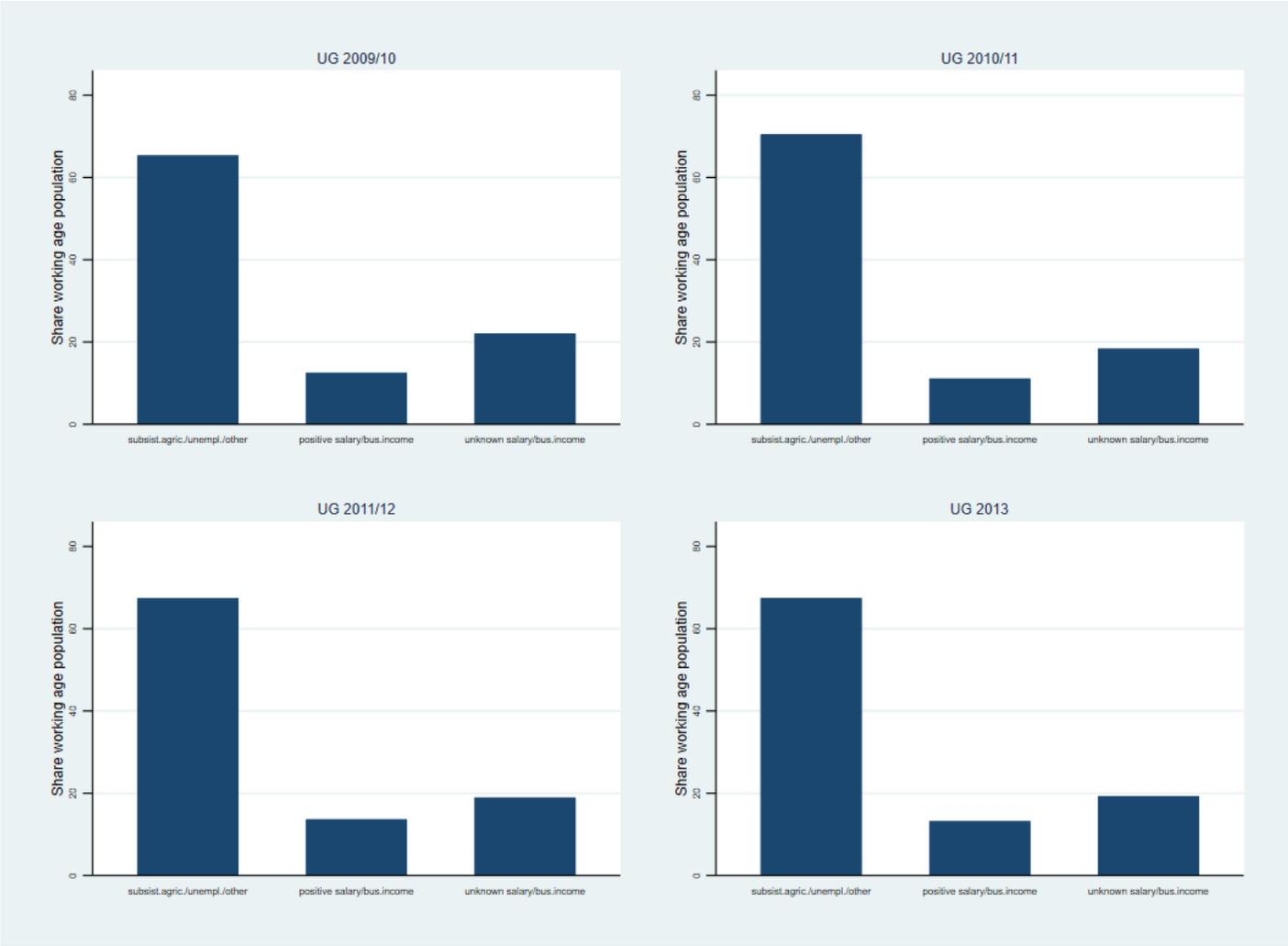


Figure 7: Formality share across survey waves, Ghana



Figure 8: Formality share across survey waves, Rwanda



Figure 9: Formality share across survey waves, Tanzania

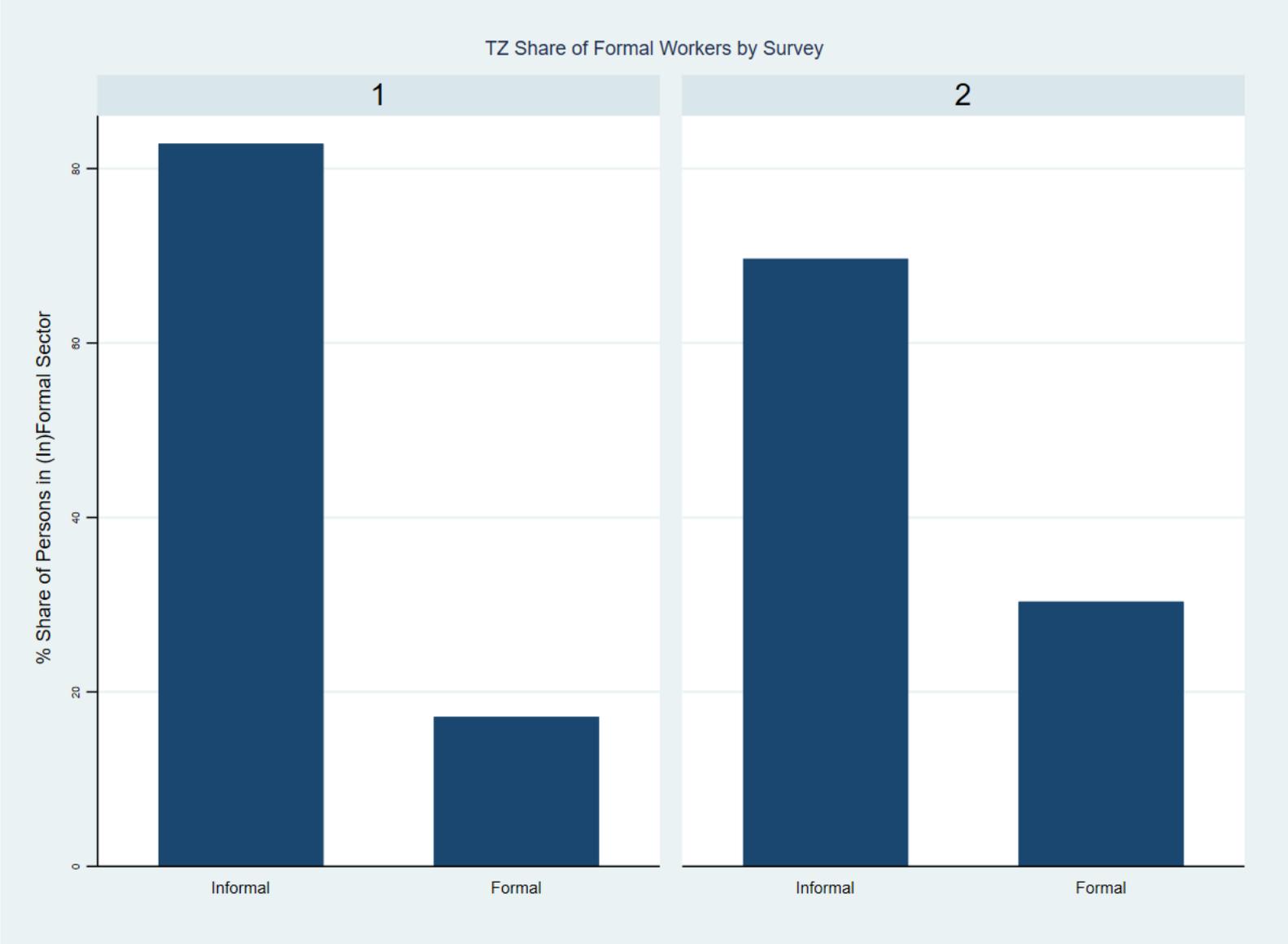
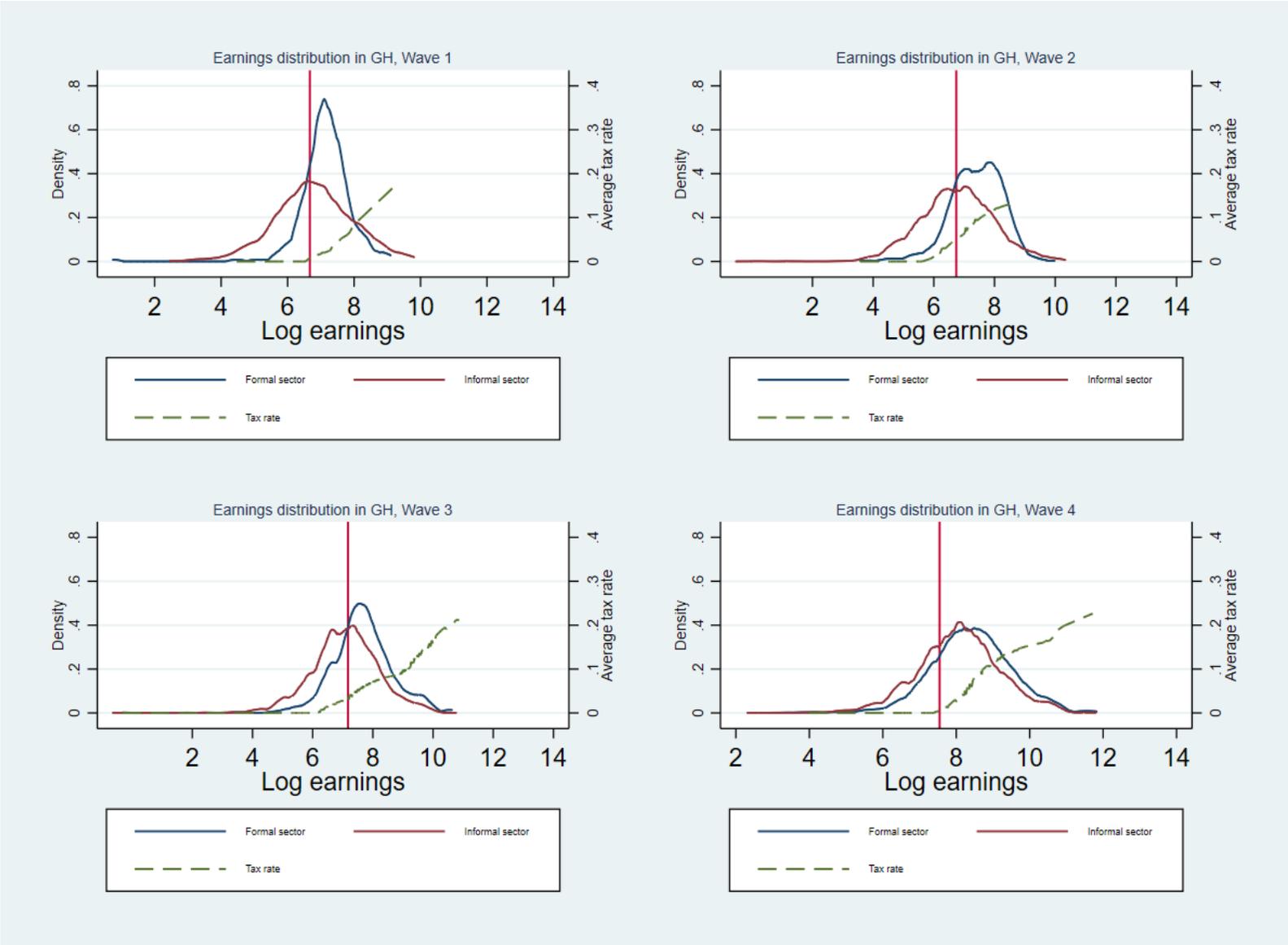


Figure 10: Formality share across survey waves, Uganda

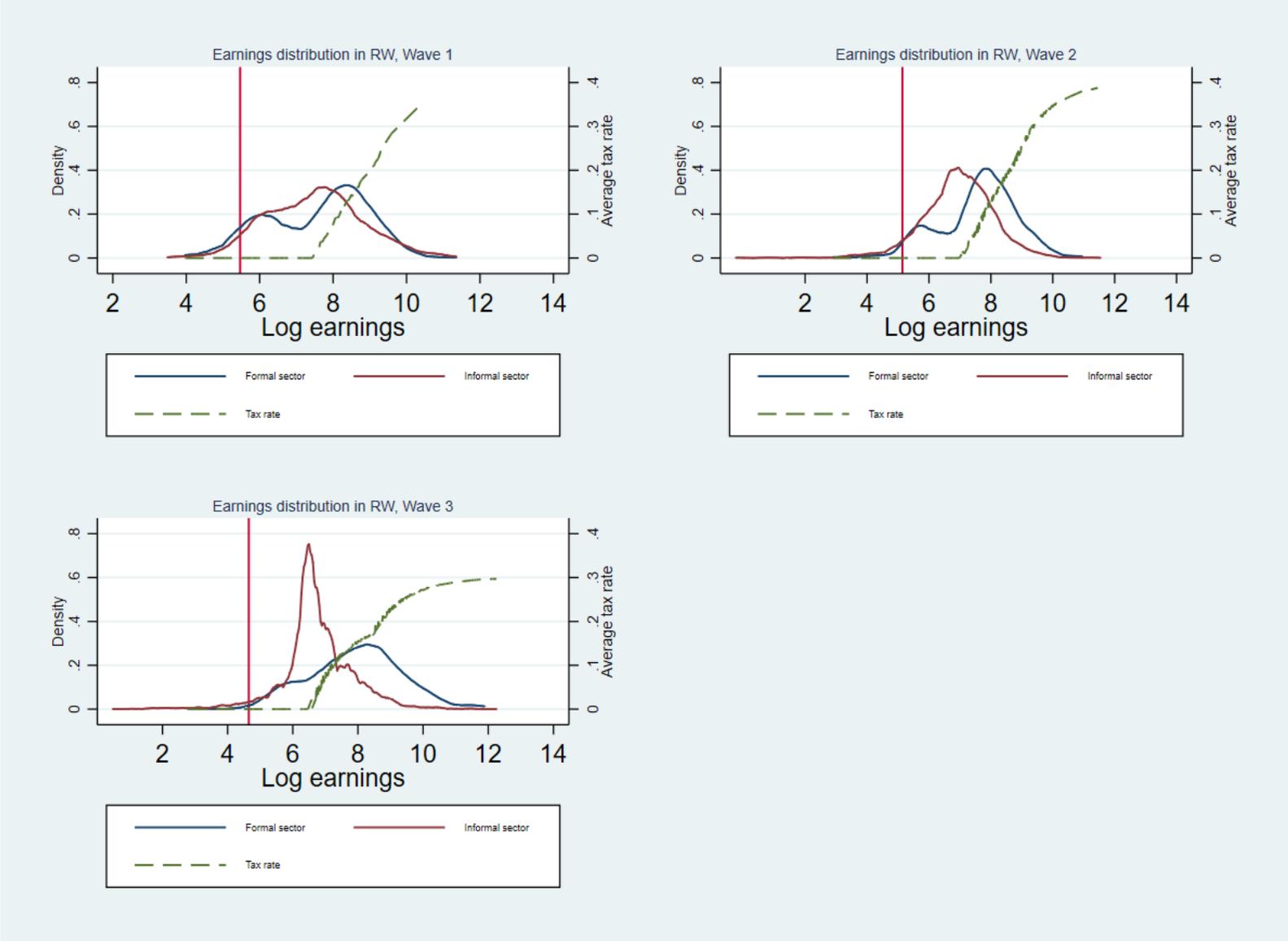


Figure 11: Distribution of formal-sector and informal-sector earnings in Ghana



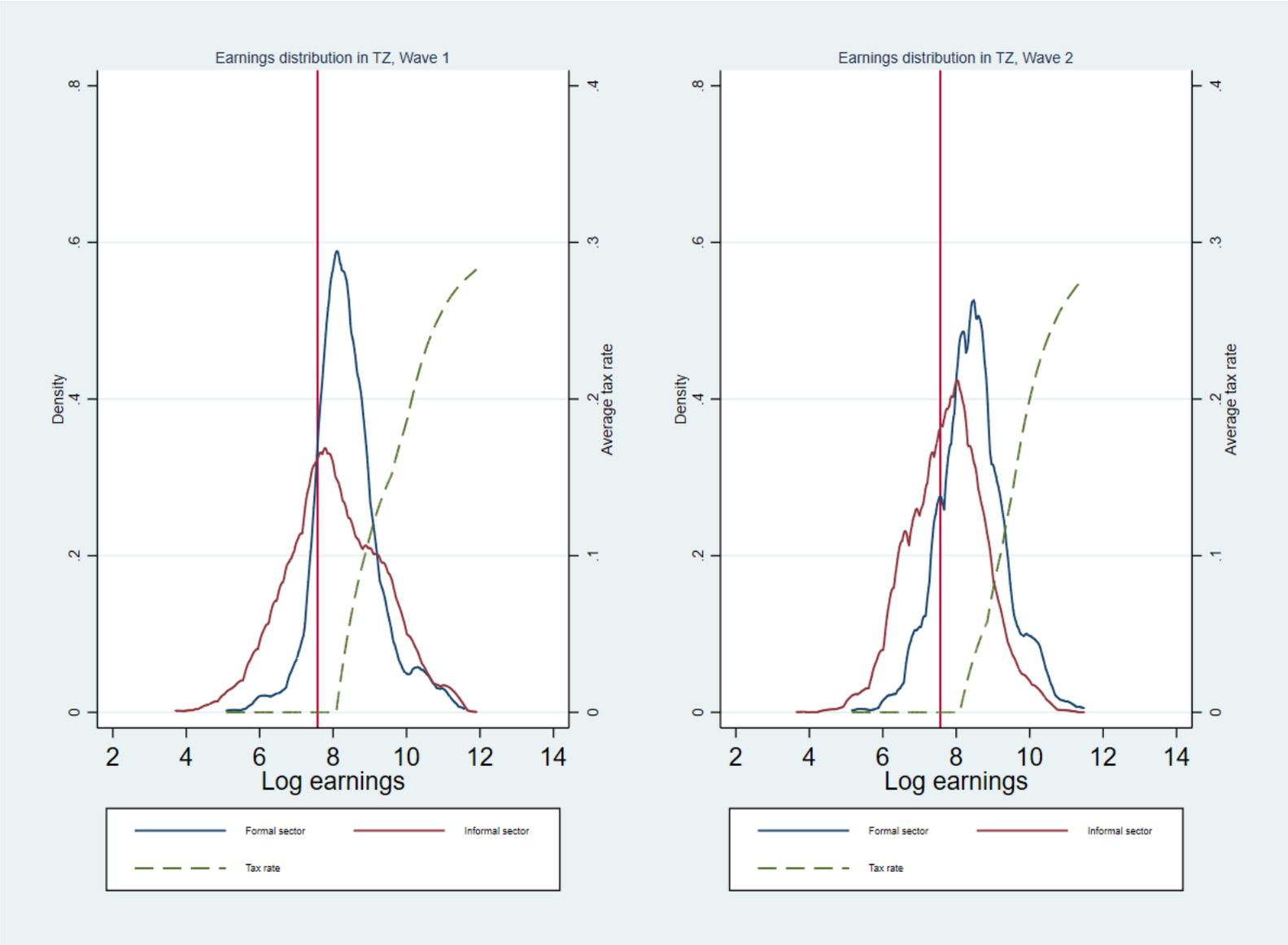
Note: the vertical line depicts the annual minimum wage.

Figure 12: Distribution of formal-sector and informal-sector earnings in Rwanda



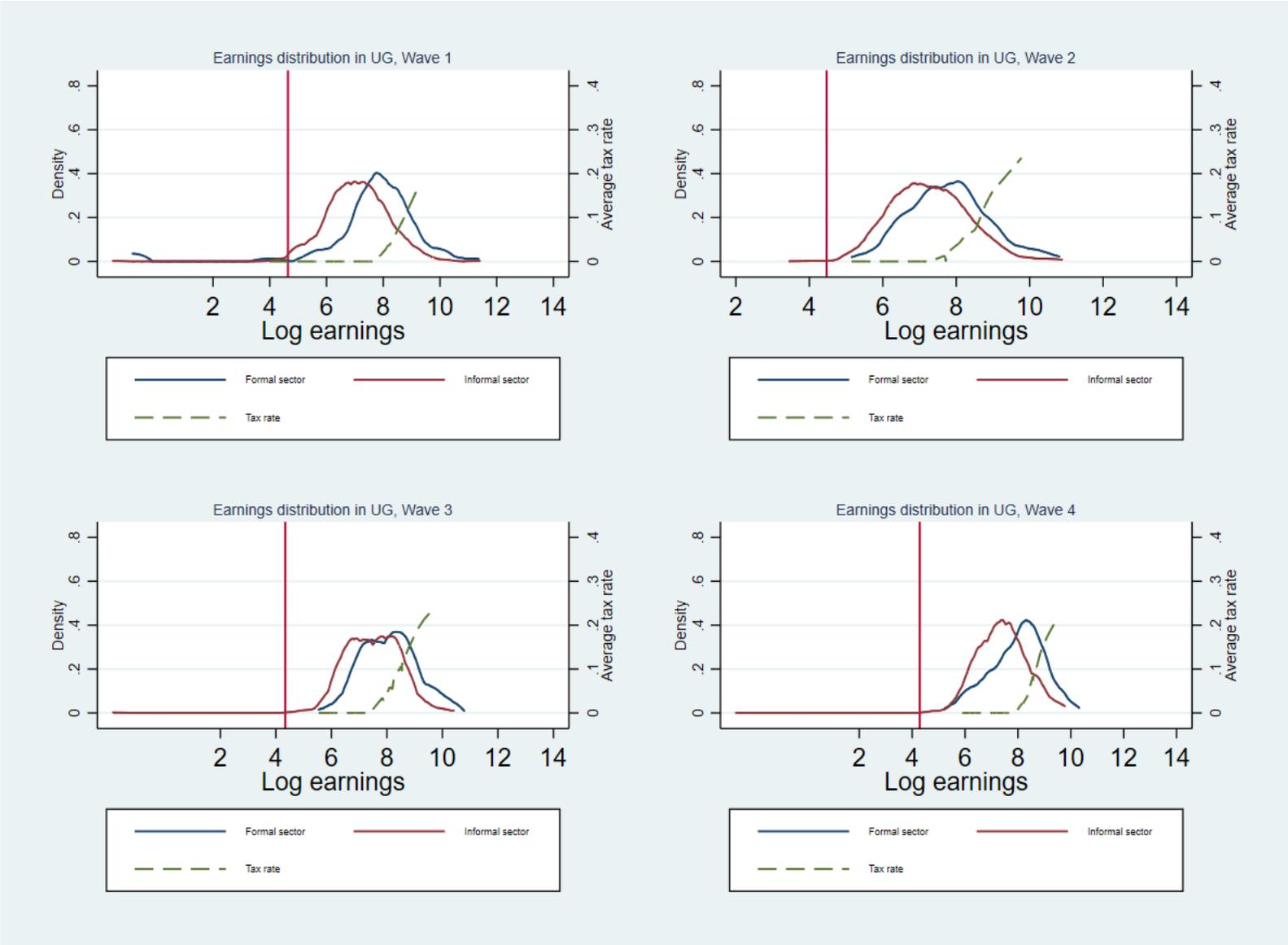
Note: the vertical line depicts the annual minimum wage.

Figure 13: Distribution of formal-sector and informal-sector earnings in Tanzania



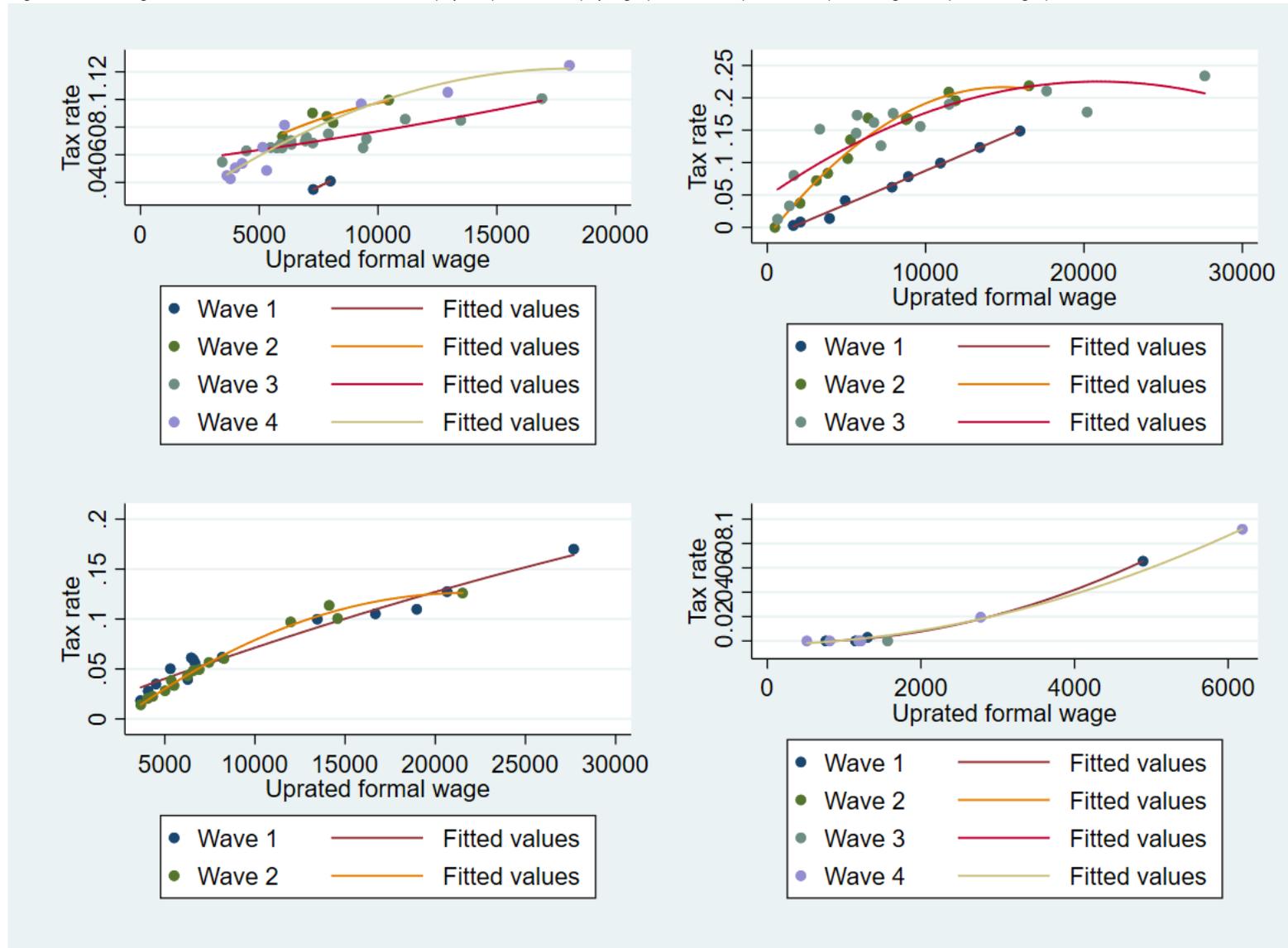
Note: the vertical line depicts the annual minimum wage.

Figure 14: Distribution of formal-sector and informal-sector earnings in Uganda



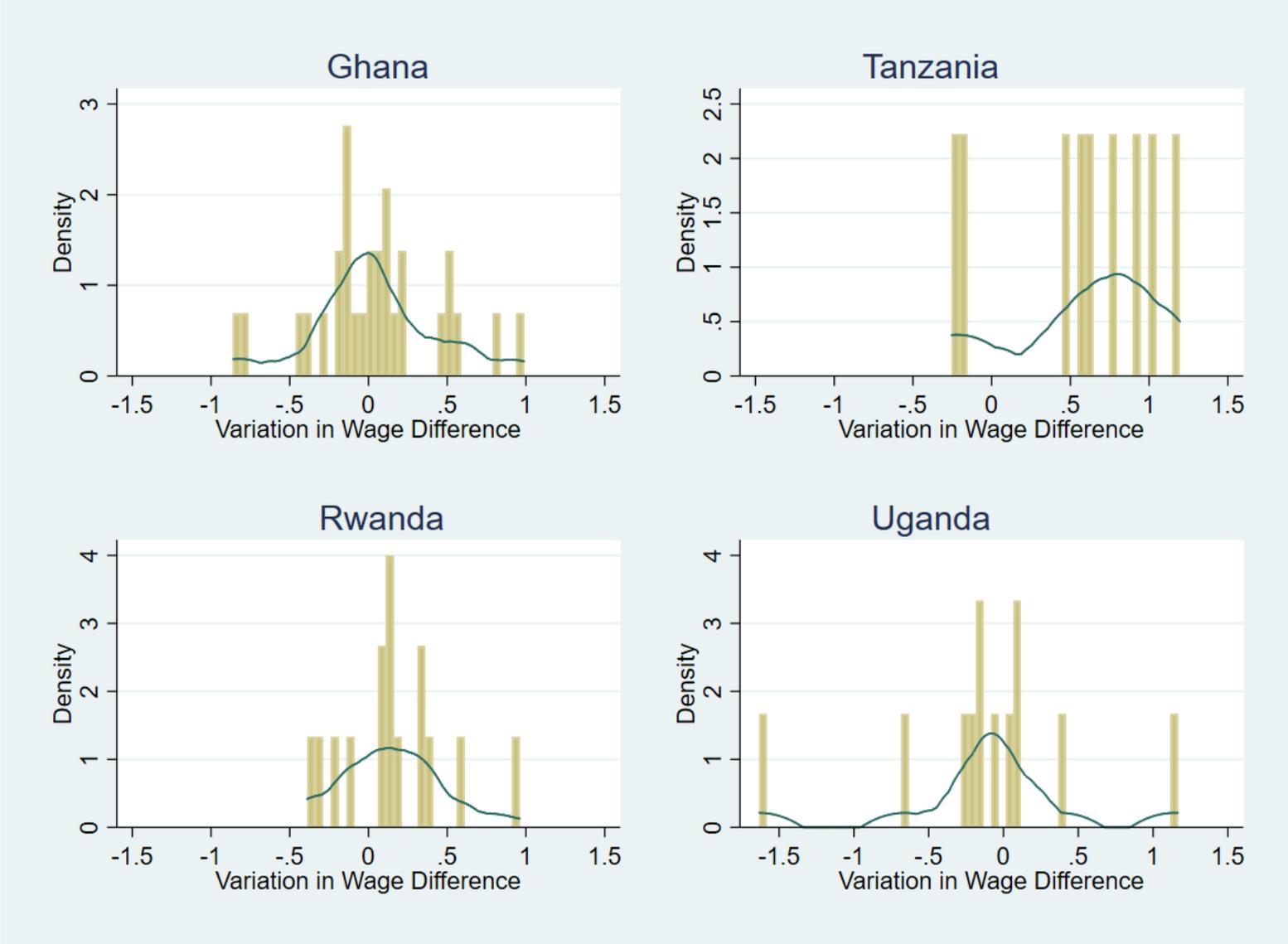
Note: the vertical line depicts the annual minimum wage.

Figure 15: Average tax rates in cell-level data: Ghana (top left); Rwanda (top right); Tanzania (bottom left); and Uganda (bottom right)



Note: Earnings from earlier years uprated to the level of the latest wave using mean earnings growth.

Figure 16: Changes across waves in the difference between formal- and informal-sector wages (histogram and kernel density): Ghana (top left); Rwanda (top right); Tanzania (bottom left); and Uganda (bottom right)



## Tables

Table 1: Self employed by choice or because of lack of formal-sector job

	Madagascar	Malawi	Uganda	Zambia
Choice	73.5	49.6	44.7	39.3
Non-choice	26.5	50.4	55.3	60.7

Source: authors, based on data from McKay et al. (2018)

Table 2: Survey waves in the estimation sample

Countries	Year-groups				
	1	2	3	4	5
	1991–92	1998–2001	2005–06	2009–11	2012–14
Ghana	GLSS3 (91/92)	GLSS4 (98/99)	GLSS5 (05/06)		GLSS6 (12/13)
Rwanda		EICV1 (00/01)	EICV2 (05/06)	EICV3 (10/11)	
Tanzania			ILFS (2006)		ILFS (2014)
Uganda				NPL (09/10)	
				NPL (10/11)	NPL (11/12)
				NPL (11/12)	NPL (13/14)

Note: the table summarizes the division of countries into five waves. GLSS = Ghana Living Standards Survey; EICV = Integrated Household Living Conditions Survey; ILFS = Integrated Labour Force Survey; NPLS = Uganda National Panel Survey.

Table 3: Summary statistics for the estimation data, Ghana

	Informal	Formal	Total
Annual net income	4123.9 (6676.6)	6640.4 (10695.6)	5063.3 (8492.3)
Male	0.419 (0.493)	0.606 (0.489)	0.489 (0.500)
Household head	0.536 (0.499)	0.682 (0.466)	0.590 (0.492)
Household size	4.488 (2.732)	4.216 (2.460)	4.387 (2.637)
Age 15–24	0.168 (0.374)	0.0864 (0.281)	0.137 (0.344)
Age 25–34	0.353 (0.478)	0.339 (0.474)	0.348 (0.476)
Age 35–44	0.269 (0.444)	0.291 (0.454)	0.277 (0.448)
Age 45–54	0.162 (0.368)	0.210 (0.408)	0.180 (0.384)
Age 55–60	0.0479 (0.214)	0.0732 (0.260)	0.0573 (0.232)
Primary or less	0.379 (0.485)	0.153 (0.360)	0.294 (0.456)
Lower secondary	0.459 (0.498)	0.358 (0.479)	0.421 (0.494)
Upper secondary	0.143 (0.350)	0.240 (0.427)	0.179 (0.383)
Tertiary/post-secondary	0.0199 (0.140)	0.249 (0.433)	0.106 (0.307)
Quasi-public	0.00308 (0.0554)	0.0237 (0.152)	0.0108 (0.103)
Private employee	0.252 (0.434)	0.350 (0.477)	0.288 (0.453)
Self employed/employer	0.666 (0.472)	0.275 (0.447)	0.520 (0.500)
Family business/home	0.0294 (0.169)	0.0250 (0.156)	0.0277 (0.164)
Other work	0.0380 (0.191)	0.0138 (0.117)	0.0289 (0.168)
Armed forces	0.00185 (0.0430)	0.0261 (0.159)	0.0109 (0.104)
Legislator/manager/senior official	0.0108 (0.103)	0.0352 (0.184)	0.0199 (0.140)
Professional	0.0208 (0.143)	0.205 (0.403)	0.0895 (0.285)
Technician/assoc. professional	0.0200 (0.140)	0.0813 (0.273)	0.0429 (0.203)
Clerk	0.0103 (0.101)	0.0576 (0.233)	0.0280 (0.165)
Service/sales workers	0.399 (0.490)	0.251 (0.434)	0.344 (0.475)
Agricult. workers	0.0425 (0.202)	0.0144 (0.119)	0.0320 (0.176)
Craft/related trade workers	0.289 (0.453)	0.142 (0.349)	0.234 (0.423)
Plant/machine operators assemblers	0.0783 (0.269)	0.100 (0.300)	0.0865 (0.281)
Elementary occupation	0.127 (0.333)	0.0881 (0.284)	0.113 (0.316)
Observations	21,621		

Table 4: Summary statistics for the estimation data, Rwanda

	Informal	Formal	Total
Annual net income	2033.3 (5033.4)	5016.3 (10305.8)	2615.3 (6519.6)
Male	0.635 (0.482)	0.640 (0.480)	0.636 (0.481)
Household hHead	0.539 (0.499)	0.539 (0.499)	0.539 (0.499)
Household size	5.282 (2.417)	6.114 (2.667)	5.445 (2.489)
Age 15–24	0.297 (0.457)	0.216 (0.412)	0.281 (0.450)
Age 25–34	0.336 (0.472)	0.388 (0.487)	0.346 (0.476)
Age 35–44	0.197 (0.398)	0.254 (0.435)	0.208 (0.406)
Age 45–54	0.129 (0.335)	0.114 (0.318)	0.126 (0.332)
Age 55–60	0.0406 (0.197)	0.0280 (0.165)	0.0381 (0.192)
Primary or less	0.889 (0.314)	0.394 (0.489)	0.792 (0.406)
Lower secondary	0.0326 (0.178)	0.0841 (0.278)	0.0427 (0.202)
Upper secondary	0.0691 (0.254)	0.370 (0.483)	0.128 (0.334)
Tertiary/post-secondary	0.00946 (0.0968)	0.152 (0.360)	0.0374 (0.190)
Quasi-public	0.0158 (0.125)	0.0947 (0.293)	0.0312 (0.174)
Private employee	0.279 (0.449)	0.393 (0.489)	0.301 (0.459)
Self employed/employer	0.135 (0.342)	0.0723 (0.259)	0.123 (0.328)
Family business/home	0.548 (0.498)	0.134 (0.341)	0.467 (0.499)
Other work	0.00786 (0.0883)	0.000249 (0.0158)	0.00638 (0.0796)
Armed forces	0 (0)	0 (0)	0 (0)
Legislator/manager/Senior official	0.0168 (0.128)	0.214 (0.410)	0.0552 (0.228)
Professional	0.00923 (0.0956)	0.0962 (0.295)	0.0262 (0.160)
Technician/assoc. professional	0.0112 (0.105)	0.122 (0.328)	0.0329 (0.178)
Clerk	0.125 (0.330)	0.0674 (0.251)	0.113 (0.317)
Service/sales workers	0.134 (0.340)	0.266 (0.442)	0.160 (0.366)
Agricult. workers	0.464 (0.499)	0.107 (0.309)	0.394 (0.489)
Craft/related trade workers	0.0428 (0.202)	0.0226 (0.149)	0.0389 (0.193)
Plant/machine operators assemblers	0.0307 (0.173)	0.0303 (0.172)	0.0306 (0.172)
Elementary occupation	0.167 (0.373)	0.0745 (0.263)	0.149 (0.356)
Observations	12,395		

Table 5: Summary statistics for the estimation data, Tanzania

	Informal	Formal	Total
Annual net income	5277.0 (8807.8)	8143.5 (9493.1)	6007.4 (9073.5)
Male	0.560 (0.496)	0.691 (0.462)	0.594 (0.491)
Household head	0.540 (0.498)	0.722 (0.448)	0.586 (0.492)
Household size	3.182 (2.344)	3.383 (2.714)	3.234 (2.445)
Age 15–24	0.220 (0.414)	0.101 (0.301)	0.189 (0.392)
Age 25–34	0.368 (0.482)	0.341 (0.474)	0.361 (0.480)
Age 35–44	0.255 (0.436)	0.288 (0.453)	0.263 (0.440)
Age 45–54	0.115 (0.319)	0.208 (0.406)	0.139 (0.346)
Age 55–60	0.0425 (0.202)	0.0620 (0.241)	0.0475 (0.213)
Primary or less	0.859 (0.348)	0.446 (0.497)	0.754 (0.431)
Lower secondary	0.123 (0.329)	0.305 (0.460)	0.169 (0.375)
Upper secondary	0.0149 (0.121)	0.168 (0.373)	0.0538 (0.226)
Tertiary/post-secondary	0.00255 (0.0505)	0.0817 (0.274)	0.0227 (0.149)
Quasi-public	0.0172 (0.130)	0.0899 (0.286)	0.0357 (0.186)
Private employee	0.248 (0.432)	0.394 (0.489)	0.285 (0.452)
Self employed/employer	0.688 (0.463)	0.155 (0.362)	0.552 (0.497)
Family business/home	0.0289 (0.168)	0.00570 (0.0753)	0.0230 (0.150)
Other work	0.000174 (0.0132)	0 (0)	0.000130 (0.0114)
Armed forces	0 (0)	0 (0)	0 (0)
Legislator/manager/senior official	0.00378 (0.0614)	0.0345 (0.182)	0.0116 (0.107)
Professional	0.00517 (0.0717)	0.0913 (0.288)	0.0271 (0.162)
Technician/assoc. professional	0.0206 (0.142)	0.220 (0.415)	0.0715 (0.258)
Clerk	0.00694 (0.0830)	0.0580 (0.234)	0.0199 (0.140)
Service/sales workers	0.352 (0.478)	0.253 (0.435)	0.327 (0.469)
Agricult. workers	0.0358 (0.186)	0.0275 (0.164)	0.0337 (0.180)
Craft/related trade workers	0.220 (0.414)	0.0938 (0.292)	0.188 (0.390)
Plant/machine operators assemblers	0.0539 (0.226)	0.131 (0.337)	0.0735 (0.261)
Elementary occupation	0.302 (0.459)	0.0912 (0.288)	0.248 (0.432)
Observations	19,966		

Table 6: Summary statistics for the estimation data, Uganda

	Informal	Formal	Total
Annual net income	2589.9 (3866.8)	5510.4 (7001.4)	3458.9 (5182.9)
Male	0.712 (0.453)	0.629 (0.483)	0.687 (0.464)
Household head	0.481 (0.500)	0.632 (0.483)	0.526 (0.499)
Household size	6.485 (4.171)	6.362 (3.623)	6.448 (4.016)
Age 15–24	0.371 (0.483)	0.0959 (0.295)	0.289 (0.453)
Age 25–34	0.316 (0.465)	0.345 (0.476)	0.325 (0.468)
Age 35–44	0.193 (0.394)	0.356 (0.479)	0.241 (0.428)
Age 45–54	0.0897 (0.286)	0.174 (0.379)	0.115 (0.319)
Age 55–60	0.0308 (0.173)	0.0294 (0.169)	0.0304 (0.172)
Primary or less	0.690 (0.463)	0.214 (0.411)	0.548 (0.498)
Lower secondary	0.188 (0.391)	0.261 (0.439)	0.210 (0.407)
Upper secondary	0.0478 (0.213)	0.0721 (0.259)	0.0550 (0.228)
Tertiary/post-secondary	0.0738 (0.261)	0.452 (0.498)	0.186 (0.390)
Quasi-public	0.0302 (0.171)	0.0874 (0.283)	0.0472 (0.212)
Private employee	0.460 (0.498)	0.332 (0.471)	0.422 (0.494)
Self employed/employer	0.00151 (0.0388)	0.00284 (0.0533)	0.00191 (0.0436)
Family business/home	0.422 (0.494)	0.0533 (0.225)	0.312 (0.463)
Other work	0 (0)	0 (0)	0 (0)
Armed forces	0.000867 (0.0294)	0.0128 (0.112)	0.00441 (0.0663)
Legislator/manager/senior official	0.00539 (0.0732)	0.0277 (0.164)	0.0120 (0.109)
Professional	0.0402 (0.196)	0.290 (0.454)	0.114 (0.318)
Technician/assoc. professional	0.0749 (0.263)	0.323 (0.468)	0.149 (0.356)
Clerk	0.00994 (0.0992)	0.0368 (0.188)	0.0179 (0.133)
Service/sales workers	0.164 (0.370)	0.0772 (0.267)	0.138 (0.345)
Agricult. workers	0.0875 (0.283)	0.0211 (0.144)	0.0678 (0.251)
Craft/related trade workers	0.0944 (0.292)	0.0187 (0.135)	0.0719 (0.258)
Plant/machine operators assemblers	0.0332 (0.179)	0.0462 (0.210)	0.0371 (0.189)
Elementary occupation	0.490 (0.500)	0.147 (0.354)	0.388 (0.487)
Observations	3,804		

Table 7: Individual country estimation results

		No controls	All fixed effects	Above min. wage	Above first tax br.	Excl. self-empl.
		(1)	(2)	(3)	(4)	(5)
(a) Ghana	Elasticity	0.745*	-0.033	0.041	-0.123	0.189
	Std. err.	(0.400)	(0.214)	(0.189)	(0.161)	(0.177)
	Group <i>N</i>	57	57	55	45	34
(b) Rwanda	Elasticity	-0.273	0.204	0.069	-0.354	-0.363*
	Std. err.	(0.302)	(0.287)	(0.340)	(0.382)	(0.199)
	Group <i>N</i>	36	36	36	35	30
(c) Tanzania	Elasticity	1.350***	0.068	-0.015	0.598	0.055
	Std. err.	(0.475)	(0.641)	(0.621)	(0.509)	(0.547)
	Group <i>N</i>	33	33	30	29	24
(d) Uganda	Elasticity	0.828*	0.022	0.219	0.184	-0.095
	Std. err.	(0.438)	(0.203)	(0.352)	(0.36)	(0.281)
	Group <i>N</i>	32	32	32	12	26

Note: cell-level estimation results by country. Dependent variable: share of formal workers in a cell. The elasticity is the elasticity of formal work with respect to changes in the (log) difference of formal versus informal wage with the standard error calculated by the delta method. Cells created using three age groups, three educational groups, and sex. Model 1 shows cross-sectional correlation only, whereas models 2–4 include all cell and survey wave fixed effects. In model 3, all observations where earnings are below the monthly minimum wage are excluded, while in model 4 all observations where earnings are below the first tax bracket are omitted. Column (5) presents estimates for wage earners only. In all models, cells with fewer than 20 observations are dropped.

Table 8: First-stage F-tests from individual-level regressions based on three educational categories and above minimum wage income

	Ghana	Rwanda	Tanzania	Uganda
F-statistic	10.47631	19.8937	11.95272	15.44333
<i>p</i> -value	Prob > F = 0.0000			

Table 9: Pooled estimation results

	No controls	All fixed effects	Above min. wage	Above first tax br.	With country trends	Excl. self-empl.
	(1)	(2)	(3)	(4)	(5)	(6)
Elasticity	0.408*	0.038	0.341**	0.633***	0.116	-0.207*
Std. err.	(0.242)	(0.123)	(0.171)	(0.227)	(0.161)	(0.108)
Group <i>N</i>	155	148	141	118	118	110

Notes: cell-level estimations results for the pooled sample. Dependent variable: share of formal workers in a cell. The elasticity is the elasticity of formal work with respect to changes in the (log) difference of formal versus informal wage with the standard error calculated by the delta method. Cells created using three age groups, three educational groups, and sex. Model 1 shows cross sectional correlation only, whereas models 2–4 include all cell and survey wave fixed effects. In model 3, all observations where earnings are below the monthly minimum wage are excluded, while in model 4 all observations where earnings are below the 1st tax bracket are omitted. Column (5) is the same as column (4) but with country-specific trends added. Column (6) presents estimates for wage earners only. In all models, cells with fewer than 20 observations are dropped.

## Appendix

Table A1: Individual country estimation: additional results

		Men (1)	Women (2)	4 Educ. categ. (3)	Altern. groups (4)	Level wages (5)
(a) Ghana	Elasticity	-0.223	0.412	0.082	-0.595**	-0.004
	Std. err.	(0.205)	(0.508)	(0.162)	(0.302)	(0.006)
	Group <i>N</i>	33	24	65	46	55
(b) Rwanda	Elasticity	-0.300	0.483*	-0.003	0.716***	-0.012
	Std. err.	(0.441)	(0.393)	(0.357)	(0.254)	(0.051)
	Group <i>N</i>	20	16	41	38	36
(c) Tanzania	Elasticity	-0.684	0.099	0.174	0.545	-0.042
	Std. err.	(0.564)	(0.321)	(0.680)	(0.356)	(0.077)
	Group <i>N</i>	17	16	31	21	30
(d) Uganda	Elasticity	-0.075	0.951**	0.174	0.117	0.008
	Std. err.	(0.190)	(0.451)	(0.190)	(0.168)	(0.026)
	Group <i>N</i>	18	14	29	21	32

Note: cell-level estimations results by country. Dependent variable: share of formal workers in a cell. The elasticity is the elasticity of formal work with respect to changes in the (log) difference of formal versus informal wage with the standard error calculated by the delta method. Cells created using income above minimum wage, three age groups, three educational groups, and sex in models 1, 2, 4, and 5. All models include a full set of cell and survey wave fixed effects. Models 1 and 2 report the results for men and women, respectively. In model 3, instead of three different educational categories, cells are created using four educational categories (primary or less, some secondary, completed secondary, some tertiary). Instead of education, the cells are created using marital status, having children, and occupational categories in model 4. Model 5 shows the estimates using the earnings difference in levels rather than logs. In all models, cells with fewer than 20 observations are dropped.

Table A2: Pooled estimation: additional results

	Men (1)	Women (2)	4 Educ. categ. (3)	Altern. groups (4)	Level wages (5)
Elasticity	-0.081	0.119	0.271	0.246	-0.013***
Std. err.	(0.160)	(0.170)	(0.172)	(0.158)	(0.004)
Group <i>N</i>	83	65	155	1136	141

Note: cell-level estimations results for the pooled sample. Dependent variable: share of formal workers in a cell. The elasticity is the elasticity of formal work with respect to changes in the (log) difference of formal versus informal wage with the standard error calculated by the delta method. Cells created using income above minimum wage, three age groups, three educational groups, and sex in models 1, 2, 4, and 5. All models include a full set of cell and survey wave fixed effects. Models 1 and 2 report the results for men and women, respectively. In model 3, instead of three different educational categories, cells are created using four educational categories (primary or less, some secondary, completed secondary, some tertiary). Instead of education, the cells are created using marital status, having children, and occupational categories in model 4. Model 5 shows the estimates using the earnings difference in levels rather than logs. In all models, cells with fewer than 20 observations are dropped.