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The Journal of Development Studies

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/fjds20

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To cite this article: Andy McKay, Jukka Pirttilä & Caroline Schimanski (2024) The Tax Elasticity of Formal Work in Sub-Saharan African Countries, The Journal of Development Studies, 60:2, 217-244, DOI: 10.1080/00220388.2023.2279477

To link to this article: https://doi.org/10.1080/00220388.2023.2279477

The Journal of Development Studies, 2024
Vol. 60, No. 2, 217–244, https://doi.org/10.1080/00220388.2023.2279477

The Tax Elasticity of Formal Work in Sub-Saharan African Countries

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(Original version submitted June 2022; final version accepted October 2023)

ABSTRACT *When seeking to increase their tax revenues, policy makers face a likely tradeoff between decreasing personal income tax rates (making formalizing more attractive and potentially contributing to revenue) and alternatively raising tax rates (potentially slowing down the formalization of the economy if people prefer informal employment). Evidence on formal versus informal earnings and job characteristics in different sectors is limited in African countries, and in particular very little is known about the impact of tax changes on the extent of informality. This paper therefore estimates the personal income tax responsiveness of the extensive margin of formality, i.e. the propensity to be a formal as opposed to an informal worker, for Ghana, Rwanda, Tanzania, and Uganda, using repeated cross-sections of household data and applying grouping estimator techniques. Perhaps because of labour demand constraints and other frictions, the paper finds non-significant relations between the formal employment share and the formal-informal earnings differences.*

KEYWORDS: Developing countries; Sub-Saharan Africa; taxation; labour supply; informality

1. Introduction

In developing countries in general, and low- and lower middle-income countries in particular, tax revenues as a share of GDP are significantly lower than is the case in high income countries. Governments are increasingly under pressure, internally and from donors, not least in the context of the Sustainable Development Goals,[1] to raise their tax take. In the specific case of Africa many countries 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 the countries we examine), but the figures remain very low relative to what is needed. In contrast, most OECD countries collected between 30 and 45% of GDP as government revenues in 2019 according to the OECD Tax Database.

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[&]Part of the work was done when at Hanken School of Economics, UNU-WIDER and NOVA SBE
Supplementary Materials are available for this article which can be accessed via the online version of this journal available at https://doi.org/10.1080/00220388.2023.2279477.

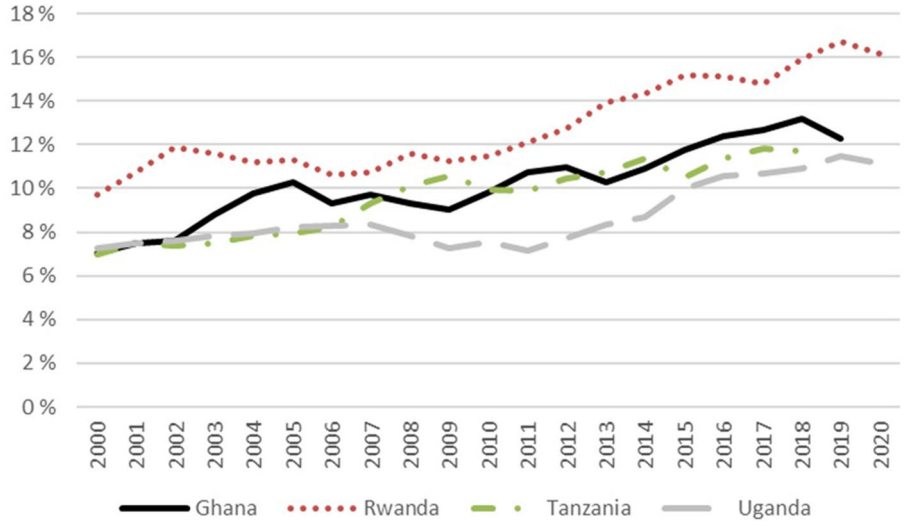

Figure 1. Tax revenues including social security contributions (SSC) as a percentage of GDP in the countries analyzed.
Source: Own calculations based on UNU-WIDER Government revenue dataset.

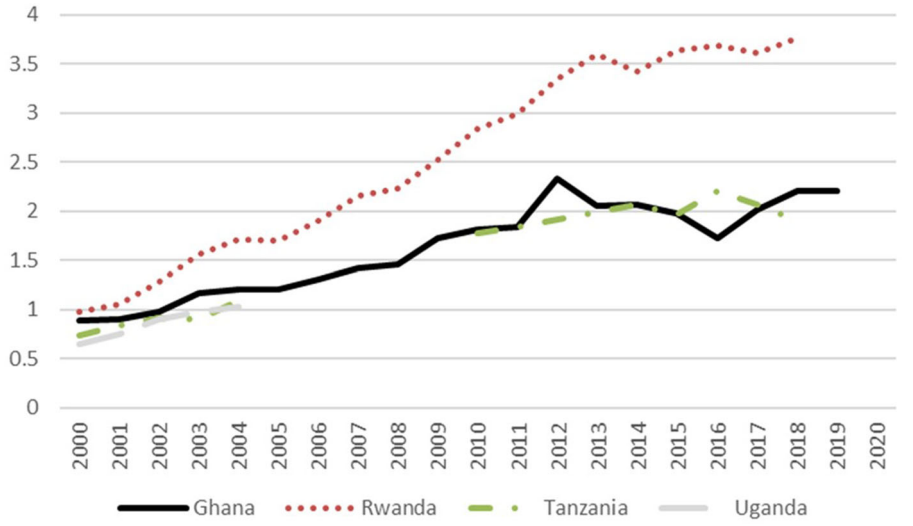

Figure 2. Labour income tax revenue including social security contributions (SSC) as percentage of GDP the countries analyzed.
Source: Own calculations based on UNU-WIDER Government revenue dataset.

In addition, the nature of taxation in poorer countries is significantly different to the situation in richer countries; poorer countries rely much less on direct taxes, including taxes on incomes of individuals and companies, and much more proportionately on indirect taxes. Figure 2 clearly confirms that they obtain little revenue using direct taxes on labour income. In addition, revenues from corporate taxes in the African countries are also very low, standing at around 1.5 per cent at the same time.[2] This situation significantly limits the redistributive power of tax, given that direct taxes can enable much more redistribution than indirect taxes, which are often neutral at best. This issue is a particular concern because of the high levels of inequality in many poorer countries. A major priority then is the need to be able to more effectively

tax individual incomes – of employees and the large number of self employed whose activities are too small to make them eligible for corporate taxes.

The major challenge to increasing tax revenue from direct taxes on individual incomes is the substantial share of informal employment and economic activity in most developing countries, as almost by definition this falls outside of the tax net. Given our focus on taxes on individual incomes, here we consider informality measured in terms of employment. The ILO estimates informal employment rates as a percentage of non-agricultural employment in some sub-Saharan African countries of over 90 per cent (ILO, 2023); and recent evidence from the ILO (2022) suggests informal work accounts for 85% of total employment in sub-Saharan Africa with no clear declining trend visible in the informal employment shares in non-agricultural employment, provided in ILO (2023).

While much of the traditional literature (e.g. Fields, 1975) had suggested that formally employed people earn more and that informal employment was an escape from unemployment while looking for formal employment, this view has recently been challenged by many studies which provide evidence for widespread voluntary informal employment (Henley, Arabsheibani, & Carneiro, 2009; Bargain & Kwenda, 2011; Maloney, 1999, 2004; Bruhn & McKenzie, 2013; see Bargain & Kwenda, 2011 for a more detailed discussion). Informal work may also have the advantage of enabling more flexibility. Findings by Günther and Launov (2012) from urban Côte d'Ivoire even show that only less than half of informal employment is involuntary, and there is a significant segment of individuals for whom informality represent an opportunity. Badaoui, Strobl, and Walsh (2008) do not find evidence for a wage gap between the two sectors in South Africa when controlling for other characteristics. Indeed many may have a higher return from working in informal employment than from formal employment (Günther & Launov, 2012; Jones & Tarp, 2015). Part of this is precisely because they fall outside the personal-income tax base available to the authorities. Related to this question, Bargain and Kwenda (2014) 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 formal employment may additionally be moderated by the varying pay premium for formal work by country, type of work, and income level.[3]

Because of imperfect enforcement of regulation, productive enterprises can choose whether to operate in the formal or informal sector in terms of registration, and they can also choose whether to employ workers on a formal or informal basis. Workers can also choose between formal or informal employment; while own account workers often fall into the category of informal employment in the informal sector. But how much mobility is there between formal and informal work and what underlies this? In practice there is plenty of evidence of workers frequently switching between being in formal or informal employment in either the formal or informal sector (Diaz, Chacaltana, Rigolini, & Ruiz, 2018), also supported by analysis of panel data sets for the same countries considered here. The high degree of informality and the ease by which workers may be able to switch between formal and informal work accounts both for lower total revenues and the greater difficulty to collect direct taxes, such as personal income tax on employees and the self-employed, and from corporate income tax on smaller firms. This accounts for the greater relative reliance on indirect taxes.

It is highly plausible that one of the most important margins of response of economic behaviour to changes in tax and transfer policies in developing countries may be the extent of engagement in formal work. Besley and Persson (2013) note that the corresponding formality 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.[4]

How large is the potential tradeoff? To be able to answer this question one would require credible evidence on the responsiveness of the share of the formal employment to changes in the net labour income differential in formal versus informal employment.

Recent quasi-experimental econometric work on this tax elasticity exists, especially for Latin American countries, though largely considering changes in payroll rather than personal income tax changes, thus targeting firm rather than individual behaviour.[5] However, we are not aware of any studies on this matter for low- or lower-middle-income African countries, where personal income taxes are much more common than payroll taxes and where the trade-off between informal and formal employment could be even more severe than in Latin America. In Latin America, larger social protection systems, that only those in formal employment may benefit from, are already in place, whereas similar programmes in African countries are only recently being scaled up and were historically only available to public sector employees.

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, Ghana, Rwanda, Tanzania, and Uganda. Building on the approach developed by Blundell, Duncan, and Meghir (1998), the idea is to utilise a number of personal income tax changes that treat different groups of individuals differently. Changes in the take-home pay across groups provide variation in the relative attractiveness of working in formal employment, which is needed for reliable estimates of the impacts of fiscal policies on formality. Our analysis here is based on repeated cross sectional household survey or labour force data sets for these four African countries, which contain the necessary data to address this question. We consider both country specific estimates and a pooled analysis, which can enable more precise estimates.

To the best of our knowledge, this paper attempts to offer the first estimates of the impacts of personal income taxes on formal employment for African countries—with the exception of South Africa—that are based on a modern estimation strategy. We also discuss various challenges related to estimating the formality responses in the African context.[6] Given the very different state and nature of social benefits and tax systems in African countries compared to those in Latin 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 Latin America. In addition to this, we also provide a considerable amount of descriptive material about the differences (with special reference to their earnings) between formal and informal workers in these African countries, something on which there is little earlier empirical work.

The paper proceeds as follows. In Section 2, we discuss the concept and definition of informality and 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. The concept of informality and background literature

2.1. The concept and definition of informality

Even focusing on an employee point of view, formality status 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 of workers: 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.

More recently the International Labour Organization (ILO) has therefore attempted to create a harmonised operational definition for (in)formal employment and the (in)formal sector. This relies on resolutions and guildelines on defining informal employment and the informal sector adopted by the 15th and 17th International Conference of Labour Statisticians (ICLS), whereby a person faces four scenarios. A person can be either in formal or informal employment, differentiated mainly through social security contributions, and can be working in either the formal or informal sector, identified mainly through the level or registration and bookkeeping maintained by the firm the person works for (ILO (1993, 2003, 2019)). Based on the ILO's definition of informality, there exists thus from the point of view of an individual worker, whether a wage employee or self-employed, options to be in informal or formal employment. Wage employees can thereby be in informal employment in either the formal or the informal sector, as well as the reverse, being in formal employment in the formal and informal sector. For those in self-employment or working as employers, being in either formal or informal employment is linked to the formality status of their firm.[7] This ILO concept of informality is the one we adopt in this paper.

2.2. *Literature on the impact of taxes on Informality*[8]

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 formal employment and or 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, Navarro, and Vroman (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 (2015), 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.

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 than 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 following the same reform using household survey data. Gorodnichenko, Martinez-Vazquez, and Peter (2009) and Zarković-Rakić, Ranđelović, and Vladisavljević (2016) looked at the effect of tax reforms on the size of the informal economy in Russia and Serbia, respectively.

As already noted, 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 (Ulyssea, 2018). 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 (2014) look at the effect of a social insurance reform in Uruguay, extending healthcare coverage to dependents 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 (2021) 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 to being eligible for social assistance benefits—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) used a difference-in-difference strategy to study how the Universal Child Allowance (AUH) programme in Argentina (an income maintenance programme) affects the incentives of informal workers to transition to the formal-sector labour market. 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) who estimate that the implementation of Mexico's Popular Health Insurance programme, finding that it reduced the stock of registered employers by 3.8 per cent and employees by 2.4 per cent. Alzúa, Cruces, and Ripani (2013) study the effect of welfare programmes on work incentives and the adult labour supply in Mexico, Nicaragua, and Honduras in a difference-in-difference analysis. 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.

In summary, existing studies, many of which have been conducted in Latin America, have shown, many based on evaluation approaches, that changes in taxes and/or social security have often had impacts on the extent of informality. In this paper, we investigate a related question for the case of selected African countries, though using a different approach.

3. Theory and estimation

3.1. Conceptual framework

This section presents a stylized model of occupational choice, inspired by the literature on the extensive margin of labour markets in public economics; for recent examples, see Jacquet,

Lehmann, and der Linden (2013) and Kroft, Kucko, Lehmann, and Schieder (2017). An individual i can either seek work in formal employment or informal employment. Conditional on searching, they find a job in formal employment with a probability p_i. When working in formal employment, the individual receives earnings equal to y_f and pays taxes equal to $T(y_f)$. Working in formal employment also incurs a cost of d_i, which can be negative, and consists of an objective cost of complying with the bureaucratic requirements of formal employment as well a subjective cost/benefit and differs based on an individuals preferences for work, such as for instance being required to work regular hours. Workers can be in informal employment either voluntarily (because they prefer an informal job) or involuntarily (when they are unsuccessful in finding a formal employment job). But neither voluntary nor involuntary informal employment necessarily means lower earnings than formal employment.

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

$$p_i(x_{f,i} - d_i) + (1 - p_i)x_{n,i} - \psi_i \geq x_{n,i}, \tag{1}$$

where ψ stands for the cost of searching for a formal job, which varies according to the individual. The condition for searching for work in the formal employment can also be written as

$$x_{f,i} - x_{n,i} \geq d_i + \frac{\psi_i}{p_i}, \tag{2}$$

which makes it clear that the probability of working in formal employment is positively related to the difference in net pay between the two states. Time is implicitly included in the framework; the condition above holds in a particular time period, with the person being able to search again in later periods. 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 employment, consumption taxes τx_i, where τ is the consumption tax rate and x_i refers to consumption, would need to be financed from disposable income from either formal or informal employment. The payroll taxes paid by the employer are, on the other hand, already reflected in the gross salary for formal workers. Denoting the payroll tax rate by s, the labour cost for the employer is $z = (1 + s)y_f$, hence $y_f = z/(1 + s)$. In reality, working for the formal sector could also bring certain benefits, such as deferred pension rights. However, here we concentrate on the tax side alone, while recognizing that the response to taxes may be moderated by the value of benefits.

Though informal employment may exist even in the public sector and employment in the public sector is therefore according to ILO (2019) not by default formal employment, the framework and analysis here excludes public sector workers, as public sector workers do not have an obvious informal alternative and few exceptions may introduce too much noise into our results. Quasi public sector workers, such as employees of state-owned enterprises are however included in the analysis.

3.2. Discussion of the framework

The model can capture the response in the share of formal employment to labour income taxes when working in informal employment is (partly) a choice. There are several caveats that may influence the determinants of the formal sector share in the African context, and in this sub-section we discuss some of them.

Is it realistic that working in informal employment is voluntary? As discussed in Section 1, the more modern view of informal employment sees it as a positive choice for some people.

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).

This view is corroborated by the findings of McKay, Newell, and Rienzo (2018) based on School to Work Transition Surveys conducted by the ILO, reported in Table 1. This shows that 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. However, it is more likely that many of the significant number of informal wage earners would prefer having a formal-sector job.

Crucially, the formal-employment share may be constrained by labour demand. With flexible wage rates, 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, there is excess supply of labour. If this is the case, the probability of finding a job in formal employment, p, approaches zero, and changes in net pay are not associated with increases in the size of formal employment.[9]

Workers may reside in areas with very limited availability of formal jobs. They may also lack the skills (such as literacy) needed for working in modern, formal, workplaces. These are likely to be main bottlenecks in the countries in our data, also given the large share of workers without monetary income (see Section 4.3). Many formal jobs are in the public sector or in international companies or institutions, and getting employed in these sectors may be very hard for the majority of job seekers.

It is also possible that individuals are not well aware of the tax incentives. They may lack knowledge of the tax code and the changes in tax rates may originate not from actual tax reforms but rather from fiscal drag/bracket creep, and hence the tax treatment of formal employment income is not necessarily very salient. Information frictions may also pertain to the formalization process for small businesses.

While it would be conceptually optimal to also include the benefits that both types of workers receive (Galiani & Weinschelbaum, 2012), limitations of the available data prevent us from doing. However in practice this is unlikely to bias the results given that many formal employment benefits have long only been available for employees in the public sector, who are excluded from this analysis. Data from the ILO's School to Work Transition Surveys confirms that very few private sector workers receive work benefits, and even if some social security benefits have recently been expanded to all formal employees, coverage still remains negligibly low. In Tanzania, for instance, pension coverage among formal employees was estimated to be just 6.5% in 2017 (ILO, 2017c). In the other countries in our sample, the coverage of contributory pension schemes, associated with formal sector benefits are 3.8, 3.8, and 6.7% in Uganda, Rwanda and Ghana respectively, still far below half of the already low formality rates in these countries (ILO, 2017a, 2017b, 2017d).

To summarise, there are various non-tax factors, which may influence the formal employment share, and hence the results below need to be interpreted with the institutional and economic background in mind. If the background characteristics were to change, the tax elasticities could also be altered. We will revert to these issues when discussing the estimation results.

3.3. Estimation

Based on the discussion above, the share of workers working in formal employment increases when the personal income tax rate decreases or when $x_f - x_n$ increases (or becomes

less negative), provided that p is strictly positive. Drawing on Equation (2), the share of the population in formal employment 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[10]

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

where $x_f - x_n$ stands for the net wage differential between the formal and informal employment. $P(y_f > 0)$ is defined to be 1 if the individual is earning strictly positive formal employment income.[11] In this model, following the above analysis, the coefficient β is expected to be positive. Here the fixed effect would control for the cost/benefit working in formal employment(d_i) and the search costs, ψ_i.

Note that since $x_f = y_f - T(y_f)$, both changes in the gross earnings in formal employment relative to informal employment earnings and changes in the tax rate influence individuals' decision making. Hence, formality responses may be estimated also in the absence of tax changes. The tax changes, however, are arguably more exogenous, and ideally, one would have sufficient tax variation alone for the estimates.

However, estimating Equation (3) brings a number of challenges. There can be unobservable characteristics that affect both the individual's pay in the case of formal employment and his/her probability to work in formal employment, and the lack of panel data makes controlling for them difficult. And 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 employment form needs to be imputed.

As already noted, the analysis in this paper is based on repeated cross sectional data sets for the four countries, which data allows us to address these challenges by comparing *groups* of individuals over time in the form of a pseudo-panel. These groups may be defined at a country level, defining groups over gender, age and education level, or can be defined by pooling across all four countries considered here to enable a larger sample size. 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 the categories listed above. Based on the difference-in-difference idea that tax reforms affect otherwise similar individuals differently depending on whether they are working in informal or formal employment, 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 (pertaining to e.g. search costs), conditional on g and t and the strictly positive annual wage y, can be captured by a permanent demographic group effect α_g, which stands for a vector of interacted dummy variables and a time fixed effect μ_t. We define the term ω_{gt} as a vector that contains the full set of interactions between group dummies and time, which are by assumption uncorrelated with η_{it}. This is the central exclusion restriction for identification of our model. This leads us to then estimate

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

by two-stage least squares (2SLS) using ω_{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.[12] Hence, this paper estimates

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

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 in formal employment and thus the share of formal workers. The grouping estimator is also useful as it reduces the measurement error in incomes.

To combat the challenge of missing income in either of the states, we thus use the cell means and average $\overline{y_f - T(y_f)}$ over individuals with formal earnings and $\overline{y_n}$ over individuals with informal earnings to get estimates for the net income in both formal and informal jobs, respectively.

Our main approach is to utilise 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 utilised to test the predictive power of the group*time interaction instruments in the first stage.

The extensive margin of the 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 formal and informal employment, can be calculated as $\beta \times [\overline{(x_f - x_n)}_{gt}/P(y_f > 0)_{gt}]$, where β is the regression coefficient β 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.[13]

Based on the above discussed conceptual framework and estimation approach, we estimate country-specific elasticities and a cross-country (pooled) elasticity of formal work.

3.4. 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 wave. For this purpose, we identify three age groups, three educational groups, and males and females—therefore up to 18 groups, given enough observations in each cell. 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):

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

In this model, μ_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 β_1 from Equation (5), we then calculate as explained earlier the elasticities for each country.

The model also allows for inclusion of additional time-varying cell-level controls. Labour supply decisions may also depend on household status and e.g. on geographical area. We therefore add a specification where cell-level averages of married individuals, household size, occupational groups (low skilled, semi-skilled, services and sales, high skilled), and rural/urban status are included as additional controls. This serves as one way of controlling for other observable time-varying employment determinants.

3.5. Pooled model

Second, we estimate the aggregate elasticity of formal work across the 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 below:

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

Here, θ_c represents the country fixed effect, whereas μ_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

As already noted, this study is based on Labour Force Survey data or labour force modules of Household Living Standard Surveys from four sub-Saharan African countries: Ghana,[14] Rwanda,[15] Tanzania,[16] and Uganda[17] over a time period from 2000 to 2019. 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 aggregated year groups as presented in Table 2. The choice of countries is focused on countries in sub-Saharan Africa, selecting countries with broadly similar levels of per capita GDP and with at least two recent waves of a nationally representative survey containing individual income data (with at least for one wave information on whether the reported income is gross or net of taxes), information regarding the individuals' demographic characteristics, and either direct or indirect information concerning the individuals' formality status for both, employees and employers/self-employed individuals.[18,19]

This study also uses information on the minimum wage, and computes after-tax incomes using data on personal and presumptive income tax rates, and tax bracket information obtained from the local tax authorities and the big-four accounting firms. Employees in formal employment are modelled to pay personal income tax (PAYE), whereas the formal employers/self-employed are modelled to pay personal income tax or, if meeting the threshold criteria, the presumptive income tax (turnover tax).[20]

Table 2. Survey waves in the estimation sample

	1	2	3	4	5
Countries	2000–2001	2005–06	2009–11	2012–15	2016–2019
Ghana		GLSS5 (05/06)		GLSS6 (12/13)	GLSS7 (16/17)
Rwanda	EICV1 (00/01)	EICV2 (05/06)	EICV3 (10/11)	EICV4 (13/14)	
Tanzania		ILFS (2006)		ILFS (2014)	
Uganda			NPL (09/10)	NPL (11/12)	
			NPL (10/11)	NPL (13/14)	NPL (15/16)
			NPL (11/12)	NPL (15/16)	NPL (18/19)

Notes: The table summarises 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.

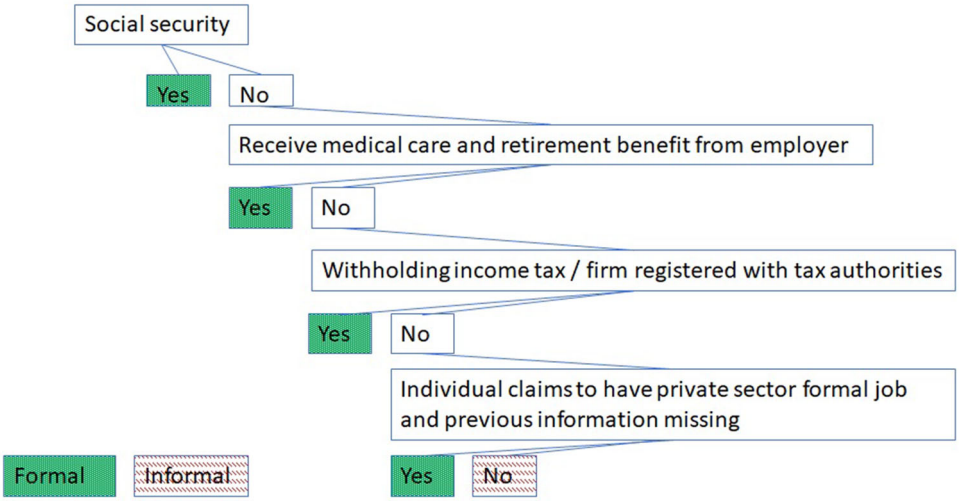

Figure 3. Identification of (in)formality status.

Annual income data[21] is inflation adjusted and rebased to the year 2014 for each country. Subsequently, incomes are converted into US dollar equivalents of 2014 using PPP exchange rates.

(In)Formal employment status is determined from questions in the labour force survey concerning social security benefits and registration with the tax authorities following the approach demonstrated in Figure 3. This approach is closely aligned to the ILO's identification strategy discussed above of (in)formal employment (see Flowchart 2 in ILO (2019)). Data on social security and social assistance benefit levels is not available, but due to the still overall low coverage during our sample period, can be considered to be negligible. In certain specifications, the cost of formal employment d_i, is proxied by the ease of starting a formal business and the ease of paying taxes, using the Starting a Business[22] and Paying Taxes scores[23] from the Doing Business survey data of the World Bank[24]).

4.2. Sample selection

Table 3 reports 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 are excluded because they are assumed to have a lower incentive to change their jobs and formality status due to the limited availability of informal alternative work. 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 in the main job (where identified), or the job with the highest earning. Income levels above the 99th percentile of the distribution are considered outliers and replaced by the cut-off value.[25]

Following Henley et al. (2009) and in line with the ILO's operational definition of informal employment[26], we use social security contributions as the main defining indicator for formality and use a residual approach to classify the remaining workers. Additionally, those people

Table 3. Share of working-age population with monetary income, share of formal workers, and share of self-employed

Country	Wave	Has monetary income (%)	Share formal employment (%)	Share formal employers/formal self-employed (%)
Ghana	2005/06	29.5	27.3	13.6
	2012/13	31.1	23.0	10.5
	2016/17	12.5	27.9	0.4
Rwanda	2000/01	12.3	21.4	1.3
	2005/06	17.0	14.1	4.1
	2010/11	36.0	9.4	4.6
	2013/14	43.4	6.3	1.9
Tanzania	2006	13.3	12.4	0.4
	2014	26.9	21.3	5.9
Uganda	2009/10	21.5	9.2	3.9
	2010/11	18.0	10.3	4.1
	2011/12	21.0	10.2	3.3
	2013/14	22.6	12.3	6.3
	2015/16	23.2	10.9	6.2
	2018/19	18.3	19.9	3.7

The Table reports the share of income earners with monetary income, the share of those in formal employment (employees, employers, self-employed) out of those with monetary income, and the share of formal employers or formal self-employed out of those with monetary.

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 also considered formal workers. Self-employed workers, who made tax payments or who are registered with the tax authorities are considered formal. All remaining workers are classified as informal workers, under the assumption that those individuals who are formal workers would have been identified as such through any of the preceding questions.

Table 3 also collects information about 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 except for the decline over time in the share of formal workers in Rwanda.

Identifying formality status allows the calculation of a net real annual wage for workers in formal and informal employment. For all those who report that taxes have already been deducted, the reported income is considered the net income. In other formal employment cases, the after tax wage is computed using information on the different tax schedules referred to above.

We further restrict the sample to only those observations for which information regarding age, gender, region (rural/urban[27]), relationship to household head, marital status, and occupation exist. These are characteristics previously shown to moderate the probability to work in formal employment. 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: primary education or less (including none); 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 ages for working, and retirement age, but uses open-ended age ranges for robustness checks.

4.3. Descriptive statistics

Summary statistics, presented in Supplementary Tables A1–A3, report the aggregated distribution of individuals across sectors, occupations, education levels, age groups, and other demographic characteristics, as well as how these individuals are divided between formal and informal employment. Survey weights are used in all descriptive statistics, whereas regressions are weighted by the number of actual observations in a cell. In all countries the quasi-public sector, consisting of state-owned enterprises, NGOs, and international organizations, represents at most 5 per cent of employment and is thus a rather small sector. In Ghana and Rwanda more than 60% work as private employees, while in Tanzania and Uganda a majority gain their main income from self-employment or working in their family business. Private wage work is more likely to be formal employment in all countries except Rwanda. In terms of occupations, larger numbers of people hold jobs in services and sales and elementary jobs in all four countries.

For all countries, men, household heads, and middle-aged individuals (25–44 years) are more likely to be formal workers, while young people are less likely to be formal workers. Moreover, the share of individuals working in formal employment rises with education. Professionals, technicians, and associate professionals are occupations most likely to be formal, whereas those in crafts and related trades and in elementary occupations are most likely to be in informal employment. Probit model estimations of the determinants of the formality status (not reported) confirm these aggregate findings, suggesting that men (except in Uganda), household heads, and those living in urban areas are more likely to have a formal job. In addition, being married or having children increases in all countries except Tanzania the likelihood of being a formal worker.

Density plots of aggregate formal net income and informal employment income show some, albeit relatively small, difference in mean income (Figures 4–7). In terms of the shape of the distributions in Figures 4–7, one observes mainly two distinct patterns. The first is especially visible for Uganda and the first two waves for Ghana, in which the distributions largely overlap, though with a much longer tail of low informal incomes. The second contains distributions where the formal employment distribution appears to be on the right of the informal employment distribution, as in Rwanda. Separate analyses of mean annual income by urban/rural status, employment type, or occupation[28] 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 as to which employment type pays more in a particular subgroup. This finding links to the debate in the literature regarding the direction of the pay gap between formal and informal employment.[29] The fact that we find higher informal than formal mean earnings for some subgroup samples, such as Tanzania 2006, is not too surprising and is supported by evidence discussed above and other studies such as 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.

The same charts show that the minimum wages in Ghana and Tanzania are significantly higher relative to the distribution of earnings than is the case for Rwanda and Uganda. Tax is often charged only on earnings significantly in excess of the minimum wage. The plots of the tax rates (both for PAYE and presumptive tax when it exists) on the same charts show that in all four countries significant numbers of workers fall into earnings brackets where they should be paying tax and so may have incentives to remain informal. As large numbers are self-employed they should be able to easily exercise this choice.

4.4. Variation in economic incentives

Table 4 summarises the income tax rate changes across the years[30]. In all countries but Ghana, there have been changes for the actual tax rates, affecting either lower income workers

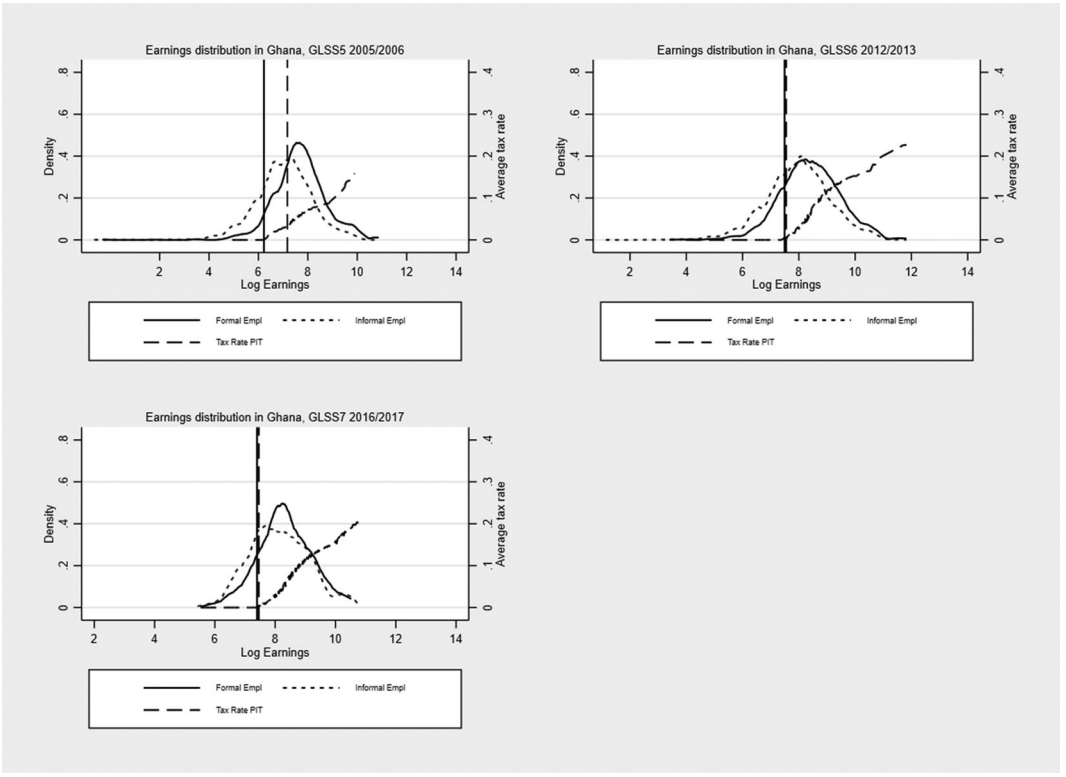

Figure 4. Distribution of formal-sector and informal-sector earnings in Ghana.
Notes: The dashed vertical line depicts the level of the minimum wage and the solid vertical line the 1st tax bracket of the personal income tax (PIT). Log earnings refers to the logarithm of the CPI adjusted earnings in PPP adjusted USD at 2014 values.

(Tanzania) or both higher and lower income workers (Rwanda and Uganda). All countries have adjusted the bracket threshold values for inflation. These changes have taken place seldom, but the changes, when they occur, are quite sizeable. Formal workers in these two countries have, therefore, experienced bracket creep (or fiscal drag) between some years, but over the longer horizon, tax brackets have been kept pace more with income growth.

A more comprehensive illustration of the tax changes is provided in Figure 8, which depicts the actual personal income tax rate variation that formal workers have encountered using our cell-level regression-analysis data. The tax brackets threshold values were significantly adjusted upwards before wave 3 in Ghana, implying that the tax rates have declined. In Rwanda, there was a tax reform in 2005, when the tax brackets were pushed up and the highest marginal tax rate was reduced from 40 to 30 per cent. This is visible as a reduction in the tax rate starting from wave 3. Between waves 3 and 4, the share of presumptive payers increased, resulting in a further decline in the average tax rates in the graph. The Tanzanian bracket threshold values were adjusted upwards and the tax rate for the lower incomes was reduced between the waves. Also the threshold for presumptive payers increased and the share of presumptive tax payers has increased over time. These changes have led to a reduction in the tax rates, visible in the graph. In Uganda, a tax reform took place in the fiscal year 2012/13. This reform increased progressivity and lowered the tax rates of low and medium incomes. In addition, the presumptive tax threshold was raised in 2015. Hence, the tax rate is lower in the last three waves in the data and the graph. This graph groups the first three and last three waves to reduce the noise in the data and illustrate the difference before and after the personal income tax reform. Figure 8

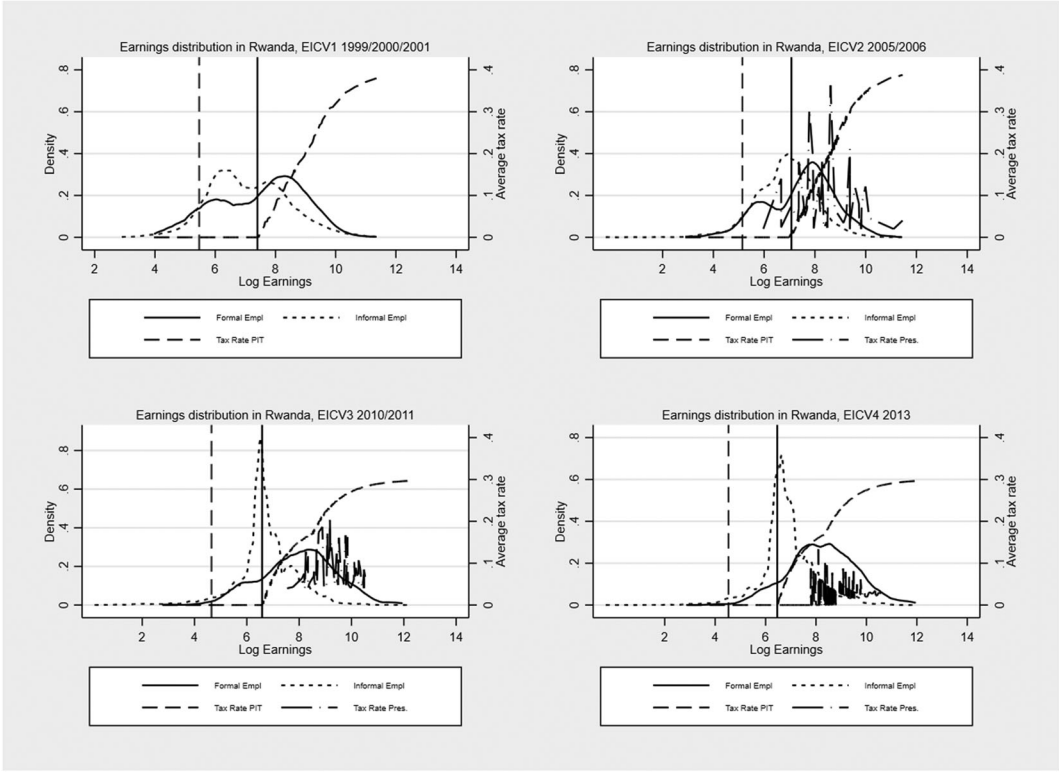

Figure 5. Distribution of formal-sector and informal-sector earnings in Rwanda.
Notes: The dashed vertical line depicts the level of the minimum wage and the solid vertical line the 1st tax bracket of the personal income tax (PIT). Log earnings refers to the logarithm of the CPI adjusted earnings in PPP adjusted USD at 2014 values.

shows an expansion of the distribution and or a right shift of the average income of the different groups in each wave in each country along the x-axis. The right shift can be explained by average income growth and or inflation over time, whereas the broader earnings distribution reflects the broadening of the tax base. The increases in tax bracket thresholds observed in the countries' tax systems are thus on the one hand reducing the bracket creep introduced by inflation, but tax bracket threshold adjustments may not be fully aligned to nominal wage growth, and cannot be easily disentangled from average effective earnings growth over time as effective earnings growth may additionally vary across demographic groups and intentional changes in the tax system.[31]

Figure 9 illustrates the cross-sectional correlation in the pooled data between the formal sector share and the difference between formal and informal sector net income. This correlation is positive – although the link would be less clear if one used differences of log incomes, and the actual regression analyses then explore how the relation changes in fully specified estimation models.

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 waves in our key regressor, $x_f - x_n$, for the four countries. The extent of the variation is depicted in Figure 10. 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.

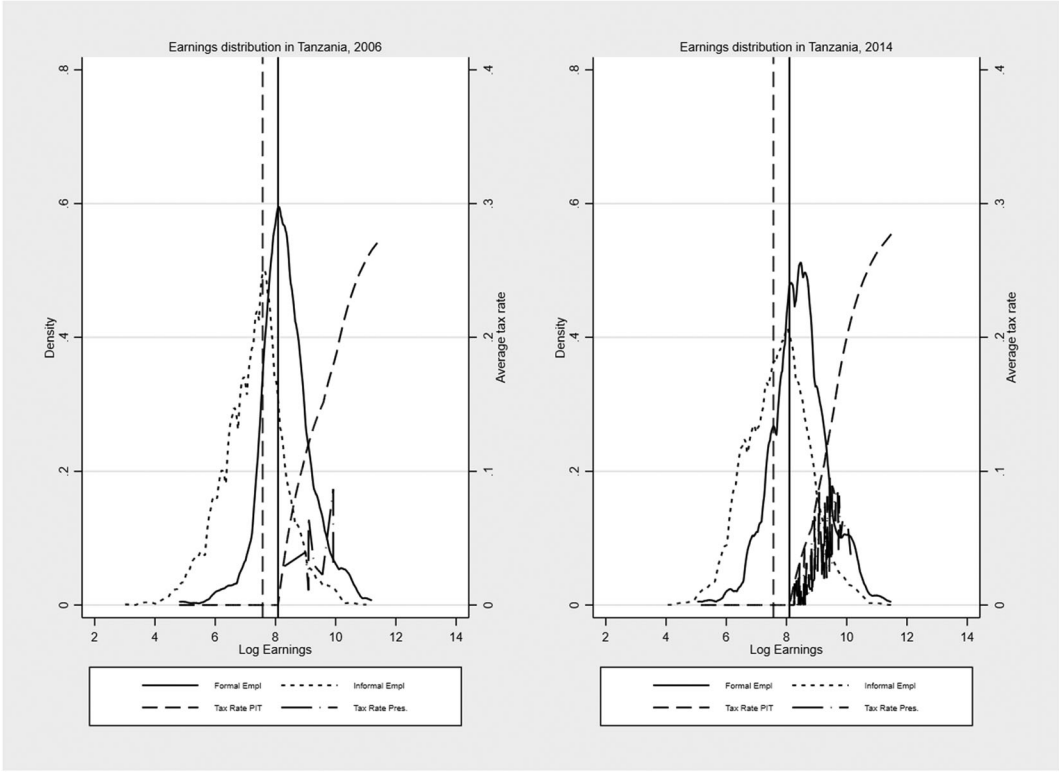

Figure 6. Distribution of formal-sector and informal-sector earnings in Tanzania.
Notes: The dashed vertical line depicts the level of the minimum wage and the solid vertical line the 1st tax bracket of the personal income tax (PIT). Log earnings refers to the logarithm of the CPI adjusted earnings in PPP adjusted USD at 2014 values.

5. Results

5.1. Individual country-level models

Table 5 presents the elasticity of formal work for each country, based on individual country models using the grouped estimator, and using the groups as defined in Section 3 above. 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. The third column adds additional control variables (the mean household size and the mean share of married, urban individuals, and self-employed as well as occupation groups in a cell). In the fourth column, all observations below the minimum wage are discarded, whereas in the fifth 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.

While there appears to be a positive cross-sectional correlation in these models for Ghana and Uganda, the impacts are only statistically significant in some models for Ghana. Most other results are statistically insignificant. This also holds when restricting the sample to only those observations with annual income above the lowest tax payment threshold (Model 5). 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. In Rwanda, the impacts could even be negative.

Apart from the grouped estimations, we also estimate individual-level regressions based on imputed income, as discussed in Section 3. In this way, we can obtain an F-statistic for the

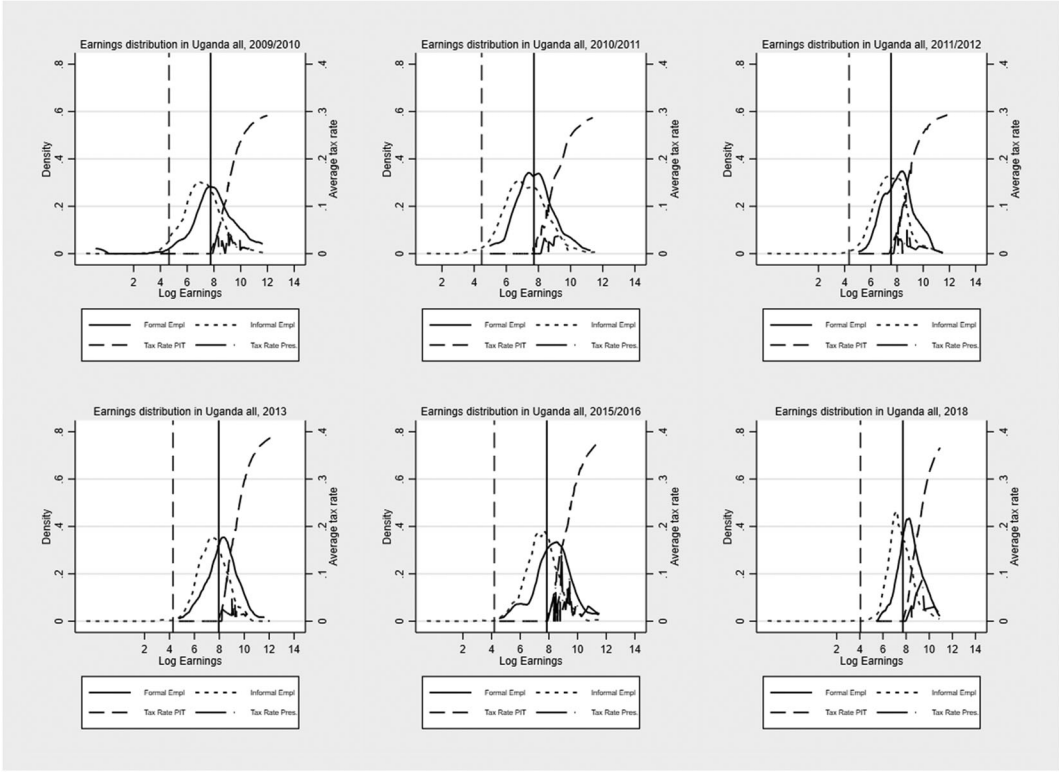

Figure 7. Distribution of formal-sector and informal-sector earnings in Uganda.
Notes: The dashed vertical line depicts the level of the minimum wage and the solid vertical line the 1st tax bracket of the personal income tax (PIT). Log earnings refers to the logarithm of the CPI adjusted earnings in PPP adjusted USD at 2014 values.

excluded variables presented in Table 6. For all countries, the group*time interactions as instruments are highly significant, but the *F*-statistic falls below ten for Ghana and Tanzania.

The additional results presented in the Appendix (separate estimates for men and women, excluding the self-employed, or wage earners, 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 Supplementary Table A8) do not change this conclusion. Therefore, there is no evidence of a clear link between the net pay difference and the share of formal work based on the country-level estimates.

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. This necessarily limits the splitting of the sample to a greater number of groups; there is an obvious trade off between the number of groups and the number of observations in one group. The number of observations in cells are depicted in Supplementary Table A9, which shows that the average number is above 200, except in Uganda, where the same number is close to one hundred. 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.[32] One reason for the imprecise estimates at the country level is, of course, the low number of cells per country, which reduces our power to detect small elasticities. That is why we move to the pooled analysis below, where the greater group numbers improve precision.

Table 4. Description of tax schedule changes

	1	2	3
	Nr and direction of tax bracket adjustments	Personal income tax rate changes	Presumptive tax changes
Ghana	2006: Increase 2nd and 5th, reduction in 4th bracket 2012: increase in 2nd to 5th bracket 2016: increase in 2nd to 5th bracket 2017: increase in 2nd to 5th bracket	2006: – Increase in 4th and 5th bracket rate (15% –> 17.5%, 20% –> 25%), - removal of 6th bracket keeping top rate constant at 25%	
Rwanda	2006: Increase in 3rd bracket	2006: – Removal of 4th and 5th tax bracket with increase in 2nd and 3rd bracket rate (15% –>20%, 25% –>30%)–reduction in top rate (40% –>30%)	2013: Additional bracket increase in top rate (30 –>40%)
Tanzania	2014: Increase in 2nd to 4th bracket	2014: Reduction in the 2nd bracket rate (18.5% –>12%)	2014: Increase turnover limit
Uganda	2013: Increase in 2nd and 3rd bracket	2013: Additional bracket increase in top rate (30 –>40%)	2015: – Increase turnover limit – introducing sector and location specific presumptive tax rates for lowest brackets

The table illustrates tax changes across the estimation years. Column (1) summarises the number of times bracket thresholds have been changed and the direction of these changes. Column (2) summarises changes to the actual tax rates, whereas Column (3) has the corresponding information about the presumptive tax.

5.2. Pooled model

Despite offering a bigger sample, the results of the pooled model, reported in Table 7, confirm the findings of the country-wise regressions above: the elasticities are insignificant throughout. In the model with country and year-group fixed effects (Column 2) and when country-specific linear trends are added to the specification (Model 3) the impact of net pay remains consistently insignificant. When restricting the sample to those above the minimum wage or above the first tax bracket level, the negative effect vanishes but the estimates remain insignificant.

When adding in column (6) proxies for the ease of formalizing one's business and the ease of paying taxes as an additional control variable to the model in column (4), the impact of the take-home pay difference remains insignificant. Controlling for country differences in these variables is important, since costly and time consuming processes to pay taxes and formalise a business may have a direct impact on the propensity to operate in the formal sector.

The results in the pooled analysis are reasonably precisely estimated, and that is why very large impacts of taxes on the share of the formal sector can be ruled out. The estimate in Model (5) implies, for example, that elasticities exceeding approximately 0.4 can be ruled out as very unlikely.

Other specifications, available in Supplementary Table A10 in the Supplementary Appendix, do not change the conclusion derived above: When the pay difference is measured in levels as

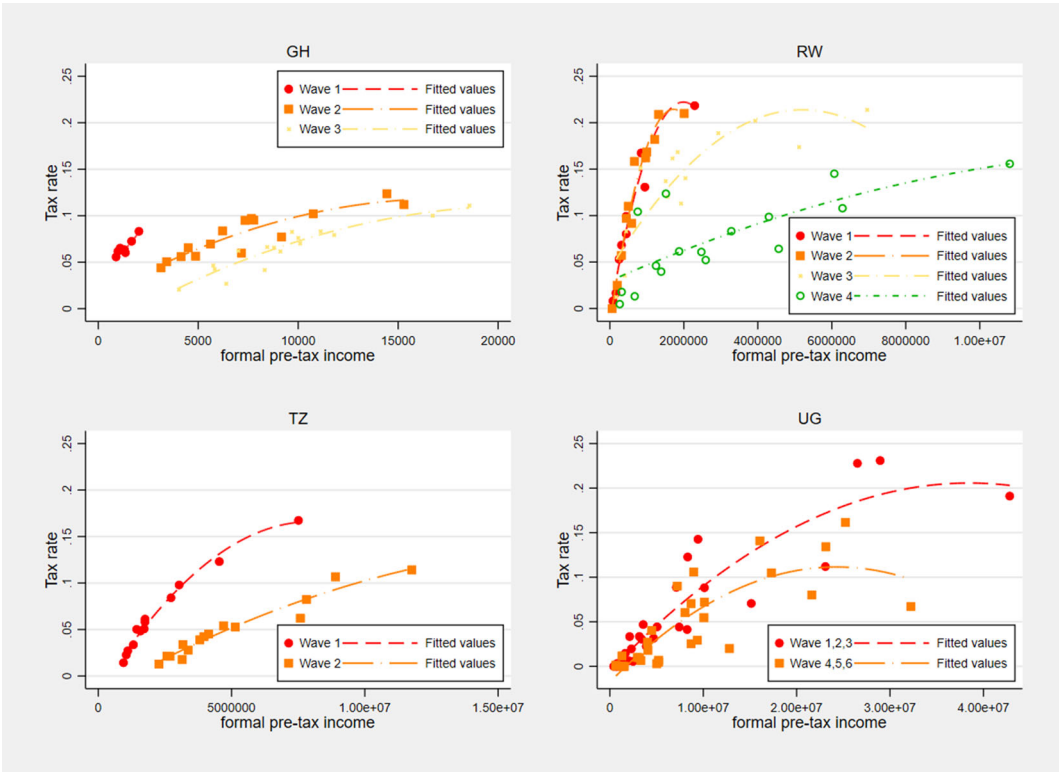

Figure 8. Average tax rates in cell-level data: Ghana (top left); Rwanda (top right); Tanzania (bottom left); and Uganda (bottom right).
Notes: All earnings are in nominal local currency units. For Uganda waves 1–3 and waves 4–6 are combined.

opposed to logs, or when looking at men or women alone, the pay difference does not appear to affect the share of formal employees.

One may argue that self-employed workers and employers make a more active choice of being in formal or informal employment as it is in their own hands to either formalise or informalise their own business in response to a change in the earnings differential. For this reason we include different regresssions for the wage earners and the self employed. Apart from the tax rate changes, or tax related earnings differential between formal and informal employment, personal preferences and the level of bureaucratic costs in time and money to formalise a business and to pay taxes d_i, may present a cost that does not necessarily evolve in the same direction as the earnings differential. Employees instead are more indirectly affected by these costs as they are more dependent on the supply of formal jobs, and thus the costs of finding a job ψ, in order to opt for formal employment, but their employers are likewise affected by the costs d_i, of the costs of personal preferences and the administrative burden of formalizing their business and paying taxes. While the personal preferences of individuals of working in formal or informal employment is an unobserved factor we cannot control for, we can control for the bureaucratic cost of formalizing a business and complying with tax obligations. Including these time-varying costs as a control variable, however, confirms the earlier result that the earnings differential between formal and informal employment is not significant. While there has been an overall trend of starting a formal business and paying taxes becoming easier, paying taxes has in Tanzania and Uganda more recently become slightly more costly. Therefore, the limited impact of the small changes in the formal–informal earnings gap on the formality status might not be surprising if compliance costs with formal employment requirements remain high or even increase.

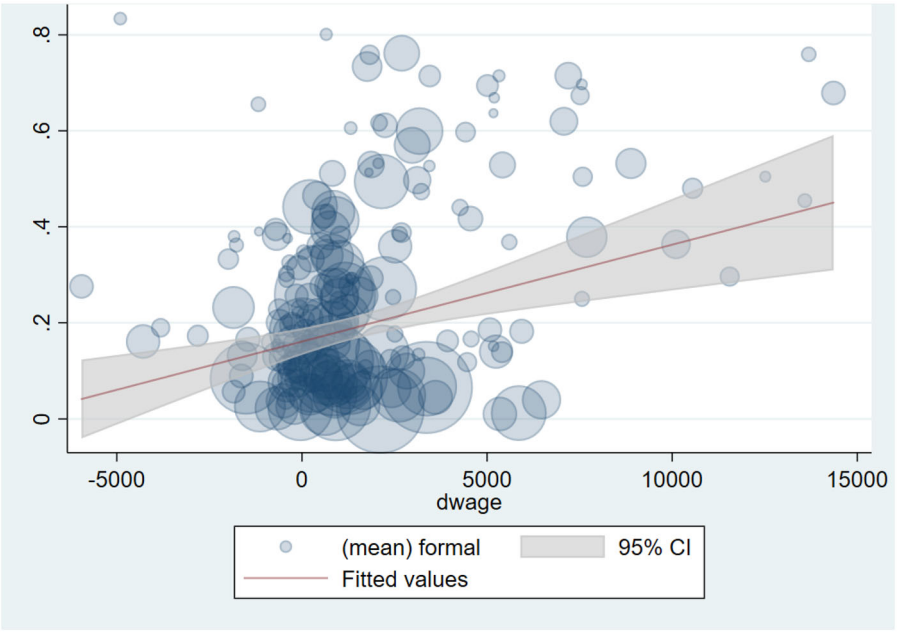

Figure 9. The relation between the formal employment share (y-axis) and the difference between formal- and informal employment income (x-axis) in the pooled data. The bubble size reflects the number of observations in a cell.

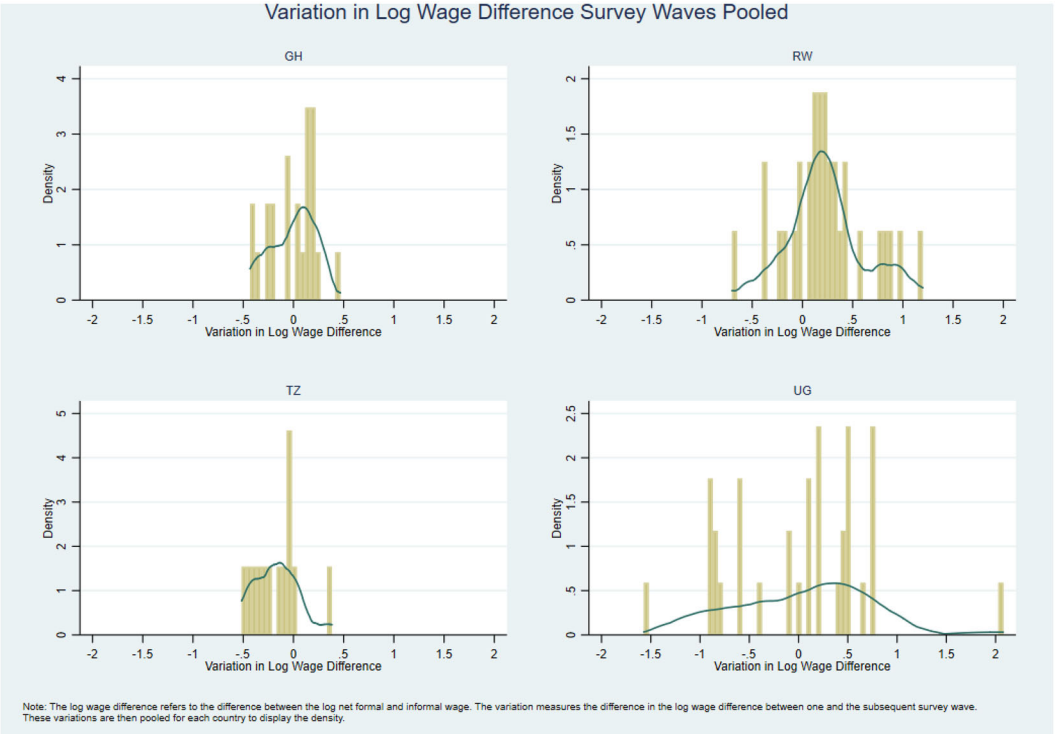

Figure 10. Changes across waves in the difference between formal- and informal employment wages (histogram and kernel density): Ghana (top left); Rwanda (top right); Tanzania (bottom left); and Uganda (bottom right).

Table 5. Individual country estimation results

		No controls (1)	All fixed effects (2)	Add controls (3)	Above min wage (4)	Above 1st tax br (5)
a) Ghana	Elasticity	0.823***	0.441**	0.356	0.571***	0.411
	Std. Err.	0.250	0.165	0.221	0.197	0.264
	Group N	54	54	54	52	51
b) Rwanda	Elasticity	−0.234	−0.400	−0.211	−0.115	−0.890***
	Std. Err.	0.338	0.299	0.196	0.278	0.312
	Group N	54	54	54	54	53
c) Tanzania	Elasticity	−0.3	0.427	0.066	−1.067*	0.856
	Std. Err.	0.519	0.436	0.573	0.642	3.2
	Group N	32	32	32	29	26
d) Uganda	Elasticity	0.307	0.015	0.046	0.099	−0.246
	Std. Err.	0.245	0.112	0.129	0.135	0.283
	Group N	69	69	69	69	32

Notes: 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 2–5 include all cell and survey wave fixed effects. Model 3 adds additional controls (share of married and urban individuals as well as share self-employed and occupations and the mean household size). In model 4, all observations where earnings are below the monthly minimum wage are excluded, while in model 5 all observations where earnings are below the first tax bracket are omitted. In all models, cells with fewer than 20 observations are dropped.

Table 6. First-stage *F*-tests from individual-level regressions based on three educational categories and above minimum wage income

	Ghana	Rwanda	Tanzania	Uganda
F-statistic	8.243716	20.02462	6.18191	13.42792
p-Value	Prob $>F=0.0000$	Prob $>F=0.0000$	Prob $>F=0.0000$	Prob $>F=0.0000$

Table 7. Pooled estimation results

	No controls (1)	All fixed effects (2)	With trends (3)	Above min wage (4)	Above 1st tax br (5)	With DB indices (6)
Elasticity	0.203	−0.163	−0.082	0.006	0.124	0.079
Std. Err.	0.141	0.107	0.100	0.115	0.132	0.129
Group *N*	189	189	189	183	159	159

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 2–6 include all cell and survey wave fixed effects. Model (3) is the same as (2) but with country-specific trends added. The rest of the models build on it. In model 4, all observations where earnings are below the monthly minimum wage are excluded, while in model 5 all observations where earnings are below the 1st tax bracket are omitted. Column (6) is the same as column (5), but with additional controls of bureaucratic costs of formalization added. In all models, cells with fewer than 20 observations are dropped.

When presenting the conceptual framework, we discussed several reasons for why formal labour supply may not be very sensitive to (small) variation in the wage differentials and/or tax treatment. 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 multiple survey waves but conducted in consecutive years. Also, survey sample sizes vary by country and survey wave, and sample sizes may not be large enough to capture the mean wage premium of working in formal employment for the respective group, and reduce the number of group observations that are included in the model.

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, a high share of informal employment 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 earnings differentials accounting for the personal income tax rate incentivise people to move from a formal job into informal employment to avoid the tax burden, or a decrease in the personal income tax rate may make working in a formal job more attractive and induce informal workers to formalise. 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 some evidence from Latin America that tax reductions may increase the incentives for individuals to work in formal employment, evidence from developing countries in other parts of the world, in particular from African countries, characterised by even larger informal employment rates, 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 2000 to 2019 are used to construct pseudo-panels, consisting of 2–5 survey waves for each country. By applying grouping estimator techniques, this study subsequently estimates the effect of an exogenously induced change in the mean earnings difference between the formal and informal employment, on the probability to be a formal worker.

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 non-public formal and informal employment, 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 relation between this earnings difference and the probability of being a formal worker. This conclusion stems from both country-wise regressions and from a pooled analysis, and from considering many modelling specifications. The estimates from the pooled analysis are more precise and they indicate that there is no evidence at all for large elasticities – exceeding 0.4.

Different explanations for the finding of a largely non-elastic formality status can be considered. The low wage differential between the formal and informal employment in all four countries is likely to be a major factor. In addition, there is likely to be limited availability of formal 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 informal employment, who might have the skills needed for

formal jobs, may not be well informed about such vacancies and advantages of formal jobs. Moreover, there might be a general lack of information regarding the functioning of the tax system, tax rate changes, and how to formalise 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 formalise. Workers may also have, irrespective of the wage differential between the two modes of employment, other reasons for preferring informal employment, such as the proximity or flexibility of the informal job, or the perceived benefits of formal employment not outweighing the perceived costs of paying taxes and the bureaucracy involved in formalizing. The tax rate changes during the sample period may not have resulted in sufficiently salient variation in the sectoral wage gap to initiate a notable response. Lastly, we were not able to model the benefit side of public policies. Accounting for benefits received when in formal versus informal employment would be an important avenue for further research. Another important extension would be to run the analysis for more countries, provided that all necessary information required for the estimations is available in the surveys in future rounds of household or labor force surveys.

While the results in the current paper are not consistent with the notion of the existence of a severe tradeoff between the share of formal work and taxation, if the underlying economic and institutional backdrop were to change, the estimated elasticities could also become more significant.

Notes

1. 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)
2. According to own calculations based on UNU-WIDER Government Revenue Dataset.
3. Falco, Kerr, Rankin, Sandefur, and Teal (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, which oftentimes consists of informal employment in the informal sector, 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.
4. This approach has proven very valuable in modern empirical public finance—see Piketty and Saez (2013).
5. Related work by Bruhn and McKenzie (2014), Benhassine, McKenzie, Pouliquen, and Santini (2018) and Rocha, Ulyssea, and Rachter (2018) examines whether interventions lowering the costs to formalise 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 personal income tax policy changes on the share of workers in formal employment.
6. 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 unemployment rates are low, unemployment insurance benefits are largely non-existent, and people typically work in the informal sector. See Bhorat, Kanbur, and Stanwix (2014) and Tondini, Ardington, and Woolard (2017) for recent quasi-experimental evidence regarding the employment effects of wage costs and social security arrangements in South Africa.
7. See Table 7 in ILO. (2019).
8. Ulyssea (2020) offers a recent review of the determinants and consequences of informality both regarding firms and workers. His survey does not concentrate primarily on the impact of taxes on the formality status of workers.
9. See Kroft et al. (2017) 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, informal employment is replaced by unemployment).
10. Formally, this derivation assumes that ψ 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.

11. The discussion in this section draws on Jäntti, Pirttilä, and Selin (2015).
12. See Angrist and Pischke (2009) for an elaborate discussion about IV estimation on grouped data.
13. We prefer referring to the elasticity as tax elasticity of formal work, since the government can directly influence taxation as opposed to market forces driving the gross earnings.
14. Ghana: Ghana Living Standards Survey GLSS 5 (2005/06), GLSS 6 (2012/13) and GLSS 7 (16/17).
15. 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), EICV 3 (2010/11) and EICV 4 (13/14).
16. Tanzania: Integrated Labour Force Survey (ILFS) (2006) and ILFS (2014).
17. Uganda: Uganda National Panel Survey (NPL) (2009/10), NPL (2010/11), NPL (2011/12), NPL (2013/14), NPL (2015/16) and NPL (2018/19).
18. We excluded countries with periods of major conflict around the time of the survey. South Africa is left out because its labour market is vastly different to those of other African countries.
19. 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 and the surveys are in no wave clear about the whether the reported income is already net of taxes or gross income.
20. In Ghana all formal self-employed workers are modelled to pay personal income tax, as there did not exist a presumptive tax during the survey years.
21. 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 minimise the recall bias as well as missing information in the income data.
22. The starting a business score considers the required mimum capital, number of prodecures, cost, and time it takes to start operating a formal business, for more detail, see: https://www.doingbusiness.org/en/methodology/starting-a-business. As data is not available for Rwanda prior to 2004, the 2004 value is used for the previous years.
23. The paying taxes score considers the total taxes and contributions, the time it takes to prepare, file and pay them, the frequency of payments and the efficiency of the postfiling process, for more detail see: https://www.doingbusiness.org/en/methodology/paying-taxes. As data is not available for Ghana and Rwanda prior to 2006, the 2004 value is used for the previous years.
24. World Bank Doing Business (2020): see https://www.doingbusiness.org/en/custom-query
25. 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.
26. See Flowchart 2 in ILO. (2019).
27. As the surveys for Ghana do not distinguish between rural and urban status, we use non-capital and capital region as the closest proxy.
28. Results available from the authors upon request.
29. For references on this debate, see Badaoui et al. (2008).
30. The tax schedules for personal employment income are gathered to Supplementary Tables A4–A7.
31. For Uganda this is less visible, as survey waves lie closer together. The right shift of the entire income distribution in Ghana ove the waves can be explained by a more rapid increase in the consumer price index in Ghana than in the other countries.
32. These results are available upon request.

Acknowledgments

This paper is part of UNU-WIDER's work programme on Building up efficient and fair tax systems. We are grateful for anonymous referees for very helpful comments. We thank the participants of the Economics of Informality Conference at the Universidad del Rosario 2018, Public Economics Theory Conference 2018, Nordic Conference on Development Economics 2018, 2018 Africa Meeting of the Econometric Society, 2018 IIPF Conference, North East Universities Development Consortium (NEUDC) Conference 2018, Zürich Development Conference 2018, Annual Meeting of Finnish Economists 2019, 5th DIAL Development Conference 2019, UNU-WIDER Conference in Bangkok 2019, seminar participants at the Universities of Umea and Turku and the Catholic University of Lisbon, as well as Niels Johannesen and Måns Söderbom, for comments and suggestions. Caroline Schimanski thanks the Yrjö Jahnsson Foundation for additional funding to work on this paper. All remaining errors are those of the authors.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This work was supported by Yrjö Jahnssonin Säätiö.

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References

Albrecht, J., Navarro, L., & Vroman, S. (2009). The effects of labour market policies in an economy with an informal sector. *The Economic Journal*, *119*(539), 1105–1129. doi:10.1111/j.1468-0297.2009.02268.x

Alonso-Ortiz, J., & Leal, J. (2013). The elasticity of informality to taxes and transfers (Working Paper 13-08). Mexico City, Mexico: Centro de Investigación Económica, ITAM.

Alzúa, M. L., Cruces, G., & Ripani, L. (2013). Welfare programs and labor supply in developing countries: Experimental evidence from Latin America. *Journal of Population Economics*, *26*(4), 1255–1284. doi:10.1007/s00148-012-0458-0

Angrist, J., & Pischke, J.-S. (2009). *Mostly harmless econometrics: An empiricist's companion*. Princeton: Princeton University Press.

Antón, A. (2014). The effect of payroll taxes on employment and wages under high labor informality. *IZA Journal of Labor & Development*, *3*(1), 1–23. doi:10.1186/2193-9020-3-20

Auriol, E., & Warlters, M. (2012). The marginal cost of public funds and tax reform in Africa. *Journal of Development Economics*, *97*(1), 58–72. doi:10.1016/j.jdeveco.2011.01.003

Badaoui, E. E., Strobl, E., & Walsh, F. (2008). Is there an informal employment wage penalty? Evidence from South Africa. *Economic Development and Cultural Change*, *56*(3), 683–710. doi:10.1086/533550

Bargain, O., & Kwenda, P. (2011). Earnings structures, informal employment, and self-employment: New evidence from Brazil, Mexico, and South Africa. *Review of Income and Wealth*, *57*(s1), S100–S122. doi:10.1111/j.1475-4991.2011.00454.x

Bargain, O., & Kwenda, P. (2014). The informal sector wage gap: New evidence using quantile estimations on panel data. *Economic Development and Cultural Change*, *63*(1), 117–153. doi:10.1086/677908

Benhassine, N., McKenzie, D., Pouliquen, V., & Santini, M. (2018). Does inducing informal firms to formalize make sense? Experimental evidence from Benin. *Journal of Public Economics*, *157*, 1–14. doi:10.1016/j.jpubeco.2017.11.004

Bergolo, M., & Cruces, G. (2014). Work and tax evasion incentive effects of social insurance programs: Evidence from an employment-based benefit extension. *Journal of Public Economics*, *117*, 211–228. doi:10.1016/j.jpubeco.2014.04.015

Bergolo, M., & Cruces, G. (2021). The anatomy of behavioral responses to social assistance when informal employment is high. *Journal of Public Economics*, *193*, 104313. doi:10.1016/j.jpubeco.2020.104313

Besley, T., & Persson, T. (2013). Chapter 2 – taxation and development. In A. J. Auerbach, R. Chetty, M. Feldstein, and E. Saez (Eds.), *Handbook of public economics, volume 5 of handbook of public economics* (pp. 51–110). Amsterdam: Elsevier.

Bhorat, H., Kanbur, R., & Stanwix, B. (2014). Estimating the impact of minimum wages on employment, wages, and non-wage benefits: The case of agriculture in South Africa. *American Journal of Agricultural Economics*, *96*(5), 1402–1419. doi:10.1093/ajae/aau049

Blundell, R., Duncan, A., & Meghir, C. (1998). Estimating labor supply responses using tax reforms. *Econometrica*, *66*(4), 827–861. doi:10.2307/2999575

Bosch, M., & Campos-Vazquez, R. M. (2014). The trade-offs of welfare policies in labor markets with informal jobs: The case of the "Seguro Popular" program in Mexico. *American Economic Journal: Economic Policy*, *6*(4), 71–99. doi:10.1257/pol.6.4.71

Bosch, M., & Esteban-Pretel, J. (2015). The labor market effects of introducing unemployment benefits in an economy with high informality. *European Economic Review*, *75*, 1–17. doi:10.1016/j.euroecorev.2014.10.010

Bruhn, M., & McKenzie, D. (2013). Using administrative data to evaluate municipal reforms: an evaluation of the impact of minas fácil expresso. *Journal of Development Effectiveness*, *5*(3), 319–338. doi:10.1080/19439342.2013.813959

Bruhn, M., & McKenzie, D. (2014). Entry regulation and the formalization of microenterprises in developing countries. *The World Bank Research Observer*, *29*(2), 186–201. doi:10.1093/wbro/lku002

Deaton, A. (1985). Panel data from time series of cross-sections. *Journal of Econometrics*, *30*(1–2), 109–126. doi:10.1016/0304-4076(85)90134-4

Diaz, J. J., Chacaltana, J., Rigolini, J., & Ruiz, C. (2018). Pathways to formalization: Going beyond the formality dichotomy–the case of Peru (Technical Report, World Bank Policy Research Working Paper, 8551). Washington, DC: The World Bank.

Falco, P. (2014). Does risk matter for occupational choices? Experimental evidence from an African labour market. *Labour Economics*, *28*, 96–109. doi:10.1016/j.labeco.2014.03.005

Falco, P., & Haywood, L. (2016). Entrepreneurship versus joblessness: Explaining the rise in self-employment. *Journal of Development Economics*, *118*, 245–265. doi:10.1016/j.jdeveco.2015.07.010

Falco, P., Kerr, A., Rankin, N., Sandefur, J., & Teal, F. (2011). The returns to formality and informality in urban Africa. Labour markets in developing countries. *Labour Economics*, *18*, S23–S31. doi:10.1016/j.labeco.2011.09.002

Feltenstein, A., & Shamloo, M. (2013). Tax reform, the informal economy, and bank financing of capital formation. *International Tax and Public Finance*, *20*(1), 1–28. doi:10.1007/s10797-012-9213-4

Fernandez, C., & Villar, L. (2017). The impact of lowering the payroll tax on informality in Colombia. *EconomÃa*, *18*(1), 125–155. doi:10.1353/eco.2017.a676998

Fields, G. S. (1975). Rural-urban migration, urban unemployment and underemployment, and job-search activity in LDCs. *Journal of Development Economics*, *2*(2), 165–187. doi:10.1016/0304-3878(75)90014-0

Galiani, S., & Weinschelbaum, F. (2012). Modeling informality formally: Households and firms. *Economic Inquiry*, *50*(3), 821–838. doi:10.1111/j.1465-7295.2011.00413.x

Garganta, S., & Gasparini, L. (2015). The impact of a social program on labor informality: The case of AUH in Argentina. *Journal of Development Economics*, *115*, 99–110. doi:10.1016/j.jdeveco.2015.02.004

Gorodnichenko, Y., Martinez-Vazquez, J., & Peter, K. S. (2009). Myth and reality of flat tax reform: Micro estimates of tax evasion response and welfare effects in Russia. *Journal of Political Economy*, *117*(3), 504–554. doi:10.1086/599760

Günther, I., & Launov, A. (2012). Informal employment in developing countries: Opportunity or last resort? *Journal of Development Economics*, *97*(1), 88–98. doi:10.1016/j.jdeveco.2011.01.001

Henley, A., Arabsheibani, G. R., & Carneiro, F. G. (2009). On defining and measuring the informal sector: Evidence from Brazil. *World Development*, *37*(5), 992–1003. doi:10.1016/j.worlddev.2008.09.011

ILO. (1993). Resolution concerning statistics of employment in the informal sector adopted by the 15th International Conference of Labour Statisticians (ICLS) (Technical report). Retrieved May 13, 2020, from https://www.ilo.org/wcmsp5/groups/public/—dgreports/—stat/documents/normativeinstrument/wcms_087484.pdf

ILO. (2003). Guidelines concerning a statistical definition of informal employment, adopted by the 17th International Conference of Labour Statisticians (ICLS). Retrieved May 13, 2020, from https://www.ilo.org/wcmsp5/groups/public/—dgreports/—stat/documents/normativeinstrument/wcms_087622.pdf

ILO. (2017a). Social protection. Ghana country profile. Retrieved April 23, 2020, from https://www.ilo.org/gimi/gess/ShowCountryProfile.action?iso=GH

ILO. (2017b). Social protection. Rwanda country profile. Retrieved April 23, 2020, from https://www.ilo.org/gimi/gess/ShowCountryProfile.action?iso=RW

ILO. (2017c). Social protection. Tanzania country profile. Retrieved April 23, 2020, from https://www.ilo.org/gimi/gess/ShowCountryProfile.action?iso=TZ

ILO. (2017d). Social protection. Uganda country profile. Retrieved April 23, 2020, from https://www.ilo.org/gimi/gess/ShowCountryProfile.action?iso=UG

ILO. (2019). Issues to be addressed in the revision of the standards for statistics on informality. Retrieved May 13, 2020, from https://www.ilo.org/ilostat-files/Documents/Informality_WGmeeting1_discussion_paper.pdf

ILO. (2022). Informal economy in Africa: Which way forward? Making policy responsive, inclusive and sustainable. Retrieved Nov 20, 2023, from https://www.ilo.org/africa/events-and-meetings/WCMS_842674/lang–en/index.htm#:~:text=Which%20Way%20Forward%3F-,Making%20Policy%20Responsive%2C%20Inclusive%20and%20Sustainable,the%20continent's%20young%20employment%20seekers

ILO. (2023). ILO Explorer. Proportion of informal employment in non-agricultural employment.

Jacquet, L., Lehmann, E., & der Linden, B. V. (2013). Optimal redistributive taxation with both extensive and intensive responses. *Journal of Economic Theory*, *148*(5), 1770–1805. doi:10.1016/j.jet.2013.07.019

Jäntti, M., Pirttilä, J., & Selin, H. (2015). Estimating labour supply elasticities based on cross-country micro data: A bridge between micro and macro estimates? *Journal of Public Economics*, *127*, 87–99. doi:10.1016/j.jpubeco.2014.12.006

Jones, S., & Tarp, F. (2015). Priorities for boosting employment in Sub-Saharan Africa: Evidence for Mozambique. *African Development Review*, *27*(S1), 56–70. doi:10.1111/1467-8268.12139

Kroft, K., Kucko, K., Lehmann, E., & Schieder, J. (2017). Optimal income taxation with unemployment and wage responses: A sufficient statistic approach. *American Economic Journal: Economic Policy*, *12*, 254–292.

Kugler, A., & Kugler, M. (2009). Labor market effects of payroll taxes in developing countries: Evidence from Colombia. *Economic Development and Cultural Change*, *57*(2), 335–358. doi:10.1086/592839

Lora, E., & Fajardo-González, J. (2016). Employment and taxes in Latin America: An empirical study of the effects of payroll, corporate income and value added taxes on labor outcomes. *Cuadernos de Economía*, *35*(67), 75–117. doi:10.15446/cuad.econ.v35n67.52580

Maloney, W. F. (1999). Does informality imply segmentation in urban labor markets? Evidence from sectoral transitions in Mexico. *The World Bank Economic Review*, *13*(2), 275–302. doi:10.1093/wber/13.2.275

Maloney, W. F. (2004). Informality revisited. *World Development*, *32*(7), 1159–1178. doi:10.1016/j.worlddev.2004.01.008

Matos, V., & Portela Souza, A. (2016). Mudancas dos differenciais de salários formal e informal: reducão da segmentacão ou do salário hedônico?. In d. F. Holanda Barbosa Filo, G. Ulyssea, & F. Veloso (Eds.), *Causas e Consequências da Informalidade No Brasil* (Chapter 2). Brazil: FGV IBRE.

McKay, A., Newell, A., & Rienzo, C. (2018). *Job satisfaction among young workers in Eastern and Southern Africa: A comparative analysis* (Technical report). Mimeo: University of Sussex.

Morales, L., & Medina, C. (2017). Assessing the effect of payroll taxes on formal employment: the case of the 2012 tax reform in Colombia. *EconomÃa*, *18*(1), 75–124. doi:10.1353/eco.2017.a676997

Piketty, T., & Saez, E. (2013). Chapter 7 – optimal labor income taxation. In A. J. Auerbach, R. Chetty, M. Feldstein, & E. Saez (Eds.), *Handbook of public economics, volume 5 of handbook of public economics* (pp. 391–474). Amsterdam: Elsevier.

Rocha, R., Ulyssea, G., & Rachter, L. (2018). Do lower taxes reduce informality? Evidence from brazil. *Journal of Development Economics*, *134*, 28–49. doi:10.1016/j.jdeveco.2018.04.003

Tondini, A., Ardington, C., & Woolard, I. (2017). Public pensions and elderly informal employment: Evidence from a change in retirement age in South Africa (Working Paper 05). Cape Town: SALDRU.

Ulyssea, G. (2018). Firms, informality, and development: Theory and evidence from Brazil. *American Economic Review*, *108*(8), 2015–2047. doi:10.1257/aer.20141745

Ulyssea, G. (2020). Informality: Causes and consequences for development. *Annual Review of Economics*, *12*(1), 525–546. doi:10.1146/annurev-economics-082119-121914

Waseem, M. (2018). Taxes, informality and income shifting: Evidence from a recent Pakistani tax reform. *Journal of Public Economics*, *157*, 41–77. doi:10.1016/j.jpubeco.2017.11.003

Zarković-Rakić, J., Ranđelović, S., & Vladisavljević, M. (2016). Labour market effects of social security contributions reform in Serbia. *Economic Annals*, *LXI*(208), 73–92.