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Female labour supply and informal employment in Ecuador

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Abstract: Low- and middle-income countries face a trade-off between raising tax revenue to strengthen social protection and creating incentives for the population to enter formal employment. However, empirical evidence on labour supply elasticities in the presence of informal employment remains scarce. This paper analyses female labour supply behaviour and the choice between formal and informal employment in Ecuador, a middle-income country characterized by persistent levels of informal employment particularly among women. We use two methods to estimate and compare formal employment elasticities: (i) a discrete choice model of labour supply with informality and (ii) grouped-data estimation techniques. For identification, we exploit variation in tax–benefit policies covering the period 2011–19, using microsimulation techniques applied to household survey data. Our results show that, on average, formal employment elasticities for single women are low regardless of the approach chosen. However, for women in couples, formal employment elasticities are larger under the discrete choice approach whereas they are low and non-significant under the grouped-data estimations.

Key words: labour supply, informal employment, tax–benefit policies, Ecuador

JEL classification: J23, J42

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1 Introduction

Labour informality remains a prevalent problem in the developing world. The International Labour Organization (ILO) estimates that almost 2 billion workers, which corresponds to 61 per cent of the world labour population, are informal (ILO 2021a). Ecuador, the country studied in this paper, is marked by higher levels of informality than the regional average. According to ILO, informality rates remain at around 60 per cent despite a drop of roughly 20 percentage points since 2000. Moreover, informality is higher among women than men.

This study aims to investigate female labour supply behaviour and how tax and social protection policies shape the choice between formal and informal employment of women in Ecuador. As common for Latin American countries, we define informal employment as being in paid work without affiliation to social security. We use two approaches in our analysis. The first approach estimates a discrete choice model of labour supply, which includes the choice between different number of hours spent alternatively in formal and informal employment. The second approach relies on grouped-data estimation techniques. Both approaches exploit variation in socio-fiscal policies over time due to various policy reforms implemented between 2011 and 2019. We capture these variations making use of ECUAMOD, the tax–benefit microsimulation model for Ecuador, based on nationally representative household data from the National Survey of Employment, Unemployment and Underemployment (Encuesta Nacional de Empleo, Desempleo y Subempleo, ENEMDU). We focus on women's behavioural responses. More precisely, we estimate and compare formal employment elasticities for single women and women in couples with the two approaches.

The focus on female labour supply and informal employment is guided by a number of factors. First, female labour force participation has increased by around 5 percentage points over the last decade in Ecuador (ILO 2021a). Second, Ecuador is among those countries in Latin America and the Caribbean where the share of women in informal employment exceeds the share of men in informal employment (ILO 2018). Third, it is widely found in the literature that women, and in particular married women, tend to adjust their labour supply more flexibly than men (Bargain et al. 2014). Moreover, we focus on formal employment elasticities because, as suggested by McKay et al. (2019), sectoral choice might be one of the most important margins of response to changes in tax–benefit policies in low- and middle-income countries.

Our results show that the discrete choice model with formal and informal hour alternatives fits the data well for single women and women in couples. Changes in tax–benefit policies over time provide substantial variation for the estimation of elasticities under the grouped-data approach, and to act as an additional source of identification for the discrete choice model. The comparison of formal employment elasticities obtained with the two approaches points to similarities in the results for single women, which on average are characterized by small elasticities. However, results from grouped estimations point to small and non-significant elasticities of formal employment for women in couples, whereas elasticities obtained for this group under the discrete choice model are larger, especially income elasticities.

Our analysis contributes to the literature in a number of ways. First, we add to the still scarce literature on formal employment elasticities in developing countries. Second, we compare two different approaches to estimate formal employment elasticities to provide evidence on the degree of congruence between the two methods. Third, our analysis extends the functionalities of ex-ante tax–benefit microsimulation and allows evaluation of the effect of hypothetical reforms taking behavioural reactions into account. The latter contribution is important from a policy perspective

to assess the extent to which policy reforms aimed at increasing fiscal capacity to strengthen social protection might affect incentives to enter formal employment, which is of relevance in the context of a recovery from the economic impact of the COVID-19 pandemic.

The remainder of the paper is structured as follows. Section 2 provides a brief overview of the literature assessing the effect of tax–benefit changes on informal employment. Section 3 discusses the evolution of female labour force participation and informal employment in Ecuador and describes the main changes in tax–benefit policies in the country over the last decade. Section 4 presents the data, the tax–benefit simulations, and the two methods used to estimate formal employment elasticities. Section 5 is dedicated to the analysis of the empirical results. Finally, Section 6 concludes.

2 Related research

Informal employment remains a highly debated and studied topic owing to its prevalence in emerging and developing countries and its socio-economic implications. The literature has highlighted contrasting views about the nature of informal employment. Traditionally, informal employment has been viewed as an alternative to unemployment due to constraints to enter formal employment, which might be related to labour market regulation (Dickens and Lang 1985; Fields 1975). Yet, another strand of the literature has suggested that workers might optimally choose between formal and informal employment given their skills and the earnings they would receive in informal employment, which would be subject to less or no taxation (Maloney 1999). These contrasting views convey the heterogeneous nature of informal employment, which encompasses workers who are constrained to participate in informal employment because of barriers to enter formality and those who voluntarily opt for informal employment (Fields 1990; Maloney 2004).

Despite the large body of literature devoted to the study of informal employment, research related to the effect of the design and changes in the design of tax–benefit policies on the decision to participate in formal employment remains scarce. Most studies in the context of Latin America have focused on assessing the effect of specific policy reforms on formal employment. A number of studies have focused on the effect of changes in payroll taxes on formal employment. The 2012 tax reform, which reduced payroll taxes by 13.5 percentage points in Colombia, has been found to have a positive and significant effect on formal employment (Antón 2014; Fernandez and Villar 2017; Morales and Medina 2017). Additionally, looking at changes in payroll taxes over the period 1982–96 and based on firm-level panel data from Colombia, Kugler and Kugler (2009) find that a 10 per cent increase in payroll taxes reduces formal employment by 4–5 per cent. Other studies have focused on the impact of social insurance and social assistance programmes on formal employment in quasi-experimental settings. Bergolo and Cruces (2014) find that registered employment in Uruguay increased by 5 per cent because of a reform extending health coverage to dependent children of registered workers. Molina-Vera (2021) finds that a similar extension of health insurance coverage to children of formal workers in Ecuador contributed to an increase in formal employment for workers with children. Studies examining the effect of Seguro Popular, a free health care insurance covering individuals not affiliated to contributory health insurance in Mexico, have found that its introduction contributed to a reduction in formal employment (Bosch and Campos-Vazquez 2014), in particular for the less-educated workers (Azuara and Marinescu 2013). For social assistance, Alzúa et al. (2013) assess the effect of welfare programmes in Mexico, Nicaragua, and Honduras and find that negative effects on adult labour supply were small and non-significant. For Argentina, Garganta and Gasparini (2015) show that the introduction of the Universal Child Allowance, a generous cash transfer for unregistered workers with children, induced significant disincentives to enter formal employment for eligible workers. For Brazil, de

Brauw et al. (2013) find that the Bolsa Família programme had a significant effect on reallocation from the formal sector to the informal sector.

More in line with the approach taken in this paper are the studies by Pradhan and van Soest (1997) and Gong and van Soest (2002), which make use of static structural labour supply models. Pradhan and van Soest (1997) estimate a labour supply model with informality for couples in urban areas in Bolivia, where informal workers are defined as those in self-employment except independent professionals such as lawyers and doctors. Their results show that a 10 per cent decrease in formal sector wages would induce a 2.1 per cent move from the formal to the informal sector for men and a 0.68 per cent move for women. Gong and van Soest (2002) estimate a discrete choice labour supply model for married women in Mexico, drawing on the approach of van Soest (1995). The model setup, however, does not account for the presence of informal employment. Their estimated labour supply elasticities of married women are in line with the literature, with an uncompensated wage elasticity of 0.87 and an income elasticity of −0.17.

Another related strand of the literature estimates labour supply elasticities using grouped estimation techniques, thus abstracting from the structural labour supply setting. This approach is inspired by the work of Blundell et al. (1998) and consists of comparing labour supply responses for different groups (e.g., cells composed by combinations of gender×cohorts×regions) over time, exploiting wage variation and changes in tax–benefit policies. McKay et al. (2019) apply this framework to estimate formality elasticities in four sub-Saharan African countries using repeated cross-sections of household data. The authors do not find robust effects of taxes on the extent of formal work. Osei et al. (2019) apply the same methodology to data from Ghana to assess the effect of expanding social protection taking into account behavioural effects. The authors find an elasticity of formal employment of 0.106, which is small in size to counteract the distributional gains from a hypothetical increase in social protection.

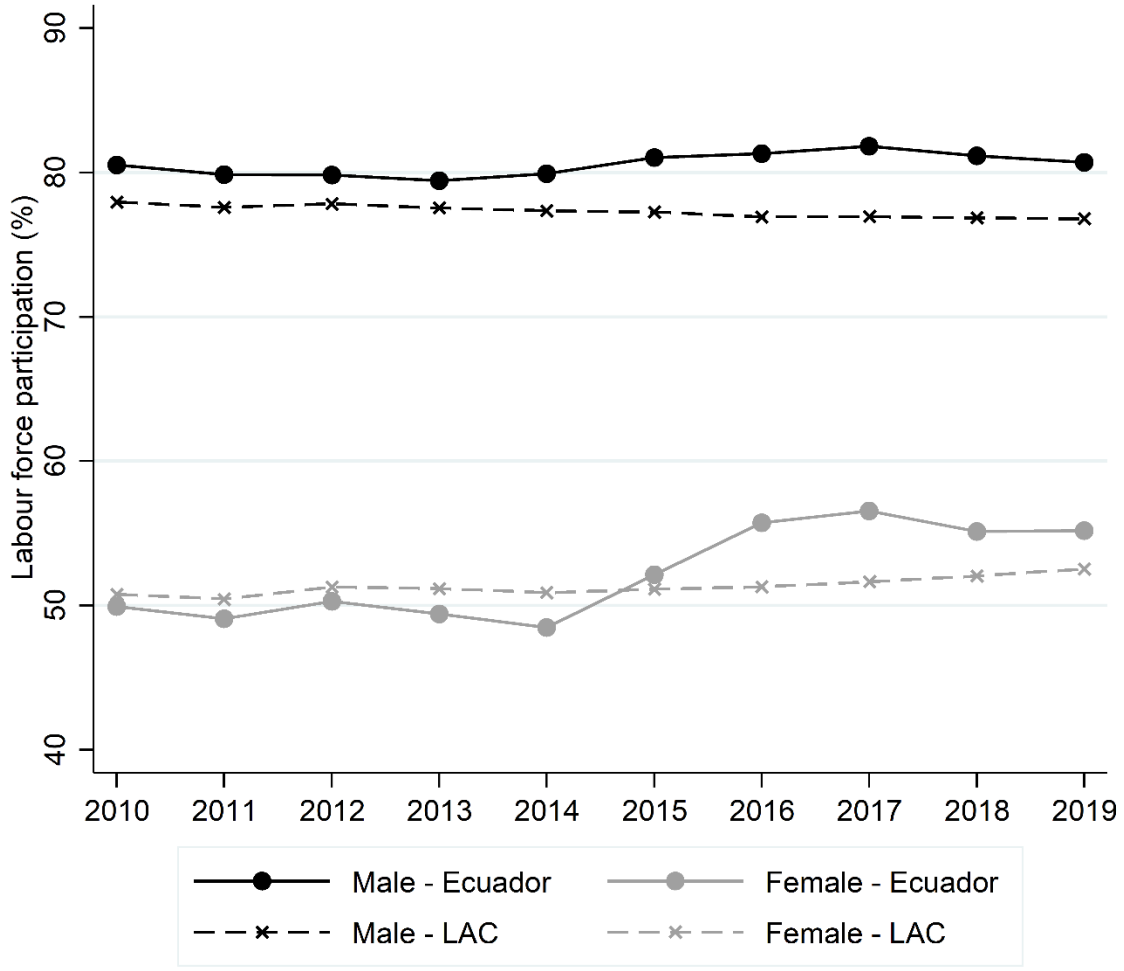
3 Institutional background

This section first provides some general background on the prevalence of informal employment and the evolution of female labour force participation in Ecuador. It then briefly reviews the main tax–benefit policies in Ecuador and reforms thereof implemented over the period 2011–19.

3.1 Female labour force participation and informal employment in Ecuador

Figure 1 shows that, over the second decade of the 2000s, female labour force participation has been increasing—from 49.9 per cent in 2010 to 55.1 per cent in 2018, whereas male labour force participation has been fluctuating around 80 per cent over the same period (ILO 2021a). The figure further shows that although the increasing trend in female labour force participation has been observed across the Latin American and Caribbean (LAC) region, Ecuador has experienced a larger increase moving above the region average since 2015.

Figure 1: Labour force participation by gender, 2010–19

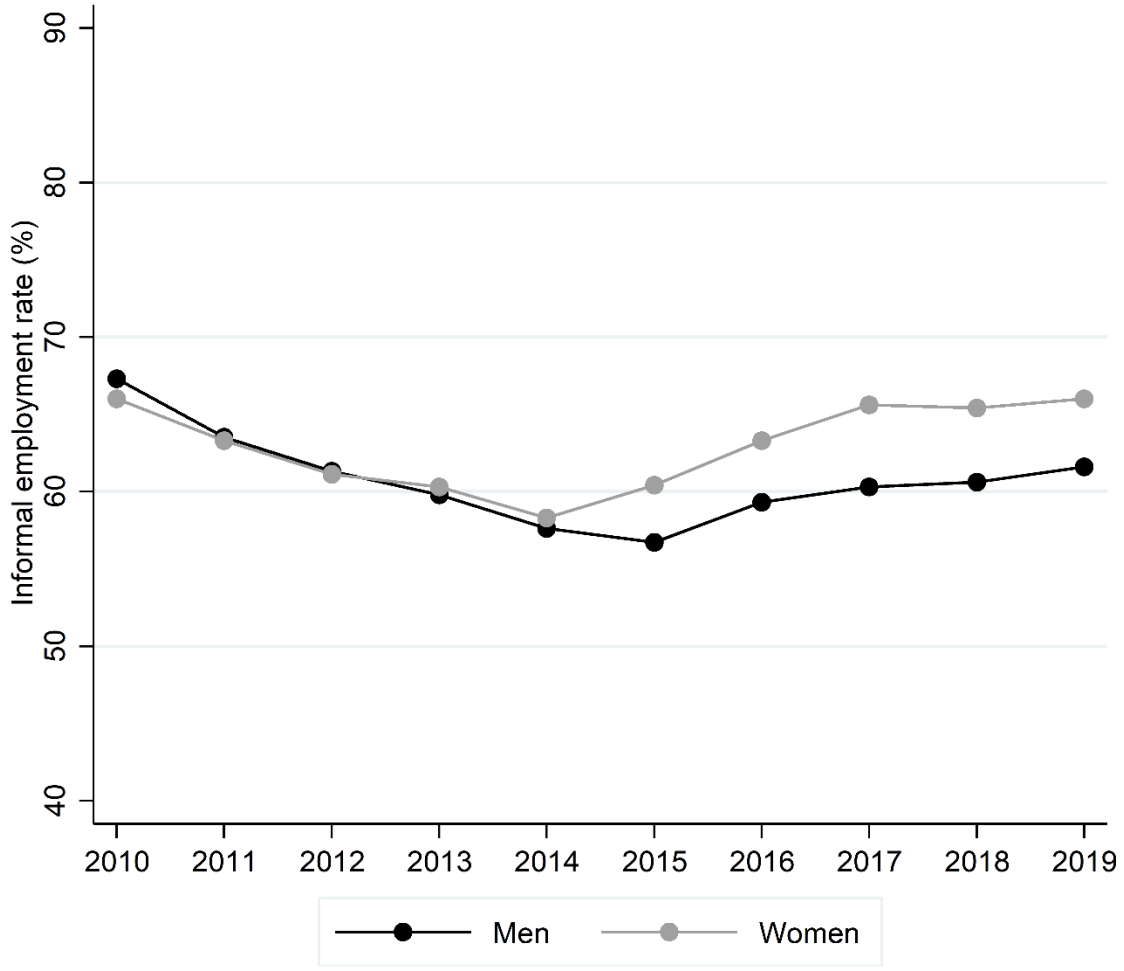


Note: LAC, Latin American and Caribbean (region).

Source: authors' elaboration based on ILO (2021a).

The evolution of informal employment in Ecuador over the second decade of the 2000s is more contrasted. Figure 2 shows a strong reduction in informal employment, from 67 per cent to 58 per cent between 2010 and 2014, with very similar trends and levels for men and women (ILO 2021b). However, female informal employment increased relatively more between 2014 and 2019, representing 66 per cent of female employment at the end of this period. The pattern is slightly different for men, with informal employment increasing between 2015 and 2019 but at lower levels than those observed for women (61.6 per cent in 2019). Ecuador also has higher levels of informal employment compared with both the Latin American and the South American average, with a slower reduction especially for female informal workers. Indeed, the rate of informality remains on average 3.3 per cent higher than the regional average of Latin America and 4.55 per cent of South America from 2000 to 2018.

Figure 2: Informal employment rate by gender in Ecuador, 2010–19



Source: authors' elaboration based on ILO (2021b).

3.2 Tax–benefit policies in Ecuador, 2011–19

Over the second decade of the 2000s, the size of the tax–benefit system in Ecuador experienced important changes. In terms of taxes, the ratio of tax to gross domestic product (GDP) in Ecuador increased by 28.8 per cent (from 16 per cent in 2010 to 20.6 per cent in 2018) compared with a 9 per cent increase (from 21.2 per cent to 23.1 per cent) on average in the LAC region (OECD et al. 2020). The increase in revenue from direct taxes (i.e. taxes on income and profits, and social security contributions) was particularly important, from 7.1 per cent to 9.9 per cent of GDP (a 39.4 per cent increase). In terms of social protection, Ecuador experienced a decline in government spending from 1.6 to 0.9 per cent of GDP between 2010 and 2015. By 2018, government spending on social protection increased again to 1.4 per cent of GDP (ECLAC 2021).

The changes in tax revenue and government spending in social protection observed over this period are explained by a number of reforms of the tax–benefit system. In the remainder of this section, we provide a general overview of the characteristics of tax–benefit instruments in Ecuador and the reforms implemented during our period of analysis (i.e. 2011–19). We concentrate on direct taxes and cash transfers as we focus on the concept of disposable income for the analysis of labour supply and informal employment. As discussed in Section 4, we use changes in tax–benefit policies as a source of identification in the estimation of formal employment elasticities.

Social insurance contributions

In Ecuador, social insurance contributions (SICs) are paid on gross employment income. The minimum contribution base (i.e. the minimum level of income to which contribution rates apply) is set at the value of the national minimum wage. SICs are compulsory for employees, whereas self-employed workers can contribute on a voluntary basis. Employee SIC rates ranged between 9.35 and 11.35 per cent in 2011 depending on the sector of the employer and increased to 9.45 and 11.45 per cent, respectively, in 2014. SIC rates for the self-employed were 17.5 per cent in 2011 and increased to 20.5 per cent in 2014.

Personal income tax

In Ecuador, personal income tax is assessed at the individual level and levied jointly on labour and capital income. Until 2007, the tax schedule applied to the tax base was made up of six tax bands, with rates ranging from 0 to 25 per cent. A more progressive tax schedule was introduced as part of a major tax reform in 2008, with nine tax bands and rates between 0 and 35 per cent. The tax schedule is characterized by a high exempted threshold (i.e. lowest tax band limit), equivalent to 2.5 times the annualized minimum wage in 2019. The 2008 tax reform also introduced deductions for personal expenditures accordingly reducing the taxable income used for the calculation of personal income tax load. These deductions include expenditure on food, clothing, education, health, and housing.[1] The 2008 tax reform was accompanied by a major taxpayer awareness and registration campaign, which likely was an important factor for the increase in personal income tax revenue observed in the second decade of the 2000s.

Social cash transfers

Individuals and their families can access three main social cash transfers in Ecuador: the Human Development Transfer (HDT, Bono de Desarrollo Humano), the disability carer benefit (Joaquín Gallegos Lara allowance), and the unemployment insurance benefit (Seguro de desempleo).

HDT is the main non-contributory social protection scheme in Ecuador. It is designed as a proxy means-tested benefit that targets three population sub-groups: (i) families with children younger than 18 years, (ii) elderly adults above 65 years who are not entitled to contributory pensions, and (iii) individuals with disabilities.[2] The proxy means-test is based on a composite index comprising household characteristics and housing conditions. Families and individuals below a specific threshold of the index are eligible for the benefit, and certain conditionalities apply to families with children.[3] The HDT has undergone a number of reforms over our period of analysis. In 2011, the benefit amount of the HDT was US$35 per month. It increased to US$50 per month in 2013. In 2014, the composite index used for determining eligibility was modified and the threshold for

[1] Deductions for personal expenditures cannot be higher than 50 per cent of taxable income or 1.3 times the basic exempted band. Additionally, there are individual limits for each type of expenditure. Expenditure in food, housing, education, and clothing cannot exceed 0.325 times the basic exempted band, individually. Expenditure in health cannot exceed 1.3 times the basic exempted band.

[2] Here, we consider all the sub-programmes of the original Human Development Transfer (HDT) under the same umbrella: HDT for families with children, non-contributory pension assistance, and non-contributory disability benefits.

[3] Two types of conditionality apply for mothers with children receiving HDT. First, it is required that children aged 6–18 years in the household enrol in school and attend at least 90 per cent of school days in a month. Second, it is required that children below 6 years in the household attend health centres at least twice per year for medical check-ups.

eligibility of families with children decreased, resulting in a smaller number of households being entitled to the benefit. From 2018, the HDT amount increased to US$100 for elderly adults, and the amount for families was modified to include a basic component of US$50 and a variable component that depends on the age and number of children in the family, with a total amount of the HDT benefit (fixed plus variable amounts) capped at US$150 per month.

The Joaquín Gallegos Lara benefit was introduced in 2010 with the aim of improving the living conditions of individuals with a severe disability or illness who are unable to live independently and who live under critical economic conditions. The benefit amount is US$240 per month, paid to the person who is responsible for the care of the individual with the disability or illness.

The unemployment insurance benefit (Seguro de desempleo) was introduced in 2016 as an insurance for unemployed individuals who are affiliated to the general social security regime. The benefit amount consists of a fixed payment from a common pool of funds and a variable top-up payment with funds from an individual account. The scheme consists of five monthly payments, starting after the third month of unemployment. The fixed payment equals 70 per cent of the national minimum wage. The variable payment tops up the fixed amount up to 70 per cent of average earnings in the last 12 months of employment. After the first month, the overall payment is reduced by 5 percentage points every month until entitlement ends.

4 Methodology

We combine tax–benefit microsimulation techniques with two different econometric approaches to estimate and compare formal employment elasticities. This section starts by discussing the data and microsimulation model used in the analysis and provides general descriptive statistics. Next, it describes the two approaches used to estimate formal employment elasticities: (i) discrete choice labour supply estimations, and (ii) grouped-data estimation techniques. While the first approach allows for sub-group analysis, this is by construction not possible in the second approach. The first approach also can be readily used to simulate implications of policy reform. The second approach, however, has the advantage of not imposing structure on individual preferences (i.e. defining a specific utility function), relying on time variations in tax–benefit policies across group in a pseudo-panel type of setting.

4.1 Data and tax–benefit simulations

Data

Our analysis is based on ENEMDU, a nationally representative survey conducted on a quarterly basis, which represents the main data source to track labour market changes and the evolution of poverty and inequality in Ecuador. ENEMDU contains information on employment, labour and non-labour income, public pensions, cash transfers, private transfers, as well as personal and household characteristics.

For our study, we make use of four waves of ENEMDU corresponding to the December rounds of years 2011, 2013, 2017, and 2019. Time variation captured by pooling different waves of cross-sectional data is the main source of identification for formal employment elasticities in grouped-data estimations. Additionally, in the case of discrete choice labour supply models, pooling waves allows having a sufficiently large dataset to deal with the sample restrictions imposed for estimating the models. Time variation in tax–benefit rules due to policy reforms implemented over the period

of analysis constitutes an additional source for identification of the behavioural parameters to be estimated.

The key variables for our analysis are formality status, gross earnings, and hours of work. We focus on employees and follow the legalistic view to define formal employment as non-affiliation to social security (Saavedra and Chong 1999), where information about affiliation to social security as reported in the data is used.[4] For the structural labour supply model, we calculate gross hourly wages by translating monthly earnings into weekly earnings and dividing them by the total number of hours worked per week. For the grouped-data estimations, gross monthly earnings are used directly in the estimations. In the discrete choice model, wages in formal and informal employment are needed for each individual regardless of their true status to calculate disposable income under each alternative. For this, we impute gross hourly wages in formal and informal employment using two separate Heckman selection models estimated for each data wave.[5]

Sample selection

Our analysis focuses on female labour supply and informal employment. More precisely, from the original data, we extract households where only one labour supply unit is present, where a labour supply unit is defined as single women or women in couples with or without dependent children or dependent elderly. Dependent children are defined as children aged 18 years or below who are in education and have no earnings, and dependent elderly are defined as parents and parents-in-law aged 60 years or above who are retired and have no earnings. Extended households, where more than one labour supply unit cohabit, are therefore excluded. Additionally, we restrict our sample to households with working-age women (i.e. those aged between 19 and 59 years) available for the labour market (not disabled, in education, or retired) and exclude those in self-employment and those with more than one job. Finally, for women in couples, we keep those whose partner is in work. Our selected sample includes 12,722 households (3,065 single women and 9,657 women in couples), which represents 18 per cent of all households with female members in our data.

Table 1 presents the categorization of households by household structure in Ecuador and describes the percentage of each category captured by our selected sample. The most common types of households in Ecuador are those of a couple with minor children (i.e. children aged 18 years or below) and extended families defined as those containing a nuclear family (i.e. single individuals or couples with or without children) plus one or more relatives. Couples with minor children also represent the most common type of households in European countries, whereas the percentage of extended families is low, except in some new member states of the European Union (Iacovou and Skew 2011).

Our labour supply sample captures 41.3 per cent of couples with minor children but only 5.2 per cent of extended families, namely those containing nuclear families with dependent elderly. All other household types represent less than 13 per cent of the whole sample. Three other household categories are part of our labour supply sample: single women, women in couples with individuals aged below 60 years, and single mothers below 60 years with minor children. Our sample of analysis captures 48.8 per cent of single women below 60 years, 39 per cent of women in couples below 60 years, and 42.1 per cent of single mothers with young children.

[4] In general, ENEMDU is considered to capture information regarding affiliation to social security well as the data are cross-validated with information from the Ecuadorian Institute of Social Security (Instituto Ecuatoriano de Seguridad Social).

[5] Results available from the authors upon request.

Table 1: Household composition and labour supply sample (pooled sample)

	Whole sample	Female labour supply sample	
		% of all households	% of each household type
Single men <60 years	3.8	0.0	0.0
Single men >60 years	2.7	0.0	0.0
Single women <60 years	1.7	0.8	48.8
Single women >60 years	3.4	0.0	0.0
Couple only, both <60 years	3.4	1.3	39.0
Couple only, at least one >60 years	5.8	0.0	0.0
Couple with minor children	25.5	10.5	41.3
Couple with adult children	12.2	0.0	0.0
Single parents with minor children	5.5	2.3	42.1
Single parents with adult children	5.9	0.0	0.0
Extended family	29.8	1.5	5.2
Other (unrelated individuals)	0.3	0.0	0.0
All	100.0	16.6	16.6

Note: minor children are defined as children aged 18 years or below.

Source: authors' elaboration based on ENEMDU and ECUAMOD v2.0.

Tax–benefit simulations

We use ECUAMOD, the tax–benefit microsimulation model for Ecuador, to simulate household disposable income for the purpose of the estimation of formal employment elasticities.[6] ECUAMOD combines detailed country-specific coded policy rules with household survey microdata to simulate direct and indirect taxes, SICs, and cash transfers for the household population of Ecuador.[7] More precisely, in the discrete choice model, ECUAMOD is used to calculate household disposable income at different bundles of gross hourly wages and weekly hours of work, which are used as alternative choices for the estimation of labour supply models. For the grouped-data estimations, ECUAMOD is used to calculate the difference between gross earnings and net income across different groups over time.

Descriptive statistics

Table 2 presents descriptive statistics of our sample of analysis. Marked differences are observed between single women (Panel A) and women in couples (Panel B), with 82 per cent of single women and 36.5 per cent of women in couples working. The majority of single women (51 percent) work in formal employment compared with 25.7 per cent of women in couples, whereas 30.7 per cent of single women and 10.8 per cent of women in couples work in informal employment.

Table 2: Descriptive statistics (pooled selected sample)

[6] ECUAMOD has been developed as part of UNU-WIDER's project on 'SOUTHMOD—simulating tax and benefit policies for development' in which tax–benefit microsimulation models have been built in the EUROMOD software for selected developing countries (Decoster et al. 2019). Simulation results for ECUAMOD have been validated against official statistics (see Jara et al. 2021a) and the model has been used in recent empirical studies by Bargain et al. (2017), Jara et al. (2021b), and Jouste and Rattenhuber (2019).

[7] We have imputed data on expenditure in food, clothing, education, health, and housing to ENEMDU based on information from the National Survey of Income and Expenditures of Urban and Rural Households (Encuesta Nacional de Ingresos y Gastos de Hogares Urbanos y Rurales, ENIGHUR 2011–12), as expenditures on these items can be deducted for personal income tax payments.

	A. Single women				B. Women in couples			
	Formal	Informal	Not working	Total	Formal	Informal	Not working	Total
Age	39	36	38	38	35	32	33	34
Primary education or none	0.15	0.43	0.36	0.27	0.10	0.36	0.37	0.30
Secondary education	0.32	0.46	0.50	0.39	0.34	0.53	0.51	0.47
Tertiary education	0.54	0.11	0.14	0.34	0.56	0.11	0.12	0.23
Hourly wage	3.75	1.45	—	2.98	4.14	1.60	—	3.45
Weekly hours	40.45	37.54	—	31.78	40.18	36.90	—	13.82
Number of children	1.02	1.55	1.39	1.24	1.57	1.81	1.94	1.83
Dependent elderly	0.21	0.06	0.07	0.14	0.04	0.04	0.04	0.04
No. observations	1,565	942	558	3,065	2,481	1,044	6,132	9,657

Note: '—' indicates not applicable.

Source: authors' elaboration based on ENEMDU and ECUAMOD v2.0.

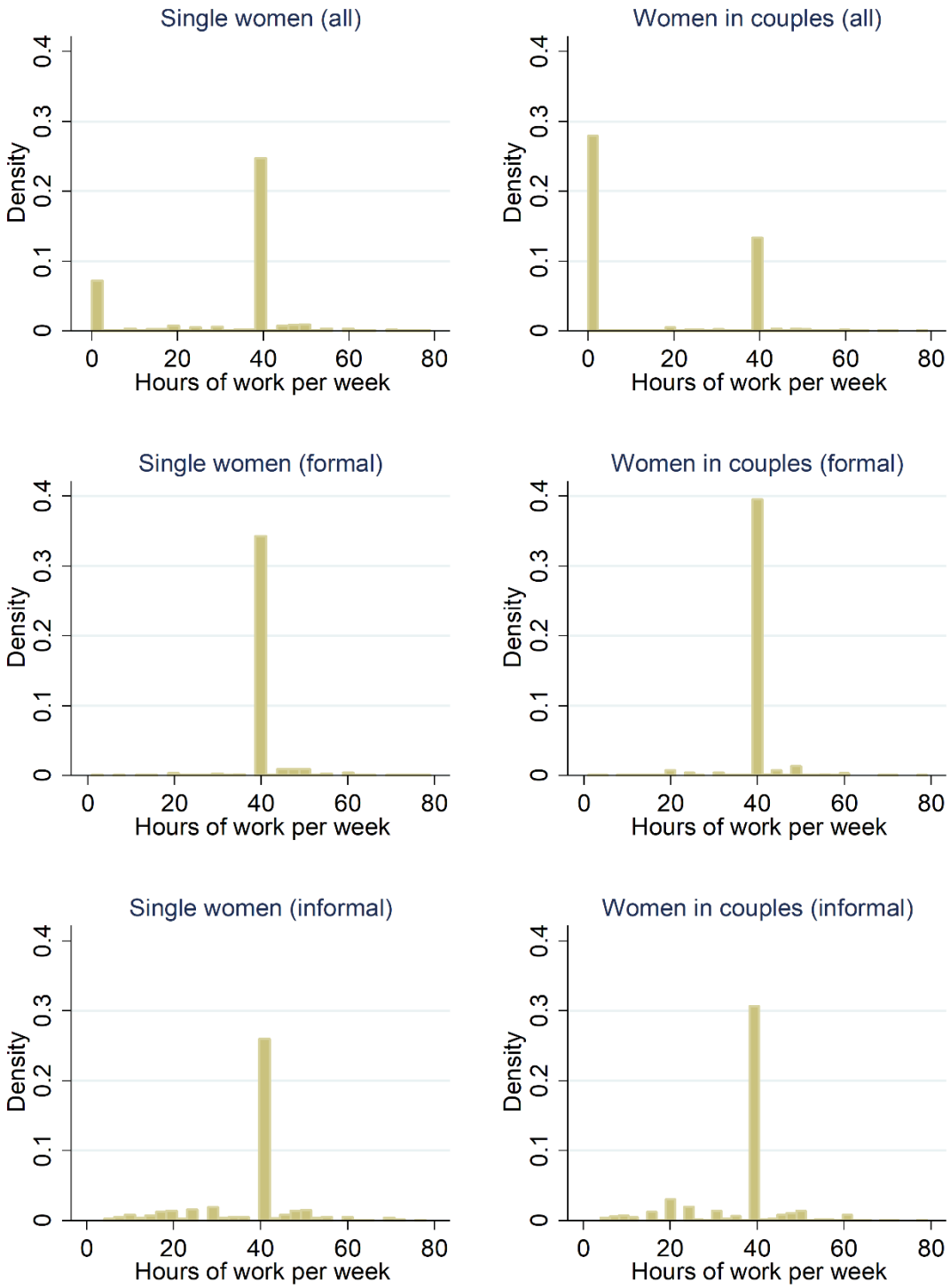
Regarding individual and household characteristics, some common patterns are observed across the two groups in Table 2. As expected, the share of individuals with tertiary education is higher in formal employment than in informal employment. Average female hourly wages in formal employment are substantially higher (i.e. 2.6 times) than in informal employment. Average weekly hours of work are lower in informal employment than in formal employment, which could point to more flexible working time arrangements in the former.

The number of children, on average, is higher for women in couples than for single women, and this holds across work categories (i.e. not working, formal employment, and informal employment). For single women in informal employment, the average number of children is similar to that for women in couples working in formal employment (1.54 versus 1.57, respectively). Finally, the number of dependent elderly in the household is higher for single women than for women in couples, and particularly so for single women in formal employment.

We now turn to the distribution of hours of work in our sample of analysis. Figure 3 presents the distribution of actual hours worked for single women (left panel graphs) and women in couples (right panel graphs). For those in work in each of these categories, Figure 3 further shows the distribution of hours of work distinguishing between those in formal (second row graphs) and those in informal employment (third row graphs).

We observe two marked peaks at zero hours (i.e. non-participation) and standard full-time work (i.e. around 40 weekly hours of work). However, the distribution varies markedly across single women and those in couples. For single women, the largest concentration is observed around standard full-time work, whereas the majority of women in couples do not participate in the labour market, which is in line with the descriptive statistics in Table 2. The distribution of working hours for women in formal employment (second row graphs of Figure 3) is dominated by those working standard full-time hours, with working hours other than standard full-time barely being observed in the data. More variation is observed in the distribution of hours of work of informally employed women (bottom row graphs of Figure 3). Although the largest mass of observations is also concentrated around standard full-time work hours, there is clearly more observations with part-time work (around 20 hours) and overtime work (more than 40 hours).

Figure 3: Distribution of weekly hours of work (pooled selected sample)



Source: authors' elaboration based on ENEMDU and ECUAMOD v2.0.

4.2 Discrete choice labour supply with informality

In this section, we describe our discrete choice labour supply model including formal and informal employment choices, which is set up as an extension of the unitary discrete choice model of household labour supply of van Soest (1995). Here, we allow individuals to choose between non-participation and hours of work in formal or informal employment. The model is derived under the random utility maximization framework.

More precisely, consider individual i who chooses among a finite number of job alternatives, J, representing different categories of work hours in formal or informal employment. The utility obtained from alternative j is U_{ij}, where j=1, …, J. Individual i chooses alternative j if and only if $U_{ij}>U_{ik}$, $\forall k \neq j$. The utility function can be decomposed into a deterministic and a stochastic component: $U_{ij}=V_{ik}+\varepsilon_{ij}$. The probability that a particular alternative j is chosen is given by

$$P_{ij} = Prob(U_{ij} > U_{ik}, \forall k \neq j) = Prob(V_{ij} + \varepsilon_{ij} > V_{ik} + \varepsilon_{ik}, \forall k \neq j) = Prob(\varepsilon_{ik} < \varepsilon_{ij} + V_{ij} - V_{ik}, \forall k \neq j)$$

The random vector $\varepsilon_i=\{\varepsilon_{i1}, \ldots, \varepsilon_{iJ}\}$ is assumed to be independent and identically distributed over alternatives and follows a type-one extreme value distribution given by $F(\varepsilon_{ij}) = e^{-e^{-\varepsilon_{ij}}}$. Under this setting, following McFadden (1974), the probability that an alternative j is chosen is expressed as

$$P_{ij} = \frac{e^{V_{ij}}}{\sum_{k=1}^{J} e^{V_{ik}}}$$

In our model, individuals choose among a finite number of working hour alternatives to maximize their utility, defined over net income and hours of work in each sector (formal or informal employment). We assume that the gross wage rates are fixed and independent of the hours of work within each sector. The decision is taken given the sector-specific gross wage rates and the tax and benefit system.

More formally, let h_i be the number of observed hours worked and s_i the sector of employment (formal or informal) of individual i. We define J discrete alternatives so that h_{ij} represents the number of hours worked by individual i under alternative j and s_{ij} the sector of employment of individual i in alternative j, with j=1, …, J. Taking into account the distribution of work hours discussed above, we define six alternatives for our discrete choice model, J=6: (i) inactivity, (ii) full-time in formal employment, (iii) overtime in formal employment, (iv) part-time in informal employment, (v) full-time in informal employment, (vi) overtime in informal employment. The discretized choice set for each individual is, therefore, given by $h_{ij}=\{0, 40f, 60f, 20n, 40n, 60n\}$, where f stands for formal employment and n for informal employment. The same discretized set applies to single women and women in couples; as for the latter, we fix their partner's hours of work for the estimation.[8]

[8] Alternatively, for couples, a combined set of discrete choice alternatives could be estimated with 6×6 discrete choices for each member of the couple. Here, however, we concentrate on labour supply behaviour and the choice between formal and informal employment of women. From a technical point of view, the estimation of the combined model is more computationally intensive and did not converge under the specified setting.

Let y_{ij} be individual i's household disposable income given the hours choice h_{ij} and sector s_{ij}, and z_i a vector of individual characteristics. Household disposable income y_{ij}, when $h_i=h_{ij}$ and $s_i=s_{ij}$ are chosen, is defined as

$$y_{ij} = w_{ij}h_{ij} + \mu_i + G(w_{is}, h_{ij}, \mu_i, z_i),$$

where w_{ij} is gross hourly wage rates in sector s_{ij}, with gross hourly wages varying across sectors but fixed across hour alternatives within each sector. μ_i is non-labour income and the function $G(w_i, h_{ij}, \mu_i, z_i)$ represents the tax–benefit rules that depend on gross wages, hours of work, non-labour income, and individual characteristics. Under our framework, workers in informal employment are assumed not to pay SICs and personal income tax but might still receive non-contributory social assistance benefits depending on their household characteristics.

Several functional forms can be used to specify the deterministic part of the utility function. Following Keane and Moffitt (1998), Brewer et al. (2007), and Kabátek et al. (2014), we define a quadratic utility function. For single women and women in couples,[9] the utility function is given by

$$V(y_{ij}, h_{ij}, s_{ij}, z_i) = \alpha_{yy}y_{ij}^2 + \alpha_{hh}h_{ij}^2 + \alpha_y y_{ij} + \alpha_h h_{ij} + \alpha_s s_{ij} + \alpha_{yh}y_{ij}h_{ij} + \alpha_{ys}y_{ij}s_{ij} + \alpha_{hs}h_{ij}s_{ij}.$$

The presence of informal employment is accounted for by introducing a dummy for informal employment alternatives (s_{ij}=1) in the utility function, as well as interactions with income and leisure to considering their differentiated effect across sectors.

Observed heterogeneity in preferences for hours of work and informal employment is accounted for through interactions with personal characteristics:

$$\alpha_h = \alpha_{h0} + \alpha'_{hx}z_i$$

$$\alpha_s = \alpha_{s0} + \alpha'_{sx}z_i$$

The models are estimated separately for single women and women in couples by maximum likelihood. Elasticities under the discrete choice approach are calculated numerically using the parameters of the estimated models. Elasticities of formal employment are obtained following a simulated 10 per cent increase in formal gross wages (wage elasticity) or non-labour income (income elasticity). Disposable income under the 10 per cent increase is recalculated for the discrete alternative of formal employment (full-time and overtime formal employment) using ECUAMOD. The estimated coefficients are then used to calculate the average probability of being at each alternative under the new and baseline value of disposable income. Formal employment elasticities are obtained by calculating the change in the predicted frequencies of formal employment.

Identification for the estimation of discrete choice labour supply models with cross-sectional data is provided by non-linearities, non-convexities, and discontinuities in budget constraint due to tax–benefit policies (Bargain et al. 2014; Blundell et al. 2000; van Soest 1995), meaning that due to their characteristics individuals with the same gross wage usually end up with different levels of

[9] For women in couples, income represents household disposable income where the hours of work of partners are fixed at their observed value.

disposable income. By pooling several waves of data, variation of tax–benefit policies over time provides an additional source of identification, which we exploit in this paper.

4.3 Grouped-data estimation of elasticities

In this section, we describe an alternative approach to obtain formal employment elasticities, which is based on the grouping estimators developed by Blundell et al. (1998) to estimate labour supply responses. The approach has been recently applied to the context of African countries by McKay et al. (2019) and Osei et al. (2019) to estimate formal employment elasticities. We follow closely these two studies to describe the grouped-data approach to estimate formal employment elasticities.

Assume individuals can either work in formal or informal employment. If the individual is in formal employment, they receive earnings x_f, pay taxes $T(x_f)$ and receive benefits $B(x_f)$, with disposable income in formal employment denoted by $y_f=x_f+T(x_f)+B(x_f)$. If the individual is in informal employment, they receive earnings x_n and receive benefits $B(x_n)$, with disposable income in informal employment denoted by $y_n=x_n+B(x_n)$. Let utility be linear (or log linear) in income, then the individual searched for formal employment if

$$p(y_f - d_i) + (1-p)y_n - \psi_i \geq y_n,$$

where p is the probability of finding a job in formal employment, d_i is a cost incurred when working in formal employment, and ψ_i is the cost of searching for a formal job. The condition above can be written as

$$y_f - y_n \geq d_i + \psi_i, \tag{1}$$

implying that the probability of working in formal employment is positively related to the difference in disposable income between formal and informal employment. The empirical counterpart of Equation (1) for the estimation can be expressed as

$$P(x_f > 0)_{it} = \alpha + \beta[y_f - y_n]_{it} + \epsilon_{it}, \tag{2}$$

where $P(x_f>0)_{it}$ is the probability of working in formal employment for individual i in period t and y_f-y_n stands for the difference between disposable income in formal and informal employment. $P(x_f>0)$ takes the value 1 if the individual earns strictly positive formal employment income.

The estimation of Equation (2) poses two important challenges. First, there can be unobserved characteristics that are correlated with formal employment income and with the probability to work in formal employment. Second, employment income for one of the formality statuses needs to be imputed as each individual is observed earning either formal or informal employment income at a given point in time.

To tackle these challenges, we follow the group-based pseudo-panel approach proposed by Blundell et al. (1998), where repeated cross-sections are grouped into cells g based on individual types (e.g., gender, age, education). The data are then aggregated by groups at each period, and group mean values are used to estimate (y_f-y_n). The equation is then estimated at the group level, including group and time fixed effects, as

$$\overline{P(x_f > 0)}_{gt} = \alpha + \beta\overline{(y_f - y_n)}_{gt} + \alpha_g + \mu_t + \eta_{it}, \tag{3}$$

which is estimated by generalized least square using group cell size as weights and heteroscedasticity robust standard errors.

The elasticity of formal employment with respect to the change in net income is given by

$$\varepsilon = \beta \frac{\overline{(y_f - y_n)}_{gt}}{P(x_f > 0)}$$

In our analysis, we adapt Equation (3) to account separately for the effect of taxes (including SICs) and benefits as follows:

$$\overline{P(x_f > 0)}_{gt} = \alpha + \beta \overline{(y_f^T - y_n^T)}_{gt} + \gamma \overline{\left(B(x_f) - B(x_n)\right)}_{gt} + \alpha_g + \mu_t + \eta_{it}, \qquad (4)$$

where $(y_f^T - y_n^T)$ is the difference in net earnings (i.e. earnings after tax and SICs) between formal and informal employment and $(B(x_f) - B(x_n))$ is the difference in benefits between formal and informal employment. Separating the effect of taxes and benefits is possible because benefits do not depend directly on household income in Ecuador as eligibility is assessed based on a composite index. In this sense, the elasticity of formal employment with respect to the change in net earnings comes close to the concept of wage elasticities in the discrete choice model and the elasticity of formal employment with respect to the change in benefits comes close to the concept of income elasticities.

Identification for the grouped-data estimations rely on time variation in tax–benefit policies across groups but also on variation in gross earnings over time.

5 Empirical results

This section presents the results of our analysis. We first present the estimation results and the fit of the structural labour supply model with respect to the observed data. Next, we show descriptive results of the variation in economic incentives across groups used for identification in the grouped-data estimations. Finally, we compare the formal employment elasticities obtained from the two methods, discuss potential reasons for discrepancies, and conclude with elasticities by sub-groups.

5.1 Discrete choice model estimation results

Table 3 presents the results of the labour supply estimations for single women and women in couples. The only restriction imposed in the estimation is for marginal utility of income to be positive, which can be considered as a minimum consistency requirement for meaningful interpretation of the results (Bargain et al. 2014). No restrictions are imposed for marginal utility of leisure. However, marginal utility of leisure is positive for 98 per cent of single women and women in couples.

In terms of leisure taste shifters, the presence of young children is associated with higher preferences for leisure for both single women and women in couples, which is in line with the literature. For both groups, being over 40 years old and living in rural areas is associated with higher preferences for leisure. Finally, the presence of dependent elderly adults in the household is associated with lower preferences for leisure for single women, whereas the coefficient is not significant for women in couples.

The coefficients of informal employment are hard to interpret as they could be considered as capturing preferences for informal employment or restrictions in the availability of jobs in a particular sector (i.e. (in)formal employment is more prevalent among individuals with certain characteristics). The model setup does not allow disentangling between preferences or constraints due to data limitations.[10] We discuss the implications and how our findings compare with the literature further in Section 5.4 and in the conclusion.

Table 3: Labour supply estimation

	A. Single women		B. Women in couples	
Coefficients	Coefficient	SE	Coefficient	SE
Income^2	1.07e−05	(7.41e−06)	9.91e−05***	(6.21e−06)
Income	0.00228***	(0.000360)	0.00232***	(0.000248)
Leisure^2	−0.00185***	(9.83e−05)	−0.00303***	(9.63e−05)
Leisure	0.229***	(0.0124)	0.405***	(0.0120)
× >40 years	0.0130***	(0.00266)	0.00313*	(0.00172)
× rural	0.00972***	(0.00273)	0.0106***	(0.00154)
× child (0–4 years old)	0.0173***	(0.00308)	0.0151***	(0.00149)
× dependent elderly	−0.0300***	(0.00432)	−0.00302	(0.00359)
Informal employment	5.066***	(0.264)	7.791***	(0.248)
× >40 years	−0.482***	(0.104)	−0.456***	(0.105)
× rural	−0.217**	(0.110)	−0.0435	(0.0864)
× child (0–4 years)	0.251**	(0.120)	0.0221	(0.0835)
× dependent elderly	−0.364**	(0.167)	−0.138	(0.222)
× low education level	0.563***	(0.100)	0.0311	(0.0765)
Income × Leisure	0.00918***	(0.000669)	0.00446***	(0.000255)
Income × Informal employment	−0.00417***	(0.000231)	−0.00273***	(9.06e−05)
Leisure × Informal employment	−0.0982***	(0.00447)	−0.162***	(0.00451)
Log-likelihood	−3,638.32		−8,099.02	
Pseudo R^2	0.111		0.411	
No. observations	3,065		9,657	

Note: standard errors in parentheses.

Source: authors' elaboration based on ECUAMOD v2.0.

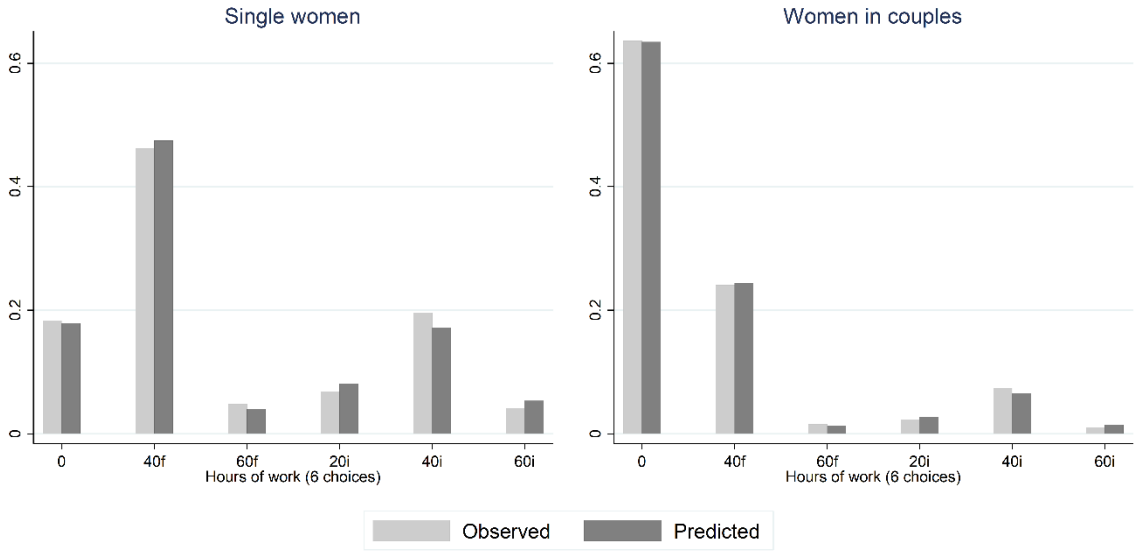
The results show a positive and significant coefficient for the informal employment dummy. For all women, the effect is smaller for those aged above 40 years. For single women, the effect is also smaller for those living in rural areas and those with elderly dependents, whereas the effect is larger for single mothers and those with a low education level.

We check how well the models fit the data by comparing predicted and observed frequencies. Predicted frequencies are obtained by averaging individual probabilities for each discrete alternative over the whole sample, whereas observed frequencies are simply the frequencies of each observed choice over the whole sample. Figure 4 compares predicted and observed frequencies for single women and women in couples. Our model appears to fit well the distribution of observed discretized hours of work. For single women, we observe a small under-prediction of full-time informal employment and a small over-prediction of full-time formal employment, as

[10] Accounting for differences in preferences and constraints would, for instance, require self-reported information about individual preferences over formal or informal employment (Duval-Hernández 2020) or imposing structure about the availability of specific types of jobs for different types of workers in the model (Dagsvik and Strøm 2006).

well as part-time and overtime in informal employment. Overall, the model for women in couples fits the data well.

Figure 4: Observed and predicted frequencies



Note: 'f' stands for formal employment; 'i' stands for informal employment.

Source: authors' elaboration based on ENEMDU and ECUAMOD v2.0.

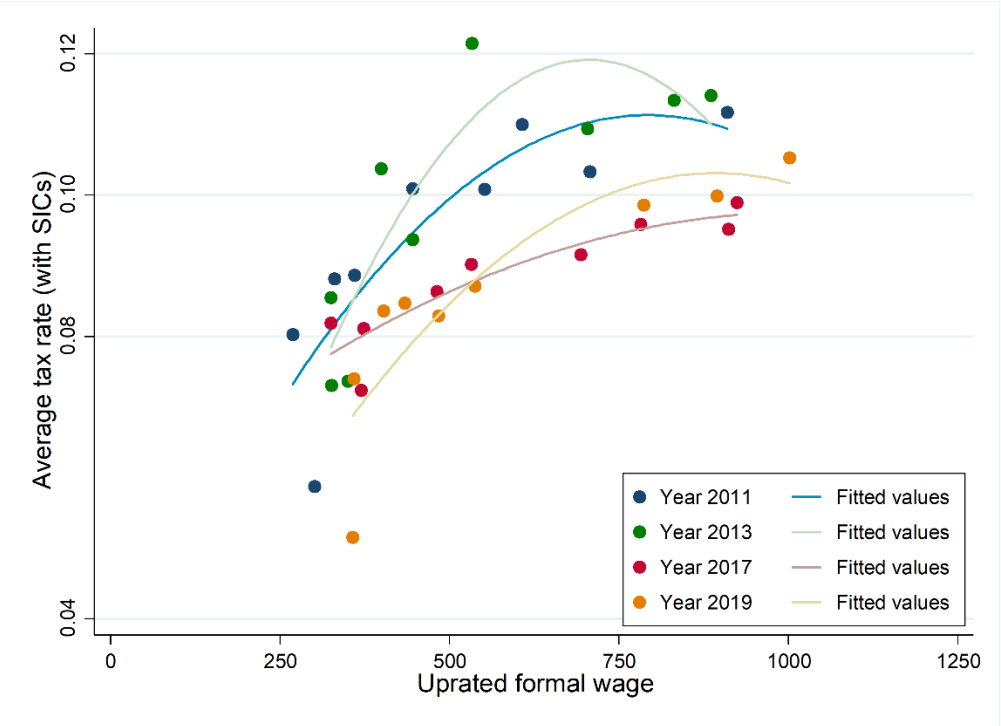
5.2 Grouped-data estimation: variation across groups

For our grouped-data estimations, we define nine worker types that are combinations of three age (18–34, 35–44, and 45–60 years) and three education (no education and primary, secondary, and tertiary) categories, which makes a total of 36 type×year cells for single women and women in couples. We further restrict the estimation to cells with a minimum cell size of 20, including at least five observations in formal employment and five observations in informal employment. This results in a total of 31 cells for single women and 29 cells for women in couples.

The main source of identification in the grouped estimations is variation in economic incentives across groups. To assess the degree of variation across groups, Figure 5 provides information on actual average tax rates (i.e. taxes divided by gross earnings) of formal workers by cell groups and years. Earnings of early years have been uprated to 2019 prices using the Consumer Price Index (CPI). The graph shows substantial variation in the average tax rate by cell groups across the income distribution. The variation captures the changes in SIC rates and also the difference in wage growth with respect to CPI, as the personal income tax schedule is adjusted each year with respect to the latter.

Differences in net income between formal and informal employment are also influenced by differences in gross earnings. To assess the degree of variation in net earnings, we calculate the change across waves in the difference between formal and informal income as in a pseudo-panel (i.e. following the same group over time). Figure 6 shows that there is substantial variation in net income, which is necessary for identification.

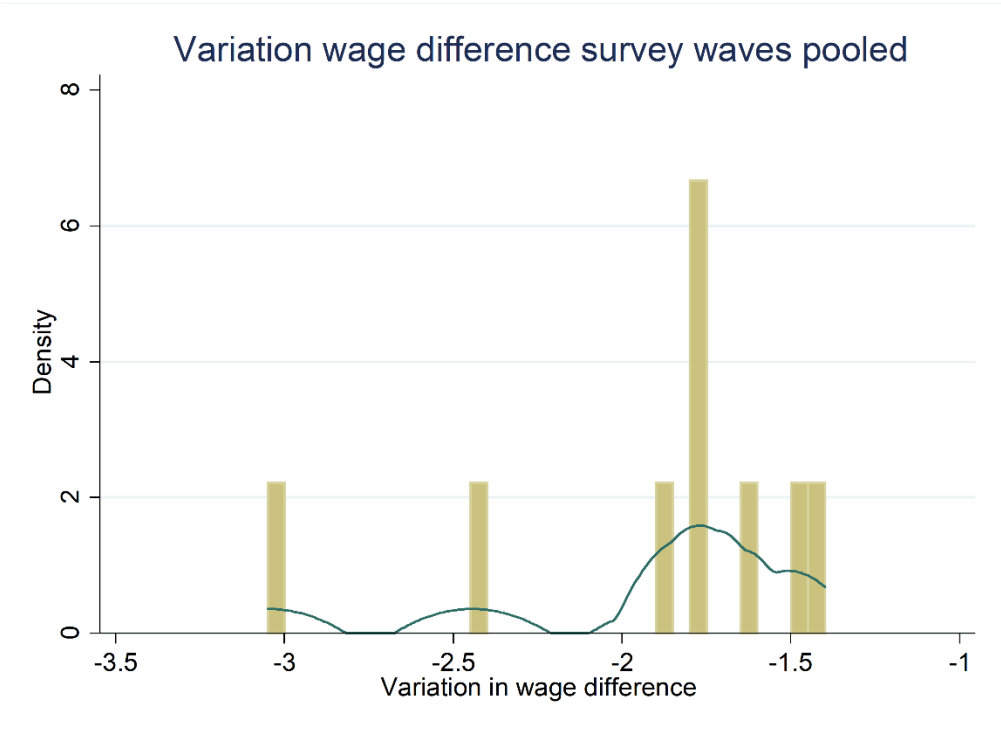
Figure 5: Average tax rates in cell-level data



Note: SICs, social insurance contributions. Earnings of early years uprated to 2019 levels using the consumer price index.

Source: authors' elaboration based on ENEMDU and ECUAMOD v2.0.

Figure 6: Changes across waves in the difference between formal and informal income (histogram and kernel density)



Note: earnings of early years uprated to 2019 levels using the consumer price index.

Source: authors' elaboration based on ENEMDU and ECUAMOD v2.0.

5.3 Formal employment elasticities

This section compares the elasticities of formal employment obtained from our discrete choice model and from grouped estimations. Table 5 presents the results. For single women, elasticities of formal employment are low with both approaches. Income elasticities are of similar magnitude, whereas wage elasticities have a negative sign, although non-significant, in the case of the grouped-data estimation. The results for women in couples diverge more between the two approaches. Formal employment elasticities obtained with the labour supply model are larger than those of single women, especially income elasticities. On the contrary, elasticities obtained with grouped estimation techniques are negative and non-significant for women in couples.

Table 5: Formal employment elasticities: discrete choice model versus grouped-data estimation techniques

	Discrete choice labour supply	Grouped-data estimation
Single women		
Wage elasticity	0.07	−0.10
	(0.001)	(0.124)
Income elasticity	0.09	0.05
	(0.002)	(0.047)
Women in couples		
Wage elasticity	0.12	−0.05
	(0.001)	(0.087)
Income elasticity	0.36	−0.04
	(0.004)	(0.046)

Note: standard errors in parentheses. Standard errors for discrete choice model elasticities are based on bootstrapping. Standard errors for grouped-data elasticities are calculated by the delta method.

Source: authors' elaboration based on ENEMDU 2017 and ECUAMOD v2.0.

5.4 Heterogeneity of formal employment elasticities

The discrete choice model allows us to look further into how specific population groups differ in their response. Sub-group formal employment elasticities are obtained by comparing the change in predicted formal employment frequencies within each sub-group following a simulated 10 per cent increase in formal gross wages (income).

Table 6 presents elasticities of formal employment obtained with the discrete choice model by education and income groups. The pattern of elasticities by education group clearly differs between single women and women in couples. For single women, formal employment elasticities decrease with the level of education; for women in couples, an inverted U-shaped pattern is observed, with elasticities increasing for individuals with middle education but decreasing for individuals with higher education. The pattern of elasticities across disposable income quintiles provides further insights. For single women, formal employment elasticities remain broadly uniform for quintiles 1 to 4 but they are lower for the top quintile. For couples, elasticities, and in particular income elasticities, increase for quintiles 1 to 4 but they decrease for the top quintile group.

A potential explanation for the observed pattern could be that at the bottom of the income distribution individuals might face constraints to enter formal employment as widely described in the literature (e.g., see Fields 1975). Therefore, they respond less to changes in formal wages or income. As income increases individuals face less constraints to enter formal employment, and we therefore observe larger elasticities. However, elasticities drop at the top of the distribution most likely because the cost of entering formal employment for higher earners is larger as they would be liable to personal income tax. Therefore, we observe a smaller change in the predicted frequencies of formal employment within the top income quintile group. Note that the potential

disincentive effect of personal income tax occurs only at the top quintile because Ecuador is characterized by a high exempted threshold, implying that individuals at the top of the income distribution enter the personal income tax brackets.

Table 6: Formal employment elasticities by education and income: discrete choice model

	Single women		Women in couples	
	Wage elasticity	Income elasticity	Wage elasticity	Income elasticity
Low education	0.10	0.14	0.10	0.34
	(0.0012)	(0.0023)	(0.0008)	(0.0032)
Middle education	0.08	0.12	0.13	0.44
	(0.0010)	(0.0022)	(0.0010)	(0.0052)
High education	0.05	0.06	0.12	0.29
	(0.0011)	(0.0023)	(0.0026)	(0.0066)
Q1	0.08	0.12	0.11	0.24
	(0.0018)	(0.0026)	(0.0014)	(0.0032)
Q2	0.09	0.13	0.12	0.32
	(0.0016)	(0.0028)	(0.0009)	(0.0024)
Q3	0.09	0.13	0.13	0.38
	(0.0014)	(0.0028)	(0.0009)	(0.0031)
Q4	0.08	0.11	0.14	0.45
	(0.0016)	(0.0025)	(0.0011)	(0.0056)
Q5	0.05	0.07	0.11	0.33
	(0.0012)	(0.0024)	(0.0026)	(0.0073)
All	0.07	0.09	0.12	0.36
	(0.0008)	(0.0015)	(0.0013)	(0.0039)

Note: bootstrapped standard errors in parentheses. Quintiles are defined in terms of per capita household disposable income.

Source: authors' elaboration based on ENEMDU 2017 and ECUAMOD v2.0.

6 Conclusion

Understanding the behavioural effects of changes in tax–benefit policies in developing countries is of paramount importance in view of increasing fiscal capacity to strengthen social protection. Empirical evidence on the impact of reforms to taxes and benefits on labour supply and informal employment in low- and middle-income countries remains scarce, however. Most studies, in particular for Latin America, have used quasi-experimental settings to assess the effect of specific policy reforms on informal employment. This strand of the literature shows that tax reductions might have a positive effect on participation in formal employment, whereas evidence for the effect of increased social assistance on formal employment is mixed.

This paper analyses female labour supply behaviour and the choice between formal and informal employment of women in Ecuador. Our analysis compares two approaches to estimate formal employment elasticities: (i) a discrete choice model of labour supply with informality, and (ii) grouped-data estimation techniques. The two approaches use variation in tax–benefit policies covering the period 2011–19 as a source of identification. This variation is captured by means of tax–benefit microsimulations using ECUAMOD, the microsimulation model for Ecuador, based on nationally representative household data.

Our results show that the estimated discrete choice model of labour supply with informality fits the data well and there appears to be substantial variation in tax–benefit policies over the period of analysis for identification of grouped-data estimations and the discrete choice model. Some similarities are observed in terms of income elasticities of formal employment for single women, whereas wage elasticities for this group differ under both approaches. Elasticities obtained with the grouped-data estimations are negative and non-significant. The latter also applied to formal employment elasticities of women in couples under the grouped-data approach, whereas under the discrete choice model formal employment elasticities are positive and larger for this group than for single women. Results from the discrete choice model provide further information about the heterogeneity in formal employment elasticities. An inverted U-shaped pattern is observed across the income distribution, meaning that individuals at the bottom and the top of the income distribution react less to changes in formal wages (incomes). The former might be due to constraints to enter formal employment for low-skilled workers. The latter might be because of the effect of personal income tax payments.

The differences in formal employment elasticities estimated with the two approaches can be explained by several factors. First, our analysis looks at a relatively short period of time (2011–19) which might affect the results from the grouped-data estimations as they rely entirely on time variation in tax–benefit policies and wages. In particular, the largest changes in tax–benefit policies concern reforms to social assistance, whereas taxes and SICs have remained broadly unchanged. In this sense, wage elasticities of formal employment might tend to be small. Second, the restrictions imposed on our sample of analysis might also affect more the grouped-data estimations. In our analysis, we focus on female labour supply, which reduces the number of cell groups in the grouped-data approach as gender could be used in addition to age and education to generate the cell groups. Moreover, we exclude individuals in self-employment. Including the self-employed could increase formal employment elasticities based on grouped-data regressions (Osei et al. 2019); however, it would complicate the structure of the discrete choice model as the discrete alternatives would need to be specified not only in terms of hours of work and formality status but also in terms of employment status (employees or self-employed workers).

Finally, under both approaches the role played by constraints or barriers to enter formal employment cannot be disentangled. As previously mentioned, in the discrete choice model, constraints cannot be explicitly modelled without imposing further structure in model (e.g., specifying a stochastic process for modelling the intensity at which a job offer of a specific type—formal or informal—is made)[11] or with additional data on self-reported preferences over formal or informal employment. The parameters of the utility function, thus, partly capture the role of constraints and the smaller formal employment elasticities at the bottom of the income distribution might be explained by barriers to enter formal employment rather than preferences over informal employment. The low and negative elasticities obtained with the grouped-data estimations might also reflect the effect of constraints, in particular for employees (McKay et al. 2019). In any case, given the importance of assessing individual responses to changes in taxes and benefits, comparing different methods to obtain formal employment elasticities seems a useful approach.

[11] See, for instance, Dagsvik and Strøm (2006).

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