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Impact Of Wage Growth On Extreme In-Work Poverty And Household Food Shortages: Evidence From Sudan

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Abstract

This study examines the causes and factors of the prevalence of working poverty among workers in the Sudanese labour market and its impacts on families' food security. A poor worker is defined as a person who is employed in a job in the labour market but lives in a poor household. This branch of labour economics merges labour market input with welfare economics. Households' extreme poverty with working members is a widespread phenomenon in many developing countries and has serious consequences for productivity and well-being. This study employs an instrumental variable binary probit model to control for endogeneity between household food shortage propensity and wages, using cross-sectional data from the 2022 Labour Market Framework Survey in Sudan. We construct a household food shortage indicator as a proxy measure for in-work poverty. The results demonstrate that more than 40% of workers in Sudan live in extreme poverty. The model reveals that a 100% increase in wages would reduce the tendency towards poor household's food shortages by 50%–60%. Wages should be increased at least threefold to eliminate food shortages due to poor working families' lack of resources prior to the necessary increase to meet other basic living needs such as education, health, adequate housing and other concerns. This means that Sudan must substantially restructure the current labour market and wages to eliminate working poverty.

تأثير نمو الأجور على الفقر المدقع أثناء العمل ونقص الغذاء في الأسر: أدلة من السودان

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ملخص

تتناول هذه الدراسة أسباب وعوامل انتشار الفقر بين العاملين في سوق العمل وتأثيراته على الأسر. يُعرّف العامل الفقير بأنه الشخص الذي يعمل في وظيفة في سوق العمل ولكنه يعيش في أسرة فقيرة. يجمع هذا الفرع من اقتصاديات العمل بين مدخلات سوق العمل واقتصاديات الرفاهية. يُعدّ الفقر المدقع في الأسر وفي أماكن العمل ظاهرة منتشرة في العديد من البلدان النامية، ولها عواقب وخيمة على الإنتاجية والرفاهية. تستخدم هذه الدراسة نموذج بروبيت الثنائي للمتغيرات الآلية للتحكم في مشكلة التداخل بين احتمالية نقص الغذاء والأجور، وذلك باستخدام بيانات مقطعية من مسح إطار سوق العمل في السودان عام 2022. ويُستخدم مؤشر نقص الغذاء في الأسرة كمقياس بديل للفقر بين العاملين. وقد وجدت الدراسة أن أكثر من 40% من العمال يعيشون في فقر مدقع. وقدّر النموذج أن زيادة الأجور بنسبة 100% ستخفض احتمالية نقص الغذاء على مستوى الأسرة بنسبة تتراوح بين 50 و60 نقطة مئوية. ينبغي زيادة الأجور ثلاثة أضعاف على الأقل للقضاء على نقص الغذاء الناتج عن نقص المال في الأسر العاملة الفقيرة، وذلك قبل الزيادة اللازمة لتلبية الاحتياجات الأساسية الأخرى، مثل التعليم والصحة والسكن اللائق وغيرها. وهذا يعني أن السودان بحاجة إلى إجراء إعادة هيكلة جوهرية لسوق العمل والأجور للقضاء على الفقر بين العاملين.

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1. Introduction

Household poverty for the population segment with only paid work employment as an asset is a direct outcome of insufficient wages and weak labour market structure, and the relationship between employment and poverty attracted interest in early economic literature (Jansson and Broström, 2021; Lampman, 1965; Squire, 1981). Poor workers have been defined as working individuals who have been employed or self-employed for a certain period of time but still live in poor households (Crettaz and Bonoli, 2011). This phenomenon is denoted as 'in-work poverty', and the related strand of economic research combines individuals' labour market status with welfare and households' standard of living. Working poverty is a complex global challenge in developed and developing countries (Lohmann and Marx, 2018). However, a straightforward way to pull poor households out of poverty is to increase wages and enhance the labour market structure. Therefore, this study quantifies the causal effect of increasing wages on households' propensity to experience extreme poverty.

Considerable research interest in understanding and solving the problem of work poverty in developing countries has emerged. It is essential for employees to maintain a decent standard of living for themselves and their dependents, which can be challenging amidst a weak wage structure. Households living in extreme poverty can experience food insecurity or starvation. This outcome was examined and measured in Sudan in a recent labour market household survey, Sudan Labor Market Panel Survey, SLMPS 2022 (Krafft et al., 2024), in which many workers noted that they were unable to afford regular meals and food for their families **because of a lack of money**. We denote this phenomenon as **household food shortages because of a lack of money**, which is used as a proxy for extreme working poverty status for workers in the sample. This study examines and quantifies the effect of increasing wages on reducing (or eliminating) the prevalence of household food shortages as a consequence of lack of money and subsequent extreme in-work poverty.

Working poverty has attracted substantial attention worldwide in recent years. United Nations International Labour Organisation (ILO) statistics on global working poverty in 2024 reveal that Sudan ranks 21st in the world in terms of countries with a high proportion of extremely poor workers, with approximately 31% of employees in the labour market in extreme in-work poverty. This proportion was measured using an international poverty income threshold of $2.15/day. Low wages are the main drivers of working poverty in the sub-Saharan Africa (SSA) region in general (Amadou and Aronda, 2020; Lohmann and Marx, 2018), particularly in Sudan (Assaad et al., 2023; Krafft et al., 2023).

We use a distinguished cross-sectional household data set from a countrywide Sudan Labour Market Panel Survey (SLMPS 2022) conducted by the Economic Research Forum (ERF) in collaboration with Sudan's Central Bureau of Statistics (CBS). Our analysis focuses on workers in wage-paid jobs in the labour market, constructing a binary variable to identify

workers in extreme poverty who faced food shortages due to lack of money. We then apply a binary regression estimation technique to predict and quantify the causal effect of increased wages on reducing extreme poverty propensity. However, we encounter endogeneity concerns as household food shortage variables and wages could be correlated with unobserved confounders such as capabilities, family background and macroeconomic and political circumstances. This introduces potential omitted variable bias, which could produce inconsistent estimates if endogeneity is ignored and not controlled for. To address this problem, we use the instrumental variable (IV) probit model, which controls for endogeneity and considers the non-linear structure of the model. We also use an inverse-probability weighting causal effect estimator to examine the consequences of working poverty. This study makes a significant contribution to in-work poverty studies in economics. In addition to quantifying the effect of wages on the propensity for extreme in-work poverty, our empirical results provide insightful results demonstrating the causes and constituencies of the phenomenon at the microeconomic level.

The remainder of this paper is organised as follows. The next section presents an overview of Sudan's economy and labour market structure. Section 3 presents a review of the literature on in-work poverty. Section 4 describes the applied micro econometric estimation methods. Sections 5 and 6 present the respective data and model results. Finally, conclusions and recommendations are presented in Section 7.

2. Overview of the Sudanese economy

As in the majority of the least developed countries, particularly in SSA, agriculture and services are the two largest sectors in Sudan's economy, accounting for 84% of its gross domestic product (GDP). Approximately 47.4% of the labour force works in the agricultural sector (Elbadawi et al., 2022). Sudan experienced a period of economic growth between 1999 and 2011, and the real GDP increased from 12 to 65 billion US dollars (USD) (base 2010), which has been associated with Dutch Disease rather than institutional development (Ndip and Lange, 2019; Omer and Maglad, 2021). This period of economic growth was primarily generated by high oil export revenue but ended with the separation of South Sudan as an independent country, accounting for 75% of this revenue and ended the longest war in Africa. During the oil boom period, Sudan experienced poor financial performance, high military expenditure, increased poverty and income inequality (Hessain Yagoob and Zuo, 2016; Omer and Maglad, 2021).

To compensate for the deficit in the balance of payments due to the drop in oil production and revenue, Sudan directed substantial attention towards the gold exploration and mining industry (Chevrillon-Guibert, 2016), which extended the Dutch Disease phenomenon but succeeded in bringing crucial revenue to the Sudanese economy. The share of gold reached

33% of exports by 2017 but with very high annual volatility (Elbadawi and Suliman, 2018). The mining sector in Sudan is highly informal, which increases corruption and illegal mining activities, and has attracted a labour force from many other productive sectors such as agriculture (Elbadawi and Suliman, 2018), resulting in a decline in output from these sectors, particularly the agricultural sector (Ali et al., 2024).

The economic growth generated by oil and gold production has been associated with a resource curse with consequences for different economic sectors (Ali et al., 2024), including the labour market (Ndip and Lange, 2019). After the 2011 separation of South Sudan, corruption increased in the Sudanese economy (Ardigo, 2020; Hessain Yagoob and Zuo, 2016). However, numerous additional factors have contributed to the severity of the country's economic challenges such as the civil war in Darfur and United States' economic sanctions, which ended in 2020 (Wang et al., 2023) and political instability that led to the current civil war on the 15 April 2023 (Assaad et al., 2023).

Additionally, the Sudanese labour market has a broad informal sector, with fewer job opportunities for educated and highly qualified individuals (Assaad et al., 2023) and high inequality in opportunities for women (Ahmed et al., 2020). Nour (2011) demonstrated an increased unemployment rate and inflation between 2000 and 2008, revealing a considerable gender difference in labour market input in urban and rural areas, indicating that major economic reforms are essential. Ndip and Lange (2019) used data spanning 2009–2014, determining that labour market indicators in Sudan improved and 90% of wage workers in the country received wages above the poverty threshold. However, recent labour market data reveal trends and patterns that contradict these results and signal extreme challenges in the country such as widespread working poverty.

Nour (2014) argued that the labour market in Sudan is characterised by weakness and inefficiency due to long-term political instability and civil wars as well as the spread of poverty, unemployment and the country's high debt. Since 2011, Sudan has experienced multiple events that have negatively impacted the national economy and labour market. The first of these events was the separation of South Sudan as an independent country. Second is the long-term civil wars in Darfur and Blue Nile regions. Third is the political instability during and after the removal of the Omar Al-Basher regime (Krafft et al., 2023). Fourth, the COVID-19 pandemic and economic lockdown affected many small businesses and the self-employed (Nour, 2022). Finally, the military coup in October 2021 and its subsequent consequences and the conflict that ended with the current civil war across the whole country on 15 April 2023 (Krafft et al., 2023).

3. In-work poverty

Working poverty is defined as working individuals who live in poor households (Jansson and Broström, 2021). This topic has been well-researched in developed and developing countries with growing interest in recent years (Lohmann and Marx, 2018). A long debate has ensued concerning how in-work poverty should be measured. The first set of measures is based on wage distribution, where a worker is considered to be in a poor household if their per-capita income is below 60% of the country's median disposable income (Crettaz and Bonoli, 2011). The alternative measure uses a poverty line threshold, where a household is considered to be poor if its per-capita income is less than a certain monetary value that is determined either locally using the country's currency or internationally using USD (Jansson and Broström, 2021).

The underlying factors affecting working poverty are low wages and employment benefits and household size and number of dependents (Marx and Nolan, 2014). In developed countries, this phenomenon is related to factors such as single parenthood, low skills and migration (Jansson and Broström, 2021). Increased in-work poverty in developed countries has also been correlated with an expanded service sector as a post-industrial economic phenomenon (Marx and Nolan, 2014). The service sector generates new job opportunities for women, youth and low skilled workers that are more likely to be characterised by low pay and insecurity (Lohmann and Marx, 2018). Additionally, service sector expansion can increase the informal sector in the economy, and informal sector jobs are likely to be mismatched in terms of skills and/or education, subjecting workers to wage loss compared with equivalent workers in the formal sector (Pholphirul et al., 2016).

Hick and Lanau (2018) found that the number of workers in the household is a strong predictor of household poverty in the United Kingdom. Beccaria et al. (2015) argued that family allowances and cash transfers to the working poor are minimally effective in pulling poor workers out of poverty. However, Marx and Nolan (2014) noted that a full-time minimum wage would be insufficient for bringing workers out of employment poverty. Most studies in developed countries have used wage distribution as a measure of poverty.

However, poor countries generally have low wages and income; therefore, a poverty line threshold of $2.15/day is regularly used by researchers and the ILO to measure in-work poverty (Jolliffe et al., 2025; Ferreira et al., 2016). Using this poverty line measure, Sudan ranks 21st in the list of countries with extreme working poverty. However, more than 15 African countries are among the 20 countries above Sudan on the list, indicating that this problem affects labour markets in the majority of the countries on the continent (International Labour Organization, 2024).

Low wages are the main factor driving workers into poverty in developing countries (Lohmann and Marx, 2018). Barrientos and Unnikrishnan (2018) showed that SSA, including Sudan, is among the regions with the highest in-work poverty levels and attribute this to the widespread nature of the agriculture sector (Golub and Hayat, 2015). The large scale of the informal sector in Africa is also considered a main factor in the prevalence of working poverty on the continent (Quak, 2021). SSA suffers from under-employment problems because of a lack of capability to implement structural reforms in the labour market and regulations to adapt to demographic population changes, in addition to the inability to generate adequate job opportunities for new labour market entrants and youth (Adegboye and Arodoye, 2023; Amadou and Aronda, 2020).

In South Africa, Feder and Yu (2020) found that in-work poverty is predominant among low-educated and middle-aged workers and females in the informal sector. In Kenya, Fibaek (2021) determined that large scale farm employment can reduce working poverty if it is balanced with rural development and human capital investment. In contrast, Diao et al. (2017) demonstrated a decline in poverty in Africa that is associated with a reduced share of the labour force in the agricultural sector. Industrialisation of the African agricultural sector has been one of the major factors reducing poverty (McMillan and Zeufack, 2022).

Many studies have investigated the spread of poverty in Sudan in a general sense. Hessain et al. (2016) argued that the primary causes of poverty in Sudan are the government's imbalanced policies concerning rural and urban areas, resulting in wide immigration to urban areas in the past decades, in addition to the wars and conflicts. El Amin (2003) added that the non-productive massive extraction and use of resources in the country in the past decades is one of the causes of poverty. Ardigo (2020) focused on corruption, arguing that the poverty rate in Sudan reached 52% in 2020, with a very high unemployment rate among youth as a consequence of the spread of corruption in public and private sectors. We did not identify any research examining the wage structure in the labour market in Sudan or specifically working poverty among workers.

4. Econometric methods

4.1 Instrumental variable probit model

We use a sample of independent and identically distributed observations of size n indexed by i, where $i = 1,2, \dots, n$. We employ the IV probit model to estimate the causal effect of wages on households' food shortage propensity while simultaneously controlling for endogeneity problems related to the correlation of unobserved confounders. y_i denotes a binary dependent variable that takes a value one if a food shortage because of a lack of money is observed for individual i's household and zero otherwise.

We estimate the conditional probability of an event on a continuous endogenous regressor w_i and a set of covariates, denoted by $\mathbf{x}_i = (x_{1i}, \cdots, x_{Pi})$, a $1 \times P$ vector. Suppose that a vector of $1 \times Q$ IVs $\mathbf{z}_i = (z_1, \cdots, z_Q)$ is available; then, the latent variable structural equation and the reduced-form equation are defined as follows:

$$y_i^* = \mathbf{x}_i^* \boldsymbol{\beta}^* + u_i \quad (1)$$
$$\mathbf{w}_i = \mathbf{z}_i^* \boldsymbol{\Pi} + v_i \,' \quad (2)$$

where $\mathbf{x}_i^* = (1, w_i, \mathbf{x}_i), \mathbf{z}_i^* = (\mathbf{x}_i, \mathbf{z}_i), \boldsymbol{\beta}^* = (\alpha_0, \delta, \boldsymbol{\beta}')'$ and $\boldsymbol{\Pi} = (\boldsymbol{\gamma_1}', \boldsymbol{\gamma_2}')'$. $\boldsymbol{\beta}$ is a $P \times 1$ vector of the coefficients of the covariates of the variables in $\mathbf{x}_i$ of the structural equation. $\boldsymbol{\gamma_1}$ and $\boldsymbol{\gamma_2}$ are $P \times 1$ and $Q \times 1$ vectors of the coefficients of $\mathbf{x}_i$ and $\mathbf{z}_i$ in the reduced-form equation. We obtain the binary y_i variable as follows:

$$y_i = I(y_i^* > 0).$$

The (e_i, v_i) errors in the model are assumed to be independent of $\mathbf{x}_i$ and $\mathbf{z}_i$ and have a bivariate normal distribution with a zero mean and non-zero correlations, $corr(e_i, v_i) = \rho \neq 0$.

The log likelihood for observation i is as follows:

$$\ln L_i = \left[y_{1i} \ln \Phi(m_i) + (1 - y_{1i}) \ln\{1 - \Phi(m_i)\} + \ln \phi \left(\frac{w_i - \mathbf{z}_i^* \boldsymbol{\Pi}}{\sigma} \right) - \ln \sigma \right], \quad (3)$$

where

$$m_i = \frac{\mathbf{x}_i^* \boldsymbol{\beta}^* + \rho (w_i - \mathbf{z}_i^* \boldsymbol{\Pi})/\sigma}{(1-\rho^2)^{\frac{1}{2}}},$$

where σ is the standard division of v_i, $\Phi(\cdot)$ is the standard normal distribution function, $\phi(\cdot)$ is the standard normal density function and $\rho = \frac{1}{2} \ln \left(\frac{1+\rho}{1-\rho} \right)$ and $ln(\sigma)$ are estimated and reported.

4.2 Inverse-probability weighting causal effect estimator

We employ the inverse-probability weighting estimator to determine the causal effect of household food shortages because of a lack of money on a number of outcome variables. In this model, y_i is the treatment variable that has a causal effect on outcome variable o_i. y_i is a dummy variable that equals one if worker i experienced a food shortage in the household during the reference period. The data are non-experimental for each individual, o_i is only observed in one group, either the control (households without food shortage) or treatment (households with food shortage) group. Therefore, the estimation approach applies the

counterfactual outcome method (Wooldridge, 2010). Consider the observed outcome as a function of the counterfactual outcomes of the treatment as follows:

$$o_i = y_i o_i(1) + (1 - y_i) o_i(0), \tag{4}$$

where o_i is the observed outcome, $o_i(1)$ is the potential treatment group outcome and $o_i(0)$ is the potential control group outcome. If an individual is observed in the treatment group ($y_1 = 1$) we observe the potential outcome $o_i(1)$ and vice versa if the individual is observed in the control group. The treatment effect on individual i is obtained using $o_i(1) - o_i(0)$. Therefore, estimating the causal effect requires estimating the counterfactual outcome for each individual in the sample.

Covariates are required to fulfil an assumption called selection on observables or conditional mean independence (Wooldridge, 2010). The causal effect from the sample can be summarised in the form of two quantities. The average treatment effect (ATE) as follows:

$$\tau_{ate} = E[o_i(1) - o_i(0) | \mathbf{x}_i], \tag{5}$$

and the ATE on the treated (ATT) as follows:

$$\tau_{att} = E[o_i(1) - o_i(0) \mid y_i = 1, \mathbf{x}_i]. \tag{6}$$

The conditional mean independence assumption states that potential outcomes are independent of treatment given the following covariates:

$$\big(o_i(0), o_i(1)\big) \perp\!\!\!\perp y_i \mid x_i,$$

and the following overlap assumption is applied:

$$0 < Pr(o_i = 1 \mid \mathbf{x}_i) < 1.$$

This indicates that an individual in the treatment or control group is likely to be observed for any set of values in $\mathbf{x}_i$, and no combination of values in $\mathbf{x}_i$ should provide a definite allocation to any group.

We then estimate the conditional probability of the treatment on $\mathbf{x}_i$ using the probit model, which is denoted as the propensity score to achieve the conditional mean independence assumption in the data and estimate the ATE that is estimated using the following formula:

$$\widehat{\mathrm{ATE}}_{\mathrm{ipw}} = \frac{1}{n}\sum_{i=1}^{n}\left[\frac{y_i o_i}{\hat{r}(\mathbf{x}_i)} - \frac{(1-y_i)o_i}{1-\hat{r}(\mathbf{x}_i)}\right], \tag{7}$$

where $\hat{r}(\mathbf{x}_i) = \widehat{Pr}(y_i = 1 \mid \mathbf{x}_i)$, is the propensity score.

$$\widehat{\text{ATT}}_{\text{att}} = \frac{1}{n_1}\sum_{i:y_i=1} o_i - \frac{1}{n_1}\sum_{i:y_i=0} \frac{\hat{r}(\mathbf{x}_i)}{1-\hat{r}(\mathbf{x}_i)} o_i, \quad (8)$$

where n_1 denotes the number of observations in the sample with $y_i = 1$, and robust standard errors can then be estimated for each estimate.

5. Data

The SLMPS 2022 was conducted by the ERF, a regional economic network in the Middle East and North Africa that is based in Cairo, Egypt, in cooperation with Sudan's CBS. The Centre for Labour Economics (IZA) in Bonn, Germany and the World Bank (WB) funded the survey, which covers many topics, including the labour force, unemployment, education and earnings. Currently, only the first wave was completed, which is the wave we use in this study, and the data are available online at the ERF website. Data collection occurred between June and October 2022, meaning that the interviews were completed about six months prior to the current Sudanese civil war, which began on 15 April 2023.

We select questions that measured household food shortages because of a lack of money. The questions in the SLMPS 2022 were as follows: In the last 12 months, have you ever:

1. Ate only a few kinds of foods because of a lack of money?
2. Skipped a meal because of a lack of money?
3. Run out of food because of a lack of money?

Respondents answered each question either positively (yes) or negatively (no). Food shortage is confirmed if the respondent answered positively to a relevant question. We construct a binary indicator variable for each question to measure the propensity for each food shortage form. The binary variables equal one if food shortage is observed and zero otherwise. These variables are used as dependent binary indicators in the probit model and as treatment variables in causal effect estimators. We use the information from individuals employed in wage-paid jobs in the labour force that are 16 years old or higher, based on the definition of in-work, considering the working poor as workers living in poor households. This study uses working individuals as the unit of analysis rather than households.

Our main covariate in the binary response model is monthly wage, which is constructed using the ERF data on workers' registered hourly wages. The employed respondents in the survey noted their hourly wage rate and the number of hours that they worked, and we calculated monthly wage by multiplying these two variables. Other covariates include workers' demographic variables such as age, number of years of schooling, gender, marital status and job-related variables such as travel time to work, medical insurance and type of

contract. We also include household measures such as the number of household members, whether there are children under five, whether there are household members aged 70 years and older and regional dummies. Education performance is used as an IV as well as job security, a dummy variable that measures whether the worker wants to work additional hours, a dummy variable that measures whether the worker was hired in the job informally and the number of rooms in the household. Exogenous IVs were chosen that have no direct effect working poverty, i.e. their effect is only through the endogenous variable. Additionally, the chosen IVs satisfy the exclusion restriction, which was tested using over-identification restrictions. Table A4 present the OLS regression results of the reduced form model to check for any multicollinearity among the IVs. The table shows that there is no indication of multicollinearity among the instrumental variables in the model. This indicates that the IV are valid to be used in the IV-probit model which will be estimated using the maximum likelihood method.

Observations with missing values on any of the dependent variables, covariates and IVs, those related to unemployed individuals and those not participating in the labour market were excluded from the analysis. The final sample size includes 1833 workers from 1361 households. The dataset only represents individual workers in households with some members working in wage-paid jobs; other households with self-employed members, employers or those running a family business are also excluded because no labour market earnings were reported in the survey.

We then extracted a sub-sample of workers who have started working in their current jobs since 2021 or before from the full sample. The objective of analysing this sub-sample is to examine the prevalence of household food shortages because of the lack of money for workers who were employed throughout the 12-month reference period in the survey questionnaire. Therefore, the lack of money that caused the food shortage is not a consequence of job loss or unemployment. The number of workers in the final sub-sample employed since 2021 or before is 1361 workers from 1136 households.

Table 1 presents the descriptive statistics of the food shortage indicators, revealing that approximately 42% of the individuals ate a few kinds of food because of a lack of money, 34% had to skip meals and almost 29% of individuals ran out of food in the household because of a lack of money. The summary statistics demonstrate that the phenomenon spreads at a staggered rate across workers in the Sudanese labour market. The proportions are also high in the sub-sample of workers in employment since 2021. The proportions demonstrate an extreme poverty problem among workers in the labour market because of low wages.

The descriptive statistics in Table 1 reveal that an average of six household members, and workers' average age is 38 years in the sample of all workers and 39 in the sub-sample of

workers employed since 2021 or before. Males make up the majority of the sample, at 79%. The average log monthly wage in the last row of Table 1 is 10.88 for all workers and 11.02 for the sample of workers employed since 2021. This is equivalent to 53103.6 and 61697.6 Sudanese pounds (SDG) per month for the sample of all workers and the sample of workers employed since 2021, respectively. This demonstrates an average monthly wage of less than $150 per month in both samples based on the local currency exchange rate during the survey data collection period. Considering the average number of household members in the first row, households' per-capita share of wages is less than $1 per day. This indicates extreme poverty status for the majority of households in the sample, which more likely drives food shortages that are observed for most families.

Table (1): Descriptive statistics

Type of food shortage	**Full sample**		**Workers employed since 2021 or before**	
	Mean	SD	Mean	SD
Ate only a few kinds of foods	0.416	0.493	0.386	0.487
Had to skip a meal	0.344	0.475	0.314	0.464
Ran out of food	0.291	0.454	0.265	0.441
Covariate				
Monthly wage	10.88	1.735	11.02	1.559
Household size	5.817	2.578	5.699	2.489
Age	38.12	13.83	39.27	13.55
Schooling years	7.125	5.389	7.230	5.466
Travel time to work	33.20	43.86	33.13	38.38
Hours of work per week	47.23	26.74	49.11	25.73
Male	0.786	0.410	0.791	0.407
Rural	0.406	0.491	0.387	0.487
Public sector	0.283	0.451	0.324	0.468
Medical insurance	0.233	0.423	0.271	0.445
Job requires skills	0.279	0.449	0.313	0.464
Head of household	0.588	0.492	0.616	0.487
Spouse of the head of household	0.087	0.282	0.092	0.289
Son/daughter of the head of household	0.265	0.441	0.240	0.427
Never married	0.306	0.461	0.278	0.448
Married	0.630	0.483	0.659	0.474
Under 5 child(ren)	0.488	0.500	0.486	0.500
Over 70 elder(s)	0.133	0.340	0.131	0.337
n	1833		1361	

6. Results

We perform two binary regression model specifications for each sample. First, we use a binary probit model without controlling for endogeneity. Second, we employ a structural binary probit model that controls for endogeneity in the log wage variable. The average marginal effects of the probit models are presented in Appendix Table A.1. The coefficients represent the change in conditional probability when the relevant covariate changes, whereas the other covariates remain fixed. At the bottom of the table, we present the chi-squared (chi^2) statistic for the Wald test of exogeneity, demonstrating that the exogeneity assumption is rejected in all models with high significance. This indicates that an endogeneity problem is present in the probit model. Appendix Tables A.2 to A.3 in presents the coefficients of the first- and second-stage regressions. The dependent variables in each model are Model 1, ate only a few kinds of foods, Model 2, had to skip a meal and Model 3, ran out of food. The coefficient of log wage is highly significant for all models in the full sample and sub-sample. The last two rows present Amemiya–Lee–Newey minimum chi^2 statistics for the over-identification test and its associated p-value (Lung-Fei, 1992). . All models satisfy the exclusion restrictions and the null hypothesis test of the over-identification test is accepted for all models.

The marginal effects in Table 2 range between −40% and −60%, indicating a decreased propensity for household food shortages for a 100% increase in wages. The effect of the dummy variable that measures whether a job requires skills become stronger in the IV model. Workers living in households with food shortages generally have larger households. Workers in the public sector have an approximately 16%–23% lower propensity to be from households with food shortage problems. All models indicate that households with children under five or elderly members do not impact the propensity for food shortage. The models demonstrate that low wage is the main driver of working poverty. After correcting for endogeneity concerns, many factors become insignificant. This also indicates that increased wages and their structure is a direct way out of food shortages and the major significant factor that can genuinely reduce or eliminate in-work poverty among employees. The results also reveal that gender has a significant effect on the phenomenon, and other factors are more related to job characteristics than personal or household characteristics.

Before controlling for endogeneity, the probit model implies that monthly wage is insignificant while education is significant and lowers working poverty. In contrast, the IV probit model demonstrates that education is insignificant and increased monthly wage reduces working poverty. This result is consistent with our argument that in-work poverty is a problem that is primarily generated by low pay and wage structures in Sudan's labour market.

Table (2): Marginal effects of the IV probit model

Variables	Full sample			Workers employed before 2021		
	Model 1	**Model 2**	**Model 3**	**Model 1**	**Model 2**	**Model 3**
Monthly wage	−0.579*** (0.188)	−0.605*** (0.201)	−0.511*** (0.169)	−0.498*** (0.155)	−0.481*** (0.155)	−0.403*** (0.127)
Household size	0.102* (0.057)	0.115* (0.059)	0.073 (0.051)	0.097* (0.055)	0.127** (0.053)	0.091* (0.046)
Age	−0.040 (0.117)	−0.001 (0.119)	−0.035 (0.103)	−0.018 (0.112)	−0.024 (0.106)	−0.035 (0.092)
Schooling years	0.011 (0.040)	0.027 (0.042)	0.005 (0.035)	0.003 (0.035)	0.017 (0.034)	−0.001 (0.029)
Travel time to work	0.056* (0.031)	0.085*** (0.032)	0.053* (0.027)	0.059** (0.027)	0.076*** (0.026)	0.045** (0.022)
Rented house	−0.096 (0.086)	−0.083 (0.088)	−0.045 (0.075)	−0.088 (0.083)	−0.063 (0.082)	−0.055 (0.068)
Male	0.195** (0.087)	0.196** (0.082)	0.192*** (0.065)	0.133 (0.084)	0.144* (0.075)	0.146** (0.060)
Rural	0.007 (0.058)	−0.017 (0.058)	−0.001 (0.050)	0.081 (0.053)	0.065 (0.050)	0.070 (0.044)
Public sector	−0.203** (0.083)	−0.226*** (0.077)	−0.167** (0.071)	−0.224*** (0.082)	−0.234*** (0.073)	−0.171** (0.068)
Medical insurance	0.053 (0.082)	0.037 (0.086)	0.007 (0.075)	0.044 (0.084)	0.020 (0.083)	0.015 (0.073)
Job requires skills	0.134** (0.068)	0.177** (0.071)	0.164** (0.064)	0.123* (0.067)	0.168*** (0.065)	0.145** (0.058)
Head of household	0.074 (0.138)	0.116 (0.133)	0.072 (0.119)	0.076 (0.139)	0.136 (0.117)	0.076 (0.107)
Spouse of the head of household	−0.118 (0.145)	−0.018 (0.157)	−0.077 (0.121)	−0.111 (0.144)	0.033 (0.148)	−0.057 (0.113)
Son/daughter of the head of household	0.101 (0.115)	0.149 (0.120)	0.141 (0.105)	0.169 (0.131)	0.175 (0.129)	0.177 (0.113)
Never married	−0.001 (0.143)	0.054 (0.146)	−0.094 (0.112)	−0.002 (0.122)	0.040 (0.114)	−0.128 (0.083)
Married	0.092 (0.114)	0.128 (0.109)	0.040 (0.103)	0.084 (0.097)	0.087 (0.090)	0.001 (0.086)
Under 5 child(ren)	−0.045 (0.066)	−0.051 (0.068)	−0.013 (0.058)	−0.073 (0.067)	−0.092 (0.065)	−0.035 (0.056)
Over 70 elder(s)	−0.038 (0.074)	−0.002 (0.075)	0.029 (0.067)	−0.065 (0.077)	−0.013 (0.074)	0.031 (0.068)
Regional dummy coefficients are not reported for brevity						
Log likelihood	−4606	−4540	−4466	−3251	−3187	−3229
Exogeneity test Chi-squared	34.10	35.23	32.18	31.44	29.90	29.64
Exogeneity test p-value	0.000	0.000	0.000	0.000	0.000	0.000
Overidentifying restrictions [chi²(5)]	0.79	1.32	1.18	2.44	3.07	1.70
Overidentifying restrictions (p-value)	0.939	0.858	0.881	0.654	0.547	0.792
n	1833			1361		

Note: Delta method standard errors are in parentheses, based on robust variance–covariance matrix. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table 3 presents the estimated causal effect of household food shortages on the six outcome variables. We use the covariates set in the probit model above to reach the conditional mean independence assumption but did not include the log wage in the causal effect model. Two additional covariates (the number of hours worked per week and firm size dummies) are added to the propensity score regression. The bottom rows in Table 3 present the test results for the balance of covariates between treatment and control groups. The results reveal that the covariates are appropriately balanced between the groups.

We examine the causal effect of household food shortage because of lack of money on six outcome variables, encompassing whether any of the children was absent from school during the weeks before the interview; whether the household borrowed food from relatives, friends or neighbours; whether the household received aid from the government or a national/international organisation in the past 12 months; the number of months that this aid was received; whether the worker has wishes to work more; and whether the household has difficulty accessing regular health care services.

The causal effect of household food shortages on the propensity of children to miss school is positive at a 3.5% level but significant at the margin. The probability of borrowing food from friends, neighbours or relatives rises by 32%–40%, but the probability of receiving aid from the government or national/international organisations only increases by 9%–10%. The duration of receiving aid is approximately half a month longer for households with food shortages, which is an extremely short period of time. Workers in poverty have approximately 8%–11% more desire to work more hours than they actually do. Additionally, households in extreme poverty have 9%–13% more difficulty in accessing regular health services. The ATE and ATT estimates are consistent in the full sample and the sub-sample, with minor differences.

Table (3): Causal effects estimates

Variables		Full sample			Workers employed before 2021		
		Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
School absent	**ATE**	0.035^{**} (0.015)	0.013 (0.015)	0.030^{*} (0.017)	0.042^{**} (0.018)	0.024 (0.018)	0.031 (0.021)
	ATTT	0.045^{**} (0.018)	0.033^{*} (0.019)	0.037^{*} (0.021)	0.054^{**} (0.021)	0.047^{**} (0.023)	0.029 (0.026)
Borrow food	**ATE**	0.322^{***} (0.021)	0.336^{***} (0.024)	0.394^{***} (0.026)	0.335^{***} (0.025)	0.351^{***} (0.029)	0.402^{***} (0.031)
	ATTT	0.319^{***} (0.022)	0.322^{***} (0.024)	0.369^{***} (0.027)	0.327^{***} (0.026)	0.340^{***} (0.029)	0.383^{***} (0.032)
Receive aid	**ATE**	0.097^{***} (0.019)	0.094^{***} (0.021)	0.104^{***} (0.023)	0.094^{***} (0.022)	0.090^{***} (0.025)	0.096^{***} (0.026)

Variables		Full sample			Workers employed before 2021		
		Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
	ATTT	0.106*** (0.020)	0.089*** (0.022)	0.098*** (0.023)	0.105*** (0.023)	0.089*** (0.025)	0.105*** (0.027)
Duration of aid	ATE	0.481*** (0.158)	0.517*** (0.173)	0.618*** (0.194)	0.551*** (0.190)	0.598*** (0.211)	0.694*** (0.235)
	ATTT	0.503*** (0.155)	0.494*** (0.168)	0.563*** (0.178)	0.620*** (0.187)	0.646*** (0.205)	0.744*** (0.219)
Work more	ATE	0.116*** (0.020)	0.084*** (0.022)	0.085*** (0.024)	0.107*** (0.024)	0.077*** (0.027)	0.076*** (0.028)
	ATTT	0.109*** (0.021)	0.079*** (0.022)	0.077*** (0.023)	0.099*** (0.024)	0.072*** (0.025)	0.069** (0.028)
Health care access	ATE	0.095*** (0.020)	0.126*** (0.022)	0.075*** (0.023)	0.103*** (0.023)	0.137*** (0.026)	0.095*** (0.028)
	ATTT	0.087*** (0.021)	0.123*** (0.022)	0.053** (0.024)	0.105*** (0.024)	0.142*** (0.026)	0.067** (0.028)
Balance test	Chi^2	15.40	25.29	21.62	16.60	27.83	17.98
	p-value	0.908	0.390	0.602	0.865	0.267	0.804
	n	1833			1361		

Note: Robust standard errors are in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

7. Conclusion and recommendations

This study analyses the factors that cause working poverty among employees in the Sudanese labour market using 2022 SLMPS data. In-work poverty is measured using dummy variables indicating households that have ever faced different forms of food shortage because of a lack of money during a 12-month reference period prior to the date of interviews. This indicator identifies households in extreme working poverty, referring to workers who are unable to feed their families adequate food and regular meals every day. Accordingly, we investigated a crucial problem and approached it from a sensitive angle.

This study quantifies the effect of increased wages on the propensity for household food shortages due to a lack of money. Notably, wages and food shortage propensity are both affected by unobserved confounders, which introduces omitted variable bias into the model. Therefore, we employ an IV probit model using the maximum likelihood method. We also examine the causal effect of working poverty on a number of outcomes using the inverse-probability weighting ATE estimator. The causal effect analysis provides insights into the consequences of in-work poverty on households and workers' labour market supply. The results from the IV probit regression confirm that working poverty is correlated with insufficient wages; therefore, wages must be increased approximately threefold to eliminate this problem among extremely poor workers. Although the propensity for food shortages

due to lack of money is higher for large households, it has a sharp tendency to decrease with increased wages. The workers in the sub-sample that was employed throughout the reference period experienced the same prevalence of in-work poverty phenomena. This study demonstrates that working poverty is a genuine economic problem in Sudan's labour market and not only relevant to unemployment or job loss.

Due to the large scale of the informal sector in the Sudanese economy, it would be relevant to support this sector and organise its activities. Exclusive focus on the formal sector would be inadequate because it must be backed by an efficient education system, which has been disrupted by continuous conflicts in the country. Informal economic activities can be supported but restricted to service and agricultural activities and denied for major natural resource sectors such as the gold mining industry. Policies must be designed to reverse the Dutch Disease phenomenon that has damaged the country's economic institutions and communities in the past two decades.

The civil war that was reignited in Sudan in 2023 destroyed the nation's infrastructure and business sector, resulting in reduced employment opportunities and labour market size. This has increased the spread of working poverty among the workers in the labour market. According to the WB statistics, the GDP growth rate was 29.4% in 2023 and 13.4% in 2024. Sudan's economy lost substantial production capacity due to this war. Ahmed et al. (2025) estimated that the national poverty rate would increase by 19%, suggesting that Sudan should prioritise restoring economic productivity and employment recovery strategies. The war generated the largest population displacement and migration scale in the history of Sudan, pushing millions of workers out of their homes and jobs, further expanding the informal sector and reducing welfare and adequate labour market wage structure.

The stock of human capital in Sudan is at risk of diminishing in quality and size. This issue requires deeper investigations with focused studies and surveys. Sudan must implement deep reforms to its labour market wage structure and policies, which are as significant as bringing peace and stability to the country. Wages have reached this level due to the ongoing power conflict in the country, political instability and economically inefficient policies and resource management.

References

Adegboye, A. C., & Arodoye, N. L. (2023). Structural changes and employment growth in sub-saharan africa: Does demographic structure matter? Journal of Economic Development, 48(2).

Ahmed, H. M. M., Osman, E. A. M., & Mahran, H. A. (2020). Inequality of opportunity in the labor market: Evidence from sudan. Journal of Social Science Studies, 7(2), 38–56.

Ahmed, M., Raouf, M., & Siddig, K. (2025). What Are the Economic and Poverty Implications for Sudan If the Conflict Continues Through 2025?. The Journal of Development Studies, 1-22.

Ali, S., Murshed, S. M., & Papyrakis, E. (2024). The socio-economic impact of an abrupt loss of oil: A synthetic control approach in the case of sudan. Journal of Asian and African Studies, 00219096241249981.

Amadou, A., & Aronda, T. (2020). Structural transformation in sub-saharan africa: A comparative analysis of sub-regions performances. African Journal of Economic and Management Studies, 11(2), 233–252.

Ardigo, I. A. (2020). Sudan: Overview of corruption and anti-corruption. U4 Anti-Corruption Resource Centre and Transparency International, 22.

Assaad, R., Krafft, C., & Wahby, S. (2023). Labor market dynamics in sudan through political upheaval and pandemic. Economic Research Forum Working Paper Series (Forthcoming).

Barrientos, A., & Unnikrishnan, V. (2018). In-work poverty and social assistance in developing countries. In Handbook on in-work poverty (pp. 347–364). Edward Elgar Publishing.

Beccaria, L., Maurizio, R., Vázquez, G., & Espro, M. (2015). Factors associated with poverty and indigence mobility in five latin american countries. In Measurement of poverty, deprivation, and economic mobility (Vol. 23, pp. 71–107). Emerald Group Publishing Limited.

Chevrillon-Guibert, R. (2016). The gold boom in sudan. Challenges and opportunities for national players. International Development Policy| Revue Internationale de Politique de développement, 7.1.

Crettaz, E., & Bonoli, G. (2011). Worlds of working poverty: National variations in mechanisms. In Working poverty in europe: A comparative approach (pp. 46–69). Springer.

Diao, X., Harttgen, K., & McMillan, M. (2017). The changing structure of africa's economies. The World Bank Economic Review, 31(2), 412–433.

El Amin, K. A. (2003). Poverty causes in sudan: Some economic and political aspects 1990-2000. Economic Research Forum Working Papers.

Elbadawi, I., Elbashir, A., Osman, A., Elobaid, A. H., Eltahir, E., & Alhelo, A. (2022). Sudan's challenges and opportunities: A renaissance project for sudan: From poor agriculture to agro-industrial growth and sustainable development. Economic Research Forum Working Papers.

Elbadawi, I., & Suliman, K. M. (2018). The macroeconomics of the gold economy in sudan. Economic Research Forum Working Paper Series No, 1203.

Feder, J., & Yu, D. (2020). Employed yet poor: Low-wage employment and working poverty in south africa. Development Southern Africa, 37(3), 363–381.

Ferreira, F. H., Chen, S., Dabalen, A., Dikhanov, Y., Hamadeh, N., Jolliffe, D., ... & Yoshida, N. (2016). A global count of the extreme poor in 2012: data issues, methodology and initial results. The Journal of Economic Inequality, 14(2), 141-172.

Fibaek, M. M. (2021). Working poor? A study of rural workers' economic welfare in kenya. Journal of International Development, 33(1), 41–69.

Golub, S., & Hayat, F. (2015). Employment, unemployment, and underemployment in africa. The Oxford Handbook of Africa and Economics, 1, 136–153.

Hessain Yagoob, A., & Zuo, T. (2016). Patterns of economic growth and poverty in sudan. Journal of Economics and Sustainable Development, 7(2).

Hick, R., & Lanau, A. (2018). Moving in and out of in-work poverty in the UK: An analysis of transitions, trajectories and trigger events. Journal of Social Policy, 47(4), 661–682.

International Labour Organization. (2024, November). Statistics on working poverty. ILOSTAT. https://ilostat.ilo.org/topics/working-poverty/#elementor-toc__heading-anchor-3

Jansson, B., & Broström, L. (2021). Who is counted as in-work poor? Testing five different definitions when measuring in-work poverty in sweden 1987–2017. International Journal of Social Economics, 48(3), 477–491.

Jolliffe, D., Mahler, D. G., Lakner, C., Atamanov, A., & Tetteh-Baah, S. K. (2025). Poverty and prices: Assessing the impact of the 2017 PPPs on the international poverty line and global poverty. The World Bank Economic Review, 39(3), 497-521.

Krafft, C., Asaad, R., Cortes-Mendosa, A., & Honzay, I. (2023). The structure of the labor force and employment in sudan.

Krafft, C., Assaad, R., & Cheung, R. (2024). Introducing the Sudan Labor Market Panel Survey 2022. Demographic Research, 51, 81-106.

Lampman, R. J. (1965). Approaches to the reduction of poverty. The American Economic Review, 55(1/2), 521–529.

Lohmann, H., & Marx, I. (2018). Handbook on in-work poverty. Edward Elgar Publishing.

Lung-Fei, L. (1992). Amemiya's generalized least squares and tests of overidentification in simultaneous equation models with qualitative or limited dependent variables. Econometric reviews, 11(3), 319-328.

Marx, I., & Nolan, B. (2014). In-work poverty. Reconciling Work and Poverty Reduction: How Successful Are European Welfare States, 131–157.

McMillan, M., & Zeufack, A. (2022). Labor productivity growth and industrialization in africa. Journal of Economic Perspectives, 36(1), 3–32.

Ndip, A. E., & Lange, S. (2019). The labor market and poverty in sudan. The World Bank Group.

Nour, S. M. (2014). Structure of labour market and unemployment in sudan. 305–338.

Nour, S. S. O. M. (2011). Labour market and unemployment in sudan. Available at SSRN 1949171.

Nour, S. S. O. M. (2022). The impact of covid-19 on the MENA labor market: The case of sudan. ERF Policy Brief No, 87.

Omer, O. E., & Maglad, N. E. (2021). Income inequality and middle class in sudan: Some statistical facts 1996-2011. Magallat Al-Tanmiyat Wa-Al-Siyasat Al-Iqtisadiyyat, 23(1), 29–49.

Pholphirul, P., Khong-ngern, D., & Thowladda, K. (2016). Educational mismatches and labor market outcomes. Development economic review, 10(2), 118-118.

Quak, E. (2021). The link between demography and labour markets in sub-saharan africa. K4D Helpdesk Report, Brighton: Institute of Development Studies.

Squire, L. (1981). Employment policy in developing countries: A survey of issues and evidence. Population and Development Review, 10(1), 148.

Wang, Y., Alfakiali, A. Y., & Niu, Y. (2023). Why sanctions termination doesn't put an end to humanitarian crises: The case of sudan. Journal of Asian and African Studies, 00219096231192319.

Wooldridge, J. M. (2010). Econometric analysis of cross section and panel data, second edition. MIT Press.

Appendix

Table (A1): Marginal effects of the probit model

	Full-sample			Workers employed before 2021		
	Model 1	**Model 2**	**Model 3**	**Model 1**	**Model 2**	**Model 3**
Monthly Wage	-0.003 (0.006)	-0.006 (0.006)	-0.010^{*} (0.006)	-0.003 (0.008)	-0.006 (0.008)	-0.004 (0.007)
Household size	0.103^{***} (0.026)	0.117^{***} (0.025)	0.075^{***} (0.024)	0.077^{***} (0.030)	0.105^{***} (0.028)	0.074^{***} (0.027)
Age	-0.121^{***} (0.044)	-0.086^{**} (0.044)	-0.107^{***} (0.041)	-0.102^{**} (0.050)	-0.106^{**} (0.049)	-0.105^{**} (0.046)
Schooling years	-0.061^{***} (0.012)	-0.047^{***} (0.011)	-0.057^{***} (0.011)	-0.061^{***} (0.014)	-0.043^{***} (0.013)	-0.052^{***} (0.012)
Travel time to work	0.014 (0.010)	0.041^{***} (0.010)	0.017^{*} (0.009)	0.027^{**} (0.012)	0.046^{***} (0.011)	0.020^{**} (0.010)
Rented house	-0.014 (0.034)	0.001 (0.033)	0.030 (0.032)	-0.020 (0.040)	0.004 (0.038)	0.002 (0.036)
Male	-0.057 (0.038)	-0.058 (0.036)	-0.010 (0.034)	-0.074 (0.046)	-0.047 (0.043)	-0.008 (0.040)
Rural	0.064^{***} (0.024)	0.043^{*} (0.023)	0.049^{**} (0.022)	0.088^{***} (0.028)	0.074^{***} (0.026)	0.078^{***} (0.025)
Public sector	-0.040 (0.035)	-0.064^{*} (0.034)	-0.027 (0.033)	-0.036 (0.039)	-0.060 (0.038)	-0.021 (0.036)
Medical insurance	0.019 (0.037)	-0.001 (0.037)	-0.028 (0.035)	0.035 (0.041)	0.009 (0.040)	0.003 (0.039)
Job requires skills	0.023 (0.026)	0.058^{**} (0.025)	0.063^{***} (0.024)	0.023 (0.028)	0.067^{**} (0.028)	0.059^{**} (0.026)
Head of HH	-0.063 (0.059)	-0.018 (0.057)	-0.041 (0.054)	-0.071 (0.071)	0.006 (0.064)	-0.034 (0.063)
Spouse of the Head of HH	-0.165^{**} (0.065)	-0.066 (0.066)	-0.111^{*} (0.057)	-0.197^{***} (0.069)	-0.057 (0.076)	-0.120^{**} (0.061)
Son/daughter of the Head of HH	-0.020 (0.048)	0.022 (0.047)	0.033 (0.045)	-0.044 (0.057)	-0.030 (0.053)	0.002 (0.052)
Never married	-0.111^{*} (0.059)	-0.062 (0.058)	-0.172^{***} (0.046)	-0.046 (0.073)	-0.001 (0.071)	-0.151^{***} (0.053)
Married	-0.062 (0.053)	-0.030 (0.051)	-0.095^{*} (0.049)	-0.015 (0.062)	-0.010 (0.058)	-0.081 (0.056)
Under 5 child(ren)	0.009 (0.027)	0.006 (0.027)	0.035 (0.025)	0.010 (0.032)	-0.013 (0.030)	0.032 (0.029)
Over 70 elder(s)	-0.003 (0.034)	0.035 (0.034)	0.058^{*} (0.032)	0.008 (0.039)	0.058 (0.040)	0.090^{**} (0.039)
Reginal marginal effects are not shown for brevity						
Log Like	-1098	-1036	-955.4	-798.8	-735.0	-672.2
Pseudo R^2	0.118	0.122	0.136	0.120	0.133	0.145
Chi-square	220.3	225.6	244.1	164.3	162.1	169.7
p-value (chi2)	0.000	0.000	0.000	0.000	0.000	0.000
$\boldsymbol{n}$	1833			1361		

Delta method standard errors in parentheses, based on robust variance-covariance matrix.

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table (A2): First stage regression in the IV probit model

	Full-sample			Workers employed before 2021		
	Model 1	**Model 2**	**Model 3**	**Model 1**	**Model 2**	**Model 3**
Household size	-0.040 (0.093)	-0.044 (0.093)	-0.044 (0.093)	-0.023 (0.098)	-0.014 (0.098)	-0.018 (0.098)
Age	0.080 (0.180)	0.081 (0.180)	0.079 (0.180)	0.099 (0.194)	0.109 (0.194)	0.102 (0.194)
Schooling years	0.098* (0.050)	0.099** (0.050)	0.099** (0.050)	0.099* (0.052)	0.098* (0.052)	0.100* (0.052)
Travel time to work	0.076* (0.041)	0.077* (0.041)	0.077* (0.041)	0.069* (0.042)	0.068 (0.042)	0.069* (0.042)
Rented house	-0.122 (0.141)	-0.120 (0.142)	-0.120 (0.142)	-0.105 (0.159)	-0.113 (0.159)	-0.108 (0.159)
Male	0.509*** (0.122)	0.505*** (0.122)	0.506*** (0.123)	0.483*** (0.111)	0.490*** (0.111)	0.486*** (0.111)
Rural	-0.054 (0.085)	-0.053 (0.086)	-0.053 (0.086)	0.046 (0.091)	0.042 (0.091)	0.044 (0.090)
Public sector	-0.338*** (0.115)	-0.333*** (0.115)	-0.330*** (0.115)	-0.440*** (0.128)	-0.438*** (0.128)	-0.434*** (0.128)
Medical insurance	0.022 (0.124)	0.026 (0.124)	0.027 (0.124)	-0.028 (0.140)	-0.024 (0.140)	-0.024 (0.140)
Job requires skills	0.197** (0.094)	0.195** (0.094)	0.197** (0.094)	0.205** (0.097)	0.201** (0.097)	0.205** (0.097)
Head of HH	0.308 (0.208)	0.311 (0.208)	0.313 (0.208)	0.389 (0.240)	0.386 (0.240)	0.394 (0.240)
Spouse of the Head of HH	0.134 (0.238)	0.136 (0.238)	0.137 (0.238)	0.259 (0.260)	0.259 (0.260)	0.266 (0.261)
Son/daughter of the Head of HH	0.218 (0.158)	0.221 (0.158)	0.223 (0.159)	0.454** (0.195)	0.455** (0.195)	0.460** (0.195)
Never married	0.170 (0.213)	0.170 (0.214)	0.169 (0.214)	0.055 (0.188)	0.047 (0.188)	0.049 (0.189)
Married	0.208 (0.163)	0.210 (0.163)	0.210 (0.163)	0.133 (0.153)	0.126 (0.153)	0.129 (0.153)
Under 5 child(ren)	-0.079 (0.102)	-0.077 (0.102)	-0.078 (0.102)	-0.145 (0.112)	-0.152 (0.111)	-0.150 (0.111)
Over 70 elder(s)	-0.060 (0.117)	-0.062 (0.117)	-0.060 (0.117)	-0.152 (0.132)	-0.152 (0.132)	-0.150 (0.132)
Reginal coefficients are not shown for brevity						
Graduation grade good of higher	0.180** (0.078)	0.170** (0.076)	0.173** (0.080)	0.181** (0.083)	0.230*** (0.082)	0.198** (0.085)
Satisfied with work security	-0.245*** (0.081)	-0.242*** (0.081)	-0.239*** (0.082)	-0.317*** (0.100)	-0.325*** (0.102)	-0.336*** (0.102)
Desired hours of additional work	-0.006 (0.004)	-0.004 (0.004)	-0.006 (0.004)	-0.005 (0.005)	-0.003 (0.004)	-0.005 (0.005)
Informal job search	-0.080* (0.042)	-0.054 (0.039)	-0.041 (0.042)	-0.057 (0.046)	-0.027 (0.046)	-0.006 (0.050)
Number of rooms in HH	0.063*** (0.022)	0.067*** (0.022)	0.068*** (0.023)	0.082*** (0.026)	0.072*** (0.027)	0.077*** (0.026)

	Full-sample			Workers employed before 2021		
	Model 1	**Model 2**	**Model 3**	**Model 1**	**Model 2**	**Model 3**
Intercept	9.661*** (0.731)	9.629*** (0.732)	9.622*** (0.732)	9.599*** (0.791)	9.566*** (0.792)	9.564*** (0.792)
Log Like	-4606	-4540	-4466	-3251	-3187	-3229
Chi-square	34.10	35.23	32.18	31.44	29.90	29.64
p-value (chi2)	0.000	0.000	0.000	0.000	0.000	0.000

Robust standard errors in parentheses.
$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table (A3): Second stage coefficients of the instrumental variables probit model

	Full-sample			Workers employed before 2021		
	Model 1	**Model 2**	**Model 3**	**Model 1**	**Model 2**	**Model 3**
Monthly Wage	-0.567*** (0.029)	-0.576*** (0.027)	-0.576*** (0.028)	-0.611*** (0.044)	-0.620*** (0.042)	-0.612*** (0.044)
Household size	0.100 (0.063)	0.110* (0.065)	0.082 (0.062)	0.120* (0.069)	0.163** (0.075)	0.137* (0.074)
Age	-0.039 (0.118)	-0.001 (0.113)	-0.039 (0.120)	-0.022 (0.138)	-0.030 (0.139)	-0.054 (0.144)
Schooling years	0.011 (0.037)	0.026 (0.035)	0.006 (0.038)	0.004 (0.042)	0.022 (0.041)	-0.002 (0.044)
Travel time to work	0.055** (0.025)	0.081*** (0.026)	0.060** (0.025)	0.072** (0.029)	0.098*** (0.031)	0.068** (0.030)
Rented house	-0.097 (0.087)	-0.083 (0.088)	-0.052 (0.087)	-0.112 (0.107)	-0.084 (0.110)	-0.087 (0.109)
Male	0.207*** (0.077)	0.211*** (0.076)	0.255*** (0.077)	0.172* (0.094)	0.203** (0.091)	0.251*** (0.094)
Rural	0.006 (0.057)	-0.016 (0.054)	-0.001 (0.056)	0.098 (0.068)	0.082 (0.067)	0.105 (0.070)
Public sector	-0.206*** (0.075)	-0.234*** (0.077)	-0.203*** (0.078)	-0.290*** (0.095)	-0.331*** (0.097)	-0.283*** (0.101)
Medical insurance	0.052 (0.082)	0.035 (0.082)	0.008 (0.084)	0.053 (0.106)	0.025 (0.107)	0.023 (0.110)
Job requires skills	0.133** (0.059)	0.168*** (0.060)	0.181*** (0.061)	0.152** (0.070)	0.215*** (0.070)	0.214*** (0.071)
Head of HH	0.073 (0.135)	0.115 (0.131)	0.083 (0.134)	0.096 (0.173)	0.185 (0.162)	0.119 (0.164)
Spouse of the Head of HH	-0.119 (0.159)	-0.017 (0.153)	-0.091 (0.159)	-0.142 (0.203)	0.042 (0.184)	-0.091 (0.195)
Son/daughter of the Head of HH	0.098 (0.103)	0.138 (0.102)	0.153 (0.103)	0.205 (0.142)	0.218 (0.140)	0.257* (0.139)
Never married	-0.001 (0.140)	0.051 (0.132)	-0.110 (0.153)	-0.003 (0.150)	0.051 (0.142)	-0.210 (0.168)
Married	0.093 (0.109)	0.128 (0.105)	0.046 (0.114)	0.106 (0.121)	0.116 (0.118)	0.002 (0.131)
Under 5 child(ren)	-0.045 (0.063)	-0.049 (0.063)	-0.014 (0.065)	-0.091 (0.078)	-0.121 (0.077)	-0.053 (0.081)
Over 70 elder(s)	-0.038 (0.072)	-0.001 (0.071)	0.032 (0.076)	-0.081 (0.094)	-0.017 (0.095)	0.046 (0.105)
Reginal coefficients are not shown for brevity						
Intercept	5.935*** (0.493)	5.592*** (0.493)	5.904*** (0.498)	6.316*** (0.619)	6.016*** (0.628)	6.245*** (0.630)
$atanh(\rho)$	1.788*** (0.306)	1.891*** (0.319)	1.797*** (0.317)	1.574*** (0.281)	1.623*** (0.297)	1.546*** (0.284)
$log(\sigma^2)$	0.511*** (0.036)	0.511*** (0.036)	0.511*** (0.036)	0.402*** (0.044)	0.402*** (0.044)	0.402*** (0.044)
Log Like	-4606	-4540	-4466	-3251	-3187	-3229
Exogeneity test Chi-squared	34.10	35.23	32.18	31.44	29.90	29.64

	Full-sample			Workers employed before 2021		
	Model 1	**Model 2**	**Model 3**	**Model 1**	**Model 2**	**Model 3**
Exogeneity test p-value	0.000	0.000	0.000	0.000	0.000	0.000
Overidentifying restrictions [chi^2(5)]	0.79	1.32	1.18	2.44	3.07	1.70
Overidentifying restrictions (p-value)	0.939	0.858	0.881	0.654	0.547	0.792
n	1833			1361		

Robust standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table (A4): First stage OLS regression for IV variables multicollinearity check

	Full-sample		Workers employed before 2021	
	Coef.	**VIF**	**Coef.**	**VIF**
Household size	-0.027 (0.099)	1.505	-0.023 (0.104)	1.480
Age	0.079 (0.167)	2.471	0.086 (0.175)	2.286
Schooling years	0.102** (0.047)	1.570	0.111** (0.049)	1.583
Travel time to work	0.077** (0.038)	1.059	0.070* (0.040)	1.069
Rented house	0.127 (0.129)	1.110	-0.098 (0.137)	1.094
Male	0.510*** (0.139)	2.103	0.472*** (0.152)	2.293
Rural	-0.060 (0.089)	1.228	0.043 (0.094)	1.244
Public sector	0.060 (0.089)	1.228	0.043 (0.094)	1.244
Medical insurance	0.020 (0.139)	2.247	-0.023 (0.140)	2.324
Job requires skills	0.205** (0.094)	1.158	0.216** (0.095)	1.158
Head of HH	0.305 (0.216)	7.327	0.402* (0.238)	7.992
Spouse of the Head of HH	0.129 (0.266)	3.674	0.275 (0.290)	4.200
Son/daughter of the Head of HH	0.219 (0.185)	4.315	0.470** (0.207)	4.690
Never married	0.166 (0.231)	7.334	0.056 (0.246)	7.266
Married	0.208 (0.194)	5.710	0.142 (0.207)	5.736
Under 5 child(ren)	-0.088 (0.104)	1.750	-0.149 (0.109)	1.776
Over 70 elder(s)	-0.047 (0.125)	1.177	-0.139 (0.133)	1.201
Reginal coefficients are not shown for brevity				
Graduation grade good of higher	0.173 (0.145)	1.245	0.082 (0.149)	1.260
Satisfied with work security	-0.267*** (0.098)	1.078	-0.356*** (0.105)	1.096
Desired hours of additional work	-0.011 (0.009)	1.044	-0.011 (0.010)	1.046
Infimal hiring	-0.078 (0.089)	1.249	0.016 (0.094)	1.253
Number of rooms in the household	0.047 (0.035)	1.381	0.077** (0.037)	1.407

	Full-sample		Workers employed before 2021	
	Coef.	**VIF**	**Coef.**	**VIF**
Intercept	9.700*** (0.683)		9.598*** (0.716)	
R-squared	0.077		0.081	
SSR	5093		3037	
F stat	5.550		4.336	
p-value (F)	0.000		0.000	
Observations	1,833		1,361	

Robust standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.