Estimating Women Empowerment in Kenya

Using Women's Relative Intra-household Income as a Determinant

Mathilde Wuite

2629244

MSc Spatial, Transport and Environmental Economics

Wendy Janssens

01/07/2020

Abstract

Previous research showed that the effect of intra-household income distribution on women empowerment is often biased due to omitted variables and reversed causality. Additionally, most papers study the effect of *absolute* income while the collective household model suggests that women's *relative* income versus men's is a better determinant of her bargaining position. Using weekly household income diaries from rural Western-Kenya, this study aims to address these two limitations in existing work. It first accounts for omitted variable bias by including alternative women empowerment measures, such as relative education or number of children. The regression results show that the effect of relative income outweighs all other determinants except for women's working status. Secondly, using COVID-19 lockdown measures as an exogenous shock in income, the study finds that that the effect of women's relative income on women empowerment is consistent over time. The findings indicate that a key policy priority should therefore be to stimulate women empowerment through targeted innervations which raise female income relative to men.

Keywords: women empowerment, intra-household income distribution, reversed causality, COVID-19

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1 Introduction

Increasingly many women empowerment studies show that next to humanitarian arguments, there are economic reasons for "achieving gender equality and empowering girls and women" (European Comission, 2021; UN Women, 2020). Several papers found that women's bargaining power within a household is determinant for expenditures on health, food and education (Doss, 2013; Duflo & Udry, 2003). Regarding the positive impact on key economic factors, developing countries could benefit largely from stimulating women empowerment. However, multiple papers point out that the complexity and unobservability of intrahousehold bargaining processes form methodological challenges (Almas et al., 2018; Doss, 2013; Laszlo et al., 2020). Since power dynamics are hard to quantify, the majority of studies use qualitative surveys to capture the woman's position in household decision making processes (Peterman et al., 2021). Only a few consider the alternative approach suggested by the collective household theory introduced by Browning et al., (1994), which suggests that women's relative income serves as a determinant of bargaining power. While some papers examine how women's income affects her position in decision-making processes, they focus on the effect of a change in *absolute* women's wage (e.g. targeted cash transfer) and do not consider the effect of women's *relative* income (Arthur-Holmes & Abrefa Busia, 2020; Waqas & Sarwar Awan, 2019). To the best of the author's knowledge, only a handful of studies explicitly estimates the effect of woman's relative income on women's household position (Aizer, 2010; Qian, 2008). One of which was conducted by Aizer (2010) who found that a decrease in women's relative income leads to higher domestic violence. The study is also one of the few which accounts for endogeneity arising from a possible reversed relationship between empowered women and working status. By incorporating changes in demand for women versus men dominated labour industries, the probability of reversed causality is reduced. Other studies use shocks in crop harvests, pregnancy, the size of family or village-

clustered averages of women's working status to capture exogenous variations in income (Lenze & Klasen, 2017; Qian, 2008). In general, previous findings show that if women empowerment estimates are not corrected for reversed causality and omitted variable bias, results can be misleading. The purpose of this study is to address these issues by estimating the effect of relative income on women empowerment whilst controlling for alternative women empowerment indicators and introducing COVID-19 as an exogenous shock in women's relative income.

The lockdown in response to COVID-19 is regarded as a suitable indicator to capture an external variation in women's relative income. The World Bank 2020, reported that Kenyan women experienced a 14% higher decline in earnings than men. Other recent studies also show that the COVID-19 pandemic affects women and men differently (Alon et al., 2020; Chauhan, 2020; European Comission, 2021). As women primarily carry the burden of increased child care due to school closure and are involved in casual labour with less secure contracts, their position is expected to be more vulnerable to pandemic response measures (Alon et al., 2020; KNBS, 2020). These findings suggest that the gender gap for developing countries including Kenya will grow as a consequence of the COVID-19 pandemic. A recent report of the Kenyan National Bureau of Statistics (2020), states that while Kenya has shown efforts to improve women's position on a legal level, only 29% of the women are considered empowered based on attitudes towards violence, social resources, decision-making, sexual relation and economic conditions. They find that the most vulnerable are women living in the country's rural areas, who are half as likely to be empowered than in urban areas (KNBS, 2020). Also when looking at the Global Gender Gap 2020 ranking, Kenya is only listed 109th of 153, which urges for stronger measures to stimulate women empowerment (WEF, 2019). Especially in areas such as Kenya, where women often face cultural norms which discourage participation in empowerment, it is important to stimulate female empowerment (Bello et al., 2019). This

research aims to contribute by studying key factors affecting women empowerment in rural Kenya, such that policymakers know which measures are effective in preventing further increase in gender inequality.

Aiming to find whether women's relative income is a determinant of women empowerment, this paper uses a two-stage randomly sampled household data set from Western Kenya retrieved during the COVID-19 pandemic. Each adult household member was asked to fill in a pre-COVID baseline in December 2019 and a post-COVID endline survey in December 2020. Next to general socio-demographics, female household members were asked to report on intrahousehold decision-making processes and power dynamics. Additionally, *individual*-level weekly incomes and expenditures were collected, which enabled the derivation of women's relative incomes. Using least-square and panel regression models, the goal of this paper is to find the actual effect of relative income on women empowerment by correcting for omitted variable bias and reversed causality. The study hereby aims to contribute to the growing body of research that evaluates women empowerment estimation methods.

1.1 Outline

The remainder of this study is structured in the following way: Chapter 2 describes two key household models. Chapter 3 presents the data set and provides context on the COVID-19 situation in Kenya. Chapter 4 discusses how women empowerment can be estimated by surveys, relative income and other key determinants. Chapter 5 describes the methodology, and in Chapter 6, the population characteristics and regression results are reported, which are discussed in Chapter 7.

2 Theoretical Framework

Household dynamics can be captured by unitary or non-unitary models. This section introduces the main differences between these two main theories and how they can aid in modelling women empowerment.

2.1 Unitary Household Model

Traditional models treat households as a single decision-making unit, where two (or more) members (e.g. a woman *w* and a man *m*) maximize a single utility function subject to a shared household budget constraint. The utility function (1) is solely dependent on the quantity of goods Q consumed privately and collectively by both household members. The budget constraint (2) sets total household income *y* equal to total expenditures, which are defined as the product of quantity *Q* and price *P* of goods consumed.

$$\max U(Q) \quad (1)$$

$$s.t.\ PQ = y \quad (2)$$

Solving the utility maximation problem above results in the following demand function (3). This function, determined by the price of goods consumed and total household income, can then be used to derive the number of goods consumed by a household.

$$Q = f(P, y) \quad (3)$$

By assuming that consumption is only affected by total and not individual household income, the model requires that all members pool their income and implies that the income distribution between females and males do not affect (Vermeulen, 2002). This contradicts with findings that redistributing resources among women and man changes household expenditure patterns (Arthur-Holmes & Abrefa Busia, 2020; Duflo & Udry, 2003). Doss (2013) stated that women are more likely to invest in health, education and well-being of their children than men, which highlights heterogeneous preferences between women and men. These findings violate the

model's assumption that household members behave according to a single utility function which would require that either there is only one dictating decision-maker or members have equal preferences (Vermeulen, 2002). By assuming a single decision-making unit, the unitary model does not provide any information on women's position in a household and is therefore considered unsuitable for women empowerment studies. Because the unitary household model often fails to capture reality, an extension of the model is considered below.

2.2 Collective Household Model

In contrast to the unitary model, the collective household theory allows household member's individual preferences and intrahousehold resource allocation to influence the outcome. The model was developed by Browning et al. (1994) and is increasingly used in the field of developmental economics. The collective model assumes that females and males bargain until they've reached a Pareto efficient outcome, a stage at which one cannot be made better off without making the other worse off (Vermeulen, 2002). Thus, depending on their bargaining power, their individual utilities are weighted differently in the outcome. Consequently, the collective household utility function (4) is a weighted sum of woman's (*w*) and man's (*m*)[1] utilities u_w and u_m, which is maximized subject to the budget constraint (5).

$$\max U = \alpha u_w(Q) + (1-\alpha)\, u_m(Q) \qquad (4)$$

$$s.t. \;\; PQ = y_w + y_m = y \qquad (5)$$

Often, the bargaining weight denoted as α, is a function of income, prices and "distribution factors" (Browning et al., 1994). The latter are variables that do not affect individual preference or budget but do affect bargaining power. Studies on women empowerment have used a variety of distribution factors such as gender distribution (e.g. higher share of women in community) or policy changes (e.g. female property rights). This paper, however, is going to use female

[1] Whilst specifying female and male only, the study acknowledges that more than two genders exist.

relative household income as a determinant for bargaining power like Almas et al. (2018). By allowing α to vary with woman's relative income RI_w (6), the effect of intrahousehold redistribution of resources on bargaining power can be analysed.

$$RI_w = \frac{y_w}{(y_w + y_{m)}} \qquad (6)$$

The collective household model suggests that relative income is a determinant for a woman's bargaining position, implying that if women's income increases respective to men, it strengthens her ability to make decisions in the household (Baland & Ziparo, 2018).

In previous research, it has been difficult to capture a causal effect of relative income on women empowerment due to the probability of reversed causality (Aizer, 2010; Khwaja, 2005). It is often unclear whether higher relative income increases women empowerment or that empowered women are more likely to work and earn money, which increases their relative income. By using COVID-19 as an exogenous change in women's relative income, this paper aims to address the problem of reversed causality. Recent research suggests that the COVID-19 pandemic affected women's income differently than men's income and caused a shock in women's relative income, which is further discussed in section 3.1. Correcting for this economic shock can therefore validate if relative income is a significant numeric determinant of women empowerment.

3 Data

This section explains the data used in this study. The financial diaries were collected from 12/2019 until 12/2020 on low-income households in West Kenya to evaluate the effect of relative income on women empowerment. In the next two sections, a situation analysis of Kenya during the study period is given by listing the main COVID-19 response measures and briefly discussing pandemic related income shocks. Subsequently, the data structure and collection procedures are discussed. Finally, a description of the selected sample is given.

3.1 COVID-19 Response Measures in Kenya

In Kenya, the first positive COVID-19 infection was detected on the 13th of March. To prevent the spread of the virus, Kenyan authorities closed schools, restaurant, bars and advice everyone to work from home. Between December 2019 – 2020, the study areas, Kisumu and Kakamega, mainly experienced indirect effects of COVID-19 response measures as no deaths and only one infection was reported in the areas. While during the first few weeks, lockdown restrictions were called out on a national level, from April onwards, only the most infected counties such as Nairobi, Mombasa and Mandera faced "Cessation of movement". Travels in and out of those areas was thus restricted. The same areas reported the highest number of cases during the two nationwide peaks in COVID-19 infections; in July and November. In general, it should be kept in mind that the number positive COVID-19 cases reported in Kenya could be inaccurate due to a limitation in testing capacities. A more detailed time line of the pandemic response measures is listed in Appendix A0.

3.2 Effect of COVID on household incomes in Kenya

Several studies in Kenya evaluated the health impact of the pandemic but a growing body of literature focuses on the economic consequences of COVID-19 response measures (Hivos, 2020; Janssens et al., 2021). Despite tax reliefs and funding's in response to the pandemic, findings from a consensus that the pandemic has negatively impacted income and

unemployment rates in Kenya. Janssens et al. (2021) uses the same data as this study and found that overall household income's dropped by one third in the five weeks after the first COVID-19 case and response measures were taken. They state that the decline was partially due to the household receiving fewer gifts and borrowed less money, but mainly caused by a lack of job opportunities. These findings are in line with the Pandemic Navigation Report of the World Bank (2020), which states that in June 2020, the unemployment rate had increased by 16% compared to the last quarter of 2019. The report points out that especially, incomes from the service sector dropped nearly to zero as all hospitalities had to close temporarily and for those which kept their job, the working hours decreased significantly. In contrast to Janssens et al. (2021), which evaluates household-level trends in income and expenditure, the World Bank report (2020) also briefly differentiates between the effect of the COVID crisis on women and men. Their findings, and also of the European Commission Gender Inequality Report suggest that women's income is affected more significantly by COVID-19 than that of men (European Comission, 2021; The World Bank, 2020). Recent results thus show that COVID-19 response measures caused a decrease in the relative household income of women in Kenya. Nevertheless, to the best of the author's knowledge, there has not yet been any research that captured the effect of the shock in relative income on women empowerment. This study wishes to close this gap by using household data on women in rural Kenya.

3.3 Data Collection Method

Initially, the data was collected to evaluate the impact of a phone-based health insurance programme through a Randomized Controlled Trial (RCT) in Kakamega and the effect of free health care access through prospective cohort study in Kisumu. Both programmes, however, were stopped during the study period of this paper. For the sample, first, 32 rural villages were randomly chosen in the two counties, from which then a random sample of ten households with a pregnant woman or children below four years was drawn. The study period ranged over a

year, beginning from 12/2019 until 12/2020, including a base- and endline status for each household member. In between, households were asked to report on individual incomes and expenditures on a weekly basis.

During the base- and endline interviews, information on socio-demographics, education, health, food, assets and employment was collected from each household member. Additionally, for all women older than 12 years who were cohabiting or married, questions on their empowerment status were asked in private. Women which had a stable partner were also asked to report on household power dynamics. In contrast to the two household surveys, the financial diaries were collected in a panel format. Every week, each adult household member was asked to report their income, expenditures, gifts, loans, credit, and savings. In contrast to many other household data sets, the interviews were collected on an individual rather than household level, which makes it possible to analyse the intrahousehold income distribution between women and men and its effect on women empowerment.

3.4 Sampling Methodology

The financial diaries were collected in private and in person until mid-March. Afterwards, due to social distance measures, the interviews were conducted by phone. Most participants owned a phone or could be reached through alternative contacts, so response rates only slightly declined by 2-10% (Janssens et al., 2021). Further, due to missing observations as well as fluctuations in expenditures and income during the holidays from December till January 2019, this study follows the approach of Janssens et al. (2021) and uses only weekly financial data from February 2019 onwards.

The objective of this study is to analyse (binary) bargaining processes between women and men. Therefore, second/third wives, children, other household members were excluded from the study sample (n=313). Additionally, in order to estimate the effect of relative income change on women empowerment, households had to have records in the base- and endline

survey as well as the financial diaries (Table 2). The Baseline household survey contained 92 single-headed households and 7 women which did not participate in the women empowerment module for unknown reasons[2], which reduced the sample to n=306.

However, 93 women in the sample recorded no information in the endline, which further shrunk the sample to n=213. Of the missing endline observations some women showed no observations in the financial diaries and were probably replaced (n=44), another 38 women were not available in the last few weeks of the diaries and thus probably dropped from the sample. The rest (n = 8) was present in the last week but did not fill in the empowerment module, either because they were no longer eligible (e.g. husband left) or they were not willing to participate. To extract information on women's *relative* income, only households where both women and men participated in the financial diaries were kept in the sample.[3] This resulted in a final sample size of n=199.

Table 1

Sampling steps to retrieve the final sample of women recording data on women empowerment and relative income.

Selection criteria	count	percentage
Baseline	405	100.00
Households with co-habiting/married women	313	77.28
Housholds with co-habiting women pariticpating in Baseline Empowerment module	306	75.56
Households with co-habiting women pariticpating in Base- & Endline Empowerment module	213	52.59
Households with co-habiting women pariticpating in Base- & Endline Emp. and Financial Diaries	199	49.14

[2] Only one woman gave as a reason that the partner was unavailable. Two women were registered as third wives, which might be the reason for the missing observations.
[3] If the man or woman was not present in a week, the individual-level average of the observed weeks is imputed. See (Janssens et al., 2021) for similar method and robustness check.

4 Measuring Women Empowerment

This paper focuses on measuring women empowerment on a household level. Most commonly "empowerment" is defined as improvement in the "ability to make choices". However, it is a multidimensional construct, so there exists a broad variety of literature suggesting different methods to quantify women empowerment. OXFAM (2017) defined three levels of women empowerment. The personal level, meaning that the way they regard themselves changes. The relational level, implying that a woman gains strength in her network (i.e. household, work) and lastly, the third level, considers empowerment in culture and norms. The focus of this paper is on the relational scale as it looks at the changes in dynamics between a woman and her spouse. It is important to note, however, that all three levels influence and interact with each other and are not strictly independently observable. Thus, it should be kept in mind that a women's position within her household is also determined by personal and cultural attitudes outside the household. This section first introduces the survey structure and methods used to approximate women empowerment in this study. Subsequently, it discusses how women's relative income and other key variables can be used as determinants to estimate women's position within a household.

4.1 Traditional Survey

Most research, use surveys to determine the principal decision-maker on household expenditures (Donald et al., 2020; Jayachandran et al., 2021; Laszlo et al., 2020). The women empowerment survey conducted at the beginning and end of this study included two parts; intrahousehold decision-making (DM) and power dynamics (PD) between woman and spouse. From these two modules, the study derives a women empowerment (WE) index for each adult female participant. In the DM module, each adult woman is asked 13 questions on whether she participated "alone", "only the husband", "together" or "somebody else" in household decisions on food, health, education, clothing and children. This survey design is traditionally

used in women empowerment studies, however, it is less common to include a fourth, "somebody else" option (KNBS, 2020; Peterman et al., 2021; Pulerwitz et al., 2000). In this study, women who respond "somebody else" or "husband only" are treated as equal because in both cases, women show zero participation in decision-making. If a woman responds that she decides "together" with her husband, the study considers her to have higher bargaining power and if she decides "alone" she is empowered[4]. Nevertheless, it is important to keep in mind that in practice, this ranking is less strict as sometimes women who take decisions jointly with their husband might have higher bargaining power, than those which take decision by themselves (Almas et al., 2018). While in the past, this survey design has been criticised for failing to capture enough variation in DM as women respond mostly that decisions are taken "jointly", this is no issue for the sample as each question shows different response patterns, which indicates that new information can be derived from each (see A2.1) (Almas et al., 2018; Jayachandran et al., 2021). Next to the 3-point scale questions, the DM module also asks women about their working status, the amount of income they pool as well as save and whether they can ask their parents for financial help.

Afterwards, in the PD part, the women with a stable partner indicated to what extent they agree with 11 statements on household power dynamics on a 5-point Likert scale ranging from strongly agree to strongly disagree. While this module is less commonly used than the DM scheme, the PD statements are useful in capturing how much the woman's behaviour is determined by the husband's wishes e.g. "He won't let me wear certain things" or "He wants to know where I am". Cassidy et al. (2020) use the same questionnaire, which was derived from piloting. The scale is ordinal, meaning that if a woman strongly agrees with the statement, she is considered less empowered than when she disagrees. Additionally, each woman is asked

[4] Most women responded that they agree that "He has more to say about joint decisions", which legitimizes the choice to rank "jointly" lower than "alone". See Appendix A1 for base- and endline PD scores.

whether she is allowed to go out without her husband's permission and if the husband was present during the interview.

Note that all variables were coded such that a higher variable corresponds to more empowerment. . For some observations, values in the empowerment module were imputed.[5] If more than 10% of the women did not respond to an item in the base- or endline, the item was excluded.[6]

4.1.1 Women Empowerment Index

The women empowerment index (WEI) is derived from a factor analysis of the DM and PD modules. Using the baseline results, a confirmatory factor analysis (CFA) with a single factor is conducted to examine whether all items measure the same construct. As most items are of ordinal scale, the assumption of normal distribution and linear relationship for Pearson correlation is unlikely to be satisfied (Ekström, 2011). Therefore, the study uses a polychoric correlation matrix, which estimates the coefficients based on the assumption that ordinal variables have underlying bivariate normal distributions. The coefficient is called Spearman's rho and measures the strength and sign of a monotonic, rather than linear, relationship. In this case, monotony implies that the coefficient estimates how much variables increase or decrease together. With this approach, the study aims to correct for the crudity of using a finite set of response categories, while participants` behaviours might be more facetted.

To increase efficiency, items with extremely high (>0.9) or negative polychoric correlations were excluded. Resultingly, a factor analysis with 12 DM and 11 PD items was conducted to indicate the item's loadings in the WEI index. When looking at the loadings, it can be seen that some items are higher correlated with the WEI construct than others (see

[5] For 4.5% of the final sample (n=9), there were no children in the household so responses for decision-making questions concerning children were imputed with the median. Additionally, three women (of which two without children) had no stable partner in the endline and thus had also imputed median PS values. The regression in Appendix C1 shows that results are robust towards the imputed values.
[6] Two items for DM were excluded, and one item in PD module

Appendix A3). Overall, the items in the DM module (e.g. she decides herself to go to work) are weighted higher than those of the PD module (e.g. she disagrees to be more committed). The traditional DM survey method is thus more informative about the study's WEI index than the PD module, which can also be seen in Figure 1 where the two modules are plotted as underlying distributions of the WEI index[7]. The final WEI index is derived by taking the normalized weighted sum score of all items for each respondent, using the factor loadings as weights. The same factor loadings are also applied to the endline responses, which results in two comparable WEI scores at the beginning and end of the study period.

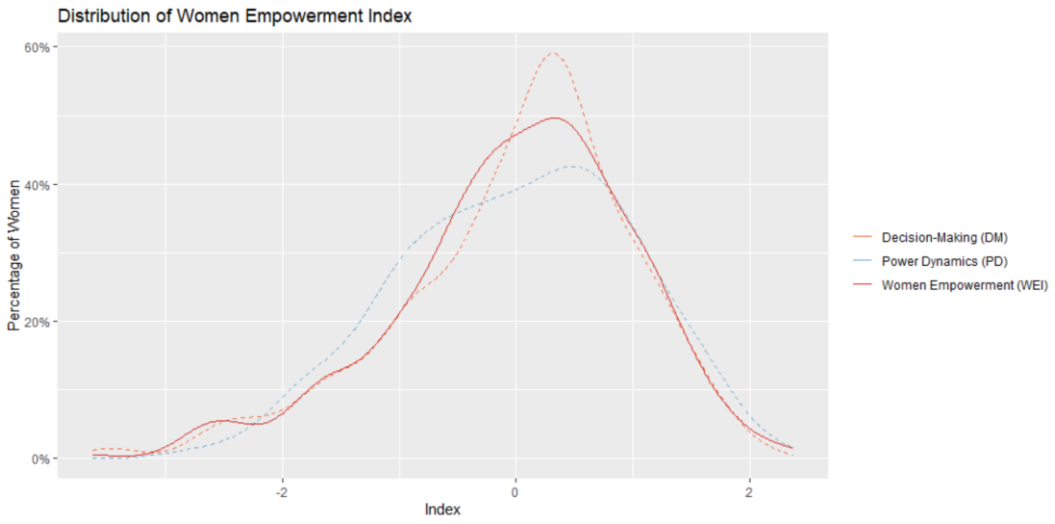


Fig. 1. Distribution of Women Empowerment Index (red) and the underlying constructs (PD and DM) retrieved in Appendix A2.

4.2 Intrahousehold income distribution

This paper aims to estimate how intra-household allocation of economic resources between wife and husband influences "the ability of women to define her goals and act upon them" (Laszlo et al., 2020). The latter is captured in the WEI index described above. To estimate the effect of economic resource allocations on women empowerment, several studies looked at the

[7] Two separate factor analysis were performed to retrieve a PD and DM index. Their item's correlation matrix and factor loadings are documented in Appendix A2. The robustness check in Appendix C1 shows how the regression results change for the individual indices.

effect of an *absolute* increase in women's income through cash transfer programs (Oxfam, 2017; Waqas & Sarwar Awan, 2019). However, others including Almas et al. (2018), Cassidy et al. (2020) and Peterman et al. (2021), suggest based on the collective household model, that women's *relative* income share also is a determinant for bargaining power. Using COVID-19 response measures as an exogenous shock, this paper aims to validate this assumption.

To capture the effect of intrahousehold resource distribution as well, weekly financial household diaries are used. The diaries record incomes from either business revenues, salaries, crop sales or other types of income on an individual level. While other financial inflows, such as gifts or marital assets might occur, this study treats female relative income from work versus men as the main determinant for intrahousehold resource allocation. If a respondent's income was missing (meaning the household member was not present) it was replaced by the individual's average income during that month. Also, if a household reported a total income of zero, relative income was coded 1 as both earned nothing.

As mentioned earlier, because of missing variables and income fluctuations during the holiday period (Jan/Dec), the study only uses data from February onwards. Therefore, the "pre-COVID" period is defined from February until mid-March when the first COVID-case in Kenya occurred and a lockdown was implemented. Because of high-income fluctuations, the study uses women's average relative income during these six weeks as the pre-COVID observation. It should be noted that this introduces a two-month gap between the pre-COVID, respectively baseline, WEI observation (December 2019) and the relative income observation is introduced. Nevertheless, the pre-COVID income observation is correlated with the baseline income in December 2019 and also expected to be more precise because households are more used to documenting their incomes weekly.[8] Additionally, in contrast to the baseline survey, the financial diaries are collected in private and separately, which avoids possible bias

[8] The correlation for female (male) income at baseline and pre-COVID is 0.09 (0.28) with p-value = 0.28 (0).

introduced by the spouse's presence. For the "post-COVID" relative income observation the average of the six weeks before the endline (mid-October until November) is used.

4.3 Alternative indicators of Women Empowerment

This section introduces alternative indicators of women empowerment which are used in this study to validate the relationship between WE and relative income. By including additional variables which might determine WEI as well, the study aims to avoid an overestimation of the relative income effect. Table 3 briefly describes the effect of five main alternative indicators, suggested by the literature.

Table 2

Summary of women empowerment determinants suggested by previous women empowerment studies and used in this study.

Alternative indicators	Effect on women's empowerment	Studies
Age difference	Women who are considerably younger than their husbands might be stronger influenced by cultural norms determining that the man a stronger voice.	(Almas et al., 2018; Jayachandran et al., 2021; Lenze & Klasen, 2017)
Educational difference	Women who are less educated than their husbands are likely to lack negotiation skills in decision-making processes.	(Almas et al., 2018; Jayachandran et al., 2021)
Absolute woman's income	Women who have more money to spend can decide more on household expenditures.	(Arthur-Holmes & Abrefa Busia, 2020; Waqas & Sarwar Awan, 2019)
Absolute man's income	Men who have more money to spend can decide more on household expenditures.	(Pitt et al., 2003)
Number of children	Women who have more control over birth decisions have fewer children. Also, if a woman has more children, she has less mobility to work.	(Almas et al., 2018; Baland & Ziparo, 2018)

Next to these relatively common indicators (Table 6), papers also evaluate other measures such as antenatal care or women's property rights (Bello et al., 2019; O'Sullivan, 2017). Almas et al. (2018) and Jayachandran et al. (2021) also analysed whether the willingness to pay to control a cash transfer which otherwise a man would control can is an indicator for women empowerment. However, while such lab games can serve as means to provide clear evidence for causal effects, they are costly to perform and might not capture socio-cultural attitudes (e.g. money is man's domain), which does not make them applicable to all countries. The study's survey thus only includes information on the additional indicators listed in Table 6. The variables' correlation with WEI is shown in Figure 6.

Due to limited information on the endline status of individuals, some alternative indicators such as others such as differences in age and education, number of children are assumed to be time-invariant over the one-year study period. Others, the indicators are assumed to be time-variant such as the absolute incomes and woman's working status, others such as difference in age and education, the number of children are assumed to be time-invariant over one year.

5 Methodology

This section explains which steps are taken to determine the effect of relative income as a strong predictor of women empowerment. Because the sample was drawn by first randomly selecting villages and then households, standard errors are clustered at village level for all regressions. This accounts for the study's uncertainty that households are selected from villages instead of the entire population.

First, a baseline least squares regression is performed to determine whether the pre-COVID relative income observation is positively and significantly associated with the baseline women empowerment. However, as mentioned in section 4.3. there are several alternative determinants of women empowerment, which might also account for the variation in women empowerment. This would lead to an overestimated effect of the relative income coefficient, respectively an omitted variable bias. To correct for this bias, the same baseline regression including alternative indicators described in section 6.1. were ran. The formula below shows the regression of the average pre-COVID woman's relative income $RI_{i,0}$ on baseline women empowerment score $WEI_{i,0}$ of women i. Relative income $RI_{i,0}$ is calculated as in Equation 6. The vector $A'_{i,0}$, captures all alternative indicators, while the vector $X'_{i,t}$ represents the women's baseline demographic characteristics such as religion, age or county, and the variable $u_{i,t}$ is the idiosyncratic error term.

$$WEI_{i,0} = \beta_0 + \beta_1 RI_{i,0} + \gamma A'_{i,0} + \alpha X'_{i,0} + u_{i,0} \qquad (7)$$

By including alternative indicators the study aims to correct for an upward bias of the relative income effect β_1. However, Equation 7 does not exclude the presence of reversed causality, meaning that the coefficient could also capture the opposite effect, where empowered women are more likely to be mobile and work and thus have higher relative income (Aizer, 2010).

So, to ensure that the study measures the effect of interest, COVID-19 is included as an exogenous shock in relative income. Recent literature suggests that the pandemic response measures affected labour sectors differently, which lead to a disproportionate change in income of men and women (European Comission, 2021; The World Bank, 2020). Because of the arbitrary effect on the population's income, the pandemic is assumed to be an appropriate variable to capture an exogenous variation in relative income. To test whether this assumption is also applicable to the sample in Kenya, a regression discontinuity design is used to see whether the income of men and women changed significantly. If relative income changes notably after the first- COVID case in Kenya, then it can be assumed that the pandemic and its response measures form an exogenous shock. With this information in mind, the same regression model as in Equation 7 is applied to the post-COVID observations (Equation 8). If there is still a strong correlation *after* an exogenous change in relative income, it suggests that there is a link from relative income to women empowerment is.

$$WEI_{i,1} = \beta_0 + \beta_1 RI_{i,1} + \gamma A'_{i,1} + \alpha X'_{i,1} + u_{i,1} \quad (8)$$

However, β_1 in Equation 8 might still capture time-variant variations in women empowerment, which are inexplicable by relative income or alternative indicators. Therefore, a panel regression including a COVID (0/1) indicator and interaction term as described in Eq. 9, is ran to test whether the effect is robust to changes over time.

$$WEI_{i,t} = \beta_0 + \beta_1 RI_{i,t} + \beta_2 COVID + \beta_3 COVID \times RI_{i,t} + \gamma A'_{i,t} + \alpha X'_{i,t} + u_{i,t} \quad (9)$$

The β_3 the coefficient in Equation 9 captures the effect of relative income on women empowerment has changed over time. If that coefficient is negligible and the effect of relative income in the panel results is found to be significant there would be substantial evidence that it is a strong predictor of women empowerment.

6 Results

6.1 Descriptive statistics

This section describes the sample characteristic of key variables used in this study (Table 4). On average, women are approximately 6.6 years younger than their husbands. Further, the majority of women and men in the sample are Protestant (see Appendix B1) and educated. The number of children is defined as the number of household members that are younger than 12 years. The sampled women have on average three, and at most eight children. Regarding geographical distribution, 35% of the household live in Kisumu while the other 65% live in Kakamega (see Appendix B2 for village-level distribution).

Table 3

Descriptive statistics of key base- and endline characteristics. For the variables, which are assumed to be time-variant, the endline statistics are also provided.

	Baseline				Endline			
	Min.	Median	Mean	Max.	Min.	Median	Mean	Max.
Age	16.00	28.00	29.18	58.00	-	-	-	-
Age difference (m-w)	-2.00	6.00	6.62	32.00	-	-	-	-
Protestant	0.00	1.00	0.75	1.00	-	-	-	-
Educated	0.00	1.00	0.97	1.00	-	-	-	-
Education difference (m-w)	-1.00	0.00	-0.01	1.00	-	-	-	-
Working	0.00	0.00	0.39	1.00	0.00	1.00	0.68	1.00
Work difference (m-w)	-1.00	1.00	0.54	1.00	-	-	-	-
Number of children	0.00	3.00	2.98	8.00	-	-	-	-
Kisumu	0.00	0.00	0.35	1.00	-	-	-	-
Relative Income	0.00	0.17	0.27	1.00	0.00	0.22	0.34	1.00
Income [KES] (w)	0.00	71.84	405.95	11074.38	0.00	61.67	299.92	6542.38
Income [KES] (m)	0.00	1104.55	1953.97	29640.32	0.00	804.26	1777.88	29640.32

Employment rates in Table 4, show that 55% more men than women are working at baseline. The main reasons for women not to work are either because they need to care for their family (47%) or cannot find work (38%). Men, however, are mostly unemployed because they cannot find work (46%), are sick or pensioner (see Appendix B3). In endline, women's employment rate is 0.28 percentage points higher. While men's average income dropped by

nearly 200 KES, women's income declined by around 100 KES. Therefore, women's relative income increased by 0.17 percentage points.

Regarding women empowerment scores, average scores hardly deviate from each other. In Figure 2 the distributions are represented in boxplots. During post-COVID the mean WEI is only slightly higher than in pre-COVID.

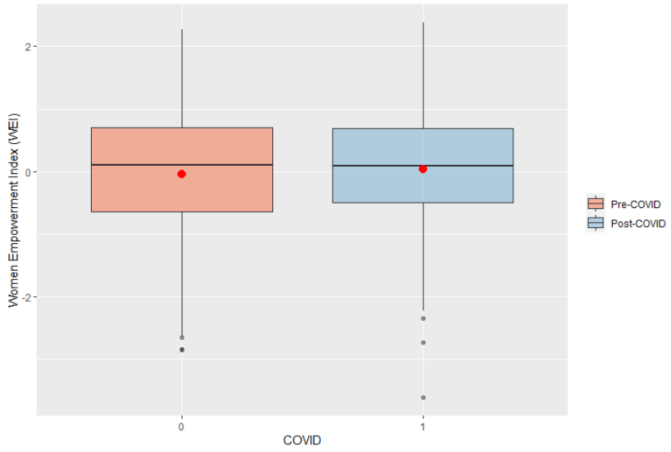
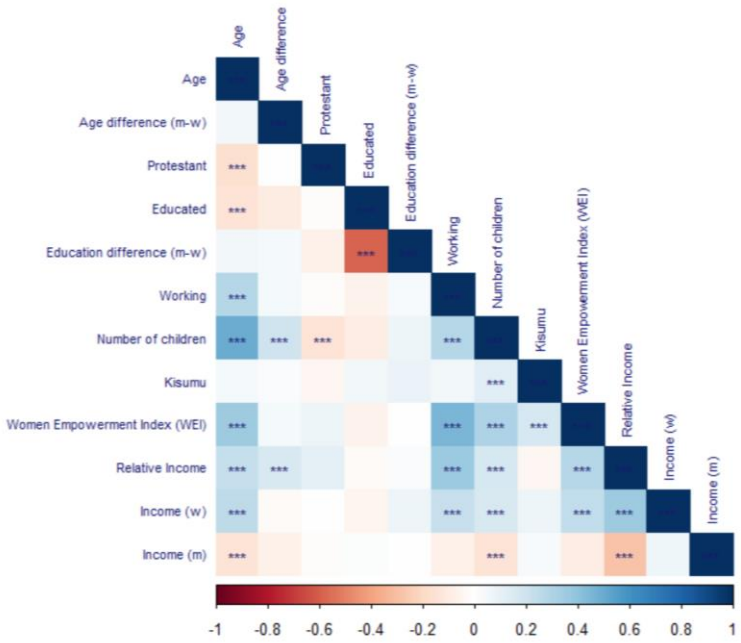


Fig. 2 Box plot of the distribution of pre-covid and post-COVID WEI scores and means indicated as red points.

To check whether the variables are multicollinear, the matrix in Figure 3 presents the correlation coefficient and significance between the key variables used in this study. Only "Education" and "Education difference" between man and woman shows a high negative correlation, probably because the education rates are very similar. The variables which show a weak correlation with WEI such as religion, education or age difference are expected to have an insignificant effect on empowerment. Surprisingly, women's education shows a negative correlation with empowerment. However, the coefficient is insignificant.



p-value < 0.1=*, 0.01 =**, 0.001=***

Fig. 3 Baseline correlation matrix of key variables used in the regressions

6.2 Baseline Regressions

First, baseline regression results are listed to see whether relative income has a positive effect on women empowerment. Table 5 presents eight models starting with the most simple regression including women's main characteristics only. In each following model, from (2) until (7), an alternative measure is added to the first model to see how the relative income coefficient changes. In the last model, all variables are included. Overall the models explain around 20% of the total variation in WEI. Regarding the baseline characteristics, the results reveal that older women are slightly more empowered and that on average women living in Kisumu have notably higher WEI scores. Further, women's education seems to have little effect.

Table 4

Baseline Least Squares Regression results

Coeffcient	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	-1.86 ** (0.50)	-1.80 ** (0.44)	-1.55 * (0.63)	-1.85 ** (0.49)	-1.87 ** (0.47)	-1.87 ** (0.50)	-1.81 ** (0.49)	-1.39 * (0.56)
Relative Income	0.80 * (0.28)	0.36 (0.23)	0.81 * (0.29)	0.81 * (0.30)	0.75 * (0.29)	0.81 * (0.29)	0.68 * (0.29)	0.25 (0.27)
Age	0.05 ** (0.01)	0.04 ** (0.01)	0.05 ** (0.01)	0.05 ** (0.01)	0.04 ** (0.01)	0.05 ** (0.01)	0.05 ** (0.01)	0.03 ** (0.01)
Education	-0.16 (0.40)	-0.08 (0.33)	-0.46 (0.61)	-0.17 (0.39)	-0.13 (0.37)	-0.16 (0.40)	-0.15 (0.41)	-0.37 (0.53)
Kisumu	0.40 ** (0.11)	0.35 ** (0.10)	0.41 ** (0.11)	0.40 ** (0.11)	0.36 ** (0.12)	0.40 ** (0.11)	0.38 ** (0.11)	0.33 ** (0.10)
Protestant	0.28 (0.17)	0.30 * (0.16)	0.26 (0.17)	0.28 (0.17)	0.30 * (0.17)	0.28 (0.17)	0.28 (0.16)	0.29 * (0.15)
Work		0.75 ** (0.10)						0.71 ** (0.11)
Education Difference (m-w)			-0.35 (0.36)					-0.36 (0.38)
Age difference (m-w)				-0.00 (0.01)				-0.00 (0.01)
Number of children					0.09 * (0.04)			0.06 (0.04)
Income (m)						0.00 (0.00)		-0.00 (0.00)
Income (w)							0.00 (0.00)	0.00 (0.00)
Observations	199	199	199	199	199	199	199	199
R^2	0.215	0.313	0.218	0.215	0.229	0.215	0.222	0.327

*$p<0.1$ **$p<0.01$

In nearly all baseline regression models, the effect of relative income is statistically and economically significant at the 0.1 level. The effect of a 100% increase in relative income leads to a 0.7-0.8 standard deviation increase in WEI. Only for Model (2) and (8), when work and other variables are included, relative income loses its significance, indicating that a woman's employment status dominates in determining WEI. Next to work, the number of children is also significant. However, one additional child only leads to a small, 0.09 standard deviation increase in the WEI index. Interestingly, the effects of income of males and females are zero. Even if the unit (KSH) is shrunk by dividing by a hundred, the coefficient remained zero.

As mentioned in section 5, baseline relative income coefficients might be biased by reverse causality, which the study aims to test by introducing COVID-19 as an exogenous shock. The following results support the assumption that COVID-19 response measures caused an exogenous variation in relative income.

6.3 COVID as an exogenous shock

To find out whether COVID-19 caused an exogenous shock in relative income, a regression discontinuity line[9] was plotted for absolute and relative income. Figure 4 shows the weekly income average of men (upper line) versus women (lower line) pre- and post-COVID, where the date of the first positive COVID case in Kenya (13th March) marks the threshold. In response to the positive case, lockdown measures (Table 1) were implemented which affected labour sectors differently (section 3.2.). Figure 4 reveals that relative to men, women's income drops significantly less. Their average income decreased by more than 500 KES after the first COVID-19 case in Kenya was recorded. Even though men's income climbed afterwards, it did not recover to the pre-COVID level. For both, women and men income declined pre-COVID[10]. Overall, women's income hardly changed over the COVID-19 period. Figure 5 visualizes the relative income change of women and reveals that after the first COVID-case in Kenya, the relative income of women increased by 7% but stayed relatively constant thereafter.

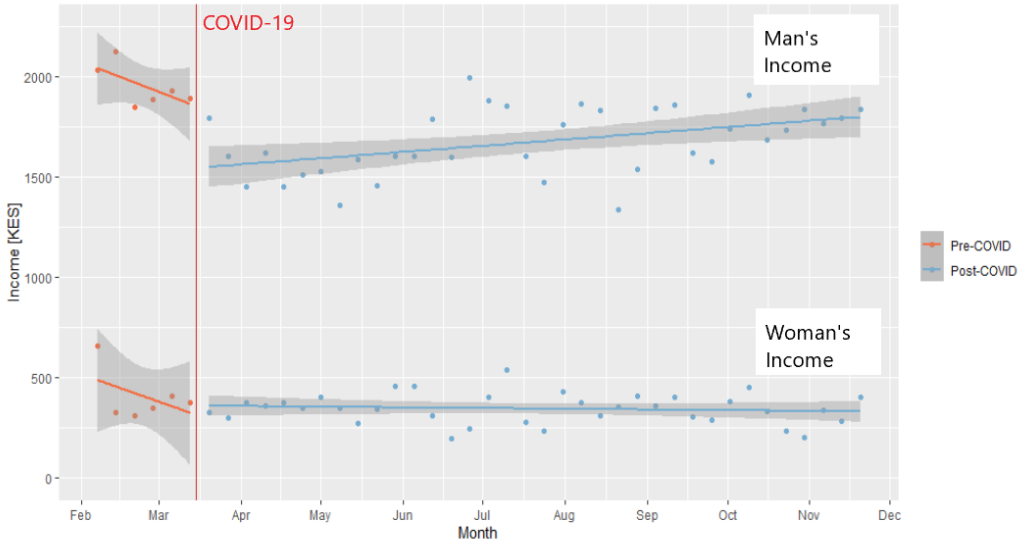


Fig. 4. Regression discontinuity design of men's and women's weekly income average in 2020 with the first positive COVID-19 case in Kenya as a threshold.

[9] The line is fitted to the individual weekly observations by non-parametric local regression, whereby multiple regressions are ran to predict income for the local neighborhood.

[10] Heavy rainfall was reported in March-May 2019, which might have affected agricultural labour incomes. Also, for women's income there is a large outlier which steepens the slope.

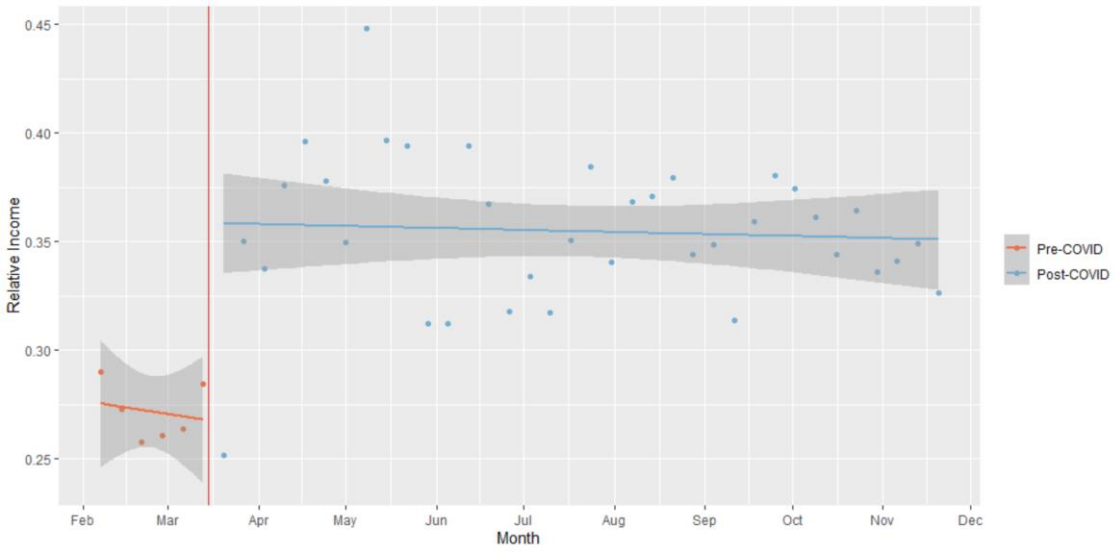


Fig. 5. – Regression discontinuity of Women's weekly relative income average in 2020 using first COVID-19 case in Kenya as a threshold.

Table 6 shows that both, relative income and WEI increase after COVID-19. Relative income increases from an average of 0.27 to 0.34 percentage points in post-COVID, while WEI only increases by a small 0.08 standard deviation.

Table 5

The change in women's relative income and WEI between pre- and post-COVID observation.

	Relative Income	**WEI**
Coeffcient		
Intercept	0.27 **	-0.04
	(0.02)	(0.07)
COVID	0.07 *	0.08
	(0.03)	(0.10)
Observations	398	398
R^2 / R^2 adjusted	0.014 / 0.012	0.002 / -0.001

** p<0.1 ** p<0.01*

The baseline WEI score and relative income change are uncorrelated[11]. This strengthens the assumption that COVID is an exogenous shock and points out that the relative income

[11]Pearson correlation coefficient =- 0.06 and p-value= 0.37

change is not determined by the initial WEI level of women. While women with higher income may be more likely to be hit by the economic shock, even if the shock is purely random, the disproportionate gendered effects of COVID on income in Figure 4 strongly suggest that the pandemic caused an exogenous shock in relative income in our study sample.

6.4 Endline Regressions

When comparing the baseline and endline (see Table 7), respectively pre- and post-COVID, the study finds that the relative income effect is approximately 0.3 percentage points smaller for post-COVID observations, but remains significant. This suggests that the effect of relative income on WEI remains robust also after an exogenous shock, which diminishes the probability of reversed causality bias.

Table 6

Endline Least Squares regression results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Coeffcient								
Intercept	-0.81 (0.73)	-1.06 (0.73)	-0.38 (0.67)	-0.87 (0.75)	-0.81 (0.72)	-0.75 (0.73)	-0.80 (0.73)	-0.71 (0.68)
Relative Income	0.53 * (0.20)	0.36 * (0.19)	0.54 * (0.20)	0.51 * (0.21)	0.53 * (0.20)	0.48 * (0.22)	0.50 * (0.21)	0.28 (0.23)
Age	0.02 ** (0.01)	0.02 ** (0.01)	0.02 ** (0.01)	0.02 ** (0.01)	0.02 * (0.01)	0.02 ** (0.01)	0.02 ** (0.01)	0.02 * (0.01)
Education	-0.17 (0.71)	-0.13 (0.72)	-0.59 (0.62)	-0.15 (0.71)	-0.15 (0.70)	-0.17 (0.70)	-0.17 (0.71)	-0.40 (0.63)
Kisumu	0.15 (0.15)	-0.02 (0.14)	0.18 (0.15)	0.15 (0.15)	0.13 (0.16)	0.16 (0.16)	0.14 (0.16)	-0.01 (0.14)
Protestant	0.15 (0.16)	0.08 (0.15)	0.13 (0.16)	0.15 (0.16)	0.16 (0.16)	0.15 (0.16)	0.15 (0.16)	0.06 (0.15)
Work		0.69 ** (0.13)						0.66 ** (0.14)
Education Difference (m-w)			-0.49 * (0.23)					-0.33 (0.30)
Age difference (m-w)				0.01 (0.01)				0.00 (0.01)
Number of children					0.05 (0.03)			0.01 (0.04)
Income (m)						-0.00 (0.00)		-0.00 (0.00)
Income (w)							0.00 (0.00)	0.00 (0.00)
Observations	199	199	199	199	199	199	199	199
R^2	0.091	0.197	0.100	0.093	0.098	0.094	0.093	0.206

*$p<0.1$ **$p<0.01$

Model 2 in Table 7 reveals that work is still a strong determinant, but that in contrast to the baseline, the relative income effect also remains significant. For all other variables, except Kisumu, the coefficients are similar to the baseline. Surprisingly, however, the R-squared of the endline models are lower (~0.09) than of those of the baseline.

6.5 Panel regression

While section 6.3 reveals that relative income remains significant even after an exogenous shock, there might be unobserved time-variant changes in women empowerment that are not associated with relative income or other determinants. Therefore, a panel regression including a COVID time indicator and interaction term with relative income is performed (see Eq. 9). This regression model tells whether the effect of relative income changes for pre- and post-COVID observations. Model 1 in Table 8 shows the simple models with no alternative women empowerment indicators, Model 2-4 include time-variant alternative indicators separately and Model 5 is the panel regression including all additional measures.

Looking at the results in Table 8, the study finds that relative income coefficients remain large, positive and significant for panel regression models 1-4. The pre-COVID average relative income is 0.27, (Figure 5), so the average effect of relative income on women empowerment in Model 1 is 0.23. Since the interaction term coefficient is insignificant, the relative income effect does not notably change for post-COVID observations. Regarding the coefficient of COVID, women with baseline relative income zero hardly experience any improvement in empowerment during the pandemic, namely only a 0.16 standard deviations increase in WEI on average. The panel regression results suggest that women's relative income is a strong and consistent determinant of WEI, respectively the women's position in a household.

Table 7

Panel regression

	(1)	(2)	(3)	(4)	(5)
Coeffcient					
Intercept	-1.41 * (0.58)	-1.38 * (0.52)	-1.38 * (0.58)	-1.37 * (0.58)	-0.99 * (0.54)
Relative Income	0.88 ** (0.29)	0.45 * (0.24)	0.85 ** (0.30)	0.77 * (0.29)	0.33 (0.27)
Age	0.04 ** (0.01)	0.03 ** (0.01)	0.04 ** (0.01)	0.03 ** (0.01)	0.02 ** (0.01)
Education	-0.17 (0.51)	-0.11 (0.47)	-0.17 (0.51)	-0.17 (0.52)	-0.39 (0.49)
Kisumu	0.27 * (0.10)	0.16 * (0.08)	0.27 * (0.10)	0.26 * (0.10)	0.16 * (0.09)
Protestant	0.21 (0.13)	0.18 (0.12)	0.21 (0.13)	0.21 (0.13)	0.17 (0.12)
COVID	0.16 (0.11)	-0.11 (0.10)	0.16 (0.11)	0.15 (0.11)	-0.10 (0.10)
COVID*Relative Income	-0.41 (0.32)	-0.11 (0.27)	-0.41 (0.32)	-0.34 (0.32)	-0.06 (0.28)
Work		0.70 ** (0.09)			0.67 ** (0.09)
Income (m)			-0.00 (0.00)		-0.00 (0.00)
Income (w)				0.00 (0.00)	0.00 * (0.00)
Education Difference (m-w)					-0.35 (0.28)
Age difference (m-w)					0.00 (0.01)
Number of children					0.03 (0.04)
Observations	398	398	398	398	398
R^2	0.151	0.250	0.152	0.156	0.260

*$p<0.1$ **$p<0.01$

7 Discussion

Previous women empowerment studies struggled to define a causal effect of intrahousehold resource distribution on women empowerment due to omitted variable bias and reversed causality issues (Aizer, 2010; Khwaja, 2005). By including a variety of women empowerment measures and an exogenous shock in relative income, this study tried to minimize the bias introduced by these problems. The following section discusses the regression results, exogeneity of COVID-19, survey methods, and applicability of the findings.

Nearly in all base- and endline models, the study finds a strong positive correlation between women's relative income and the Women Empowerment Index (WEI). Out of all alternative indicators, the working status of women appears to have the strongest effect, implying that if a woman works, she has more decision power. Surprisingly, and in contrast to earlier findings reported by Hagen-Zanker et al. (2017) and Waqas & Sarwar Awan (2019), the absolute income effect on women empowerment is zero for all regressions. This might be due to the woman's relative income variable being derived from the household absolute income and thus absorbs all effects. A non-linear or log model may be able to capture the relationship between absolute income and women empowerment better. Interestingly, women's education and the difference between men's education seem to have no effect either. Probably because nearly all (97%) participants in the sample attended school. Also, Kisumu-district showed significantly higher average women empowerment scores than Kakamega, which could be explained by the different size or cultural norms of the city. To correct for reversed causality and other time-variant changes in WEI, the study ran panel regressions and found that the effects are very similar to the baseline regression results effect, which suggest that women's relative income is a time-invariant and strong determinant of women's decision-making power. Supported by the findings of Aizer (2010), who states that domestic violence increases with declining relative income, the study's results suggest that increasing the women's income

relative to men is a strong measure to stimulate women empowerment. Nevertheless, to exclude the probability of reversed causality one should consider using COVID-19 as an instrumental variable. This was not possible for this study as COVID-19 simultaneously served as a time indicator and thus did not stratify the exclusion restriction. If one aimed to conclude a causal effect, an experimental or laboratory setting with e.g. games or cash transfer would be needed (Almas et al., 2018).

The exogenous effect of COVID-19 on income described by the regression discontinuity designs contradicts previous studies which found that lockdown measures caused a larger decline in women's income(European Comission, 2021; The World Bank, 2020). The men in rural Western Kenya saw a larger decrease in income than women after the detection of the first positive case in the country, around the 13th of March. It should be kept in mind, that even though the unusual steep shock in relative income is very likely to be caused by COVID-19 lockdown measures, the results remain prone to seasonal variations. These findings aid in understanding the steep decline in absolute household incomes reported by Janssens et al. (2021), which appears to be mainly caused by the decrease in income of men. The study assumes that because the male employment rate of the sample is 54% higher than for the females, men are more likely to experience a drop in income from work. Also, most men work in casual part-time labour sectors (see Appendix B4), and therefore face low job security in times of economic crisis. The study results reveal that COVID-19 is a suitable variable to model an exogenous shock in women's relative income as labour sectors and population income distributions are affected randomly.

Regarding the measurement methods, the questionnaire used to build the women empowerment index (WEI) is considered a good proxy for the women's position in the household (Almas et al., 2018; Cassidy et al., 2020). The index, however, mainly represents decision-making power and less reflective of factors such as domestic violence or political

rights. It would be interesting to examining whether the regression results are also significant for questions on women's position in other domains, such as sexual relations, cultural norms or politics (Arthur-Holmes & Abrefa Busia, 2020; Calvi, 2020). Such questions, however, are more sensitive to collect (Donald et al., 2020). While there is a need for a standardized approach to ensure comparability and consistency among women empowerment studies, the complexity of the construct and variety of global cultures makes it hard to develop such a universal standard (Donald et al., 2020; Peterman et al., 2021). To select the most efficient combination of questions, one could consider using machine learning methods suggested by Jayachandran et al. (2021). For future research, alternative indexing methods, such as coding women as "empowered" (1) if WEI score exceeds a certain threshold (e.g. mean), and "not empowered" (0) otherwise, could ease the interpretability of regression coefficients. Overall, as pointed out by recent studies, small variations in survey design can significantly affect women empowerment estimation, so the generalizability of the results is limited to the study-specific survey content, in this case; household decisions. Regarding the financial diaries, it is exceptional for this study is that income data was collected on an individual rather than a household-level. This allowed for the estimation of the effect of women's *relative* income variable on WEI. An interesting addition to the findings could be to see whether not only relative income from work but also income from gifts and remittances affect women empowerment.

Despite using the collective instead of unitary model, the applicability of the study's model is limited as the study assumes only two utility functions; one capturing the preference of the husband, the other capturing those of the first wife (Eq.4).In reality, many households consist of more than two members but if other household members such as second/third wives, children or grandparents are included, intrahousehold power dynamics become highly complex (Chiappori & Donni, 2009; Vermeulen, 2002). For sake of simplicity, the study thus chose to

look at binary bargaining processes and only kept households that recorded full information for both husband and wife in the study sample. The sample size is thereby reduced to n=196 but the study still found significant coefficients for relative income, suggesting that the effect on women empowerment is strong enough to even be measured in a small population. The sample size, however, reduces the scope of the findings, which limits the applicability to other areas in Kenya and other countries. The effect of relative income is thus specific to the study population and an area with different traditional mindsets and cultures towards women might show other effects. Further research is therefore needed to find compare effects over a variety of regions, such as developed and developing countries as well as rural and urban areas.

8 Conclusion

The main goal of this study is to establish the actual effect of relative income on women empowerment by accounting for omitted variable bias and endogeneity issues. Several regression analyses accounting for these issues reveal that relative income is a reliable determinant of women's intrahousehold decision-making power. For future research, the study shows that COVID-19 response measures can be used as an indicator to capture an exogenous variation in intra-household resources distributions. Whilst full causality could not be established, the consistency of the effect over various regression models, suggests that compared to alternative measures, women's relative income is a key predictor of empowerment. Only the working status of women emerged as a similarly strong determinant. The insights rural Kenya authorities can draw from this study is to consider gender-specific policy interventions which improve women's salaries and working status relative to men. A natural progression of this research is to analyse whether the findings are also applicable to other countries.

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Appendix A

Women Empowerment Index

The household survey contained a women empowerment module, which consisted of two parts. The first part aimed to estimate women's decision-making (DM) participation and the second asked about power dynamics (DM) within the household. The distributions of the base- and endline responses are shown in the following four figures in A1. Then, in A2, the intermediate steps to construct the DM and PD index are listed. These indices are built for the robustness analysis in C. Finally, in A3, a table with the factor loading of each item in the WEI index is given.

A0 COVID-19 Timeline for Kenya

Table 8
Timeline of COVID-19 Response measures in Kenya from end February until end November.

Date	Restrictions
29th February	- Avoid contact with individuals with symptoms and refrain from non-essential travels
13th March	- *First positive case*
15th March	- Schools close - Advice to work from home
22th March	- Bars close and restaurants open for take-away only - No public gatherings - Suspend all international flights
27th March	- Curfew (19:00-05:00)
7th April	- "Cessation of Movement" only in Nairobi, Mombasa and Mandera
27th April	- Restaurants reopen nationwide
6th June	- "Cessation of Movement" lifted in some counties - Curfew (21:00-04:00)
7th July	- "Cessation of Movement" lifted entirely
26th July	- First peak (nation-wide 960 cases and 2 deaths) (CGTN Africa, 2021)
1st August	- International flights allowed with a negative COVID-19 test

26th August	-	Bars close
	-	Infections in more rural areas are increasing
29th September	-	Curfew (23:00-04:00)
	-	Ban of alcohol sales lifted (open until 22:00)
5th November	-	Stricter public health restrictions
	-	No public gatherings
	-	Curfew (22:00-04:00)
27th November	-	Second peak (nation-wide 1554 cases and 14 deaths) (CGTN Africa, 2021)

A1 Distribution of Survey Responses

Table A.1.1 Questions in "Who is the Decision-Maker?" format in the DM part. Women were asked whether their husband or somebody else (1), together (2) or she alone (3) decided on expenditures concerning health, children, food and other consumptions. Four questions were formatted in Yes/No and are not included in the Table (see A2.1 for all questions).

	DM Questions (3-level)
1	who decides whether you should seek treatment if you are feeling sick
2	who takes decisions about you buying clothes
3	who takes decisions about you buying phone credit
4	who takes decisions concerning the large expenditures of the household
5	who takes decisions concerning which food to cook every day
6	who decides how the money you usually earn will be used
7	who decides whether you go to work to earn money
8	who takes the decisions concerning your visits to family/relatives
9	Who takes the decisions concerning visits to your friends
10	if a child does not want to go to school, who would decide whether s/he mu
11	who decides about purchasing children clothes/shoes

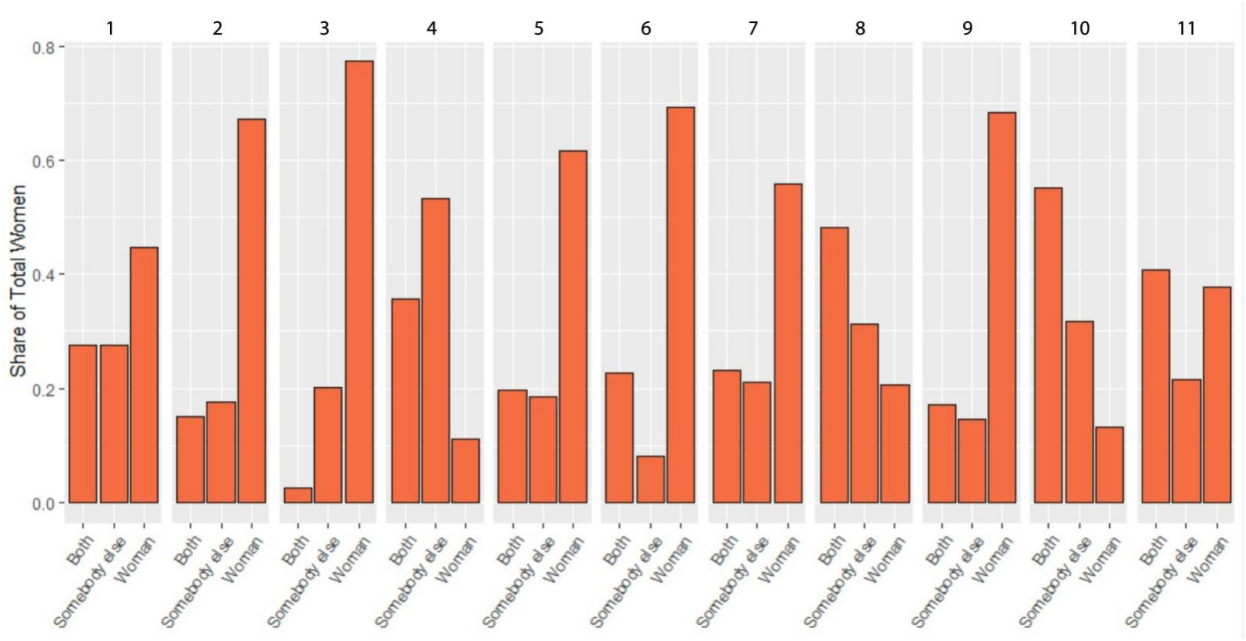


Fig. A1.1 Distribution of Baseline DM Responses. The Graph presents the responses of women in December 2019 to the questions in Table A.1.1.

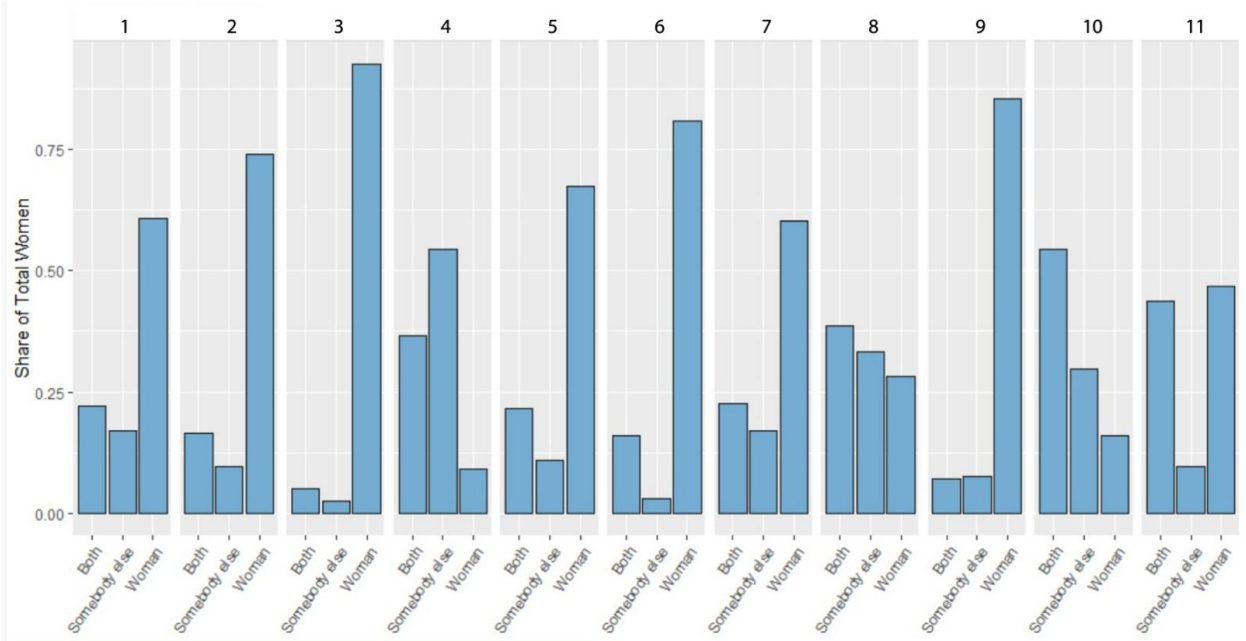


Fig. A1.2 Distribution of Endline DM Responses. The Graph presents the responses of women in December 2020 to the questions in Table A.1.1.

Table A1.2 Distribution of Base- and Endline PD Responses. Women were asked on a 5-point Likert scale whether they "strongly agree (1)"- "strongly disagree (5)" with statements on their husbands' behaviour and power. One question formatted in Yes/No is not included (see Table A2.2. for the questions)

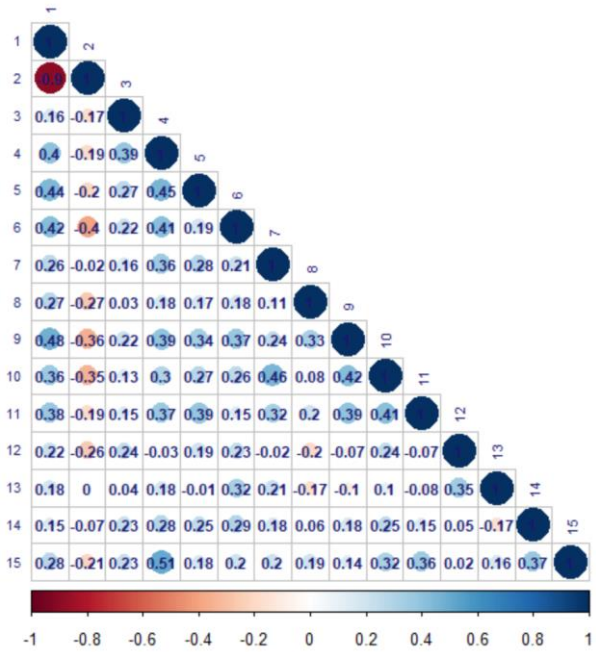
	Baseline					Endline				
	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
we generally do what he wants	0.19	0.48	0.06	0.24	0.04	0.26	0.39	0.05	0.23	0.08
he won't let me wear certain things	0.17	0.45	0.02	0.25	0.12	0.26	0.33	0.01	0.26	0.14
i'm around him	0.09	0.26	0.03	0.40	0.22	0.06	0.19	0.02	0.47	0.27
he has more say about joint decisions	0.28	0.47	0.05	0.19	0.02	0.34	0.44	0.02	0.17	0.04
he controls who i spend time with	0.11	0.25	0.03	0.43	0.18	0.11	0.21	0.04	0.45	0.20
i feel trapped or stuck	0.12	0.18	0.10	0.42	0.19	0.10	0.17	0.06	0.42	0.25
he does what he wants	0.24	0.32	0.03	0.35	0.06	0.24	0.36	0.04	0.29	0.08
i'm more committed	0.20	0.32	0.08	0.35	0.06	0.15	0.32	0.05	0.38	0.11
he sees other people	0.11	0.12	0.18	0.37	0.23	0.14	0.11	0.20	0.36	0.20
he wants to know where i am	0.22	0.34	0.03	0.32	0.09	0.26	0.37	0.02	0.28	0.08
he gets his way when we disagree	0.19	0.32	0.10	0.32	0.08	0.27	0.37	0.02	0.28	0.06
Total Average	**0.17**	**0.32**	**0.06**	**0.33**	**0.12**	**0.20**	**0.30**	**0.05**	**0.33**	**0.13**

A2 DM and PD Index Construction

The indices are constructed the same way as the Women Empowerment Index (WEI), only now the polychoric correlation matrix and factor analysis are performed separately for each part.

Table A2.1 and **Fig. A2.1** DM items and corresponding Polychoric Correlation Matrix. The Table lists all questions (incl. Yes/No) in the DM part. The Figure shows the polychoric correlation coefficients which are used to derive the factor loadings in A2.2.

DM Items	
1	the woman have worked for money during the last 12 months
2	the woman received money from other sources
3	who decides whether you should seek treatment if you are feeling sick
4	who takes decisions about you buying clothes
5	who takes decisions about you buying phone credit
6	who takes decisions concerning the large expenditures of the household
7	who takes decisions concerning which food to cook every day
8	who decides how the money you usually earn will be used
9	who decides whether you go to work to earn money
10	who takes the decisions concerning your visits to family/relatives
11	Who takes the decisions concerning visits to your friends
12	could you ask for financial help to your mother or father/other relatives
13	does your household have children
14	if a child does not want to go to school, who would decide whether s/he mu
15	who decides about purchasing children clothes/shoes



For efficiency purposes, items 2, 12 and 13 are removed during factor analysis. They show a negative polychoric correlation with other items, meaning that they do not measure the construct decision-making power.

Table A2.3 Factor Loadings of DM items. The factor loadings are derived by performing a single-factor analysis on the selected variables listed in A2.1. These loadings are used as weights to calculate the DM index.

DM Item's Factor Loadings

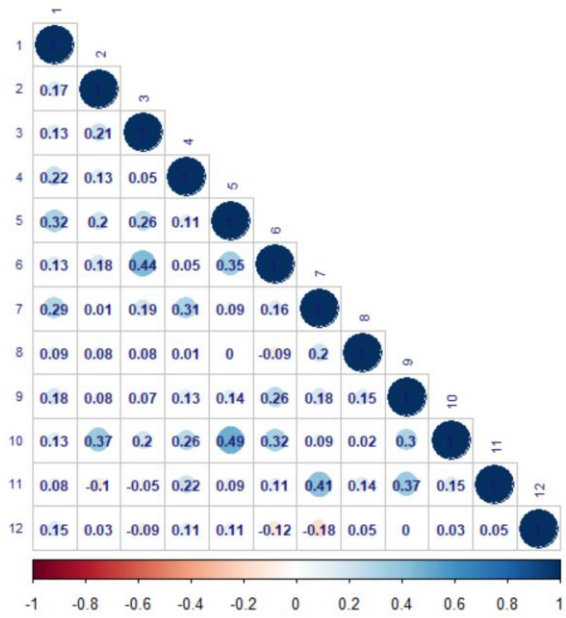
	Factor Loading
the woman have worked for money during the last 12 months	0.66
who decides whether you should seek treatment if you are feeling sick	0.38
who takes decisions about you buying clothes	0.71
who takes decisions about you buying phone credit	0.58
who takes decisions concerning the large expenditures of the household	0.51
who takes decisions concerning which food to cook every day	0.49
who decides how the money you usually earn will be used	0.32
who decides whether you go to work to earn money	0.62
who takes the decisions concerning your visits to family/relatives	0.57
Who takes the decisions concerning visits to your friends	0.58
if a child does not want to go to school, who would decide whether s/he mu	0.39
who decides about purchasing children clothes/shoes	0.51

The DM factor loading tables indicate that decisions on whether the wife works or buys clothes herself are weighted higher than items concerning health treatment or how her own money is spent. The DM factor is thus less reflective on the latter issues.

Table A2.4 and **Fig. A2.3** PD items and corresponding Polychoric Correlation Matrix. The Table lists all questions (incl. Yes/No) in the PD part. The Figure shows the polychoric correlation coefficients which are used to derive the factor loadings in A2.4.

PD Items

1	we generally do what he wants
2	he won't let me wear certain things
3	i'm around him
4	he has more say about joint decisions
5	he controls who i spend time with
6	i feel trapped or stuck
7	he does what he wants
8	i'm more committed
9	he sees other people
10	he wants to know where i am
11	he gets his way when we disagree
12	can you go out without the permission of your husband



Item 12, shows negative correlations with multiple items and is thus removed.

Table A2.5 Factor Loadings of PD items. The factor loadings are derived by performing a single-factor analysis on the selected variables listed in A2.1. These loadings are used as weights to calculate the PD index.

PD Item's Factor Loading

	Factor Loading
we generally do what he wants	0.38
he won't let me wear certain things	0.38
i'm around him	0.41
he has more say about joint decisions	0.32
he controls who i spend time with	0.61
i feel trapped or stuck	0.54
he does what he wants	0.32
i'm more committed	0.09
he sees other people	0.41
he wants to know where i am	0.66
he gets his way when we disagree	0.27

For the PD construct, the loadings of the items vary as well and are highest for those which indicate women's mobility (e.g. "he wants to know where I am"). Whether he does what he wants or has more to say in joint decisions is less reflected,

A3 Women Empowerment Index

Table A2.5 Factor Loadings of WEI items. The factor loadings are derived by performing a single-factor analysis on the selected variables listed in A2.3 and A2.5. These loadings are used as weights to calculate the WEI index.

WEI Item's Factor Loading

	Factor Loading
the woman have worked for money during the last 12 months	0.68
who decides whether you should seek treatment if you are feeling sick	0.36
who takes decisions about you buying clothes	0.68
who takes decisions about you buying phone credit	0.56
who takes decisions concerning the large expenditures of the household	0.52
who takes decisions concerning which food to cook every day	0.48
who decides how the money you usually earn will be used	0.32
who decides whether you go to work to earn money	0.64
who takes the decisions concerning your visits to family/relatives	0.57
Who takes the decisions concerning visits to your friends	0.57
if a child does not want to go to school, who would decide whether s/he mu	0.37
who decides about purchasing children clothes/shoes	0.48
we generally do what he wants	0.24
he won't let me wear certain things	0.21
i'm around him	0.08
he has more say about joint decisions	0.27
he controls who i spend time with	0.31
i feel trapped or stuck	0.18
he does what he wants	0.11
i'm more committed	-0.09
he sees other people	-0.12
he wants to know where i am	0.22
he gets his way when we disagree	0.06

Overall, DM items are weighted higher than PD items in the WEI index.

Appendix B

Population Description

This section describes additional key features of the population, including religion, villages, unemployment features, and the distribution of female and male labour participation.

B1 Religion

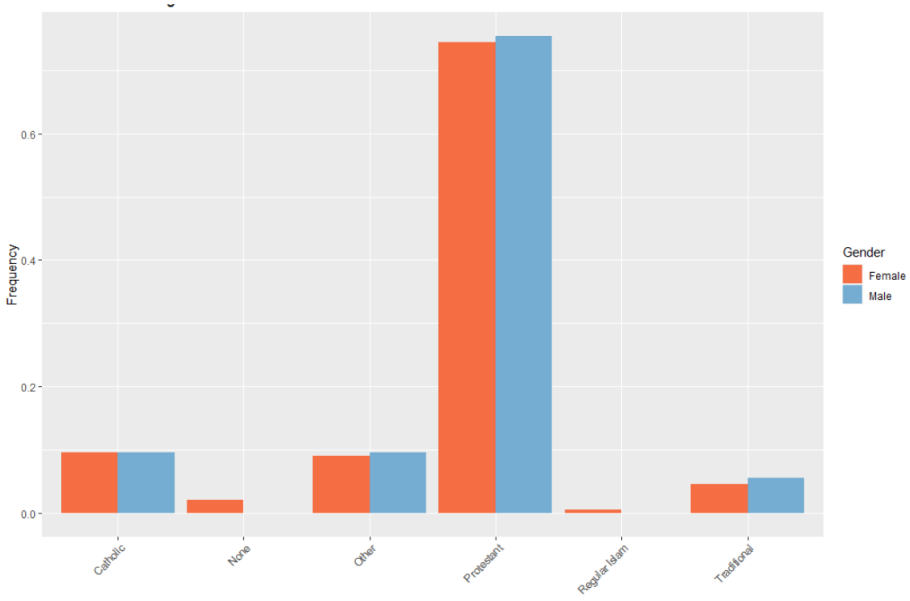


Fig. B1.1 Distribution of religion of female and male study participants.
Men and women were asked to report whether their religious belief was catholic, protestant, regular Islam, traditional or other. They could also indicate that they had no religion.

The distribution of religion is practically the same for both genders. More than 70% of the sample is Protestant. Because of this peak in responses, the study does not include a dummy for each religion but instead recodes the variable such that it is 1 if the participant is Protestant and 0 otherwise.

B2 Distribution of villages

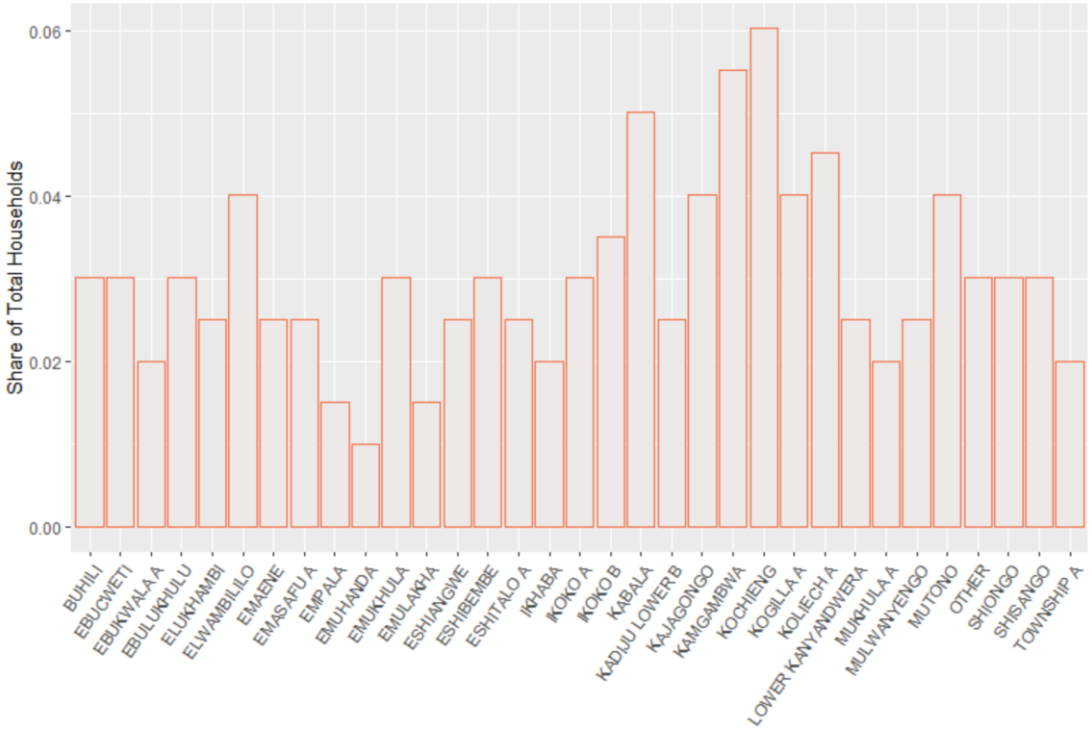


Fig. B2.1 Graph of the distribution of households over villages in Kisumu and Kakamega county. The original study sample is drawn by first randomly selecting 32 villages and then drawing samples of 10 households from each. The Graph shows the distribution of the households used in this study.

B3 Reason for unemployment

Table B3.1 Distribution of reasons why unemployed women and men in the sample do not work**.**

	Women	Men
sick, injury	0.03	0.23
student	0.01	0.00
caring for ill family	0.03	0.00
cannot find work	0.38	0.46
do not want to work	0.00	0.00
too young to work	0.00	0.00
too old/pensioner	0.00	0.23
taking care of family	0.47	0.00
other	0.08	0.08

A large percentage of women and men report that they are unemployed because they cannot find work. While 47% of unemployed women reason that they have to work, 0% of the men do so. They are more likely to respond that they are injured or too old.

B4 Labour participation rates

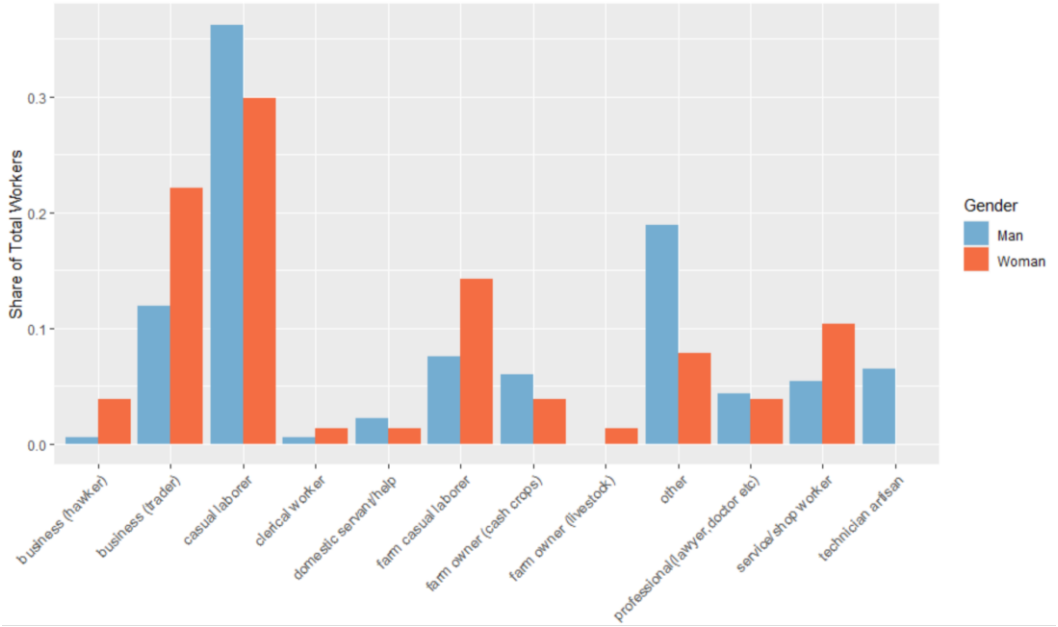


Fig.4.1 Distribution of labour among working women and men.

Each household member older than 12 was asked to report on his/her labour activities.

Appendix C

Robustness analysis

The following two regressions serve to check whether the effect of relative income is comparable and similar if decision making scores (DM) and power dynamic scores (PD) separately. Then, in C3 the study verifies whether the implementation of variables has significantly affected regression results.

C1 DM and PD Panel Regression

Table C1.1. Panel regression of relative income on DM and PD index. The derivation of the indices is shown in A2. The results for five panel regression models including the COVID indicator and interaction term are listed for both indices.

	DM (1)	DM (2)	DM (3)	DM (4)	DM (5)	PD (1)	PD (2)	PD (3)	PD (4)	PD (5)
Coeffcient										
Intercept	-1.47 * (0.52)	-1.43 * (0.47)	-1.43 * (0.52)	-1.41 * (0.52)	-0.94 * (0.52)	-0.32 (0.50)	-0.32 (0.48)	-0.32 (0.51)	-0.35 (0.50)	-0.14 (0.53)
Relative Income	0.76 * (0.31)	0.29 (0.26)	0.74 * (0.32)	0.61 * (0.32)	0.13 (0.30)	0.69 ** (0.22)	0.59 ** (0.20)	0.69 ** (0.21)	0.77 ** (0.22)	0.68 ** (0.22)
Age	0.04 ** (0.01)	0.03 ** (0.01)	0.04 ** (0.01)	0.03 ** (0.01)	0.02 * (0.01)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	0.02 (0.01)
Education	-0.02 (0.42)	0.05 (0.38)	-0.02 (0.42)	-0.00 (0.43)	-0.29 (0.46)	-0.45 (0.42)	-0.44 (0.41)	-0.45 (0.42)	-0.46 (0.40)	-0.69 (0.39)
Kisumu	0.10 (0.09)	-0.02 (0.09)	0.10 (0.09)	0.07 (0.09)	-0.04 (0.09)	0.42 * (0.19)	0.39 * (0.18)	0.42 * (0.19)	0.43 * (0.19)	0.44 * (0.18)
Protestant	0.15 (0.11)	0.12 (0.11)	0.15 (0.11)	0.15 (0.11)	0.11 (0.11)	0.16 (0.17)	0.15 (0.16)	0.16 (0.17)	0.16 (0.17)	0.11 (0.17)
COVID	0.14 (0.14)	-0.16 (0.12)	0.14 (0.14)	0.13 (0.14)	-0.15 (0.13)	0.14 (0.12)	0.08 (0.11)	0.14 (0.12)	0.15 (0.12)	0.08 (0.12)
COVID*Relative Income	-0.20 (0.34)	0.12 (0.29)	-0.20 (0.34)	-0.11 (0.34)	0.20 (0.30)	-0.53 * (0.29)	-0.46 (0.27)	-0.53 * (0.29)	-0.58 * (0.28)	-0.53 * (0.26)
Work		0.76 ** (0.09)			0.70 ** (0.08)		0.16 (0.12)			0.20 (0.12)
Income (m)			-0.00 (0.00)		-0.00 (0.00)			-0.00 (0.00)		-0.00 (0.00)
Income (w)				0.00 * (0.00)	0.00 * (0.00)				-0.00 (0.00)	-0.00 (0.00)
Education Difference (m-w)					-0.44 (0.27)					-0.27 (0.32)
Age difference (m-w)					0.00 (0.01)					0.00 (0.01)
Number of children					0.08 * (0.03)					-0.08 * (0.04)
Observations	398	398	398	398	398	398	398	398	398	398
R^2	0.136	0.252	0.137	0.146	0.279	0.076	0.080	0.076	0.078	0.101

*$p<0.1$ **$p<0.01$

The effect of relative income on both, women's decision making (DM) and household power dynamics (PD) is positive and significant for most models. Surprisingly, the interaction term

of COVID and relative income has a significant effect on PD, which implies that the effect of relative income on PD is different in post-COVID than in pre-COVID. The coefficient is not significant in the DM models, indicating that relative income is a more reliant determinant of DM than PD. Looking at the R-squared, it can also be seen that relative income explains more variation in DM than in PD. Further, the effect of work is relevant for DM but not for PD. Also, the difference between Kisumu and Kakamega in WEI is mainly explicable by variation in PD scores. Whilst the two indices are positively correlated with 0.21 (p-value = 0.01), the regression results reveal that the effect of relative income is not time-invariant for both.

C2 Panel regression without Imputed values

Table C2.1. Panel regression of relative income on WEI excluding imputed observations. The table lists the results for the five panel regression models in Section 6.4. without the 17 women with imputed values.

	(1)	(2)	(3)	(4)	(5)
Coeffcient					
Intercept	-1.40 * (0.58)	-1.34 * (0.51)	-1.36 * (0.58)	-1.37 * (0.58)	-0.96 (0.54)
Relative Income	0.93 ** (0.29)	0.50 * (0.23)	0.89 ** (0.30)	0.83 * (0.30)	0.39 (0.27)
Age	0.03 ** (0.01)	0.03 ** (0.01)	0.03 ** (0.01)	0.03 ** (0.01)	0.02 ** (0.01)
Education	-0.18 (0.51)	-0.12 (0.46)	-0.18 (0.50)	-0.17 (0.51)	-0.38 (0.50)
Kisumu	0.29 * (0.11)	0.19 * (0.09)	0.29 * (0.11)	0.28 * (0.11)	0.19 * (0.10)
Protestant	0.25 * (0.13)	0.21 * (0.11)	0.25 * (0.13)	0.25 * (0.13)	0.20 * (0.11)
COVID	0.20 * (0.12)	-0.07 (0.11)	0.21 * (0.12)	0.20 * (0.12)	-0.06 (0.11)
COVID*Relative Income	-0.46 (0.32)	-0.18 (0.27)	-0.47 (0.32)	-0.41 (0.32)	-0.14 (0.28)
Work		0.71 ** (0.09)			0.69 ** (0.09)
Income (m)			-0.00 (0.00)		-0.00 (0.00)
Income (w)				0.00 (0.00)	0.00 (0.00)
Education Difference (m-w)					-0.31 (0.32)
Age difference (m-w)					-0.00 (0.01)
Number of children					0.02 (0.04)
Observations	378	378	378	378	378
R^2	0.153	0.254	0.154	0.157	0.262

*$p<0.1$ **$p<0.01$

The effect of relative income remains significant after excluding imputed variables. Other coefficients also hardly change. The table shows that the imputed variables have not led to under- or overestimation of the effects.