1. Introduction

Despite their lower emission of greenhouse gases, developing countries remain more vulnerable to climate variability than developed countries (Diffenbaugh and Burke, 2019; Fankhauser and McDermott, 2014; Tol et al., 2004). At the country and regional levels, this vulnerability of developing countries is reflected in their slower economic growth, adverse health outcomes, and lower productivity as a result of an increasing number of extreme weather events such as floods, droughts, and extreme temperatures (Burgess et al., 2017; Park et al., 2018; Tol et al., 2004). At the individual and household levels, the impact of extreme weather and climate variability is more nuanced. Economically disadvantaged groups such as low-income individuals, women-headed households, and migrants often suffer more from the consequences of climate variability than their more prosperous counterparts (Flatø et al., 2017; IPCC, 2014). For instance, low-income earners who often work in sectors with more exposure to extreme weather lose (part of) their income (Park et al., 2018), female farmers are less capable of adopting drought-tolerant technologies and bear more risks of losing agricultural income (Fisher and Carr, 2015), while women-headed households left behind by migrant partners may also have fewer contacts with social networks and lower possibilities for coping with adverse consequences of extreme weather (Flatø et al., 2017).

Household employment choices and allocation of labor to agricultural and non-agricultural activities may be especially affected by climate variability. Many studies document that extreme weather events increase mortality (Burgess et al., 2017; Deschênes and Greenstone, 2011; Deschênes and Moretti, 2009; Otrachshenko et al., 2018, 2017), reduce self-rated health (Yang et al., 2022), reduce cognitive performance (Chang and Kajackaite, 2019; Cho, 2017; Groppo and Kraehnert, 2017; Park et al., 2020b, 2020a; Park, 2022; Randell and Gray, 2016), retard birth weight and early-childhood development (Banerjee and Maharaj, 2020; Greenstone et al., 2013; Lohmann and Lechtenfeld, 2015; Rocha and Soares, 2015;

Skoufias and Vinha, 2012), increase the likelihood of conflicts (Otrachshenko et al., 2021; Ranson, 2014; Vestby, 2019), and reduce labor productivity (Letta and Tol, 2019; Maccini and Yang, 2009; Park et al., 2018; Zhang et al., 2018). These impacts have direct implications for labor market activities. However, relatively few studies investigate how climate change and extreme weather events affect labor allocation, and their results are quite mixed. For instance, in a pioneering study on this topic, Graff Zivin and Neidell (2014) suggest that extreme heat in the US induces reallocation of time from work to non-work. In line with this finding, Otrachshenko and Popova (2022) show that extreme heat affects regional-level income distribution in Russia by increasing the unemployment rate. Recent studies on China also suggest that extreme heat leads to a reduction in work hours and the reallocation of labor from agricultural to non-agricultural sectors, but does not drive individuals out of the labor force or into unemployment (Huang et al., 2020; Jessoe et al., 2018; Jiao et al., 2021; Li and Pan, 2021).

This paper examines how climate variability affects individual labor supply in Uzbekistan, a highly traditional lower-middle-income country in Central Asia. Employing novel household survey data, we first study the impact of rainfall variability and mean temperature on employment in agricultural and non-agricultural sectors. Then, we focus on more specific employment choices in rural and urban areas such as having own business activities, salaried employment, self-employment in a farm or a croft, having irregular remunerated activities, or being out of labor force, holding unemployment as a default choice. In addition, we analyze whether greater women's empowerment at the household level helps a household to be more resilient to climate variability. Women's empowerment is measured as a degree of women's involvement in household spending decisions, labor market participation, and various social activities. We hypothesize that women's empowerment brings additional adaptive capacity to households in the face of climate change, for instance, by bringing additional household income, directing employment choices toward less risky activities, and/or encouraging other household members to do so.

Our findings suggest that both temperature and rainfall variability affect occupational choices, especially the likelihood of having own business, of being involved in irregular remunerated activities, and of being out of the labor force. Climate variability also affects the probabilities of being in agricultural and non-agricultural sectors. The results differ between rural and urban areas, and women's empowerment serves as a channel for the relationship between climate variability and employment choices, especially in rural areas.

Our paper contributes to the literature in several ways. First, we provide evidence that women's empowerment helps to make households in lower-middle income and developing countries more resilient to risks associated with climate change. This has the important policy implication that strengthening the role of women in household decision-making creates additional adaptive capacity in the face of climate change. Second, we provide a comprehensive analysis of individual labor supply decisions in response to climate variability. For this, we focus on both the individual involvement in agricultural and non-agricultural activities and on several specific employment choices, including employment, self-employment, business activities, irregular activities, staying out of labor force, and being unemployed. Such an analysis is important for understanding the employment dynamics and factors linking individuals in rural and urban areas to the labor market. Finally, we focus on Uzbekistan, a country prone to climate risks and dependent on agriculture that also maintains traditional gender roles, but has a legacy of the Soviet past, with its focus on gender equality.

2. Mechanisms and hypotheses

Both exposure to extreme heat and rainfall scarcity may affect labor market decisions (Huang et al., 2020). The impact of temperature on labor market decisions may be attributed to several interrelated channels. The first is biological. The exposure to extreme heat is a thermal stress to the human body that induces thermoregulation and physiological adjustment (Basu and Samet, 2002; Dell et al., 2014). This reduces human performance in cognitive and physical tasks (Graff Zivin et al., 2018; Park et al., 2020a; Seppänen et al., 2006), leading to a lower labor productivity and the reallocation of labor from employment to leisure and unemployment (Graff Zivin and Neidell, 2014; Zhang et al., 2018).

Another channel that may explain the effect of temperature on household employment decisions is the difference in relative exposure to heat between economic sectors. For instance, extremely hot temperature leads to reallocation of labor away from sectors with a relatively high exposure, e.g. agriculture and farming, to sectors with a relatively low exposure, e.g. non-agricultural activities (Huang et al., 2020; Jessoe et al., 2018; Li and Pan, 2021; Park et al., 2018). Such reallocation may be triggered by health-related reasons. Due to detrimental effects on their health, individuals would wish to reduce their exposure to extreme temperatures and choose employment in a sector with a lower exposure. Another reason for such reallocation is economic opportunities. Due to lower labor and capital productivity, exposure to heat may reduce the relative returns in sectors with greater exposure such that sectors with a lower exposure become more attractive (Huang et al., 2020; Jessoe et al., 2018; Zhang et al., 2018).

While most literature on extreme weather events and labor market outcomes focuses on the impact of extreme heat, the impacts of droughts and rainfall scarcity on labor market choices has received less attention. Heat in combination with rainfall shortage may produce even more detrimental effects for human health and labor market decisions.

In low-income economies a large share of labor force is devoted to and dependent on agriculture, and often has no means for drought-tolerant agricultural production technologies. Given that water is an important input in agricultural production, rainfall shortage leads to agricultural income loss, increased food prices, and consumption shocks, forcing individuals to seek ways to adjust to such adverse shocks (Barrios et al., 2010; Chuang, 2019; Flatø et al., 2017; Hirvonen, 2016). One such adjustment is the diversification of household income sources by relocating labor supply of household members from farming-related self-employment and business activities to non-farming activities and wage-earning employment (Bandyopadhyay and Skoufias, 2015; Chuang, 2019; Huang et al., 2020). Low precipitation also reduces demand for agricultural workers, leading to higher unemployment (Huang et al., 2020; Jessoe et al., 2018; Mueller et al., 2020).

Given these mechanisms, we therefore outline a first set of testable hypotheses.

H1a: Climate variability leads to reallocation of labor from agricultural to non-agricultural activities and unemployment.

H1b: Climate variability leads to reallocation of labor from business and employment to unemployment.

A second set of our hypotheses is related to women's empowerment and differences in labor market activities between men and women. A recent study documents that facing heat stress, women perform on math and verbal tasks better than without heat stress, while men perform better at lower temperatures (Chang and Kajackaite, 2019). Moreover, women are more risk-averse, prefer less-competitive situations, are more cooperative, more sensitive to social signals, and more emotional in uncertain situations (Croson and Gneezy, 2009; Frank et al., 1993; Loewenstein et al., 2001; Ortmann and Tichy, 1999). Given these differences between men and women, we hypothesize that women's empowerment may affect employment decisions of household members and increase household resilience to climate shocks. This may occur through several possible mechanisms.

First, female labor force participation brings additional income to a household, reducing its liquidity constraints and smoothing its consumption when faced with climate shocks (Cattaneo and Peri, 2016; Flatø et al., 2017; Hirvonen, 2016; Park et al., 2018). In households with a higher degree of women's empowerment, women are more likely to be in the labor market. Having an additional earner in a family makes such households less vulnerable to temperature and rainfall shocks.

Households with more members participating in the labor market also have more opportunities to diversify income sources through diversifying employment choices. This brings an additional adaptive capacity to such households. For instance, in regions with high rainfall variability, it is less likely that all members of the same household will be self-employed in agriculture (Bandyopadhyay and Skoufias, 2015) and more likely that household members will diversify their employment choices (Chuang, 2019).

Earlier literature also suggests that men and women differ in their labor market decisions when faced with temperature and precipitation shocks. While men are more likely to shift their time from non-agricultural work to leisure as a result of heat and drought exposure, there is no such effect for women's employment decisions (Huang et al., 2020). However, due to differences in access to resources and social networks, women are also less likely to adopt drought-tolerant agricultural production technologies (Fisher and Carr, 2015), making female-headed households more vulnerable to climate variability (Flatø et al., 2017).

Finally, since women are more risk averse (Croson and Gneezy, 2009; Loewenstein et al., 2001), it is more likely that they will make employment choice in favor of less risky activities and possibly encourage other household members to do so (Azmat and Petrongolo, 2014). Thus, we hypothesize that persons in households with a greater degree of women's empowerment will more likely prefer non-agricultural activities and salaried employment as compared to households with a lower degree of women's empowerment.

Thus, our hypothesis regarding the role of women's empowerment is as follows.

H2: Employment choices in households with a greater degree of women's empowerment are less affected by climate variability.

3. Background

3.1. Climate and economy of Uzbekistan

Uzbekistan is a doubly landlocked lower-middle income economy and the most populated country in Central Asia. It borders Kazakhstan, Turkmenistan, Afghanistan, Tajikistan, and Kyrgyzstan, which are also landlocked. The area of Uzbekistan is approximately equal to that of Spain and the population is over 33 million with equal shares of women and men. Almost half of the population of the country (49.6% in 2019) lives in the rural area (World Bank, 2019).

The north-east and south-east parts of the country are mountainous. In the north-central and western parts, deserts are located. Deserts and steppe comprise 80% of country's territory and mountains occupy the remaining 20%. The administrative division of Uzbekistan includes 12 provinces, one autonomous republic, and one independent city that are classified into 7 geographic-economic zones.[1]

The climate of Uzbekistan is dry and continental. The average temperature in January varies from -5°C in the north to +5°C in the south, while the average temperature in July varies from +26°C and +30°C in the north to +32°C and +41°C in the south. The average annual precipitation varies from 80 mm in the north, 200-300 mm in the west, and 1000 mm in mountainous areas.

Uzbekistan is especially prone to climate risks. Over the last 50 years, the average annual temperature increased in Uzbekistan by 1.5°C, which is twice more than the global average for the same period. According to different estimates, average annual temperature in Uzbekistan is projected to increase by 3-8°C by 2040 (Boehlert et al., 2013). The average annual precipitation has fallen by 10 mm over the last 50 years. Projections suggest an

[1] Southern (Qashqadaryo and Surkhandaryo regions), Northern (Karakalpak, Khorezm), Fergana (Andijan, Fergana, Namangan), Central (Samarkand, Bukhara, Navoi), Tashkent capital, Tashkent region, and Mirzachul (Djizzakh, Sirdaryo).

increasing rainfall variability in the future with even drier climate in most of the country and increasing precipitation in mountainous areas (Boehlert et al., 2013).

Water scarcity, water salinization, desertification, and land erosion are the main climate-related challenges of Uzbekistan. Currently, 90% of the surface water is used for irrigation purposes. The World Bank predictions suggest that the water scarcity problem will worsen in the future, leading to an increase in the water deficit from 2,000 m^3 in 2005 to 13,000 m^3 by 2050 and reducing the yields of almost all crops by 20-50% by 2050 (Boehlert et al., 2013). This brings significant risks to the economy of Uzbekistan. According to the World Development Indicators (World Bank, 2019), agriculture is one of the major economic sectors. It contributes 25.5% to the country's GDP and employs 23.9% of the labor force. Uzbekistan is one of the largest producers and exporters of cotton. Services and industry contribute approximately equal shares of GDP (32.2% and 33.2%, respectively). 46.6% of the labor force is employed in services and 29.5% in industry, including construction.

3.2. Women's empowerment in Uzbekistan

Traditional gender roles play an important role in Uzbekistan, especially in rural areas. Surveys indicate that 80% of the population in Uzbekistan supports the family model in which men are breadwinners and women are homemakers (FAO, 2019). Families in Uzbekistan are often extended and have patriarchal power structure with a high authority of elders, and boys controlling girls even when the girls are older (Bhat, 2011). Women are responsible for most household chores in the family, including taking care of children and the elderly, cooking (regularly and on special family occasions), and housekeeping (Tokhtakhodjaeva, 1997). Moreover, especially in rural areas, the chores also include home-based activities to support household current consumption, including working in the garden plot, looking after livestock and poultry, and delivering water for drinking and domestic needs (Bhat, 2011). Women also have fewer opportunities for economic activities than men, and are often criticized for deviating from traditional roles and engaging in self-employment activities such as shuttle trade (Bhat, 2011; Kamp, 2005; Welter and Smallbone, 2008).

Traditional gender roles are also reflected in the labor market. As shown in Table A1 in the appendix A, according to the World Development Indicators (World Bank, 2019), female labor force participation in Uzbekistan is 52% of the working age women, which is much lower than in neighboring Kazakhstan (72%) and Russia (69%). Low female labor force participation and low preprimary enrollment rates for both boys and girls also confirm that women are often housekeepers and primary caregivers in Uzbekistan (FAO, 2019). Moreover, as compared to Kazakhstan and Russia, women in Uzbekistan are more likely to be self-employed or employed in agriculture and less likely to be employed in industry and services. Traditional gender norms also imply that priority in receiving education is given to boys in the family (Bhat, 2011; Tokhtakhodjaeva, 1997), which is confirmed by a lower rate of enrollment in tertiary education of women than men.

4. Data

4.1. Survey details

We use cross-sectional household-level survey data collected in Uzbekistan from November 2015 to January 2016. The initial sample includes 600 households with 3,000 individual observations from about 100 districts (*mahalla*).[2] For the analysis we use data on working age population, which is about 1,600 observations. The primary sampling unit is a household, and the respondent is the household head or the most knowledgeable person in the household. 95% of all interviews were conducted in the Uzbek language and 5% in Russian.

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[2] *Mahalla* is derived from the Arabic "mahali" which means "local". In Uzbekistan, the term *mahalla* means neighborhood, local community, or state administrative unit.

The survey is country representative. In each geographic-economic zone, a random sampling of regions, districts, and a random selection of households in each district is done. Sampling quotas are calculated for each geographic-economic zone, and the share of urban and rural population. Of 600 interviews, 51% (304) were conducted in urban areas and 49% (296) in rural areas. The survey was covered regions from each geographic-economic zone (see Figure A1 in the appendix A).

The survey questionnaire includes information on household and individual socioeconomic characteristics, including age, gender, education, employment status, and the economic sector of main occupation of each household member, administrative unit and *mahalla* of residence, rural or urban area of residence, migration patterns in household, and women's empowerment experiences in the household. Table 1 presents the descriptive statistics for all variables used in our analysis. Table A2 in the appendix A also provides the sample descriptive statistics for rural and urban areas and by gender.

4.2. Employment choices

We first focus on the sector of main occupation, including agricultural sector, non-agricultural sector, being unemployed, and being out of labor force. We then take a closer look at employment choices in rural and urban areas and analyze several more specific employment choices, including (1) having own business, (2) being employed in the state or private sector, (3) being self-employed in a farm or a croft (*tomorqa)*, (4) having an irregular remunerated activity, (5) being unemployed, or (6) being out of labor force.

Having own business as a main occupation means that a respondent has a registered business in non-agricultural sector, i.e., has a patent to operate as an independent entrepreneur or this business is registered as a legal entity, has an unregistered business in non-agricultural sector, or is a farm owner. Thus, this category includes both formal and informal businesses.

Being employed means that a respondent has a salaried job in a public or private sector, including being on maternity leave. Self-employed are those respondents who work in a family farm or a croft, including those who work in a croft but are perceived as unemployed. Having an irregular remunerated activity means being a *mardikor*, i.e., having temporary, one-time, or seasonal work. Being self-employed and having an irregular remunerated activity are both also typically informal.

We consider unemployed under the definition of the International Labor Organization, i.e., those who currently do not work, but actively search for a job and are ready to start working immediately given the job opportunity.[3] Those who are out of labor force are working-age respondents who currently do not work and for any reason do not search for a job. Our sample excludes individuals younger than 18 years old, students, retired, and individuals with severe disabilities.[4]

It is important to account for informal employment while studying the occupational choices in developing and transition economies (Lehmann, 2015; Lehmann and Pignatti, 2018; Williams and Lansky, 2013). Informal employment typically includes work without an employment contract, self-employment without registering this activity, or irregular remunerated activities (Lukiyanova, 2015; Staneva and Arabsheibani, 2014; Williams and Lansky, 2013). Due to the nature of informal employment, it is often difficult to distinguish between unemployment and informal employment. The occupational choices we studied include both formal and informal activities, and we account for self-employment and irregular activities as separate categories.[5] Also, all choices in our sample are mutually exclusive. Thus,

[3] Unfortunately, we do not have information on the unemployment duration.

[4] The retirement age in Uzbekistan is 60 years old for men and 55 years old for women, but the retired can also continue working while receiving retirement benefits. If a respondent has reached retirement age but considers business, salaried employment, self-employment, or irregular activity as his/her main occupation despite being retired we keep such respondents in our sample. Such persons constitute 1% of our sample.

[5] The sample size does not allow us to distinguish between formal and informal businesses as separate categories.

the respondents are likely to have no incentive to state that they are unemployed when they are in fact employed informally.

Finally, in a separate model specification we also account for secondary occupations from the same set of choices as the main occupation (business, employment, self-employment, and irregular activity).

4.3. Women's empowerment

The question on women's empowerment in our survey is formulated as follows: "Do you agree or do not agree with the following statements: (i) women in our family take active participation in decision making of main issues (i.e. planning of family expenses, large expenditure items, organization of family events, and education of children), (ii) women in our family can make independent decisions (iii) if women in our family want to work, no one will impede them, and (iv) women in our family can go to a wedding, visit relatives living far away, go shopping without formal authorization from their spouse, father, brothers etc." This question is answered by a most knowledgeable person in a household. If a respondent agrees with a statement, the answer is coded as one and zero otherwise.

Based on this survey question, we construct a categorical variable for women's empowerment that equals zero if a respondent disagrees with all statements (this category is used as a default in our analysis), 1 if a respondent agrees with one statement, 2 if a respondent agrees with two statements, 3 if a respondent agrees with three statements, and 4 if a respondent agrees with all four statements. Using this categorical variable helps to capture a possible non-linearity of women's empowerment in a household from 0 (the lowest) to 4 (the highest). Figure 1 presents the distribution of answers to the women' empowerment question.

In Figures A2-A4 in the appendix A, we disentangle the responses to this question by gender and urban/rural area. In rural areas, responses of women and men are similar, while in urban areas, women feel more empowered than men evaluate them to be. Also, women and men in urban areas are more likely to agree with women's empowerment statements than women and men in rural areas. The responses to the women's empowerment question by gender also confirm that men are more conservative than women and in rural areas women are less empowered than in urban areas.

4.4. Temperature and rainfall variability

The data on temperature (°C) and precipitation (mm) are taken from the Earth Map for the period from 1979 to 2015 at a district (*mahalla*) level. These data are based on the fifth generation European Centre for Medium-Range Weather Forecasts (ECMWF) atmospheric reanalysis of the global climate (ERA5).[6]

The key variable that we use in our analysis is rainfall variability (RV). RV is an index of climatic risk and is the average deviation in annual departures from normal rainfall in percent of long-term average (Conrad, 1941; Schulze, 2012, 2007a, 2007b) and is constructed as follows:

$$RV_s = \frac{Standard\ deviation_{s,1979-2015}}{Annual\ precipitation_{s,1979-2015}}$$

where $Standard\ deviation_{s,1979-2015}$ stands for the average standard deviation from its mean during the 1979-2015 period in district s. $Annual\ precipitation_{s,1979-2015}$ is the average annual precipitation during the 1979-2015 period.

5. Methodology

5.1 The model

An individual i has the following employment choices: (1) to be involved in agricultural activities, (2) to be involved in non-agricultural activities, (3) to stay out of labor force, or (4) to

[6] For more details, see http://www.openforis.org/tools/earth-map.html.

stay unemployed. Following Cameron and Trivedi (2005), we use the additive random utility model for multiple alternatives in which the individual utility associated with the n^{th} alternative is as follows:

$$U_{ins} = V_{ins}(x_{is}, RV_s, temp_s) + \varepsilon_{ins}$$

$$V_{ins}(\boldsymbol{x}_{is}, RV_s, temp_s) = \delta_n temp_s + \theta_n RV_s + \boldsymbol{x}'_{ins}\boldsymbol{\beta}_n \quad (1)$$

where the subscripts $i,\ n = \overline{1,4},$ and s stand for an individual, occupation alternatives, and a district, respectively. U_{ins} stands for the utility of an individual i, who decides regarding an occupation n in a district s. $V_{ins}(\cdot)$ is the deterministic component of an individual i utility. $\boldsymbol{x_i}$ is a set of individual characteristics such as age, gender, level of education, living in urban or rural areas, and a particular geographic-economic zone. RV_s and $temp_i$ stand for rainfall variability and the average annual temperature (˚C) for the 1979-2015 period, respectively, that an individual i has faced in a district s. ε_{ins} is the random component of an individual i utility and stands for individual unobserved characteristics. δ_n, θ_n, and $\boldsymbol{\beta_n}$ are a set of parameters to be estimated.

The individual decision regarding occupation is based on choosing the alternative with the greatest utility. That is, she chooses occupation n if the utility for this occupation is greater than the k^{th} alternative, implying that $U_{ins} \geq U_{iks}$ for $\forall\ n \neq k$. In this study staying unemployed is used as the reference alternative. Thus, the probability that an individual i chooses occupation n is as follows:

$$\Pr[Occupation_{is} = n] = \Pr[U_{ins} \geq U_{iks}]$$

$$= \Pr\left[V_{ins}(x_{is}, RV_s, temp_s) + \varepsilon_{ins} \ \geq\ V_{iks}(x_{is}, RV_s, temp_s) + \varepsilon_{iks}\right]$$

$$= \Pr\left[\ V_{ins}(x_{is}, RV_s, temp_s) - V_{ik}(x_{is}, RV_s, temp_s) \geq \varepsilon_{iks} - \varepsilon_{ins}\ \right]\ for\ \forall\ n \neq k \quad (2)$$

where $\boldsymbol{\varepsilon}$ are independent identically distributed type 1 extreme values and have the following density function:

$$f(\varepsilon_{ins}) = e^{-\varepsilon_{ins}} \exp(-e^{-\varepsilon_{ins}}) \quad for \ n = \overline{1,4} \qquad (3)$$

Given (2) and (3), we obtain the multinomial logit model:

$$\Pr[Occupation_{is} = n] = \frac{e^{V_{ins}}}{e^{V_{i,agriculture,s}} + e^{V_{i,non-agricultur\ ,s}} + e^{V_{i,out,s}} + e^{V_{i,unempl.,s}}} \ (4)$$

Following a similar methodology, we then model the following occupational choices of an individual *i*: (1) to have own business, (2) to be employed, (3) to be self-employed in a farm or a croft, (4) to have irregular remunerated activities, (5) to stay out of labor force, or (6) to stay unemployed. In all model specifications, robust standard errors are clustered at a district (*mahalla*) level. In addition, we estimate all models for urban and rural areas separately. In a separate model specification we also analyze the occupational choices by gender.

To analyze whether women's empowerment serves as a channel behind the impact of climate variability on employment decisions, we include women's empowerment variable in Eq. (4) with four separate categories, as described in the data section above. If the main effect of climate variability changes in magnitude or loses its significance when women's empowerment categories are included, this implies that women's empowerment may serve as a channel for the climate variability and employment decisions relationship.

In addition, we provide several robustness checks to our results, as described in the appendix B.

6. Results

6.1. Main results – agricultural vs. non-agricultural jobs

Tables 2 and 3 present the main estimation results (marginal effects) for Eq. (4). Unemployment is used as a default category and marginal effects are interpreted in comparison to this category. Given that individuals in rural and urban areas face different employment opportunities, we disentangle the results by urban and rural areas (Table 2). We then also present these results by gender (Table 3). For simplicity, Table 2 and 3 present only the main results regarding the effects of temperature and rainfall variability (for full regression results, see Table A3 and A4 in the appendix A).

As shown in Table 2, rainfall variability reduces the probability of being in the agricultural sector in urban areas by 1.7 p.p. and increases the probability of being in the non-agricultural sector in rural area by 3.1 p.p. Thus, because of increasing rainfall variability, individuals in an urban area would rather be unemployed than involved in agricultural activities, while in a rural area, individuals prefer working in the non-agricultural sector. In addition, in a rural area, with an increase in rainfall variability, individuals are also more likely to become unemployed instead of being out of labor force by 3.6 p.p. This result supports our Hypothesis 1a.

We further disentangle these results also by gender. The results are presented in Table 3. In urban areas, employment choices of both women and men are unaffected by temperature and rainfall variability, while in a rural area, we uncover several important differences in the impact of temperature and rainfall variability on employment choices of men and women. A 1 p.p. increase in rainfall variability leads to an increase in women's involvement in agricultural sector by 3.9 p.p. and to an increase in men's involvement in non-agricultural sector by 4.96 p.p. At first glance, this may seem counterintuitive that women prefer involvement in riskier agricultural sector when rainfall variability rises. However, non-agricultural jobs are scarce in a rural area and traditional gender norms imply that men should be given priority when employment opportunities are low. Since rainfall variability may tighten the liquidity constraints for rural households, the agricultural sector may become the only possibility for a woman in a rural area to earn money instead of remaining unemployed. This explanation is also confirmed by a substantial decrease in the likelihood of being out of labor force for women in a rural area (by 6 p.p.). These findings are also consistent with the results presented in Table 2.

6.2. Occupational choices in urban and rural areas

Tables 4 and 5 present the estimation results (marginal effects) for several specific occupational choices in urban and rural areas, including having own business activities, salaried employment, self-employment in a farm or a croft, having irregular remunerated activity, and staying out of the labor force, holding unemployment as a default choice. Similarly to the results above, we first present these results for urban and rural areas (Table 4) and then disentangle these results by gender (Table 5).[7]

As shown in Table 4, a 1˚C increase in temperature raises the likelihood of being out of labor force in both urban and rural areas (by 1.5 p.p. and 5.1 p.p., respectively). This finding is consistent with the literature on the allocation of time during heat (Graff Zivin and Neidell, 2014). In addition, an increase in temperature raises the probability of being employed in an urban area by 6.8 p.p. and raises the likelihood of having business in a rural area by 1.2 p.p.

Regarding rainfall variability, its increase by 1 p.p. raises the probability of having own business in an urban area by 2.82 p.p. and reduces the probability of having irregular remunerated activity by 2.77 p.p. when compared to unemployment. This result might be explained by increasing opportunities for running business in the service sector on a regular basis instead of being involved in irregular activities. Thus, we find support for Hypothesis 1b in urban areas in the case of irregular remunerated activities, but not in the case of business activities.

In rural areas, we observe that rainfall variability decreases the probability of having own business by 0.71 p.p. and increases the probability of having irregular remunerated

[7] Full results for Table 4 are presented in Table A5 in the Appendix A.

activity by 2.76 p.p. Rainfall variability in a rural area also reduces the likelihood of being out of labor force by 3.3 p.p., i.e., individuals become unemployed and start looking for a job.

These results suggest that individuals in rural and urban areas indeed react to climate variability differently. In urban areas, where economic sectors are more diversified, in response to rainfall variability individuals prefer to run own business and reduce irregular activities. In rural areas, where most activities are related to either agriculture or its related services, higher rainfall variability increases the risks for farming, and as a result, reduces income. Thus, individuals choose to be involved in irregular remunerated activities to secure their livelihood. Interestingly, in both rural and urban areas the choice to be employed in private or public sector is unaffected by rainfall variability and the choice to be self-employed is unaffected by either temperature or rainfall variability.

We then disentangle the results by gender. The results are presented in Table 5. For women in a rural area, rainfall variability marginally increases the likelihood of being employed (by 2.3 p.p.) and having irregular activities (by 0.9 p.p.) and significantly decreases the likelihood of being out of labor force (by 6 p.p.). This suggests that with an increase in rainfall variability, women start looking for a job, but the job opportunities for women in a rural area might be scarce. For men in a rural area, rainfall variability raises the likelihood of moving from unemployment to irregular activities by 4 p.p., providing opportunities to earn when own business is risky or regular employment possibilities are scarce. In an urban area, rainfall variability affects women's employment choices only and does not affect the employment choices of men. For women, the likelihood of being involved in business increases by 3.3 p.p. in response to 1 p.p. increase in rainfall variability, while the likelihood of being involved in irregular activities and in employment decreases by 1.4 p.p. and 4.3 p.p., respectively. Temperature has no effects on employment choices of men in both rural and urban areas. With an increase in the average temperature by 1˚C, women in a rural area are more likely to become out of labor force as compared to being unemployed and are less likely to be self-employed, while in urban areas, women are more likely to become employed.

6.3. The role of women's empowerment

Next, we test whether women's empowerment smooths the impact of climate variability on the occupational choice. Table 6 presents the results for employment in agricultural and non-agricultural sectors. In the presence of women's empowerment, the magnitude of the marginal effect of rainfall variability on being employed in the agricultural sector in urban areas has slightly increased. In rural areas, the magnitude of the marginal effect of rainfall variability on being employed in a non-agricultural sector becomes nonsignificant, while the magnitude of the marginal effect of rainfall variability on being out of labor force decreases and becomes marginally significant. These results point out that under climate risks, women's empowerment in urban areas shifts labor force away from the risky agricultural sector. In rural areas, employment choices are shifted from being out of labor force to unemployment and from unemployment to non-agricultural jobs, providing the possibility to receive income that is less vulnerable to climate risks. This is in line with our Hypothesis 2 and with the literature that shows that women are more risk averse.

Table 7 presents the results with the women's empowerment for occupational choices. As shown, the introduction of women's empowerment makes the marginal effect of temperature on the choice of having own business in rural areas nonsignificant. Moreover, the impact of temperature on the choice of being out of labor force becomes marginally significant and of lower magnitude, while the negative impact of temperature on the choice of irregular activities becomes statistically significant. Women's empowerment also reinforces the positive impact of temperature on the likelihood of being employed in an urban area. These findings suggest that women's empowerment serves as a channel through which the relationship between temperature and choice is explained.

Concerning rainfall variability, we find that in an urban area the magnitude of marginal effects on having own business has decreased by 13 p.p. (=[2.453-2.817]/2.817) and on having irregular remunerated activities has increased by 5.7 p.p., respectively. In rural areas, the marginal effect of rainfall variability on the choice of having own business becomes nonsignificant and on the choice of irregular remunerated activity increases by 20 p.p. In rural areas women's empowerment also decreases the magnitude of the effect of rainfall variability on the choice of being out of labor force (26 p.p.) and makes it marginally significant. Thus, women's empowerment affects the relationship between rainfall variability and having own business in both rural and urban areas. A possible explanation is that running a business is not only associated with a high risk and uncertainty but also requires some efforts and investment. In this case women, who are more risk averse than men, may remain unemployed or advise their family members to remain unemployed. On the other hand, we find that the marginal effect of rainfall variability on having irregular remunerated activity increases in the presence of women's empowerment, suggesting that such empowerment encourages finding a job when climate risks increase. These findings suggest that women's empowerment may help to secure their household's livelihood under climate risks, providing support to our Hypothesis 2.

6.4. Secondary jobs

7.3% of the respondents in our sample also have a secondary occupation in addition to their main one. The secondary occupation is from the same set of the main employment choices, i.e., having own business, being employed, being self-employed, or having irregular activities. Based on this information we create a dummy variable that equals 1 if an individual has a secondary occupation and zero otherwise. The choice to have a secondary job is conditional on having the main one. Therefore, we exclude individuals who are unemployed or out of labor force as their main occupational choice.

As shown in Table 8, an increase in rainfall variability of 1 p.p. raises the likelihood of having a secondary job in a rural area by 2.67 p.p., while in the whole sample and in the subsample of an urban area there is no such effect. This implies that rainfall variability substantially increases the risk of income loss for individuals in a rural area, so individuals are forced to look for additional income sources and choose to have a secondary occupation in addition to the main one.

When we include women's empowerment in Table 8, the magnitude of the marginal effect of rainfall variability in rural area becomes slightly less (by 6.4 p.p.). This suggests that women's empowerment may partially serve as a channel between the rainfall variability and the choice to have a secondary job. With women's empowerment, it is likely that women in a household also work, providing an additional income to the household. This smooths the impact of rainfall variability.

7. Conclusion

This paper contributes to the literature by analyzing the impact of climate variability on individual labor supply decisions in Uzbekistan, a country with high risks of bearing the adverse economic consequences due to global warming due to its dependency on agriculture and significant climatic risks. Earlier studies on the role of climate variability on labor market have mostly focused on the effects of extreme temperatures. Our findings underscore that it is important to account for both temperature and rainfall variability. We find that temperature and rainfall variability affect the decisions to be active in agricultural or non-agricultural sector as well as the decisions to have own business activities, to have irregular remunerated activities, or to be out of labor force. The effects of climate variability differ in rural and urban areas. Interestingly, women's empowerment helps to smooth the effects of climate variability and shifts employment choices to less risky activities. This implies that women's empowerment is an important instrument in protecting households from income losses in the presence of global warming.

Our results open several avenues for future research that can be pursued upon the availability of panel data at regional and individual levels. First, we examine the individual labor supply allocation specifics at a given point of time. It would also be interesting to analyze the role of climate variability on occupational choices over time. By showing that occupational choices do not depend on the period over which climate variability is calculated, we provide a starting point for such an analysis. Given that the frequency and intensity of extreme weather events increase over the course of global warming, future studies may examine how the labor allocation changes over time, which occupational choices and industries are affected more, and whether women's empowerment plays an increasing role over time. This is especially important for lower-middle income and developing economies, many of which suffer from the consequences of global warming given their geographic location and traditionally high involvement in agriculture.

Another important dimension to consider is the role of climate variability and women's empowerment on the labor demand. Finally, it would be important to take a closer look at the regional dimension and investigate whether and how climate variability affects the regional-level allocation of labor between different industries and understand the extent to which rural-urban migration plays a role in this process.

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Tables

Table 1: Descriptive statistics.

	N=1,618			
Variables:	Mean	S.D.	Min.	Max.
Occupational choice:				
Having own business	0.10	0.29	0.00	1.00
Salaried employment	0.47	0.50	0.00	1.00
Self-employed	0.08	0.28	0.00	1.00
Irregular-employment	0.12	0.32	0.00	1.00
Out of labor force	0.14	0.34	0.00	1.00
Unemployed	0.10	0.30	0.00	1.00
Employed in agricultural sector	0.16	0.36	0.00	1.00
Employed in non-agricultural sector	0.61	0.49	0.00	1.00
Women's empowerment	2.05	1.16	0.00	4.00
Average temperature	14.39	1.76	10.12	27.60
Rainfall variability (RV)	0.22	0.03	0.17	0.29
Male	0.51	0.50	0.00	1.00
Age	35.51	11.53	18	76
Higher education	0.20	0.40	0.00	1.00
Urban	0.44	0.50	0.00	1.00
Household size	3.34	1.42	1.00	7.00

Note: S.D. stands for standard deviations. Min. and Max. are minimum and maximum values of variables, respectively.

Table 2: Agricultural and non-agricultural sectors – Marginal effects

	Urban area		
	Agricultural sector	Non-agricultural sector	Out of labor force
Average temperature	-0.010	0.065**	0.009
	(0.013)	(0.027)	(0.006)
Rainfall variability	-1.699**	-0.155	1.022
	(0.792)	(1.749)	(1.226)
Observations	708	708	708
	Rural area		
	Agricultural sector	Non-agricultural sector	Out of labor force
Average temperature	-0.014	-0.004	0.052**
	(0.026)	(0.025)	(0.020)
Rainfall variability	1.688	3.070**	-3.356***
	(2.077)	(1.466)	(1.228)
Observations	910	910	910

Notes: ***, **, and * correspond to 1%, 5%, and 10% significance levels, respectively. Multinomial logit results (marginal effects) are presented. Robust standard errors are clustered at a district level. All specifications include individual characteristics and regional fixed effects. Individual characteristics include gender, age and its square, a dummy for having higher education, and household size.

Table 3: Agricultural and non-agricultural sectors – Marginal effects – By Gender

	Women					
	Urban			Rural		
	Agricultural sector	Non-agricultural sector	Out of labor force	Agricultural sector	Non-agricultural sector	Out of labor force
Average temperature	-0.021	0.024	0.006	-0.050**	0.035	0.099***
	(0.057)	(0.038)	(0.020)	(0.024)	(0.028)	(0.031)
Rainfall variability	-0.786	-3.388	2.657	3.945**	0.828	-6.046***
	(1.098)	(2.952)	(2.301)	(1.698)	(1.329)	(1.871)
Observations	365	365	365	430	430	430
	Men					
	Urban			Rural		
	Agricultural sector	Non-agricultural sector	Out of labor force	Agricultural sector	Non-agricultural sector	Out of labor force
Average temperature	-0.004	0.158	0.045	0.019	-0.025	0.011
	(0.009)	(0.295)	(0.000)	(0.049)	(0.050)	(0.017)
Rainfall variability	-2.087	5.337	-3.084	-0.620	4.955**	-0.595
	(1.269)	(16.253)	(0.000)	(2.599)	(2.520)	(1.313)
Observations	343	343	343	480	480	480

Notes: ***, **, and * correspond to 1%, 5%, and 10% significance levels, respectively. All regression results include individual characteristics and regional fixed effects. Individual characteristics include gender, age and its square, a dummy for having higher education, and household size. Robust standard errors are clustered at a district level.

Table 4: Occupational choices – Marginal Effects – Rural and urban areas

	Urban area				
	Business	Employed	Self-employed	Irregular	Out of labor force
Temperature	-0.002	0.068***	-0.012	-0.005	0.015**
	(0.002)	(0.019)	(0.040)	(0.047)	(0.006)
Rainfall variability	2.817***	-1.376	-0.639	-2.767***	1.123
	(0.617)	(1.825)	(0.672)	(1.038)	(1.252)
Observations	708	708	708	708	708
	Rural area				
	Business	Employed	Self-employed	Irregular	Out of labor force
Temperature	0.012**	0.014	-0.024	-0.018	0.051**
	(0.006)	(0.029)	(0.017)	(0.013)	(0.020)
Rainfall variability	-0.710*	1.195	1.350	2.764***	-3.297***
	(0.410)	(1.305)	(0.993)	(0.769)	(1.191)
Observations	910	910	910	910	910

Notes: ***, **, and * correspond to 1%, 5%, and 10% significance levels, respectively. Multinomial logit results (marginal effects) are presented. Robust standard errors are clustered at a district level. All specifications include individual characteristics and regional fixed effects. Individual characteristics include gender, age and its square, a dummy for having higher education, and household size.

Table 5: Main results – Marginal effects – By gender

	Women									
	Urban					Rural				
	Business	Employed	Self-employed	Irregular	Out of labor force	Business	Employed	Self-employed	Irregular	Out of labor force
Temperature	0.000	0.043**	-0.022	-0.037	0.022	0.006	0.020	-0.048*	0.011	0.094***
	(0.006)	(0.020)	(0.056)	(0.031)	(0.014)	(0.018)	(0.026)	(0.026)	(0.011)	(0.035)
Rainfall variability	3.325***	-4.305*	-0.881	-1.387***	1.966	-0.685	2.303*	2.022	0.931*	-5.992***
	(0.301)	(2.612)	(1.109)	(0.408)	(1.904)	(1.063)	(1.233)	(1.272)	(0.560)	(2.076)
Observations	365	365	365	365	365	430	430	430	430	430
	Men									
	Urban					Rural				
	Business	Employed	Self-employed	Irregular	Out of labor force	Business	Employed	Self-employed	Irregular	Out of labor force
Temperature	-0.018	0.044	-	0.141	0.038	0.009	0.004	0.023	-0.036	0.008
	(0.050)	(0.146)		(0.108)	(0.295)	(0.017)	(0.046)	(0.028)	(0.023)	(0.018)
Rainfall variability	3.364	2.152	-	-2.689	-2.769	-0.856	-0.441	1.388	4.027***	-0.561
	(2.256)	(9.841)		(5.272)	(19.938)	(0.981)	(1.976)	(1.225)	(1.103)	(1.351)
Observations	343	343		343	343	480	480	480	480	480

Notes: ***, **, and * correspond to 1%, 5%, and 10% significance levels, respectively. Robust standard errors are clustered at a district level. All regressions include regional fixed effects. The sample contains only one observation for a self-employed male in urban area, and therefore this category is not estimated.

Table 6: Women's empowerment – Agricultural and non-agricultural sectors – Marginal effects

	Urban area		
	Agricultural sector	Non-agricultural sector	Out of labor force
Average temperature	-0.013	0.069**	0.007
	(0.013)	(0.028)	(0.007)
Rainfall variability	-1.739**	0.224	0.767
	(0.848)	(1.818)	(1.272)
Women's empowerment (default = disagree with all statements):			
Agree with one statement	0.019***	0.078	-0.058**
	(0.005)	(0.047)	(0.026)
Agree with two statements	0.051***	0.038	-0.056
	(0.011)	(0.059)	(0.043)
Agree with three statements	0.010**	0.097**	-0.108***
	(0.005)	(0.042)	(0.041)
Agree with four statements	0.010	0.115***	-0.117***
	(0.011)	(0.034)	(0.032)
Observations	708	708	708
	Rural area		
	Agricultural sector	Non-agricultural sector	Out of labor force
Average temperature	-0.004	0.003	0.039**
	(0.029)	(0.028)	(0.020)
Rainfall variability	1.043	2.898	-2.514*
	(2.337)	(1.824)	(1.335)
Women's empowerment (default = disagree with all statements):			
Agree with one statement	0.095**	-0.082*	-0.070**
	(0.043)	(0.049)	(0.028)
Agree with two statements	0.102*	-0.009	-0.104***
	(0.058)	(0.066)	(0.034)
Agree with three statements	0.011	0.057	-0.099***
	(0.059)	(0.068)	(0.030)
Agree with four statements	0.039	-0.025	-0.043
	(0.079)	(0.058)	(0.043)
Observations	910	910	910

Notes: ***, **, and * correspond to 1%, 5%, and 10% significance levels, respectively. All regression results include individual characteristics and regional fixed effects. Individual characteristics include gender, age and its square, a dummy for having higher education, and household size. Robust standard errors are clustered at a district level. See section 4.3 for the definition of the women's empowerment variable.

Table 7: Women's empowerment – Occupational choices – Marginal effects

	Urban area				
	Business	Employed	Self-employed	Irregular	Out of labor force
Average temperature	-0.001	0.078***	-0.027	-0.002	0.015**
	(0.002)	(0.020)	(0.038)	(0.046)	(0.007)
Rainfall variability	2.453***	-0.439	-0.758	-2.925***	0.897
	(0.830)	(2.240)	(0.706)	(0.976)	(1.305)
Women's empowerment (default = disagree with all statements):					
Agree with one statement	-0.052**	0.081*	0.126***	-0.022	-0.075***
	(0.025)	(0.047)	(0.023)	(0.020)	(0.023)
Agree with two statements	-0.023	0.035	0.145***	-0.030	-0.075**
	(0.030)	(0.063)	(0.021)	(0.028)	(0.038)
Agree with three statements	-0.065	0.106	0.140***	-0.031	-0.132***
	(0.053)	(0.082)	(0.025)	(0.020)	(0.049)
Agree with four statements	-0.012	0.116***	-0.006	0.026	-0.112***
	(0.031)	(0.037)	(0.018)	(0.032)	(0.032)
Observations	708	708	708	708	708
	Rural area				
	Business	Employed	Self-employed	Irregular	Out of labor force
Average temperature	0.012	0.044	-0.028	-0.027**	0.038*
	(0.008)	(0.034)	(0.025)	(0.013)	(0.020)
Rainfall variability	-0.421	-0.460	1.293	3.318***	-2.431*
	(0.515)	(1.755)	(1.499)	(0.829)	(1.285)
Women's empowerment (default = disagree with all statements):					
Agree with one statement	-0.038	0.021	0.062	-0.034	-0.062***
	(0.029)	(0.059)	(0.048)	(0.030)	(0.022)
Agree with two statements	-0.041	0.143	0.035	-0.051	-0.096***
	(0.026)	(0.094)	(0.078)	(0.033)	(0.028)
Agree with three statements	-0.004	0.159*	-0.019	-0.073*	-0.092***
	(0.025)	(0.090)	(0.078)	(0.038)	(0.026)
Agree with four statements	-0.012	0.082	-0.050	-0.015	-0.034
	(0.026)	(0.101)	(0.085)	(0.053)	(0.036)
Observations	910	910	910	910	910

Notes: ***, **, and * correspond to 1%, 5%, and 10% significance levels, respectively. All regression results include individual characteristics and regional fixed effects. Individual characteristics include gender, age and its square, a dummy for having higher education, and household size. Robust standard errors are clustered at a district level. See section 4.3 for the definition of the women's empowerment variable.

Table 8: Secondary occupation – Marginal effects

	Baseline results			Results with women's empowerment		
	All	Urban	Rural	All	Urban	Rural
Average temperature	-0.009	-0.006	-0.017	-0.006	-0.003	-0.020
	(0.011)	(0.006)	(0.014)	(0.011)	(0.006)	(0.020)
Rainfall variability	0.877	-2.448	2.673***	0.744	-2.013	2.501***
	(0.737)	(1.841)	(0.735)	(0.648)	(1.911)	(0.823)
Women's empowerment (default = disagree with all statements):						
Agree with one statement	-	-	-	-0.013	0.029	-0.029
				(0.026)	(0.081)	(0.031)
Agree with two statements	-	-	-	0.037	0.066	0.005
				(0.031)	(0.083)	(0.039)
Agree with three statements	-	-	-	0.008	0.109	-0.112
				(0.051)	(0.076)	(0.085)
Agree with four statements	-	-	-	0.010	0.090	-0.047
				(0.049)	(0.082)	(0.075)
Observations	1,240	536	704	1,240	536	704

Notes: ***, **, and * correspond to 1%, 5%, and 10% significance levels, respectively. All regression results include individual characteristics and regional fixed effects. Individual characteristics include gender, age and its square, a dummy for having higher education, and household size. Robust standard errors are clustered at a district level.

Figures

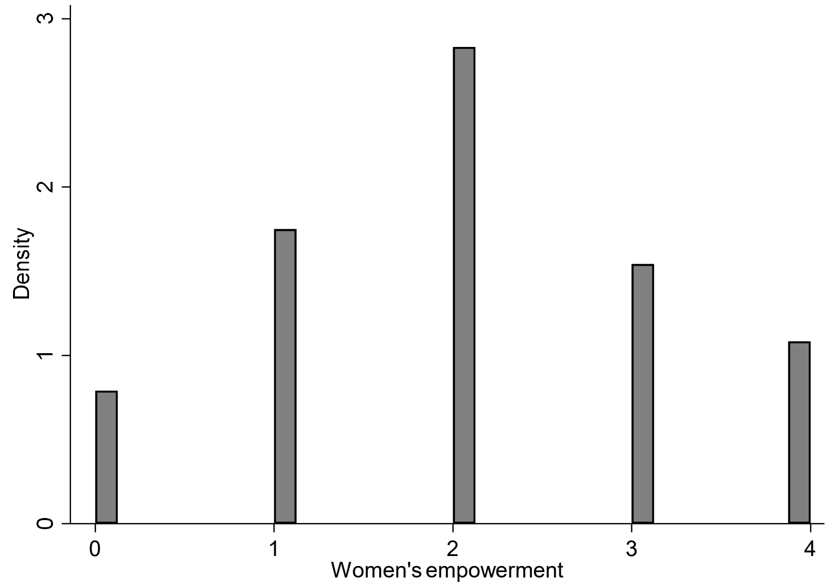

Figure 1. The distribution of answers to the women's empowerment question.

Source: Authors' construction. Note: The figure shows the shares of respondents who (0) disagreed with all statements regarding women's empowerment, (1) agreed with one statement, (2) agreed with two statements, (3) agreed with three statements, and (4) agreed with all four statements, as described in section 4.3.

Appendix A

Table A1. Labor supply characteristics, by gender, 2016.

	Uzbekistan	Russian Federation	Kazakhstan
Labor force participation rate			
female (% of female population ages 15-64)	52.35	68.95	72.36
male (% of male population ages 15-64)	78.22	80.00	81.94
Labor force, female (% of total labor force)	40.40	48.46	48.33
Employment in agriculture			
female (% of female employment)	25.79	5.02	15.98
male (% of male employment)	28.55	8.32	18.45
Employment in industry			
female (% of female employment)	13.65	16.00	11.62
male (% of male employment)	29.61	37.42	28.86
Employment in services			
female (% of female employment)	60.56	78.98	72.40
male (% of male employment)	41.84	54.26	52.69
Self-employed			
female (% of female employment)	38.14	6.36	24.61
male (% of male employment)	36.51	8.54	26.78
Unemployment			
female (% of female labor force)	5.02	5.35	5.50
male (% of male labor force)	5.32	5.76	4.46
Ratio of female to male labor force participation rate (%)	65.80	77.86	84.06
School enrolment, preprimary			
female (% gross)	24.75	86.11	60.01
male (% gross)	25.37	88.10	59.48
School enrolment, primary			
female (% gross)	100.84	100.12	110.03
male (% gross)	102.27	99.52	109.74
School enrolment, secondary			
female (% gross)	92.01	101.49	114.76
male (% gross)	93.18	103.26	111.81
School enrolment, tertiary			
female (% gross)	6.61	87.73	51.64
male (% gross)	10.23	73.88	41.74

Source: The World Bank's World Development Indicators (2019). Notes: Labor force participation, employment, self-employment, and unemployment are according to the International Labor Organization estimates. Gross school enrolment is the ratio of total enrolment, regardless of age, to the population of the age group that officially corresponds to the level of education shown.

Table A2: Sample descriptive statistics by settlement type and gender.

Variables:	Rural N=910 Mean	Urban N=708 Mean	Women N=795 Mean	Men N=823 Mean
Occupational choice:				
Have own business	0.08	0.11	0.05	0.14
Salaried employment	0.44	0.52	0.44	0.50
Self-employed	0.14	0.01	0.11	0.06
Irregular employment	0.12	0.11	0.04	0.19
Out of labor force	0.14	0.13	0.25	0.03
Unemployed	0.09	0.11	0.12	0.08
Employed in agricultural sector	0.26	0.02	0.14	0.17
Employed in non-agricultural sector	0.52	0.73	0.50	0.72
Women's empowerment	2.05	2.05	2.12	1.98
Average temperature	14.03	14.85	14.42	14.36
Rainfall variability (RV)	0.22	0.23	0.22	0.22
Men	0.53	0.48	-	-
Age	35.26	35.83	34.62	36.36
Higher education	0.15	0.27	0.18	0.21
Urban	-	-	0.46	0.42
Household size	3.66	2.94	3.24	3.44

Source: Authors' calculations.

Table A3: Agricultural and non-agricultural sectors – Marginal effects (full results).

	Urban area			Rural area		
Variables:	Agricultural sector	Non-agricultural sector	Out of labor force	Agricultural sector	Non-agricultural sector	Out of labor force
Average temperature	-0.010	0.065**	0.009	-0.014	-0.004	0.052**
	(0.013)	(0.027)	(0.006)	(0.026)	(0.025)	(0.020)
Rainfall variability	-1.699**	-0.155	1.022	1.688	3.070**	-3.356***
	(0.792)	(1.749)	(1.226)	(2.077)	(1.466)	(1.228)
Male	-0.000	0.252***	-0.221***	0.028	0.210***	-0.216***
	(0.021)	(0.027)	(0.009)	(0.037)	(0.042)	(0.023)
Age	0.000	0.015**	-0.001	0.011	0.013	-0.010
	(0.002)	(0.007)	(0.005)	(0.013)	(0.013)	(0.009)
Age squared/100	-0.000	-0.015*	0.000	-0.010	-0.013	0.010
	(0.002)	(0.009)	(0.006)	(0.017)	(0.018)	(0.011)
Higher education	0.002	0.219***	-0.140***	-0.198***	0.320***	-0.074**
	(0.021)	(0.038)	(0.025)	(0.046)	(0.058)	(0.029)
Household size	0.004	-0.005	-0.003	0.002	-0.005	0.002
	(0.003)	(0.007)	(0.007)	(0.013)	(0.016)	(0.007)
Regional Fixed Effects	yes	yes	yes	yes	yes	yes
Observations	708	708	708	910	910	910

Notes: ***, **, and * correspond to 1%, 5%, and 10% significance levels, respectively. Robust standard errors are clustered at a district level.

Table A4: Agricultural and non-agricultural sectors – Marginal effects – By Gender (full results).

	Women						Men					
	Urban			Rural			Urban			Rural		
	Agricultural sector	Non-agricultural sector	Out of labor force	Agricultural sector	Non-agricultural sector	Out of labor force	Agricultural sector	Non-agricultural sector	Out of labor force	Agricultural sector	Non-agricultural sector	Out of labor force
Average temperature	-0.021	0.024	0.006	-0.050**	0.035	0.099***	-0.004	0.158	0.045	0.019	-0.025	0.011
	(0.057)	(0.038)	(0.020)	(0.024)	(0.028)	(0.031)	(0.009)	(0.295)	(0.000)	(0.049)	(0.050)	(0.017)
Rainfall variability	-0.786	-3.388	2.657	3.945**	0.828	-6.046***	-2.087	5.337	-3.084	-0.620	4.955**	-0.595
	(1.098)	(2.952)	(2.301)	(1.698)	(1.329)	(1.871)	(1.269)	(16.253)	(0.000)	(2.599)	(2.520)	(1.313)
Age	0.000	0.003	0.002	0.019	0.005	0.001	-0.003	0.027***	-0.007	0.005	0.019	-0.018***
	(0.003)	(0.012)	(0.009)	(0.019)	(0.013)	(0.019)	(0.005)	(0.010)	(0.000)	(0.016)	(0.016)	(0.007)
Age squared/100	-0.000	0.004	-0.006	-0.021	0.000	-0.007	0.004	-0.033**	0.009	-0.004	-0.024	0.023***
	(0.003)	(0.015)	(0.011)	(0.026)	(0.018)	(0.025)	(0.006)	(0.013)	(0.000)	(0.021)	(0.022)	(0.008)
Higher education	-0.014	0.397***	-0.307**	-0.411***	0.478***	0.002	0.041	0.711	-0.735	-0.172**	0.214***	-0.024
	(0.026)	(0.084)	(0.120)	(0.146)	(0.096)	(0.080)	(0.111)	(3.557)	(0.000)	(0.087)	(0.078)	(0.035)
Household size	0.003**	-0.010	-0.000	0.012	-0.030	0.014	0.004	-0.004	-0.005	-0.008	0.015	-0.008*
	(0.001)	(0.018)	(0.013)	(0.008)	(0.018)	(0.015)	(0.010)	(0.009)	(0.000)	(0.022)	(0.023)	(0.005)
Regional fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	365	365	365	430	430	430	343	343	343	480	480	480

Notes: ***, **, and * correspond to 1%, 5%, and 10% significance levels, respectively. Robust standard errors are clustered at a district level.

Table A5: Occupational choices – Marginal Effects – Rural and urban areas (full results).

	Urban area					Rural area				
	Business	Employed	Self-employed	Irregular	Out of labor force	Business	Employed	Self-employed	Irregular	Out of labor force
Temperature	-0.002	0.068***	-0.012	-0.005	0.015**	0.012**	0.014	-0.024	-0.018	0.051**
	(0.002)	(0.019)	(0.040)	(0.047)	(0.006)	(0.006)	(0.029)	(0.017)	(0.013)	(0.020)
Rainfall variability	2.817***	-1.376	-0.639	-2.767***	1.123	-0.710*	1.195	1.350	2.764***	-3.297***
	(0.617)	(1.825)	(0.672)	(1.038)	(1.252)	(0.410)	(1.305)	(0.993)	(0.769)	(1.191)
Male	0.108**	0.068	-0.020**	0.115***	-0.261***	0.074***	0.051	-0.072***	0.174***	-0.208***
	(0.042)	(0.050)	(0.010)	(0.015)	(0.024)	(0.021)	(0.039)	(0.018)	(0.045)	(0.026)
Age	0.004	0.020*	0.000	-0.006*	-0.003	-0.007	0.012*	-0.002	0.022***	-0.011
	(0.010)	(0.011)	(0.001)	(0.004)	(0.004)	(0.007)	(0.007)	(0.007)	(0.007)	(0.010)
Age squared/100	-0.002	-0.026*	-0.000	0.008*	0.003	0.012	-0.009	0.003	-0.032***	0.012
	(0.015)	(0.014)	(0.001)	(0.005)	(0.004)	(0.008)	(0.010)	(0.008)	(0.010)	(0.012)
Higher education	0.008	0.355***	-0.001	-0.108***	-0.179**	-0.003	0.462***	-0.166**	-0.234**	-0.037
	(0.034)	(0.060)	(0.015)	(0.032)	(0.071)	(0.022)	(0.065)	(0.069)	(0.092)	(0.040)
Household size	-0.006	0.022	0.003***	-0.019**	-0.004	-0.017***	-0.001	-0.003	0.018***	0.002
	(0.007)	(0.020)	(0.001)	(0.008)	(0.008)	(0.006)	(0.013)	(0.005)	(0.005)	(0.007)
Regional Fixed Effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	708	708	708	708	708	910	910	910	910	910

Notes: ***, **, and * correspond to 1%, 5%, and 10% significance levels, respectively. Robust standard errors are clustered at a district level.

Figure A1. Map of survey regions

Source: Authors' construction. Notes: Zones 1-7 correspond to geographic-economic zones of Uzbekistan. Regions 1-14 correspond to administrative units of Uzbekistan. The survey was conducted in regions representative of each geographic-economic zones: Qashqadaryo region (zone 1), Khorezm region (zone 2), Fergana region (zone 3), Samarkand region (zone 4), Tashkent region (zone 5), Siradaryo region (zone 6), and Tashkent capital (zone 7). The survey regions are highlighted in blue.

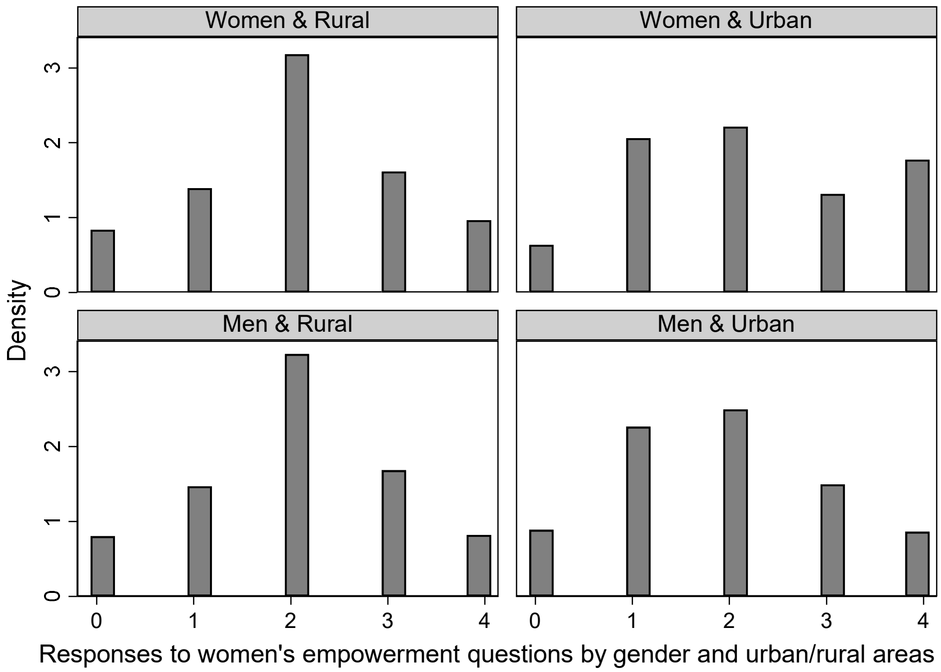

Figure A2. Women's empowerment by gender in rural and urban areas

Source: Authors' construction. Note: The figure shows the shares of respondents who (0) disagreed with all statements regarding women's empowerment, (1) agreed with one statement, (2) agreed with two statements, (3) agreed with three statements, and (4) agreed with all four statements. The statements correspond to the following survey question: "Do you agree or do not agree with the following statements: (i) women in our family take active participation in decision making of main issues (i.e. planning of family expenses, large expenditure items, organization of family events, and education of children), (ii) women in our family can make independent decisions, (iii) if women in our family want to work, no one will impede them, and (iv) women in our family can go to a wedding, visit relatives living far away, go shopping without formal authorization from their spouse, father, brothers etc.".

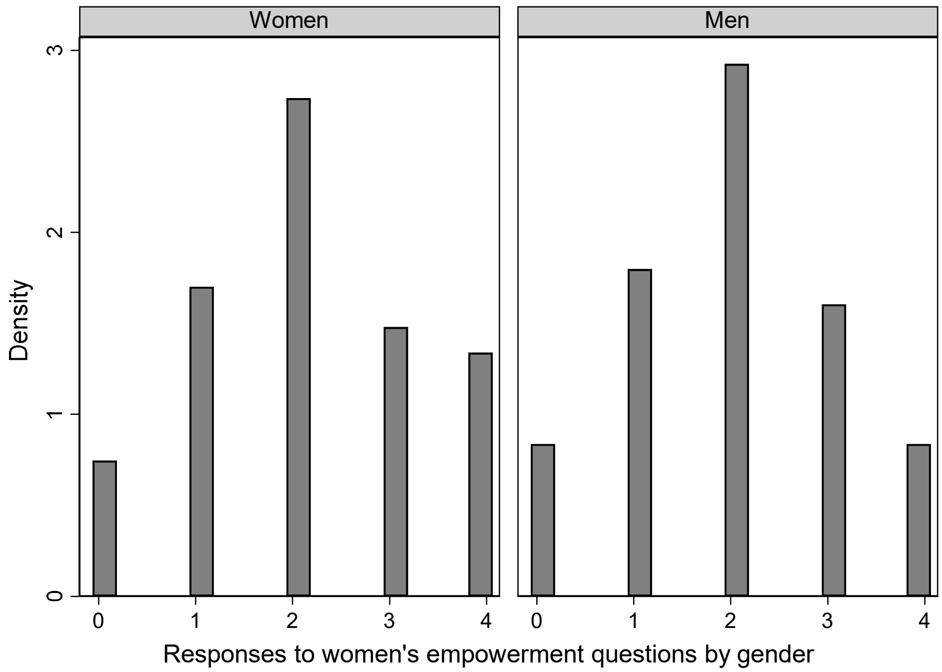

Figure A3. Responses to women's empowerment question, by gender.

Source: Authors' construction. Note: The figure shows the shares of respondents who (0) disagreed with all statements regarding women's empowerment, (1) agreed with one statement, (2) agreed with two statements, (3) agreed with three statements, and (4) agreed with all four statements. The statements correspond to the following survey question: "Do you agree or do not agree with the following statements: (i) women in our family take active participation in decision making of main issues (i.e. planning of family expenses, large expenditure items, organization of family events, and education of children), (ii) women in our family can make independent decisions, (iii) if women in our family want to work, no one will impede them, and (iv) women in our family can go to a wedding, visit relatives leaving far away, go shopping without formal authorization from their spouse, father, brothers etc.".

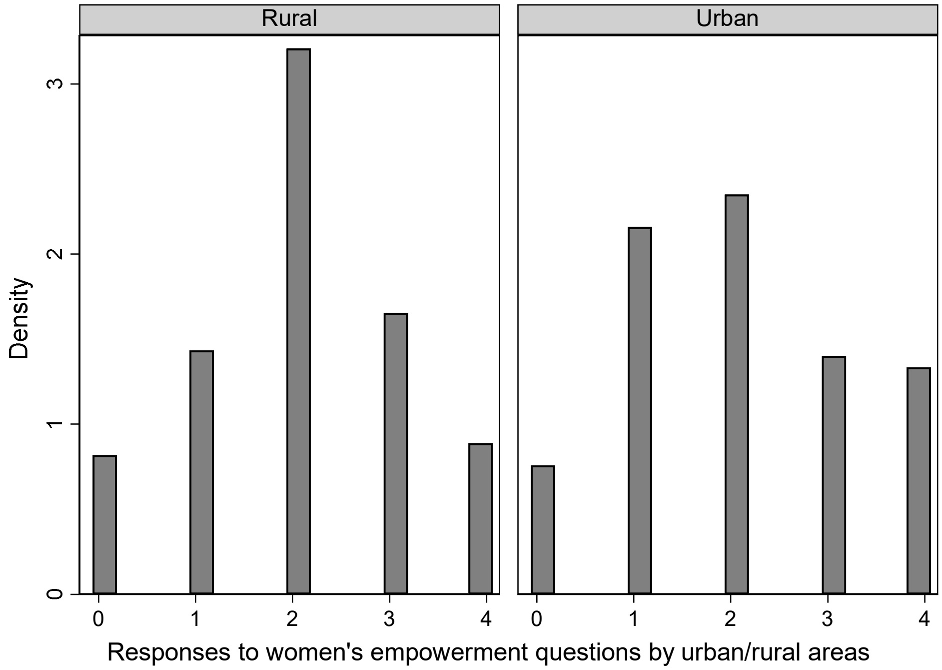

Figure A4. Responses to women's empowerment question by rural/urban area.

Source: Authors' construction. Note: The figure shows the shares of respondents who (0) disagreed with all statements regarding women's empowerment, (1) agreed with one statement, (2) agreed with two statements, (3) agreed with three statements, and (4) agreed with all four statements. The statements correspond to the following survey question: "Do you agree or do not agree with the following statements: (i) women in our family take active participation in decision making of main issues (i.e. planning of family expenses, large expenditure items, organization of family events, and education of children), (ii) women in our family can make independent decisions, (iii) if women in our family want to work, no one will impede them, and (iv) women in our family can go to a wedding, visit relatives living far away, go shopping without formal authorization from their spouse, father, brothers etc.".

Appendix B. Robustness checks

The econometric model presented above might be subject to several potential caveats. First, it might be the case that individuals in our sample have a choice between staying in Uzbekistan or leaving the country to work abroad. As a result, our data may contain only stayers, leading to a sample selection problem. That is, the results of our estimation might be biased because the sample may contain only a specific group of individuals, the stayers. To show that this is not our case, we implement Heckman's sample selection procedure, consisting of the two following steps (Heckman, 1979). First, we run the selection equation with a dependent variable that equals 1 when a household has any member who works outside Uzbekistan, and zero when all members work in Uzbekistan. The survey contains the information only on having any member of a household working abroad and does not contain the information regarding the individual migration experience of household members. However, previous research shows that employment choices of individuals in households with past migration experience differ from the choices of individuals in households with no past migration experience (Giulietti et al., 2013; Grigorian and Melkonyan, 2011; Kakhkharov et al., 2021; Mendola and Carletto, 2012; Piracha and Vadean, 2010). Having a household member who currently works or has worked abroad may also create an incentive for other members of the household to also migrate (Epstein and Gang, 2006; Ivlevs and King, 2012). Thus, in our case, the selection equation is likely to adequately capture the differences between individuals from households with and without past migration experience.

To identify the selection equation, we use the information regarding the mode of savings that household members have. The survey questions that we use are formulated as follows: "In which form do you and household members have savings? (i) cash in Uzbek sums, (ii) cash in foreign currency, such as USD, Euro, or other currency, (iii) money in a bank account in Uzbek sums." The responses to (i)-(iii) are binary (yes/no). In the case of positive responses to (i) and (iii), it is likely that members plan to stay and spend money in a country while a positive response to (ii) may be an indicator that members consider going abroad. Therefore, the responses to these questions are related to a decision to stay or move out of the country and are related to employment choices only through the effect on this decision. Thus, we expect that estimated coefficients on (i) and (iii) are positive while on (ii) is negative and the selection equation is formulated as follows.

$$S_i = \propto_0 + \propto_1 CashUz_i + \propto_2 CashF_i + \propto_3 AccUz_i + \boldsymbol{Z}_i'\Omega + \omega_i \qquad (5)$$

where the subscript *i* stands for a respondent. S_i is a binary dependent variable and is equal to 1 when all members of a particular household work in Uzbekistan and zero if someone from a household works outside a country. $CashUz_i$, $CashF_i$, and $AccUz_i$ equal 1 if a respondent and other household members have savings in cash in Uzbek sums, cash in foreign currency, and money in a bank account in Uzbek sums, respectively, and zero otherwise. $\boldsymbol{Z}_i$ is a vector of explanatory variables such as settlement, region fixed effects, rainfall variability, and the average annual temperature for the 1979-2015 period. Then, we compute the inverse Mills ratio:

$$Lambda_i = \frac{\phi(\hat{S}_i)}{\Phi(\hat{S}_i)} \qquad (6)$$

where ϕ and Φ are the normal probability density and cumulative distribution functions.

In the second step we estimate Eq. (4) with $Lambda_i$ as one of the explanatory variables. If the estimated coefficient on $Lambda_i$ is statistically significant, then we have a selection bias in our baseline estimation.

The next potential caveat is the change of climate over time. This means that in more recent periods rainfall variability and the average temperature may differ from earlier periods. Since we analyze the labor allocation specifics at a given point in time and not the changes in employment structure over time, rainfall variability and the average temperature from recent and earlier periods are likely to have no difference in our results. However, the magnitude of the impact of those indicators on occupational choices may still depend on the way the climate variables are computed. To show that this is not the case, we compute rainfall variability and the average temperature over different time periods, such as 1989-2015 and 1994-2015. Then we compare the estimates from those models with our baseline estimates for the 1979-2015 period. If the magnitudes are similar, this suggests that our estimates are robust to the choice of period over which climate variables are computed.

We first present the results with the Heckman's correction for a possible selection into staying. As shown in Table B1 below, the estimated coefficient on $Lambda_i$ is not statistically significant in all choices in urban area and in the case of being out of labor force in rural area, indicating that selection into migration is not an issue that drives our results in these cases. However, $Lambda_i$ is statistically significant for agricultural and non-agricultural activities in rural area, suggesting that individuals working in rural areas may be indeed inclined to migrate. Comparing the results in Table 2 and B1, we find that the impact of rainfall variability on employment in agricultural sector does not change, as it was and remains positive but insignificant in both tables. This suggests that the selection issue does not affect our results for this category. Regarding the employment in non-agricultural sector, the estimated coefficient on rainfall variability becomes insignificant in Table B1. That is, after correcting for selection, we do not find the impact of rainfall variability for this category.

The results with the Heckman's correction in the model with occupational choices are presented in Table B2 below and suggest no selection issue in most of the choices, except for irregular activities. This suggests that individuals in a rural area who have household members working abroad and who themselves have only irregular activities may indeed be more inclined to migrate. Comparing the marginal effect on rainfall variability for this category in Tables 4 and B2, we find that accounting for selection makes the magnitude of this effect less. However, the confidence intervals on the effect of rainfall variability in these two models overlap, suggesting that the selection issue should not affect our results for this category.

As described in section 5.2, we then also present the results with a different definition of rainfall variability (see Table B3). The results for the model with occupational choices are presented in Table B4a and B4b for urban and rural areas, respectively. In all model specifications, the confidence intervals of marginal effects on rainfall variability and temperature for different periods and for our baseline period overlap. Thus, we may conclude that the period over which climatic variables are measured does not change the impact of climate variability on occupational choices in either rural or urban areas.

Table B1: Heckman selection model – Agricultural and non-agricultural sectors – Marginal effects

	Urban			Rural		
	Agricultural sector	Non-agricultural sector	Out of labor force	Agricultural sector	Non-agricultural sector	Out of labor force
Average temperature	-0.010	0.067**	0.009	-0.029	0.017	0.046**
	(0.014)	(0.028)	(0.006)	(0.027)	(0.026)	(0.023)
Rainfall variability	-1.695**	-0.327	1.054	3.076	1.377	-3.006**
	(0.745)	(1.744)	(1.213)	(2.022)	(1.326)	(1.341)
Lambda	-0.002	0.114	-0.028	-0.231***	0.274***	-0.054
	(0.043)	(0.122)	(0.080)	(0.079)	(0.041)	(0.066)
Observations	708	708	708	910	910	910
Heckman selection equation. Dep. variable: Having a household member who works outside Uzbekistan						
Cash in Uzbek sums	0.072	0.072	0.072	-0.068	-0.068	-0.068
	(0.048)	(0.048)	(0.048)	(0.044)	(0.044)	(0.044)
Cash in foreign currency	-0.183***	-0.183***	-0.183***	-0.325***	-0.325***	-0.325***
	(0.048)	(0.048)	(0.048)	(0.121)	(0.121)	(0.121)
Bank account in Uzbek sums	0.207***	0.207***	0.207***	-	-	-
	(0.033)	(0.033)	(0.033)			
Observations	304	304	304	297	297	297

Notes: ***, **, and * correspond to 1%, 5%, and 10% significance levels, respectively. All regression results include individual characteristics and regional fixed effects. Individual characteristics include gender, age and its square, a dummy for having higher education, and household size. Robust standard errors are clustered at a district level. The selection equation also includes average temperature and rainfall variability. Identifying variables are based on a survey question "In which form do you and household members have savings? (i) cash in Uzbek sums, (ii) cash in foreign currency, such as USD, Euro, or other currency, (iii) money in bank account in Uzbek sums." Having a bank account in Uzbek sums is not used as identifying variable in rural area, because only 1.7% of households in rural area answered positively to this question.

Table B2: Heckman selection model – Occupational choices – Marginal effects

	Urban					Rural				
	Business	Employed	Self-employed	Irregular	Out of labor force	Business	Employed	Self-employed	Irregular	Out of labor force
Average temperature	-0.003	0.071***	-0.013	-0.003	0.015***	0.009	0.015	-0.026	-0.007	0.045**
	(0.002)	(0.017)	(0.038)	(0.048)	(0.006)	(0.009)	(0.028)	(0.017)	(0.014)	(0.022)
Rainfall variability	2.846***	-1.492	-0.667	-2.818***	1.154	-0.442	1.151	1.460	1.963**	-2.849**
	(0.614)	(1.873)	(0.647)	(0.951)	(1.241)	(0.569)	(1.299)	(1.044)	(0.868)	(1.279)
Lambda	-0.028	0.086	0.016	0.033	-0.024	-0.043	0.017	-0.017	0.111**	-0.066
	(0.035)	(0.114)	(0.025)	(0.085)	(0.074)	(0.064)	(0.075)	(0.087)	(0.047)	(0.065)
Observations	708	708	708	708	708	910	910	910	910	910
Heckman selection equation. Dep. Variable: Having a household member who works outside Uzbekistan										
Cash in Uzbek sums	0.072	0.072	0.072	0.072	0.072	-0.068	-0.068	-0.068	-0.068	-0.068
	(0.048)	(0.048)	(0.048)	(0.048)	(0.048)	(0.044)	(0.044)	(0.044)	(0.044)	(0.044)
Cash in foreign currency	-0.183***	-0.183***	-0.183***	-0.183***	-0.183***	-0.325***	-0.325***	-0.325***	-0.325***	-0.325***
	(0.048)	(0.048)	(0.048)	(0.048)	(0.048)	(0.121)	(0.121)	(0.121)	(0.121)	(0.121)
Bank account in Uzbek sums	0.207***	0.207***	0.207***	0.207***	0.207***	-	-	-	-	-
	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)					
Observations	304	304	304	304	304	297	297	297	297	297

Notes: ***, **, and * correspond to 1%, 5%, and 10% significance levels, respectively. All regression results include individual characteristics and regional fixed effects. Individual characteristics include gender, age and its square, a dummy for having higher education, and household size. Robust standard errors are clustered at a district level. The selection equation also includes average temperature and rainfall variability. Identifying variables are based on a survey question "In which form do you and household members have savings? (i) cash in Uzbek sums, (ii) cash in foreign currency, such as USD, Euro, or other currency, (iii) money in bank account in Uzbek sums." Having a bank account in Uzbek sums is not used as identifying variable in rural area, because only 1.7% of households in rural area answered positively to this question.

Table B3: Results with a different definition of climatic variables – Agricultural and non-agricultural sectors – Marginal effects

	Urban			Rural		
	Agricultural sector	Non-agricultural sector	Out of labor force	Agricultural sector	Non-agricultural sector	Out of labor force
			Baseline (1979-2015)			
Average temperature	-0.010	0.065**	0.009	-0.014	-0.004	0.052**
	(0.013)	(0.027)	(0.006)	(0.026)	(0.025)	(0.020)
Rainfall variability	-1.699**	-0.155	1.022	1.688	3.070**	-3.356***
	(0.792)	(1.749)	(1.226)	(2.077)	(1.466)	(1.228)
Observations	708	708	708	910	910	910
			1989-2015			
Average temperature	-0.012	0.069**	0.011*	-0.011	-0.028	0.067**
	(0.014)	(0.030)	(0.006)	(0.038)	(0.027)	(0.030)
Rainfall variability	-1.605**	0.322	0.521	0.858	3.879***	-3.246**
	(0.723)	(1.799)	(1.223)	(2.433)	(1.441)	(1.532)
Observations	708	708	708	910	910	910
			1994-2015			
Average temperature	-0.007	0.068**	0.010	-0.012	-0.029	0.069**
	(0.015)	(0.029)	(0.006)	(0.042)	(0.029)	(0.035)
Rainfall variability	-1.456*	-0.302	0.891	0.773	3.761**	-3.211*
	(0.747)	(1.808)	(1.257)	(2.557)	(1.506)	(1.707)
Observations	708	708	708	910	910	910

Notes: ***, **, and * correspond to 1%, 5%, and 10% significance levels, respectively. All regression results include individual characteristics and regional fixed effects. Individual characteristics include gender, age and its square, a dummy for having higher education, and household size. Robust standard errors are clustered at a district level. Baseline results are the results from Table 2. The results 1989-2015 and 1994-2015 correspond to a calculation of rainfall variability and average temperature over the corresponding time periods instead of a baseline period 1979-2015.

Table B4a: Results with a different definition of climatic variables – Marginal effects - **Urban area**

	Business	Employed	Self-employed	Irregular	Out of labor force
			Baseline (1979-2015)		
Average temperature	-0.002	0.068***	-0.012	-0.005	0.015**
	(0.002)	(0.019)	(0.040)	(0.047)	(0.006)
Rainfall variability	2.817***	-1.376	-0.639	-2.767***	1.123
	(0.617)	(1.825)	(0.672)	(1.038)	(1.252)
Observations	708	708	708	708	708
			1989-2015		
Average temperature	-0.001	0.070***	-0.013	-0.003	0.016**
	(0.002)	(0.021)	(0.037)	(0.047)	(0.007)
Rainfall variability	2.617***	-0.966	-0.578	-2.347**	0.544
	(0.706)	(2.107)	(0.595)	(1.072)	(1.282)
Observations	708	708	708	708	708
			1994-2015		
Average temperature	-0.006**	0.071***	-0.011	0.003	0.015*
	(0.003)	(0.025)	(0.035)	(0.034)	(0.008)
Rainfall variability	2.845***	-1.714	-0.508	-2.340*	0.882
	(0.760)	(1.965)	(0.606)	(1.422)	(1.326)
Observations	708	708	708	708	708

Notes: ***, **, and * correspond to 1%, 5%, and 10% significance levels, respectively. All regression results include individual characteristics and regional fixed effects. Individual characteristics include gender, age and its square, a dummy for having higher education, and household size. Robust standard errors are clustered at a district level. Baseline results are the results from Table 4. The results 1989-2015 and 1994-2015 correspond to a calculation of rainfall variability and average temperature over the corresponding time periods instead of a baseline period 1979-2015.

Table B4b: Results with a different definition of climatic variables – Marginal effects - **Rural area**

	Business	Employed	Self-employed	Irregular	Out of labor force
	Baseline (1979-2015)				
Average temperature	0.012**	0.014	-0.024	-0.018	0.051**
	(0.006)	(0.029)	(0.017)	(0.013)	(0.020)
Rainfall variability	-0.710*	1.195	1.350	2.764***	-3.297***
	(0.410)	(1.305)	(0.993)	(0.769)	(1.191)
Observations	910	910	910	910	910
	1989-2015				
Average temperature	0.016*	-0.008	-0.026	-0.017	0.065**
	(0.009)	(0.031)	(0.021)	(0.021)	(0.030)
Rainfall variability	-0.681	2.277*	0.895	2.029**	-3.166**
	(0.514)	(1.209)	(1.201)	(1.011)	(1.518)
Observations	910	910	910	910	910
	1994-2015				
Average temperature	0.016	-0.008	-0.027	-0.020	0.068*
	(0.011)	(0.033)	(0.023)	(0.023)	(0.035)
Rainfall variability	-0.689	2.180*	0.792	2.040*	-3.130*
	(0.597)	(1.303)	(1.274)	(1.063)	(1.697)
Observations	910	910	910	910	910

Notes: ***, **, and * correspond to 1%, 5%, and 10% significance levels, respectively. All regression results include individual characteristics and regional fixed effects. Individual characteristics include gender, age and its square, a dummy for having higher education, and household size. Robust standard errors are clustered at a district level. Baseline results are the results from Table 4. The results 1989-2015 and 1994-2015 correspond to a calculation of rainfall variability and average temperature over the corresponding time periods instead of a baseline period 1979-2015.