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Externalities of Irrigation Policy on Youth Entrepreneurship in Malawi

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This paper assesses the spill-over effects of irrigation on youth entrepreneurship. Using the Fourth Integrated Household Survey (IHS4) the study employs a hierarchical three level random effects logit model in an attempt to achieve the objective. The study confirms the presence of positive spill over effects of irrigation programs on youth entrepreneurship. This provides more justification for increased funding to generic programs like irrigation with additional rationale of trying to provide the much needed finance to the youth in Malawi so as to mitigate the problem of youth unemployment.

JEL Classification: A10, D62, E24

Key words: Malawi, IHS4, hierarchical, random effects logit model.

1. Introduction

1.1 Background

Malawi is one of the countries with a relatively large youth demographic, accounting for 34% of the country's population (which is estimated at around 17,563,749) aged between 15 and 34 years NSO (2018). Youth unemployment and underemployment are very high in Malawi. According to the 2013 Malawi labour force survey, which is the only such survey that Malawi has ever had, unemployment among the economically active population stood at 21%. The youth unemployment rate was higher than the general unemployment rate, standing at 23%, while 27% of the employed population in Malawi were underemployed NSO (2013). There are a number of reasons that lead to high unemployment and underemployment in Malawi, ranging from rapid population growth, low levels of education, skills mismatch, and corruption, among others. Interestingly, newer generations of the youth are generally better educated than their predecessors. Nonetheless, employment opportunities have not increased commensurate with the increased number of educated youth.

High youth unemployment is of concern for policymakers, as youth unemployment has consequences such as loss of productivity resulting in intergenerational poverty and social exclusion, and high risk of social conflicts, such as juvenile delinquency, resulting in high social costs to the country (Altaman, 2007). It is not surprising therefore to note that Malawi has over the years enacted policies and strategies aimed at addressing youth unemployment in the country.

Most policies and strategies that have since been developed and/or implemented have been youth specific. This means that they have focused on providing the youth with education and skills, among

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other things, that may enable them to thrive on the labour market. Examples of the policies that Malawi has developed in this regard are as indicated in table 1 below.

Table 1: Domestic Youth Specific Policies

Period	Policy
2006-2010	Malawi growth and development strategy(MGDS) I
2011-2016	MGDS II
2017-2022	MGDS III
2014	The national employment and labour policy
2013 & 1996	The national youth policy
1999	Technical, Entrepreneurial and Vocational Education and Training Act
2008-2017	The National Education Sector Plan(NESP)

In addition to these domestic policies related to the youth in Malawi, it should be noted that, on 25 September 2015, Malawi joined other countries in adopting a new set of global goals to end poverty, protect the planet and ensure prosperity for all as part of the 2030 Agenda for Sustainable Development. One of the 17 new Sustainable Development Goals (SDGs) seeks to promote economic growth and ensure decent work for all (SDG 8).

Generally, all these policies aim to: increase the absorption of skills, technology and innovation by youth; increase youth participation in decision-making processes; improve the youth's technical, vocational, entrepreneurial and life skills; improve the youth's access to credit facilities for entrepreneurship; and construct and rehabilitate sports infrastructure, among others. Despite all these youth-centred policy interventions over the years, youth unemployment in Malawi has been on the rise and disproportionately distributed across space and gender (Charman, 2013).

That being said, we note that most of the residents of Malawi reside in rural areas, pursuing agricultural livelihoods. In fact, according to NSO (2017), 84% of the residents of Malawi are rural residents. Agriculture remains the backbone of Malawi's economy, contributing about 35% to the country's GDP. The agricultural sector is not only the backbone of the Malawian economy; it is also the main sector for employment. The agricultural sector provides 64.1% of all employment in the country (*Mussa, 2016*). In comparison, the manufacturing sector's contribution to employment is minimal: only 4.1% of those working are employed in the manufacturing sector.

Because of the relevance of the agricultural sector over the years, Malawi has implemented a number of policies aimed at improving outcomes in the agriculture sector. Such efforts have included macroeconomic policies such as international trade policies and exchange rate policies aimed at improving agricultural exports. The government of Malawi has also pursued other policies such as those providing guidelines for land utilisation and ownership, as well as marketing and pricing of produce, in an attempt to improve outcomes in the agriculture sector. However, specific notable flagship policies recently have been the Farm Input Subsidy Programme (FISP) and the Greenbelt Initiative (GBI).

FISP was initiated in the 2005/06 agricultural season following a poor maize-harvest season and a high maize import bill. It was aimed at improving resource-poor smallholder farmers' access to agricultural inputs (CDM & FUM, 2017). Under this programme, smallholder farmers receive coupons which they use to purchase fertilisers and seeds at subsidised prices. Initially, the programme focused on subsidising inputs used to grow maize – Malawi's staple food. Over time, inputs for other crops such as cotton, tobacco, and legumes were included. In a number of evaluation studies(see Chirwa et al, 2013), FISP has been lauded for raising maize yields, contributing to economic growth, and improving the food

security situation in Malawi. Despite this positive response, these benefits come at various costs, including concerns with the fiscal sustainability of FISP's of its budgetary allocations, which have ranged from 5 to 16 % of GDP over the years.

In response to the criticisms regarding the unsustainability of the FISP, the GBI was launched in 2009, as a potential exit strategy for FISP. The GBI is a broad umbrella for irrigation intensification, targeted at the attainment of sustainable economic growth and development. GBI has been described as "a mechanism to protect the gains in food security, reduce vulnerability to drought, and diversify crop production by irrigating a million hectares of land lying within 20 km radius of the country's three lakes and 13 perennial rivers" (Chinsinga & Chasukwa, 2012, p. 9). Just as was the case for FISP, the GBI aims at reducing poverty and improving sustainable food security by making use of fresh water resources that cover 21% of Malawi's land, including lakes, perennial rivers and lagoons (MoAFS, 2011).

Because of the perceived unsustainability of FISP, initiatives related to irrigation and the GBI in the MGDS III receive more prominence – despite lower budgetary allocations – than activities related to FISP. The MGDS III also includes the GBI as one of the flagship projects that must be implemented in the medium term. This may indicate government's plan to slowly phase out FISP in favour of the GBI. It is worth noting, however, that the GBI, just like FISP, does not target the youth in particular. They are both generic policies.

1.2 The Research Problem

We have noted in the previous section that youth unemployment is worrisomely high in Malawi despite the youth-targeted policies that Malawi has implemented over the years. We have also noted that most people, the youth inclusive, reside in rural areas on farming households. There have been calls to diversify the economy into industrialisation to provide decent and well-paying jobs to the youths. However, the expansion of the manufacturing sector has been very slow over the past 10 years, employing only an average of 4.1% of the labour force. In other words, the economy is not growing fast enough to create decent employment opportunities for our youths. One possible solution to this problem, among others, is promoting youth entrepreneurship. However, one of the problems with promoting youth entrepreneurship is the lack of access to finance. Therefore, the problem we want to answer in this paper is: is it possible to use generic policies (in this case irrigation policies) in the agricultural sector to provide the much-needed finances for the youth? Recognising the fact that the generic policies have registered success stories in increasing production (which implies improving income), we want to assess if such policies can have spill over positive effects on the youth by providing the much-needed finances for entrepreneurship.

1.3 Research Question

The paper seeks to estimate the effects of irrigation programs on youth entrepreneurship. The research question is "do irrigation programs increase youth ownership of businesses?" The answer to this question generated by the study shall guide policy on whether it is important to encourage generic programs, like those regarding irrigation, as a means of promoting youth entrepreneurial behaviour and eventually fighting youth unemployment in Malawi. Our main hypothesis is that the irrigation programmes, by increasing agricultural productivity and hence household income, could make more resources available to households and therefore allow the youth to start owning and managing businesses.

1.4 Policy Relevance

On the policy anterior, the paper contributes by providing reliable estimates useful when formulating strategies and initiatives aimed at fighting youth unemployment. The research provides insight to the Ministry of Finance and Economic Planning of Malawi as well as similar ministries in other countries in Sub-Saharan Africa on the process of allocating national budgetary resources to agriculture. Positive results in the study shall provide an additional rationale for increased funding to generic programs like those concerning irrigation. This shall be under an additional aim of increasing youth entrepreneurship, implying a reduction in youth unemployment. Should the study find a negative or non-existent effect on youth entrepreneurship, then there is a need for resource allocation into areas that will yield high results.

2. Related Literature

2.1 Theoretical Literature

This paper is guided by an Eclectic Theory of Entrepreneurship developed by Verheul et al. (2001). The theory integrates different perspectives of the determinants of entrepreneurship ranging from economic, psychological and sociological perspectives. According to this theory, there is a broad range of determinants that explain the level of entrepreneurship, including economic and social factors. Most importantly, the process by which the actual rate of entrepreneurship is established involves both macro and micro components. At the demand side, entrepreneurial opportunities are created by the market demand for goods and services, whereas the supply side generates (potential) entrepreneurs that can seize the opportunities, provided they have the resources, abilities and preferences to do so. Moreover, personality characteristics need to be in line with the entrepreneurial opportunity. The entrepreneurial decision, i.e., occupational choice, is made at the individual level, taking into account entrepreneurial opportunities and resources, ability, personality traits and preferences of the individual. Most importantly, the theory has an extensive description of how government policy measures may influence entrepreneurship. It is explained that the government can exert influence on entrepreneurship in different ways: directly through specific measures and indirectly through generic measures. Policy measures and institutions may influence either the key determinants in the individual decision-making processes, and in that way indirectly co-determine business ownership, or the mechanism itself.

2.2 Contribution to Empirical Literature

In general, empirical literature on youth unemployment has not given adequate attention to the unintended consequences of generic programs. Therefore, results from the paper shall spur further scientific research on the topic. The replication and comparability of the study becomes important since the chosen program – irrigation – is currently being promoted in most sub-Saharan countries. We have also taken into account the climatic changes and the fact that our choice of the dataset – the LSMS-ISA – is collected from several countries as well in the region using the same survey instruments. To the best of our knowledge, this paper is a pioneer in the outlined specifications of the literature.

3. Methodology

3.1 Outcome Variable

Our dependent variable is youth entrepreneurship. Before we explain how we have measured that variable, a brief discussion from the literature on the definition of entrepreneurship is imperative. There is no generally accepted definition of entrepreneurship (Bull & Willard, 1993; Lumpkin & Dess, 1996; Van Praag, 1999). According to Fiet (1996), entrepreneurship is a multidimensional concept, the definition of which depends largely on the focus of the research undertaken. Hébert and Link (1989) define an entrepreneur as someone who specialises in taking responsibility for and making judgmental decisions that affect the location, form, and the use of goods, resources or institutions. Sahlman and Stevenson (1991) use the following definition: entrepreneurship is a way of managing that involves pursuing opportunity without regard to the resources currently controlled. Entrepreneurs identify opportunities, assemble required resources, implement a practical action plan, and harvest the reward in a timely, flexible way. One can have a static or a dynamic perspective (EIM/ENSR, 1995) . EIM/ENSR (1995) claim that the so-called self-employment or business ownership rate is an important static indicator of the level of entrepreneurship. Based on this, Verheul et al. (2001) recommend using the terms business ownership and self-employment as equivalent to entrepreneurship. As such, our outcome variable in this paper is binary: taking value 1 if the youth own any business and 0 otherwise.

3.2 Study Design

The shock variable is also binary: taking value 1 if the household from which the young person comes practices irrigation and 0 otherwise. The youth in this case may be a household head or not. What matters is whether the household from where they come practice irrigation or not. The study, therefore, constitutes two arms: (1) the control arm, which consists of youths that come from households that do not practice irrigation, and (2) the treatment arm, comprising youths that come from households that practice irrigation. This paper, therefore, compares the difference in ownership of a business venture between those in the control arm and those in the treatment arm.

3.3 Conceptual Framework

Guided by the Eclectic Theory of Entrepreneurship developed by Verheul et al. (2001), our proposed pathway is as follows. Assuming irrigation is an orthogonal shock to household resources; participants might experience increased funds for the following reasons: firstly, irrigation could result in increased funds due to increased production of food crops beyond the consumption needs of the household. This could imply: 1) increased availability of funds in the household through a reduction in expenditure on food due to increased consumption from own production, given a fixed household income; 2) increased household income through sale of excess food produced. This could be enhanced by the fact that the household would be able to harvest twice a year, and that irrigation could result in increased funds due to increased production of cash crops. The sale of these cash crops would imply an increase in the availability of funds for the household. The available funds from both channels could then be used as a source of finance for starting business ventures for the youth in the households.

3.4 Analytical Approach

In this study we use the hierarchical logit model to estimate the impact of irrigation on youth employability.

3.4.1 Hierarchical Logit Model

The study employs a multilevel/hierarchical logit model. An extended discussion of this model and other generalized linear models can be found in, for example, Rabe-Hesketh and Skrondal (2008). Consider a young man or woman *i* aged 15 to 34 years who resides in household *j* which is in community *c* of district *d*. Let y_{ijcd} be a dichotomous response variable for youth ownership of a business, taking value 1 if young man or woman *i* owns a business enterprise and taking value 0 otherwise. The probability that the individual owns a business enterprise can be modelled using the following three-level random effects logit

$$Pr(y_{ijcd} = 1|Irrigation; X) = \Lambda(\alpha + \beta Irrigation_{jcd} + \theta' X + \eta_{cd} + \mu_d) \qquad (1)$$

Λ is a logistic cumulative distribution function (cdf); *Irrigation* is a dummy variable for participation in the irrigation programme, taking a value 1 if the household practiced irrigation in a reference cropping season and 0 otherwise;$\eta_{cd} \sim N(0, \sigma_\eta^2)$ are community level random effects, assumed to be uncorrelated across communities, and uncorrelated with covariates; $\mu_d \sim N(0, \sigma_\mu^2)$ are district level random effects which accommodate cross-district differences in the probability of owning a business. They thus capture the combined effect of all omitted covariates at the district levels that make some individuals to be more likely to own a business than others on account of the place they live only. For instance, young people living in the same geographical area may exhibit similar lifestyle behaviour, attitudes towards work, or be influenced by the same local policy. The random effects may also capture non-business-related (demand-side) characteristics such as the condition of roads in the district, and the general level of economic development of the district, which reflects local business opportunities.

The parameter *X*, is a vector of control variables which include age of the youth, education level of the individual, sex of the individual and marital status. Further, business opportunities may be available differently between rural and urban areas. We therefore capture this rural-urban differential in business opportunities by adding a rural-urban dummy variable, which is equal to 1 if a youth stays in an urban area, and 0 otherwise. Malawi is divided into three regions (north, centre, and south), and in order to capture possible regional fixed effects in business opportunities, two regional dummies, namely south and centre, are introduced. We also recognize the fact that some youths may be coming from districts with a lot of business potential that may easily motivate them as compared to other districts. For example, holding all other things constant, one would expect individuals in Zomba to be more likely to be motivated to venture into business than individuals from other districts, such as Nsanje[‡]. Generally, one expects the cities to have more education infrastructures than rural districts. We therefore include a dummy variable capturing city fixed effects on youth entrepreneurship. Similarly, we also include an ethnic group categorical variable to capture differences in entrepreneurial orientation among different ethnic groups. We do the same with regard to religion. The other Greek coefficients are the parameters that will be estimated. We estimate the model using maximum likelihood estimation technique.

The extent of the community and district level clustering is measured by decomposing the overall error variance into two components, leading to an intra-class correlation coefficient (ICC),

[‡] Zomba is more developed and has a city, whereas Nsanje is mainly a rural, undeveloped district

$$\rho' = \left({\sigma_\eta^2} \Big/ {\sigma_\eta^2 + \sigma_\mu^2 + \pi^2/_3} \right)$$

which measures the strength of clustering within the community, and

$$\rho'' = {}^{'}\left({\sigma_\mu^2} \Big/ {\sigma_\eta^2 + \sigma_\mu^2 + \pi^2/_3} \right),$$

which measures the strength of clustering within the district. ${\pi^2}/_3$ is a level-one variance of the idiosyncratic error term, which is assumed to follow a logistic distribution. ρ' and ρ'' approach 1 if unobserved differences between communities and districts matter more than unobserved differences within communities and districts. The ICCs will be close to zero if the reverse holds. A likelihood ratio (LR) test of the null hypothesis

$$H_0: \left({\sigma_\eta^2} \Big/ {\sigma_\eta^2 + \sigma_\mu^2 + \pi^2/_3} \right) = \left({\sigma_\mu^2} \Big/ {\sigma_\eta^2 + \sigma_\mu^2 + \pi^2/_3} \right) = 0$$

is used to determine the presence of random effects. If there is no clustering, the random effects logit reduces to an ordinary one level logit. The random effects logit is estimated using maximum likelihood with adaptive quadrature. To determine the nature of the relationship between youth ownership of business and irrigation we use the signs and magnitudes of the marginal effect;

$$\begin{aligned} \partial\, Pr(y_{ijcd} = 1 | Irrigation; X) \Big/ {\partial Irrigation} \Big|_{\eta_{cd}+\mu_d=0} \\ = \frac{\partial \Lambda(\alpha + \beta Irrigation_{jcd} + \theta' X + \eta_{cd} + \mu_d)}{\partial Irrigation} |_{\eta_{cd}+\mu_d=0} \\ = \beta \Lambda(\alpha + \beta Irrigation_{jcd} + \theta' X) \Big(1 - \Lambda(\alpha + \beta Irrigation_{jcd} + \\ \theta' X)\Big) \end{aligned}$$

Essentially a null hypothesis $H_0: \frac{\partial \Lambda(\alpha+\beta Irrigation_{jcd}+\theta' X+\eta_{cd}+\mu_d)}{\partial Irrigation} |_{\eta_{cd}+\mu_d=0} = 0$, was tested. It must be noticed here that testing that $H_0: \frac{\partial \Lambda(\alpha+\beta Irrigation_{jcd}+\theta' X+\eta_{cd}+\mu_d)}{\partial Irrigation} |_{\eta_{cd}+\mu_d=0} = 0$, which essentially is the same as testing $\beta \Lambda(\alpha + \beta Irrigation_{jcd} + \theta' X) \Big(1 - \Lambda(\alpha + \beta Irrigation_{jcd} + \theta' X)\Big) = 0$, is technically similar to testing that $H_0: \beta = 0$.

We do understand, however, as we have explained in the section on the theory of change, that irrigation does not directly influence entrepreneurship. It does so through increasing resource availability by influencing food and cash crop production. One may therefore argue that introducing a dummy variable directly as we have done in equation (1) above may not be appropriate. Rather, one would expect us to interact the irrigation dummy with "food" and "cash crop" production to map out the channels through which irrigation influences youth entrepreneurial behaviour. However, we argue in this paper that no

matter what channel irrigation passes through, the end result is that it may or may not influence the outcome variable. Besides, mapping out the channels, in this case, may not be informative, policy-wise.

3.4.2 Identification Challenge

Running equation (1) directly may not be technically appropriate. This is because of endogeneity that may arise due to the fact that irrigation is not a random process. This is because, we suspect, the land acquisition process in Malawi cannot be assumed to be random since good land (in this case irrigable land) is usually allocated to individuals with some characteristics such as connections to the local leadership or those with high incomes. As such, in this study, we propose to use instrumental variables. We use a dichotomous variable capturing whether a household owns irrigable land (such as a swamp or wetland) as an instrument. The choice of the instrumental variable is premised on the fact that households that have irrigable land (wetlands or swamps) are more likely to practice irrigation as compared to households that do not. However, having irrigable land has no connection at all with probability of owning a business enterprise. As such the model that we actually run is a two-stage regression model.

At this point, it must be mentioned that, as is a practice in econometrics, the use of the two-stage estimation approach over the direct instrumental variable is premised on account of avoiding measurement error problems in the model. In other words, one would argue and expect us to run the following equation;

$$\Pr\left(y_{ijcd}=1\middle|\left(Irrigation=Irrigable\right);X\right)=\Lambda\left(\alpha+\beta\left(Irrigation=Irrigable\right)_{jcd}+\theta'X+\eta_{cd}+\mu_{d}\right) \quad (2)$$

Where $Irrigable$ is a dichotomous variable capturing whether the household from which a youth comes owns $Irrigable$ land or not. However, the problem with this technique is that much as is being used here as an instrument for irrigation, these two variables are different. As such, using directly may introduce measurement error issues in the model, bringing more problems to the model than we are trying to solve. As such we estimate equation (1) in two stages:

Step 1: Run the irrigation participation model to get predicted treatment assignments:

$$Irrigation_{j}=\vartheta+\pi(Irrigable)_{j}+\sigma^{'}Z+\varepsilon_{j} \quad (3)$$

Step 2: Use the predicted treatment assignments (i.e.$Irrigation_{j}^{P}$) to evaluate their impacts on youth employability as follows:

$$Pr\left(y_{ijcd}=1|Irrigation;X\right)=\Lambda\left(\alpha+\beta Irrigation_{jcd}^{p}+\theta^{'}X+\eta_{cd}+\mu_{d}\right) \quad (4)$$

In this way, the instrument generates exogenous variation in the irrigation that is not correlated with the error term thereby addressing the source of bias. The predicted values capturing the exogenous variation of irrigation obtained in the first stage (i.e. $Irrigation_{j}^{P}$) are then included in the second stage. In terms of estimation technique, we estimated the first step equations using a linear probability model (LPM), not the nonlinear discrete models (e.g. probit and logit models). Mindful of the shortfalls of LPM, we, however, used it following an argument by Angrist (2001), echoed by Karamba (2013) and Amin (2015), that when a nonlinear model is used in the first step, second step estimates are inconsistent unless the first stage model is correct. Angrist (2001) actually suggests that using a linear probability model is safer and produces consistent estimates.

3.4.3 Test for Endogeneity and Validity of Instruments

It must be mentioned here, however, that we will run equation (4) and not equation (1) upon testing and finding statistical evidence of endogeneity in equation (1). The first step in our analysis, therefore, is to test for endogeneity. We use the Durbin-Wu-Hausman test for endogeneity. Baum et al (2003, 2007) provide a lucid discussion of this tests. The null hypothesis of the Durbin and Wu–Hausman test is that the variable under consideration can be treated as exogenous.

4. Empirical Results

4.1 Data Description and Summary Statistics

The data used is from the Fourth Integrated Household Survey (IHS4), which is a nationally representative survey designed to provide information on the various aspects of household welfare in Malawi. This data set was collected by the NSO from April 2016 to April 2017, under the umbrella of the World Bank Living Standards Measurement Study–Integrated Surveys on Agriculture (LSMS-ISA) initiative. The survey collected information from a sample of 12, 480 households that were statistically designed to be representative at national, district, urban and rural levels. The total number of districts or strata covered was 31. A closer look at the survey suggests that, on average, a total of 768 communities are selected from the 31 districts across the country. In each district, a minimum of 24 communities were interviewed, while in each community a total of about 16 households were interviewed. About 53,885 individuals were interviewed in total. When we imposed the youth age restriction of 15-34 years, including some data cleaning exercises, we ended up with a sample size of 17,567 youths.

Table 2: Comparison of background characteristics of treatment and control groups

	Whole Sample	Treatment Group	Control Group	P-value
Household Size	4.99	5.41	4.32	0.985
Sex of household head	0.77	0.78	0.79	0.542
Age of the individual	23.12	37.82	36.54	0.203
Residence	0.79	0.82	0.58	0.107
Northern Region	0.22	0.19	0.22	0.112
Central Region	0.35	0.33	0.28	0.765
Southern Region	0.44	0.40	0.41	0.437
PLSC	0.10	0.08	0.09	0.442
JCE	0.11	0.14	0.12	0.453
MSCE	0.10	0.19	0.17	0.853
Tertially	0.05	0.05	0.07	0.321

Table 2 and Table 3 present some summary statistics of some of the variables employed in the analysis. Table 2 presents a basic balance test between control and treatment groups' observable characteristics. We used simple T-tests when conducting these balance tests. These tests checked for statistical differences between two groups to justify the use of an average treatment effect estimator. The findings show no statistically significant difference between participants in the treatment and control groups in terms of age, education, household size, residence, and sex of the youths. Table 3 presents a simple comparison of the observable characteristics on the basis of business ownership status. With

regard to business ownership, the table shows that about 26% of the youth in the sample owned and/or managed business enterprises. The table also shows that, although about 10.9% (19.9%) of the youths came from households (communities) that can potentially practice irrigation, only 0.5% of the total households actually practice irrigation.

Table 3: Descriptive statistics of variables by status in business ownership

	Whole sample	With Business	Without Business	P-value
Household Size	4.99	4.99	5.48	0.000
Household can practice irrigation	0.11	0.12	0.09	0.000
Household Practices Irrigation	0.01	0.01	0.01	0.127
Sex of household head	0.77	0.76	0.79	0.328
Business Ownership	0.26	---	----	---
Age of the individual	23.12	40.11	38.83	0.000
Irrigation Scheme	0.20	0.21	0.17	0.000
Residence	0.79	0.84	0.64	0.000
Northern Region	0.22	0.21	0.23	0.023
Central Region	0.35	0.35	0.33	0.025
Southern Region	0.44	0.44	0.44	0.000
PLSC	0.10	0.10	0.11	0.000
JCE	0.11	0.10	0.12	0.000
MSCE	0.10	0.09	0.15	0.000
Tertially	0.05	0.04	0.06	0.000

This indicates that very few households in Malawi practice irrigation. In the table, we have also tried to compare characteristics of the youth between those that are business owners and those that do not own any business. We notice from the table that most youths that come from households with the potential to practise irrigation do not own business enterprises. In addition, we notice that most youths that own businesses are more educated, compared to youths that do not own businesses. Having briefly examined the data and descriptive statistics, we then moved on to present the results of the three-level random effects model.

However, before we estimated the model, we tested for the presence of endogeneity in the model, the results of which are presented in Table 4.

Table 4: Durbin and Wu-Hausman test of Endogeneity test

Equation	Durbin (score) chi2	P-value	Wu-Hausman F	P-value
Irrigation	9.74066 ***	0.0018	9.73662 ***	0.002

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

One notices here that both the Durbin Chi2 and the Wu-Hausman F statistics are statistically significant, implying that we reject the null hypothesis of exogeneity. This means that the suspicion we had about the potential presence of endogeneity has been statistically validated. This implies that we run equation (3) and not equation (1). However, as explained earlier, a test of validity of the instrument is imperative here before we run equation (3). Table 5 presents results of identification, determining the strength of the instrument that we have chosen.

Table 5: Identification Test

Variable	R-squared	Adjusted R-squared	Partial R-squared	F(1,17510)	P-Value
Irrigation	0.0267	0.0258	0.0160	284.267	0.0000

Minimum eigenvalue statistic = 284.267

The results clearly indicate that instrument is a significant determinant of the endogenous irrigation variable in the first stage.

4.2 Model Specification Test

Before presenting the regression results, we first present the model specification tests. Table 6 presents the results on model specification tests using Likelihood Ratio (LR) tests, and the extent of clustering at the community and district levels using intraclass correlation. The LR tests results lead to the rejection of the null hypothesis of no community and district level random effects in the model. This conclusion has two implications: first, even after controlling for individual characteristics, there are significant community-specific and district-specific factors which affect the probability that a youth owns a business, and, second, estimating a standard binary logit model in this context is technically inappropriate. In terms of clustering, the ICCs at the community level are lower than those at the district level, suggesting that clustering is more pronounced at the district level than at the community level.

Table 6: Likelihood ratio (LR) tests and inter-cluster correlation coefficients

Hypothesis	LR Statistic	Conclusion	ρ'	ρ''
$H_0 : p' = p'' = 0 \; H_a : p' = p'' = 0$	201.34	Reject	0.01	0.2

NB: H_0 represents null Hypothesis H_a represents alternative Hypothesis

4.3 Regression Results

Table 7 presents three-level random effects logit model results. As we can see from the results, the coefficient of the dummy variable capturing the status of irrigation (albeit instrumented) is positive and statistically significant at 5% significance level. It is therefore clear that youths that come from households that practise irrigation are more likely to own a business venture as compared to youths that come from households that do not practise irrigation.

Table 7: Three level random effects logit model results

Variable Name	Coefficient	Marginal effect
Irrigation (Yes=1;No=0)	0.269***	0.042***
Youth specific variables		
Sex of the youth(Male=1; Female=0)	0.054	0.009
Age of the youth(in years)	0.014***	0.002***
Education attainment		
PSLC(Primary School certificate)	0.678***	0.097***
JCE(Junior Secondary Certificate)	0.861***	0.128***
MSCE(Malawi Secondary certificate)	0.688***	0.098***
Tertiary(University qualification)	-0.026	-0.003
Household specific variables		
Household size	0.049***	0.008***
Household Wealth index	0.189***	0.030***
Residence(rural=1;urban=0)	0.125	0.021
Region		
Central region	-0.048	-0.008
Southern region	0.104	0.016
Religion of the household head		
Traditional religion	-0.099	0.016
Christianity	-0.151	-0.024
Islam	0.082	0.013
Other Religions	0.913	0.145
Ethnic group of household head		
Yao(Yes=1;No=0)	0.542**	0.012***
Chewa(Yes=1;No=0)	0.043	0.001
Tumbuka(Yes=1;No=0)	0.032	0.004
Sena(Yes=1;No=0)	0.042	0.012
Lomwe(Yes=1;No=0)	0.094	0.005
Random effects		
Community economic infrastructure index	0.071***	0.023***
District is a city(Yes=1;No=0)	0.094***	0.012***

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

In passing, we notice that older educated (at least up to secondary school level) youths that come from cities or well-to-do communities (measured in terms of economic infrastructure e.g. road networks, good markets etc) are more likely to own business ventures. This is expected, considering the fact that one expects the cities or indeed wealthy communities to have a lot more business opportunities compared to rural districts or indeed poor communities. Similarly, the youth that come from the Yao tribe are more likely to own business ventures compared to the other tribes, holding all other things constant. This is not surprising bearing in mind the fact that the Yao are known to be business oriented on average.

5. Conclusion and Policy Implication

This study has assessed the spill-over effects of irrigation policies on youth entrepreneurship in Malawi. The hierarchical three-level random effects logit model was employed using the IHS4 data. In the modelling, apart from the youth and household specific fixed effects, the model considered random effects, both at community and district levels, that influence the probability of owning and running a business venture.

The model indicated that youths that come from households that practice irrigation (albeit instrumented) are more likely to own business enterprises than those that come from households that do not practise irrigation. Our proposed theory for this finding here is that irrigation provides increased availability of funds. This provides extra resources for the household, some of which are used as finances for youths to start businesses. We find this finding to be highly informative, policy wise, because it implies that we can promote youth entrepreneurship through promoting generic policies (such as irrigation, in this case). This provides more rationale for increased funding of the generic policies for such policies have the potential to promote youth entrepreneurship and therefore fight youth unemployment in the country.

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