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Abstract

Entrepreneurial initiatives targeting disadvantaged populations can be a tool for improving the well-being of households, particularly those suffering from food insecurity. This study aims to analyse the contribution of inclusive business models (IBMs) to improving household food security in Burkina Faso. The data used in this study were collected from 780 beneficiaries and non-beneficiaries of Inclusive Business Models in the cities of Ouagadougou and Bobo-Dioulasso in 2019, as part of a research project on the economic inclusion of youth and women in inclusive entrepreneurship in Africa. The methodological approaches are based on endogenous switching regressions and propensity score matching models of participation in such activities and gains in terms of food expenditure and dietary diversity. The results show that participation in IBMs has a positive impact on household food expenditure and dietary diversity in Burkina Faso. The potentially significant contribution of IBMs could provide the empirical basis for such a public strategy to promote food security and, more generally, the well-being of households in Burkina Faso.

Key words: Inclusive business models, food security, Burkina Faso, Endogenous switching regression

JEL Classification: M21, C68

1. The Issues

Food security, defined as a situation in which people always have physical and economic access to safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life, has returned to the top of the political agenda in the wake of recent regional and global food crises[1]. The years 2007 and 2008 were marked by the worst food crisis since 1974. Rising food prices on the international market, especially for staple foods, pushed more than one billion people into food insecurity (FAO, 2009). More recently, the proportion of the world's population suffering from acute food insecurity has risen from 9.6% in 2018 to 11.9% in 2020, an increase of 2.3 percentage points. This incidence is more pronounced in sub-Saharan Africa, where it is projected to reach 20.6% in 2018 and 25.9% in 2020, an increase of 5.3 percentage points (FAO, 2021).

In Burkina Faso, food insecurity has worsened as the security situation has deteriorated. Between 2013 and 2019, the number of undernourished people increased by 22% (MAAH, 2021). Similarly, moderate food insecurity affected 9.7 million people between 2018 and 2020, compared to an average of 8 million between 2015 and 2017, an increase of 21.25% (FAO, 2021).

The prevalence of acute food insecurity in Burkina Faso increased from 10.9% between 2015 and 2017 to 15.4% between 2018 and 2020 (FAO, 2021). The country also has a high prevalence of undernourishment (14.4%), higher than Ghana (6.1%) and Mali (10.4%), but slightly lower than Côte d'Ivoire (14.9%) (FAO, 2021). In 2019, Burkina Faso's hunger index was 25.8, placing it 90th out of 107 countries, according to the report of the International Food Policy Research Institute (IFPRI, 2020).

Aware of the challenges of food security, Burkina Faso has committed at international summits to eradicate hunger by 2025. To this end, the government, in collaboration with its partners, has developed a National Food and Nutrition Security Policy (PNSAN). Structured around five strategic areas, the policy aims to strengthen the resilience of the population and improve their access to sufficient and quality food. It is part of the National Plan for Economic and Social Development (PNDES), the country's strategic planning document. These strategic axes aim to increase the availability of food to meet needs on a sustainable basis, strengthen the capacity to prevent and respond to food and nutrition crises, improve physical and financial access to food,

[1] FAO (1996) 'Rome Declaration on World Food Security and World Food Summit Plan of Action', Rome, 13-17 November 1996.

improve the nutritional status of the population, and strengthen food and nutrition security governance. Despite these enormous efforts to ensure food security for the population, it must be said that food insecurity remains a cause for concern.

Several factors contribute to food insecurity in Burkina Faso, including low agricultural productivity, the effects of climate change, volatile food prices, and the prevalence of poverty. Indeed, as Sen (1981) points out, poverty is a major determinant of food insecurity. In Burkina Faso, 41.4% of the population lives below the poverty line (EHCVM, 2018), a situation that exacerbates difficulties in accessing sufficient and quality food. Zidouemba et al. (2020) have shown that food insecurity is particularly acute among poor households, regardless of whether they live in rural or urban areas.

Inclusive business is an exciting way to strengthen food security. This business model, which has poverty reduction at its core, aims to integrate vulnerable groups into value chains and provide them with sustainable economic opportunities. In this sense, it can play a crucial role in improving access to sufficient and quality food.

The inclusive business model is based on entrepreneurial initiatives that seek to contribute to poverty alleviation by including low-income communities in the value chains of formal enterprises while pursuing the ultimate goal of the enterprise, which is to make a profit (WBCSD and SNV, 2006). The inclusive business model contributes to improving the quality of life of low-income communities by integrating them into the company's value chain as suppliers of services and/or raw materials, as distributors of goods and/or services, and as consumers by providing goods and services to meet their basic needs at affordable prices (WBCSD and SNV, 2011). It offers social and economic benefits to communities at the base of the pyramid (see figure A3 in the appendix). This business model, which promotes the integration (participation) of smallholders and low-income people in commercially viable value chains, thus contributes to poverty reduction and food security (Nelson et al., 2009; Likoko and Kini, 2017; Ros-Tonen et al., 2019).

The inclusive business model is rooted in the theory (Prahalad and Hurt, 2002; Prahalad, 2004) of business and development potential serving people at the bottom of the welfare pyramid. The Food and Agriculture Organization of the United Nations (FAO, 2015) defines inclusive enterprises as formal businesses that integrate smallholders into markets with mutual benefits for the poor and the business community while enabling the poor to move out of poverty.

According to George et al. (2012), inclusive business provides opportunities for disenfranchised individuals and communities that were previously

inaccessible due to socio-economic, geographical, and structural barriers. Inclusive businesses contribute to local development through financial investment, knowledge transfer and innovation, job creation, and the provision of goods and services (Lucci, 2012). For Ahouré and N'Dri (2020), inclusive business contributes to job quality. According to human capital theory (Mincer, 1974; Schultz, 1961), society and individuals reap economic benefits from investing in people's education. Indeed, IBM's practice takes the form of coaching and training provided to poor people to improve their skills and knowledge. This economic model also provides low-income people with access to the labour market (UNDP, 2008). Access to the labour market enables poor people to have a stable and sustainable income, which helps them to achieve food security.

From an empirical perspective, Gebru et al. (2019) concluded that the inclusion of smallholder farmers in the brewing industry in Ethiopia improved food security in Ethiopia. Mangnus (2019) found that improving food security through inclusive agricultural enterprises is conditioned by the diversity of livelihood strategies at the household level, and the diversity of farm types at the community level.

Despite its potential, inclusive business models remain underdeveloped in most African countries (see Figure A1 in the appendix). In particular, out of 551, 556, and 423 enterprises surveyed in Burkina Faso, Côte d'Ivoire, and Kenya respectively, only 128, 119, and 112 enterprises are inclusive, i.e. an adoption rate of 23.23%, 21.40%, and 26.48% for Burkina Faso, Côte d'Ivoire and Kenya respectively. This implies low participation in inclusive business models (IBMs), estimated at 384 (34.44%) individuals (representing the household or business) in Burkina, 578 (35.55%) individuals in Côte d'Ivoire[2].

In Burkina Faso, people at the base of the pyramid (BoP) play a crucial role in business value chains, particularly in distribution, consumption, employment and the supply of raw materials. Inclusive business models are particularly present in the agriculture, trade, and agri-food sectors (Final Report of the Economic Inclusion Research Project, 2020).

Indeed, the Asian Development Bank (2016) argues that inclusive business models also promote women's economic empowerment, as women are disproportionately affected by poverty. This is supported by Teodosio and

[2]Rapport final du projet de recherche « inclusion économique des jeunes et des femmes par l'entrepreneuriat inclusif : cas du Burkina Faso, de la côte d'ivoire et du Kenya », CAPEC (Côte d'Ivoire), LAQAD-S (Burkina Faso) et KIPPRA (Kenya), janvier 2020, https://idrc-crdi.ca/fr/projet/promouvoir-lentrepreneuriat-inclusif-des-jeunes-et-des-femmes-une-etude-de-cas-sur-le (15 avril 2024)

Comini (2012). For these two authors, the inclusive business model aims to create sustainable and decent income opportunities for groups with little or no mobility in the labour market.

According to the Asian Development Bank (2016), inclusive business models contribute significantly to the economic empowerment of women, a group disproportionately affected by poverty. This claim is also supported by Teodosio and Comini (2012), who highlights the ability of these models to create sustainable and decent income opportunities for populations with limited or no access to the labour market.

This raises the question of how participating in IBMs affects household food security in Burkina Faso.

2. Research Objectives and Hypotheses

The overall objective of this research is to analyse the impact of participation in inclusive business models on household food security in Burkina Faso. Specifically, the objectives are: (i) to determine the integration structure of the BoPs population in inclusive business models in Burkina Faso, (ii) to assess the impact of participation in the inclusive business model on food security.

To achieve our objectives, we assume that participation in inclusive business models increases food expenditure. Similarly, participation in inclusive business models has a positive impact on dietary diversity.

The aim of this study is twofold: to contribute to the empirical literature on inclusive business, a concept that is still little explored, and to shed light on its contribution to food security in the Burkinabe context, an area that, to our knowledge, has not been studied in depth. Although previous research has examined the impact of smallholder participation in inclusive agribusiness on food security in Ethiopia and Kenya (Gebru et al., 2019; Wangu et al., 2020; Worku, 2019), this work has been limited to the agribusiness sector and the analysis of specific case studies. Our study distinguishes itself by broadening the scope of analysis to several areas and sectors of activity.

Our study seeks to add to the empirical literature by examining how the decision to participate or not in inclusive business models affects household food security in Burkina Faso. As a reminder, Kamgnia and Ahouré (2023) analysed the impact of IBMs on poverty in Côte d'Ivoire and Kenya. Ahouré and N'dri (2020) analysed the impact of inclusive business on the quality of work in Burkina Faso and Côte d'Ivoire. Oubda et al. (2025) assessed the impact of

inclusive business models on household welfare in Burkina Faso. To the best of our knowledge, we have the first database dedicated to the concept of inclusive entrepreneurship (Rapport final du projet de recherche ' inclusion économique des jeunes et des femmes par l'entrepreneuriat inclusif: cas du Burkina Faso, de la Côte d'ivoire et du Kenya, 2020). The database is particularly rich and includes both beneficiaries and non-beneficiaries of inclusive entrepreneurship initiatives, as well as a very large set of control variables. This allowed us to establish a link between participation in IBMs and food security. We also wanted to inform policymakers about the merits of inclusive entrepreneurship as a potential tool for poverty reduction.

3. Literature Review

Food security is a multidimensional concept that encompasses aspects of food availability and access; the ability of households to obtain food from the market or their production or donations; food utilisation; and stability, which is the ability of households to withstand risks and shocks that undermine any of the other dimensions (Webb et al., 2006). During the 1980s, the focus shifted from indicators of food availability to indicators of food access, such as household food consumption expenditure and household dietary diversity. For many years, age-adjusted calorie intake per capita was considered the gold standard of food access at the household level (Hoddinott and Yohannes, 2002). Although calorie intake per capita reflects current consumption, the question of quantity does not consider many other elements of the complex concept of food security, such as quality (dietary diversity and micronutrient sufficiency). In this literature review, we explore in turn the concept of inclusive business, the business relationship between inclusive business and BoPs, and the link between inclusive business models and food security.

Defining inclusive business

The concept of inclusive business has not been studied in depth at a theoretical level. Rather, it is highlighted by social entrepreneurship or the social economy, which is its very narrow understanding (Amaro da Luz, 2014). It is rooted in the United Nations 2030 Agenda for Sustainable Development, which states that "no one should be left behind" in the current efforts to address global challenges (Woodhill et al., 2016).

More specifically, the inclusive business model or inclusive entrepreneurship is an economic model that presents an opportunity to combine business development and growth on the one hand, and the fight against poverty and

hunger on the other. It is a 'pro-poor' business model, and enterprises that adopt this business model are said to be inclusive.

For Golja and Pozega (2012), an inclusive business offers a wider range of products or services to a low-income population, as well as opportunities for income generation that are financially competitive and capable of achieving scale. By enabling the poor to be part of its value chain, it reduces poverty while maintaining a viable level of profitability.

An inclusive business is, therefore, one that seeks to contribute to poverty reduction by including communities at the Base of the Pyramid (BoP) in its value chain, without losing sight of the business's ultimate goal of making a profit (UNDP, 2008)[3].

The American economists Prahalad and Hart (2002) developed the concept of the 'base of the pyramid' (BoP) in the late 1990s. They developed the idea of the existence of wealth at the base of the income pyramid, arguing that it represents a potentially attractive market that is ignored by multinational companies.

A BoP is defined as a person living below the poverty line or a vulnerable person (women/young people, small farmers, disabled people, etc.). It is a concept whose challenge is to achieve both societal development goals, such as food security, and profits for domestic and foreign private companies (Likoko and Kini, 2017; Wach, 2012; Bitzer and Hamann, 2015).

Business relationships between inclusive business and BoPs

An inclusive business model is characterised by the integration of people at the base of the pyramid into its value chain, with the dual aim of maximising profit and contributing to poverty reduction. By partnering with BoPs, the company provides them with essential resources such as infrastructure, inputs, knowledge, support, and training. In return, the company expects to receive better quality goods and services while securing its supply chain. The BoP communities, in turn, commit to providing products that meet the required standards to ensure sustainable and improved incomes. This type of partnership is based on a sharing of risks and responsibilities between the parties involved.

Adopting an inclusive business model strengthens the partnership between inclusive businesses and low-income people, thereby creating business networks. This helps to reduce market imperfections such as information

[3] United Nations Development Programme (2008). “Creating Value for All: Strategies for Doing Business with the Poor.

asymmetries, lower transaction costs, etc. (Kelly et al., 2015). Inclusive businesses integrate low-income people into their value chains as suppliers, processors, distributors, retailers or consumers, and employees (Woodhill, 2016; Veglio and Fiedler, 2016). Inclusive business models include the poor on the demand side as customers and consumers, and on the supply side as employees, producers, and business owners at various points in the value chain.

The inclusion of people at the base of the pyramid (BoP) manifests itself in two ways: on the demand side, through the provision of essential goods and services (consumption, health, water, education, energy, finance); and on the supply side, as suppliers or employees, particularly in the agricultural and agri-food sectors, or as distributors and sales agents. Partnerships between inclusive businesses and low-income communities offer multiple benefits:

As suppliers, sourcing directly from the poor reduces the need for businesses to act as intermediaries, allowing them to better manage quality while reducing investment and production costs (Business Solutions to Poverty, 2010). As consumers, BoPs have access to a wider variety of products, are introduced to new products, and benefit from lower prices for products they need.

As distributors in local markets, companies can reduce costs, improve efficiency, and extend market reach. These distributors have a good understanding of local market conditions and can draw on local networks to reach low-income consumers, even in remote areas. Finally, inclusive businesses that employ a base of the pyramid communities can significantly improve their operational efficiency. For BoPs, access to jobs and training opportunities, and thus to increased and stable incomes, will in turn help stimulate economic growth (Business Solutions to Poverty, 2010).

In developing countries, the concept focuses on business potential, development, and poverty reduction, primarily through the inclusion of smallholder farmers in global venture capital firms as entrepreneurs or suppliers. The concept has been adopted by governments, NGOs, donors, and large agribusinesses (Chamberlain and Anseeuw, 2019; German et al., 2018; SNV and WBCSD, 2008; Vorley and Proctor, 2008; Woodhill, 2016).

Proponents of Inclusive Business (IB) see it as a win-win arrangement that meets agribusiness supply chain needs while increasing smallholder incomes and reducing market risks (Nelson et al., 2009). Over the past decade, IBMs have fuelled policy debates and development practices to improve food and nutrition security for low-income smallholder farmers (Danse et al., 2020; Mangnus, 2019).

Empirically, the relationship between participation in inclusive business and food security is controversial. Kamgnia and Ahouré (2023) found that participation in inclusive business initiatives had a positive impact on total per capita expenditure and food expenditure in Kenya and Côte d'Ivoire. Gebru et al. (2019) found that participation in a vegetable enterprise in Raya Azebo, Ethiopia, significantly improved the income of participating households. Therefore, the improved income of the participating households contributed to improved food security by facilitating access to food during lean periods, i.e. when they do not have food they have produced themselves. However, further analysis shows that the increase in income does not affect household food variety and diversity, calorie intake, or child anthropometry.

Similar results were found by Wangu et al. (2020) in Makueni, Kenya, in the mango agro-industry. Participants experienced a significant increase in income, thanks to the added value of the mango and market opportunities to which they previously had no access. The resulting increase in income contributed to an overall improvement in household food security. However, there was no significant difference in diet between participant and non-participant households, with the diet remaining very low in white roots and tubers, fruits, fish, eggs, and meat. The authors attribute this finding to the limited availability of diversified foods in local markets and perhaps a lack of adequate nutritional knowledge. In addition, Gebru et al, (2019) found that the inclusion of smallholder farmers in malted barley in Ethiopia led to increased incomes. Increased income was associated with improved food access and dietary diversity, but did not improve real calorie intake, dietary diversity score, child nutrition, or food availability. However, Worku (2019) shows that household participation in the second malting barley enterprise in Ethiopia has a significant positive impact on income. However, the increase in income does not contribute to improved household food security or dietary diversity. Income from participation has not been used to purchase better diets; smallholders spend it on non-food items such as education, health care, and agricultural inputs. Furthermore, Herrmann et al, (2018) find that despite a significant increase in income for inclusive enterprise participants compared to non-participants, there is no significant difference in household food security. The authors conclude that other factors are essential for food security, such as access to drinking water, sanitation, health care, and education. Similarly, Tommasi (2018) concludes that the contribution of inclusive agribusiness enterprises to food security is limited in the case of Ethiopia, with no improvement in dietary diversity for participating households.

4. Conceptual Framework

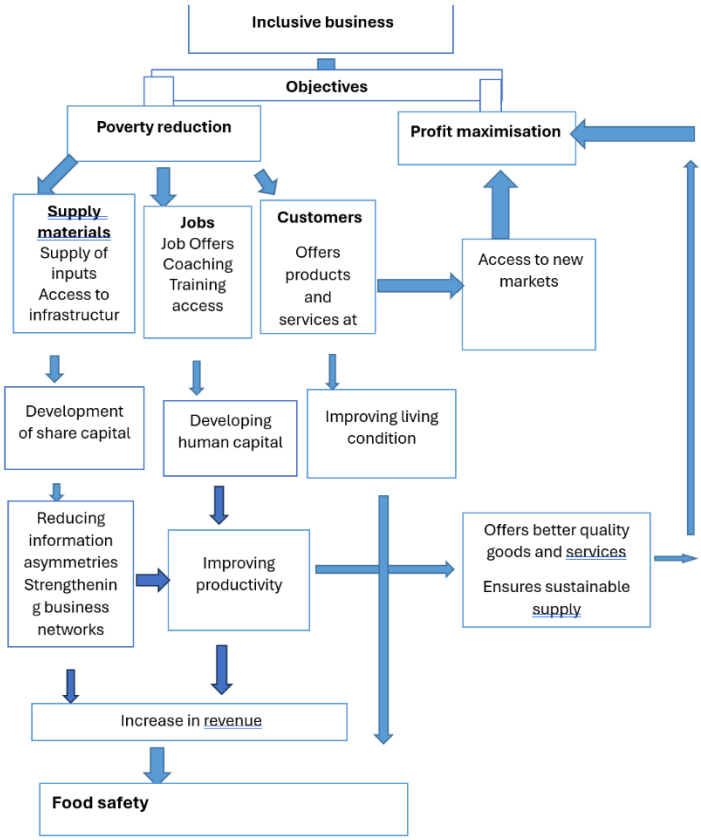
The inclusion of low-income people in inclusive value chains brings several benefits to both businesses and low-income people (see Figure 1). These benefits include income (UNDP, 2013), access to basic goods, services, infrastructure, and finance (IFC, 2012; UNDP, 2013), job creation and improved job quality (IFC, 2012), skills development (Kelly et al., 2015) and access to finance (UNDP, 2013).

The link between participation in IBMs and food security can be highlighted by human capital theory, social capital theory, etc. IBMs promote the training and qualification of the labour force, which, according to human capital theory (Becker, 1964; Schultz, 1961), increases productivity. This increase in productivity raises incomes, allowing for a better allocation of the budget to food consumption and hence food security.

Social capital theory also highlights the link between participation in IBMs and food security. Social capital, which indirectly influences food security through access to credit, asset accumulation, and collective action, is strengthened by IBMs that promote business networks. This strengthening reduces opportunistic behaviour and information asymmetries and facilitates access to resources, thereby stimulating business development, income growth, and, consequently, food security.

Social capital is still a vague and intangible concept (Rodríguez-Pose and Berlepsch, 2014). In general, social capital is described as the interaction between many individuals and social groups that is considered necessary for economic development (Han et al., 2013). It is the idea or concept that individuals and groups can draw resources from their relationships with each other. Resources include information, ideas, advice, business opportunities, financial capital, emotional support, reputation, trust, and cooperation (Inglehart and Baker, 2000).

Figure 1: Conceptual framework for the relationship between IBM and food security



Source: Author

5. Research Methodology

This section outlines the methodology used to achieve the general objective of this study, which combines descriptive statistical and econometric methods. In line with our first specific objective, we conducted a descriptive statistical analysis to characterise the integration structure of BoPs in IBMs in Burkina Faso. To address our second specific objective, we used an econometric impact assessment model to examine the relationship between participation in IBMs and food security. The methodological approach is divided into three stages: calculation of dietary diversity scores, presentation of the theoretical impact

analysis model, and description of the data and variables included in the model.

Calculation of dietary diversity scores

Dietary diversity has been studied by several authors, but with different approaches in terms of the reference period and/or the number of food groups considered (Bezerra and Sichieri, 2011; Workicho et al., 2016). The HHD has been promoted by (FANTA, 2006; FAO, 2010).

In this paper, we use 'anytime' access as the reference period, which was used to administer the survey questionnaires and capture the aspect of stability. The question asked whether the household had access to cereals or tubers, roots, animal proteins, vegetable proteins, fruits, or other food groups at any time. Therefore, only six (06) food groups (cereals, roots and tubers, animal proteins, vegetable proteins, fruits, and other food groups) were used to calculate dietary diversity scores.

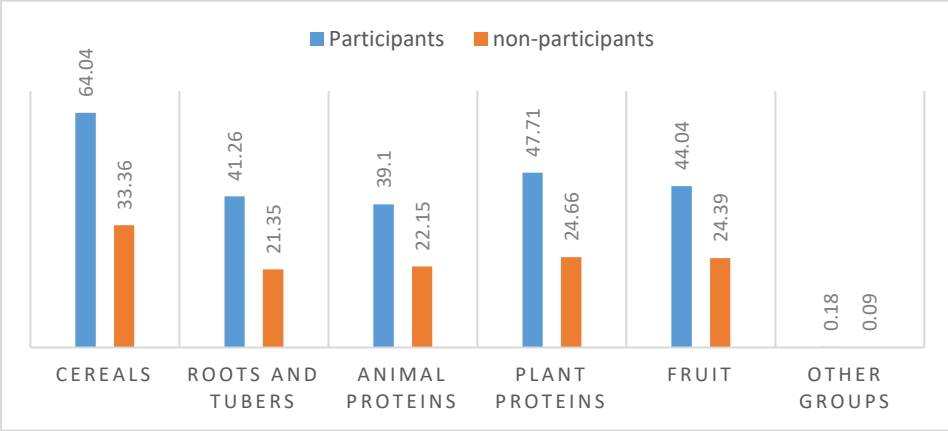
$$SDA_i = \sum_{j=1}^{6} \rho_j \qquad (1)$$

$$j = 1,2 \ldots \ldots ,6$$

Where SDA_i is the dietary diversity score of household i and ρ_j is the number of food groups consumed during the reference period (at any time).

Figure 2 summarises the number of food groups included in the calculation of the dietary diversity score and the proportion with which these food groups are consumed according to the status of participants and non-participants in the IBM.

Figure 2: Proportion of households consuming the food groups



Source: Authors based on LAQAD-S 2019 survey

The unit of analysis is the household, although the respondent may be integrated as an entrepreneur, employee, trader, etc. In addition, the survey questionnaire collected information on the household of all respondents without exception. In addition, the survey questionnaire collected information on the household of all respondents without exception and the respondent was designated as the representative of his/her household or enterprise. In this sense, this research aims to assess the impact of participation in IBMs on household food security in Burkina Faso.

Impact assessment model

To analyse the impact of participation in IBMs on food security, two main concerns were considered. The first is selection bias, i.e. the systematic error that occurs when participation in the programme is not random and can have several origins, namely a bias resulting from the selection behaviour of inclusive enterprises and a bias resulting from the self-selection of BoPs. Inclusive businesses select beneficiaries based on certain criteria (low-income, women, young people, etc.). Companies also choose BoPs that can guarantee them better results (improved performance and profitability). Taking the example of the commercial relationship between inclusive business and BoPs that enter the chain as suppliers of raw materials, an inclusive business may decide to integrate only BoPs that are members of a professional organisation to minimise risks (asymmetry of information, etc.). In Burkina Faso, in the shea value chain, women form associations from nut collection to production to supply raw shea butter to companies for processing into cosmetics.

The self-selection bias is related to the fact that being part of an inclusive business initiative is a decision based on individual choice. BoPs participate in IBMs in the expectation of better returns. The decision to participate in inclusive business models can be analysed in terms of utility maximisation.

Let u_{1i} be the utility derived from participating in inclusive entrepreneurship models and u_{0i} be the utility associated with not participating in inclusive business models. The difference in utility between participants and non-participants is denoted by u_i. Individual i will decide to participate in IBMs only if participation provides greater utility than non-participation. Mathematically, we have:

$$u_i = u_{i1} - u_{i0} > 0 \quad (2)$$

As these benefits are unobservable, the individual's decision to participate can be represented by an unobservable latent variable I_i^*, defined as follows:

$$I_i^* = \partial Z_i + u_i \quad (3)$$

$$I_i = \begin{cases} 1 \quad si \quad I_i^* > 0 \\ 0 \; si \quad I_i^* \leq 0 \end{cases}$$

Where I_i is the participation variable, which takes the value 1 for participants and 0 for non-participants, Z_i is a vector of individual characteristics that are assumed to influence the decision to participate in IBMs, and u_i is the error term.

The second concern is that participation may be endogenous and correlated with disturbances. Certain unobservable characteristics may affect both participation and food security variables. As a result, comparisons between participating and non-participating households may not provide causal effects of participation, and ordinary least squares estimation may produce biased estimates (Salazar et al., 2016; Angrist, 2001). To overcome these econometric problems, methods (experimental and quasi-experimental) have been employed in the literature. In this research, we use the quasi-experimental method, which consists of the instrumental variable model, Endogenous Switching Regression models (ESR), Propensity Score Matching (PSM), and Inverse Probability Weighted Regression Adjustment (IPWRA).

The instrumental variables (IV) method is used to analyse the selection equation and assess the impact of participation on the outcome variables. This method corrects for endogeneity without correcting for selection bias.

The propensity score matching method is applicable under the programme assignment rules (random or non-random) and can correct for selection bias. However, the method does not only consider bias due to unobservable factors.

In this study, we use ESR as an impact analysis method, inspired by the work of Kamgnia and Ahouré (2023). As a reminder, these authors used three methods (PSM, IWPRA, and ESR) and discussed the results of each model.

This model makes it possible to control for selection bias due to observable and unobservable factors (Lokshin and Sajaia, 2004; Di Falco et al., 2011; Asfaw et al., 2012). Similarly, the selection equation (participation) and the impact model are estimated simultaneously, allowing for counterfactual analyses.

Following the endogenous switching regression model, the decision to participate in inclusive business initiatives and their impact on food security is modelled in two steps. In the first step, we use a selection model for participation in inclusive business models, where a BoP chooses to participate when it provides maximum utility. As mentioned above, a BoP will choose to participate in IBMs only if participation provides greater utility than non-participation.

Equation (2) represents the probability of a BoP participating in the IBMs or not.

In the second step, we model the effect of participation on food security.

The endogenous switching model includes separate estimates for the two groups of individuals. Thus, participation becomes the selection criterion indicating the regime (participation or non-participation) to which individuals belong.

The food security variables (dietary diversity and food expenditure) are observed for both groups of individuals (Maddala, 1983; Asfaw et al., 2012).

$I_i = 1 \qquad si \quad \partial Z_i + u_i > 0$

$I_i = 0 \qquad si \quad \gamma Z_i + u_i \leq 0$

Regime 1 : $y_{1i} = \beta_{1i} x_{1i} + v_{1i} \quad si\ I_i = 1\ (participants)$ (4)

Regime 2 : $y_{2i} = \beta_{2i} x_{2i} + v_{2i} \quad si\ I_i = 0\ (non - participants)$ (5)

Where y_{1i} and y_{2i} represent the food security (dietary diversity and food expenditure) of household i, x_{1i} and x_{2i} are vectors of exogenous variables affecting the outcome variables, β_{1i} , β_{2i} and γ are vectors of parameters.

It is likely that the error term in the adoption Equation (3) and the error terms in the outcome equations (4) and (5) are correlated. To solve this problem, Equations (3), (4) and (5) are estimated simultaneously using full information maximum likelihood, which remains the most efficient approach (Lokshin and Sajaia, 2004).

Assume that β_{2i} , v_{1i} and v_{2i} have a trivariate normal distribution with mean vector zero and covariance matrix:

$$\begin{bmatrix} \sigma_u^2 & \sigma_{1u} & \sigma_{2u} \\ \sigma_{1u} & \sigma_1^2 & . \\ \sigma_{2u} & . & \sigma_2^2 \end{bmatrix}$$

Where σ_u^2 is a variance of the error term in the selection equation, σ_1^2 and σ_2^2 are variances of the error terms in the continuous equations. σ_{1u} is a covariance of u_i and v_{1i} and σ_{2u} is a covariance of u_i and v_{2i}. The covariance between v_{1i} and v_{2i} is not defined, since y_{1i} and y_{2i} are never observed simultaneously. We can assume that $\sigma_{2u} = 1$ (γ is only estimable up to a scalar factor). The important implication of the error structure is that the error term of the selection equation u_i is correlated with the error terms of the food expenditure/dietary diversity score functions (v_{1i} and v_{2i}).

$$E[v_{1i} / I_i = 1] = \sigma_{1u} \frac{\phi(Z_i\alpha)}{\Phi(Z_i\alpha)}$$

$$= \sigma_{1u}\lambda_{1i} \text{ , et}$$

$$E[v_{2i} / I_i = 0] = -\sigma_{2u} \frac{\phi(Z_i\alpha)}{1 - \Phi(Z_i\alpha)}$$

$$= \sigma_{2u}\lambda_{2i}$$

Where $\phi(.)$ is the standard normal probability density function, $\phi(.)$ the standard normal cumulative density function and $\lambda_{1i} = \frac{\phi(Z_i\alpha)}{\Phi(Z_i\alpha)}$, $\lambda_{2i} = \frac{\phi(Z_i\alpha)}{1-\Phi(Z_i\alpha)}$. If the estimated value of the covariance $\widetilde{\sigma_{1u}}$ and $\widetilde{\sigma_{2u}}$ is statistically significant, then the decision to participate in IBMs and food expenditure as well as dietary diversity scores are correlated. As a result, we establish evidence of endogenous switching and reject the hypothesis of no sample selection bias.

Considering the previous assumptions on the distribution of the error terms, the log-likelihood function is as follows:

$$\ln L_i = \sum_{i=1}^{N} I_i \left[\ln \phi \left(\frac{v_{1i}}{\sigma_1} \right) - \ln \sigma_1 + \ln \Phi \left(\theta_{1i} \right) \right] + (1 - I_i) \left[\ln \phi \left(\frac{v_{2i}}{\sigma_2} \right) - \ln \sigma_2 + \ln\left(1 - \Phi(\theta_{2i})\right) \right]$$

$$\theta_{ji} = \frac{\left(Z_{i\alpha} + \rho_j v_{ji}/\sigma_j\right)}{\sqrt{1 - \rho_j^2}} j = 1; 2$$

where ρ_j is the correlation coefficient between the error term of the selection equation u_i and the error term of the outcome equations v_{1i} and v_{2i}.

The use of the ESR model requires at least one variable in the selection equation (3) that does not appear in the outcome Equations (4) and (5) by exclusion (Di Falco et al., 2011). This step involves identifying an exogenous variable that significantly affects participation in IBMs but is not significant for the outcome variables. In the literature, Kamgnia and Ahouré (2023) used distance to the nearest health centre and distance to the hospital as instruments in their ESR model. In this study, we consider the variable distance to the nearest health centre. Empirically, we performed a falsification test to verify the validity of the instrument (Di Falco et al., 2011). This consists of performing a rejection test: a variable is a valid selection instrument if it affects the decision to participate in IBMs but does not affect the outcomes of non-participants.

Thus, the endogenous switching model is used in this research to compare the food expenditure and dietary diversity scores of IBM participants (a) with those of non-participants; (b) it also allows estimating the expected food expenditure and dietary diversity scores in the counterfactual cases (c) where participants did not participate in the inclusive business models and (d) where non-participants did participate. These measures are important in explaining the differences in food expenditure and dietary diversity scores between the two groups. The conditional expectations for the outcome variables in cases (a), (b), (c) and (d) are shown below:

$$E(y_{1i}/I_i = 1, x_{1i}) = X_{1i\beta_1} + \sigma_{1u}\lambda_{1i} \qquad (a)$$

$$E(y_{1i}/I_i = 0, x_{1i}) = X_{2i\beta_1} + \sigma_{1u}\lambda_{2i} \qquad (c)$$

$$E(y_{2i}/I_i = 1, x_{2i}) = X_{1i\beta_2} + \sigma_{2u}\lambda_{1i} \qquad (d)$$

$$E(y_{2i}/I_i = 0, x_{2i}) = X_{2i\beta_2} + \sigma_{2u}\lambda_{2i} \qquad (b)$$

Cases (a) and (b) show the actual expectations, while cases (c) and (d) show the counterfactual expectations.

The effect of inclusive business models on IBM participants is expressed in equation (6). It is called the average treatment effect on the treated (ATT)., which is the difference between cases (a) and (c) (Heckman et al., 2001; Asfaw et al., 2012).

$$ATT = E(y_{1i}/I_i = 1) - E(y_{2i} / I_i = 1) \qquad (6)$$

Similarly, the difference between cases (d) and (b) is the effect of the treatment on non-participants (ATU):

$$ATU = E(y_{1i}/I_i = 0) - E(y_{2i} / I_i = 0) \qquad (7)$$

Robustness analysis

As the ESR model may be sensitive to the choice of identification instrument, we conducted a complementary analysis using the propensity score matching (PSM) method.

The matching method is applicable regardless of the programme's assignment rules (random or non-random). It consists of using large databases to create the best possible comparison group for a given treatment group. PSM assumes that sample selection bias can be controlled by conditioning on observable variables by matching each participating household with one or more non-participating households with similar observable characteristics. This method aims to balance the distribution of observable characteristics between the beneficiary and control groups to neutralise the bias due to the difference in these characteristics and ultimately to preserve the treatment's effect, which makes it possible to identify a causal link between the decision to participate and the outcome variables (Zhao, 2000). One of the weaknesses of the PSM method is that it does not capture selection bias due to unobserved heterogeneity. However, the sensitivity analysis of Rosenbaum's (1983) bounds makes it possible to check whether the PSM results are sensitive to hidden bias (Becke and Andrea, 2002). The causal effect of IBMs on food security is estimated in two steps: in the first step, propensity scores or the conditional probability of participating in inclusive entrepreneurship models (equation (3)) were estimated using the logit model. In the second stage, participants and non-participants were matched on their propensity scores using nearest neighbour matching.

The main objective of propensity score matching is to balance the distribution of observed covariates (Lee, 2008), so that there are no systematic differences in the distribution and overlap of covariates between the two groups after matching.

In the literature, researchers have used several food security indicators and methods to analyse the determinants of food security. Zakaria et al. (2014) used logistic regression to analyse the factors influencing food security (balanced food ratio) in Niger. Bellemare and Novak, (2016) studied the impact of participation in contract farming on food security, defined as the length of the hunger season during which at least one household member reported going without three meals a day. Sanou et al. (2018) also used multinomial logistic regression to identify the determinants of household dietary diversity in four regions of northern Burkina.

In this study, we used two indicators of food security, namely household food expenditure and household food diversity scores. Household food expenditure

measures the dimension of food access, as it takes into account food sources other than one's production, while the household food diversity score, which measures the number of different types of food or food groups that people consume, and therefore the quality of the diet, as well as the frequency with which they consume them, measures the dimension of food use. The use of these two indicators in this study ensures a comprehensive measure of food security.

The data

The data used in this research were collected as part of the project Economic Inclusion of Youth and Women through Inclusive Entrepreneurship in Africa: Cases from Côte d'Ivoire, Kenya, and Burkina Faso, with funding from the International Development Research Consortium (IDRC) of Canada. The study was conducted in Burkina Faso and Côte d'Ivoire between February and May 2019, using a quasi-experimental methodology. More specifically, the Burkina Faso database has been used in this document. Using snowball sampling, a total of 224 large, medium, and small enterprises were surveyed, starting with the 30 initially identified. A two-stage survey was used to select the treatment and control groups. The selection of the treatment group was based on a list of BoPs obtained from companies (surveyed in the first stage of data collection) that reported implementing a clear BoP model and interacting with multiple BoPs in their value chain. The control groups were identified through a census of households or small businesses in the areas where the beneficiary BoPs were located. For each beneficiary interviewed, two non-beneficiaries with the same profile (field of activity, sector of activity, age group, gender, disability status) were selected for the non-beneficiary survey. Beneficiaries were randomly selected within each age, gender, and disability group. Non-beneficiaries were also randomly selected from among the non-beneficiaries identified based on the profile of beneficiaries. Data were collected from 1,115 BoPs, including 384 beneficiaries and 731 non-beneficiaries. The main variables are described above.

Definitions of variables

Table 1 shows the definitions of the study variables. The outcome variables of the study are food expenditure and dietary diversity score.

- The food expenditure variable is a continuous variable representing the total annual expenditure spent by the household on food.

- The dietary diversity score is a continuous variable that indicates the number of food groups to which the household has access at any given time. The table shows that, on average, households have access to about three food groups at any one time.

- The treatment variable used is a dummy variable that takes the value 1 if the respondent participates in inclusive business models and 0 otherwise.

-The household size variable is a continuous variable representing the number of people sharing the same main meal in the respondent's household. The households in our sample have an average of 7 people. Based on Malthusian theory, this variable can have a negative impact on food security. Cock et al (2013) showed that a small household was less likely to be food insecure in rural South Africa. Similarly, Kabunga et al, (2014) found that larger households were associated with greater food insecurity in Kenya. Bhalla et al. (2018) found that household size has a negative impact on dietary diversity scores, but a positive impact on food consumption expenditure. However, Maitra and Rao (2015) concluded that an increase in household size is likely to increase the likelihood of food security.

- The age variable is captured by the number of years of age of the respondent. Mulwa and Visser (2020) show that age is associated with higher per capita food expenditure and higher dietary diversity scores.

- The income variable is a continuous variable representing the monthly income earned by the individual from their main job. Bhalla et al, (2018) showed that wage income had a large and significant impact on consumption and food security scores. Sanou et al, (2018) found that only income from gold panning improved high dietary diversity at the expense of agricultural income. Lourme-Ruiz et al, (2016) show that women's non-agricultural income has a positive and stable effect on their dietary diversity in all seasons in Burkina Faso.

- The gender variable of the respondent is captured by a binary variable, which takes the value of 1 if the respondent is female and 0 otherwise. Bhalla et al, (2018) found that being female had a negative impact on dietary diversity scores and consumption expenditure. Kassie et al, (2014) concluded that female-headed households are more vulnerable to food insecurity than male-headed households in Kenya. Tibesigwa and Visser (2016) assessed the impact of gender inequality on the food security of smallholder households in South Africa. Their results showed that male-headed households were more food secure than their female counterparts. Mulwa and Visser (2020) reported that being male increased per capita food expenditure. Zakari et al, (2014) showed that female-headed households were more vulnerable to food insecurity than male-headed households in Niger. However, Mallick and Rafi (2010) examined the food security status of male and female-headed households in Bangladesh. They found that the gender of the household head did not affect household food security.

- The place of residence variable is a binary variable that takes the value of 1 if the respondent lives in a rural area and 0 otherwise.

- The association membership variable is a binary variable that takes the value 1 if the respondent is a member of an association and 0 otherwise. Membership in a social organisation can provide access to credit and make labour mobile. This organisation represents strong social capital that can help individuals improve their well-being. Nkomoki et al. (2019) show that belonging to a group increases the likelihood of household food and nutrition security in Zambia. Mulwa and Visser (2020) found that the social capital index has a positive impact on per capita food expenditure in Namibia.

- The marital status variable is a binary variable that takes the value 1 if the respondent is married and 0 otherwise.

- The number of years of education variable represents the number of years the respondent has spent studying. Nkomoki et al, (2019) show that a higher level of education of the household head increases the probability of being food secure. Maitra and Rao (2015) found that a household head with a higher level of education increased the probability of the household being food secure. Niankara (2021) found that education increased the joint probability of being food and monetary secure in Burkina Faso.

- The Ouagadougou variable is binary, equal to 1 if the respondent lives in the city of Ouagadougou and 0 otherwise.

- The variable Bobo-Dioulasso is a binary variable that takes the value 1 if the respondent lives in the city of Bobo-Dioulasso and 0 otherwise.

- The distance to the nearest health centre variable is a continuous variable that measures the distance in kilometres travelled to reach the nearest health centre.

- The social protection variable is a binary variable that takes the value 1 if the respondent benefits from social protection and 0 otherwise.

Table 1: Description of variables

Variables	**Description of the variables**	Expected sign
	Outcome variables (food safety)	
Dietary diversity score	= number of food groups	
Food expenses	=food expenses	
	Treatment variable	

Participation of IBM	=1 if IB participant, 0 otherwise	+
	Control variables	
Gender (female=1)	=1 if female, 0 otherwise	+/-
Association membership	=1 if association member, 0 otherwise	0+
Income	=income in FCFA	+
Ouagadougou	=1 if resident in Ouagadougou, 0 otherwise	0+/-
Bobo-Dioulasso	= 1 if resides at Bobo-Dioulasso and 0 otherwise	+/-
Household size	=household size	-
Number of years of study	=number of years of study	+
Place of residence	=1 if rural, 0 otherwise	+/-
Marital status	=1 if married, 0 otherwise	+/-
Social protection	=1if social protection, 0 otherwise	+
Possession of bank card	=1 if has a card, 0 otherwise	+
Age	= number of years	+/-

Source: Author, using data from the LAQAD-S 2019 beneficiary survey.

6. Results and Interpretation

In this session, we first analyse the descriptive statistics of the variables used to assess the impact of inclusive business models on food security and then interpret the results of the econometric regressions.

Structure of integration of BoPs in the inclusive business model

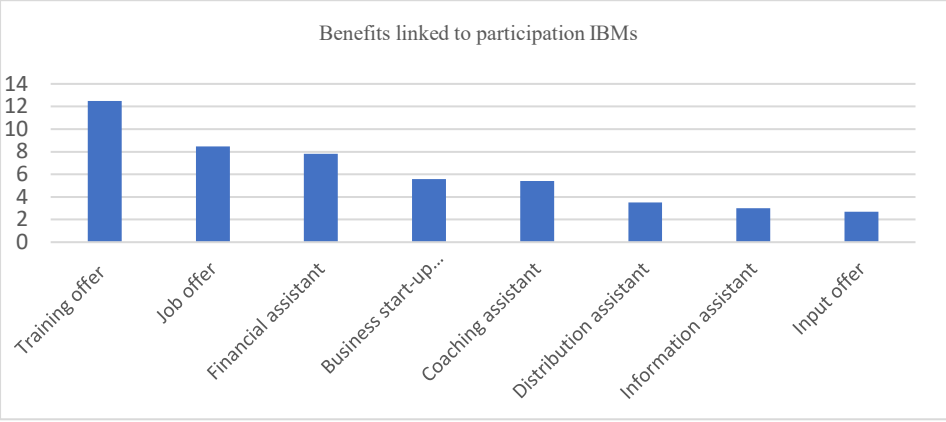
In this research, we consider a participant/beneficiary of an inclusive business initiative as any individual who is integrated into the value chain of a formal enterprise, either as a supplier/producer of raw materials, an employee of the enterprise, a customer, or a distributor of products. In Burkina Faso, BoPs participate in inclusive business models by playing the same roles, and this business relationship provides mutual benefits to stakeholders. Figure 3

summarises the benefits of participating in IBMs in Burkina Faso, based on data collected as part of the research project on the economic inclusion of youth and women through IB in Burkina Faso, Côte d'Ivoire, and Kenya in 2020.

The data collected in Burkina Faso shows a BoP participation rate in IBMs of around 34.44%, compared to a non-participation rate of 56.92%. This significant disparity can be attributed to the nascent development of inclusive business models in West Africa, and Burkina Faso in particular (see Figure 4). When BoPs engage in business relationships with inclusive enterprises, they become part of their value chains, taking on different roles such as suppliers of raw materials, distributors, permanent or temporary employees, and/or consumers (see Figure 5).

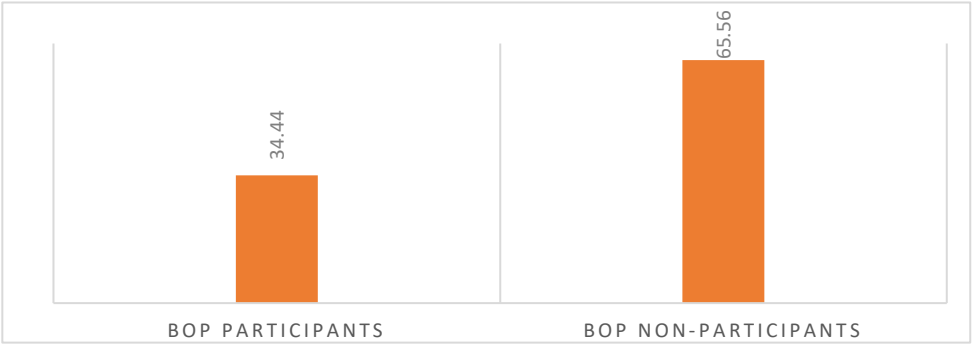
The figure shows that BoPs are most integrated as distributors (10%), followed by consumers/customers at around 9%, and as permanent employees (7%). Fewer BoPs are involved as suppliers of materials (5%) and as non-permanent employees (3%). By way of comparison, the work of Kamgnia and Ahouré (2023) shows that in Côte d'Ivoire, the highest rate of integration is for raw material suppliers (59%), followed by distributors/traders (49%); the lowest rate is for non-permanent employees (10%). In Kenya, on the other hand, individuals are most often integrated as non-permanent employees (25%), followed by permanent employees (23%), with the lowest percentage for distributors/traders (7%).

Figure 3: Benefits of participating in IBMs.



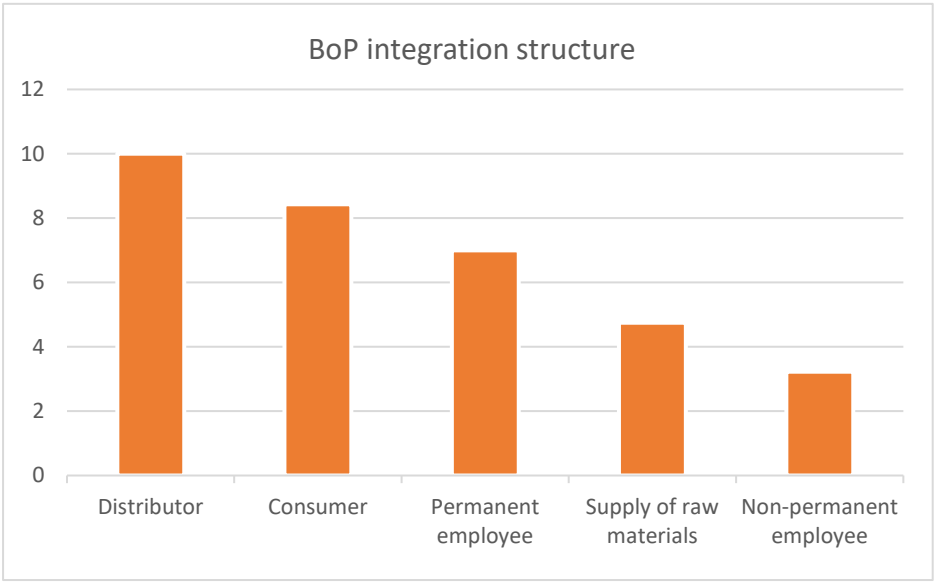
Source: Authors based on LAQAD-S 2019 survey

Figure 4: Proportion of participants and non-participants



Source: Authors based on LAQAD-S 2019 survey

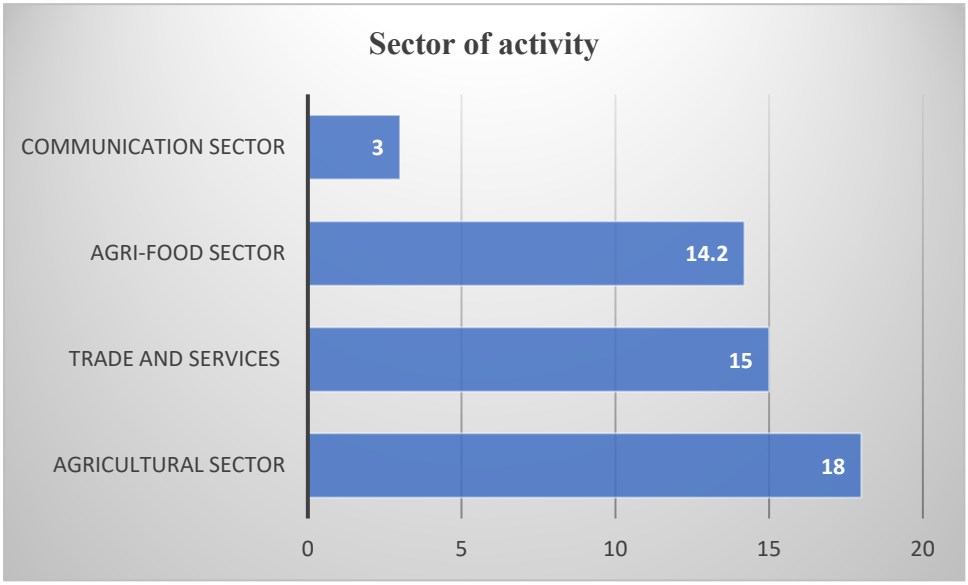
Figure 5: Structure for integrating BoPs into inclusive value chains



Source: Authors based on LAQAD-S 2019 survey

BoPs are integrated into inclusive value chains by playing different roles in different sectors of activity (see Annex A2). Figure 6 shows that BoPs are most represented in the agriculture sector (18%), followed by the trade sector (15%), the agro-food sector (14.2%), and the communication sector (3%).

Figure 6 Proportion of BoPs in the business sectors of inclusive companies



Source: Authors based on LAQAD-S 2019 survey

Socio-economic characteristics of the respondents

Table 2 presents the descriptive statistics for the socio-economic characteristics, while Table 3 presents the tests for differences of means and proportions for the main socio-economic variables of the households according to participant and non-participant status. In particular, the test for difference of means compares the equality of means and proportions for continuous and binary variables. The results show that the average monthly gain/income is 379,984.1 CFA francs for beneficiaries and 206,900.4 CFA francs for non-beneficiaries, i.e. a significant difference in income between participants and non-participants of around 5%. The table shows a marginally significant difference (10%) in diversity scores between participants (3.916) and non-participants (3.735). There was also a significant difference in annual food expenditure between beneficiaries and non-beneficiaries, estimated at FCFA 666,657 and FCFA 500,421.6 respectively. Female beneficiaries of inclusive business models represent 63.5% compared to 64.69% of non-beneficiaries, with no significant difference between female beneficiaries and non-beneficiaries. Among beneficiaries, 40.15% are members of an association compared to only 26.43% of non-beneficiaries who are members of an association, with a significant difference of 1% between beneficiaries and non-beneficiaries in terms of membership of an association. This could be

explained by the fact that inclusive enterprises favour professional groups, as this type of partnership involves risk sharing between stakeholders. The average household size is around 7 persons for both beneficiary and non-beneficiary households. The average number of years of education is higher for beneficiaries at 7.04 years compared to 6.02 years for non-beneficiaries, a significant difference of 1% between these groups. The average number of years of education is higher for beneficiaries at 7.04 years compared to 6.02 years for non-beneficiaries, a significant difference of 1% between these groups. There was also a significant difference between beneficiaries and non-beneficiaries in terms of access to social protection, with IBM participants benefiting from social protection (17.88%) compared to (9.4%). The table shows a non-significant difference in terms of place of residence, with 27.74% of beneficiaries living in rural areas compared with 32.54% of non-beneficiaries.

Table 2: Socio-economic characteristics of continuous variables

Variables	Average	Standard deviation	Min	Max
Food expenditure	558742,4	23809,1	0	11000000
Dietary Diversity Score	3,799	0,050	1	6
Number of years of study	6,363	0,214	0	24
Income	267623,8	113472,6		6500000
Household size	6,932	0,179	1	43
Distance au centre santé	2,444	0,390	0	300
Age (year)	36,142	0,540	0	97

Source: Authors from the literature

Table 2: Socio-economic characteristics of respondents

Variables	Total sample	Non-participants (a)	Participants (b)	Difference (a-b)
Dependent variables				
Food expenditure	558,742.4	500,421.6	666,657	-166,235.4***
Diversity Score Food	3.798	3.735	3.916	-0.180*
Selection Variable				
Participation of IBMs		35.08	64.92	
Control variables				
Age	36.188	35.499	37.463	-1.964*
Household size	6.939	6.930	6.956	-0.025
Gender (female=1)	64.27	64.69	63.5	0.011
Place of residence (rural=1)	30.8	32.5	27.7	4.8
Social protection (yes=1)	12.41	9.46	17.88	-08.4***
Number of years of study	6.371	6.02	7.043	-1.035***
Income	267,623.8	206,900.4	379,984.1	-173,083.7
Association membership (yes=1)	31.24	26.43	40.15	-13.7***
Ouagadougou (yes=1)	58.50	58.94	59.80	-0.09
Bobo-Dioulasso (yes=1)	12.93	13.80	11.31	02.4
Distance from the health centre	2.447	1.997	3.279	-1.281

Marital status (married=1)	66.96	64.49	71.53	-07.0**	

Notes: ***p < 0.01, **p < 0.05, *p < 0.1. Source: Authors from the literature

Interpretation of econometric results

The results of the estimation of the ESR model are first presented and interpreted, focusing on their impact on food expenditure and dietary diversity score. A robustness analysis is then carried out using the PSM model to validate the reliability of these results for the same indicators.

Estimation results of the ESR model for food expenditure

Table 4 presents the estimation results for the determinants of IBM participation and food expenditure for IBM participants and non-participants using the endogenous switching regression model estimated using full information maximum likelihood. The second, third, and fourth columns of the table present, respectively, the estimated coefficients of the selection Equation (1) for participation or non-participation in IBMs and the food expenditure Equations (2a) and (2b) for individuals who participated or did not participate in IBMs.

The results of the estimation of the endogenous switching regression model show that the log-likelihood test, which is equal to (43.39), indicates that the model is globally significant at 1%. As a result, the specification of the model is good, and the selected variables can effectively explain participation in IBMs and determine the impact on food security (food expenditure).

The results show that the parameters (rho0= -0.012 and rho1= 0.831), which measure the correlation between the error term in the selection equation and the equation for food expenditure for participants and non-participants, are significantly different from zero for rho1. This indicates the presence of selection bias problems. Since rho0 and rho1 have opposite signs, this implies that individuals choose to participate in IBMs based on their comparative advantages. A positive rho1 indicates a negative selection bias. This means that individuals with above-average food expenditures are less likely to benefit from inclusive entrepreneurship initiatives (Lokshin and Sajaia, 2004).

The Wald test for independence of the equations is significant and equal to 28.13. This rejects the hypothesis H_0, which states that the three equations (selection and results) must be specified independently. This suggests that the three equations are jointly dependent.

Determinants of participation in inclusive business models

The first stage of the analysis of the endogenous regime change model (the selection equation) made it possible to estimate the determinants of participation in inclusive business models. The results show that access to social protection, the number of years of education, membership of an association, the city of residence Bobo-Dioulasso, and the distance to the nearest health centre are the factors that determine participation in IBMs (see Table 1 in the appendix). The results show that people living in rural areas are 26.12% less likely to participate in IBMs. The results show that people who benefit from social protection are 30.63% more likely to participate in IBMs. It was also found that an increase in the number of years of study increased the probability of participating in IBMs by 1.9%. The results show that individuals who are members of a professional organisation are 43.02% more likely to participate in IBMs. Residence in Bobo-Dioulasso increased the probability of participating in IBMs by 8.43%.

Determinants of food expenditure

Concerning the determinants of food expenditure for IBM participants and non-participants, the table shows that there is a positive relationship between household size and food expenditure for IBM participants and non-participants. This relationship implies that an increase in the number of people in the households of participants and non-participants leads to an increase in their food expenditure. Our results are consistent with the work of Bhalla et al. (2018), who found that household size has a positive impact on food expenditure.

We find that the number of years of study positively influences the food expenditure of participants and non-participants. This relationship implies that an increase in the number of years of study leads to an increase in food expenditure. This relationship can be explained by the fact that individuals with a high level of education are more likely to have a higher income, which enables them to finance their household food expenditure.

The results show that the use of social protection has a significant positive effect on the food expenditure of beneficiary households. This effect can be explained by the reduction in financial burdens that social protection brings, freeing up additional resources for food.

Similarly, membership of an association is a determinant of increased food expenditure. This correlation can be attributed to the tangible and intangible

benefits offered by professional organisations, which help to improve the ability of members to meet their food needs.

For non-participating households, the analysis shows that income has a significant impact on their food expenditure. An increase in income leads to a proportional increase in food expenditure, in line with economic theory which suggests a positive relationship between these two variables. These findings are corroborated by the work of Bhalla et al. (2018), who also highlights the significant impact of wage income on food consumption.

The analysis shows that marital status and gender have a positive effect on the food expenditure of non-participating households. More specifically, households headed by a married person or a woman tend to spend a higher proportion of their expenditure on food.

Table 4: Determinants of IBM participation and food expenditure

Variables	**Selection equation**	**Food expenditure**	
		Participants	Non-participants
Age	0.000	0.002	0.004
	(0.003)	(0.002)	(0.003)
Household size	-0.003	0.062***	0.032 ***
	(0.009)	(0.009)	(0.010)
Gender (female=1)	0.019	0.094	0.153*
	(0.104)	(0.104)	(0.090)
Place of residence (rural=1)	-0.183	-0.304***	0.138
	(0.111)	(0.120)	(0.104)
Social protection (yes=1)	0.370**	0.411***	-0.021
	(0.149)	(0.158)	(0.129)
Number of years of study	0.021***	0.018*	0.028**

	(0,009)	(0.009)	(0.011)
Income	0.015	0.015	0.017*
	(0.010)	(0.011)	(0.010)
Association membership (yes=1)	0.394***	0.375***	0.070
	(0.106)	(0.117)	(0.130)
Ouagadougou (yes=1)	-0.013	-0.208*	-0.309***
	(0.121)	(0.111)	(0.089)
Bobo-Dioulasso (yes=1)	0.276*	0.481***	0.111
	(0.165)	(0.153)	(0.151)
Distance from the health centre	0.030**		
	(0.014)		
Marital status (married=1)	0.197*	0.158	0.339**
	(0.112)	(0.111)	(0.125)
Constant	-1.043***	11.148***	11.738 ***
	(0.209)	(0.278)	(0.247)
Rho0	-0,012		
	(0,066)		
Rho1	0,831***		
	(0,071)		
Wald test of indep. eqns.:	28,13	Prob > chi2	= 0,0000
Observations	780		

Note: The stars (***), (**) and (*) indicate the significance of the coefficients in the table at the 1%, 5% and 10% thresholds respectively. The figures in brackets are standard deviations. Source: Authors, estimation results based on LAQAD-S 2019 beneficiary survey data.

Estimation results for the ESR model on dietary diversity scores

Table 5 presents the estimates of the endogenous switching regression model using full information maximum likelihood. The second, third, and fourth columns of the table present, respectively, the estimated coefficients of the selection equation (1) on participation or non-participation in inclusive business models and the dietary diversity scores (2a) and (2b) for respondents who did or did not participate in inclusive business activities.

The results of estimating the endogenous switching regression model show that the log-likelihood test is equal to (361.74), indicating that the model is globally significant at 1%. As a result, the specification of the model is good, and the selected variables can effectively explain participation in inclusive activities and determine the impact on food security (dietary diversity).

The results show that the parameters (rho0=-0.437 and rho1 =0.283) measuring the correlation between the error term of the selection equation and the dietary diversity equations of IBM participants and non-participants are only significantly different from zero for rho0. This result indicates the presence of selection bias. This means that if participants choose not to participate in inclusive business models, the effect may not be similar to the effect on non-participants because there are systematic differences between participants and non-participants. Since rho0 and rho1 have opposite signs, this implies that individuals choose to participate in IBMs based on their comparative advantages. As rho0 is negative, this sign indicates a positive selection bias. This means that individuals who have benefited from inclusive business initiatives have higher dietary diversity scores compared to a random individual in the sample (Lokshin and Sajaia, 2004).

The Wald test for independence of the equations is significant and equal to 4.96. This rejects hypothesis H_0, which states that the three equations (selection and outcomes) must be specified independently. This suggests that the three equations are jointly dependent.

Since the analysis of the determinants of the first stage (selection equation) has been carried out for food expenditure, we move on to the analysis of the determinants of dietary diversity scores.

Determinants of dietary diversity scores

Regarding the determinants of dietary diversity for IBM participants and non-participants, Table 5 shows a positive and significant relationship between income and dietary diversity scores for participants and non-participants. This relationship can be explained by the fact that an increase in income leads to an increase in the number of food groups consumed. An increase in income provides more opportunities to increase the number of food groups consumed. Our findings corroborate the work of Bhalla et al. (2018), who showed that wage income has a large and significant effect on food security scores.

The number of years of study has a positive impact on the dietary diversity scores of participants and non-participants. That is, an increase in the number of years of study leads to an increase in the number of food groups consumed by participants and non-participants. Our results corroborate the work of Maitra and Rao (2015), who found that a household head with a higher level of education increases the likelihood of the household being food secure. Our results are also consistent with Niankara (2021), who found that education increased the joint probability of food and monetary security in Burkina Faso.

The results show a negative relationship between household size and dietary diversity score. This finding suggests that as the number of people in the household increases, the number of food groups consumed by the household decreases. Our results are consistent with the work of Bhalla et al. (2018), who found that household size negatively affects dietary diversity score but contradicts the work of Maitra and Rao (2015), who conclude that an increase in household size is likely to increase the likelihood of food security.

We find that living in the cities of Ouagadougou and Bobo-Dioulasso has a positive effect on the dietary diversity score of IBM non-participants. This result can be explained by the fact that food access and supply are more guaranteed in large cities.

The results show that living in a rural area has a positive effect on the dietary diversity score of non-participants. This result could be explained by the fact that food is generally produced in rural areas, which guarantees the availability of food.

Table 5: Determinants of IBM participation and dietary diversity

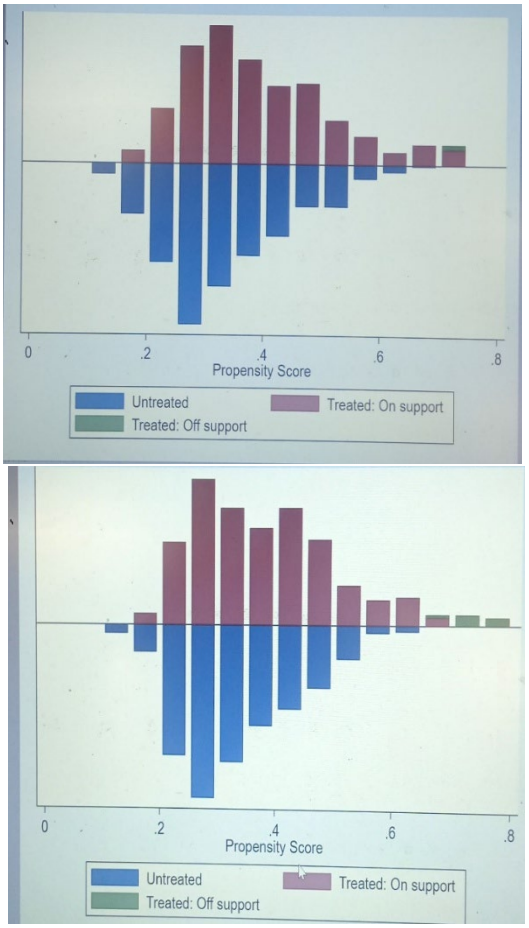
Variables	Selection equation (1)	Dietary Diversity Scores	
		Participants (2a)	Non-participants (2b)
Age	0.004 (0.003)	0.003 (0.004)	0.004 (0.004)
Household size	-0.005 (0.009)	-0.023 (0.016)	-0.029*** (0.011)
Gender (female=1)	0.008 (0.106)	0.02 (0.147)	-0.031 (0.117)
Place of residence (rural=1)	-0.206 (0.127)	0.037 (0.176)	0.605*** (0.112)
Social protection (yes=1)	0.403*** (0.151)	-0.129 (0.214)	0.149 (0.207)
Number of years of study	-0.021 (0.013)	0.074*** (0.020)	0.090*** (0.016)
Income	0.017* (0.010)	0.078*** (0.016)	0.049*** (0.012)
Association membership (yes=1)	0.445*** (0.105)	0.069 (0.177)	-0.481*** (0,150)
Ouagadougou (yes=1)	0.376*** (0.184)	0.252 (0.161)	1.059*** (0.114)
Bobo-Dioulasso (yes=1)	-0.107 (0.170)	1.332 (0.146)	1.783*** (0.138)
Distance from the health centre	0.039* (0.022)		
Marital status (married=1)	0.492 (0.159)	-0.204 (0.242)	-0.166 (0.211)
Constant	-1.05*** (0.210)	2.182 (0.459)	2.080*** (0.259)
Rho0	-0.437** (0.221)		

Rho1	0.283 (0.194)	
Wald test of indep. eqns	4.96	Prob > chi2 = 0.083
Observations	780	

Note: The stars (***), (**) and (*) indicate the significance of the coefficients in the table at the 1%, 5% and 10% thresholds respectively. The figures in brackets are standard deviations. Source: Authors, estimation results based on LAQAD-S 2019 beneficiary survey data.

PSM model estimation results

Figure 7. Distribution of propensity scores in the common support region



Source: Authors based on LAQAD-S 2019 survey

Impact of inclusive business on food security

The results in Table 6 show that the average treatment effect on the treated (ATT), i.e. the impact of the inclusive business models on food expenditure for households that participated in the inclusive business models, is positive and significant using both the ESR and PSM methods. The inclusive business models increase food expenditure for IBM participants by 3% according to the ESR model. In contrast, in the PSM model, inclusive business models increase food expenditure by 2.17% for participating households. This result could be explained by the fact that the increase in income associated with IB participation is partly allocated to food expenditure. Our results corroborate the work of Gebru et al, (2019) and Wangu et al, (2020). This result confirms our hypothesis that IBM participation has a positive impact on food expenditure.

In terms of dietary diversity scores, we find that the impact of inclusive business models on the dietary diversity scores of households that participated in IBMs is positive and significantly different from zero through the ESR and PSM models. This implies that inclusive business models increase the dietary diversity score of IBM participants by 13.06% thanks to the ESR model. For the PSM model, IBMs increase the dietary diversity score of participating households by only 3.55%. These results are in line with the work of Gebru et al. (2019) but contradict those of Worku (2019) and Wangu et al. (2021), who showed in their work that although the inclusion of smallholders in inclusive value chains improved the income of beneficiaries, it did not contribute to a significant increase in the number of food groups consumed (dietary diversity).

Table 6: Average impact of inclusive business models on food security

	Average effect of treatment on treated (ATT)			
Variables	**ESR**	**Change[2] (%)**	**PSM**	**Change[2] (%)**
Food expenditure	0.218***	3%	0.158*	2.17%
	(0.016)		(0.086)	
Dietary diversity score	0.95***	13.06%	0.258**	3.55%
	(0.028)		(0.128)	

Notes: *** defines significance at 1%; ** significance at 5%; *significance at 10%. a

NB: 2. According to Ma and Abdulai (2016), since the outcome variables are in logarithmic form in the estimates, the predictions are also in logarithmic form, hence the need to convert to percentages.

Source: Author, based on data from the LAQAD-S 2019 beneficiary survey.

7. Conclusion and Policy Implications

Achieving food security in Burkina Faso remains a challenge for the public and private sectors in the context of growing insecurity. Against this background, this paper analyses the impact of participation in IBMs on food security (food expenditure and dietary diversity). The data used in this research were collected by LAQAD-S in Burkina Faso from February to May 2019, in collaboration with Côte d'Ivoire and Kenya, with financial support from the International Development Research Consortium (IDRC) of Canada. A total of 302 beneficiaries and 790 non-beneficiaries were interviewed. A sample of 780 individuals was selected for analysis.

The causal impact of participation in inclusive business programmes on food security was estimated using endogenous switching regression (ESR) and propensity score matching. The results show that participation in IBMs leads to higher levels of food expenditure and dietary diversity for participating households compared to non-participants in IBMs. Participation in inclusive business models allows participating individuals to increase their food expenditure and dietary diversity score by about 3% and 13.06%, respectively.

Our results show that access to social protection, years of education, membership in an association, and place of residence are the factors that determine participation in IBMs.

In light of these findings, and to improve food security for vulnerable people, participation in inclusive business models should be encouraged. Upstream, policymakers should support the development of inclusive business models by implementing projects and programmes for people at the bottom of the social pyramid, and downstream, they should make these people aware of the existence of these types of enterprises and help them to organise themselves into associations to increase their chances of benefiting from an inclusive business programme.

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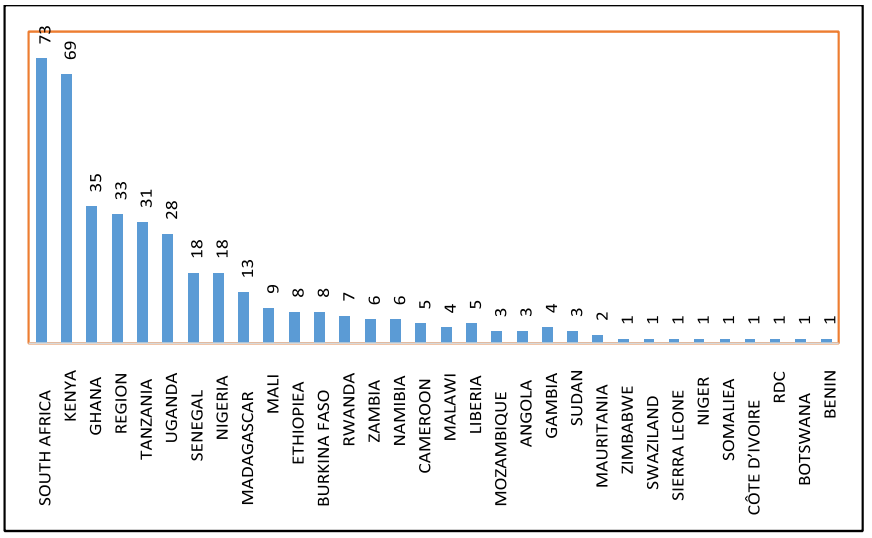
Appendix

Figure A1 Geographical Distribution of Inclusive businesses in Africa.

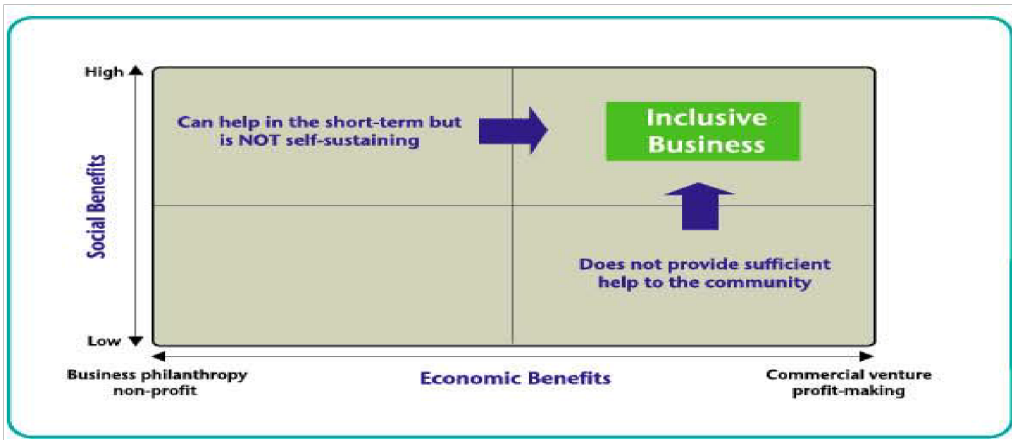


Source: UNDP /2013

Figure A2: Integrating the poor into the value chain

Source : WBCSD and SNV, 2006

Figure A3 Economic and social benefits of inclusive business



Source: WBCSD and SNV, 2006

Table A1: Determinants of participation in inclusive business models

Variables	Selection variable	
	Coefficients	**Marginal effects**
Age	0.002	0.001
	(0.003)	(0.001)
Household Size	-0.001	-0.000
	(0.009)	0.003
Gender (female=1)	-0.012	-0.004
	(0.105)	(0.036)
Place of residence (rural=1)	-0.261**	-0.091**
	(0.118)	(0.041)
Social protection (yes=1)	0.306**	0.107**
	(0.149)	(0.052)
Number of years of study	0.019**	0,006**
	(0.009)	(0.003)

Income	0.023**	0.008**
	(0.010)	(0.003)
Association membership (yes=1)	0.430***	0.151***
	(0.105)	(0.035)
Ouagadougou (yes=1)	-0.084	-0.029
	(0.156)	(0.055)
Bobo-Dioulasso (yes=1)	0.967***	0.338***
	(0.282)	(0.096)
Distance from the health centre	0.044**	0.015**
	(0.021)	(0.007)
Marital status (married=1)	0.156	0.054
	(0.114)	(0.039)
Constant	-1.126***	
	(0.219)	
Wald chi2(12)	58.16	
Prob > chi2	0,0000	
Observation	780	

Source: Author, using data from the LAQAD-S 2019 beneficiary survey

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