Does FDI in agriculture promote food security in developing countries? The role of land governance*

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Abstract

As climate change, population growth, rising incomes and rapid urbanization increase the demand for food, the world is facing further pressure to enhance food security for all. Investment in agriculture and food systems is not only necessary but also critical. Foreign direct investment (FDI) is an important source to close the funding gap that developing countries face to increase food production and agricultural productivity. Yet, it poses serious challenges on domestic populations. The goal of this study is to investigate the effect of FDI in agriculture on food security in the host country. The empirical analysis employs a land access index by the International Fund for Agricultural Development (IFAD) to control for differences in land governance. Using data from 56 developing countries over a 16-year period, the empirical analysis finds evidence that FDI in agriculture has an inverse effect on food security in the host country. FDI has a more favourable impact where the land governance system is better. The findings call for an imperative role to governments for tenure reforms by formalization of customary rights to enhance tenure security for a more equitable access to land. It is also essential that good monitoring and impact assessment systems are developed to ensure transparency of the processes associated with agricultural investments.

Keywords: developing countries, FDI, food security, land governance, tenure security

JEL classification codes: F21, F63, Q15

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1. Introduction

Food insecurity remains a major long-term concern and is expected to increase even more under the impacts of economic slowdown and downturns following the COVID-19 pandemic, ongoing conflicts and climate extremes. While the global prevalence of undernourishment (PoU) fell from 1,011 million people in 1990–1992 to 927 million in 2000–2002 and to 821.6 million in 2014–2016, this declining trend reversed in 2015 (FAOSTAT). In 2020, both the share of the undernourished in total population and the number of the undernourished increased following a stagnant period from 2014 to 2019. The prevalence of undernourishment climbed to about 9.9 per cent in 2020, from 8.4 per cent the previous year (FAO et al., 2022).

Foreign direct investment (FDI) in agriculture has gained increasing scope and scale in the context of reducing hunger and promoting food security for all. In 2014, UNCTAD estimated that the investment in agriculture and food security required between 2015 and 2030 is $480 billion, and that the investment gap is $260 billion (UNCTAD, 2014). FDI is essential to closing the funding gap to increase food production and agricultural productivity. The developmental benefits of foreign investor involvement in investment in agriculture can be realized through four channels: (i) job creation; (ii) providing access to markets and technology for local producers; (iii) local and national tax revenues; and (iv) supporting social infrastructure, often through community development funds using land compensation (Deiningier et al., 2011; UNCTAD, 2009). The actual impacts and implications vary across countries, by agricultural produce, and influenced by factors, such as the type of foreign involvement, the institutional environment, and the host country's level of development (UNCTAD, 2009).

The potential benefits of foreign investment in agriculture are counterweighted by the concerns raised due to the examples of the past decades. Firstly, the scale of investment projects involves large areas of land and affects a large number of people. Secondly, the sectoral breakdown of FDI reveals that investment flows to agriculture do not follow a steady pattern. Third, and more importantly, most land deals lack transparency and are either underreported or not reported at all, which makes monitoring a challenge. Consequently, it is hard to reach the desired socioeconomic outcomes such as job creation, empowering rural communities, and reducing poverty and food insecurity in the host country.

One of the critical factors of concern relating to land investment in many developing countries is that land governance is only vaguely defined in legislation. Land governance is the process of decision-making on access to, and use of, land and natural resources, and how conflicting interests are reconciled. According to the Rights and Resources Initiative (RRI), about 65 per cent of the global land reserves are held by indigenous people and communities under customary tenure regimes, with only one-tenth being formally recognized (RRI, 2015). In the least developed countries (LDCs), particularly in Africa, land tenure systems are shaped by historical

conditions and social relations rather than a formal legal framework. Most farmland investments in developing countries in recent years exploit this gap in the legal system. Foreign investors predominantly target "unutilized" or "underutilized" land which are in practice under the use of local communities (Cotula, 2013; Conigliani et al., 2018). This obscurity in land governance makes rural populations vulnerable to the adverse effects of agricultural investments (World Bank, 2014).

While agricultural investment can promote food security in the home country by increased availability of food, their implications for food security in the host country remain ambiguous. This study sets out to explore this relation and will make a novel contribution to the recent land acquisition debate on the differences in land governance across developing countries. Recent literature on large-scale land acquisitions emphasizes the role of institutions. Some studies identify tenure insecurity as one of the main drivers of land deals (Arezki et al., 2013; Giovanetti and Ticci, 2016; Lay and Nolte, 2018); others still find that investors prefer to invest in countries with better regulated land tenure as it provides more guarantees for their investment and helps when potential disagreements or conflicts occur (Mazzocchi et al., 2018; Tagini, 2009). However, the discussion is mostly based on findings from individual case studies. Lack of data on land governance and land deals make it a challenge to turn the case studies into empirical analysis.

The goal of this study is to investigate the implications of FDI in agriculture for food security in the host country. Empirical research on the relationship between sectoral allocation of FDI and food security is quite limited. This study aims to contribute to this literature. Using FAO data, this study seeks to answer two main questions: Does FDI in agriculture promote food security in developing countries? And how does the land governance system affect the ultimate relation?

Empirical findings shed some light on the socioeconomic outcomes of farmland acquisitions in developing countries, and especially the impact these acquisitions have on food security in host countries. By this, the study can support evidence-based policymaking on alleviating the increasing pressure on agricultural land as growing populations require more food production, and as environmental degradation and climate change escalate the competition for limited natural resources in developing countries.

This study is organized as follows. Following the introduction, the second section of the paper provides a brief overview of the trends FDI in agriculture followed since 1995. The third section reviews the literature on FDI and food security, and the fourth section examines the relation empirically, and presents a detailed discussion of the econometric results. Concluding remarks and policy implications are contained in the final, fifth section.

2. Trends in FDI in agriculture

Agricultural investments in developing countries have risen dramatically in recent decades. FDI in agriculture was not previously unknown but it has evolved significantly over time, with variations across regions, in target commodities, scale and how it has impacted smallholder farming. All these variations affect the socioeconomic outcomes of investments (Deiningier et al., 2011).

In general, FDI in agriculture comprises a significantly small share of total FDI, as compared to other economic sectors. However, such investments have grown globally since the mid-1990s and, after 2007, FDI inflows to developing country agriculture rose significantly. This development is explained by several factors. To begin with, the global food price surge of 2007–2008 highlighted the vulnerability of food-dependent countries and spurred them to find new secure food sources. With this motivation, countries with a growing population and sufficient funds started investing overseas to avoid food supply shocks in their home country (Deiningier et al., 2011). The drivers of this new wave of investment are mainly emerging countries with rapidly growing populations, a shortage of fertile land, but with abundant capital. Major investors from China, the Gulf States, and the Republic of Korea have invested in food crops and livestock production in developing countries. Target countries are in the Global South with abundant cultivable land and low agricultural productivity. In addition, following the global financial crisis of 2008, investors rediscovered farmland as a worthwhile alternative investment tool with stable returns.

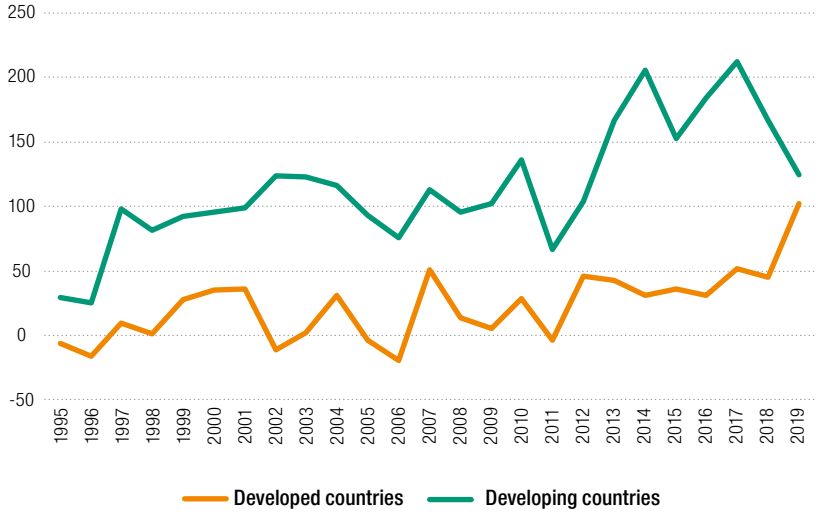
Figure 1 shows the FDI trend in agriculture since 1995.[1] These investments represented 2.8 per cent of global FDI inflows between 2010 and 2019, 0.7 percentage points higher than the previous decade.[2] The pace of investments slowed before the 2008 global financial crisis and was followed by a sharp decline which lasted until 2011. The pace picked up momentum again until its subsequent decline in 2021. UNCTAD (2022) shows a continuing decline in the numbers of international private investment projects in the food and agriculture sector, which have not recovered from the COVID-19 pandemic. Despite an overall increase, FDI inflows in agriculture fluctuates remarkably and reacts strongly to global economic shocks. These sudden changes in FDI inflows make developing countries more vulnerable to global business cycles than their developed-county counterparts.

Regional distribution of FDI in agriculture has been profoundly uneven, even though it has overall increased (figure 2). The East Asia and the Pacific region has received

[1] The main information source for FDI in agriculture is the FAO's Foreign Investment Database which reports FDI flows in agriculture using the International Standard Industrial Classification of all Economic Activities (ISIC) Rev.4 category on "agriculture, forestry and fishing". The term "agriculture" is used to cover this broad category.

[2] Author's own calculations based on data from the FAO's Foreign Investment Database (accessed 4 May 2022).

Figure 1. FDI in agriculture, 1995–2019 (Millions of dollars)



Source: Author's calculations based on data from the FAO's Foreign Investment Database.

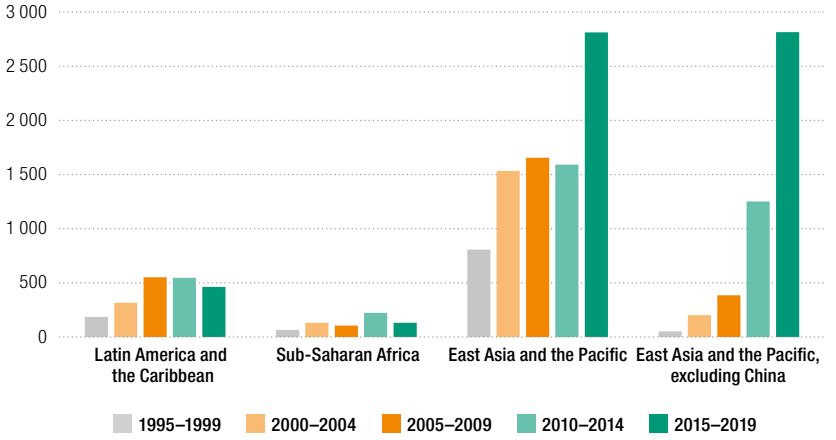
the most FDI in the agriculture sector since 1995. FDI to the region has increased, led by high economic growth, strong institutional capacities, large potentials in agricultural industries and government incentives. Until recently, China was the main FDI destination in the region, but South-East Asian countries have managed to attract increasingly larger shares of FDI. Indonesia has been a prime target of farmland investments: from 2015 to 2019, it was the world's largest recipient of FDI inflows to agriculture, with average inflows of $3.1 billion per year.[3] China accounted for the largest portion of investment in agriculture since 1995, rising as high as 85 per cent of total FDI in the sector in 2008, before falling to 20 per cent before the COVID-19 pandemic.[4] Indonesia and Malaysia have been targeted for palm oil production in large estates, while in Thailand and Viet Nam foreign investments mostly targeted rice production by smallholders (Deiningier et al., 2011).

FDI inflows to the Latin America and the Caribbean region have risen significantly since the early 2000s. This increase was mainly due to growing interest in crop production of biofuels and livestock ranching. Brazil has long been a particularly attractive destination for farmland investments in the region. Since 2000, foreign investors bought over 6 million hectares of land in Brazil for agricultural production, timber extraction, carbon trading, industry, renewable energy production, conservation, and

[3] Indonesia is followed by Norway with $940 million per year on average, and by Oman with $816 million per year on average from 2015 to 2019 (FAO, 2022).

[4] Author's own calculations based on data from the FAO's Foreign Investment Database (accessed 4 May 2022).

Figure 2. FDI in agriculture, by region, 1995–2019 (Millions of dollars)



Source: Author's calculations based on data from the FAO's Foreign Investment Database.

tourism (ILC, 2022). These deals resulted in heated debates on displacement and harassment of indigenous and traditional communities, and the deforestation of the Amazon Forest.

Sub-Saharan African countries attract the smallest share of global FDI inflows to agriculture. However, the value of FDI flows to agriculture to these countries more than doubled in the period between 2010 and 2019, compared to between 2005 and 2009. This is due to a change of approach in how African governments deal with development and the rural sector. Political commitment to reduce poverty and hunger and increasing production and productivity in the agricultural industries were contained in the Maputo Declaration on Agriculture and Food Security in 2003, and the Comprehensive African Agricultural Development Programme (CAADP) Compact in 2007. Government incentives to attract investments to the rural sector have encouraged transnational companies to consider investing in the region. According to the Land Matrix database, as of July 2022, 9.5 million hectares of land was acquired in sub-Saharan Africa for agricultural production (ILC, 2022). Mozambique, Ethiopia and Ghana, in that order, were the top recipient countries of farmland investments in the region.

3. Literature review

The analysis of the relation between FDI and food security began in the 1980s. Prior to this, food security was considered a part of social welfare, and only became a parameter in empirical analysis after Sen's introduction of the concept of *entitlements* (Sen, 1981), but still largely from a sociological perspective. Since the late 1980s, several cross-national studies focused on the impact of international

investment and trade on micro-level measures of welfare, such as nutrition, infant mortality, literacy rate, and life expectancy (Firebaugh and Beck, 1994; Shen and Williamson, 1997; Wimberley, 1991). These studies were particularly important as they applied earlier sociological research on basic needs to the broader question of economic development.

Several cross-national studies testing the effect of FDI on food consumption found a direct and negative relation (London and Smith, 1988; London and Williams, 1990; Wimberley, 1991). They argue that FDI is detrimental to food supply. This is criticized by studies claiming that they misinterpreted the negative sign on FDI. These studies argue that foreign investment does not decrease food supply, but rather that it is not as beneficial as domestic investment (Firebaugh and Beck, 1994; Firebaugh, 1996). Several studies found that foreign capital penetration does not have a robust significant effect on food consumption (Brady et al., 2007; Jenkins and Scanlan, 2001).

The surge of large-scale land acquisitions in developing countries resulted in increased interest on a wide range of topics, among others, the drivers and outcomes of foreign investment in land. The literature almost unanimously agrees that the issue of property rights and land tenure security are crucial in the context of large-scale acquisitions. Several studies suggest that the lack of formal recognition of customary land tenure rights can increase the risk of "land grabbing" by reducing the potential of large-scale land deals to contribute to inclusive growth (Cotula, 2013; Cotula et al., 2019; De Schutter, 2011). Other studies argue that some populations are disproportionately affected under tenure insecurity (Behrman et al., 2012; German et al., 2013). Schoneveld et al. (2011) show that vulnerable groups, such as women and migrant farmers, are particularly affected because of their comparatively insecure access to vital livelihood resources.

Empirical work investigating the direct link between agricultural FDI and food security is quite limited, mainly due to the lack of disaggregated sectoral data. However, a small number of studies show both a positive relation (Ben Slimane et al., 2015; Dhahri and Omri, 2020; Santangelo, 2018; Wardhani and Haryanto, 2020) and a negative relation (Abdul-Hanan et al., 2022; Djokoto, 2012; Kinda et al., 2022; Mihalache-O'keef and Li, 2011). Ben Slimane et al. (2015) explain the positive impact of FDI in the primary sector on food security through increased agricultural production and employment creation, thereby increasing per capita income; while Mihalache-O'keef and Li (2011) found that FDI in the primary sector has a negative effect on food security due to increasing unemployment, changing use of agricultural land, and negative environmental and demographic changes.

Country or regional case studies provide further findings on this. Schoneveld et al. (2011) show that agricultural investment projects directly impact food security and the income earning potential of communities following their loss of access to vital resources, especially forests and land. Kinda et al. (2022) investigate the impacts of investments for biofuel and food crop production. Their analysis indicates that land acquisition for mixed production of biofuel and food crops, and land for other

uses contribute to food insecurity in sub-Saharan Africa as it decreased cereal production and increased malnutrition. They also found that land acquisition for biofuel has no significant effect on food security. Mechiche-Alami et al. (2021) argue that even when the main objective is agricultural production, most large-scale agricultural investments are not likely to improve food security, but rather serve the financial interests of transnational companies.

Santangelo (2018), using project-level information, argues that an investor's country of origin has an impact on the host country's food security, when engaging in FDI in developing country agriculture. She shows that while FDI in land by investors from developed countries positively influenced food security in the host country, investments by investors from developing countries hampered it. The main reason for this is that developed country investors are pressured by home institutions to respect human rights and engage in responsible farmland investments. Investors from developing countries, on the other hand, are pressured to promote national interests and government policy objectives at the expense of the interests of the host country, e.g. through the decrease of its cropland. Abdallah et al. (2022) distinguish between investments in land by domestic and foreign entities and show that both domestic and foreign investments lead to worse food security outcomes, but that the effect is larger for domestic investments.

This study aims to contribute to this growing empirical literature on the implications of foreign direct investment in developing country agriculture on food security in the host country. Considering the evidence from the literature, the following hypotheses will be tested:

- H_1: FDI in developing country agriculture does not always enhance food security in the host country.
- H_2: Better governance of land tenure is positively associated with food security.

4. Empirical analysis

4.1. Model specification

Hypotheses are tested on an unbalanced panel of 56 developing countries over the period 2005–2020. The selection of countries is determined by data availability. Econometric analysis is based on the following reduced-form model:

$$Y_{it}=\alpha+\beta_1 FDI\_agri_{it-1}+\Gamma X_{it}+\lambda_i+\eta_t+\varepsilon_{it}$$

where Y_{it} stands for the food security indicators of country i in year t. The coefficient of interest is β_1 showing the impact of FDI in agriculture sector on food security indicators. There may, in principle, be a dynamic impact from undernourishment to FDI through a healthier workforce as healthy and productive labour attract more FDI. This reverse causality is disentangled using a lagged independent variable

(FDI_agri_{it-1}) in a first difference model (Allison, 2009). X is the vector of control variables affecting the dependent variable. λ_i and η_t are country and time fixed effects, respectively; and ε is the error term. Several variations of the model are estimated using different indicators to measure food security. The model is estimated using the fixed effects method to account for omitted time-invariant factors. The only exception is the estimation where a binary variable for resource-rich countries is controlled for. For these estimations, the random effects method is used.

4.2. Data and variables

The variable of interest of the analysis is FDI in agriculture. The main source of information is FAO's Foreign Investment Database which reports FDI flows in agriculture following ISIC Rev.4 category on "agriculture, forestry and fishing". FAO follows UNCTAD's definition of FDI and records the value of cross-border direct investment transactions received by the reporting economy over the course of a year. The data represents transactions affecting the investment in enterprises of a specific industry resident in the reporting economy. Therefore, this variable does not focus solely on large-scale land deals. FDI is measured as a share of total FDI flows. In the FAO database it is reported on a net basis. Hence, FDI flows with a negative sign indicate that at least one of the components of FDI is negative and not offset by positive amounts of the remaining components. These are instances of reverse investment or disinvestment.

Food security is measured by two indicators to capture two FAO dimensions of food security, namely: (i) the prevalence of undernourishment, to measure access to food; and (ii) dietary energy consumption, to measure the availability of food.[5] Prevalence of undernourishment expresses the share of population that continuously consumes an amount of calories that is insufficient to cover their energy requirement for an active and healthy life. Dietary energy consumption is proxied by dietary energy supply. Ideally, data on food consumption should come from nationally representative household surveys. However, only very few countries conduct such surveys on an annual basis. Thus, FAO's dietary energy consumption values are estimated from the daily per capita dietary energy supply reported in the individual country food balance sheets compiled by FAO (see FAO et al., 2022). It shows the amount of food available for consumption, expressed in kilocalories per person per day (kcal/person/day). At the country level, it is calculated as the food remaining for human use after all non-food consumption, e.g. food exports, animal feed, industrial use, seed and wastage, is removed.

[5] The most widely accepted definition of food security is that "[it] exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life" (FAO et al., 2022, p. 202). This definition encompasses the four dimensions of food security, namely: (i) availability; (ii) access; (iii) stability; and (iv) utilization.

Both indicators are based on the notion of an average individual in the reference population. The data for each measure is taken from FAO.

Based on previous literature, several other determinants of food security are controlled for, and include: (i) economic development; (ii) agricultural production; (iii) export dependency; (iv) population structure; and (v) democracy. This study adds land governance as a new control variable. Unless otherwise indicated, most data are collected from the World Development Indicators (World Bank, 2022a). Table A1 shows the definition and source of each variable used in the analysis.

An effective and transparent land governance system is required to protect local livelihoods from the potential negative impacts of FDI in agriculture, and on land in general. To measure the effectiveness of land governance policies, IFAD's access-to-land index is used. This index assesses the extent to which the institutional, legal and market framework provides secure land tenure and equitable access, and is based on five components, namely: (i) the extent to which law guarantees secure tenure for land rights of the poor; (ii) the extent to which the law guarantees secure land rights for women and other vulnerable groups; (iii) the extent to which land is titled and registered; (iv) the functioning of land markets; and (v) the extent to which government policies contribute to the sustainable management of common property resources at the community level. It takes values between 1 and 6 with higher values indicating better land governance.

Economic development is measured by GDP per capita. Income per capita measures households' ability to afford food and non-food elements which improve the quality of nutrition (e.g. hygiene, education, information, etc.). It is used in logarithmic form because of its skewed distribution (Mihalache-O'keef and Li, 2011).

Agricultural production and export dependency have direct effects on food security in terms of food availability. Agricultural production is measured by a crop production index which takes the 2014–2016 average as the base year. Export dependency is measured by food exports as a share of total merchandise exports. The World Bank defines food exports as consisting of food and live animals, beverages and tobacco, and animal and vegetable oils and fats (World Bank, 2022a). Food exports may limit its availability as it diverts land from crop production for domestic consumption to export agriculture, and as a result undermine food security in the exporting country. However, revenue from food exports may improve the ability to import food that cannot be produced in the country concerned. Including food exports and crop production as control variables together with FDI may also lead to the problem of multicollinearity. This issue is explored with a correlation matrix (table A2). The correlation between FDI and food exports is 0.19, and FDI and crop production is -0.20, indicating no problem of multicollinearity.

Population structure is measured by age dependency and population density. Age dependency has implications for both the supply of and demand for food, and therefore affects food security. It is measured as the ratio of dependents (those who are younger than the age of 15 and older than 65) to the working-age population.

Population density, measured as population divided by land area in square kilometers, affects food security through food demand, agricultural production, and wages. The immediate effect of high population density is increased demand for food and pressure on land. Increasing population density may also have a negative impact on food security through declining agricultural wages if the majority of the population is employed in agriculture. However, higher population density may also be related to the development of markets and institutions, and to lower transaction costs, and lead to increased agricultural production (McMillan et al., 2011). Boserup (1965) suggest that increasing population density leads to more input use per unit of land and increased agricultural production, as a result of farmers shifting from long fallow to short fallow and multiple cropping per year. Ricker-Gilbert et al. (2014) suggest that this relation depends on the extent to which rural agricultural markets are integrated with local non-farm markets and urban markets.

Based on Sen's observation (Sen, 1981) that democracy creates political incentives for rulers to provide basic needs, democratic governments are expected to be more responsive to food security concerns than autocratic regimes. The political stability and absence of violence/terrorism indicator is used to control for democracy. It measures perceptions of the likelihood of political instability and/or politically motivated violence, including terrorism. Estimates give the country's score on the aggregate indicator, in units of a standard normal distribution. This indicator takes values between (about) -2.5 to 2.5, with higher values indicating higher levels of democracy (World Bank 2022b).

There has been a significant increase over the past decade in FDI flows to resource-rich countries. A broad range of literature investigates the economic and social outcomes of resource abundance. Some studies find that resource-rich economies have worse well-being indicators, such as life expectancy, child mortality and educational attainment (Bonilla Mejia 2020; Gylfason, 2001; Perez and Claveria, 2020); some, however, argue that there is no robust effect (Stijns, 2006). Several studies suggest that the human development effect of resource abundance depends on institutions, and resource abundance need not be a curse, and could contribute to economic and human development if the process is well managed and good governance structures are in place (Kolstad, 2009; Osaghae, 2015; Zallé, 2019). A binary variable is used to control for resource abundance. This variable takes the value 1 for countries that are rich in natural resources, and 0 otherwise. The categorization is based on UNCTAD's classification for oil-rich and mineral-rich countries.

4.3. Regression sample

The regression sample consists of 56 developing countries over the period 2005–2020. Summary statistics of the variables are provided in table 1. The average prevalence of undernourishment is 10.6 per cent of total population, and daily dietary energy consumption per capita is 2,810 kcal. Table 2 presents

a disaggregated sample by region, which shows that sub-Saharan Africa has the highest levels of food insecurity as the region has the lowest mean for daily dietary energy consumption per capita, with 2,496 kcal, and the highest prevalence of undernourishment with 21.7 per cent.

The share of FDI in agriculture in total FDI is considerably low in all regions. This is not surprising, as agriculture usually attracts a small portion of total FDI compared to other sectors. In the sample, the East Asia and the Pacific has the highest level of FDI in agriculture, while the mean values are almost even for Latin America and the Caribbean and sub-Saharan Africa.

IFAD's access-to-land index is not provided for every country and only covers the period up to 2018. Its average value is 3.98, with indiscernible variation across regions. The average access-to-land index value is highest in the Latin America and the Caribbean region, reflecting a more equitable access to land, and is followed by sub-Saharan Africa.

Table 1. Summary statistics, full sample

	Observations	Mean	Standard deviation	Minimum	Maximum
Prevalence of undernourishment (%)	795	10.58	8.65	2.50	43.20
Dietary energy consumption (kcal/per capita)	831	2 811	373.47	1 837	3 755
FDI in agriculture (% of total FDI)	670	3.71	6.95	-14.02	62.86
Access to land (1 to 6)	619	3.98	0.60	1.30	5.63
GDP per capita (2015, in constant $)	896	4 382	3 642	346	16 038
Crop production index (2014–2016=100)	840	93.40	16.32	39.27	169.14
Food exports (% of total merchandise exports)	842	27.88	21.16	0.15	93.61
Age dependency (% of working-age population)	896	60.54	16.99	36.49	111.94
Population density (people km^2 of land area)	896	117.80	178.67	5.61	1 265
Political stability (approximately -2.5 to 2.5)	848	-0.41	-0.71	-2.80	1.06
Resource-rich countries (1: yes)	896	224	25.0%	0	1

Source: Author's estimations.

Note: The mean and standard deviation for the resource-rich countries dummy indicate their respective number and share.

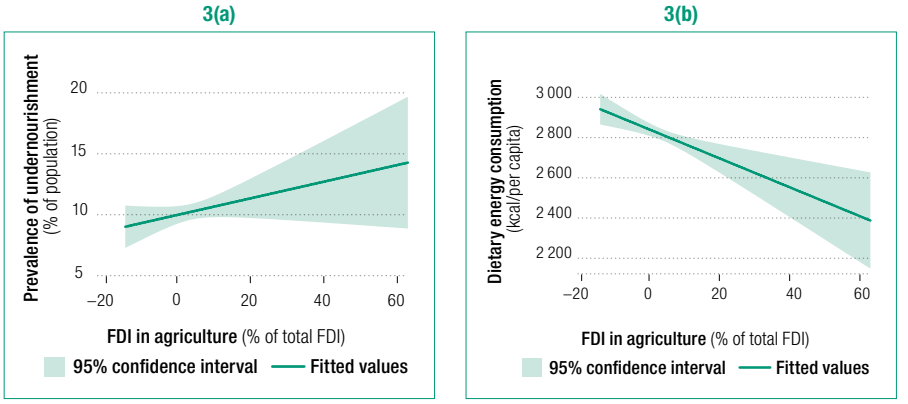
Table 2. Summary statistics, by region

Variables	East Asia and the Pacific				Latin America and the Caribbean				Sub-Saharan Africa			
	Obs.	Mean (std. dev)	Min	Max	Obs.	Mean (std. dev)	Min	Max	Obs.	Mean (std. dev)	Min	Max
Prevalence of undernourishment (%)	150	9.29 (5.26)	2.50	27.80	255	9.55 (6.14)	2.50	26.80	135	21.74 (10.49)	4.70	43.20
Dietary energy consumption (kcal/percapita)	160	2 741 (218.25)	2 200	3 336	272	2 770 (289.78)	2 133	3 314	127	2 497 (377.53)	1 837	3 261
FDI in agriculture (% total FDI)	143	4.12 (7.41)	-1.73	59.81	203	3.96 (7.76)	-9.72	62.86	138	3.99 (6.01)	-8.21	38.11
Access to land (1 to 6)	122	3.86 (0.61)	2.00	5.25	196	3.97 (0.48)	2.90	5.20	151	3.92 (0.49)	2.60	4.90
GDP per capita (2015, in constant $)	160	3 828 (2 752)	542	11 414	272	7 101 (4 085)	1 573	16 037	192	1 783 (2 280)	384	10 643
Crop production index (2014–2016=100)	150	95.11 (18.00)	39.27	165.23	255	93.32 (13.92)	52.87	126.93	180	95.51 (18.31)	48.93	133.89
Food exports (% of total merchandise exports)	150	17.54 (16.54)	0.61	67.67	266	37.96 (22.43)	2.87	93.61	185	36.95 (19.43)	5.79	87.09
Age dependency (% of working-age population)	160	50.84 (8.96)	36.49	78.46	272	57.18 (8.52)	43.38	86.64	192	82.17 (18.22)	41.29	111.94
Population density (people per km^2 of land area)	160	136.16 (95.15)	26.92	367.51	272	60.28 (69.21)	8.52	313.04	192	148.61 (180.5)	10.75	623.52
Political stability (-2.5 to 2.5)	144	-0.32 (0.62)	-1.78	0.92	272	-0.22 (0.58)	-2.05	1.06	192	-0.30 (0.76)	-2.26	1.02
Resource-rich countries (1: yes)	..	..	0	1	80	29.4%	0	1	128	66.7 %	0	1

Source: Author's estimations.
Note: The mean for resource-rich dummy denotes the share of these countries in each region.

The correlation between variables is explored using a correlation matrix (table A2). The significance level of correlation coefficients is also provided. The correlation matrix shows that most correlation coefficients are significant at 5 per cent level. Both food security measures are correlated with the FDI variable. Due to the nature of the indicators, they move in opposite directions against FDI; as the share of FDI in agriculture in total FDI increases, prevalence of undernourishment goes up while per capita dietary energy consumption goes down (figure 3).

Figure 3. Food security versus FDI in agriculture



Source: Author's estimations.

4.4. Results and discussion

The association between FDI in agriculture and food security is explored by two different measures of food security on a fixed effects model. This helps to address the different dimensions of food security as defined by FAO, namely the availability of food within the country, and its utilization by domestic population. These factors allow to address food security as both a supply- and demand-side phenomenon. Moreover, using these two measures as dependent variables allows to check the robustness of regression results.

The model is first estimated without the access-to-land index to explore the effect of FDI in agriculture on food security, without controlling for the level of land governance. It also has the advantage of having a longer time analysis as the access-to-land index data is available until 2018 which limits the time dimension of the panel data. Tables 3 and 4 present the estimation results. Diagnostic statistics are provided in each column. The validity of using fixed effects over random effects is tested using the Hausman test. A *p*-value that is smaller than 0.05 indicates that the results of fixed effects are preferred over a random effects estimation. Estimations using a

resource-rich country dummy are not provided for the *p*-value for the Hausman test as these regressions are run using the random effects technique.

Tables 3 and 4 present the results of the estimations with prevalence of undernourishment and dietary energy consumption as dependent variables, respectively. Initial results yield significant and negative coefficients on prevalence of undernourishment, and significant and positive ones on dietary energy consumption, indicating a positive effect of FDI in agriculture on food security (columns 1-3 of tables 3 and 4). However, the direction of the relation is negated by what is observed in the descriptive analysis (figure 3). The relation changes when an interaction variable between FDI and access to land is included in the estimation, supporting the hypothesis of this study that better land governance matters for the ultimate effect of FDI on food security (columns 5 and 6). The full model (column 6 in each table) shows that on average a 1 percentage point increase in FDI in agriculture is associated with a 13-percentage-point increase in prevalence of undernourishment, and a 7.5 kcal decrease in per capita food available for dietary consumption. This outcome supports the first hypothesis of this study.

The estimate on land governance is of particular interest in this study. Figure 4 plots the relation between land governance and food security measures. Both figures 4(a) and 4(b) show a linear and positive relation, as can be seen from the prevalence of undernourishment's downward sloping line and the dietary energy consumption's upward sloping line. This indicates that better governance of land tenure systems is associated with lower food insecurity. Note that the access-to-land index enters the equation twice: first, as a stand-alone independent variable and second, as an interaction term with FDI. The results of the estimations show no significant effect of land governance on food security. With or without FDI as a right-hand side variable, this outcome does not change. This is contrary to expectations. To investigate this result further, the access-to-land index is interacted with FDI. This interaction term is significant and negative in estimations using both food security measures. This new finding indicates that FDI has a more favourable effect where there is better land governance. Additionally, to explore the stand-alone effect of land governance, the model is estimated with FDI and the access-to-land index separately. The results of these estimations yield insignificant coefficients for the access-to-land index. To further analyse the role of land governance in similar socioeconomic, historical and cultural settings, the full model is estimated for the three geographic regions in the second part of the analysis.

Table 3. Effect of FDI in agriculture on prevalence of undernourishment

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
FDI in agriculture (lag_1)	-0.0489*** (-3.35)	-0.0489*** (-3.37)	-0.0383** (-2.45)	-	0.170** (2.29)	0.187** (2.52)	-	0.175** (2.25)	-
GDP per capita (ln)	-6.276*** (-7.63)	-6.080*** (-4.46)	-5.361*** (-3.39)	-7.899*** (-5.71)	-8.068*** (-7.57)	-5.605*** (-3.60)	-5.357*** (-3.41)	-5.129*** (-7.06)	-6.000*** (-10.17)
Crop production	-0.0401*** (-5.02)	-0.0389*** (-4.87)	-0.0451*** (-4.18)	-0.0573*** (-5.26)	-0.0524*** (-5.01)	-0.0487*** (-4.56)	-0.0463*** (-4.31)	-0.0546*** (-5.05)	-0.0581*** (-8.11)
Food exports	0.00732 (0.6)	0.000816 (0.06)	-0.00357 (-0.27)	0.00697 (0.57)	0.00209 (0.16)	0.000755 (0.06)	-0.00308 (-0.23)	0.0149 (1.16)	0.0369*** (4.07)
Age dependency	0.128*** (3.71)	0.0613 (1.45)	-0.0442 (-0.75)	-0.0676 (-1.53)	0.0715 (1.64)	-0.0647 (-1.10)	-0.0414 (-0.71)	0.0558 (1.40)	0.0573** (2.28)
Population density	0.0501*** (4.76)	0.0417*** (3.93)	0.0581*** (4.83)	0.0646*** (6.31)	0.0614*** (5.29)	0.0567*** (4.82)	0.0584*** (4.89)	0.00602* (1.80)	0.00623** (2.09)
Political stability	-1.356*** (-4.50)	-1.494*** (-4.84)	-2.267*** (-6.10)	-2.135*** (-5.90)	-1.914*** (-5.53)	-2.223*** (-6.12)	-2.241*** (-6.07)	-1.667*** (-4.77)	-1.051*** (-3.77)
Land governance	-	-	0.13 (0.39)	0.409 (1.38)	-	-	0.216 (0.64)	-	-
FDIxLand	-	-	-	-	-0.0536*** (-2.88)	-0.0579*** (-3.10)	-0.0122*** (-3.08)	-0.0556*** (-2.84)	-
Resource rich	-	-	-	-	-	-	-	5.726*** (3.74)	5.561*** (4.06)
Constant	50.99*** (7.51)	55.11*** (5.45)	53.65*** (4.58)	74.42*** (7.22)	67.74*** (7.60)	57.70*** (5.12)	53.20*** (4.57)	51.56*** (7.05)	57.95*** (10.57)
Observations	550	550	439	542	439	439	439	439	723
country fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
year dummy	no	yes	yes	yes	no	yes	yes	yes	yes
R^2 within	0.3707	0.4012	0.4778	0.4392	0.4630	0.4908	0.4826	0.4466	0.3626
R^2 between	0.3197	0.3036	0.1210	0.1522	0.2611	0.1227	0.1209	0.6762	0.7168
R^2 overall	0.3295	0.3192	0.1109	0.1593	0.2412	0.1128	0.1111	0.6906	0.7072
Hausman (p_value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	..	..

Source: Author's estimations.

Note: t-statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

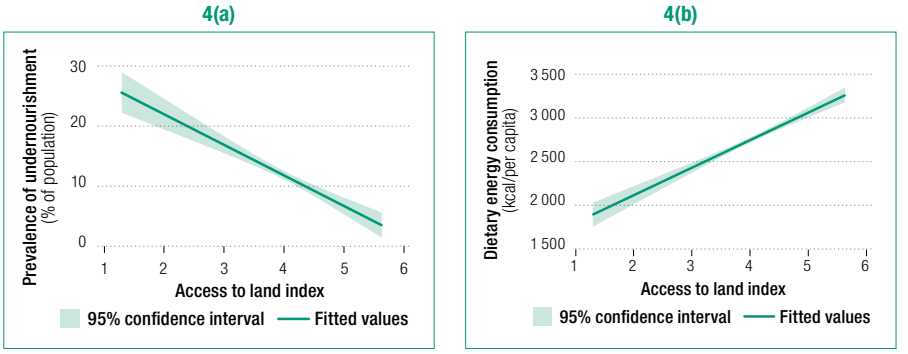
Table 4. Effect of FDI in agriculture on dietary energy consumption

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
FDI in agriculture (lag_1)	1.324** (2.45)	1.372** (2.54)	0.725 (1.41)	-	-9.498*** (-2.61)	-10.05*** (-2.75)	-	-9.390** (-2.47)	-
GDP per capita (ln)	390.2*** (13.81)	355.7*** (7.58)	386.2*** (8.02)	495.4*** (12.52)	506.4*** (14.97)	398.4*** (8.38)	388.0*** (8.10)	305.0*** (9.08)	299.5*** (10.23)
Crop production	1.864*** (7.13)	1.912*** (7.23)	1.257*** (4.02)	1.426*** (4.83)	1.514*** (4.84)	1.399*** (4.49)	1.292*** (4.14)	1.735*** (5.51)	2.583*** (10.69)
Food exports	-0.507 (-1.18)	-0.626 (-1.39)	-0.0373 (-0.09)	-0.0303 (-0.09)	0.066 (0.16)	-0.114 (-0.27)	-0.0541 (-0.13)	-0.344 (-0.81)	-1.155*** (-3.62)
Age dependency	-5.160*** (-4.49)	-4.343*** (-3.10)	0.746 (0.43)	-1.31 (-1.07)	-3.126** (-2.31)	1.915 (1.09)	0.779 (0.45)	2.214 (1.47)	-2.528*** (-2.75)
Population density	-1.335*** (-3.84)	-1.307*** (-3.71)	-2.057*** (-5.82)	-2.601*** (-9.03)	-2.038*** (-5.85)	-1.988*** (-5.76)	-2.019*** (-5.80)	-0.512*** (-2.79)	-0.630*** (-3.69)
Political stability	-25.22** (-2.35)	-20.38* (-1.83)	8.934 (0.76)	3.41 (0.32)	-6.466 (-0.57)	9.823 (0.85)	7.414 (0.64)	8.423 (0.73)	-9.689 (-0.97)
Land governance	-	-	-6.048 (-0.61)	1.884 (0.23)	-	-	-	-	-
FDIxLand	-	-	-	-	2.507*** (2.88)	2.597*** (2.97)	0.215* (1.76)	2.477*** (2.72)	-
Resource rich	-	-	-	-	-	-	-	-177.8* (-1.76)	-155.1* (-1.67)
Constant	-104.8 (-0.46)	117.4 (0.33)	-239.1 (-0.67)	-965.5*** (-3.25)	-1 002*** (-3.60)	-448.7 (-1.28)	-287.5 (-0.83)	81.14 (0.27)	394 (1.59)
Observations	535	535	425	528	425	425	425	425	708
country fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
year dummy	no	yes	yes	yes	no	yes	yes	yes	yes
R^2 within	0.5991	0.6118	0.7070	0.6869	0.6856	0.7143	0.7077	0.6958	0.5863
R^2 between	0.3940	0.3803	0.2160	0.2313	0.3063	0.2180	0.2216	0.3971	0.4709
R^2 overall	0.3872	0.3765	0.2213	0.2528	0.3056	0.2237	0.2266	0.4136	0.4803
Hausman (p_value)	0.0006	0.0086	0.0001	0.000	0.000	0.0001	0.0002	..	..

Source: Author's estimations.

Note: t-statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

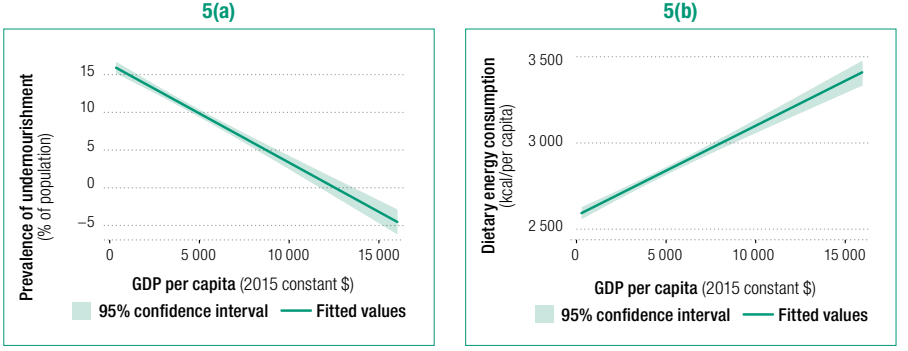
Figure 4. Food security versus access to land index



Source: Author's estimations.

Among the control variables, per capita income has a significant effect on both food security measures. This effect is robust across estimations. Both estimates indicate a positive association between GDP per capita and food security. The magnitude of the effect is also the largest of all control variables suggesting that GDP per capita is a strong determinant of food security. This is supported by findings in the literature. Income per capita is the main determinant of households' ability to afford food and non-food elements that improve the quality of nutrition (e.g. hygiene, education, information, etc.). In the full model, a 1 per cent increase in GDP per capita is associated with a 5.6 per cent decrease in prevalence of undernourishment, and a 3.98 kcal increase in dietary energy consumption. Figure 5 displays this positive relation between GDP per capita and the food security measures used in the analysis.

Figure 5. Food security versus GDP per capita



Source: Author's estimations.

Coefficients on crop production and population density have significant coefficients in the full sample regressions and are robust across estimations. The estimates indicate that crop production is positively associated with food security. This could be explained by two reasons: (i) production of food crops could increase the availability of food in the host country; and (ii) that the production of biofuel crops and cash crops, e.g. coffee, soy, maize, rice, may increase incomes, resulting in better nutritional status.

Population density has positive and significant coefficients in cases where prevalence of undernourishment is the dependent variable, and negative coefficients where dietary energy consumption is the dependent variable, signaling that it is negatively associated with food security. This is in line with views in the literature that point out the immediate effect. Increasing population density may worsen food security by increasing demand for food. It may further undermine food security through lower agricultural wages if most of the workforce is employed in this sector.

Resource-rich countries are found to have a worse food security status, with a 5.7 per cent more undernourished population compared to non-resource-rich countries, and 177 kcal less available for dietary consumption (column 8). This confirms earlier findings in the literature that resource-rich countries tend to have worse human development outcomes (Bonilla Mejia 2020; Gylfason, 2001; Perez and Claveria, 2020). However, whether this negative impact is due to a lack of strong institutions, or any other structural problem, is beyond the scope of this study.

In the second part of the analysis, the full model is estimated separately for three geographic regions. The goal of this exercise is to explore the impact of similarities in social, historical and cultural structures that are empirically related to contemporary food and land governance systems. Dividing the sample by region reveals that FDI in agriculture has significant and robust coefficients only in East Asia and the Pacific where, on average, a 1 percentage point increase in share of FDI in agriculture in total is associated with an around 7 percentage point increase in the prevalence of undernourishment, and a 3 kcal increase in dietary energy consumption (columns 1 and 7 in table 5). In Sub-Saharan Africa, FDI in agriculture is found to increase dietary energy consumption but has no significant effect on prevalence of undernourishment. In Latin America and the Caribbean, no significant effect is found. These findings suggest that FDI in agriculture promotes food security in East Asia and the Pacific, while the results are either not significant or not robust for Latin America and the Caribbean and sub-Saharan Africa.

In conclusion, the empirical analysis provides evidence that FDI in agriculture does not always enhance food security in the host country, which supports the first hypothesis of this study. Even though no significant link is found between land governance and food security, evidence shows that land governance systems matter when considering the ultimate effect of FDI in agriculture. This outcome leads to conclude that the second hypothesis of the study is partially supported. Regional breakdown of the sample establishes a strong and positive relation in

Table 5. Effect of FDI in agriculture on food security, by region

	Prevalence of undernourishment						Dietary energy consumption					
	East Asia and the Pacific		Latin America and the Caribbean		Sub-Saharan Africa		East Asia and the Pacific		Latin America and the Caribbean		Sub-Saharan Africa	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
FDI in agriculture (lag_1)	-0.0790***	-0.0670**	-0.00038	-0.00667	0.0276	0.0261	3.156***	2.738***	-0.87	-0.616	2.283**	1.934*
	(-3.03)	(-2.46)	(-0.02)	(-0.25)	(0.78)	(0.72)	(4.10)	(3.39)	(-1.36)	(-0.81)	(2.16)	(1.81)
GDP per capita (ln)	-6.132***	-5.392***	-8.781***	-14.66***	-6.515***	-5.889**	405.8***	466.1***	510.1***	613.4***	236.7***	334.7***
	(-4.65)	(-3.25)	(-3.37)	(-3.82)	(-3.07)	(-2.02)	(10.43)	(9.49)	(6.80)	(5.65)	(4.31)	(4.09)
Crop production	-0.0429***	-0.0622***	0.0231	0.0242	-0.110***	-0.117***	2.514***	1.854***	0.279	0.635	2.654***	1.927***
	(-2.78)	(-2.82)	(1.22)	(1.05)	(-7.61)	(-6.34)	(5.52)	(2.84)	(0.51)	(0.97)	(7.04)	(3.88)
Food exports	0.0174	0.0276	0.0145	0.00772	-0.048	-0.0462	1.626	0.85	-0.361	-0.168	-1.017	-0.773
	(0.29)	(0.42)	(0.75)	(0.36)	(-1.65)	(-1.50)	(0.92)	(0.44)	(-0.65)	(-0.28)	(-1.44)	(-1.07)
Age dependency	0.317***	0.288***	-0.00726	-0.144	-0.367***	-0.329***	-1.116	-2.081	3.075	5.189	-3.264	-3.689
	(3.95)	(3.02)	(-0.07)	(-1.02)	(-3.56)	(-2.82)	(-0.47)	(-0.74)	(0.99)	(1.29)	(-1.23)	(-1.30)
Population density	0.0448	0.0423	-0.0699	-0.154	0.0350*	0.0281	-0.410	-1.535	4.811**	6.761**	-0.697	-1.065*
	(1.60)	(1.19)	(-0.89)	(-1.40)	(1.86)	(1.13)	(-0.50)	(-1.46)	(2.12)	(2.17)	(-1.61)	(-1.84)
Political stability	-2.128***	-2.074**	-2.841***	-2.681**	-2.268***	-1.992***	-6.507	12.47	49.65**	42.24	-5.576	-20.73
	(-2.83)	(-2.47)	(-3.78)	(-2.54)	(-3.45)	(-2.82)	(-0.29)	(0.50)	(2.30)	(1.42)	(-0.23)	(-0.83)
Land governance	..	-0.897	..	-0.758	..	0.30	..	2.468	..	-15.07	..	-49.61*
		(-1.62)		(-1.00)		(0.28)		(-0.15)		(-0.70)		(-1.85)
Constant	39.18***	39.91***	87.78***	155.1***	100.5***	94.46***	-693.7**	-862.7**	-2 177.8	-3 279.8***	975.2*	615.9
	(3.62)	(3.21)	(3.36)	(3.81)	(5.51)	(4.53)	(-2.17)	(-2.34)	(-2.90)	(-2.86)	(1.98)	(1.07)
Observations	120	103	193	154	95	85	120	103	193	154	80	71

Source: Author's estimations.
Note: t-statistics in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01.

East Asia and the Pacific, but not in other regions.

Empirical results should be interpreted carefully. While the two indicators used to capture two different dimensions of food security (in its official definition), and supply- and demand-related issues, these indicators react reasonably fast to external changes. Availability of food for per capita consumption in a country is directly linked to its ability to produce, export, and import food in a given year. Prevalence of undernourishment is calculated as a crude number of people whose consumption remains below this level in the same year. Other dimensions of food security may reflect longer term factors that affect food security. Health-related indicators, such as stunting among children and anemia among women, capture longer term consequences of food insecurity. One may or may not be undernourished today but may suffer growth retardations and other related problems due to past experiences of undernourishment. Production-related indicators, such as export dependency of essential food groups, variability of food supply, share of arable land equipped for irrigation, reflect a country's productive capacity and the stability of the food security status of the country over the long term. Therefore, empirical analysis concludes that FDI in agriculture improves food security in the short-run but that the results cannot be generalized for long-term food security.

5. Conclusion and policy implications

As population growth, rising incomes and urbanization increase the demand for food, investment in agriculture and food systems is not only essential but also critical to enhance food security and food safety for all. Foreign direct investment in developing country agriculture can play an important role in closing the investment gap. However, the recent wave of agricultural investments in developing countries pose significant challenges. This is a matter of concern because of the potential direct impacts on local populations, which are mainly due to legal gaps in the governance of land tenure systems. In most developing countries, tenure systems, which define how people and communities access natural resources (e.g. land, water, fisheries and forests), are based on unwritten customs and practices rather than written policies and laws.

This study argues that FDI in agriculture does not always enhance food security in the host country. Because the recent wave of farmland investments is characterized by resource-seeking, and their main motivation is to promote food security in the investor country. Even when intended for crop production, foreign investors do not always produce for the domestic market. The ultimate effect depends on other factors, such as the type of investment, structure of agriculture sector in the host country, and the institutions involved. Existing land governance systems are particularly important as they determine the direct impact of investment projects on local populations and have an indirect impact on domestic food security.

To this end, the effect of FDI in agriculture on food security in the host country is examined empirically. Using data from 56 developing countries, empirical analysis shows that FDI in agriculture has a significant and negative effect on food security in the host country. The land governance index used to explore the role of land governance, is only significant when it interacts with FDI, which indicates that FDI has a more favourable effect where land governance is better.

The critical thing about customary land and resource tenure systems is that they make no distinction between legal property rights and de facto use rights. Most recent farmland investments in developing countries exploit this gap in the legal system. Foreign investors target predominantly "unutilized" or "underutilized" land, which is nonetheless used by local communities. These common lands are critical sources of livelihoods for indigenous people and rural populations for agriculture or raising livestock. The resilience of small communities and related agro-systems is deeply connected to this land. It is also a central factor in economic growth. Therefore, no statutory recognition of the customary land tenure in some developing countries make rural populations vulnerable to poverty and food insecurity. Transferring the property rights of these lands to foreign investors, temporarily or permanently, endangers the survival of rural communities by depriving them of land and other critical resources for food security, resulting from the production of food for direct consumption and providing income-generating activities.

Growing interest in farmland investment requires vigilance. Measures need to be taken to promote responsible and sustainable investment in developing country agriculture. When considering an investment in agriculture, one of the main principles to observe is not to jeopardize food security and the overall livelihoods of local populations directly affected by these investments. It is therefore important that investors are aware of local conditions and respect existing local rights to land and resources use. Tenure reforms by formalization of customary rights are essential to enhance tenure security for a more equitable and transparent access to land. Governments need to support sound systems for monitoring and assessing the impact of agricultural investments and processes associated with them. In order to address concerns about the consequences on local livelihoods, governments should formulate integrated policy frameworks to ensure transparency in international investments, to prevent marginalization of rural populations, and to enhance environmental sustainability.

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Appendix

Table A1. Description of the variables

Variable	Nature of variable	Definition and source of data
Prevalence of undernourishment	Dependent	Percentage of the population whose habitual food consumption is insufficient to provide the dietary energy levels that are required to maintain a normal active and healthy life (World Development Indicators).
Dietary energy consumption	Dependent	Food available for human consumption, after deduction of all non-food consumption (exports, animal feed, industrial use, seed and wastage), expressed in kilocalories per person per day (FAOSTAT).
FDI in agriculture	Independent	Share of net FDI flows into the agriculture sector (agriculture, forestry and fishing) in total FDI (FAO Foreign Investment Database).
Land governance	Independent	Access to land index takes values between 1 and 6 with higher values indicating more equitable access to land (IFAD).
GDP per capita	Control	Gross domestic product (in constant 2015 United States dollars) divided by midyear population (World Development Indicators).
Crop production	Control	Agricultural production for each year relative to the base period 2014–2016 (World Development Indicators).
Food exports	Control	Share of food exports in total merchandise exports (World Development Indicators).
Age dependency	Control	Ratio of dependents – people younger than 15 or older than 64 – to the working-age population – those ages 15–64 (World Development Indicators).
Population density	Control	Midyear population divided by land area in km^2 (World Development Indicators).
Political stability	Control	Country scores that measure perceptions of the likelihood of political instability and/or politically-motivated violence, including terrorism; ranges from approximately -2.5 to 2.5 (World Governance Indicators).
Resource rich	Control	1=if country has oil or mineral resources, 0=otherwise (UNCTAD).

Source: Author's compilation.

Table A2. Correlation matrix and tests of significance

	undernou	dec	FDI_agri	land_acce	ln_gdppc	crop_pro	food_X	age_dep	pop_dens	pol_stab	resour_rich
undernou	1										
dec	-0.8617*	1									
FDI_agri	0.0598	-0.1406*	1								
land_acce	-0.3442*	0.4774*	-0.0533	1							
ln_gdppc	-0.7414*	0.6390*	-0.1139*	0.4657*	1						
crop_pro	-0..0588	0.1256*	-0.2029*	0.1163*	0.0785*	1					
food_X	0.2517*	-0.3287*	0.1954*	-0.1429*	-0.0392	0.1622*	1				
age_dep	0.7863*	-0.6584*	0.1176*	-0.3679*	-0.7084*	-0.0925*	0.2362*	1			
pop_dens	0.0935*	-0.1420*	-0.1004*	-0.0209	-0.1497*	0.1222*	-0.0997*	-0.1051*	1		
pol_stab	-0.2704*	0.1795*	0.1062*	0.2202*	0.3755*	0.0717*	0.1943*	-0.2945*	-0.0681*	1	
resour_rich	0.4260*	-0.2771*	-0.0632	-0.0739	-0.2598*	-0.0187	-0.0962*	0.4423*	-0.1615*	0.0074	1

Source: Author's calculations.
Note: * denotes correlation significance at the 5 per cent level.