Migration, Food Expenditure, and Household Food Security In Eastern Indonesia

Abstract

This paper investigates the impact of migration on food expenditure and the household food security status of migrant-sending households (MSHs). Combining the food frequency and food consumption module of Indonesia Family Life Survey (IFLS East) 2012, this paper investigates the effect of migration on the current food security status of MSHs using the food consumption score (FCS). Utilising data from the less-developed region of Indonesia, this paper applies propensity score matching (PSM) and shows that migration significantly increases monthly food expenditure, and overall household monthly expenditure. The current household food security estimate using FCS shows not only that having at least one migrant increases the composite index of FCS but also increases the probability to be categorised in better food security group based on FCS threshold for Indonesia. Further, evaluation of food diversity using expenditure on a broad set of food group shows that migration increases expenditure on six out of 10 food groups, such as vegetables & fruits, dried food, spices, sugar & beverages, oils, and snack (prepared food eaten at home).

JEL: **O15, R23, Q18**

Keywords: migration, food expenditure, food security, IFLS East

1. Introduction

Migration has become one of the risk-reduction strategies used by households to overcome many poverty-related problems in developing countries. At the macro level, an investigation of economic outcomes of migration shows remittances have a potential role in promoting economic growth and reducing poverty of migrant-sending countries in the Asian region (ADB, 2009). Migration brings many benefits to the lives of migrants and their families (migrant sending household or MSH), such as increase family income from remittances, decreased credit constraints, and investment in physical and human capital.

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Poverty reduction is the welfare objective of many development programs. Many indicators are used to reflect multidimensional type of poverty such as, monetary poverty, food insecurity, malnutrition and other material well-being, however, they are not only different in concept but also do not always coincide (IFPRI, 2013). Multidimensional type of poverty has brought many development projects to set specific indicators and determinants of poverty reduction objectives. Under the New Economic Labour of Migration (NELM) framework, the outcome of the migration is shared between migrants and MSHs (Stark & Bloom, 1985). This framework has resulted in many studies on how migration can help MSHs to escape from poverty (Adams & Page, 2005; Spatafora, 2005; Adams, 1991; Stark & Taylor, 1989). However, there are very few studies that link the poverty effect of migration to food insecurity issue.

This paper extends the limited literature on Indonesian migration in several ways. First, it investigates impact of migration on food security using the food consumption score (FCS) as an indicator of household food security as suggested by the World Food Program (WFP) and the Food Agriculture Organization (FAO). The FCS is a proxy indicator of current household food security, and it represents several elements of food access and food utilisation (consumption). Second, this study utilises data from the less-developed part of eastern Indonesia. This region has been the focus of national development in addressing regional disparities as part of Indonesia's National Medium-Term Development Plan 2015-19 (RPJMN). In eastern Indonesia, seventy-nine out of 100 districts are categorised as most vulnerable to food insecurity as reported on Food Security and Vulnerability Atlas (FSVA) of Indonesia (WFP, 2009). As a region with a high vulnerability to food insecurity, it is expected that migration will still be a household's strategy toward smooth consumption and improvement of its living standard. Last, this study exploits the availability of a recent Indonesia Family Life Survey (IFLS) East 2012 dataset that now makes investigation in this region possible. IFLS East 2012 data contains the first household survey of the eastern part of Indonesia and covers seven provinces. These seven provinces (East Kalimantan, Southeast Sulawesi, East Nusa Tenggara, Maluku, North Maluku, Papua, and West Papua) were never included in the previous IFLS (Satriawan et al. 2014). In this way, this paper will also contribute to a comprehensive migration study in an Indonesian setting.

This paper analyses the impact of migration on food as one basic consumption by investigating the effects of migration on three household expenditure measures; the logarithm of monthly food expenditure, logarithm of monthly per capita food expenditure and the logarithm of total monthly expenditure. To investigate migration's impact on household food security, this study explores the effect of migration on household's chances of improving their level of food security. Investigation on food security analyses three groups of FCS using thresholds for Indonesia. Further investigation on food diversity is applied by investigating the outcome of migration on expenditure of ten sets of food groups.

2. Overview of existing literature

2.1. Effects of migration

In contrast to the neoclassical framework, the New Economics Labour of Migration (NELM) framework (Stark & Bloom 1985) postulates that the decision to migrate is made at the household level. It is a household strategy to maximise expected income, minimise risks, and respond to various kinds of market failures. Under the NELM framework, extensive literature shows the direct impact of remittances on the economy of migrant-sending countries. Remittances are used to escape poverty (Adams 1991 & 2006; Weber et al. 2007; Gupta et al. 2009; Park & Wang 2010; Beegle et al. 2010), smoothen consumption (Stark & Levhari 1982; Lucas & Stark 1985; Stark & Bloom 1985; Stark & Rosenzweig 1989; Amuedo-Dorantes & Pozo 2011), provide working capital and liquidity (Giuliano & Ruiz-Arranz 2005; de Brauw & Rozelle 2008).

Studies on the developmental impact of remittances investigate the expenditure pattern of MSHs. Remittances are spent on daily consumption (Oberai & Singh 1980), food expenditures (Rosenzweig & Stark 1989), durable goods, health care, and housing (Airola 2007). Remittances increase both consumption and investment and promote both the standard of living in the short term and development of rural areas in the long term (Lall et al. 2006). Remittances support household consumption and boosts agricultural and non-agricultural expenditure in rural areas (Hamilton et al. 2003). Studies highlight the multiplier effect of remittances to receiving economies even though they are used for consumption spending (Durand et al. 1996; Taylor et al. 1996; Sumata 2002; De Haas 2010). Remittances not only raise consumption of MSHs but also create a multiplier effect when they are spent on domestically produced goods (Ratha, 2003). Remittances play an important role in the development of migrant-sending economies.

Within the studies of expenditure patterns of MSHs, there are few studies focusing on the impact of migration on the food consumption expenditure. Among those few studies, limited research examines further linkage of migration and food expenditure on nutrition, health or food security. Two notable studies that address the relation between migration and food security are studied by Nguyen & Winters (2011) in Vietnam and Karamba *et al.* (2011) in Ghana. Using three measures to proxy food security; per capita food expenditures, per capita calorie consumption, the study in Vietnam shows that short-term migration significantly contributes to food consumption and food security. Using data from Ghana, Karamba *et al.* (2011) use food consumption patterns as measured by expenditure to investigate relation between migration and food security and shows that food expenditures increases only in high migration region. Both of studies used instrumental variable to address selection bias. This paper extent of those studies by investigating direct impact of migration on current household food security using FCS as indicator suggested by the FAO and WFP and applied counterfactual approach of PSM to address non-random selection of migration.

2.2. Migration measures

There are two approaches that measure the effect of migration. Some studies consider that the impact of migration is channelled through remittances, and so they measure the impact of remittances on the expenditure pattern of MSHs. However, other studies have underlined that remittance might inadequately capture the impact of migration, as migration can have effects beyond that of remittances on factors such as knowledge, information, or changes in MSHs labour supply (Taylor & Mora 2006; Zezza et al. 2011). However, as highlighted by Taylor and Mora (2006), in terms of expenditure outcome, the remittance effect is not distinct from the migration effect. Notable studies in two US migrant-sending countries, Mexico and Ecuador, use different measures of migration, but they report similar findings. Taylor and Mora (2006) used the migration measure and investigated on a broader set of household consumption and investment in Mexico. Applying migration history as an instrument for international migration decisions, they found that budget shares on investments, health, and consumer durables are relatively large compared to food and housing. Meanwhile, a recent study by Göbel (2013) used the remittances approach and investigated the household expenditure pattern using the Ecuador Living Standard Survey 2005/2006. Using both parametric and nonparametric methods, remittances significantly increase expenditure on education, health, and housing but decrease expenditure on food.

To portray the complex impact of migration, this paper analyses the effect of migration status rather than remittances and differentiated between migrants and non-migrants in the empirical model.

In measuring migration, studies consider not only internal, international, and rural-to-urban movement but also the length of the migration period as important factors that affect the outcome of the migration. A study by Chandrasekhar et al. (2015) focused on short-term migrants (STM) and investigated their impact on food consumption expenditure in India; meanwhile, in Vietnam, Nguyen and Winters (2011) differentiated between short-term migrants and long-term migrants in their empirical model. Both studies used the instrumental variable approach, but they report opposing impacts on food consumption. In India, MSHs with STM have lower per capita food consumption compared to non-migrant households, but in Vietnam, short-term migration increases per capita food expenditures. Long-term migrants from Vietnam tend to stay permanently in a destination once they settle so that they have weaker ties and less remittance transfer to their origins compared to short-term migrants. On the other hand, short-term migrants from rural India work in the informal and unorganised sector without written job contracts.

2.3. Food security

Before the redefinition of food security at an international forum of the World Food Summit (WFS, 1996), food security was defined and interpreted in different ways. Many measures and indicators of food security were used in research and policy. In studies that investigated the direct link of migration to food security, various indicators were used. Fransen and Mazzucato (2014) used an indicator of frequency of difficulties in meeting food needs in Burundi. They calculated difficulties of meeting food requirements using a Likert scale from 1 (every day difficulties) to 5 (never had difficulties). Anaglo et al. (2014) measured food security using food availability in Ghana. Their studies showed a different outcome of migration. In the Burundi setting, remittances improved not only living conditions but also the food security index of the households in the lowest group of the asset index. However, in Ghana, the findings showed no significant differences in food availability of migrant-sending communities. Using a simple indicator of food security, the two studies contribute to a preliminary investigation of the direct link of migration to food security, but food security requires more than just frequency of meeting food requirements or food availability (WFP 2009).

Two studies applied various combinations of household food security indicators. Crush (2013) used three types of food security indicators, the Household Food Insecurity Scale (HFIAS), the Household Food Insecurity Access Prevalence (HFIAP), and the Household Dietary Diversity Scale (HDDS). Meanwhile, Tageje (2014) measured food security using five indicators: land ownership, types of crops grown and their purposes, postharvest food management, amount of food produced and the time after harvest, and food availability and access in the market. Crush's study looked into migrants at urban areas of destination by comparing the food security between migrants and nonmigrants in Southern Africa; meanwhile, Tageje focused on the hypothesis that peasant migrants contribute to agricultural production in rural areas of their destination in Tanzania. Tageje's study found that migration improves food security in the rural area of destination in most indicators, but Crush's findings showed that migrants in urban areas are more likely to be food insecure compared to non-migrants. Both studies used many types of independent data collection, but they did not investigate causality in their analyses. Applying different empirical analyses may contribute in establishing causality and further policy implications of these studies.

2.4. Food consumption score

The World Food Summit in 1996 clarified a globally accepted definition of food security. "Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (FAO 1996, p. 5). The 2009 World Summit on Food Security reconfirmed this definition by adding the four pillars of food security: food availability, food access, food utilisation, and food stability.

At the national level, a food-secure country means a country should have adequate food availability that comes from production, stocks, and imports to meet all citizens' food requirements for a healthy life. At the household level, household food security (HFS) is when a household is able to keep sufficient nutritional intake for physical well-being by ensuring three sets of entitlements, namely, food availability, food accessibility, and food utility (UNICEF, 2008).

Two agencies of the United Nations, the WFP and FAO, actively focus on fighting against hunger, malnutrition, and food insecurity. In 2012, a joint statement by FAO and WFP (2012)

suggested two indicators of food security: HDDS and FCS. FCS is a composite score capturing the frequency of weighted diet diversity using a standard weight for each food group to reflect nutrient density. It represents elements of food frequency, dietary diversity, and relative nutrition importance of food consumed by households. It is an acceptable proxy indicator of current household food security (WFP 2008).

2.5. Self-selection of migration

Previous literature has taken into account the possibility that individuals who migrate are a selected group. Migration can be correlated with unobservable individual and family characteristics that also affect the outcomes of interest. Without controlling for these factors, estimation of the impact of migration will be biased (McKenzie & Yang 2010). In this case, the selection might lead to overestimation of the positive impact of migration on food expenditure.

If available, a randomised experiment is the best method to overcome methodological problems in studying the outcome of migration. Using the migrant lottery system from Tonga to New Zealand, Stillman et al. (2012) were able to compare migrants with non-migrants randomly, but this type of randomisation is very rare in the data, and this study was the only one found in the literature to utilise the approach. An exogenous shock from nature, such as exchange rate shocks before and after the Asian financial crisis in 2007, as in Yang (2008), proved to be a good natural experiment; however, this nature-type shock will be very difficult to be emulated by other studies.

In the absence of experimental data, various econometric approaches exist to deal with non-random selection of migration. In the presence of at least two points of time data, fixed effect and difference in difference method are able to control for time-constant unobserved heterogeneity. In the presence of time-varying unobserved characteristics, Instrumental Variable (IV) method are mostly used. The challenge in using the IV method is to find the valid instrument, i.e a variable which is related to migration status but not related to the outcome of interest. If the selected instrument is not truly exogenous (unrelated to the outcome of interest) similarly, weak instruments (that do not have a strong relationship to the endogenous variable) may result in a biased estimators (Baum *et al.*, 2003).

Another method to address the selection issue is Propensity Score Matching (PSM) (Rosenbaum and Rubin 1983; Rubin 1974), this method controls for a possible selection on observable by comparing household with very similar observable characteristics but different migration status.

Propensity score matching relies on the *Conditional independence assumption* (Lechner 1999). It depends on the availability of a large and informative set of pre-treatment independent variables with which MSHs can be matched with fully equivalent non-MSHs. With this assumption, the assignment of households to the treatment (migration) is based entirely on a set of observed pre-migration attributes. If there is a set of exogenous variables (X) such that, conditional on X, household outcomes are independent of the treatment assignment, the difference outcomes between MSHs and a set of matched non-MSHs with very similar pre-migration attributes can be estimated (McKenzie, Gibson & Stillman 2010; Poppe 2010). Comparing several estimation strategies, McKenzie, Gibson, and Stillman (2010) also report that the PSM method using a good set of exogenous pre-migration variables shows a better estimation than ordinary least squares (OLS) and outperform IV regressions with relatively weak instruments.

PSM approach has been used in a few studies of migration and its outcome. The effect of remittances on household wealth in Burundi ((Fransen & Mazzucato, 2014), remittances, expenditure patterns, and gender in Ecuador (Göbel, K. 2013), labor migration and investment in Nepal (P. Bohra-Mishra, 2012), migration and consumption in Tanzania (Beegle *et all*, 2011) and impact of children's migration on elderly kin's health (Kuhn, *et all , 2011*).

3. Data

3.1. East Indonesia context

There are several reasons why it is important to investigate the impact of migration on people's lives in Indonesia. This country has a long history of rural to urban migration. Migration within country shows increasing pattern, the number of both recent and lifetime migrant increases from 1970 to 2010 (Figure 1). Migration to cities is a relatively unconstrained process and contributed to a 25 percent increase in urban population growth in the last 20-30 years (Meng & Manning, 2010). IFLS 2000-2007 indicated that around 60 percent of migrant workers

comes from rural households (Nguyen & Purnamasari, 2011). During the Asian financial crisis, lost jobs and layoffs made many people return to their villages of origin (Wiradi, 1998; Sandee, 1999). However, many subsequently returned to urban areas due to lack of employment in rural regions (Hugo, 2000; Ananta 2000).

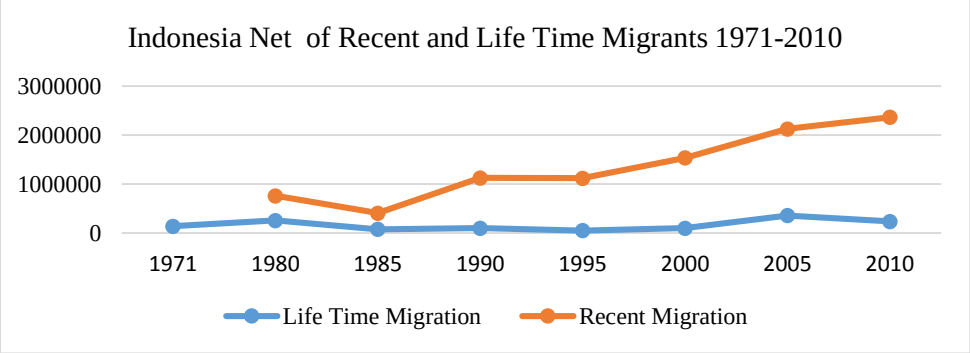

Figure 1. Net of recent and lifetime migrants in Indonesia, 1971–2010.

Source: **Population censuses 1970, 1980, 1990, 2000, and 2010 and intercensal population survey 1985, 1995, and 2005 (CBS).**

Whilst Indonesia is categorised as a lower-middle income country, there are relative disparities between the eastern and western regions. The eastern provinces of Indonesia are characterized to be less-developed compared to the western regions. This region has a lower per capita of gross domestic regional product, higher labour participation rates and higher household size compared to the national average. Two provinces in this region have higher poverty rates compared to national average and four provinces have minimum wage below the national average (CBS, 2012). Almost 79 percent districts in the eastern region are most vulnerable to food insecurity. Rather than food unavailability, the lack of affordability and vulnerability to food price shocks are factors that contribute to food insecurity in Indonesia as reported in the Global Food Security Index 2012 (Economist, 2012). Reducing poverty, regional disparity and food insecurity are the challenges facing development in Indonesia.

3.2.Data construction and descriptive statistics

This study uses a large-scale multi-topic household and community survey of the IFLS East 2012. It is specifically designed to cover the seven provinces in eastern region of Indonesia. These seven provinces have never been accommodated in previous regular IFLS; Nusa Tenggara Timur, Kalimantan Timur, Sulawesi Tenggara, Maluku, Maluku Utara, Papua Barat,

and Papua. The survey was administered in 2012 to around 10,000 individuals in around 2,500 households living in 99 communities (Sikoki et al. 2013). IFLS East 2012 selected 3,159 households which jointly had 10,887 household members. The response rate was about 80.6%; hence, there were 2,547 households that provided at least a partial interview.

The IFLS survey was not designed to focus on migration; however, besides basic household characteristics, the IFLS includes a consumption module and also collects a few questions related to migration. The consumption module collects information on the value of foods purchased in the last week and consumed in the last week for self-production, purchases of household, and personal care items during the last month. Quantities and purchase prices for several frequently purchased staples are also collected, from which unit prices may be derived.

The IFLS defines migration as movement across a village to live in a new location for over six months. In this paper, "migrant" is defined as a person 15 years old and above who moves across village boundaries to live in a new location for over six months and for work-related purposes. MSHs are households that have at least one member of the family aged 15 years or older moving across village boundaries to live in a new location for over six months and for work-related purposes.

Based on the above criteria, there are 407 people identified as migrants from 10,887 individuals. From 2,547 households surveyed by IFLS EAST in 2012, there are 331 households categorised as MSHs. East Kalimantan and North Maluku are two provinces that have the highest migrants, followed by Papua. Most initial migration occurred after 2007 and within the country, with a balanced proportion between moving to another village or town and a big city as their destination. The profile of migrant individuals presented in Table 1 shows that most migrants are husbands or heads of household with mostly high school as the highest education, and there are more males than females.

Table 1. Individual profile of migrants and non-migrants.

Individual profiles	Migrant (%)	Non-Migrant (%)
Province of origin:		
East Nusa Tenggara	2.9	97,1
East Kalimantan	5.3	94,7
South Sulawesi	3.2	96,8
Maluku	3.5	96,5
North Maluku	4.4	95,6
West Papua	3.3	96,7
Papua	3.9	96,1
Gender :		
Male	59.2	48.8
Female	40.8	51.2
Status in Household :		
Husband/head	37.4	22.9
Wife	16.0	18.2
Son/Daughter	25.1	46.7
Sibling/brother/sister in law	4.91	1.66
Nephew/Niece/cousin	9.09	1.57
Grandchild	1.97	5.61
others	5.53	3.36
Highest education :		
Primary school	15.2	62.8
High school	53.8	30.3
University	30.47	6.0
Marital status :		
Single	40.3	52.0
Married	57.5	42.3
Divorce/Widow	2.2	5.7
N	407	10480

Table 2 presents the statistics summary of estimated samples, both MSHs and non-MSHs. It describes head-of-household characteristics, household characteristics, and community characteristics. MSHs can be found in either rural or urban areas and mostly consist of four family members with one child between 6 to 18 years old. The mean age of the household head is 41 years, and 86% of them are male. The MSHs have at least four people who have finished primary school. Over 50% of MSHs have their own house and own nonfarm family businesses, and some have land for farming.

Table 2. Means and standard deviation of the estimated sample.

	MSHs		Non-MSHs	
	Mean	**SD**	**Mean**	**SD**
Head of Households (HH) characteristics:				
Age	41.91	12.99	44.75	13.22
Sex	0.86	0.35	0.83	0.37
Marital status	2.01	0.36	2.10	0.37
Self-employed	0.65	0.47	0.28	0.45
Household characteristics:				
HH size	4.42	2.32	4.25	2.04
Number of children under-5 yrs	0.67	0.83	0.67	0.81
Number of children between 6yrs to 18 yrs	1.08	1.30	1.27	1.28
Number of member finish Primary School	3.72	2.03	3.34	1.80
Own house	0.54	0.49	0.79	0.40
Number of rooms in house	5.20	2.4	4.93	2.13
Use electricity	0.94	0.24	0.81	0.39
Own land	0.34	0.47	0.58	0.49
Own non-farm family business	0.50	0.50	0.39	0.49
Community characteristics :				
Infrastructure of road and phone in the last 5 years	0.27	0.44	0.18	0.38
N	331		2216	

3.3. Constructing FCS as current household food security

HDDS and FCS have different approaches to measure the state of food security. HDDS requires a 24-hour recall of consumption of 16 food groups, which can be expensive and time-consuming in the survey. FCS is appropriate for in-depth food security assessments since it combines a longer reference period and incorporation of frequency of consumption. FCS is a composite score of household-level consumption of eight weighted food groups using a seven-day recall. FCS is a composite score representing frequency of weighted diet diversity using a standard weight for eight food groups and is calculated to reflect nutrient density. The eight food groups are cereals and tubers, pulses, vegetables, fruit, meat and fish, milk, sugar, and oil. A higher FCS indicates an improved household food security. Table A5 in the appendix provides a sample calculation of FCS as directed by the WFP Emergency Food Security Assessment Handbook (January 2009) and the Indonesia Food and Nutrition Security Monitoring System (FNSMS).

Although IFLS East 2012 is not designed to measure food security, the availability of food consumption module and eating frequency module in this dataset makes possible the calculation of FCS as proxy for the current food security indicator at the household level. The food frequency module provides information about eating frequency (number of days in a week) of several types of food in the last week; meanwhile, the consumption module provides information on the monetary value of several food types consumed in the last week. For information on food frequency containing only five groups of food, we combine the two modules to obtain information on the number of days in a week for a total of eight food groups. To measure the weight (kg or litre) of the food bought in the last week, the monetary value of food expenditure in the consumption module is divided by the price of food (refer to *Pusat Informasi Harga Pangan Strategis* (*PIHPS*), *Central Bank of Indonesia*), and to obtain the number of days of consumption of food, the weight is divided by the national average daily consumption based on the report of the National Socioeconomic Household Survey (Susenas), Statistics Bureau of Indonesia. The FCS is a continuous variable; standard statistics such as the mean and variance of FCS calculated in this study are presented in Table 3. The data shows that FCS index of MSHs is higher than those of non-MSHs, however these descriptive statistics should be interpreted after control for differences between the two groups.

Using the thresholds for Indonesia and based on the calculated FCS, households are categorised into three food consumption groups: FCS-acceptable if the FCS is over 42, which means adequate food consumption; FCS-borderline if the FCS is between 28.5 and 42; and FCS-poor if the composite score is less than 28. Table A6 in the appendix shows the corresponding thresholds of FCS groups suggested by FNSMS.

Table 3. Summary statistics calculated FCS.

	MSHs		**Non-MSHs**	
	Mean	**SD**	**Mean**	**SD**
FCS	56.36	18.66	48.18	19.62
FCS-acceptable	63.72	14.46	61.57	13.98
FCS-borderline	37.42	3.99	35.40	3.95
FCS-poor	21.85	4.05	21.01	5.21
N	331		2216	

4. Estimation methods

In estimating the impact of migration, this study begins by estimating the basic equation:

$$Y_i = \beta_0 + \beta_1 M_i + \beta_2 X_i + \varepsilon_i \quad \text{..... (1)}$$

where Y is the variable outcome of interest of the i_{th} household; M_i is the dummy indicator of a migrant household if 1, and 0 for otherwise; X_i is the vector of control (exogenous) variables; and β_1 and β_2 are parameters to be estimated; and ε is the error term. The vector of exogenous covariates includes variables that capture the head-of-household characteristics, household characteristics, and community characteristics.

Three sets of outcome variables are to be estimated. First, there are three measures of expenditure: the logarithm of monthly food expenditure, the logarithm of monthly per capita food expenditure, and the logarithm of total monthly expenditure. IFLS East 2012 reported all expenditure measures in the nominal monetary value of the Indonesian Rupiah in 2012. The second set is the household's current status of food security using the composite index of FCS and the probability of being in the FCS-acceptable, FCS-borderline or FCS-poor group. The last set is the monthly expenditure on eight food groups to obtain the further impact of migration on household food diversity

To define the presence of migrants in the household, we define migration if at least one member of the family moves across village boundaries for over six months for work-related reasons. In this definition, MSHs are households with at least one member who is a migrant or moves across village boundaries for more than six months.

4.1. Propensity score matching (PSM)

As discussed in Section 1.6, this paper takes into account the possible selection bias from observable characteristics. Household characteristics may cause a higher probability to migrate and also a higher probability to obtain a positive outcome of migration (e.g., higher food consumption expenditure or better status of food security). In this situation, comparing the outcome of migration between MSHs and non-MSHs may be misleading

The PSM method (Rosenbaum & Rubin 1983; Rubin 1974) allows us to control for a possible selection bias from observable variables in investigating migration outcomes. In this method,

nonrandom selection is corrected by comparing each MSH with a similar non-MSH based on their propensity scores. Propensity score is the probability of being in the treatment group (having a migrant in the households) conditional on observed baseline characteristics. Propensity score is estimated from a series of observed characteristics that predict the probability that a household will engage in treatment (migration) (Rosenbaum & Rubin 1983; Rubin 1974). In the PSM method, the outcome of the non-MSHs (control group) is interpreted as the counterfactual outcome of the MSHs (treated group) in the absence of migration (treatment).

The PSM method reduces the bias resulting from observed variations. Black and Smith (2004) and Ichino, Mealli, and Nannicini (2008) highlighted the advantages of the PSM method over the OLS method. First, PSM provides an explicit method with which a common support can be ensured. PSM ensures a MSH can be compared with a non-MSH with sufficient overlap between the distributions of the observed characteristics of the two groups (Heckman 1997; Heckman, Ichimura & Todd 1998). Second is the nonparametric nature of PSM; it does not depend on restrictive functional form assumptions for identification.

PSM develops an index of propensity score for the treated (MSHs) and control (non-MSHs) groups to match. Dehejia and Wehba (2002), McKenzie and Gibson (2006), and White (2006) suggest that when households self-select into the programme, PSM gives more accurate non-experimental estimates. Jalan and Ravallion (2001) highlight that using the counterfactual approach, the mean impacts can be estimated without arbitrary assumptions about functional forms and error distributions.

In using the PSM method, households are divided into two categories:

D_i = 1, if they have at least one member of family migrating, and D_i = 0 if not.

Y_{i1} = Outcome having a migrant in the household and

Y_{i0} = Outcome having no migrant in the household.

ΔY_i = The effect of treatment for household *i* is the differences between the outcome of having a member of family migrate and the outcome without having a member family migrate, as specified below:

$$\Delta Y_i = E(Y_{i1} / D_i = 1) - E(Y_{i0} / D_i = 1) \quad \text{..... (2)}$$

However, it is not possible to observe households in two different states simultaneously. The outcome of the household having a family member who migrates can be observed but we cannot observe the same outcome in the absence of migration (counterfactual). PSM estimates are based on the *conditional independence assumption,* which states there is a set X of covariates observable such that after controlling for these covariates, the potential outcomes are independent of the treatment status. After controlling for X, the treatment assignment is "as good as random" (Lechner 1999). PSM assumes there exists a set of observable conditioning variables (X)), for which the non-migration outcome (Y_{i0}) is independent of migration status (M), or $Y_{i0} \perp M \mid X$.

$$E(Y_{i0} / D_i = 1, X_i) = E(Y_{i0} / D_i = 0, X_i) \quad \text{..... (3)}$$

In PSM, migration participation is conditioned on the propensity score $P(X)$. The propensity score is the probability of households having a migrant conditional on a vector of observable characteristics, such that

$$P(X_i) = \Pr\{D_i = 1 / X_i\}$$

The average treatment effect of household *i*:

$$\Delta Y_i = E[Y_{i1} / D_i = 1, P(X_i)] - E[Y_{i1} / D_i = 0, P(X_i)] \quad \text{.....} \quad (4)$$

A probit regression will be used to estimate predicted probabilities of having a migrant D_i, or having no migrant based on series of observable covariates X_i.

$$\Pr\{D_i = 1 \mid X_i\} = \Phi(h(\beta_i X_i + e)) \quad \text{..... (5)}$$

The STATA routine *psmatch2,* (Lauven and Sianesi, 2003), has been used to perform the estimation.

Matching algorithms

Three types of matching algorithms are applied to obtain robust estimates of counterfactual approach. *Nearest-neighbour (NN)* matching chooses a counterfactual household for each MSH based on closest propensity. The unit that has the nearest propensity score from the comparison group (non-MSHs) is chosen as a matching partner for a treated (MSHs) unit. We apply both choices of *NN* "with replacement," where an untreated unit is used more than once as a match, and "without replacement." *Caliper* matching is used to address situations where the closest neighbour is far away, so using *NN* matching will cause bad matches. Applying *caliper* matching means an individual from the comparison group is chosen as a matching partner for a treated individual that lies within the *caliper* (propensity range) and is closest in terms of the propensity score. Austin (2009) summarises that literature, mostly using small numbers such as 0.005 or 0.001. Following Raynor (1983), who states that a tighter *caliper* is more appropriate and produces close matches for efficiency, this paper set 0.001 *caliper* in matching algorithm.Lastly, we apply *kernel* matching, which matches each treated unit (MSHs) to a weighted sum of comparison units (non-MSHs) with the greatest weight assigned to units with closer scores (Heckman et al. 1998).

4.2. Propensity score estimation

Heckman, Ichimura, and Todd (1997) suggest the choice of covariates should be based on economic theory and on a sound knowledge of previous research. In terms of specification, this paper follows Bryson, Dorsett, and Purdon (2002), who stated that over-parameterised models should be avoided because inclusion of non-significant variables may not bias the estimates but can increase variance. Covariates based on characteristics of head of households, households, and from the community are used to estimate the propensity score.

The probit model in Table 4 presents the propensity scores of becoming a MSH or having at least one migrant in the household given the observed pre-remittance characteristics. The dependent variable is a binary of one if a household has at least one migrant and zero otherwise.

Table 4. Probit model predicting MSHs.

Variable	Coefficient	t-test (prob)
Head of HH characteristics:		
Age	-0.0169	(0.00) **
Sex	0.263	(0.173)
Marital status (single, married, divorce)	-0.119	(0.163)
Type of Work (1=worker, 0=self-employed)	0.492	(0.108) ***
Household characteristics:		
HH size	-0.363	(0.150) *
Number of children under-5 yrs	0.139	(0.159)
Number of children between 6yrs to 18 yrs	-0.078	(0.084)
Number of member finish Primary School	0.339	(0.139) *
Own House (1=yes, 0=no)	-0.639	(0.110) ***
Number of rooms in house	-0.028	(0.026)
Use electricity (1=yes, 0=no)	0.676	(0.244) **
Own land (1=yes, 0=no)	-0.259	(0.114) *
Own non-farm family business (1=yes, 0=no)	0.227	(0.105) *
Community characteristics :		
Infrastructure of road and phone in the last 5 years	0.244	(0.115) *
Constant	-0.848	(0.458)
N	2117	
Pseudo-R^2 McFadden	0.244	
Pseudo-R^2 Nagelkerke	0.291	
Percent correct	93.25 %	
LR test (prob)	254.358 (0.000)***	

Standard error in parentheses

**P < 0.05, ** p < 0.01, *** p<0.001*

The estimates show that in terms of head household characteristics, the probability of having a migrant decreases significantly with the age of the head of household. Older head of households have lower chances to migrate to find new or better jobs, and members of the household have less mobility to migrate when they have to leave behind an aging parent. The probability of having a migrant is also related to the employment status. A head of household who is not self-employed has a higher probability to migrate to find a new or better job compared to a self-employed head, who is also more likely to stay and create his or her own job.

The probability of having a migrant decreases significantly with household size. This is in line with the study in Vietnam reported by T.B. Tran et al. (2012). This negative relation indicates that a larger household size, mostly found in lower- and middle-income groups, is less likely to migrate. The probability of having a migrant in the household increases significantly if the households have no house or land. Education plays an important role, since the more members finish at least primary school, the higher the probability to migrate. In the eastern region where access to electricity is not adequate compared to the western region of Indonesia, having electricity also contributes to the probability to migrate. Having a nonfarm family business decreases the probability of having a migrant. This is similar to the head household's characteristic type of job; having an available job at home decreases the probability to migrate.

Community characteristics show that the probability of having a migrant increases significantly with developing road and telecommunication in the last five years. A community that enjoys developments in infrastructure such as road and telecommunication increases migration access and forms a migration network.

5. Results and Discussion

The estimation result of the impact of migration on food expenditure, current food security status, and food diversity is presented in Tables 5, 6, and 7. Both PSM and OLS are applied to estimate the outcome of migration. Figure 2 shows a histogram of the propensity scores, and Figure 3 shows a kernel density estimate of propensity scores for the treatment and control groups. Both graphs show there is overlap in the propensity scores of the treatment and control groups.

Table 5 presents the impact of having at least one member as migrant on three outcomes of expenditure: the logarithm of monthly food expenditure, the logarithm of monthly per capita food expenditure, and the logarithm of total monthly expenditure. The OLS estimates show a positive and significant impact of migration on those three outcomes, and PSM significantly confirms those results. Both OLS and PSM produce positive and significant impact with at least 10% significance level.

Table 5. Impact of migration on food expenditure (PSM and OLS).

Outcome Variables	PSM Estimates (Average Treatment of the Treated (ATT))						OLS Estimates		
	Matching Algorithm	Diff	SE	t-test	N_T	N_C	B	SE	N
Monthly Expenditure on food (log)	NN Caliper= 0.001 with replacement	0.239 +	0.126	1.90	104	1959	0.176 *	0.075	2101
	NN Caliper= 0.001 without replacement	0.282 *	0.120	2.34	102	1959			
	Kernel	0.182 *	0.871	2.09	53	1959			
Monthly Per capita expenditure on food (Log)	NN Caliper= 0.001 with replacement	0.244 +	0.133	1.84	104	1959	0.230 **	0.079	2101
	NN Caliper= 0.001 without replacement	0.315 *	0.128	2.46	102	1959			
	Kernel	0.208 *	0.930	2.24	139	1959			
Monthly per capita Total expenditure (log)	NN Caliper= 0.001 with replacement	0.238 +	0.122	1.96	103	1941	0.282 ***	0.062	2082
	NN Caliper= 0.001 without replacement	0.247 +	0.119	2.07	97	1941			
	Kernel	0.277 **	0.797	3.48	138	1941			

*Note : + p<0.10 , *P < 0.05, ** p < 0.01, *** p < 0.01*

The difference of the average treatment effect on the treated (ATT) on food expenditure and total expenditure is robust in three different matching techniques. The three matching algorithms show that both the values of the coefficients and their significance are similar. In all three matching algorithms, the counterfactual approach shows that being a MSH significantly increases monthly expenditure on food by 18% to 28%, monthly per capita expenditure on food by 20% to 31%, and monthly per capita total expenditure by 23% to 27%. A similar magnitude of the outcome and significance is also produced in OLS estimates. The estimation shows that migration has a positive impact not only on food expenditure but also on the total expenditure of the household. This supports earlier findings of studies that focus on the impact of migration on food consumption and food expenditure such as those of Nguyen and Winters (2011) and Karamba et al. (2011). This finding is also in line with the view that

migration and remittance help smoothen consumption, increase food expenditure (Rosenzweig & Stark 1989), and invest in daily needs (Kabki, Mazzucato & Appiah 2004; Mazzucato 2009).

Table 6. Impact of migration on food consumption score (PSM and OLS).

	PSM Estimates (Average Treatment of the Treated/ ATT)						OLS Estimates		
	Matching Algorithm	Difference	SE	t-test	N_T	N_C	B	SE	N
FCS	NN Caliper= 0.001 with replacement	6.859 *	2.916	2.35	107	1975	4.260 **	1.618	2117
	NN Caliper= 0.001 without replacement	6.861 *	2.806	2.44	97	1975			
	Kernel	5.549 **	1.885	2.94	139	1975			
FCS-Acceptable	NN Caliper= 0.001 with replacement	0.149 *	0.702	2.13	107	1975	0.123 **	0.039	2117
1=if HH have FCS>42 and 0=otherwise	NN Caliper= 0.001 without replacement	0.185 **	0.066	2.81	97	1975			
	Kernel	0.131 **	0.045	2.93	139	1975			
FCS-Borderline	NN Caliper= 0.001 with replacement	-0.065	0.062	-1.05	107	1975	-0.082 *	0.035	2117
1=if HH have FCS>28 & FCS<=42 , and 0=otherwise	NN Caliper= 0.001 without replacement	-0.103	0.058	-1.78	97	1975			
	Kernel	-0.087	0.039	-2.23	139	1975			
FCS-poor	NN Caliper= 0.001 with replacement	-0.084	0.489	-1.72	107	1975	-0.040	0.026	2117
1=if HH have FCS<=28 0=otherwise	NN Caliper= 0.001 without replacement	-0.082	0.045	-1.82	97	1975			
	Kernel	-0.044	0.298	-1.47	139	1975			

*Note : + p<0.10 , *P < 0.05, ** p < 0.01*

The impact of migration on food security using FCS is explored in Table 6. FCS is a composite score that captures frequency of weighted diet diversity. Estimating the impact of migration on FCS as in the first panel of Table 6, the ATT shows a significant impact of migration on FCS in three different matchings. The estimates show that being MSHs significantly increases FCS ranges from 5.6 to 6.9 points in the composite score. This increase corresponds to a 30% and 37% standard deviation of the FCS, respectively.

The increase in the composite index of FCS means that migration significantly increases dietary diversity and frequency of consumption. This finding shows that migration does not only contributes to increase household food expenditure but also increases the current household status of food security. OLS shows consistent estimates in terms of significance level and an increase of 4.2 in FCS composite score.

To obtain a further analysis of the outcome of migration on a composite score of FCS, the second panel of Table 6 shows an estimation of the impact of migration on the probability to be in the acceptable, borderline, and poor group of FCS. The three groups are defined using binary variables. FCS Acceptable refers to an FCS index over 42; FCS-borderline reflects an index between 28.5 and 42, and FCS-poor indicates an index between 0 and 28.

The ATT for FCS-acceptable shows that having at least one migrant in the household significantly increases the probability to be categorised as FCS-acceptable households by 13% to 18%. Using the linear probability model, the OLS estimation shows similar results with a 12% increase in probability.

The second set of outcomes signals two positive outcomes of migration with regard to household food security. Migration does not only increase the composite index of FCS but also increases the probability to be categorised in the highest group of food security status. This positive impact of migration on food security is in line with earlier studies such (Nguyen & Winters 2011) showing that in Vietnam households maintain their food security through short-term migration, (Fransen & Mazzucato, 2014) showing that remittances have strong effects on food security in Burundi, and (Tageje, 2014) showing that peasant migration positively contributes to food security in Rural District Tanzania,

An estimation of the impact of migration on food diversity outcome is presented in Table 7. The evaluation is estimated by regressing migration on 10 sets of food groups. I. The result shows that being MSHs significantly increases the food expenditure in six out of 10 food groups. Having a migrant in the family positively affects the expenditure of six out of 10 food groups: vegetables and fruits, dried food, spices, sugar and beverages, oils, and snacks (prepared food eaten at home). Migration enables MSH to have not only increased food access and food utilisation as captured in FCS but also increased food diversity.

In terms of household diversity, migration may produce positive and negative impacts on the habit of household diet. Migration may change a household habit into better or poorer diet, such as eating more high-calorie foods or low-nutrient foods (A. Zezza et al. 2011). An increase in liquidity and time allocation are the reasons for the changes in food consumption pattern. The absence of a migrant mother may increase the consumption of prepared food (snacks) eaten at home or eating out. Among 10 food groups, the expenditure on snacks (prepared food eaten

at home) shows the highest increase. The PSM estimates show that being MSHs significantly increases the range of expenditure on snacks (prepared food eaten at home) from 32% to 58%. Expenditure on sugar and beverages is the next that shows a high increase. This result supports earlier findings on a less nutritious shifting of dietary habits of MSHs: remittances in Ecuador do not translate to long-term nutritional effects (Anton 2010), children who stay behind experience poorer diet quality in Tonga (Gibson et al. 2011), migration has shifted household consumption to less nutritious food in Ghana (Karamba et al. 2011), and international migration from Mexico increases the probability of childhood obesity among older boys (Damon & Kristiansen 2014).

Table 7. Impact of migration on expenditure on food group (PSM and OLS).

Outcome Variables (Logarithm Monthly Expenditure)	PSM Estimates (Average Treatment of the Treated/ ATT)						OLS Estimates		
	Matching Algorithm	Difference	SE	t-test	N_T	N_C	B	SE	N
Staple foods	NN Caliper= 0.001 with replacement	0.242	0.208	1.16	75	1463	0.103	0.122	1572
	NN Caliper= 0.001 without replacement	0.204	0.208	0.98	73	1463			
	Kernel	0.042	0.133	0.32	108	1463			
Vegetables & Fruits	NN Caliper= 0.001 with replacement	0.260	0.154	1.69	85	1425	0.274 **	0.101	1539
	NN Caliper= 0.001 without replacement	0.335 *	0.153	2.19	78	1425			
	Kernel	0.348 **	0.112	3.11	114	1425			
Dried food	NN Caliper= 0.001 with replacement	0.369 *	0.145	2.55	98	1645	0.296 **	0.091	1770
	NN Caliper= 0.001 without replacement	0.358 *	0.139	2.56	95	1645			
	Kernel	0.317 **	0.099	3.20	123	1645			
Meat & Fish	NN Caliper= 0.001 with replacement	0.189	0.156	1.22	91	1596	0.021	0.101	1712
	NN Caliper= 0.001 without replacement	0.182	0.156	1.17	89	1596			
	Kernel	0.133	0.112	1.19	116	1596			
Dairy product	NN Caliper= 0.001 with replacement	-0.216	0.175	-1.23	77	1234	0.0749	0.108	1340
	NN Caliper= 0.001 without replacement	-0.227	0.173	-1.31	72	1234			
	Kernel	0.140	0.121	1.15	103	1234			
Spices	NN Caliper= 0.001 with replacement	0.200	0.145	1.38	91	1799	0.219 *	0.093	1915
	NN Caliper= 0.001 without replacement	0.226	0.140	1.62	86	1799			
	Kernel	0.273 *	0.104	2.63	116	1799			
Sugar & Beverages	NN Caliper= 0.001 with replacement	0.323 *	0.133	2.43	92	1735	0.236 **	0.083	1862
	NN Caliper= 0.001 without replacement	0.421 **	0.133	3.15	87	1735			
	Kernel	0.247 **	0.885	2.80	125	1735			

Oils	NN Caliper= 0.001 with replacement	0.279 +	0.142	1.96	68	1377	0.216 *	0.095	1472
	NN Caliper= 0.001 without replacement	0.287 +	0.141	2.03	65	1377			
	Kernel	0.275 *	0.103	2.67	94	1377			
Snack (prepared food eaten at home)	NN Caliper= 0.001 with replacement	0.582 *	0.211	2.76	46	602	0.402 **	0.146	720
	NN Caliper= 0.001 without replacement	0.540 *	0.205	2.63	45	602			
	Kernel	0.316 +	0.156	2.02	74	602			
Food-out (prepared food eaten away from home)	NN Caliper= 0.001 with replacement	0.307	0.371	0.83	14	327	-0.006	0.182	425
	NN Caliper= 0.001 without replacement	0.254	0.373	0.68	13	327			
	Kernel	-0.206	0.200	-1.03	54	327			

*Note : + p<0.10 , *P < 0.05, ** p < 0.01*

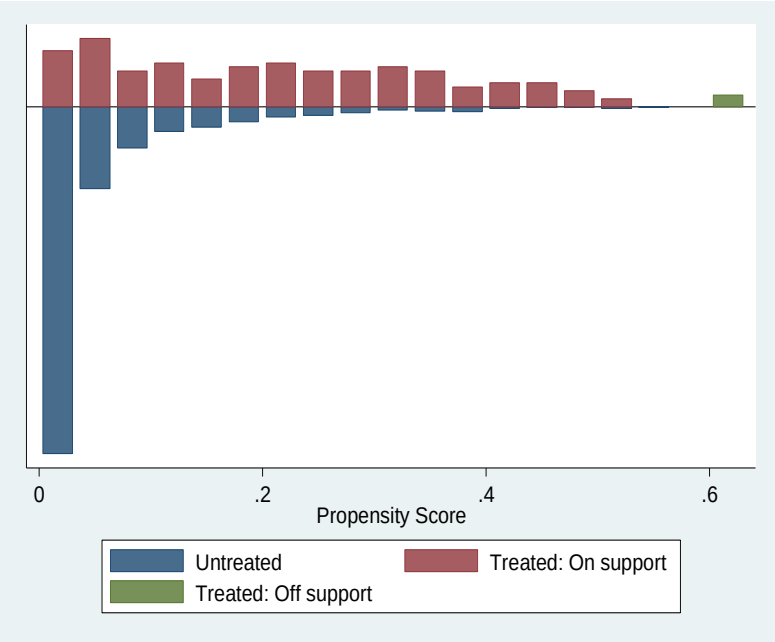

Figure 2. Histogram of propensity scores of treatment versus control group.

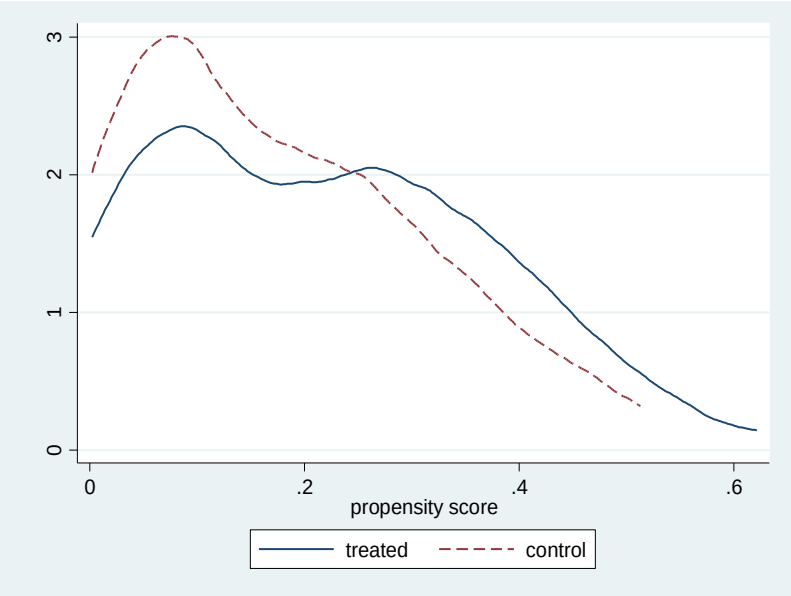

Figure 3. Kernel graphs of propensity score for treatment and control groups.

6. Conclusion

This paper evaluates the impact of migration on food expenditure and food security indicator setting in a region with a high vulnerability to food insecurity. Despite mixed evidence reported in the literature on the outcomes of migration on MSHs expenditure, this paper focuses on the food expenditure outcome and takes further analysis on household food security outcome using FCS as a household food security indicator suggested in the WFP.

The availability of the first wave of IFLS East 2012 is composed of seven provinces that have no household survey reported before, making it possible to investigate the outcome of migration within this less-developed region. The findings in this paper supports positive outcomes of migration on three sets of outcomes. The first set of outcome shows that migration increases food expenditure and total expenditure of MSHs. The second set of outcomes shows that being MSHs corresponds to an increase not only in food expenditure but also in food security status and the chances to be in the first group of household food security. The positive contribution of migration to household food security can be translated into the view that migration helps MSHs overcome the lack of affordability and vulnerability to food price shocks, knowing that in Indonesia food unavailability is not the cause of food insecurity. The third set of outcome shows that migration resulted in a food diversity increase of at least 6 out of 10 food groups. However, migration also brings about poorer diet habits since expenditure on snacks (prepared food eaten at home) shows the highest expenditure among food groups, followed by sugar and beverages and dried food.

Despite many indicators used to measure household food security, this paper uses FCS. IFLS East 2012 makes possible the investigation of the treatment of migration to not only food expenditure but also to food security by combining the food frequency module and the food expenditure module. Shortcoming comes from food frequency information, since only some foods represent their group. Having a food security–purposed survey enables all dimensions of food security to be captured using many indicators measuring food security. As the first dataset to capture a household survey in seven provinces of East Indonesia, this study relies on its cross sectional nature.

In addressing non-random selection problem, PSM controls for observable bias based on two necessary assumption, conditional independence and presence of common support. If non-random selection comes from unobservable bias, the PSM result should be interpreted with caution. However, with a good set of exogenous pre-migration variables, the PSM estimator does better than OLS and has been found to outperform IV regressions with relatively weak instruments (McKenzie, Gibson, and Stillman 2010).

Findings from this paper are important for both the limited literature about the eastern region of Indonesia and a better understanding of the outcomes of migration in designing and implementing policies to maximise the benefits of migration and minimise the associated costs. Development of infrastructure, better migration management for international migration, remittance transfer mechanisms, use of remittance to households, and migrant protection are some of the strategies to enhance the positive outcome of migration to accelerate poverty alleviation in this less-developed eastern region.

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7. Appendix

The following appendix provides summary statistics of three sets of outcomes. Table A1 provides summary statistics on food expenditure outcomes, Table A2 shows summary statistics on household food security outcomes using calculated FCS, and Table A3 shows summary statistics on food diversity outcome (expenditure of 11 food groups in logarithm of monthly expenditure). Table A4 shows covariate balance before and after matching. Table A5 presents an example of an FCS calculation based on Comprehensive Food Security & Vulnerability Analysis Guidelines (WFP 2009), and Table A6 has food consumption groups with corresponding FCS thresholds for Indonesia based on the Food and Nutrition Security Monitoring System (FNSMS)

Table A1. Summary statistics food expenditure & total expenditure (Indonesian Rupiah 2012)

	Treated (MSHs)				**Control (Non-MSHs)**			
	Mean	**SD**	**Min**	**Max**	**Mean**	**SD**	**Min**	**Max**
Monthly expenditure on food (log)	14.20	0.84	8.78	16.76	13.76	1.02	8.37	16.37
Monthly Per capita expenditure on food (Log)	12.86	0.91	8.08	15.43	12.43	1.03	7.27	15.50
Monthly per capita total expenditure (log)	13.63	0.83	11.30	15.77	13.16	0.92	9.90	16.07
N	331				2216			

Table A2. Summary statistics household food security outcomes

	Treated (MSHs)				**Control (Non-MSHs)**			
	Mean	**SD**	**Min**	**Max**	**Mean**	**SD**	**Min**	**Max**
FCS	56.36	18.66	13.0	100.5	48.18	19.62	2	108
FCS-Acceptable Group	63.72	14.46	42.5	100.5	61.57	13.98	42.5	108
FCG-Borderline Group	37.42	3.99	28.5	42	35.40	3.95	28.5	42
FCS-Poor Group	21.85	4.05	13.0	27.5	21.01	5.21	2	28
FCS-Acceptable [1= if HH have FCS>42 and 0=otherwise]	0.761	0.427	0	1	0.574	0.494	0	1
FCS-Borderline [1=if HH have FCS>28 & FCS<=42 , and 0=otherwise]	0.169	0.375	0	1	0.259	0.438	0	1
FCS-Poor	0.069	0.254	0	1	0.166	0.372	0	1

[1=if HH have FCS<=28 0=otherwise]		
N	331	2216

Table A3. Summary statistics food diversity outcome (expenditure of eleven food groups in logarithm of monthly expenditure)

	Treated (MSHs)					Control (Non-MSHs)				
	Mean	**SD**	**Min**	**Max**	**N**	**Mean**	**SD**	**Min**	**Max**	**N**
Staple foods	12.28	1.26	8.37	14.98	273	12.28	1.21	9.06	15.28	1633
Vegetables & fruits	11.89	1.00	9.06	15.28	277	11.44	1.13	8.37	14.47	1607
Dried food	11.57	0.96	9.06	14.41	303	11.25	1.02	7.68	14.48	1845
Meat & fish	12.28	1.12	8.77	15.32	289	12.02	1.09	9.06	15.41	1795
Dairy product	11.59	1.12	8.55	14.26	244	11.36	1.10	8.37	14.72	1389
Spices	11.44	0.97	8.37	14.60	291	11.19	1.00	8.01	14.43	2014
Sugar & beverages	11.75	0.90	8.37	14.25	310	11.53	0.86	8.37	15.02	1952
Oils	11.34	0.87	9.29	13.94	235	11.19	0.87	8.37	13.92	1536
Snack (prepared food eaten at home)	11.65	1.11	9.06	15.18	164	11.31	1.12	8.37	14.92	725
Food-out (prepared food eaten away from home)	11.87	1.15	9.76	14.70	114	11.57	1.16	8.37	14.92	409

Covariate balance

The results from balance tests for PSM is presented in Table 8. The table shows the mean, the standardised bias, reduction in bias, and the *t-test* and *p-value* of each covariate of the treatment and control group. The test shows a significant improvement in balance. Within the head-of-household characteristics, the bias of the age of the head of household drops as much as 89.1% after matching, and other covariates also display similar rates of reduction. Except for two covariates, most household characteristics show over 85% reduction in bias. The standardised difference in the matched sample is much smaller than 50%, suggesting that the matching will cause a reliable regression adjustment, as suggested in Rubin (2001). Covariates show that the mean differences between treatment and control in the matched sample do not differ significantly at the 10% significance level. The matched sample shows a significant reduction in bias since the mean value drops from 46.5 to 6.1. Overall, the result suggests that matching helps reduce the bias associated with observable characteristics.

Table A4. Covariate balance before and after matching.

Variable	**Mean-treated**	**Mean-control**	**% bias**	**% reduction in bias**	***t***	***p***
Head of HH characteristics:						
Age	36.408	35.57	7.5	89.1	0.77	0.442
Sex	0.901	0.852	15.0	2.3	1.26	0.208
Marital status (single, married, divorce)	1.951	1.979	-8.0	80.0	-0.63	0.527
Type of Work (1=worker, 0=self-employed)	0.648	0.598	10.6	86.5	0.86	0.393
Household characteristics:						
HH size	3.338	3.323	0.7	98.5	0.07	0.946
Number of children under-5 yrs	0.591	0.605	-1.8	85.9	-0.16	0.873
Number of children between 6yrs to 18 yrs	0.732	0.775	-3.7	92.3	-0.33	0.744
Number of member finish Primary School	2.774	2.767	0.4	98.8	0.04	0.970
Own House (1=yes, 0=no)	0.331	0.309	4.8	95.5	0.38	0.704
Number of rooms in house	4.669	4.563	4.9	56.9	0.40	0.686
Use electricity (1=yes, 0=no)	0.979	0.972	2.4	95.9	0.38	0.703
Own land (1=yes, 0=no)	0.232	0.232	0.0	100	0.00	1.000
Own non-farm family business (1=yes, 0=no)	0.507	0.478	5.7	68.7	0.47	0.636
Community characteristics						
Infrastructure of road and phone in the last 5 years	0.309	0.373	-14.9	50.9	-1.12	0.262

Sample FCS calculation and household food consumption groups

1. Using a standard seven-day food frequency data, group all the food items into specific food groups.
2. Sum all the consumption frequencies of food items of the same group, and recode the value of each group above seven as 7.
3. Multiply the value obtained for each food group by its weight and create new weighted food group scores.

4. Sum the weighed food group scores creating the FCS. The most diversified and best consumption with the maximal FCS at 112 means that all food groups are eaten seven days a week.
5. Using the thresholds for Indonesia, households are categorised into three food consumption groups: poor, borderline, and acceptable food consumption.

Table A5. Sample FCS calculation (based on Comprehensive Food Security & Vulnerability Analysis Guidelines, WFP 2009).

Food item	Food Group	Weight (A)	Number of Days eaten in a week (Example) (B)	FCS= (A) x (B)
Rice, maize, millet, sorghum, bread and other cereals	Cereals tubers, and root crops	2	7	14
Potatoes, sweet potatoes and Cassava				
Beans, peas, cashew nuts and groundnuts	Pulses	3	2	6
Vegetables, leaves and relish	Vegetables	1	3	3
Fruits	Fruit	1	1	1
Beef, goat, pork, poultry, eggs, and fish	Meat and fish	4	0	0
Milk, yoghurt, and other dairy	Milk	4	1	4
Sugar and sugar products	Sugar	0.5	4	2
Oils, fats, and butter	Oil	0.5	2	1
Condiments	Condiments	0	0	0
Composite score				31

Source: **CFSVA (WFP 2009)**

Table A6. Food consumption groups with corresponding FCS thresholds for Indonesia (Indonesia Food and Nutrition Security Monitoring System / FNSMS).

Food Consumption Groups	Food Consumption Score (FCS)	Description
Poor	0-28	Household consumes staple (7 days), vegetables (5-6 days), sugar (3-4 days), oil/fat (1 day) in a week, animal proteins are absent
Borderline	28.5 - 42	Household consumes staple (7 days), vegetables (6-7 days), sugar (3-4 days), oil/fat (3 days), meat/fish/egg/pulses (1-2 days) in a week, dairy products are absent
Acceptable	> 42	The same with borderline group, but with more number of days in a week eating meat, fish, egg, oil, and complemented by other foods such as pulses, fruits, milk

Source: **Food and Nutrition Security Bulletin Indonesia, 2009**

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