Disentangling the Impact of International Migration on Household Food and Nutrition Security: Evidence from Bangladesh

This paper explores the linkages between international migration and household food and nutrition security (FNS). Specifically, using Bangladesh as a case study, the paper pursues three specific objectives. First, building on the limited amount of previous literature, it outlines a comprehensive conceptual framework for identifying the main microeconomic channels through which international migration can affect household FNS. Second, by adopting an encompassing definition of migrant households that includes all households with current or past experience of international migration and those that are receiving remittances, the paper estimates the overall impact of international migration on the FNS of Bangladeshi households. Third, by disentangling the overall effect of international migration on household FNS, the paper assesses the role played by the various microeconomic channels, i.e. the change in the household structure, overseas remittances and the presence of returned migrants.

The empirical strategy for assessing the impact of international migration is based on a multiple treatment counterfactual framework, using a linearized propensity score matching technique. On the one hand, the estimates indicate that international migration has a positive impact on all FNS dimensions, allowing households to consume more food, to have access to more expensive food and to shift towards a more diversified, high-protein and micronutrient-rich diet. On the other hand, the disentanglement of the impact corroborates the validity of the conceptual framework and supports the conclusion that the average effect of international migration on household FNS is always non-negative.

Finally, the paper contributes to the literature on the so-called 'Bangladesh paradox'. Indeed, the analysis identifies international migration as a key factor that can contribute to explain the exceptional health progress achieved by Bangladesh during a period characterized by relatively poor economic performances.

Keywords: Household food security; International migration; Bangladesh.

JEL Code: F22; I1; I3; O15.

1. Introduction

International migration has become one of the most relevant phenomena worldwide. Official statistics show that the number of international migrants almost tripled over the last thirty-five years, from about 93 million in 1980 to about 243 million in 2015 (World Bank, 2016a). International remittances have also grown steadily, rapidly becoming the developing countries' second largest source of external finance after foreign direct investments (Ratha and Shaw, 2007; World Bank, 2015). No wonder, therefore, that over the last two decades the number of theoretical and empirical works exploring the linkages between international migration and economic development has grown substantially. In particular, even though a 'Washington consensus' on migration is still lacking (Hanson, 2010), since the beginning of the 1990s the literature has tended to stress the development potential of international migration (de Haas, 2010; 2012).

Despite the increasing number of studies exploring the effects of international migration on migrant-sending countries, only few works directly investigated the nexus between migration and food and nutrition security (FNS). In particular, while some country-level studies explored the effects of migration and remittances on different dimensions of household investments (Mendola, 2008; Yang, 2008; Adams and Cuecuecha, 2010; Giannelli and Mangiavacchi, 2010), many others focused on the impact of international migration (Jimenez-Soto and Brown, 2012; Bertoli and Marchetta, 2014; Möllers and Meyer, 2014) and remittances (Lokshin *et al*., 2010; Adams and Cuecuecha, 2013; Barham and Boucher, 1998) on poverty, emphasizing their positive role in alleviating poverty in migrants' countries of origin. However, although poverty is closely related to undernourishment and malnutrition, they are indeed different concepts (Sen, 1981) and, therefore, it is somehow surprising that the literature on migration and development has paid so little attention to FNS issues (Zezza *et al*., 2011). Symmetrically, as pointed out by Crush (2013), also the FNS literature seems to have largely ignored migration issues.

This paper aims at contributing to fill this gap and investigates to what extent international migration impacts on household FNS. Specifically, using Bangladesh as a case study, the paper pursues three specific objectives. First, it provides a general conceptual framework for identifying and interpreting the microeconomic channels through which international migration can affect household FNS, i.e. via the change in the demographic composition of the household, the net increase of household income due to remittances, and the effect of returned migrants on household consumption behavior. Second, by adopting an encompassing definition of migrant household that embraces remittance-recipient households as well as households currently having a member migrated

abroad or a returned migrant, the paper estimates the overall effect of international migration on FNS of migrant households. Third, the paper disentangles the overall effect by empirically estimating the role played by each of these channels, i.e. household structure recomposition, remittances and returnees.

The paper also contributes to shed some further light on the so-called 'Bangladesh paradox' (Chowdhury *et al*., 2013). In fact, considering the well-established correlation between FNS and health outcomes, the analysis identifies an additional channel – international migration – that may have played a role in the exceptional improvements in several health and nutrition outcomes achieved by Bangladesh during a period characterized by a relatively slow economic growth.

In pursuing the objectives above, the paper is organized as follows. Section 2 briefly introduces the Bangladesh context with specific reference to the long-medium term trends in economic growth, migration and FNS. Section 3 outlines the conceptual framework, emphasizing the most relevant channels linking migration and FNS. Section 4 provides a brief overview of the data and methods. Section 5 discusses the empirical strategy. Section 6 reports the empirical findings focusing first on the overall impact of international migration and then disentangling the impact of the various transmission mechanisms that link migration to household FNS. Section 7 draws some concluding remarks, emphasizing the policy implications stemming out from the analysis.

2. The 'Bangladesh Paradox': Social Progress with Moderate Economic Growth

Over the last twenty-five years South Asia has experienced remarkable achievements in terms of poverty reduction and food security improvement. The regional economic growth has been sustained, averaging 6.5 percent per year (World Bank, 2016b), and the Millennium Development Goals targets 1A (halving the proportion of the poor) and 1C (halving the proportion of the hungry) have been achieved for the region as a whole.

Among South Asia countries, Bangladesh recorded the best performance in terms of the improvement of several health and FNS indicators and managed to close the gap with its neighbouring countries. The percapita caloric intake gap that in early 1990s stood at 200 kcal/day disappeared by the second half of the 2000s and the proportion of undernourished people rapidly declined from 37 to 16 percent (World Bank, 2016a). Similarly, over the last twenty-five years, the prevalence of stunted and underweight children fell by more than one third, child mortality dropped by two thirds and life expectancy at birth increased by about ten years (World Bank, 2016a).

Considering the initial size of the gap, the pace of the improvements and the circumstances in which they occurred, Bangladesh's socio-economic achievements appear truly remarkable. In fact, a

distinctive feature of Bangladesh's health and FNS improvements is that they occurred during a period in which the economy of Bangladesh underperformed relatively to the rest of the region. These two concomitant and apparently conflicting circumstances – relatively slow economic growth and rapid social progress[1] – attracted the attention of several scholars who tried to find an explanation for this 'Bangladesh paradox' (Chowdhury *et al*., 2013).

The development literature pointed out different possible candidates for explaining it. For example, Asadullah *et al*. (2014) emphasized the role played by private stakeholders committed to inclusive development such as local and international non-governmental organizations and, especially for improvements in schooling and education, religious organizations. Alternatively, Headey *et al*. (2015) identified the markedly pro-poor economic growth[2], the improvement of the status of women, the rapid increase of children's schooling, the improvements of sanitation and changes in neonatal and antenatal care practices as the five major drivers of the above-mentioned progress in health and nutrition.

Surprisingly, international migration has received little attention in the discussion regarding the possible causes behind the Bangladesh paradox. However, over the last two decades, migration literally reshaped Bangladesh's society and the most recent data show that in 2010-2011 about one out of nine Bangladeshi households has been directly affected by international migration, i.e. by having migrant members and/or by receiving overseas remittances. Indeed, even though the diaspora of migrant workers can be traced back to the 1970s, it scaled up and gained macroeconomic relevance only since the mid-1990s. According to United Nations (2013), Bangladesh has been the country that recorded the highest number of emigrants during the 2000s. In 2015, the estimated stock of Bangladeshi international migrants was the fifth largest in the world (UN, 2016). Similarly, the value of officially recorded remittances increased by a factor of seven since year 2000 and, according to Bangladesh Bank's estimates (2014), they were worth $15 billion in 2014 – about 11 percent of the country's GDP and half of the total export value (Table 1).

At the same time, the potential positive effect of international migration on FNS is intuitively supported by anecdotal evidence (Table 2), showing that migrant households perform systematically better than households not experiencing international migration in terms of food consumption. As a

[1] Using cross-country regressions and a wide set of health, education and demographic indicators, Asadullah *et al*. (2014) show how, controlling for the level of per capita income, Bangladesh systematically underperformed in each of the regressions in 1980 and, symmetrically, significantly outperformed twenty-five years later.

[2] Bangladesh economic growth was markedly pro-poor on the back of rapid agricultural growth, labor-intensive manufacturing and the recent upsurge in overseas remittances. In particular, agricultural growth played a key role. The marked-oriented agricultural policies implemented during the 80s and the early 90s (Ahmed *et al*., 2000) and the concomitant diffusion of high yield varieties of rice paved the way for a remarkable increase in the cereal production (Hossain, 2010) and, consequently, for the improvement of the physical availability of food.

result, Bangladesh represents a very interesting case study to analyze the relationship between international migration and household FNS. The following sections provide a theoretical justification for a causal relationship from international migration to household FNS and an empirical assessment of its effects.

Table 1. Trend in overseas remittances, Bangladesh (1993-2014)

Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Remittances (million USD)	1,009	1,154	1,202	1,355	1,525	1,599	1,807	1,955	2,071	2,848	3,178
Remittances growth	n.a.	14.31%	4.16%	12.80%	12.52%	4.87%	12.97%	8.21%	5.94%	37.51%	11.58%
As % of GDP	3.04%	3.42%	3.17%	3.33%	3.60%	3.63%	3.95%	4.15%	4.41%	5.99%	6.12%
As % of total export	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Remittances (million USD)	3,565	4,250	5,484	6,563	8,979	10,718	11,005	12,168	14,164	13,832	14,926
Remittances growth	12.20%	19.20%	29.04%	19.67%	36.82%	19.36%	2.68%	10.57%	16.40%	-2.34%	7.91%
As % of GDP	6.30%	7.05%	8.86%	9.59%	11.29%	11.99%	10.97%	10.87%	12.21%	10.65%	9.95%
As % of total export	n.a.	40.79%	43.03%	47.19%	51.60%	62.87%	50.82%	45.08%	51.34%	51.45%	50.93%

Source: Authors' calculation on Bangladesh Bank (2014) and World Bank (2016a) data.

Table 2. Household FNS achievements conditional to household size and total per capita expenditure

		Migrant households			Non migrant households			FNS indicator
		Total p.c. expenditure			Total p.c. expenditure			
		25th percentile	50th percentile	75th percentile	25th percentile	50th percentile	75th percentile	
Household size	25th percentile	39.50	48.73	65.33	31.24	40.93	54.99	P.c. food expenditure (tk)
		2,328	2,492	2,838	2,093	2,438	2,720	P.c. caloric intake (kcal)
		68.78	75.05	80.82	66.40	70.61	77.49	Shannon index (food exp.)
		52.64	60.59	67.51	47.21	51.86	60.43	Shannon index (cal. Intake)
		76.81	80.87	83.61	73.47	76.65	81.49	Gini-Simpson index (food exp.)
		50.80	57.06	62.03	45.00	48.84	56.22	Gini-Simpson index (cal. Intake)
		54.7	51.2	48.0	65.0	62.4	57.4	Foodshare (%)
	50th percentile	39.16	51.50	62.05	31.14	40.17	51.63	P.c. food expenditure (tk)
		2,197	2,506	2,670	2,079	2,365	2,618	P.c. caloric intake (kcal)
		70.73	77.34	80.31	66.36	71.64	77.17	Shannon index (food exp.)
		53.74	61.48	66.32	46.68	51.95	58.69	Shannon index (cal. Intake)
		77.83	81.74	83.13	72.79	77.06	80.52	Gini-Simpson index (food exp.)
		50.92	57.38	60.57	43.97	48.38	53.67	Gini-Simpson index (cal. Intake)
		54.7	53.8	45.1	64.7	61.2	53.9	Foodshare (%)
	75th percentile	38.40	52.01	63.81	31.85	39.52	49.58	P.c. food expenditure (tk)
		2,230	2,624	2,577	2,108	2,333	2,461	P.c. caloric intake (kcal)
		71.92	79.12	76.85	66.29	71.83	76.88	Shannon index (food exp.)
		52.33	59.33	60.66	44.98	50.57	57.42	Shannon index (cal. Intake)
		77.28	81.51	81.18	72.16	76.60	80.32	Gini-Simpson index (food exp.)
		48.59	53.74	55.24	41.64	46.35	52.22	Gini-Simpson index (cal. Intake)
		54.3	55.0	47.6	65.8	60.1	52.1	Foodshare (%)

Source: Authors' calculation on HIES (2010) data.

3. A Conceptual Framework for Analyzing the Impact of Migration on FNS

Household FNS has a multidimensional nature and can be influenced by migration in several ways. According to the World Food Summit definition, food security is a situation in which "all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 1996). In order to take into account the most important aspects of the complex reality of the food problem, this definition links food security to four separate dimensions, namely food availability, access, utilization and stability. Building on the previous literature (Azzari and Zezza, 2011; Crush, 2013; Karamba *et al*., 2011; Zezza *et al*., 2011), Table 3 outlines a conceptual framework for identifying the direct and indirect channels through which international migration can affect the four dimensions of household FNS.

Table 3. Conceptual framework: how migration affects food and nutrition security

FNS DIMENSIONS		MICROECONOMIC TRANSMISSION CHANNELS		
		Changes in HH composition	Remittances	Returned migrants
		↓	↓	↓
Availability	←	Changes in self-consumption (depending on hh assets)	In-kind remittances	
Access	←	Less total (potential) HH labor supply, compensation of migration investment	Monetary remittances	
Utilization	←	New hierarchies within the HH, different opportunity costs labor at home		Transfer of knowledge, transmission of different food habits, new hierarchies within the HH
Stability	←	Less opportunity of labor diversification	More diversification / Hedging against idiosyncratic shocks	

Source: Authors' elaboration.

First, the departure of a member leads to a new equilibrium within the household. Specifically, a change in the household composition implies a change in the relative prices of household labor and a modification of the internal hierarchies. Depending on the migrant's individual characteristics and on

the household's assets, it can influence food availability, food access and food utilization. The migrant's departure entails a reduction of aggregate household food requirements but also of total household (potential) labor supply. In addition, if migration implies shifting the household headship from the male household head to his wife, it can influence the intra-household distribution of labor and consumption, affecting food security at both the household and the individual level.[3]

Second, households can receive overseas remittances. Even though in most of the cases remittances are received from a migrant member of the household,[4] they are sometimes sent also by friends or more distant relatives who are not household members. Remittances can be either monetary or in-kind and produce a direct impact on all the dimensions of food security except food utilization: in-kind remittances increase food availability, monetary remittances enhance food access and both types may enhance food stability. Indeed, as pointed out by the new economics of labor migration literature (NELM), migration can be interpreted as a household risk-diversification strategy when insurance and capital markets are incomplete or missing (Stark and Bloom, 1985).

Third, consumption patterns of the household may be influenced by the presence of a returned migrant. Indeed, the returnee can bring back food habits acquired abroad, hence influencing the household food utilization dimension. Moreover, the prolonged absence of a member may have *irreversibly* altered the household hierarchies and, after his return, the internal equilibrium of the household may differ from the one prior to migration.[5]

The overall effect jointly produced by the above-mentioned transmission channels depends on the specific circumstances in which every migration episode takes place and cannot be determined *a priori*. For example, if the migrant is not able or not willing to remit, the negative effects may easily offset the positive ones. On the other hand, anticipating an increase in their future income, some households may be induced to smooth consumption and to increase their living standard even before receiving remittances.

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[3] This can happen whenever female and male household heads exhibit a systematic difference in their resource allocation preferences (Buvinic and Gupta, 1997).

[4] For a discussion of the motivations behind the decision to remit, see Carling (2008), Rapoport and Docquier (2005), and Agarwal and Horowitz (2002).

[5] This effect is analyzed from a somewhat different perspective in the so-called migration-linked norm transfer literature (Beine *et al*., 2013; Bertoli and Marchetta, 2015).

4. Material and Methods

4.1. Data

The dataset of this study is the fifteenth round of the Bangladesh Household Income and Expenditure Survey (HIES) 2010.[6] This survey gathers information on 12,240 households distributed across 612 primary sampling units and 16 strata (6 rural, 6 urban and 4 metropolitan areas). It is nationally representative and collects a wide range of socio-economic information at both the individual and the household level.

The HIES 2010 is the primary source of information on household consumption behavior. Specifically, the consumption modules include information on quantity, monetary value and origin of 145 different food items aggregated into seventeen main categories. These data can be used to compute quantitative indicators of food security, such as per capita food expenditure or daily caloric intake, as well as measures of dietary diversity, such the Gini-Simpson and normalized Shannon indices, that can be used as proxies of the quality of the household diet.

The dataset also includes detailed information on migration and remittances. For each migrant, it provides individual information regarding his socio-demographic status, migration and remittances. In addition, HIES 2010 asks the respondents to provide an estimation of the total monetary value of the remittances received by the household from relatives living within the country or abroad over the past twelve months. Finally, with specific reference to international migration, the survey asks if any of the members present at the time of the interview has been abroad for at least six months during the past five years and, if so, the reason why he/she returned home.

In total, the number of households directly affected by international migration is 1,445 – the 11.8 percent of the sample population. These households can be further disaggregated into four different subgroups according to the transmission channels by which international migration can affect household FNS – i.e. households with a migrant member currently abroad, households receiving remittances, household with returned migrants, and households having a member currently abroad and receiving remittances.[7] The sample size and the summary statistics of each of each group are reported in Table 4.

[6] The HIES 2010 was carried out by the Bangladesh Bureau of Statistics (BBS) with the technical and financial assistance of the World Bank between February 2010 and January 2011 (BBS, 2012).

[7] Cf. section 4.2.2 for a more accurate definition of different treatments.

Table 4. Summary statistics of the various treatment groups

Household characteristics	Total Sample	Overall impact of intl. migration		Microeconomic transmission channels of intl. migration			
		Migrant	Non Migrant	A. Migrants	B. Remittances	C. Returnees	A∩B. Migrants & Remittances
P.c. food expenditure (taka/day)	45.11	55.76	43.69	54.53	49.66	52.98	57.46
Gini-Simpson (food exp.)	76.61	80.03	76.15	80.41	79.53	80.68	79.87
Norm. Shannon (food exp.)	71.66	75.86	71.09	76.12	75.82	77.25	75.47
P.c. caloric intake (kcal/day)	2387	2582	2361	2441	2503	2412	2647
Gini-Simpson (cal. intake)	49.29	54.66	48.57	56.72	52.84	54.84	54.58
Norm. Shannon (cal. intake)	53.29	59.47	52.46	61.58	57.66	60.17	59.27
Household size*	4.65	5.74	4.51	5.90	4.48	5.07	5.90
Children (0-5)	0.54	0.60	0.53	0.58	0.45	0.59	0.60
Kids (6-17)*	1.29	1.40	1.27	1.35	1.37	1.29	1.45
Female adults (18-45)*	1.02	1.17	1.00	1.12	1.05	1.16	1.16
Female adults (46-65)*	0.30	0.42	0.29	0.48	0.27	0.28	0.44
Male adults (18-45)*	0.98	1.49	0.91	1.66	0.78	1.19	1.57
Male adults (46-65)*	0.34	0.41	0.33	0.47	0.32	0.33	0.42
Elders (66+)*	0.19	0.25	0.18	0.24	0.24	0.22	0.26
Schooling, female adults (years)*	3.63	4.55	3.50	4.65	4.96	5.75	4.28
Schooling, male adults (years)*	4.36	4.34	4.36	4.26	4.84	6.61	3.87
Religious belief (Islam)	0.88	0.95	0.87	0.94	0.94	0.93	0.95
Entrepreneurship (formal)*	0.06	0.05	0.06	0.05	0.08	0.07	0.04
Entrepreneurship (informal)*	0.18	0.10	0.19	0.07	0.19	0.24	0.07
Access to elect. network	0.58	0.76	0.55	0.80	0.71	0.81	0.75
Urban	0.36	0.32	0.37	0.27	0.35	0.41	0.31
Landless	0.07	0.03	0.07	0.04	0.03	0.02	0.03
Number of observations	12,234	1,445	10,789	153	154	123	952

Note: * information on migrant members absent at the time of the survey data collection is taken into account.
Source: Authors' calculation on HIES (2010) data.

4.2. Methodology

4.2.1. Counterfactual Framework

The evaluation of the impact of international migration on household FNS is carried out within the counterfactual framework of the Rubin causal model generalized to a multiple treatment setting (Lechner, 2001; 2002) for the second part of empirical the analysis. According to the multiple treatment generalized setup, each analytical unit of a given population (in this context, the surveyed households) has, in principle, a different potential outcome under each set of mutually exclusive causes to which it can be exposed. It follows that, given a treatment support $T = \{t_1, t_2, \dots, t_n\}$ of n different treatments, each analytical unit i will have a set of n potential outcomes given by $Y_i = \{Y_i(t_1), Y_i(t_2), \dots, Y_i(t_n)\}$. At the individual level, the effect of a treatment t_j with respect to an alternative treatment t_k is defined as

$$\tau_i(k,j) = Y_i(t_j) - Y_i(t_k) \quad \text{with } t_j, t_k \in T,\ j \neq k \tag{1}$$

where $Y_i(t_j)$ and $Y_i(t_k)$ are the potential outcomes of the individual i under the treatment states t_j and t_k respectively. Since the effect of a treatment necessarily needs to be evaluated in relation to the exposure to an alternative treatment state, the number of possible individual treatment effects, given by all the $D(n, 2)$ possible pairwise dispositions, tends to explode with the increase of the number of treatments. Similarly, moving from the individual to the aggregate level, the average treatment effect (ATE) is formally defined as

$$\mathrm{ATE}(t_k,t_j) = E[\, Y(t_j) - Y(t_k) \,] \qquad \text{with } t_j, t_k \in T, j \neq k. \tag{2}$$

It follows that, given a sample of size N, the total number of individual and the number of average treatment effects will be $N{\cdot}D(n, 2)$ and $D(n, 2)$ respectively. However, since both the individual and the average treatment effect are symmetric, e.g. $\mathrm{ATE}(t_k,t_j)=-\mathrm{ATE}(t_j,t_k)$ and $\tau_i(k,j)=\tau_i(j,k)$, the number of the effects can be respectively reduced to $N{\cdot}C(n, 2)$ and $C(n, 2)$, respectively.

Rather than estimating the ATE, the present research is interested in estimating the treatment effect on a particular subset of the population, namely the subset of the population that effectively received the treatment, i.e. the average treatment effect on the treated (ATET):

$$\text{ATET}(t_k,t_j) = E[\ Y(t_j) - Y(t_k) \mid D_j(t) = 1\ ] \qquad \text{with } t_j, t_k \in \text{T}, j \neq k \qquad (3)$$

where $D_j(t)$ is an indicator function for $t = t_j$. It can be noted that ATE and ATET asymptotically converge only in the case of random treatment assignment. Vice versa, if treated and non-treated units systematically differ in their attributes, ATET and ATE are likely to differ.[8]

4.2.2. Definition of Treatments

The empirical analysis pursues two objectives, each of them requiring a different definition of the treatment states. While for the estimation of the overall effect of international migration on household FNS it is sufficient to define a binary treatment, disentangling the different microeconomic transmission channels requires the definition of multiple active treatments.

The overall impact of international migration on household FNS can be conveniently evaluated by defining an active treatment that includes all households that have been somehow affected by the phenomenon. Hence, the households exposed to the active treatment are identified as those households that, at the time of the survey, reported at least one of the following conditions: (*i*) a member of the household is currently abroad, (*ii*) the household has received remittances from abroad over the past twelve months, (*iii*) a member of the household has been abroad for at least six consecutive months over the past five years.

The empirical assessment of the microeconomic transmission channels requires the definition of four active treatment states, namely:[9]

- Treatment group 'A', meant to capture the 'pure' effect of the change in household structure, includes those households that reported to have a migrant member currently abroad but did not receive remittances[10] over the past twelve months and did not have previous experience[11] in international migration (153 obs.);
- Treatment group 'B', meant to capture the net effect of receiving remittances, encompasses all the households that, although having neither migrants currently abroad nor previous

[8] This happens when the attributes do not influence only the treatment assignment but also the outcome variable.

[9] The definition of the five (4 active + 1 passive) mutually exclusive treatments leaves out some marginal case like the intersections 'A ∩ C', 'B ∩ C' and 'A ∩ B ∩ C'. However, since the sample size of these cases (63 households in total) is not enough for the estimates, they have not been considered in the analysis.

[10] In order to increase the size of the groups 'A' and 'C', households in the 5th percentile of the remittances/income ratio distribution has been considered as not receiving remittances. A sensitivity analysis shows that this manipulation does not affect the results except for the significance of treatment 'A' on p.c. caloric intake.

[11] A household is considered having previous experience in international migration if at least one of the members present at the time of the interview has been abroad for six consecutive months over the past five years.

experience of international migration, did receive remittances from abroad over the past twelve months (154 obs.);

- Treatment group 'C', meant to capture the net effect of returned migrants, includes the households with a previous experience in international migration but with no members currently abroad and did not receive remittances over the past twelve months (122 obs.);
- Treatment group 'A ∩ B', meant to capture the joint effect of migration and remittances, encompasses the households that received remittances and currently have a migrant member but do not have any returned migrant among its members (952 obs.).

Finally, the passive treatment state contains the large pool of households having no current or past experience in international migration and are not receiving overseas remittances (10,795 obs.).

By defining five alternative treatments, it is theoretically possible to estimate twenty different ATET. However, since the aim of the study is to assess the impact of the various channels with reference to a no-migration counterfactual scenario, the analysis focuses only on the evaluation of the four active treatments vis-à-vis the passive one. Following Lechner (2001, 2002), the impacts are estimated performing a series of binary comparisons. Compared to the adoption of a multiple-choice model, the main advantage of this strategy rests in its relative simplicity and in its higher robustness to model misspecification.

4.2.3. Definition of the Outcome Variables

FNS is inherently a multi-dimensional construct: as such, it is not suitable to be summarized by a single measure. Over the years, the literature has proposed several indicators, each of them capturing some of the dimensions of the food security problem (Masset, 2011; de Haen *et al*., 2011; Carletto *et al*., 2013). In general, however, the appropriateness of an indicator needs to be assessed on a case-by-case basis with regard to the purpose of the analysis (Habicht and Pelletier, 1990). Moreover, given a set of theoretically suitable indicators, the final choice is usually constrained by the availability of data. The present study makes no exception and, given the lack of available anthropometric measures, it relies on indicators that can be computed using household-level information on nutritional inputs and consumption behavior. Specifically, household FNS is measured using a set of six indicators, namely the daily per capita food expenditure, the daily per capita caloric intake and two dietary diversity indicators, the normalized Shannon and the Gini-Simpson diversity indices, computed for both household food expenditure and sources of caloric intake.

Per capita food expenditure and per capita caloric intake are computed from HIES consumption modules. Whereas the estimation of food expenditure is straightforward, the computation of the caloric intake requires some assumptions. Indeed, even though the BBS provides the caloric conversion factor for each food item quantity (weight or volume), some of them are reported in units (e.g. the number of eggs, chocolate snacks, cups of chai, etc.) for which the weight/volume has been assumed.[12]

Shannon and Gini-Simpson indices are two of the most common measures of diversity that, in the context of migration and food security studies, have been already used by Ngouyen and Winters (2011). Formally, they are defined as

$$I_{ShannonNorm} = \frac{\sum_{c=1}^{C} s_c \, ln(s_c)}{\max\left(\sum_{c=1}^{C} s_c \, ln(s_c)\right)} \times 100 \quad (4)$$

$$I_{Gini-Simpsozon} = (1 - \sum_{c=1}^{C} s_c^2) \times 100 \quad (5)$$

with c = {1, 2, …, C} indexing the food categories and s_c their relative share of either total food expenditure or caloric intake. The value of the two indices ranges from 0 to 100 and a higher value is associated with a higher degree of diversity. The measurement of dietary diversity is relevant because diet diversification has proven to be a robust proxy for households' food security as well as for child nutritional status (Hoddinott and Yohannes, 2002; Arimond and Ruel, 2004; Thorne-Lyman *et al.*, 2010). In particular, Arimond and Ruel (2004) found that dietary diversity is significantly correlated with children's height-for-age *z*-score, a correlation that remains significant also after controlling for the socio-economic status of the household.

In conclusion, whereas food expenditure and caloric intake can be considered proxies of food access and food availability dimensions, dietary diversity measures can be regarded as proxies of the food utilization dimension. Unfortunately, the cross-sectional nature of data does not allow to capture food stability.

[12] However, they are relatively few and they represent a negligible share of the total caloric intake. For instance, eggs represent on average only 0.44 percent of daily caloric intake.

5. Evaluation Strategy

5.1. Methodological Issues in Microeconomic Migration Studies

Since it is not possible to observe the same unit under more than one treatment state, the problem of causal inference can be conceived as a problem of missing data (Morgan and Winship, 2007). Indeed, the accurate measurement of a treatment effect would require to know, besides the realized outcome, also the other potential outcomes of the households that, by definition, are unobservable. On the top of this general statement, valid for any causal model estimation, the microeconomic estimation of the impact of migration raises a series of specific methodological issues. Following Adams's (2011) taxonomy, the main issues can be identified as those arising because of (*i*) the simultaneity of the migration decision with other decisions, as household labor supply and fertility, that may also influence the outcome of the variable(s) of interest, (*ii*) the self-selection of migrants, who systematically differ from the stayers, (*iii*) the reverse causality nexus between poverty and migration and (*iv*) the presence of relevant omitted/unobservable variables. Within a non-experimental setting, these issues are often addressed by means of instrumental variable (IV) estimators, that are considered to deliver the best estimates. However, lack of data and/or concerns regarding the validity of the exclusion restriction may limit the scope of this approach.

In the absence of credible instruments, matching methods represent a valid alternative. If selection on observables can be assumed to plausibly hold, matching methods are able to address the aforementioned issues and produce reliable estimates. Matching methods have been increasingly used in a number of migration studies (Ham *et al*., 2011; Jimenez-Soto and Brown, 2012; Bertoli and Marchetta, 2014; Möllers and Meyer, 2014). Comparing the results of a set of commonly-used non-experimental estimators with the benchmark unbiased ATET estimates obtained by taking advantage of a natural experiment (i.e. the New Zealand's visa lottery for Tongan migrants), McKenzie *et al.* (2010) showed that matching methods perform reasonably well and can be considered the best non-experimental solution after IV.[13]

[13] However, McKenzie *et al*. (2010) also point out that the matching method are not able to fully remove the bias and argue that selection on observables might still represent an issue. On the other hand, it should be noted that their implementation of propensity score matching is not fully satisfactory. Indeed, all their specifications include only variables related to the individual migrants but no information on the households of origin. Clearly, overlooking the relevance of household characteristics in determining individuals' migration decisions is not fully consistent with the NELM literature. Vice versa, the specification adopted in this study (cf. section 5.4) includes several variables related to the socio-demographic composition of the households that can be reasonably considered exogenous to the treatment(s) and, at the same time, turn out to be significantly correlated with both the outcome variables and the probability of migration.

5.2. Implementing the Matching Strategy

The identification assumption of matching methods is that it is possible to estimate counterfactual outcomes by finding untreated units that are similar to the treated ones under every relevant respect except for the exposition to an alternative treatment state (Holland, 1986). The two assumptions on which they rely, conditional independence (CIA) and stable unit treatment value (SUTVA).[14]

The ideal matching procedure entails to find one or more perfectly corresponding matches for each of the treated units. Implementing a direct matching on *X*, however, turns out to be problematic because the probability of finding exact matches rapidly falls with the number of the covariates. Rosenbaum and Rubin (1983) demonstrated that this problem can be addressed by conditioning on a balancing score *f*(*X*), defined as function of the original covariates. In the economic literature, the most frequently used balancing score is the propensity score, a scalar function of *X* that represents the unit-level probability of being assigned to the treatment.

In general, the migration literature that used matching methods relied on propensity score (Cox-Edwards and Oreggia, 2008; Ham *et al*., 2011; Jimenez-Soto and Brown, 2012; Bertoli and Marchetta, 2014). This study departs from this tradition performing the matching on the linearized propensity score (*lps*), formally defined as the logarithm of the odds of the propensity scores (Rubin, 2001):

$$\ell(X) = log\left(\frac{e(X)}{1-e(X)}\right) \qquad (6)$$

where *e*(*X*) is the propensity score. The adoption of *lps* has two main advantages: on the one hand, it guarantees the consistency of standard matching estimators (NN, radius and caliper) and, on the other hand, it allows a clearer identification of the region of common support. Indeed, given the non-linearity of propensity score, also the distances between observations is non-linear. If not properly addressed, this issue can lead to biased matches. The linearized propensity score is a straightforward

[14] CIA requires that, after conditioning for a set of relevant characteristics *X*, individual potential outcomes are independent to the treatment assignment. In practice, however, CIA is not a sufficient condition for matching. Indeed, for practical utilization, matching methods further require the observable nature of *X*, a condition known as 'selection on observables' (Rubin, 1977). In practice, the observable covariates should not be necessarily conceived as the 'real' conditioning variables but rather as proxy variables that are correlated with the (possibly latent) factors governing the process of selection into the treatment. SUTVA, implicitly made by imposing the number of individual potential outcomes equal to the number of treatment states, requires that the potential outcomes of each unit are not affected by other units' treatment assignment (Rubin, 1986). In economic terms, this corresponds to the absence of general equilibrium and spillover effects: if it does not hold, the estimates can be considered robust only for the marginal unit.

and theoretically consistent method to address the problem: by removing the non-linearity of the propensity score, it makes comparable the distances between observations (Imbens and Rubin, 2015).[15]

In applying matching methods, the analyst should be very careful in interpreting the various explanatory variables, making a clear distinction between (*i*) treatments, (*ii*) intrinsic characteristics of the analytical units and (*iii*) non-specific identifying features (Cox, 1992), e.g. the region in which a household lives. This procedure turns out to be particularly relevant when the outcome variables, which are expressed in monetary terms, and prices exhibit a significant variability between strata. For instance, if a counterfactual outcome is estimated matching on control households that live in a region where food prices are higher, the estimated treatment effect may result positive just because of local price differences. Accordingly, in the assessment of the overall impact of international migration on households' FNS the sample has been split into four strata on the basis of the regional food poverty lines provided by the Bangladesh Bureau of Statistics (BBS, 2012) and the matching has been performed within each stratum. The final results are then computed by adding up the estimates of each stratum and by re-estimating the standard errors for the entire population. This procedure allows to properly address part of the heterogeneity stemming from households' non-specific identifying features and to estimate the *lps* on the households' individual characteristics only.

The within-strata matching procedure has not been implemented in the second part of the empirical analysis, i.e. the assessment of the impact of different microeconomic transmission channels, because of the lack of adequate proportions of treated units within each stratum. In this case, the empirical assessment is carried out by performing matching on the entire sample and the problem of non-specific identifying features is partially addressed by including regional dummies among the covariates. Even though this is the standard procedure in the literature (cf. Bertoli and Marchetta, 2014; Möllers and Meyer, 2014; Jimenez-Soto and Brown, 2012), it should be acknowledged as a second-best solution. Since this limitation can lead to distortions caused by the spatial differences in price levels, the outcome variables based on food expenditures have not been used in the analysis aiming at disentangling the effect of the various transmission mechanisms.

5.3. Choosing the Conditioning Variables

The choice of covariates used to estimate the balancing score is a crucial step of the estimation strategy, since they represent the variables that are supposed to ensure the conditional independence

[15] The computation of *lps* requires propensity scores that can be estimated either by a logit or a probit model. In our analysis, we used the latter (cf. Tables A.1 and A2 in the Appendix) because it provides slightly better fit and overlapping.

of potential outcomes and, therefore, to overcome the methodological issues typical of microeconomic empirical studies on migration (Adams, 2011). In order to be eligible, a variable (*i*) needs to influence both the probability of migration and the outcome variable but, at the same time, (*ii*) should not be itself influenced by the treatment (Caliendo and Kopeinig, 2008). As a general rule of thumb, a variable can be considered exogenous if its value is determined before the exposition to the treatment.

Building on existing literature (Cox-Edwards and Oreggia, 2009; Jimenez Soto and Brown, 2012; Bertoli and Marchetta, 2014), the set of conditioning covariates X includes six variables meant to describe the demographic structure of the household, two variables describing the educational attainment of the adult members and a set of other five variables related to household religion, non-agricultural business activities, land assets, access to the electricity network and urban/rural status (Tables A.1 and A.2). In order to avoid matching distortions, all variables related to education and to household demographic composition are corrected for taking into account any eventual migrant member. Following Zanutto (2006), also sample weights are included in the specification of the probit model.

The final specification of the probability model partially departs from previous works that employed matching methods in the context of migration studies. On the one hand, in order to be fully consistent with the NELM approach, the model emphasizes the importance of the household structure when it comes to migration decisions by including six pre-treatment variables describing the demographic structure of the household. On the other hand, the specification excludes some demographic variables that have been employed in previous works but raise concerns regarding their exogeneity. For example, departing from Bertoli and Marchetta (2014) and Möllers and Meyer (2014), age dependency ratio is not included because migration is likely to influence household's fertility choices and, in turn, the ratio itself. For the same reason, no information on children below the age of six is included. The education attainment of male and female adults, both included in the *lps* specification, are two reasonably exogenous pre-treatment variables and are correlated with the pre-migration economic status of the household and with the individual ability of the members. Conversely, the educational level of younger members has not been taken into account because of its potential endogeneity.

The specification also includes two pre-treatment dummy variables indicating the household's involvement in either formal or informal business in the non-agricultural sector.[16] These variables are correlated with the pre-migration economic status of the household and, very likely, with some

[16] In the case of migrant households, the dummies take value 1 only if the business was already running before migration.

unobservable characteristics of the household head conditioning the economic behavior (and therefore the economic outcome) of the households (Welter, 2011). The households' assets could be considered endogenous to migration but, given the shallow land market in Bangladesh (Mendola, 2008), the 'landless dummy' can be considered a proxy for households' pre-migration income.

Finally, departing from Möllers and Meyers (2014), Jimenez-Soto and Brown (2012) and Calero *et al*. (2009), the matching covariates do not include any variable directly related to the household head. Indeed, even though some characteristics of the head may well influence the household's choices, the headship is endogenous to migration and matching on household head characteristics would be misleading. In fact, female-headed household are significantly more frequent among migrant households but, at the same time, almost all migrants are male and one out of three is registered as husband of the head, suggesting that the headship shifted to the wife after the husband's migration.

A last comment is in order about the specification of the probit model for treatment 'C' (presence of returned migrants), that also includes the household-level per capita expenditure. Such inclusion is justified by the fact that the treatment group 'C' is related to a different stage of the migration process and without conditioning for the level of per capita expenditure the treatment effect would have captured the long term cumulative effect of migration, possibly remittances and presence of returnees rather than only the latter. It should be noted that only in this case, given the definition of treatment 'C', the expenditure can be considered exogenous to the treatment.

5.4. Robustness Checks

Matching estimates based on a balancing score are robust only if the score itself is effectively able to ensure an adequate balance in the distribution of the covariates among the treatment and the matched control groups. Table 5 reports some post-estimation statistics. After matching, both the mean and median bias of the covariates are significantly reduced. Specifically, the mean bias is always below the five percent threshold except for stratum number 4, in which it decreases from 24.0 to 6.8 percent. However, in the case of the overall impact analysisit has been necessary to drop 40 observations (2.8 percent of the treated households) in order to reach a satisfactory level of balance. Following Sianesi (2004), in order to test for the orthogonality of the treatment and the covariates, Table 5 also reports the pseudo-R^2 and the p-value of the likelihood ratio test for joint significance of the coefficients of the probit regression on matched and unmatched samples. In all cases, the goodness

of fit of the matched probit is not substantially different from zero and the hypothesis of joint significance is always rejected[17].

For the sake of computational easiness, the counterfactual scenario has been estimated employing a nearest neighbor matching (NNM) caliper estimator ($n = 3$) with replacement, the caliper being approximately 0.1 standard deviations of the *lps*. All results prove to be robust to different specification of the same estimator ($n = 1, 2, 4$) and to a radius estimator.

Table 5. Robustness checks

Overall impact						
Stratum	Sample	Mean Bias	Median Bias	Pseudo-R2	LR test	Out of common support
1	Before matching	28.1	25.7	0.211	0.000	5 out of 225
	After matching	4.9	5.8	0.012	0.953	
2	Before matching	24	22.3	0.189	0.000	8 out of 428
	After matching	3.4	3.3	0.006	0.966	
3	Before matching	29	25	0.25	0.000	21 out of 554
	After matching	3	1.9	0.004	0.985	
4	Before matching	24	20.2	0.229	0.000	6 out of 238
	After matching	6.8	7.2	0.016	0.752	
Impact of microeconomic transmission channels						
Treatment group	Sample	Mean Bias	Median Bias	Pseudo-R2	LR test	Out of common support
A	Before matching	28.8	24.9	0.252	0.000	0 out of 153
	After matching	4.9	3.7	0.014	0.999	
B	Before matching	14	10	0.065	0.000	0 out of 154
	After matching	2.9	2.2	0.004	0.999	
C	Before matching	23.2	20.6	0.103	0.000	0 out of 122
	After matching	4.5	4.5	0.018	0.999	
A∩B	Before matching	25.8	20.6	0.271	0.000	1 out of 952
	After matching	2.7	1.9	0.005	0.926	

Source: Authors' calculation on HIES (2010) data.

[17] Figure A.1 and A.2 in the Appendix provide a visual assessment of the matching procedure in the case of the four blocks of the overall impact analysis and in that of the four treatment states in the analysis aiming at disentangling the aggregate impact of migration, respectively.

6. Results

6.1. Aggregate Impact of International Migration on Household FNS

This section reports and discusses the estimates of the overall impact of international migration on household FNS. The results are largely consistent with previous findings (Azzari and Zezza, 2011; Ngouyen and Winters, 2011) and indicate that international migration produces a positive and statistically significant impact on all six indicators considered in the study (Table 6). Specifically, migrant households' diet increases both in terms of quantity (+276 kcal/day per capita, +11.9 percent in relative terms) and in terms of variety (normalized Shannon and Gini-Simpson indexes rise from 72.44 to 75.77 and from 77.05 to 79.99, respectively). The impact of international migration on food expenditure is qualitatively similar though higher in terms of total amount than in terms of variety.

Table 6. ATET of international migration on household food and nutrition security

FNS Indicator	Observed	Counter-factual	ATET	% change	Standard Error	p-value
Caloric intake						
P.c. caloric intake (kcal)	2587	2312	276	11.9%	34.41	0.000
Norm. Shannon Index (caloric intake)	59.48	53.19	6.29	11.8%	0.51	0.000
Gini-Simpson index (caloric intake)	54.71	48.80	5.91	12.1%	0.45	0.000
Food expenditure						
P.c. food expenditure (taka)	55.85	44.84	11.01	24.6%	1.07	0.000
Norm. Shannon Index (food exp.)	75.77	72.44	3.33	4.6%	0.39	0.000
Gini-Simpson index (food exp.)	79.99	77.05	2.94	3.8%	0.28	0.000

Note: S.E. do not take into account that *lps* is estimated.
Source: Authors' calculation on HIES (2010) data.

From a FNS viewpoint, these results indicate that international migration allows households to consume more food and to have access to a more diversified diet. In addition, consistently with consumption theory, they suggest that also the average quality of food increases. In fact, the percentage increase in per capita food expenditure (+24.6 percent) turns out to be larger than the corresponding increase in caloric intake. This indicates that on average migrant households shift their consumption towards superior food goods. However, since the ATET refers to an unweighted basket of different goods, this last point can be consistently assessed only by comparing the changes within each food category that is estimating food category specific ATETs (Tables 7 and 8).

The estimation of the overall impact of international migration on the consumption of specific food-item groups gives a deeper insight into the changes in migrant households' dietary habits. In general, caloric intake significantly increases for all categories except inferior goods, such as 'Food

grains', and 'Dining out' (Table 7).[18] Notably, the three largest increases in food consumption indicate a switch towards animal protein rich foods such as 'Milk & Dairy' (+75.2 percent), 'Meat' (+66.7 percent) and 'Eggs' (+56.7 percent). 'Food grains' remain, by far, the primary source of calories, recording a modest increase in the quantity consumed (+4.0 percent) but decreasing their relative share in the average households' food basket by 4.9 percentage points. Finally, also the changes in the consumption of vitamin-rich foods and fats, like 'Vegetables' (+15.5 percent), 'Fruits' (+33.0 percent) and 'Oil & Fats' (+35.9 percent), reveal a significant increase in the intake of fundamental vitamins and micro-nutrients.

The impact of international migration on item-wise food expenditure (Table 8) largely mirrors the one on caloric intake. More precisely, the impact is always positive except for 'Dining out' and 'Tobacco and Tobacco products', whose ATET exhibit a negative sign although the latter is not significant at conventional confidence levels.[19] In relative terms, 'Meat', 'Milk and Dairy' and 'Fruits' are the food items showing the highest increase.

Comparing the effect on caloric intake with the effect on food expenditure provides interesting insights regarding the changes in the quality of food consumed by migrant households. In fact, the difference between the percentage changes in expenditure and in quantity approximates the percentage change in the prices of the products, which can be used as a proxy for changes in the average quality of each food item consumed by the household. The analysis of change in the quality of consumed food confirms the intuition behind the comparison of the two 'aggregated' treatment effects. For example, migrant households shift their consumption toward more expensive varieties of 'Fruits' and 'Pulses' products whose average prices are 15.4 percent and 14.4 percent higher than those of non-migrant households, respectively.[20]

[18] The interpretation of this results is difficult in absence of more specific information on household eating behavior. However, considering that 98.3 percent of migrants are males (and in at least 36.6 percent of the cases the male migrant is the former household head) and the cultural Bangladeshi environment, we tend to interpret this as a consequence of the fact that male migration translates into a reduced opportunity to go out for the rest of the family, especially for women. Also, the negative effect of consumption of tobacco products, typically consumed by male adults, can be interpreted along similar lines.

[19] Other food items whose impacts result to be not statistically significant are 'Sweetmeat', 'Drinks' and 'Miscellaneous Food'.

[20] However, a word of caution in drawing these conclusions is needed because the standard errors are not available.

Table 7. Food-specific ATETs of international migration on household food intake (kcal/day)

Food item	Observed		Counterfactual		% change	ATET	Standard Error	P- value
	Absolute value (kcal)	As % of total intake	Absolute value (kcal)	As % of total intake				
Food Grains	1663.1	64.3%	1599.4	69.2%	4.0%	63.7	23.4	0.007
Pulses	64.4	2.5%	56.6	2.4%	13.7%	7.8	2.2	0.000
Fish	95.8	3.7%	72.5	3.1%	32.2%	23.3	2.2	0.000
Eggs	14.4	0.6%	9.2	0.4%	56.7%	5.2	1.0	0.000
Meat	35.7	1.4%	21.4	0.9%	66.7%	14.3	2.0	0.000
Vegetables	176.0	6.8%	152.4	6.6%	15.5%	23.6	2.9	0.000
Milk & Dairy	45.2	1.7%	25.8	1.1%	75.2%	19.4	2.0	0.000
Sweetmeat	14.7	0.6%	10.2	0.4%	44.3%	4.5	1.4	0.002
Oil & Fats	253.4	9.8%	186.5	8.1%	35.9%	67.0	5.1	0.000
Fruits	41.9	1.6%	31.3	1.4%	33.8%	10.6	2.2	0.000
Drinks	2.8	0.1%	1.9	0.1%	52.1%	1.0	0.3	0.003
Sugar & Molasses	70.2	2.7%	47.2	2.0%	49.0%	23.1	2.9	0.000
Miscellaneous Food	2.8	0.1%	1.6	0.1%	71.8%	1.2	0.3	0.000
Dining out (Food outside)	22.8	0.9%	27.4	1.2%	-16.8%	-4.6	2.2	0.038
Spices	74.2	2.9%	59.7	2.6%	24.3%	14.5	1.5	0.000
Betel leas & Chewgoods	10.0	0.4%	8.6	0.4%	16.2%	1.4	0.5	0.006

Note: S.E. do not take into account that *lps* is estimated.
Source: Authors' calculation on HIES (2010) data.

Table 8. Food-specific ATETs of international migration on household food expenditure (Taka/day)

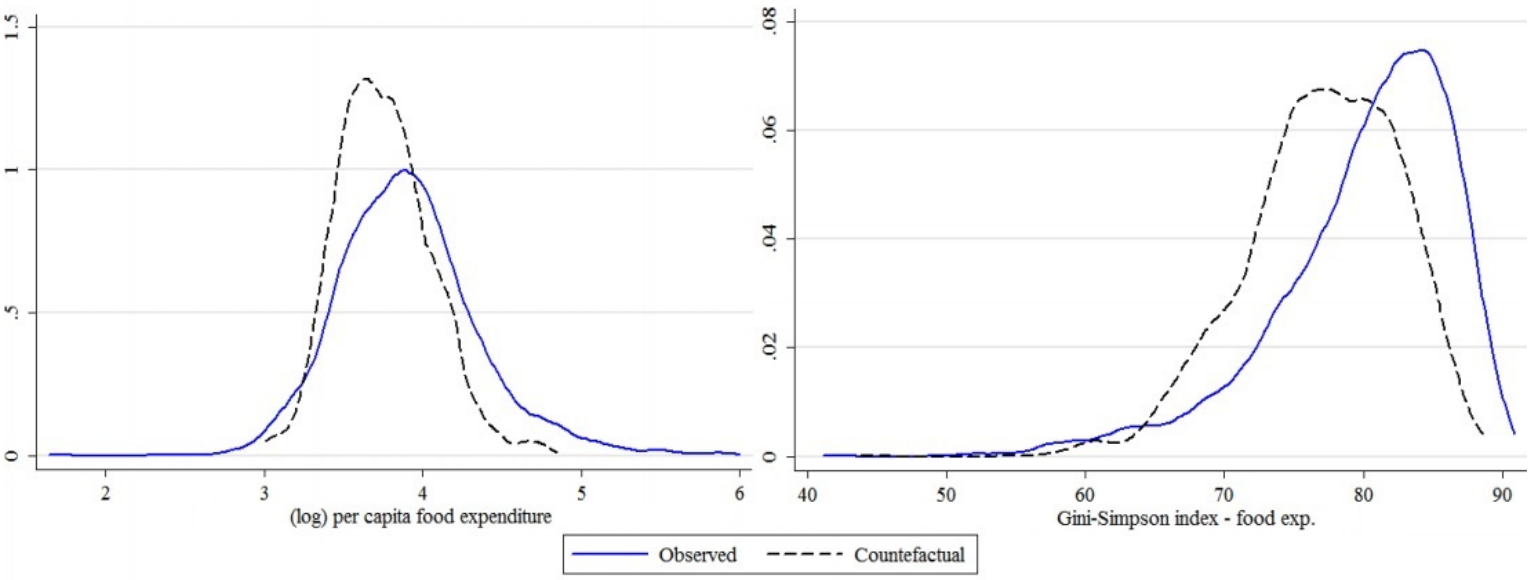
Food item	Observed			Counterfactual			% change	ATET	Standard Error	P- value
	Absolute value (tk)	As % of food exp.	As % of total exp.	Absolute value (tk)	As % of food exp.	As % of total exp.				
Food Grains	16.68	29.9%	13.6%	15.67	34.9%	18.3%	6.5%	1.01	0.08	0.000
Pulses	1.51	2.7%	1.2%	1.18	2.6%	1.4%	28.1%	0.33	0.09	0.000
Fish	9.08	16.3%	7.4%	6.63	14.8%	7.7%	36.9%	2.45	0.08	0.000
Eggs	1.03	1.9%	0.8%	0.70	1.6%	0.8%	47.6%	0.33	0.10	0.000
Meat	5.97	10.7%	4.9%	3.58	8.0%	4.2%	66.9%	2.39	0.01	0.000
Vegetables	4.21	7.5%	3.4%	3.47	7.7%	4.0%	21.4%	0.74	0.04	0.000
Milk & Dairy	2.31	4.1%	1.9%	1.28	2.9%	1.5%	80.4%	1.03	0.04	0.000
Sweetmeat	0.41	0.7%	0.3%	0.34	0.8%	0.4%	22.6%	0.08	0.14	0.588
Oil & Fats	2.59	4.6%	2.1%	1.93	4.3%	2.2%	34.3%	0.66	0.05	0.000
Fruits	2.91	5.2%	2.4%	1.95	4.3%	2.3%	49.2%	0.96	0.05	0.000
Drinks	0.56	1.0%	0.5%	0.38	0.8%	0.4%	48.0%	0.18	0.10	0.074
Sugar & Molasses	0.94	1.7%	0.8%	0.64	1.4%	0.7%	47.6%	0.30	0.08	0.000
Miscellaneous Food	0.11	0.2%	0.1%	0.06	0.1%	0.1%	76.4%	0.05	0.37	0.895
Dining out (Food outside)	1.19	2.1%	1.0%	1.43	3.2%	1.7%	-16.9%	-0.24	0.05	0.000
Tobacco & Tobacco products	0.76	1.4%	0.6%	1.07	2.4%	1.2%	-29.2%	-0.31	0.23	0.171
Spices	4.28	7.7%	3.5%	3.37	7.5%	3.9%	26.8%	0.90	0.05	0.000
Betel leas & Chewgoods	1.32	2.4%	1.1%	1.18	2.6%	1.4%	12.2%	0.14	0.24	0.551

Note: S.E. do not take into account that *lps* is estimated.
Source: Authors' calculation on HIES (2010) data.

The empirical findings are relevant considering the well-established relation between an adequate intake of micro-nutrients, vitamins and proteins and physical growth, mental development and general health status of household members (Hoddinott and Yohannes, 2002; Arimond and Ruel, 2004; Headey, 2013), and of children and pregnant women in particular. On a more general ground, they contribute to the development literature by providing further evidence of the positive effect of international migration on household FNS (Azzari and Zezza, 2011; Ngouyen and Winters, 2011; Karamba *et al.*, 2011). On a more context-specific level, these results also contribute to shed some light in explaining the 'Bangladesh paradox' (Chowdhury *et al.*, 2013). In fact, through its effect on household FNS, international migration may have contributed to the remarkable improvements in the health status of Bangladeshi population despite a relatively sluggish economic growth.

Finally, Figure 1 provides a visual comparison between the observed and the counterfactual distributions of migrant households' per capita food expenditure (left panel) and the Gini-Simpson index calculated on food expenditure (right panel). On the one hand, it clearly shows how migration, contributes to an increase in household FNS by shifting both distributions to the right. On the other hand, it reveals the risky nature of an investment in international migration. Indeed, even though the two distributions shift to the right, they have (slightly) fatter left tails, indicating that for some households migration 'went wrong' and induced a deterioration of households' FNS.

Figure 1. Distribution of (log) per capita caloric intake (left panel) and Gini-Simpson index (right panel)



6.2. Microeconomic Transmission Channels Linking International Migration to Household FNS

Disentangling the overall impact is useful to assess the relative importance of the various microeconomic transmission channels through which international migration affects household FNS (Table 9).

Having a member currently abroad and receiving remittances (treatment group 'A ∩ B') is, by far, the most frequent case (cf. Table 4). As expected, this treatment turns out to produce a positive and statistically significant effect on both the quantity and the variety of the food consumed by household members. Specifically, the households exposed to this treatment are those that exhibit the highest increase in per capita caloric intake, both in relative and absolute terms. With a double-digit increase, also the effect on dietary diversity is substantial.

The second most numerous treatment group consists of households that receive remittances from abroad although they have no current or past experience of migrant members (treatment group 'B'). Since in this case the treatment consists in a simple income transfer, the sign of the ATET is expected to be non-negative. The signs of the treatment effect are indeed positive but, while the impact is statistically significant for the indicators of diet variety, the impact turns out to be not significant for per capita caloric intake. This result can be partly explained by the relatively high level of caloric intake estimated in the counterfactual scenario: if the counterfactual level of caloric intake is already adequate, it may be that these households would prefer to use part of their additional income changing their own diet rather than just eating more than they used to. Secondly, it has to be considered that the average value of the remittances received by this group of households is on average lower (about one third) than the value received by households belonging to the 'A ∩ B' group. Thirdly, since these remittances come from friends or relatives who are outside the inner circle of the household, it is more likely that they are not sent on a regular basis. In fact, it is conceivable that *una tantum* transfers, made for specific reasons (e.g. a gift, debt repayment), are used by the recipient household for purposes other than food consumption.

Group 'A' is the third treatment group in terms of size and consists of those households that currently have some members abroad but no returnees and do not receive remittances. The effect of this treatment is not statistically significant in terms of per capita caloric intake[21] but it is positive and strongly significant for the normalized Shannon and the Gini-Simpson indexes. These findings

[21] Removing the 5th percentile cut-off threshold for remittances, the impact of migration turns out to be positive and significant. This is the only result that failed to pass the sensitivity test of the cut-off threshold.

suggest that a standalone change in household's internal hierarchies is enough to produce, on average, a positive tangible effect on dietary diversity, a proxy for the utilization dimension of FNS.

The last group (treatment group 'C') comprises those households that have been exposed in the past to international migration but, at the time of the survey, do not have any migrant member abroad and do not receive remittances. Consistently with the theoretical framework, the presence of returned migrants does not produce any significant impact on per capita caloric intake but significantly increases the dietary diversity, again a tangible effect on the utilization dimension likely due to the new knowledge/information brought back home by the returnees.

In general, even though the nature of the data does not always allow a full identification of every effect, the findings are largely consistent with the conceptual framework. For example, it is remarkable that, in accordance with the theory, the 'pure' migration effect (treatment 'A') and the effect of returned migrants (treatment 'C') influence only dietary diversity, somehow confirming the significance of the effect on the utilization dimension due to the change in household composition and to the presence of retuned migrants. The above results are relevant because they provide the first empirical evidence of the various microeconomic channels linking international migration to household FNS that so far had been only theoretically envisaged.

Table 9. Estimates of the various ATETs

Treatment group	Observed	Counterfactual	ATET	% change	P-value
		Per capita caloric intake			
A. Migrants	2456	2402	54	2.25%	0.548
A∩B. Migrants & Remittances	2643	2282	361	15.82%	0.000
B. Remittances	2503	2394	109	4.54%	0.171
C. Returnees	2412	2350	62	2.63%	0.354
		Normalised Shannon index (caloric intake)			
A. Migrants	61.77	52.63	9.14		0.000
A∩B. Migrants & Remittances	59.25	51.65	7.62		0.000
B. Remittances	57.66	54.60	3.05		0.010
C. Returnees	60.17	57.07	3.10		0.024
		Gini-Simpson index (caloric intake)			
A. Migrants	56.86	48.10	8.76		0.000
A∩B. Migrants & Remittances	54.57	47.31	7.28		0.000
B. Remittances	52.84	50.58	2.26		0.028
C. Returnees	54.84	52.35	2.49		0.041

Note: S.E. do not take into account that *lps* is estimated.
Source: Authors' calculation on HIES (2010) data.

7. Conclusions

This paper contributes to the migration literature analyzing the linkages between migration and household FNS. After providing a conceptual framework for interpreting how international migration can affect household food security, the paper empirically estimates the overall impact of international migration on Bangladeshi households' FNS using a within-strata matching estimator based on the linearized propensity score. Then, by disentangling this overall effect and relying on the multiple-treatment counterfactual framework, it assesses the impact of the various microeconomic transmission channels described in the theoretical framework.

The estimation of the overall effect indicates that international migration produces on average a significant and positive impact on all FNS dimensions, enhancing household food availability, access and utilization. Specifically, the analysis shows that thanks to international migration households have access to a more expensive, more diversified, calorie-richer and higher quality diet. In addition, the item-wise disaggregation of the treatment effect shows that the increase in migrant households' food consumption is concentrated on products richer in animal proteins and micro-nutrients and, in general, on higher quality products.

The assessment of the impacts of microeconomic transmission channels on the various dimensions of FNS is consistent with the conceptual framework expectations and indicates that the average effect of international migration on household FNS is always non-negative.

The findings of the paper are relevant for at least two reasons. First, given the prominence of the FNS problem in the development agenda and the growing importance of international migration, a better understanding of the linkages between these two issues can have meaningful policy implications. On one hand, the analysis suggests that policies aimed at favoring international migration (and remittances) may produce important spillover effects on the FNS of migrants' households in their home countries. On the other hand, since the migrant households are positively self-selected, information regarding the migration status of the households may be used as 'negative' targeting criterion for pro-poor FNS policies.

With specific reference to Bangladesh, the findings can contribute to shed some further light on the 'Bangladesh paradox'. Indeed, recalling the linkages between FNS and several important health outcomes, the proven positive effect of international migration on household FNS suggest international migration as an important determinant of Bangladesh's remarkable improvements in health indicators that took place during a period characterized by a relatively weak domestic economic growth.

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Appendix

Table A1. Probit regression results (within-strata)

Dep var: Migrant	Block 1	Block 2	Block 3	Block 4
Adults 18-45 (male)	0.418***	0.648***	0.523***	0.626***
	(0.0547)	(0.0440)	(0.0387)	(0.0573)
Adults 46-65 (male)	0.412***	0.354***	0.390***	0.488***
	(0.0887)	(0.0675)	(0.0654)	(0.0949)
Adults 18-45 (female)	-0.111	-0.116**	0.0223	-0.0745
	(0.0715)	(0.0546)	(0.0490)	(0.0767)
Adults 46-65 (female)	0.067	0.124*	0.233***	0.199**
	(0.0938)	(0.0667)	(0.0671)	(0.100)
Elders (65+)	0.223**	0.310***	0.165**	0.246**
	(0.0876)	(0.0605)	(0.0689)	(0.115)
Kids 6-17	0.0844**	0.0194	0.0454*	0.0679*
	(0.0346)	(0.0267)	(0.0250)	(0.0401)
Schooling (males)	-0.0554***	-0.0768***	-0.0623***	-0.118***
	(0.0128)	(0.00965)	(0.00829)	(0.0124)
Schooling (females)	0.0746***	0.0587***	0.0830***	0.118***
	(0.0149)	(0.0108)	(0.00978)	(0.0141)
Muslim	1.020***	0.502***	0.679***	0.426**
	(0.176)	(0.140)	(0.101)	(0.169)
Entrepreneurship (formal)	-0.073	-0.401**	-0.591***	-1.030***
	(0.164)	(0.156)	(0.126)	(0.202)
Entrepreneurship (informal)	-0.583***	-0.539***	-0.536***	-0.374***
	(0.126)	(0.0895)	(0.0898)	(0.124)
Access to elec. network	0.575***	0.479***	0.699***	0.409***
	(0.0937)	(0.0600)	(0.0756)	(0.157)
Sample weights	-0.000566***	-0.000392***	-0.00131***	-0.0000548***
	(0.000120)	(0.0000674)	(0.000226)	(0.0000174)
Urban	-1.456***	-1.330***	-3.292***	Omitted
	(0.226)	(0.288)	(0.430)	
Landless	-0.591*	-0.247	-0.281*	-0.453***
	(0.305)	(0.191)	(0.153)	(0.152)
Constant	-1.642***	-1.435***	1.347**	-2.467***
	(0.383)	(0.269)	(0.668)	(0.254)
Number of observations	2479	4817	3318	1620
McFadden's pseudo R2	0.211	0.189	0.25	0.229
Log Likelihood	-595.4	-1170.8	-1122.1	-521

Notes: Standard errors in parentheses; * p<0.1,** p<0.05, *** p<0.01; Migrant members characteristics are taken into account to compute the covariates; Entrepreneurship variables activate only if the business was already running before migration.
Source: Author's calculation.

Table A2. Probit regression results (binary comparisons)

	A. Migrants only	B. Remittances only	A∩B. Migrant & Remittances	C. Returnees only
Adults 18-45 (male)	0.520*** (0.0472)	-0.136** (0.0554)	0.645*** (0.0274)	0.161*** (0.0522)
Adults 46-65 (male)	0.468*** (0.0852)	-0.033 (0.0779)	0.452*** (0.0447)	0.0408 (0.0832)
Adults 18-45 (female)	-0.129** (0.0642)	0.0337 (0.0616)	-0.111*** (0.0346)	0.0266 (0.0673)
Adults 46-65 (female)	0.149* (0.0872)	0.0175 (0.0799)	0.196*** (0.0452)	-0.0313 (0.0895)
Elders (65+)	0.191** (0.0850)	0.143** (0.0713)	0.251*** (0.0444)	0.125 (0.0825)
Kids 6-17	0.0209 (0.0328)	0.0127 (0.0295)	0.0684*** (0.0173)	0.00621 (0.0329)
Schooling (males)	-0.0857*** (0.0123)	-0.0158* (0.00943)	-0.0929*** (0.00626)	0.00294 (0.0109)
Schooling (females)	0.0881*** (0.0134)	0.0447*** (0.0111)	0.0814*** (0.00694)	0.0412*** (0.0130)
Muslim	0.477*** (0.147)	0.381*** (0.128)	0.672*** (0.0820)	0.311** (0.134)
Entrepreneurship (formal)	-0.489*** (0.183)	0.0018 (0.132)	-0.584*** (0.0955)	-0.191 (0.151)
Entrepreneurship (informal)	-0.619*** (0.134)	0.0214 (0.0849)	-0.758*** (0.0690)	0.0602 (0.0910)
Access to elec. network	0.513*** (0.0932)	0.277*** (0.0791)	0.512*** (0.0471)	0.358*** (0.0968)
Sample weights	-0.0000838** (0.0000388)	-0.000166*** (0.0000504)	-0.0000453** (0.0000179)	0.0000315 (0.0000255)
Urban	-0.420*** (0.104)	-0.416*** (0.119)	-0.297*** (0.0506)	-0.152* (0.0853)
Regional dummies	Yes	Yes	Yes	Yes
Landless	-0.0605 (0.173)	-0.360* (0.185)	-0.370*** (0.104)	-0.500** (0.209)
P.c. expenditure				0.000289 (0.000397)
Constant	-3.200*** (0.230)	-2.199*** (0.230)	-2.827*** (0.120)	-3.194*** (0.203)
Number of observations	10942	10943	11741	10912
McFadden's pseudo R2	0.252	0.0646	0.271	0.103
Log Likelihood	-602	-757.2	-2409.2	-604.3

Notes: Standard errors in parentheses; * p<0.1,** p<0.05, *** p<0.01; Migrant members characteristics are taken into account to compute the covariates; Entrepreneurship variables activate only if the business was already running before migration.
Source: Authors' calculation.

Figure A1. Distribution of *lps* (block-wise)

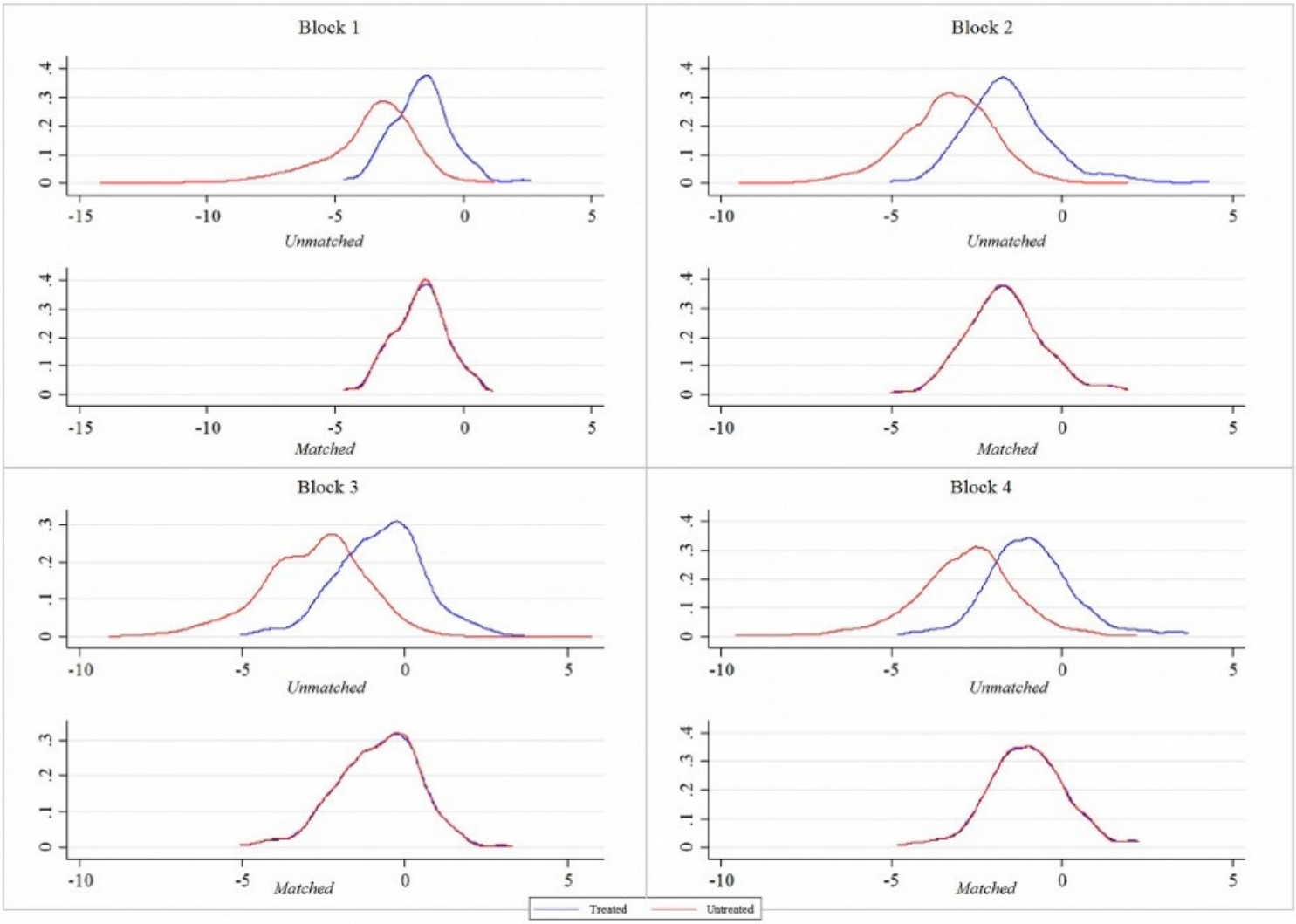

Figure A2. Distribution of *lps* (group-wise)