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On the effects of trade on multidimensional deprivation: Evidence from Vietnam's rice growing households

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ABSTRACT

Welfare and poverty are multidimensional in nature. However, empirical research on the impacts of trade liberalisation on multidimensional welfare is rare. This paper provides one of the first empirical analyses of the impact of trade liberalisation on multidimensional deprivation of rice farmers utilising data from the six waves of the Vietnam Household Living Standard Surveys. Our empirical model captures the direct effects of incomes from farm and non-farm activities and indirect effects of employment, rice price levels, rice production and domestic trade. Results unveil several important new findings which have policy implications. A higher level of export openness is correlated with higher levels of income from farming and non-farm activities. Higher income levels appear to reduce multidimensional deprivation but working in export-oriented industries increases it. Farmers selling rice to domestic private traders generate higher income than those selling to government-owned trading companies. Regional farming productivity, the scale of rice production, crop diversification, and education help increase income and reduce deprivation.

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1. Introduction

Empirical literature relating to the impacts of trade liberalisation on income poverty is rich (Winters et al., 2004; Winters and Martuscelli, 2014). Many studies using household data have established substantial evidence that trade liberalisation could increase output prices, expand access to markets, reduce import prices, lower trade costs, create more employment with higher wages, as well as deliver higher total factor productivity (Aksoy and Hoekman, 2010; Minot et al., 2010; Nicita et al., 2011). These impacts, if they work in the favour of the more disadvantaged groups, could help reduce poverty.

However, poverty is a multidimensional concept (Nussbaum and Sen, 1995; Alkire and Santos, 2014). Alkire and Santos (2014) suggesting that multidimensional deprivation analysis complements income analyses by bringing information from a different angle and which focuses directly on actual deprivation. In the context of Vietnam, for example, Mahadevan and Hoang (2016) examining data from the Vietnam Household Living Standard Surveys (VHLSS) and report that around 20 per cent of those families that are *not* classified as income poor are in fact **very deprived** in terms of multidimensional living conditions and quality. Similarly, 42 per cent of families that are *not* classified as poor from the income perspective are

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in fact close to being multidimensionally deprived. In their study, more than ten dimensions of living standards including housing qualities, access to various utility services such as water, power and self-assessed food security are captured in their measurement of multidimensional deprivation. So, for Vietnam, using only income analysis would not reveal the actual status of multidimensional poverty. Whilst empirical research in multidimensional poverty and deprivation has been growing rapidly, our literature review shows that none has a focus on the impacts of trade liberalisation on multidimensional poverty. We aim to fill in this gap by providing an empirical investigation relating to rice farming in Vietnam.

Analysis of the impacts of trade liberalisation on multidimensional deprivation in the rice sector is particularly important in the context of Vietnam for several reasons. First, this country is seen as the success story of trade liberalisation with many empirical studies showing the positive impacts of trade liberalisation on growth and poverty reduction (see [Magrini et al. \(2018\)](#) for a list of studies). Second, Vietnam's rice sector has been the primary driver of the substantial transformation of Vietnam's rural economy since this country started its "Doi Moi" (Reform) program in 1989. This sector has experienced the largest expansion in terms of production and export volumes over many decades between the late 1980s and early 2010s. The total production volume reached its peak in 2016 at over 45 million tons compared with less than 19 million tons in 1989. However, the total volume and value of rice exports have been fluctuating over many decades, due to many reasons including export price fluctuations, export quotas imposed due to domestic food security policies as well as increased international competition from other economies ([Coxhead et al., 2012](#); [Ha et al., 2015](#)). Regardless of a recent reduction in production and export levels in recent years, Vietnam's rice sector in its earlier phases of opening the economy to the world, experienced a relative higher level of international economic integration in comparison with other sectors of the economy.

Another reason why Vietnam's rice sector poses an interesting case for this research is that Vietnam has achieved remarkable outcomes in reducing income poverty, especially in the rural areas where most rice farmers are located. Previous literature indicates that whilst trade liberalisation in Vietnam could have had an overall positive impact on the welfare of households in rural areas ([Le, 2014](#); [Ha et al., 2015](#)), the global price shock worsened the welfare of farmers ([Coxhead et al., 2012](#)). Interestingly, [Hoang et al. \(2016\)](#) report that even a substantial exogenous increase in the prices of rice between 2006 and 2008 did not help reduce poverty among rural households. Recently [Magrini et al. \(2018\)](#) show that trade exposure and the risks related to trade exposure could have negative impacts on household vulnerability even in the absence of actual negative shocks.

Based on these strands of literature, it is crucial to establish empirical evidence on the overall impact of trade liberalisation on the multidimensional aspects of deprivation of Vietnamese rice farmers. In doing so, our paper extends the existing empirical literature on the Vietnamese rice sector in several important directions. First, instead of using unidimensional measures of a household's welfare such as income or expenditure, we use a multidimensional deprivation status constructed through the framework of latent class modelling (LCM). The use of multidimensional deprivation as described in Section 3 is a more sensible way to measure the multidimensionality of household welfare. Second, to assess the impact of trade liberalisation on multidimensional deprivation, we use a maximum likelihood estimator for the ordered probit model. Specifically, we use a conditional mixed process (CMP) estimator because of its ability to deal with the endogeneity issue relating to income sources and their associated determinants ([Roodman, 2011](#)). More importantly, the CMP model helps us examine the impacts of various aspects of trade liberalisation on multidimensional deprivation through their impacts on two sources of household income: farm and non-farm incomes. Last, to check for robustness of the relationship over the long term, VHLSS data from 2002 to 2012 are used to construct six panel datasets, making the richest data used in Vietnamese rice studies.

The paper is structured as follows: Section 2 presents the empirical model and framework for the possible channels through which trade liberalisation can affect poverty and household welfare and outlines the methodology used in the analysis. Section 3 reports the empirical results and provides a discussion of them and Section 4 provides conclusions.

2. Literature review on the impact of trade liberalisation on household welfare

Trade-induced effects can be traced through four main channels: (1) the economic growth channel, (2) the price channel – the impact on household's earnings through both output and production factor markets, (3) the employment channel, and (4) the fiscal channel – the impact on the public sector (changes in government's revenue and spending) ([Winters, 2002](#)). Most cross-country studies have focused on the first channel while household-level studies have concentrated on second and third channels. Given the rich literature we restrict our review to those studies on Vietnam.

In terms of the price channel, previous studies have examined the impact of the rice price in Vietnam in the 1990s. [Minot and Goletti \(1998\)](#) applied a spatial-equilibrium model to capture interaction among regions given the regional diversity of Vietnamese agriculture. They found that trade policy reforms such as relaxing or removing rice export quotas and fertiliser import quotas increased farm-gate and retail prices and therefore improved income and slightly decreased poverty incidence. [Justino et al. \(2008\)](#) found empirical evidence for the significant contribution of increases in the retail rice price to household's consumption expenditure and thereby reducing the level of poverty. [Niimi et al. \(2004\)](#) showed a similar link between gradual trade liberalisation during the 1990s with the poverty reduction and household welfare enhancement.

Regarding the employment channel, the Heckscher–Ohlin (H–O) theory predicts that freer trade would lead a developing country with abundant unskilled labour and scarce skilled labour to specialise in a sector that uses its

unskilled labour intensively and then raises labour demand in the sector that intensively uses skilled labour. Also, Stolper–Samuelson's (S–S) theorem (1941) argued that the increase in relative output prices of unskilled-labour-intensive goods relative to skilled-labour-intensive goods would translate into increased relative wages of unskilled labour, reducing the wage gap between the two groups of workers. [Goldberg and Pavcnik \(2007\)](#) found that this theory was inconsistent with empirical data in many developing countries which experienced increased rather than decreased skill premiums after the implementation of trade liberalisation. However [Fukase \(2012\)](#) demonstrated the existence of the S–S type effect in Vietnam with respect to the Vietnam–US bilateral trade agreement in 2001.

According to [Fukase \(2012\)](#), provinces exposed to increased export opportunities would experience a larger wage growth for unskilled workers and a decline (or smaller growth rate) in the relative wage of skilled and unskilled workers. Thus while [Goldberg and Pavcnik's \(2007\)](#) conclusions were mainly drawn from evidence on import liberalisation, [Fukase's \(2012\)](#) were based on export liberalisation resulting from policy changes by a countries' trading partners which would affect skill premium in developing countries. [Jenkins \(2004\)](#) concluded that despite rapid economic growth and significant reduction of poverty, the rate of industrial employment growth was slow. Recently, [Dávalos et al. \(2020\)](#) examine the impacts of exogenous changes in the price of fertilisers between 1993 and 1998 due to trade liberalisation on the reallocation of labour market in rural areas in Vietnam. The empirical findings of this paper are that a drop in the price of chemical fertilisers generally induced an increase in farm employment.

[Nguyen and Heo \(2009\)](#) applied the CGE model to scenarios involving the WTO tariff reduction in Vietnam under the assumption of all firms being profit maximisers. Their simulation results show that middle-income, high-income, and rural low-income households would gain but low-income earners in urban areas would lose. [Fosse and Raimondos-Møller \(2012\)](#) predicted that Vietnam's WTO tariff reduction scheme for the period of 2007–2014 would reduce overall welfare. Their simulation results also showed that the biggest loss would take place among poor rural households; hence increase income inequality.

[Justino et al. \(2008\)](#) examined the dynamics changes in Vietnamese household poverty using data from the VLSSs between 1993 and 1998. Using a dynamic growth model and a multinomial logit model, the study found a significant positive impact of trade liberalisation on household poverty dynamics as well as poverty transitions through the two channels of price change and employment change. Also, [Coello et al. \(2010\)](#) found that diversification in self-employed non-farm activities, especially in importing-competing industrial and agricultural sectors made a positive contribution to poverty alleviation in Vietnam from 2002 to 2006. But [Hoang et al. \(2016\)](#) in applying a similar methodology to newer data from VHLSSs for the period from 2002 to 2008, reported no evidence of the effect of an exogenous increase in the price of rice on poverty in rural area.

[Le \(2014\)](#) examined the direct link between trade openness and institutional reforms and rural household welfare at the provincial level using data from the VHLSS between 2006 and 2010. This study finds that the per capita income of rural households is higher in the provinces with higher multiple-attribute provincial competitiveness indexes associated with trade openness.

To our knowledge, none of existing literature examined the empirical relationship between trade liberalisation and multidimensional poverty. The literature has strongly argued that poverty is multidimensional in nature and that household welfare should be analysed using multiple aspects of consumption ([Alkire and Santos, 2014](#)). Previous studies have also applied various techniques to analysis multidimensional poverty in Vietnam using data from earlier waves of the VHLSS but none investigated the issue of trade liberalisation ([Asselin and Vu, 2009](#); [Roelen et al., 2012](#); [Mahadevan and Hoang, 2015, 2016](#)). Section 3 will describe the empirical strategy employed in this paper to assess the impacts of trade liberalisation on the multidimensional deprivation of rice-growing households in Vietnam over the period from 2002 to 2012.

3. Empirical strategy

We take a two stages approach in our empirical study. In the first stage, we use a latent class modelling (LCM) framework to classify households into three ordered groups of multidimensional deprivation. This latent class approach allows us to capture many dimensions of living standards for which various dimensions are available in VHLSS data. In the second stage, we use the maximum likelihood estimator to regress multidimensional deprivation status on two main sources of income: income from farming and income from non-farming activities. Using the CMP estimator, we can examine the impacts of a variety of variables related to trade liberalisation on both the farming and non-farming income sources.

3.1. Data sources

Data from six waves of VHLSS from 2002 to 2012 are used.¹ To avoid problems of losing observations, we constructed the six waves into four sets of two-year panels (2002–2004, 2004–2006, 2006–2008, and 2010–2012).² Due to the VHLSS's

¹ These surveys were conducted by the Vietnam General Statistics Office (GSO) with technical assistance from the World Bank (WB). These are the continuation of the Vietnam Living Standard Surveys of 1992/1993, but the enumeration areas were changed in 2002 and in 2008. There is a break in samples between the VHLSS iterations of 2002 and 2008 and between VHLSSs of 2008 and 2010. Therefore, the 4-year panel for 2002–2008 and the 2-year panel of 2008–2010 are not considered here.

² The number of households surveyed in the income and expenditure section of the VHLSS 2002, 2004, 2006, 2008, 2010, and 2012 were 29530, 9189, 9188, 9189, 9399, and 9399, respectively. The sample sizes reduce substantially for the single panel of four years. We also run the analysis

Table 1
Observations in panel datasets used in the analysis.

Panel datasets	Number of observations	Number of rice-growing households	Percentage of rice-growing households
<i>Two-wave panels</i>			
2002–2004	3931 × 2 = 7862	4455	56.67
2004–2006	3773 × 2 = 7546	4237	56.15
2006–2008	3935 × 2 = 7870	4193	49.14
2010–2012	3975 × 2 = 7950	3820	48.05
<i>Three-wave panels</i>			
2002–2004–2006	1662 × 3 = 4986	2881	57.78
2004–2006–2008	1571 × 3 = 4713	2657	56.38

rotating panel design, in which half of the enumeration areas in each round are replaced by new enumeration areas, the size of the three-wave panel is less than half the size of the two year panels. Table 1 provides numbers of observations in each panel dataset used in this study. As shown, more than 50 per cent of farming households are rice growers (i.e., around 4000 and 1600 rice-growing households, respectively in each of the four two-year panels and each of three-year panels.)

All variables used are from the VHLSS, other than the trade and GDP data which are from provincial statistics yearbooks published by General Statistics Office (GSO) of Vietnam. Data regarding employment in export-oriented industries (EOIs) was extracted from the VHLSS for both the household level (number of household members working in EOIs) and the commune level (total number of the commune’s labour force working in the EOIs). The United Nations’ COMTRADE’s HS commodity codes are matched with VHLSSs’ industry codes. Based on data of exports and imports, the top 20 industries with export surpluses in each surveyed year were selected as the EOIs. The inclusion of a number of local people working in EOIs at the commune level can be justified by recognising the spill-over effects of trade liberalisation via the labour channel. That is, the expansion of EOIs under the impact of trade liberalisation may lead to labour migration or job movement, land conversion problems and affect farm activity in Vietnam in general as well as rice production in particular. To capture other overall impacts of trade liberalisation, we also include two dimensions of trade openness measures: export-oriented measure of trade openness (i.e. export openness) and import-oriented measure of trade openness (i.e. import openness) (see Bussmann, 2009 for more discussions).

3.2. Measuring multidimensional poverty

Poverty and deprivation are latent phenomena with many dimensions. The status of poverty or deprivation is often not directly observed but various aspect of welfare can be directly observed: for example, the level of consumption of differing goods and services. As multidimensional poverty and deprivation are latent, the LCM framework appears to be a logical choice (Moiso, 2004). The main purpose of the LCM is to classify households into distinct classes characterised by the latent multidimensional poverty variable. This modelling approach has been used in previous empirical Vietnamese studies using the VHLSS data (Fukase, 2012; Mahadevan and Hoang, 2015, 2016).

By utilising data on the manifest indicators, the LCM can be estimated to postulate the latent structure present in data (Hagenaars and McCutcheon, 2002). Following Vermunt and Magidson (2005), this study applies a single latent variable x_i (i.e. multidimensional poverty) with K classes and J observed manifest indicators. Let y_i denote the response of household i on a set of manifest indicators (J). In order to capture various types of manifest indicators, such as nominal, ordinal, continuous, or count, the following model for mixed mode data is used:

$$f(y_i) = \sum_{k=1}^K P(x_i = k) f(y_i | x_i = k) = \sum_{k=1}^K P(x_i = k) \prod_{j=1}^J f_k(y_{ij} | x_i = k) \tag{1}$$

where $f(y_i)$ is the probability density of y_i given a specific latent class and $P(x_i = k)$ is the probability of belonging to a certain latent class.

The second part in the right-hand side of Eq. (1) can be written in the log form as

$$\ln f(y_i | x_i = k) = \beta + \beta_x + \sum_{j=1}^J \beta_j^{y_i} + \sum_{j=1}^J \beta_j^{x,y_i} \tag{2}$$

where main effects include the latent variable (β_x), the manifest indicators ($\sum_{j=1}^J \beta_j^{y_{ij}}$), and their interaction terms ($\sum_{j=1}^J \beta_j^{x,y_{ij}}$). This model can be estimated using the maximum likelihood method.³ The LCM analysis defines homogeneity

using two sets of three-year panels (2002–2004–2006 and 2004–2006–2008) giving similar results on a majority of the variables. Results can be provided upon request.

³ We use Vermunt and Magidson (2005)’s LATENT GOLD software. The software uses a specific fitting algorithm to allocate individuals/households across latent classes and in doing so, may not be trackable.

Table 2
Indicators comprising the multidimensional deprivation index (MDI).

	Indicators	Survey responses	Factor loadings					
			2002	2004	2006	2008	2010	2012
1	Own a washing machine	Yes or No	0.3917	0.7135	0.6754	0.5843	0.6306	0.7085
2	Own an air conditioner	Yes or No	0.2118	0.4219	0.411	0.3669	0.4946	0.6006
3	Own a landline	Yes or No	0.6247	0.7326	0.718	0.5833	0.4112	0.4104
4	Own a mobile phone	Yes or No	na	0.6095	0.6002	0.5737	0.4778	0.3939
5	Own a computer	Yes or No	0.2915	0.5711	0.547	0.471	0.5243	0.5881
6	Own an automobile	Yes or No	0.131	0.1415	0.142	0.1634	0.1551	0.1886
7	Own a motorbike	Yes or No	0.5765	0.4641	0.4582	0.5322	0.4553	0.3819
8	Type of toilet (<i>four levels with lowest level for the worst physical condition of the toilet</i>)	Flush toilet Pour flush toilet Double vault compost latrine Toilet directly over the water	0.7222	0.7534	0.7395	0.6618	0.6503	0.6932
9	Type of waste disposal (<i>four levels with lowest level for the worst service</i>)	Collected by someone Dumping in ponds and lakes Dumping in nearby site Landfill burial/burning	0.7376	0.6045	0.5824	0.6029	0.5146	0.5138
10	Source of drinking water (<i>six levels with lowest level for the worst physical condition</i>)	Tap in house Public tap Well Stream water Bought water Rain water	0.4993	0.5214	0.5116	0.5058	0.4687	0.4288

Table 3
Three clusters of multidimensional deprivation using four two-wave panels.

Level of deprivation	Panel 2002–2004				Panel 2004–2006			
	2002	2004	Total	%	2004	2006	Total	%
Most deprived	2991	2933	5924	75.35	2788	2379	5167	68.47
Medium deprived	506	780	1286	16.36	756	1059	1815	24.05
Least deprived	434	218	652	8.29	229	335	564	7.47
Total	3931	3931	7862	100	3773	3773	7546	100
Level of deprivation	Panel 2006–2008				Panel 2010–2012			
	2006	2008	Total	%	2010	2012	Total	%
Most deprived	2511	2138	4649	59.07	2192	2012	4204	52.89
Medium deprived	1049	1226	2275	28.91	1107	1432	2539	31.94
Least deprived	375	571	946	12.02	675	531	1206	15.17
Total	3935	3935	7870	100	3974	3975	7949	100

in terms of probabilities in which households in the same latent class are similar to each other because their responses are generated by the same probability distribution using Bayes' theorem. The households are then assigned to the class for which the posterior probability is highest.

In an ideal setting, manifest indicators of multidimensional poverty in (1) should comprise three dimensions of poverty: health, education, and living standard (Alkire and Santos, 2014). However, data on nutrition, health and education is limited in all the waves of the VHLSS.⁴ Table 2 provides descriptions of ten indicators finally selected with their factor loadings in which higher values suggest a stronger relationship with the latent variable.⁵

Following Mahadevan and Hoang (2016), we impose three distinct ordered classes for the Latent Gold Model (LGM) in Eq. (1) mainly to reflect the important relevance for policy analysis. The Vietnamese government has currently adopted new poverty classifications of three categories of 'poor', 'close-to-poor' (or vulnerable to being poor), and 'non-poor'. Tables 3 and 4 presents the LGM's results for the three classifications of households.

⁴ For example, self-assessment of food intake is used elsewhere. But data on this variable is not available in all four waves of the survey. Many other variables including type of dwelling, whether the household paid rent or owned the dwelling, whether electricity was available and the type of wall material used are also excluded as their loading factors are smaller than 0.1.

⁵ The choice of these manifest indicators is guided by considerations of data constraints, the values of factor loadings, and previous literature. These indicators are by no means exhaustive or complete.

Table 4
Three clusters of multidimensional deprivation using three-wave panels.

Level of deprivation	3-year panel 2002–2004–2006					3-year panel 2004–2006–2008				
	2002	2004	2006	Total	Percent	2004	2006	2008	Total	Percent
Most deprived	1287	1261	1100	3648	73.16	1173	982	820	2975	63.12
Medium deprived	201	322	439	962	19.29	303	456	541	1300	27.58
Least deprived	174	79	123	376	7.54	95	133	210	438	9.29
Total	1662	1662	1662	4986	100.00	1571	1571	1571	4713	100.00

3.3. Conditional mixed process (CMP) model

The literature has documented that trade liberalisation increases household incomes through higher prices of agricultural produce, employment opportunities in non-farm sectors, lower prices of imported goods and services, and improved total factor productivity at provincial and national levels. In a typical developing country such as Vietnam with limited governmental programs, it can be expected that income would be the primary driving force of multidimensional welfare. To examine the impact pathway from trade liberalisation through income on multidimensional deprivation, we adopt a following ordered probit model:

$$c_i^* = f(z_i, \text{rice_income}_i, \text{non_rice_income}_i) \tag{3}$$

where c_i^* is the ordered values of multidimensional deprivation status and \mathbf{z} is the vector of covariates, which are hypothesised to be related to the ordered outcomes, and rice_income_i and non_rice_income_i represent the income derived from rice production and non-rice activities of household i , respectively.

Poverty clearly affects work productivity, which determines both rice and non-rice incomes. Hence rice and non-rice income variables in (3) are endogenous and can have strong correlations with variables z_i . Therefore, a fully observed recursive model of ordered probit is estimated in the framework of maximum likelihood estimation to account for endogeneity, multicollinearity and reserve effects (Roodman, 2011).⁶ Specifically, this study adopts the following model:

$$c^* = \sum_{j=1}^m \gamma_j z_j + \text{rice_income} + \text{non_rice_income} + u_1, \tag{4}$$

$$\text{where: } \text{rice_income} = \alpha_1 + \sum_{j=1}^n \gamma_j v_j + u_2, \tag{5}$$

$$\text{and } \text{non_rice_income} = \alpha_2 + \sum_{k=1}^m \gamma_k v_k + u_3 \tag{6}$$

in which v_j and v_k are the vector of covariates and $u_h (h = 1, 2, 3)$ are error terms.

All covariates in Eqs. (4)–(6) are described in Table 4. The selection of these variables is guided by previous empirical studies in Vietnam (Niimi et al., 2007; Le, 2014; Hoang et al., 2016) and other developing economies as reviewed in Winters and Martuscelli (2014). Several new variables are selected with further discussion provided below.

3.4. Communal and provincial variables

The commune-level rice yield average is calculated as the arithmetic mean of rice yields of all rice farmers located in the same commune. This variable aims to capture variations in the overall rice yield productivity across communes. It can be expected that this variable is positively correlated with the level of deprivation as overall productivity affects rice income and enhances higher living standards and overall regional development.

We derive the total number of people employed in export-oriented industries⁷ (EOIs) at the commune level to capture the impact of trade liberalisation on farmers' welfare through the employment channel. As the Heckscher–Ohlin theory identifies that unskilled labour is likely to benefit from export-oriented manufacturing industries, we expect a positive relationship between this variable and the level of multidimensional deprivation.

Previous studies have used the ratios of exports to GDP and the ratio of trade (either exports, imports, or total import and export) to GDP to capture the impacts of broader trade openness (Le, 2014). Similarly, we use the provincial trade openness index, measured as the ratio of total trade to GDP at the provincial level.

⁶ The choice between ordered probit or ordered logit model needs examination. The literature has pointed out that the main difference between these two models is the distribution of error terms. The probit model has standard normal error terms whilst ordered logit uses a logistic distribution which has longer tails. In fact, the two distributions emerge only at the extremes (probabilities near zero or one), hence the choice between logit and probit usually amounts to one of personal preference. Please see Long (1997) for more details.

⁷ An export-oriented industry is defined as one that has an export value exceeding its import value and stays within the top 20 list of industries having the largest export values during the year of the survey.

Table 5

Distribution profile based on income poverty and multidimensional deprivation (percentage of rice-growing household over years).

Multidimensional deprivation	Percentage for MD			Income poverty								
				Poor (B)			Close-to-poor			Non-poor		
	2004	2008	2012	2004	2008	2012	2004	2008	2012	2004	2008	2012
Total	100	100	100	14.26	11.81	6.00	12.43	9.34	7.66	73.31	78.85	86.35
Level 1 (most deprived)	90.81	68.81	66.03	14.12	11.32	5.95	12.19	8.44	7.21	64.51	49.05	52.88
Level 2 (mid-level)	8.65	29.78	32.57	0.14	0.47	0.05	0.24	0.87	0.45	8.27	28.44	32.07
Level 3 (least deprived)	0.54	1.41	1.40	0.00	0.02	0.00	0.00	0.02	0.00	0.54	1.36	1.40

3.5. Household variables & income covariates

Household variables include household size, the ratio of working people in the household, the number of people having technical diploma and higher degrees and overseas remittances. We expect all these variables would be positively related with the multidimensional deprivation level as more people working and higher quality labour would translate into higher income and a higher level of consumption.

To capture the effect of crop specialisation and diversification and differences in farming activities across farms, we include information on whether farmers grow rice together with two other types of crops – vegetable and fruit crops and short-term industrial crops. Note that most vegetable and fruit produce are traded in local markets while other industrial crops are mainly grown for export purposes. For the relative scale effect of rice production, we include the ratio of land used for rice growing by farmers to the commune's average value.

4. Empirical results

Table 5 displays the percentage of rice-growing household classified into three groups in terms of income-based poverty and multidimensional deprivation in selected three years 2004, 2008 and 2012. In terms of income poverty, results show the percentages of families being poor and close-to-poor have declined over time while the percentage of families being non-poor has increased. For example, 73.31 per cent of rice growing families were non-poor in 2004 while 86.35 per cent were non-poor in 2012. Similarly, the percentage of families being most deprived has declined significantly from 90.81 per cent in 2004 to 66.03 per cent in 2012. The percentage of families falling into the middle-level of MDI has increased from 8.65 per cent to 32.57 per cent over the same period. The percentage of families being least deprived has increased very slightly.

Another notable finding is that there are more families being most deprived than the sum of families being income poor and income close-to-poor. This suggests that using MDI, more families are identified to be multidimensionally deprived than using income to measure poverty. In fact, 64.51 per cent of households considered not poor using the income poverty line were very deprived in 2004 (49.05 per cent in 2008 and 52.88 per cent in 2012). Note that our results capture much longer time dimensions than any previous studies on multidimensional poverty for Vietnam (Mahadevan and Hoang, 2016).

Table 6 presents the empirical estimates for Eqs. (3)–(5). Overall, one consistent result is that rice-growing households have been less deprived over time. Income from non-rice sources has a positive association with deprivation levels in all the panels while rice income is statistically significant only in two out of six panels. Results indicate that as rice and non-rice income increases, rice-growing households have a higher probability of being less deprived. We report major findings in relations to various groups of variables in the following sections.

4.1. Household characteristics and level of multidimensional deprivation

Household size and the ratio of working members are found to be negatively related to the probability of being deprived. This is consistent with the finding of Mahadevan and Hoang (2016). As explained in the literature, it is likely that large-size households and households with more members of working age have a higher capacity to generate income. Similar results are found for households with a greater number of people with vocational training. Results also confirmed that those families with household heads having a secondary school degree or higher have higher levels of rice and non-rice income.

4.2. Direct impacts of trade liberalisation on multidimensional deprivation

A negative association between deprivation level and the number of a household's members with employment in the export-oriented sector as found in the present study is in contrast to the previous literature (Niimi, 2007; Nicita, 2009). Our results suggest that having more family members working in export-oriented industries decrease the probability of being less deprived. Note that positive effects of employment in export-oriented industries on deprivation status are detected at the commune level and results were not robust across different panels.

Table 6

Conditional-mixed process regression results.

Independent variables	2002–2004	2004–2006	2006–2008	2010–2012	2002–2006	2004–2008
Household size	0.131***	0.0979***	0.0517*	0.0581**	0.0537	0.0584
Ratio of working members	0.578**	0.432*	0.301*	0.658***	−0.279	0.612***
Number of household member having technical diploma	0.360***	0.0838	0.275***	0.228***	0.172	0.214***
Received overseas remittances	−0.0935	−0.0903	0.0209	0.000884	−0.217	0.250
Rice yield commune average	0.0723	0.115*	0.119**	0.269***	0.172*	0.133*
Rice yield in RRD	0.0203	−0.238**	−0.268***	−0.374***	−0.378**	−0.187
Rice yield in MRD	0.144	−0.244*	−0.218**	−0.332***	−0.152	−0.174
In Red River Delta	−0.165	1.550**	1.524**	2.207**	2.333**	1.301**
In Mekong River Delta	−1.178	0.968	1.060**	1.349**	0.654	0.721
Number of members in EOs	−0.254***	−0.309***	−0.163***	−0.00660	−0.261***	−0.149***
Number of commune's labour work in EOs	4.61e−5	13.3e−5**	−7.7e−5	6.49e−5	22.7e−5***	−18.6e−5*
Rice Income (1000d)	2.27e−5	3.24e−5**	−4.68e−8	2.47e−5***	1.99e−5	−0.79e−5
Non-rice Income (1000d)	3.01e−05***	3.45e−05***	2.27e−05***	1.46e−05***	5.83e−05***	2.25e−5***
Year t	−0.480***	0.346***	0.420***	0.0825	0.611***	0.456***
Rice income (1000d)						
Household in rural area	104.7	419.9	799.9	1037.6	667.2*	331.0
Head has secondary degree	449.8***	405.8***	1103.3***	743.1*	329.8	1217.6*
Head working in mining	−807.7	−989.1	−2142.8	481.8	−1815.1*	−2895.4
Head working in manufacturing & processing	−891.3**	−535.7*	−1460.8**	−295.0	−1051.1**	−1074.2
Head working in servicing	−772.6***	−686.6***	−1120.5**	−80.93	−929.1***	−942.6
Rice price	597.7	974.3***	2642.9***	1021.0*	1247.3***	3306.1***
Rice price in RRD	162.8	−117.6	−62.37	−19.48	−194.6	−153.1
Rice price in MRD	3310.2***	3284.6***	4905.8***	4542.1***	3203.9***	6178.8***
Ratio of household rice-land area at commune level	4626.6***	4032.3***	5447.5***	4543.7***	5176.5***	7074.4***
Sold rice to private traders	683.2***	1558.8***	451.6	n/a	1222.3***	−858.1
Income from vegies and fruit	−441.9**	−159.7	−702.2	−2146.7***	−566.5*	−1025.5
Income from industrial crops	−325.3*	−327.9**	−1003.6**	−849.7**	−445.4**	−1593.1**
Provincial export openness	702.2	−119.2	766.5	673.3	864.6	1219.6
Provincial import openness	−77.87	399.5	−195.3	−243.5	1249.5***	−354.8
Constant	−3337.1***	−3824.7***	−8238.6***	−4757.8***	−5472.6***	−9968.1***
Non-rice income (1000d)						
Household in rural area	−1442.4**	390.0	−1368.9	−5399.1***	−447.4	1223.1
Head has secondary degree	2132.7***	3411.7***	2854.3***	5643.1***	3428.5***	3001.2***
Head working in mining	5914.4***	7291.8**	9171.0***	−4766.4	6040.9**	6897.8
Head working in manufacturing & processing	1666.2**	1675.5*	5220.2***	−340.1	2271.2**	3666.1***
Head working in servicing	2519.9***	833.8	3023.3***	−1272.7	1105.0*	1915.2**
Number of members have skilled and office-jobs	4080.6***	4285.7***	4505.9***	7870.1***	4825.7***	3935.2***
Number of members have manual jobs	1700.9***	1317.8***	1679.2***	239.4	1855.3***	1161.9***
Number of members have other types of job	4663.7***	7643.4***	5521.3***	16473.9***	6277.2***	5998.3***
Income from vegies and fruit	−1968.9***	−1940.5***	−1372.9**	−1734.8	−2218.1***	−1842.4**
Income from industrial crops	1381.5***	717.9	1627.6***	303.7	2062.9***	1182.5*
Provincial export openness	5930.9***	10053.4***	6162.6***	3079.0	7534.1***	9843.9***
Provincial import openness	−149.0	−950.1	2044.0**	610.4	−1230.7	1115.4
Constant	5145.9***	5813.5***	6009.4***	15817.4***	4003.1***	5120.5***
Observations	3435	3264	3240	2031	2310	1949

Notes: n/a: not available. A positive coefficient implies that the independent variable reduces the probability of deprivation. RRD stands for Red River Delta; MRD is Mekong River Delta, the two main regions for rice growing in Vietnam.

*Significant at 10%.

**Significant at 5%.

***Significant at 1%.

One possible explanation of these results is related to a migration of low skilled labour from farm activities to export-oriented sectors in Vietnam. As export-oriented sectors are often located in urban areas, workers need to migrate from rural to urban regions. Many of those rice-growing household' members who migrated to work in export-oriented industries had the expectation of reducing the risk of exposure to agricultural and economic shocks as well as improving family income. However, there is evidence that a substantial share of individuals and households could not improve their living conditions due to a number of reasons, notably higher living costs, lack of knowledge and experience when living in modern cities, or limited access to affordable health care services (Le et al., 2011; Nguyen et al., 2015). As living expenses in urban areas are higher, income net of living expenses of migrated workers was small and such workers were typically not able to send money back home. Families, however, still need to either work harder or employ casual labour to replace those members who migrated to urban areas. The net effects of those would be negative on family income.

4.3. The impacts of trade liberalisation on rice and non-rice income

Four variables related to the impacts of trade liberalisation were included in empirical models: the commune-level price of rice, the dummy of selling output to private traders, import and export openness indexes. Our results showed that a higher price of rice is associated with higher rice income and the price impact on rice income is greater in the MRD region. This agrees with the observation that rice farmers in the MRD region enjoy more favourable prices. As mentioned earlier, the MRD region accounts for more than half of rice production and up to 95 per cent of Vietnam's annual rice export volume while rice production in the RRD region mostly serves domestic consumption purposes at household levels.

To capture the role of the private traders in the rice value chain, we include a dummy variable to ascertain whether rice-growing households sold their output through private traders during the year surveyed.⁸ Results show that rice farmers who sold their produce through private traders have a higher level of rice income. This issue needs further research as the literature has argued that deregulation in the value chain is needed in Vietnam (Pham and La, 2014).

The export openness index has a significant positive relationship with non-rice income but not with rice income. The import openness index is found to correlate positively with rice income only in the two-year panel from 2004 to 2006. Given the aggregate nature of these variables, it can be said that, overall, there are some positive impacts from international trade liberalisation at the national to provincial levels on the incomes of Vietnamese rice farmers.

5. Discussions and conclusions

Multidimensional deprivation analysis provides a more holistic examination of the welfare of households. In particular, our empirical findings show that a significant number of rice-growing households in Vietnam are multidimensionally deprived but are not considered as income poor by any standards of income poverty classification. Given that there is no empirical literature on the impacts of trade liberalisation on farmers' multidimensional deprivation, this paper presents the first empirical study of this type by utilising the largest dataset from Vietnam Household Living Standard Surveys (VHLSS). We applied a conditional mixed process model to six panel datasets for rice-growing households from 2002 to 2012 to examine the impact of trade liberalisation on multidimensional deprivation. This is effected through two main channels: income from rice and income from non-rice sources. Empirical results provide several important findings.

First, the employment of household members in export-oriented industries does not necessarily reduce multidimensional deprivation. Our results show that the greater the number of members of a rice-growing household with jobs in export-oriented industries, the more likely that household would be deprived. This is an important empirical finding as it suggests that structural change in employment which shifts to export-oriented industries does not necessarily improve the welfare of rice-growing households. In other words, this finding supports a view that transitions from household farm work to low-skill employment in manufacturing did not bring sufficient welfare benefits to households. This finding provides empirical evidence in support of further investigation into the issue of how households can take advantage of the expansion in manufacturing sectors and how policies can address this issue.

Second, the effect of trade openness via the price channel differs from what is established in the literature. Whilst previous studies indicated little impact of the trade liberalisation through the price channel on the welfare of rice farmers, our results show that the increased price of rice has increased the income from rice production activities. Hence, this has helped decrease the multidimensional deprivation among rice-growing households in Vietnam.

Third, the overall level of export openness shows a positive effect on non-rice income, but not on rice income. Also, households are likely to be less deprived if they sell produce to private traders. This may reflect the important role of private traders in the supply chain of the rice sector in Vietnam. As most of Vietnamese rice growers are from small households and state-owned enterprises are known to be less efficient than the private sector, our empirical results pose further evidence which indicates a need for changes in the supply chain of rice so that the benefits of trade are delivered to farmers.

Fourth, crop diversification strategies such as perennial crops showed positive impacts on income, which could be due to the growing export of those crops during the periods surveyed. In a similar manner, the scale of rice farming production also has had a positive impact on rice income. Hence policies towards the promotion of increasing the scale of production as well as diversifying production are warranted. Education improvements and family planning are still shown to play an important role in lessening the level of multidimensional deprivation.

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⁸ In the VHLSS, farmers were asked "To whom did the rice farmer mostly sell or barter for the last 12 months?" The dummy is equal to unity if sold to private traders, otherwise (such as to SOEs, retail sales, etc.) is zero. This question was not available in the 2010 and 2012 surveys.

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