

Trade liberalisation and multidimensional deprivation of rice farmers in Vietnam

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Abstract:

Literature on trade liberalisation and multidimensional poverty is very limited. This paper provides one of the first empirical analysis in the context of rice growing sector using six waves of Vietnam Household Living Standard Survey. Instead of using income as a single aspect of welfare, we measure the level of multidimensional deprivation in a latent class modelling framework. We use a maximum likelihood estimator (i.e. mixed process) to account for the impacts of trade liberalisation on deprivation through the price and employment effects of farm and non-farm activities. Empirical results show that a higher level of provincial export openness is strongly correlated with higher rice income and non-rice income which in turn reduce the level of multidimensional deprivation. Employment of family members in export-oriented industries, however, increase deprivation probability. Farmers selling rice to private traders generate higher rice income than those selling to government-owned trading companies. Provincial productivity and education are other important factors that reduce the probability of being deprived. Discussions for policy implications are provided.

Key words: multidimensional poverty, provincial trade openness index, rice households, VHLSS.

JEL Classification: F14, I31, O12, Q12

1. Introduction

Empirical literature on the relationship between trade liberalisation and poverty is rich and mostly focuses on income ([Winters 2002](#); [Winters et al. 2004](#)). In cross-countries contexts, most empirical studies have established a negative association between trade liberalisation and income poverty via economic growth. 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 higher total factor productivity. All of these impacts, if they work in the favour of the more disadvantaged groups, could help reduce poverty of households especially in less developed and developing economies.

However, poverty is a multidimensional concept ([Nussbaum & Sen 1995](#); [Alkire & Santos 2014](#)). Obviously income is an important aspect of multidimensional poverty because income can be spent on a wide range of goods and services to satisfy and fulfil basic human needs. There is growing interest in the analysis of multidimensional poverty in developing countries, especially since the launch of the millennium development goals (MDGs) in 2000. According to [Alkire and Santos \(2014\)](#), multidimensional poverty analysis complements income poverty analyses in developing countries by bringing information from a different angle, focused directly on actual deprivation. This creates interesting research issues relating to the relationship between trade liberalisation and multidimensional poverty in the context of developing economies. To the best of our knowledge, there are only few previous studies focusing on this relationship. We therefore aim to fill in this gap by investigating this issue in the context of Vietnam's rice-growing sector.

Analysis of the impacts of trade liberation on poverty in rice growing farmer communities is particularly important in Vietnam for two reasons. First, rice is the crop which has been responsible for the substantial transformation of Vietnam's rural economy enjoying the largest expansion in terms of production and export volumes of all crops produced. In other words, the rice sector has experienced a high level of international economic integration. Therefore, analysis of this sector is likely to provide important policy implications. Second, Vietnam has achieved remarkable outcomes in reducing poverty which has always been more apparent in rural areas where most rice farmers are located.

This paper differs from empirical studies that have focussed on the Vietnamese rice sector in several ways. First, instead of using conventional unidimensional measures of a household's welfare such as income or expenditure, we use a multi-dimensional deprivation index (MDI) which is constructed through the framework of latent class modelling. Second, in order to deal with the endogeneity issue of income and its associated determinants, we estimate an ordered probit regression using the conditional mixed process (CMP) estimator. More importantly, the CMP model helps us examine both direct impacts of trade liberalisation on deprivation and indirect impacts through two sources of income (farm and non-farm) which in turn determine the level of multidimensional deprivation. Last, in order to check for robustness of the relationship over many periods of time, six iterations of the Vietnam Household Living Standard Surveys (VHLSSs) data from 2002 to 2012 are used to construct six panel datasets of rice-growing households in Vietnam.

Section 2 presents the empirical model and framework for the possible channels through which trade liberalization can affect poverty and household welfare and the methodology used in the analysis. Sections 3 reports the empirical results and discussion and section 4 provides conclusions.

2. Literature review

Trade-induced effects can be traced through three main micro-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 the second and third channels. Due to complicated structures of markets, measuring the impacts through the third channel poses problems in terms of data requirement and methods used. Given the literature's wide range we restrict our review on those studies which are focused on Vietnam.

In terms of the price channel, previous studies have examined the impact of the rice price in Vietnam in the 1990s. For example, [Minot and Goletti \(1998\)](#) applied a spatial-equilibrium model to capture interaction among regions within the agricultural sector given the regional diversity of Vietnamese agriculture. They found that trade policy reforms such as relaxing or removing rice export quotas and fertilizer 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 similar results from the link between gradual trade liberalization during 1990s with the poverty reduction and household welfare enhancement.

Regarding the employment channel, trade liberalization and employment do not seem to have a straightforward relationship. The standard neoclassical Heckscher-Ohlin (H-O) theory predicts that freer trade would lead a developing country with abundant unskilled labour and scarce skilled labour to specialization in a sector that uses its unskilled labour intensively and then raises labour demand in the sector that intensively uses skilled labour. In accordance with the H-O theory, Stolper-Samuelson's (S-S) theorem (1941) argued that the increase in the 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 premium after the implementation of trade liberalization. In contrast to [Goldberg and Pavcnik \(2007\)](#), [Fukase \(2012\)](#) argued 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 \(2007\)](#) conclusions were mainly drawn from evidence on import liberalization, [Fukase \(2012\)](#) were based on export liberalization resulting from policy changes by a countries' trading partners, which would affect skill premium in developing countries. [Niimi et al. \(2007\)](#) reported that employment growth in sectors with the largest export volume (i.e. seafood, furniture, garments and textile, footwear) was a direct result of import and export liberation. [Jenkins \(2004\)](#) concluded that despite rapid economic growth and significant reduction of poverty, the rate of industrial employment growth was slow.

[Nguyen and Heo \(2009\)](#) applied the CGE model to scenarios in involving the WTO tariff reduction in Vietnam under the assumption of all firms being profit maximizers. 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 the poor rural households; hence increase income inequality.

[Justino et al. \(2008\)](#) examined the dynamics changes in Vietnamese household poverty data from the various waves of the VLSSs of 1993 and 1998. They used both a dynamic growth model and a multinomial logit model to analyse the impact of trade shocks on household poverty dynamics. The study found a significant positive impact of trade liberalization 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 positive contribution to poverty alleviation in Vietnam from 2002 to 2006. However, [Hoang et al. \(2016\)](#) in applying a similar methodology to newer data of VHLSSs for the period from 2002 to 2000, found no evidence of the effect of an exogenous increase in the price of rice on poverty in rural area.

In a more indirect manner, [Le \(2014\)](#) examined the link between trade openness and institutional reforms and rural household welfare at the provincial level using data from the VHLSSs of 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 and trade openness.

To our knowledge, none of existing literature examined the empirical relationship between trade liberalisation and multidimensional deprivation. However the literature has strongly argued that poverty is multidimensional in nature and that household welfare should be analysed using multiple aspects of consumption ([Alkire & Santos 2014](#)). Previous studies have also applied various techniques to analysis multidimensional poverty in Vietnam using data of early waves of the VHLSS ([Asselin & Vu 2009](#); [Roelen et al. 2012](#)). Recently, [Mahadevan and Hoang \(2016\)](#) and [Mahadevan and Hoang \(2015\)](#), using VHLSS 2010 data, derived the multidimensional deprivation index from 13 indicators capturing various aspects of the standard of living using the framework of latent class modelling. This study found a strong statistical association between income and multidimensional deprivation measures in Vietnam.

Our aim is to examine the impacts of trade liberalisation on multidimensional deprivation in Vietnam's rice-growing sector which is chosen for a number of reasons. First, rice is the most important primary crops in Vietnam with more than 94% of the rice-growing land area is allocated to individual households ([UNEP 2005](#)). Rice currently accounts for around 78% of annual cropland, 90% of staple food production, 50% of total agricultural production¹, 70% of the total calorie intake and almost 33% of food expenditure of Vietnamese households ([Ryan 2002](#); [World Bank 2012](#)). Second, the rice sector has seen remarkable expansion through the increasing integration of Vietnam's economy into the regional and global economies. In particular, Vietnam has been a significant net exporter of rice since 1989 with the total rice export volume increasing from 3.48 million tons in 2001 to 8 million tons in 2012. This represents around 22% of total rice output over the last ten years.

3. Data sources

Data from six waves of VHLSS from 2002 to 2012 are used.² To avoid problems of missing observations, we constructed the four waves into four sets of two-year panel (2002-2004, 2004-2006, 2006-2008, and 2010-2012) and two sets of three-year panels (2002-2004-2006 and 2004-2006-2008).³ Due to the VHLSS's rotating panel design, in which half of the enumeration areas in each round are replaced by new enumeration areas, the size of the three-

¹ Rice is grown in all agro-ecological regions in Vietnam where 63 provinces are grouped into eight agro-ecological zones: (1) Red River Delta (RRD), (2) North East (NE), (3) North West (NW), (4) North Central Coast (NCC), (5) South Central Coast (SCC), (6) Central Highlands (CH), (7) South East (SE) and (8) Mekong River Delta (MRD).

² 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 panel for 2002-2008 and the panel for 2008-2010 are not considered here.

³ 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.

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% of farming households are rice growers (i.e. around 4,000 and 1,600 rice-growing households respectively in each of the four two-year panels and each of three-year panels approximately.)

-- Add Table 1 --

All variables used are from the VHLSSs, other than the trade and GDP data which are from provincial statistics yearbooks. Data regarding employment in export-oriented industries (EOIs) was extracted from VHLSSs 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 the number of local people working in EOIs at the commune level can be justified by recognising the spill-over effects of trade liberalization via the labour channel. That is, the expansion of EOIs under the impact of trade liberalization may lead to labour migration or job movement, and also land conversion problems and affect farm activity in Vietnam in general, and rice production in particular.

4. Measuring multi-dimensional poverty

As is widely argued in the literature, poverty is a latent phenomenon with many dimensions. The status of poverty 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 the multidimensional poverty is latent, LCM appears to be a logical choice ([Moisio 2004](#)). This modelling approach has been used in previous empirical Vietnamese studies using the VHLSS data ([Mahadevan & Hoang 2015](#); [Mahadevan & Hoang 2016](#)).

The main purpose of the LCM is to classify the entire population of data into distinct classes characterised by the latent multidimensional poverty variable. By utilising data on the manifest indicators, the LC model can be estimated to postulate the latent structure present in data ([Hagenaars & McCutcheon 2002](#)). Following [Vermunt and Magidson \(2005\)](#), this study applies a single latent variable x_i (i.e. multi-dimensional 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:

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

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 equation (1) can be written in the log form as

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

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.⁴ The LCM analysis defines homogeneity 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 the multidimensional poverty in (1) should comprise three dimensions of poverty: health, education, and living standard ([Alkire & Santos 2014](#)). However, data on nutrition, health and education is limited in all the waves of the VHLSS.⁵ Table 2 provides descriptions of the ten indicators finally selected with their

⁴ We use [Vermunt and Magidson \(2005\)](#)'s LATENT GOLD software. A limitation of the LATENT GOLD software is that it uses a specific fitting algorithm to allocate individuals/households across latent classes and in doing so, may not be trackable.

⁵ For example, self-assessment of food intake while 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 are also excluded as their loading factors are smaller than 0.1.

factor loadings of which higher values suggest a stronger relationship with the latent variable.⁶

-- Add Table 2 --

Following [Mahadevan and Hoang \(2016\)](#), we impose three distinct ordered classes for the latent class model (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’. Table 3 shows the LG model’s results for the three classifications of households.

-- Add Table 3 --

5. Conditional mixed process 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 like Vietnam with limited governmental programs, one can expect that income would be the primary driving force of multidimensional welfare. To examine the impact pathway from trade liberalisation through income to multidimensional deprivation, we adopt a following ordered probit model:

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

where c_i^* is the ordered values of multidimensional deprivation status and \mathbf{z} is the vector of covariates, which are hypothesized 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. It is obvious that rice and non-rice income variables in (3) are endogenous and can have

⁶ As common in the literature of latent class modelling of multidimensional poverty, the choice of these ten manifest indicators is guided by considerations of data constraints, the values of factor loadings, and whether they have been used previously in the literature or not. These indicators are by no means exhaustive or complete.

strong correlations with variables z_i . Therefore, a fully observed recursive model is estimated in the framework of maximum likelihood estimation to account for endogeneity, multicollinearity, and reserve effects ([Roodman 2011](#)). More specifically, this study adopts the following model using the Stata `cmp` command:

$$c^* = \sum_{j=1}^m \gamma_j z_j + \text{rice} - \text{income} + \text{non} - \text{rice} - \text{income} + u_1 \quad (4),$$

$$\text{where: } \text{rice} - \text{income} = \alpha_1 + \sum_{j=1}^n \gamma_j v_j + u_2, \quad (5)$$

$$\text{and } \text{non} - \text{rice} - \text{income} = \alpha_2 + \sum_{k=1}^m \gamma_k v_k + u_3 \quad (6)$$

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 equations (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](#); [Mahadevan & Hoang 2016](#)) and other developing economies as reviewed in [Winters and Martuscelli \(2014\)](#). Several new variables are selected with further discussion provided below.

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 is designed to capture variations in the overall rice yield productivity. One can expect that this variable is positively correlated with the level of deprivation as overall productivity does not only affect rice income but also promotes higher living standards and the level of development in the region.

We derive the total number of people employed in export-oriented industries⁷ at the commune level to capture the impact of trade liberalization 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.

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.

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](#)). In a similar manner, we use the provincial trade openness index, measured as the ratio of total trade to GDP at the provincial level.

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 of these variables would have a positive relationship with the multidimensional deprivation variable as the more people working and higher quality labour would translate into higher income and higher level of consumption.

To capture the issues of crop specialisation and diversification, we include information on whether farmers grow rice together with two other types of crops - vegetable and fruit crops and short-term industrial crops. These variables are expected to capture some differences in the nature of the farming business where most of vegetable and fruit produce are traded in local markets while other industrial crops are mainly for export purposes. For the scale effect of rice production we include the ratio of land used for rice growing of farmers to the commune's average value.

6. Empirical results

Tables 4 and 5 present the estimates of equations (3) – (5) for the two-year and three-year panels respectively. 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 the level of deprivation 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, which is in line with findings of [Mahadevan and Hoang \(2016\)](#). We report major findings in relations to various groups of variables in below sections.

-- Add Tables 4 & 5

Communal, provincial, and regional characteristics and multidimensional deprivation

Land productivity at the communal level is found to have a positive impact on the level of economic deprivation over time in the panels (except the panel between 2002 and 2004), which is consistent with previous studies ([Justino et al. 2008](#); [Hoang et al. 2016](#)). Rice farmers in RRD and MRD have lower level of deprivation than those in those in North Central area. This result is present in most panels (with exception for the MRD in 2004-2006 and 2004-2006-2008 panels and RRD in the 2002-2004 panel). Interactions between communal land productivity and two regional dummies reduce the total magnitude of the effect of land productivity on deprivation. Due to lower variation in land productivity within the Mekong and Red River regions the coefficients of these interaction terms are negative, which was also reported in the literature ([Glewwe et al. 2002](#); [Litchfield & Justino 2004](#); [Justino et al. 2008](#)). These finding favours further investments and policies in improving productivity as those policies could provide positive impacts on the larger portion of population.

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 economically deprived, which is consistent with the finding of ([Mahadevan & 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 more people having a vocational training level. 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.

Direct impacts of trade liberalisation on multidimensional deprivation

This study's finding of a consistent negative association between deprivation level and the number of a household's members with employment in the export-oriented sector is in contrast to previous research. Empirical results in this paper mean that having more family members working in export-oriented industries did not help to increase but rather tend to decrease the probability of rice households being less deprived. However, our results showed some positive effects of employment in export-oriented industries on deprivation status at

the commune level. The variable of number of commune people working in export-oriented industries was positive and significant for the 2004-2006 panel but negative (insignificant) in the 2006-2008 panel, and positive (insignificant) for other two-year panels. In three-year panels, they were both significant, but positive for the period 2002-2004-2006 and negative for the period 2004-2006-2008.

One possible explanation of these results is an unsuccessful 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 households' 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, such as 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 is higher, income net of living expenses of migrated workers were small, hence they were not able to send back home money. Families, however, still need to either work harder or employ casual labour to replace those members who migrated to urban. The net effects of those would be negative on family income. Also noted is that the 2008 global economic crisis aggravated the vulnerability of migrants when a number stopped sending remittances or returned to their households at the place of origin ([Oxfarm & VASS 2009](#)).

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

Four variables related to the impacts of trade liberalisation were included in our models, namely the at the commune-level price of rice, the dummy of selling output to private trade brokers, import and export openness indexes. Empirical results found a consistent positive relationship between the price of rice and the rice income of the household. Results on the interactions between regional dummies and the rice price variables suggested that this relationship only holds for the MRD. One justification for this is that rice farmers in the MRD region enjoy more favourable prices. As mentioned earlier, the MRD accounts for more than half of rice production and up to 95% of Vietnam's annual rice export volume

while rice production in the RRD 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 the private traders have a higher level of rice income in 2002-2004, 2004-2006, and 2002-2004-2006 panels. It appears then that the role of private traders had diminished over time. This issue needs further research as the literature has argued that deregulation in the value chain is needed in Vietnam ([Pham & La 2014](#)).

Results also show that the export openness index has a positive significant 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 of international trade liberalisation at the national to provincial levels on the incomes of Vietnamese rice farmers.

7. Conclusions

Using the maximum likelihood method, a condition mixed process model was estimated on six panel datasets for rice-growing households in Vietnam from 2002 to 2012. The empirical model yielded the following main findings.

First, family employment opportunities in export-oriented industries do not directly reduce but rather increase the multidimensional deprivation status. The 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 materially deprived.

⁸ In the VHLSS, farmers are asked “To whom did the rice farmer mostly sell or barter for the last 12 months?” The dummy is equal to unity if actually sold to private traders, otherwise (such as to SOEs, retail sales, etc.) is zero. This question was removed from the 2010 and 2012 surveys.

Second, the effect of trade openness via the price channel provides a different insight from the previous literature. Rice price at the commune level and the scale effect of rice growing played an important role in increasing the rice income for households, and hence, improving the probability of that household becoming less deprived when considered from the multi-dimensional poverty aspect.

Third, the export openness index showed a significant and positive effect on non-rice income, but an insignificant impact on rice income. The important role of private traders was recognised as the results showing that households are likely to be less deprived if they sell produce to private traders. This may reflect the important role of the private traders as most of Vietnamese rice growers are small households.

Fourth, the crop diversification strategies such as perennial crops showed positive impacts on farm income, which could be due to the growing export of those crops during the periods surveyed. Education improvement and family planning still show an important role in lessening the level of multidimensional deprivation.

Table 1: Observations in panel datasets used in the analysis

Panel datasets	Number of observations	Number of rice-growing households	Percentage of rice households
<i>2-year panels</i>			
2002-2004	3,931x2=7,862	4,455	56.67
2004-2006	3,773x2=7,546	4,237	56.15
2006-2008	3,935x2=7,870	4,193	49.14
2010-2012	3,975x2=7,950	3,820	48.05
<i>3-year panels</i>			
2002-2004-2006	1,662x3=4,986	2,881	57.78
2004-2006-2008	1,571x3=4,713	2,657	56.38

Table 2: Indicators comprising the multidimensional poverty index (MPI)

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	0.7222	0.7534	0.7395	0.6618	0.6503	0.6932
Pour flush toilet								
Double vault compost latrine								
Toilet directly over the water								
9	Type of waste disposal (<i>four levels with lowest level for the worst service</i>)	Collected by someone	0.7376	0.6045	0.5824	0.6029	0.5146	0.5138
Dumping in ponds and lakes								
Dumping in nearby site								
Landfill burial/burning								
10	Source of drinking water (<i>six levels with lowest level for the worst physical condition</i>)	Tap in house	0.4993	0.5214	0.5116	0.5058	0.4687	0.4288
Public tap								
Well								
Stream water								
Bought water								
Rain water								

Note: Positive (negative) values means that the relationship between the latent variable and the indicator are positive (negative).

Table 3: Number of households classified in three clusters of multidimensional deprivation

Level of Deprivation	Panel 2002-2004				Panel 2004-2006				Panel 2006-2008				Panel 2010-2012			
	2002	2004	Total	%	2004	2006	Total	%	2006	2008	Total	%	2010	2012	Total	%
Most deprived	2,991	2,933	5,924	75.35	2,788	2,379	5,167	68.47	2,511	2,138	4,649	59.07	2,192	2,012	4,204	52.89
Medium deprived	506	780	1,286	16.36	756	1,059	1,815	24.05	1,049	1,226	2,275	28.91	1,107	1,432	2,539	31.94
Least deprived	434	218	652	8.29	229	335	564	7.47	375	571	946	12.02	675	531	1,206	15.17
Total	3,931	3,931	7,862	100.00	3,773	3,773	7,546	100.00	3,935	3,935	7,870	100.00	3,974	3,975	7,949	100.00

Level of Deprivation	3-year panel 2002-2006					3-year panel 2004-2008				
	2002	2004	2006	Total	Percent	2004	2006	2008	Total	Percent
Most deprived	1,287	1,261	1,100	3,648	73.16	1,173	982	820	2,975	63.12
Medium deprived	201	322	439	962	19.29	303	456	541	1,300	27.58
Least deprived	174	79	123	376	7.54	95	133	210	438	9.29
Total	1,662	1,662	1,662	4,986	100.00	1,571	1,571	1,571	4,713	100.00

Table 4: Conditional-mixed process regression results for two-year-window panels

	2002-2004			2004-2006			2006-2008			2010-2012		
	Coef.	Std. Err.	P>z	Coef.	Std. Err.	P>z	Coef.	Std. Err.	P>z	Coef.	Std. Err.	P>z
Multidimensional poverty												
Index (MPI)												
Household size	***0.146	0.036	0.000	***0.094	0.033	0.004	0.042	0.027	0.117	***0.069	0.026	0.007
Working member ratio	**0.552	0.242	0.023	**0.419	0.183	0.022	**0.274	0.143	0.055	***0.673	0.142	0.000
Number of technical diplomas	***0.387	0.086	0.000	0.093	0.063	0.142	***0.273	0.058	0.000	***0.230	0.063	0.000
Rice yield (commune average)	0.051	0.070	0.465	*0.118	0.066	0.074	**0.110	0.054	0.039	***0.278	0.051	0.000
Rice yield * RRD	0.028	0.126	0.824	**0.233	0.108	0.032	***0.281	0.094	0.003	***0.384	0.100	0.000
Rice yield * MRD	0.207	0.173	0.232	**0.257	0.130	0.048	**0.225	0.099	0.023	***0.297	0.099	0.003
Number of hh members working in EOIs	***0.267	0.043	0.000	***0.305	0.040	0.000	***0.161	0.033	0.000	-0.00314	0.047	0.946
Number of commune people working in EOIs	0.00006	0.00006	0.295	**0.00013	0.00006	0.016	-0.00009	0.00007	0.217	0.00010	0.00007	0.175
Receives remittance from overseas	-0.053	0.219	0.810	0.043	0.178	0.808	***0.440	0.156	0.005	*0.289	0.165	0.080
In Red River Delta	-0.141	0.638	0.825	***1.502	0.567	0.008	***1.589	0.499	0.001	***2.225	0.526	0.000
In Mekong River Delta	**0.1.685	0.834	0.043	1.011	0.631	0.109	**1.088	0.497	0.029	***1.374	0.523	0.009

	2002-2004			2004-2006			2006-2008			2010-2012		
	Coef.	Std. Err.	P>z	Coef.	Std. Err.	P>z	Coef.	Std. Err.	P>z	Coef.	Std. Err.	P>z
<i>Rice income</i>	0.00001	0.00002	0.436	**0.00003	0.00001	0.024	0.00000	0.00001	0.97	*0.00001	0.00001	0.074
<i>Non-rice income</i>	***0.00002	0.00000	0.000	***0.00003	0.00000	0.000	***0.00002	0.00000	0.000	***0.00002	0.00000	0.000
Year dummy (latter year in panel)	***-0.459	0.098	0.000	***0.368	0.086	0.000	***0.409	0.070	0.000	0.098	0.086	0.256
Rice income												
In rural area	47.831	344.048	0.889	361.261	306.675	0.239	1267.143	860.950	0.141	1037.644	661.079	0.117
Head has secondary degree	**441.09	180.696	0.015	**401.213	162.610	0.014	***1172.810	420.111	0.005	*743.103	414.310	0.073
Head works in mining industry	-871.882	838.389	0.298	-986.933	924.298	0.286	-2159.719	2396.031	0.367	481.835	2120.726	0.820
Head works in manufacturing industry	** -911.423	391.291	0.020	** -557.164	295.379	0.059	** -1540.110	742.618	0.038	-294.951	609.539	0.628
Head works in service sector	***-808.472	220.242	0.000	***-702.136	195.006	0.000	** -1159.453	488.396	0.018	-80.930	456.333	0.859
Rice price (commune average)	*855.211	466.363	0.067	**1123.877	434.006	0.010	***2628.400	619.743	0.000	*1021.003	564.187	0.070
Rice price * RRD	97.633	113.652	0.390	-122.672	100.081	0.220	-142.115	230.912	0.538	-19.481	194.884	0.920
Rice price * MRD	***3340.5	163.585	0.000	***3301.35	157.082	0.000	***4861.77	372.616	0.000	***4542.1	308.947	0.000

	2002-2004			2004-2006			2006-2008			2010-2012		
	Coef.	Std. Err.	P>z	Coef.	Std. Err.	P>z	Coef.	Std. Err.	P>z	Coef.	Std. Err.	P>z
Ratio of rice-growing land area over commune's average	***4827.2	184.044	0.000	***4108.34	199.857	0.000	***5539.42	490.110	0.000	***4543.7	469.858	0.000
Sells rice to private traders	***686.67	187.485	0.000	***1612.96	187.700	0.000	443.107	453.649	0.329	n/a		
Grows rice and vegetables and annual industrial crops	** -491.1	223.454	0.028	-165.098	206.661	0.424	-697.008	526.640	0.186	***-2146.7	444.354	0.000
Grows rice and fruit, and perennial industrial crops	*-340.949	180.625	0.059	** -355.1	165.430	0.032	** -1021.42	413.329	0.013	** -849.68	386.918	0.028
Export Openness Index	865.459	611.931	0.157	16.212	436.826	0.970	670.819	932.951	0.472	673.264	646.724	0.298
Import Openness Index	-122.101	457.229	0.789	374.626	316.144	0.236	-173.152	755.424	0.819	-243.506	394.706	0.537
Intercept (Constant)	***-3856.0	945.325	0.000	***-4124.8	889.703	0.000	***-8697.58	1598.297	0.000	***-4757.7	1546.106	0.002
Non-rice income												
In rural area	***-1955.6	720.439	0.007	-969.374	1021.931	0.343	***-4126.5	1184.463	0.000	***-5399.1	1977.986	0.006
Head has secondary degree	***1999.99	365.835	0.000	***3231.59	524.889	0.000	***2800.6	554.887	0.000	***5643.1	1176.798	0.000
Head works in mining industry	***6198.25	1938.241	0.001	**7201.85	3055.834	0.018	***9026.7	3312.326	0.006	-4766.5	6275.255	0.448
Head works in manufacturing industry	*1417.39	811.780	0.081	*1854.204	978.029	0.058	***5545.2	1025.169	0.000	-340.1	1845.747	0.854

	2002-2004			2004-2006			2006-2008			2010-2012		
	Coef.	Std. Err.	P>z	Coef.	Std. Err.	P>z	Coef.	Std. Err.	P>z	Coef.	Std. Err.	P>z
Head works in service sector	***2540.9	477.408	0.000	1004.195	663.996	0.130	***3172.9	692.672	0.000	-1272.7	1408.788	0.366
Number of members with skilled-type jobs	***4207.5	217.676	0.000	***4400.49	277.247	0.000	***4721.4	293.119	0.000	***7870.1	508.071	0.000
Number of members with manual-type jobs	***1813.37	138.387	0.000	***1308.41	210.864	0.000	***1695.4	220.336	0.000	239.37	511.452	0.640
Number of members with other types of job	***4966.41	1063.339	0.000	***7517.48	1371.393	0.000	***5534.2	1549.821	0.000	***16473.9	3312.286	0.000
Grows rice and vegetable and annual industrial crops	***-2109.88	459.851	0.000	***-2178.5	641.930	0.001	** -1604.9	660.997	0.015	-1734.82	1235.538	0.160
Grows rice and fruit, and perennial industrial crops	***1421.33	376.150	0.000	567.681	547.880	0.300	***1622.0	568.690	0.004	303.68	1148.609	0.791
Export openness Index	***7618.94	1233.035	0.000	***11276.3	1376.101	0.000	***6801.5	1232.551	0.000	*3079.043	1852.285	0.096
Import openness Index	-942.589	921.341	0.306	-894.845	924.659	0.333	***2544.79	928.194	0.006	610.371	1100.277	0.579
Intercept (Constant)	***5534.74	897.404	0.000	***7267.49	1238.850	0.000	***8655.47	1391.736	0.000	***15817.4	2383.371	0.000
Number of observations	3,435			3,264			3,240			2,031		

Notes: n/a: not available. A positive coefficient implies that the independent variable reduces the probability of deprivation. Coefficient with (***) are significant at 1%; (**) significant at 5%; (*) significant at 10%.

Table 5: Conditional-mixed process regression results for three-year-window panels

	2002-2004-2006			2004-2006-2008		
	Coef.	Std. Err.	P>z	Coef.	Std. Err.	P>z
MPI						
Household size	0.053	0.054	0.320	0.054	0.040	0.177
Working member ratio	-0.277	0.285	0.332	***0.621	0.203	0.002
Number of technical diplomas	0.174	0.110	0.112	***0.224	0.075	0.003
Rice yield (commune average)	*0.182	0.098	0.064	**0.138	0.070	0.049
Rice yield * RRD	**0.367	0.176	0.037	-0.151	0.123	0.221
Rice yield * MRD	-0.135	0.218	0.534	*-0.270	0.146	0.064
Number of members working in EOIs	***-0.254	0.072	0.000	***-0.152	0.053	0.004
Number of commune people working in EOIs	***0.00023	0.000	0.004	**0.00021	0.000	0.040
Receives remittance from overseas	-0.242	0.288	0.401	**0.470	0.209	0.025
Red River Delta (RRD)	**2.226	0.926	0.016	*1.111	0.657	0.091
Mekong River Delta (MRD)	0.541	1.091	0.620	*1.184	0.704	0.092
Rice income	0.00002	0.00002	0.427	-0.00001	0.00001	0.495
Non-rice income	***0.00006	0.00001	0.000	***0.00002	0.00000	0.000
Year dummy1	***-0.605	0.149	0.000	***0.463	0.125	0.000
Year dummy2	0	(omitted)		***0.893	0.124	0.000
Rice income						
Household in rural area	636.49	408.66	0.119	823.02	1415.12	0.561
Head has secondary degree	326.09	221.60	0.141	*1317.24	704.33	0.061
Head works in mining industry	*-1901.71	1023.40	0.063	-2869.60	4668.41	0.539
Head works in manufacturing industry	**0.1105.93	444.34	0.013	-1119.48	1170.67	0.339
Head works in service sector	***-960.91	275.10	0.000	-993.70	813.28	0.222
Rice price (commune average)	**1169.03	572.16	0.041	***3556.26	1125.45	0.002
Rice price * RRD	-207.72	141.78	0.143	-252.84	393.44	0.520
Rice price * MRD	***3141.74	197.01	0.000	***6209.46	639.79	0.000
Ratio of rice cultivating area/commune's average	***5307.17	239.94	0.000	***7308.20	836.36	0.000

	2002-2004-2006			2004-2006-2008		
	Coef.	Std.	P>z	Coef.	Std.	P>z
		Err.			Err.	
Selling/bartering rice to/with private traders	***1246.56	228.37	0.000	-892.50	773.72	0.249
Grows rice, vegetables, and annual industrial crops	**_-590.24	290.70	0.042	-1008.17	882.79	0.253
Grows rice, fruit, and perennial industrial crops	**_-474.50	224.43	0.034	**_-1661.09	699.56	0.018
Export openness index	1050.54	664.56	0.114	989.13	1623.01	0.542
Import openness index	***1307.08	495.19	0.008	-296.13	1239.74	0.811
Intercept (Constant)	***_-5406.20	1191.94	0.000	***_-11125.2	2718.55	0.000
Non-rice Income						
Household in rural area	-1581.91	962.60	0.100	-600.69	1502.03	0.689
Head has secondary degree	***3210.99	490.86	0.000	***2883.27	723.51	0.000
Head works in mining industry	**6060.96	2458.70	0.014	6667.40	4971.84	0.180
Head works in manufacturing industry	**2319.82	1047.93	0.027	***3921.09	1250.73	0.002
Head works in service sector	*1240.54	650.28	0.056	**2066.45	894.23	0.021
Number of members with skilled jobs	***4887.86	277.90	0.000	***4091.20	367.46	0.000
Number of members with manual jobs	***1880.59	189.71	0.000	***1146.18	296.82	0.000
Number of members with other types of jobs	***6097.31	152.18	0.000	***6169.42	1929.87	0.001
Grows rice, vegetables, and annual industrial crops	***_-2437.14	626.55	0.000	**_-2088.10	867.37	0.016
Grows rice, fruit, and perennial industrial crops	***2025.79	514.42	0.000	1137.15	737.33	0.123
Export openness index	***8649.81	1480.06	0.000	***11039.88	1657.27	0.000
Import openness index	-1386.66	1090.85	0.204	1186.86	1147.80	0.301
Intercept (constant)	***5207.59	1203.70	0.000	***7068.96	1746.86	0.000
Number of observations	2,310			1,949		

Notes: n/a: not available. A positive coefficient implies that the independent variable reduces the probability of deprivation. Coefficient with (***) are significant at 1%; (**) significant at 5%; (*) significant at 10%.

Table 6: Comparing the estimated results of MPI vs. consumption expenditure per capita (CEPC) from CMP Regression Function

Variables	MPI function	CEPC function
Number of household's members working in EOIs	<ul style="list-style-type: none"> - Negative and statistically significant in the first three 2-year panels except for the last one for 2010-2012. - Negative and statistically significant in both 3-year panels. 	<ul style="list-style-type: none"> - 2-year panels: similar to the results of MPI function. - 3-year panels: similar to the results of MPI function, but statistically insignificant in the panel of 246.
Total number of commune's people working in EOIs	<ul style="list-style-type: none"> - Positive and statistically significant in two 2-year panels of 46 and 1012, but statistically insignificant in the other 2-year panels of 24 and 68. - Positive and statistically significant in both 3-year panels. 	<ul style="list-style-type: none"> - Positive effect but statistically insignificant in all panels.
Rice price (commune average)	<ul style="list-style-type: none"> - Positive and statistically significant on rice income in all panels, except for the first 2-year panel of 24 	<ul style="list-style-type: none"> - Similar to the results of MPI function.
Dummy of "selling rice/paddy to private traders"	<ul style="list-style-type: none"> - Positive and statistically significant in the first 2-year panels of 2002-2004 and 2004-2006, but insignificant for the panel of 2006-2008. - Positive effect and statistically significant in the first 3-year panel of 2002-2004-2006, but negative impact and statistically insignificant for the second 3-year panel of 2004-2006-2008. 	<ul style="list-style-type: none"> - Similar to the results of MPI function.
Export openness index (provincial level)	<ul style="list-style-type: none"> - Positive impact but statistically insignificant for <i>rice income</i> in all panels. - Positive and statistically significant for <i>non-rice income</i> in all panels. 	<ul style="list-style-type: none"> - Similar to the results of MPI function.
Import openness index (provincial level)	<ul style="list-style-type: none"> - <i>For rice income function:</i> + negative impact and statistically insignificant in four out of six panels for rice income function. 	<ul style="list-style-type: none"> - Similar to the results of MPI function.

Variables	MPI function	CEPC function
	<ul style="list-style-type: none"> + Positive effect and statistically significant in the 3-year panel of 2002-2004-2006. - <i>For non-rice income function:</i> + Negative impact but statistically insignificant for the two panels of 2002-2004 and 2004-2006 + Positive impact in the other two panels of 2006-2008 and 2010-2012 	
Rice income	<ul style="list-style-type: none"> - Increases the probability of rice-growing households being less deprived in the first two 2-year panels, but statistically significant only in the panel of 2004-2006. - Not necessarily decreasing the probability of rice-growing households being less deprived in the other two 2-year panels of 2006-2008 and 2010-2012. - For the 3-year panels, the coefficients are both statistically insignificant, but positive for the panel of 2002-2004-2006 and negative for the panel of 2004-2006-2008. - The magnitude of effect is very small in all panels. 	<ul style="list-style-type: none"> - Positive impact on real consumption expenditure per capita for three out of four 2-year panels, except for the panel of 2010-2012. - The impact is statistically significant for the period from 2002 to 2006 but insignificant for the period from 2006 to 2012. - Magnitude of effect is quite small in all panels.
Non-rice income	<ul style="list-style-type: none"> - Increased the probability of households being less deprived over time (shown by positive and statistically significant coefficients in all panels) - Magnitude of coefficient is quite small 	<ul style="list-style-type: none"> - Has positive and statistically significant impact on the real consumption expenditure per capita over time. - Magnitudes of coefficients are quite small.

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