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Trade liberalisation, poverty, and inequality in Vietnam: a quantile regression approach

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ABSTRACT
This study examines the effects of trade liberalisation on rural household welfare, poverty, and inequality in Vietnam, with the use of multiple estimation strategies, including the panel quantile regression approach based on Canay's two-step estimator. Taking account of the multi-faceted nature of trade liberalisation, we consider a set of household-level trade-related variables, including employment in export, import-competing, and manufacturing sectors. A unique panel data set is constructed from the Vietnam Household Living Standards Surveys conducted in 2002, 2004 and 2006. We find that employment in trade-related sectors contributes significantly to rural household welfare. Moreover, the effects of trade-related employment on welfare are heterogeneous across the welfare/income distribution, in that trade-related employment sectors have different influences on different groups/quantiles of households.

KEYWORDS
Trade liberalisation; poverty; inequality; quantile regression; rural households; Vietnam

JEL CLASSIFICATION
C23; F16; I32; O12; O24; P36

I. Introduction

This paper investigates how trade liberalisation influences household welfare and poverty, and whether such influence varies across different income groups, using the case study of Vietnam. The literature on the relationship between trade liberalisation and household welfare is abundant, but to date has dealt mainly with conditional mean relationships based on classical linear regression models (Frankel and Romer 1999; Seshan 2005; Ravallion 2006). Yet it is possible that households at different levels of income may be affected differently by trade liberalisation – for example, richer households may conceivably stand to gain more than poor households. A clear understanding of these effects, including their potential heterogeneity, would potentially be of assistance to policymakers who wish to adopt effective and equitable economic policies.

This paper utilises the quantile regression approach developed by Koenker and Bassett (1978) and Canay (2011) to address the issue of heterogeneity. As quantile regression extends the conventional linear model's estimation of the covariate effect, thus covering the entire distribution of the response variable, it is suitable for examining whether trade liberalisation influences low-income households in the same way as middle- and high-income households.

Since the mid-1980s, when Vietnam embarked on a transitional path, it has transformed from a centrally planned economy (CPE) into an open market economy, and in the process has attained some remarkable achievements in terms of inflation control, economic growth performance, and poverty reduction. Observers tend to regard economic liberalisations, including trade liberalisation, as the main driver of these achievements (see, for example, Glewwe, Agrawal, and Dollar (2004); World Bank (2005); World Bank (2011)). Yet confirmation of a linkage between liberalisation and poverty reduction does not resolve the question of whether households at different income levels benefit differently from liberalisation. To our knowledge, previous empirical research has not addressed the possible heterogeneity of these effects of trade liberalisation in the context of Vietnam (although Nguyen et al. (2007)

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examine heterogeneity, using quantile regression to analyse the rural–urban gap in income distributions, they do not specifically deal with trade liberalisation).

For our purposes, the term *economic liberalisation* refers to a country's removal or reductions of barriers, restrictions, and regulations over economic activities in general. In this paper, we are specifically interested in *trade liberalisation*, that is, a general opening to the rest of the world, or a lowering of barriers to international trade and investment. In the literature, this is often gauged in terms of an increase in *trade openness*, or the *trade ratio* which is defined as the ratio of exports plus imports to the gross domestic product (GDP). This simple aggregate measure of openness, however, is incapable of distinguishing varying degrees of trade exposure across households.

To obtain a richer understanding of the trade-poverty nexus, therefore, we analyse a set of household-level data including, in particular, household expenditure per capita. The data also include (international) trade-related variables – especially local employment in export, import-competing, and other manufacturing sectors. In this regard, we essentially follow Justino, Litchfield, and Pham (2008) but with some differences in emphasis; further details are provided in Section 3 below. A panel dataset is constructed from the Vietnam Household Living Standards Surveys (VHLSS) conducted biennially by the General Statistics Office (GSO) of Vietnam during the period 2002–2006.

It is found that trade liberalisation (as represented by local employment in export sector, import-competing sector, and other manufacturing) has significant effects on household expenditure/welfare. This finding is consistent with the claims of McCulloch, Winters, and Cirera (2001), Winters (2002), and Winters, McCulloch, and McKay (2004) that the impacts of trade liberalisation on (poor) households are multi-channeled. More importantly, we find that the effects vary considerably across different income/welfare groups, in that some channels are stronger than others for particular groups of households. The remainder of the paper is organised as follows. Section 2 provides some background on trade liberalisation, poverty and inequality in Vietnam. Section 3 describes the research methods and data used in the study. Section 4 reports and discusses the empirical results, and Section 5 concludes the paper.

II. Trade liberalisation and poverty in Vietnam

As part of the *Doi Moi* ('Renovation') process, Vietnam has increasingly been integrated into the Asia-Pacific and world economies. The trade ratio increased sharply from less than 10 per cent in the early-1980s to more than 100 per cent in the 2000s. Annual growth in real GDP per capita averaged around 5.6 per cent during the 2000s. Poverty was reduced substantially at both aggregate and provincial levels: the poverty ratio fell from 58.1 per cent in the early-1990s to 14.5 per cent by 2008, thus realising one of the UN-proposed millennium development goals (MGDs)[1] well before the proposed deadline. In 2010, Vietnam became recognised as a *lower-middle* income country according to the World Bank's classification; prior to this it had been classified as a *low-income* country (World Bank 2012).

The contribution of trade liberalisation to economic growth and poverty reduction in Vietnam has been examined in numerous studies. Minot (1998) and Ghosh and Whalley (2004) provide early evidence that price controls on rice production dampened costly domestic adjustments to volatile world prices. Despite such probable advantages of price controls, subsequent research suggests that being exposed to world price volatility through trade liberalisation may bring substantial net benefits. For example, Seshan (2005) finds that trade reform accounts for about one-half of the reduction in poverty amongst farm households. Moreover, Niimi, Vasudeva-Dutta, and Winters (2007), using a multinomial logit model, find that trade liberalisation benefits *both* rural and urban households in Vietnam.

McCulloch, Winters, and Cirera (2001), Winters (2002), Winters (2004) and Winters, McCulloch, and McKay (2004) argue that, in general, trade liberalisation may affect poverty through four channels, namely economic *growth*,

[1]To reduce by half the proportion of people with less than $1.25 a day between 1990 and 2015.

market distribution, *employment*, and *government* revenue. Glewwe, Gragnolati, and Zaman (2002) and Justino, Litchfield, and Pham (2008) employ a model of micro-determinants of growth to investigate the impacts of price and employment on household welfare in Vietnam: they find that trade liberalisation contributes to poverty reduction via the labour market (*employment*) channel. Similarly, Coello, Fall, and Suwa-Eisenmann (2010) conclude that improved *employment* in Vietnam's export sector has a positive impact on poverty. Heo and Nguyen (2009) find evidence that in Vietnam the increase in *government* revenue from trade taxes has partially been channeled into poverty-reducing activities. M. S. Le, Singh, and Nguyen (2015) conclude that trade liberalisation affects welfare and poverty in Vietnam via *all four* of the above channels, in line with the finding of Winters and Martuscelli (2014) for other countries.

Given the abundant empirical evidence, there can be little doubt that trade liberalisation has a positive effect on household welfare in Vietnam. However, as pointed out in the previous section, since all these studies rely on classical linear regressions, the effects that they measure apply to the 'average' household (i.e., the mean effect), and in principle may be quite different from the effects on households that are much poorer or richer than average.

III. Methods and data

Methods

Modelling approach to welfare and poverty

Tracing poverty reduction and inequality to the multidimensional effect of trade liberalisation is complex. As Ravallion (1998) and Haughton and Khandker (2009) point out, cross-sectional regression analysis is by far the most widespread tool used in identifying the contributions of different variables to poverty reduction. Typically, this line of analysis employs the income equation that postulates real income as a function of observed household characteristics. Recent studies – such as Glewwe, Gragnolati, and Zaman (2000) and Justino, Litchfield, and Pham (2008) – are based on a model of micro-determinants of growth, estimated using a set of panel data. In essence, these recent studies attempt to capture the dynamics of welfare/poverty under the impact of a wide range of variables.

This study employs a model of micro-determinants of welfare, expressed formally as:

$$\log(y) = X\beta + u \tag{1}$$

where $\log(y)$ is the dependent variable in logarithm, X is a vector of independent variables, β represents a vector of unknown parameters, and u is the error term. Following the monetary approach, this study uses real consumption expenditure per capita (RPCE) to measure welfare and poverty (y).[2] Many authors consider RPCE a better proxy for welfare than income, since it shows what people actually *spend* on their needs, from their available income (Deaton and Zaidi 2002; UNDP 2005; Haughton and Khandker 2009).

Our model incorporates two broad groups of independent variables: (a) trade-related variables, to capture the effects of trade liberalisation, and (b) other variables, to control for the influences of household characteristics and factors unrelated to trade. The latter variables include demographic traits (e.g., household size; age of household head; and ratios of children, the elderly, and female family members), human capital (the levels of education of the household head and his/her spouse), living conditions (total household living area), and so on. The variables used in our analysis, and their descriptive statistics, are summarised in Table 1.

Following Justino, Litchfield, and Pham (2008), agricultural production, local trade, and sectoral employment have all been considered potential trade-related variables. As this study is about the effects of liberalising *international* trade, it is appropriate to highlight the sectoral employment variables which are closely linked with exports and imports. In Table 1, these variables are listed on the last three lines: the relevant data refer to the commune where each household resides. *Export* employment ratio is calculated as the number of people in the commune employed in export activities divided by the commune's total population.

[2]See the UNDP (2005) for more discussions about the approaches to measuring poverty.

Table 1. Descriptive statistics of the model variables.

Variables	Unit	Panel 2002–2004–2006, n = 2,469 Mean	Standard deviation
Real expenditure per capita	Thousand VND	3,370.62	1,999.934
Household size	Person	4.554	1.618
Head age	Year	47.775	12.691
Proportion of children	Per cent	18.025	19.397
Proportion of elderly	Per cent	9.527	21.126
Proportion of females	Per cent	46.211	17.838
Heads' years of school	Year	6.888	3.280
Spouses' years of school	Year	5.405	3.866
Total living area	m^2	57.890	31.266
Total land area	m^2	9,222.93	17,690.63
Rice productivity	Kg/m^2	0.477	0.119
Total retail sales per capita	Million VND	3.216	2.141
Export employment ratio[a]	Per cent	2.837	6.150
Import employment ratio[a]	Per cent	1.204	4.017
Manufacturing employment ratio[a]	Per cent	6.769	10.682

[a] Data refer to the commune where the household resides.

Import and manufacturing employment ratios are calculated in a similar way for *import-competing*, and *other manufacturing* activities in Vietnam's industrial classification. The export grouping includes seafood, food processing, garments and shoes, rubber and plastic products; the import-competing grouping covers textiles, leather, chemical, metals, and machinery[3]; and the 'other manufacturing' classification encompasses mining and consumer electronics.

It can be seen readily that the three sectoral employment variables listed above are far more directly related to international trade than any of the other variables in Table 1. Trade liberalisation is expected to increase employment in these trade-related activities. In turn, rises in trade-sector employment ratios are hypothesised to increase household expenditure and welfare; the null hypothesis is that the relevant coefficients are zero.

Fixed-effects model with panel data

The fixed-effects model emerges if the time-invariant unobserved or omitted effects, c_i, in the general model:

$$y_{it} = x_{it}^{'}\beta + c_i + \varepsilon_{it} \tag{2}$$

are presumably correlated with the explanatory variables. In contrast, the random-effects model assumes that the unobserved effects are uncorrelated with the independent variables. In practice, the fixed-effects assumption is more flexible and suitable for economic modelling. This study employs the fixed-effects model to analyse differences across groups of households under the influences of trade liberalisation.

Quantile regression

The model of micro-determinants of growth can be extended to examine the impacts of trade liberalisation on welfare/income distribution. Compared with conventional linear regression, the quantile regression method is capable of providing a more comprehensive picture of the relationship between the outcome Y and the regressors X at different points in the conditional distribution of Y. Koenker and Bassett (1978) introduce a new class of statistics for the linear model termed 'regression quantiles', which extend the classical least squares estimation of conditional mean models to the estimation of an ensemble of models for several conditional quantile functions. According to Koenker and Hallock (2001), the unconditional quantiles can be defined as an optimisation problem given by:

$$\min_{\xi \in R} \sum_{i=1}^{n} \rho_\tau (y_i - \xi), \tag{3}$$

where the $\rho_\tau(.)$ is called the titled absolute value function. Solving this optimisation would yield the solution for the τth sample quantile. For quantile regression, replacing the scalar ξ in equation (3) by the function $\xi(x_i, \beta)$ and the estimates of the conditional quantiles would be obtained by solving:

$$\min_{\beta \in R^p} \sum_{i=1}^{n} \rho_\tau \left(y_i - \xi(x_i, \beta)\right). \tag{4}$$

Technically, the minimisation of (4) can be solved by linear programming methods, with $\xi(x_i, \beta)$ being formulated to be a parametric linear function. Deaton (1997) posits that the properties of the estimates from quantile regression are better than those obtained from the OLS, in terms of the way to assess heteroscedasticity in the conditional distribution of y.

Combination of panel data, quantile regression, and fixed-effects model

Although numerous methods have been developed to use panel data and quantile regression

[3]The export sectors and import-competing sectors are suggested by Niimi, Vasudeva-Dutta, and Winters (2007).

separately, little work has been done on the combination of panel fixed-effects and quantile regression, as the combination of the two remains challenging (Abrevaya and Dahl 2008).

This study follows the two-step approach of Canay (2011) by considering the model:

$$y_{it} = x_{it}^{'}\theta(U_{it}) + \alpha_i, \ i = 1, \ldots, \ n, \ t = 1, \ldots, T, \tag{5}$$

where (U_{it}, α_i) are unobservable. The main difference between the model in equation (5) and the standard quantile regression model of Koenker and Bassett (1978) is the inclusion of a time-invariant unobserved factor α_i. The unknown parameters $\theta(\tau)$ can be identified and consistently estimated from the data under certain conditions on (U_{it}, α_i), specified in Canay (2011).

Let $Q_Z(\tau \mid A)$ denote the τ-quantile of a random variable Z that is conditioned on other variable A. Define $e_{it}(\tau) \equiv x_{it}^{'}[\theta(U_{it}) - \theta(\tau)]$ and equation (5) can be re-written as:

$$y_{it} = x_{it}^{'}\theta(\tau) + \alpha_i + e_{it}(\tau), \ Q_{e_{it}(\tau)}(\tau|x_i) = 0. \tag{6}$$

This equation implies that only $\theta(\tau)$ and $e_{it}(\tau)$ depend on τ. Canay (2011) assumes that α_i is a location shift and lets $u_{it} \equiv x_{it}^{'}\left[\theta(U_{it}) - \theta_\mu\right]$, so a conditional mean equation for y_{it} can be expressed as:

$$y_{it} = x_{it}^{'}\theta_\mu + \alpha_i + u_{it}, \ E(u_{it}|x_i, \alpha_i) = 0. \tag{7}$$

Equation (7) suggests that α_i is also present in the conditional mean of y_{it}. Assume that $\hat{\theta}_\mu$ is a $\sqrt{nT}$-consistent estimator of θ_μ (such as the standard fixed-effects estimation) and define $\hat{\alpha}_i \equiv \mathbb{E}_T[y_{it} - x_{it}^{'}\hat{\theta}_\mu]$. $\theta(\tau)$ is then estimated by a quantile regression of the random variable $\hat{y}_{it} \equiv y_{it} - \hat{\alpha}_i$ on x_{it}.

In essence, the estimation is done by firstly estimating the conditional mean of u_{it} and subtracting this conditional mean from the dependent variable y_{it} to obtain a new dependent variable. Then, the new dependent variable is modelled on the independent variables by quantile regression. This two-step estimator appeals to researchers for, among other things, its computational simplicity.

Data

This study makes use of the Vietnam Household Living Standards Surveys (VHLSSs). Relative to other data available for Vietnam, VHLSS data are regarded as being of high quality and providing large sample sizes. The VHLSSs are nationwide surveys, conducted by Vietnam's General Statistics Office (GSO) under the technical auspices of the World Bank. The survey methodology is based on the World Bank's Living Standards Measurement Study (LSMS). The surveys contain information on households and communes. Each survey round has its own core module topic, based on a basket of core module topics. Since 2002, the surveys have been conducted every two years.

This paper uses data from the survey waves of 2002, 2004 and 2006. The sample period 2002–2006 is considered appropriate for studying the effects of trade liberalisation in Vietnam, for two main reasons. Firstly, during this period the pace of trade reforms quickened as Vietnam prepared for its accession to the World Trade Organisation (WTO) in 2007. Secondly, economic conditions were relatively stable for Vietnam during this period: its economy had emerged from the aftermath of the 1998 Asian financial crisis, but had not yet been affected by the shocks associated with the 2007–2008 Global Financial Crisis.

The samples are representative of regions, urban areas, rural areas, and provinces. The VHLSS samples cover 75,000 households in 2002 and 45,945 households in 2004 and 2006, in over 3,063 communes/wards. However, data on variables of interest to us are not available for many households in each survey. We thus work with the various questionnaires to compile lists of common/compatible variables across the surveys. The samples used in our analysis include 19,881 households covered in the 2002 survey wave, 4,464 households in the 2004 wave, and 4,384 households in the 2006 wave.

According to Le and Pham (2009), from the above samples it is possible to form a data panel for 3,931 households linking 2002 and 2004 data; for 4,193 households linking 2004 and 2006; and for 1,844 households linking 2002, 2004, and 2006. This study constructs a long form of the data panel, covering 1,844 households that were included in all three waves: 2002, 2004, and 2006. The process is laborious, and involves repeated mergings of subsets of data, with the number of observations being reduced at each merging, as households with missing data for essential variables are dropped. The final data panel used in our analysis covers 823 rural households, each of which was included in all three waves and provided usable data on all variables of essential interest to the analysis.

IV. Empirical results

Quantile regression

To provide a feel for the data, this subsection compares quantile and OLS regression results for, in turn, the 2002 and 2006 sets of cross-sectional data. Table 2 presents results for the 2002 regressions, where the dependent variable is the log of real per capita expenditure (RPCE), representing household welfare (and is expected to be highly correlated with household income).

The coefficient estimates obtained via OLS are presented in the first data column. They are broadly consistent with prior expectations and previous findings. For example, both the household head's investment in education (years of schooling) and that of his/her spouse are significantly and positively related to household welfare. Of most interest to our present purposes are the coefficients for export, import and manufacturing employment ratios: the OLS estimates suggest that increasing employment in export and manufacturing activities within the local commune would tend to increase the welfare (and presumably reduce poverty) of the average household, while increasing employment in import-competing activities would have no significant effect.

Table 2. Quantile and OLS estimates of the impacts of trade openness on real per capita expenditure [Cross-sectional regressions, VHLSS 2002] [Dependent variable: log of RPCE].

		Quantile		
Independent variable	OLS	25th quantile	50th quantile	75th quantile
Constant term	6.7344a	6.4348a	6.6960a	6.9263a
	[0.0363]	[0.0438]	[0.0389]	[0.0476]
Household size	−0.0910a	−0.0827a	−0.0952a	−0.1031a
	[0.0023]	[0.0024]	[0.0022]	[0.0027]
Head age	0.0291a	0.0289a	0.0286a	0.0282a
	[0.0016]	[0.0019]	[0.0017]	[0.0021]
Head age square	−0.0002a	−0.0002a	−0.0002a	−0.0002a
	[0.0000]	[0.0000]	[0.0000]	[0.0000]
Proportion of children	−0.0018a	−0.0009a	−0.0014a	−0.0024a
	[0.0002]	[0.0003]	[0.0002]	[0.0003]
Proportion of elderly	−0.0021a	−0.0017a	−0.0022a	−0.0024a
	[0.0002]	[0.0002]	[0.0002]	[0.0003]
Proportion of females	0.0012a	0.0011a	0.0008a	0.0017a
	[0.0002]	[0.0002]	[0.0002]	[0.0002]
Heads' years of school	0.0332a	0.0279a	0.0304a	0.0360a
	[0.0012]	[0.0014]	[0.0012]	[0.0015]
Spouses' years of school	0.0183a	0.0220a	0.0192a	0.0158a
	[0.0011]	[0.0013]	[0.0011]	[0.0014]
Total living area	0.0017a	0.0020a	0.0028a	0.0037a
	[0.0003]	[0.0001]	[0.0001]	[0.0001]
Total land area	0.0002a	0.0002a	0.0002a	0.0002a
	[0.0000]	[0.0000]	[0.0000]	[0.0000]
Rice productivity	−0.0013**	−0.0002**	−0.0007a	−0.0013a
	[0.0006]	[0.0001]	[0.0001]	[0.0001]
Export employment	0.0044a	0.0043a	0.0051a	0.0048a
	[0.0006]	[0.0007]	[0.0006]	[0.0007]
Import employment	0.0008	0.0005	0.0011	0.0013
	[0.0010]	[0.0013]	[0.0011]	[0.0012]
Manufacturing employment	0.0057a	0.0061a	0.0064a	0.0056a
	[0.0004]	[0.0005]	[0.0004]	[0.0005]
Retail sales per capita	0.2506a	0.2514a	0.2448a	0.2226a
	[0.0071]	[0.0092]	[0.0079]	[0.0093]
R^2	0.328			
Pseudo R^2		0.189	0.187	0.191
Number of observations	19,881	19,881	19,881	19,881

Notes:
a,**, and *: Significant at 1% level, 5% level, and at 10% level, respectively.
Figures in brackets are standard errors.

Estimates obtained via quantile regressions are presented in the last three columns of this table. They suggest that in 2002 there is some, but not a great deal of, heterogeneity in the employment-welfare relationship across households in various quantiles. For example, the quantile export employment coefficients range from 0.43 per cent for the 25th percentile regression, to 0.48 per cent for the 75th percentile regression, and 0.51 per cent for the median regression. The corresponding OLS estimate is 0.44 per cent for the 'average' household.

In contrast, it appears that there is much greater heterogeneity in the 2006 regressions (see Table 3). For example, the quantile export employment coefficient is 0.40 per cent for the 25th percentile regression, but drops to 0.23 per cent for the median regression, and becomes insignificant for the 75th percentile regression. Estimates of the manufacturing employment coefficient indicate a progression in the opposite direction: from 0.50 per cent for the 75th to 40 per cent for both the median and 25th percentile regressions. Estimates of the import-competing employment coefficient are statistically insignificant for all three quantile regressions.

Table 3. Quantile and OLS estimates of the impacts of trade openness on real per capita expenditur [Cross-sectional regressions, VHLSS 2006] [Dependent variable: log of RPCE].

		Quantile		
Independent variable	OLS	25th quantile	50th quantile	75th quantile
Constant term	7.5624a	7.3221a	7.6403a	7.8412a
	[0.0967]	[0.1237]	[0.1220]	[0.1340]
Household size	−0.0880a	−0.0843a	−0.0849a	−0.0923a
	[0.0044]	[0.0054]	[0.0055]	[0.0062]
Head age	0.0087**	0.0061	0.0024	0.0095*
	[0.0036]	[0.0045]	[0.0045]	[0.0049]
Head age square	0.0000	−0.0000	0.0000	0.0000
	[0.0000]	[0.0000]	[0.0000]	[0.0000]
Proportion of children	−0.0049a	−0.0046a	−0.0052a	−0.0053a
	[0.0004]	[0.0005]	[0.0005]	[0.0005]
Proportion of elderly	−0.0022a	−0.0010**	−0.0025a	−0.0025a
	[0.0004]	[0.0005]	[0.0005]	[0.0005]
Proportion of females	0.0000	−0.0001	0.0000	−0.0002a
	[0.0003]	[0.0004]	[0.0004]	[0.0005]
Heads' years of school	0.0293a	0.0287a	0.0309a	0.0309a
	[0.0023]	[0.0028]	[0.0028]	[0.0032]
Spouses' years of school	0.0107a	0.0130a	0.0099a	0.0076a
	[0.0020]	[0.0024]	[0.0025]	[0.0029]
Total living area	0.0043a	0.0042a	0.0044a	0.0043a
	[0.0002]	[0.0003]	[0.0003]	[0.0003]
Total land area	0.0002a	0.0002a	0.0002a	0.0002a
	[0.0000]	[0.0000]	[0.0000]	[0.0000]
Rice productivity	0.5683a	0.7251a	0.6310a	0.4663a
	[0.0559]	[0.0693]	[0.0703]	[0.0780]
Export employment	0.0027a	0.0040a	0.0023*	0.0023
	[0.0010]	[0.0013]	[0.0013]	[0.0014]
Import employment	−0.0003a	−0.0011	0.0000	0.0000
	[0.0017]	[0.0021]	[0.0020]	[0.0020]
Manufacturing employment	0.0046a	0.0040a	0.0040a	0.0050a
	[0.0007]	[0.0009]	[0.0009]	[0.0009]
Retail sales per capita	0.2480a	0.2575a	0.2516a	0.2213a
	[0.0148]	[0.0189]	[0.0191]	[0.0211]
R^2	0.397			
Pseudo R^2		0.239	0.228	0.217
Number of observations	4,384	4,384	4,384	4,384

Notes:
a,**, and *: Significant at 1% level, 5% level, and at 10% level, respectively.
Figures in brackets are standard errors.

In summary, cross-sectional regressions suggest that trade openness (as measured by employment in export, import-competing, and other manufacturing activities) has varying impacts on household welfare in 2002 and 2006. Export employment and manufacturing employment tend to increase household welfare, while the effect of import-competing employment is ambiguous. Quantile regressions indicate that these effects are heterogeneous across the welfare/income distribution: manufacturing employment tends to have a greater impact on higher-expenditure households, whilst export employment tends to benefit lower-expenditure households more. Although these cross-sectional results are informative, it should be kept in mind that combining the available data into a panel would generally be expected to provide a statistically superior understanding of the relationships of interest.

Panel-data fixed-effects models

In using panel data, there is the potential problem of unobserved heterogeneity that may arise in the pooled OLS (PLS) model: to address this issue we use the fixed-effects (FE) model. Table 4 presents estimates of the determinants of rural household welfare using the PLS and FE models, and panel data for 2002–2004–2006. The PLS model accounts for almost 41 per cent of the variations in household welfare; the FE model accounts for 47 per cent of such variations.

The estimated effects of export, import, and manufacturing employment on household welfare do not vary greatly across the two regressions. On average, holding all other variables constant, an increase of 1 per cent in the proportion of the local commune's population being employed in export activities would tend to raise real expenditure per head by about 0.33–0.35 per cent. The corresponding figure for manufacturing employment is 0.40 per cent. In

Table 4. Estimates of the pooled OLS and fixed-effects models for the impacts of trade openness on real per capita expenditure [Panel regressions, VHLSS 2002–2004–2006] [Dependent variable: log of RPCE].

	Pooled OLS Model		Fixed-Effects Model	
Independent variable	Coefficient	Standard errors	Coefficient	Standard errors
Constant term	6.4271a	0.1163	6.6083a	0.1107
Household size	−0.1038a	0.0061	−0.0930a	0.0059
Head age	0.0343a	0.0048	0.0289a	0.0045
Head age square	−0.0002a	0.0000	−0.0002a	0.0000
Proportion of children	−0.0015a	0.0005	−0.0034a	0.0005
Proportion of elderly	−0.0026a	0.0006	−0.0026a	0.0005
Proportion of females	0.0005	0.0005	−0.0003	0.0005
Heads' years of school	0.0269a	0.0033	0.0241a	0.0032
Spouses' years of school	0.0108a	0.0028	0.0099a	0.0026
Total living area	0.0036a	0.0005	0.0035a	0.0005
Total land area	0.0002a	0.0000	0.0002a	0.0000
Rice productivity	0.5125**	0.0696	0.3915a	0.0683
Export employment	0.0035**	0.0014	0.0033**	0.0013
Import employment	0.0038*	0.0022	0.0042**	0.0020
Manufacturing employment	0.0040a	0.0010	0.0040a	0.0010
Retail sales per capita	0.0779a	0.0056	0.0489a	0.0049
Time dummy (reference is year 2002)				
Year 2004			0.1840a	0.0198
Year 2006			03884a	0.0220
R^2	0.406		0.473	
Number of observations	2,469		2,469	

Notes:
a,**, and *: Significant at 1% level, 5% level, and at 10% level, respectively.

contrast to the 2002 cross-sectional results, panel-data results suggest that import-competing employment has a significant and positive effect, with an estimated coefficient of 0.38–0.42 per cent.

For completeness, we conduct the F test, defined in (8) below, to ascertain whether the FE model is more suitable than PLS:

$$F(n-1,\ nT-n-k)=\frac{\frac{\left(R^2_{FE}-R^2_{Pooled}\right)}{n-1}}{\frac{\left(1-R^2_{FE}\right)}{nT-n-k}}. \qquad (8)$$

The calculated F ratio is 155.9 (with p-value being 0.000), confirming that FE is preferred.

Combination of fixed-effects and quantile regression

In this subsection, we investigate the possible heterogeneity of the above FE estimates, by using the two-step panel-data quantile regression estimator developed by Canay (2011). The estimation results are reported in Table 5. Consistent with the estimates previously presented in Table 4, most of the trade-related employment coefficients in Table 5 are significant and positive.

More interestingly, and in keeping with the cross-sectional estimates for 2006 (reported in Table 3), the quantile trade employment coefficients in Table 5 clearly exhibit heterogeneity across quantiles. For example, the export employment coefficient is 0.56 per cent for the 10^{th} percentile regression, but steadily drops for regressions pertaining to higher percentiles, reaching 0.32 per cent for the median regression and turning negative (but insignificant) for the 90^{th} percentile regression. By contrast, the manufacturing employment coefficient is far higher (at 0.91 per cent) for the 90^{th} percentile regression than for the other regressions – e.g. 0.37 per cent and 0.34 per cent for the 10^{th} and 25^{th} percentile regressions, respectively. The coefficient for import-competing employment varies across quantile regressions in a manner more similar to that of export, than manufacturing, employment.

V. Concluding remarks

This paper examines the effects of international trade, through trade-related employment, on rural household welfare in Vietnam, in the hope of shedding further light on the trade–poverty–inequality nexus. The analysis employs a variety of estimation approaches, including cross-sectional OLS and quantile regressions, panel-data fixed-effects model, and

Table 5. Fixed-effects quantile estimates of the impacts of trade openness on real per capita expenditure [Panel regressions, VHLSS 2002–2004–2006] [Dependent variable: log of RPCE].

	Quantile fixed-effects regression				
Independent variable	10th quantile	25th quantile	50th quantile	75th quantile	90th quantile
Constant term	6.4759a	6.7384a	6.6749a	6.8698a	7.2479a
	[0.1941]	[0.0934]	[0.1593]	[0.2323]	[0.1734]
Household size	−0.0989a	−0.0950a	−0.0833a	−0.0904a	−0.1011a
	[0.0102]	[0.0066]	[0.0042]	[0.0079]	[0.0060]
Head age	0.0211a	0.0194a	0.0312a	0.0339a	0.0345a
	[0.0074]	[0.0040]	[0.0074]	[0.0091]	[0.0060]
Head age square	−0.0001**	−0.0001a	−0.0002a	−0.0003a	−0.0003a
	[0.0001]	[0.0000]	[0.0001]	[0.0001]	[0.0001]
Proportion of children	−0.0022	−0.0026**	−0.0037a	−0.0039a	−0.0049a
	[0.0017]	[0.0012]	[0.0014]	[0.0010]	[0.0007]
Proportion of elderly	−0.0029a	−0.0025a	−0.0027a	−0.0021a	−0.0013
	[0.0005]	[0.0004]	[0.0005]	[0.0002]	[0.0008]
Proportion of females	−0.0004	0.0000	−0.0005	−0.0005	0.0004
	[0.0004]	[0.0003]	[0.0005]	[0.0003]	[0.0004]
Heads' years of school	0.0222a	0.0245a	0.0260a	0.0296a	0.0211a
	[0.0025]	[0.0038]	[0.0034]	[0.0040]	[0.0024]
Spouses' years of school	0.0144a	0.0133a	0.0111a	0.0073a	0.0100a
	[0.0017]	[0.0014]	[0.0020]	[0.0025]	[0.0023]
Total living area	0.0025a	0.0037a	0.0041a	0.0044a	0.0042a
	[0.0007]	[0.0009]	[0.0006]	[0.0001]	[0.0006]
Total land area	0.0002a	0.0002a	0.0002a	0.0002a	0.0002a
	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
Rice productivity	0.6650a	0.4308a	0.3644a	0.3220a	0.1129a
	[0.0672]	[0.1329]	[0.1067]	[0.0238]	[0.0413]
Export employment	0.0056a	0.0055a	0.0032a	0.0022a	−0.0023
	[0.0009]	[0.0012]	[0.0011]	[0.0006]	[0.0016]
Import employment	0.0037**	0.0034*	0.0056a	0.0048**	−0.0002
	[0.0018]	[0.0019]	[0.0019]	[0.0020]	[0.0024]
Manufacturing employment	0.0034a	0.0029a	0.0022a	0.0027	0.0091a
	[0.0007]	[0.0006]	[0.0004]	[0.0018]	[0.0012]
Retail sales per capita	0.0418a	0.0406a	0.0545a	0.0556a	0.0558a
	[0.0066]	[0.0107]	[0.0073]	[0.0067]	[0.0070]
Pseudo R^2	0.2280	0.2049	0.2081	0.2124	0.2261
Number of observations	2,469	2,469	2,469	2,469	2,469

Notes:
a,**, and *: Significant at 1% level, 5% level, and at 10% level, respectively.
Figures in brackets are bootstrap standard errors.

two-step panel-data quantile regressions following Canay (2011).

The estimation results indicate that trade-related employment tends to increase real per capita expenditure (RPCE) and, more interestingly, that the effects are heterogeneous across the distribution of RPCE. Of the three employment channels considered (through which international liberalisation may affect income, expenditure and welfare) it appears that the manufacturing employment channel is the strongest, followed by export employment, while import-competing employment tends to exert a weaker, less robust influence.

Other things being equal, a 1 per cent increase in the share of the local commune's population being employed in manufacturing activities would be associated with an increase of approximately 0.40 per cent in RPCE for an 'average' household. For households with highest levels of expenditure, the effect is likely to be far stronger: households at the 90th percentile of the expenditure distribution are expected to experience a 0.91 per cent rise in RPCE. By contrast, households at the 10th and 25th percentiles are likely to experience increases of 0.34 and 0.29 per cent, respectively.

Whilst the manufacturing employment channel appears to favour households at the top of the RPCE distribution, the export channel tends to be of greater benefit to the poorer households. The export employment coefficient is 0.56 and 0.55 per cent for the 10th and 25th percentile regressions, respectively, compared with 0.22 per cent for the 75th percentile regression and an insignificant estimate for the 90th percentile regression. The import-competing employment coefficient follows a pattern that is more similar to that of the export coefficient than the manufacturing coefficient.

These results suggest that international trade liberalisation tends to increase employment in the trade-related activities and, through these employment channels, to increase per capita expenditure, income and welfare – and, correspondingly, to reduce poverty. Yet these employment channels tend to affect different groups of households differently. In particular, employment in export-oriented activities may be of greater benefit to lower-income households, whilst employment in other manufacturing activities (oriented toward both exports and import substitution) may be of greater benefit to top-income households – the latter may enjoy an advantage in terms of investments in education and technology skills, especially in the context of rural Vietnam.

A direct implication of our findings is that, in pursuing trade liberalisation, policymakers and advisers need to take into account the above differential effects of their proposed actions. For example, if an action is likely to promote employment in the 'other manufacturing' sector but reduce employment in the 'export' sector, supplementary actions may be needed to assist poorer households, and to prevent the scenario where trade liberalisation might worsen income inequality by benefitting mainly richer households without generating commensurate benefits for lower-income households.

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