Regional Labor Market Integration, Shadow Wages and Poverty in Vietnam

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Abstract

Poor workers suffer from low returns to their most abundant resource, labor. In this paper we show that labor market integration strongly affects these returns for poor workers in Vietnam. Using seven representative household surveys, it is shown that while regional labor markets have become increasingly integrated over the period 1993-2010 considering *market wages* of workers in wage employment, there remains a strong lack of integration considering *shadow wages* of workers in farm self-employment. Shadow wages have been increasing as a proportion of market wages during 1993-2010, but they remain only 18-23% of market wages by 2010. This lack of integration between the segments of self- and wage employment, rather than regional differences in market wages, explains primarily the gap in returns to labor between poor and non-poor workers. These findings show that labor market integration studies should not only focus on observed market wages but also on shadow wages in order to understand the relationship between labor market integration and the returns to labor.

JEL Classification Codes: J31, J42, I32

Keywords: Labor market integration, (Market and Shadow) Wages, Poverty, Vietnam

1. Introduction

Labor is key to understanding poverty as it forms the most plentiful resource that poor households have and jobs form the most important source of household income. The main problem for the poor is not the lack of jobs, however (they often have multiple jobs and work long hours), but the fact that the returns to their labor are low. Changes in poverty are therefore linked to increases in the value of work, either due to increases in productivity (in farm and non-farm self-employment) or higher real wages (in wage employment) (World Bank 2013).

A number of strategies have been identified to increase productivity and/or wages, such as diversification, skill formation, improvements in farming and better access to agricultural input and output markets, and labor migration (Inchauste *et al*. 2012, Inchauste 2012, Clemens 2011).

In this paper we suggest that there may be another and relatively less studied reason why the returns to labor, or value of labor time, are relatively low for poor people - segmentation of labor markets, in the sense that workers with identical levels of human capital face different rates of return depending on where they work. For instance, if the poor are disproportionally employed in (rural) regional labor markets that are poorly integrated with more developed (and better paid) regional labor markets, then improved labor market integration will reduce poverty.[1]

There are a number of studies which have analyzed regional labor market integration looking at wage differentials (e.g. Williamson 1992, Robertson 2000, Freeman and Oostendorp 2002). These studies analyze differentials in *market* wages earned in wage employment. However, many workers in developing countries are not employed in wage employment, and this is especially the case for poor workers in these countries. Their value of labor time is therefore not given by the market wage, but by their *shadow* wage,

[1] An interesting finding in this respect is that poverty was reduced in Bangladesh, Peru and Thailand because the earnings penalty for living outside of the capital city was reduced over time (Inchauste *et al*. 2012).

which depends on the productivity of their time in farm or non-farm activities. Only if the market for wage employment is perfectly integrated with the market for self-employment, market wages will reflect the value of labor time in self-employment. However, the value of labor time is often (much) lower in the market for self-employment, especially in developing countries, explaining why getting a wage employment job is often linked with a transition out of poverty. Therefore, in order to understand the link between labor market segmentation or integration and poverty, it is important to study not only market wages earned in wage employment but also the shadow wages earned in self-employment.

We are not aware of any previous study which has looked at labor market integration (segmentation) considering *shadow* wages. Therefore in this paper we seek to make the following contributions based on 7 representative household surveys for Vietnam spanning a period of more than 15 years (1993-2010). First, we will estimate the value of labor time for self-employed farmers in Vietnam across regions. Most of the labor force in Vietnam was until recently in farming (Oostendorp *et al*. 2009) and therefore the value of labor time in farming will be an important determinant of poverty.

Second, we will compare the estimated shadow wages with the (counterfactual) market wage that farmers could have earned in each region as an indicator of labor market integration between wage employment and farm self-employment. We find that shadow wages are only about 11-25% of the market wages within a region, but the gap between these wages has been falling over the 1993-2010 period, suggesting increasing integration.

Third, we analyze the impact of labor market integration on the value of labor time of poor workers in Vietnam. Using a decomposition technique, we find that most of the difference in the value of labor time between poor and non-poor workers can be attributed to differences between shadow and market wages rather than regional differences in market wages. However, the importance of this gap between shadow and market wages has been declining since 1993, as the increasing integration of the self- and

wage employment labor markets in Vietnam has led to a reduction in the overall gap in the value of labor time between poor and non-poor workers.

The main finding of this paper is therefore that an analysis of both market *and* shadow wages is essential to understand the impact of labor market segmentation on the returns to labor for the poor, and hence, poverty. As a corollary, labor market policies should not only focus on reducing (regional) segmentation within the wage labor market (e.g. by reducing interregional migration costs) but also on reducing the (within-region) segmentation between wage employment and self-employment (e.g. by reducing rural-urban migration costs such as improved access to urban housing and social services for rural migrants or increasing farm productivity).

The remainder of the paper is structured as follows. In the next section we provide background information on labor markets in Vietnam and introduce the data for the empirical analysis. We also show that in terms of market wages, labor markets have become increasingly integrated across regions over the period 1993-2010 in Vietnam. In section 3 we develop an econometric framework for estimating the shadow wage for workers in farm self-employment. Section 4 compares the estimated shadow wage to the counterfactual market wage to analyze the degree of integration between wage employment and farm self-employment labor markets. In section 5 we apply a decomposition framework to measure how much of the mean gap in the value of labor time between poor versus non-poor workers can be attributed to either regional variation in market wages or variation between shadow and market wages. Section 6 concludes the paper with a discussion of the results and policy implications.

2. Vietnam: Labor markets and Data

Starting from a centrally planned economy, Vietnam initiated a sequence of economic reform measures in 1986 (‘Doi Moi’ or ‘Renovation’). Multiple reform measures were introduced, such as agricultural decollectivization, exchange rate depreciation and unification, price liberalization, land reforms, reducing subsidies to and increasing

autonomy of state-owned enterprises, encouragement of private sector development as well as trade liberalization. The success of these reform measures has proven to be remarkable, with an average annual economic growth rate of 6.9% between 1993 and 2013[2]; also poverty has been declining at a high rate during this period, from 58.1% in 1993 to 14.2% in 2010 (World Bank 2012).

The economic reforms had also a profound impact on the functioning of labor markets in Vietnam. Before 1986, there were almost no labor markets functioning in Vietnam. The economy was dominated by SOEs in manufacturing and services and by cooperatives in agriculture. The private sector was very small and made up mainly of small-scale services businesses employing just a few workers. In the formal non-agricultural sector, the employment decisions were made by line ministries instead of by actual employers. It was very hard for a worker to change his or her job without having the right connections. At the same time, during this period, administrative procedures and the household registration system were very cumbersome and complicated; hence further limiting the movement of labor (ADB 2005).

With the shift away from a centrally planned economy towards a market economy, the private sector started to develop and SOE managers were allowed to make employment decisions without waiting for bureaucratic approval. This created a functioning labor market as workers were increasingly hired on the basis of economic considerations and labor became more flexible as well. It is to be expected that this led to an increasing integration of the labor market as well - something which will be tested below.

The economic reforms also led to a change in the structure of employment in Vietnam. Information on the employment structure as well as their changes over time can be derived from seven large-scale household surveys in Vietnam, namely, the Vietnam Living Standards Survey in 1992–93 (VLSS 1993) and 1997–98 (VLSS 1998), and the Vietnam Household Living Standards Surveys in 2002, 2004, 2006, 2008 and 2010 (VHLSS 2002, VHLSS 2004, VHLSS 2006, VHLSS 2008, VHLSS 2010). The total number of households interviewed was respectively 4800, 5999, 30000, 9200, 9200,

[2] World Development Indicators database.

9200, and 9400, and these surveys are representative for Vietnam (Phung and Nguyen 2008; GSO 2011).

In the next table we present the structure of employment as captured by these surveys for the period 1993-2010. We distinguish between 4 categories, namely wage employment, farm self-employment, non-farm self-employment, and unemployment/not in labor force (because students, disabled, housework, retired, ill, and for other reasons). The figures are for all respondents between 15 and 65 years, and they are related to the primary activity in the past 12 months.

Over the period from 1993 to 2010, self-employment in agriculture has been steadily shrinking compared with wage employment. In 1990s, nearly half of the employment came from farm self-employment, while wage employment accounted for only about 18%. Since the 1990s, the share of wage employment has increased substantially. Most of the increase happened between 1993 and 2004. Since 2004, the share of wage employment has been stable, around 28%.

Table 1. Employment structure in Vietnam, shares, 1993-2010

	1993	**1998**	**2002**	**2004**	**2006**	**2008**	**2010**
Wage employment	18.4	17.3	24.9	27.1	27.9	28.6	27.5
Self-employment	70.8	69.3	56.9	54.8	52.5	50.9	52.5
Farm	46.2	53.4	37.1	37.3	34.9	32.8	39.9
Non-farm	24.6	15.9	19.8	17.5	17.6	18.1	12.6
Unemployment/ Not in labor force	10.7	13.5	18.1	18.1	19.6	20.5	20.0

Note. Figures are weighted

An interesting question is whether the rise of wage employment in Vietnam has gone hand-in-hand with increasing regional labor market integration. One may argue that 'thicker' labor markets improve wage arbitrage and labor flows will be more responsive to regional variation in returns to labor. The observed increases in regional labor flows in Vietnam since the start of the reforms suggest that this has indeed been the case (Dang *et al.* 2003). At the same time, if wage employment is growing quickly but in an uneven manner across regions, migration flows may have been insufficient to equalize wage

differentials across space. Therefore it is difficult to say, a priori, how regional wage differences have developed over time, and whether they show 'convergence' or 'divergence'.

In the economics literature a number of different concepts have been developed to measure convergence, of which σ- and β-convergence are the most well-known and frequently used. The concept of σ-convergence implies that the standard deviation of the variable of interest (e.g. mean regional log hourly wages) across the different regions tends to decrease over time.[3] The concept of β-convergence on the other hand says that there is β-convergence if regions with low wages tend to have faster wage growth than rich ones. These concepts are closely related and it can be shown that β-convergence is a necessary but not sufficient condition for σ-convergence (Sala-i-Martin 1996). We therefore will use the concept of σ-convergence to measure regional wage convergence in this paper.

We calculate hourly wages for all respondents between ages 15 and 65 who report wage employment as their main activity in the past 12 months. These wage numbers are deflated by regional and monthly price deflators and subsequently we calculate regional averages.[4] We distinguish among 8 regions, namely Red River Delta (including Hanoi), North East, North West, North central Coast, South Central Coast, Central Highlands, Southeast, and Mekong Delta (including HCM City).

Table 2 reports the mean hourly wages across regions in Vietnam for the period 1993-2010, in thousands of Vietnamese Dong in January 2010 prices.[5] It is obvious to see that real market wages have been steadily and significantly increasing throughout this period. Between 1993 and 2010, the mean wages increased by about a factor 3.[6]

[3] $\sigma_{t+T} < \sigma_t$ for T>0.
[4] Applying sampling weights to correct for the sampling procedure.
[5] The US$ exchange rate for the Vietnamese Dong (VND) in January 2010 was 1 US$ = 18,206 VND.
[6] We note that some of the estimated wages seem unexpectedly high, such as for the North West region in 1993 and 1998. This is mostly the result of small numbers of observations in some of the individual regions, as the 1993 and 1998 surveys had relatively small sample sizes and there were still relatively few individuals in wage employment.

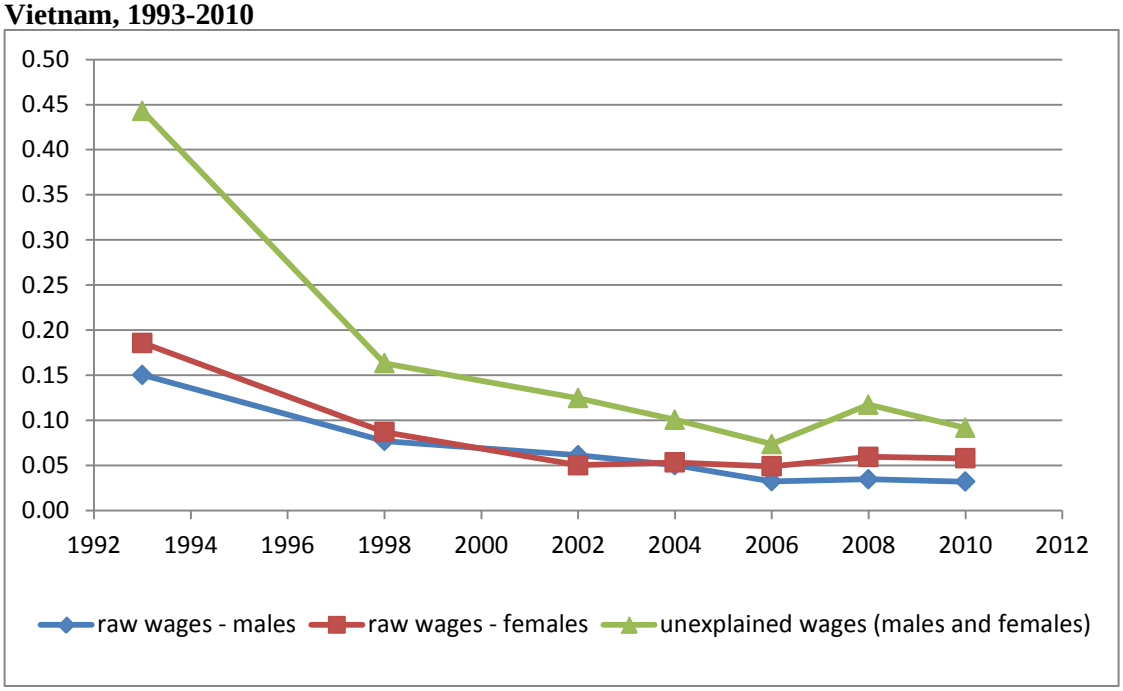
Table 2: Market wages (January 2010 price) (VND, `000s)

	1993		1998		2002		2004		2006		2008		2010	
Region	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Red River Delta	4.0	2.9	7.2	7.2	8.2	7.4	9.5	8.7	9.6	8.4	12.1	10.7	15.5	13.5
North East	5.5	3.6	7.3	8.9	8.3	8.2	9.6	10.0	10.2	10.7	12.5	11.6	13.8	13.6
North West	11.8	11.4	10.2	7.6	7.4	8.2	9.5	9.2	9.9	9.3	12.0	14.1	15.4	17.9
North Central Coast	4.5	4.1	10.4	8.5	7.3	7.3	8.2	8.3	9.3	9.1	11.3	11.1	13.2	12.6
South Central Coast	4.6	3.6	7.3	6.0	8.4	7.2	9.5	8.3	10.3	7.9	13.0	11.4	14.6	12.2
Central Highlands	4.5	3.0	7.2	8.4	7.9	7.3	9.4	8.3	10.4	8.7	13.9	13.9	13.6	14.0
South East	4.6	4.0	6.9	5.7	11.5	9.2	12.1	11.0	11.0	9.6	13.9	12.3	16.2	14.1
Mekong River Delta	4.5	3.7	6.6	5.2	7.7	6.2	8.5	7.5	8.7	7.5	11.5	9.3	13.8	11.4
Mean	4.6	3.7	7.3	6.3	8.7	7.6	9.7	9.1	9.8	8.7	12.5	11.1	14.8	13.2
Standard deviation (ln)	0.15	0.19	0.08	0.09	0.06	0.05	0.05	0.05	0.03	0.05	0.03	0.06	0.03	0.06

Source: Authors' calculation using V(H)LSS data

In Figure 1 we report the standard deviation of the log of the mean regional wages for males respectively females ('raw wages'). The standard deviation decreased from 0.15-0.19 in 1993 to 0.03-0.06 in 2010. Hence, there is σ-convergence in regional log hourly wages between 1993 and 2010 in Vietnam.

Figure 1. Standard deviation of log of hourly raw and unexplained wages across regions in Vietnam, 1993-2010



These findings suggest that regional labor markets have become more integrated between 1993 and 2010. However, the analysis looks at *average* hourly wages, and wages reflect not only prices but also human capital levels, and these will vary across regions and time. In section 4 we will present Mincer equations that provide estimates for regional wage differences that cannot be explained by regional and/or temporal variation in human capital. These unexplained regional wage differentials are reflected in the regional dummies in a Mincer wage regression.

Figure 1 also shows the standard deviation of the unexplained wages.[7] It is clear that also after controlling for human capital differences, regional wage differentials are decreasing over time.[8] This confirms again that there has been regional wage convergence in Vietnam in the period 1993-2010.

Before turning to the next section, however, we address one more issue. The main focus of this paper is *between*-region variation in hourly (market or shadow) wages rather than *within*-region variation. This focus is justified as we are interested in regional market integration, assuming that labor markets are spatially (regionally) disintegrated. Also the Vietnam (Household) Living Standard Surveys do not allow convergence analysis at a lower level of aggregation. It is important to note, however, that most of the variation in hourly wages is within-region rather than between-region. Simple analysis of variance shows that in the period 1993-2010 only between 3.1 and 8.5% of the total variance in hourly wages can be explained by between-regional variation, leaving the remainder to within-region variation.[9]

This may seem very low but we need to consider two points. First, the contribution of between-regional variation to the total variation is probably severely underestimated because an important part of the total variation may be simply measurement error in the hourly wage variable. And second, the contribution of between-regional variation forms 12.4-39.3% of the explained variation in a standard Mincer wage regression.[10] Therefore, regional wage variation is an important component of total wage variation even if it cannot explain all the existing variation.

[7] Because the Mincer equation is for log wages, we do not take (another) logarithmic transformation, unlike for the raw wages.
[8] The dispersion in unexplained regional wages is higher because regions with relatively higher wages also tend to have higher levels of human capital.
[9] After controlling for human capital differences (experience and years of schooling) as well as for gender, we find that between 1.8 and 6.9% of the total variance is due to between-region variation.
[10] The R^2 is between 0.11 and 0.36 in the Mincer equation (see Table 6).

3. Estimating Shadow Wages

It has often been argued that the major labor market issue in Vietnam is *job* creation, especially in rural areas. The current labor force is increasing by approximately 2.6% or 1.3 million each year with most of the increase occurring in rural areas (Le *et al*. 2003). Employment creation in rural labor markets however has been too weak to absorb this growing labor force and with the increasing rural-urban income gap there is increasing rural-urban migration pressure (Dang *et al.* 2003). Unless rural labor markets are further developed, it has been argued that this will result in continuing large migration flows from rural to urban areas as well as persistent rural poverty. Hence, there has been an emphasis on 'employment' rather than 'wages' among policy-makers.

However, lack of employment and low wages are two sides of the same coin in a situation of labor surplus. This is certainly the case in Vietnam where market wages are still very low, labor supply is abundant and labor markets are relatively flexible. However, even if very low, market wages may still not reflect the actual value of labor time of people in the presence of labor market imperfections (especially segmentation). It is also well known that rural areas in Vietnam suffer from severe underemployment ('surplus labor') and people are often unable to find jobs at the prevailing market wage. Under these circumstances, a more relevant indicator of labor markets may not be the market wage but the *shadow* wage earned outside wage employment. The shadow wage indicates the marginal value of labor time at the household (or individual) level and will differ from the actual market wage under market imperfections (Sadoulet and De Janvry 1995). In a situation of labor surplus, the shadow price of labor will be below the actual market wage and people are 'trapped' in relatively unproductive activities.

It may be argued that agricultural incomes often exceed the shadow wage because people may share in the total farm surplus. This is indeed true in the so-called peasant mode of production, based on the notion of traditionally organized family farms (Georgescu-Roegen 1960, Lewis 1954, Chayanov 1991). However, also in this case the marginal value of labor time is the appropriate indicator of the return to labor, as incomes also

reflect the returns to other, non-labor, assets, such as land and (farm) equipment. The fact that the marginal value of labor time is the relevant indicator is also reflected by the fact that 'surplus labor' can be defined as a situation in which the marginal product of labor is below its opportunity cost outside the household (Ray 1998). And similarly an income-maximizing household will consider the marginal value of labor time on the farm versus the income that can be earned in other locations when making migration decisions for its members.

In this section we will therefore estimate *regional shadow wages* for Vietnam to provide a better measure of labor market integration that takes into account the existing labor market imperfections. We will find that shadow wages are significantly lower than market wages, confirming a lack of integration between wage- and self-employment and the existence of surplus labor in rural areas. However, shadow wages as a proportion of market wages have increased between 1993 and 2010 for the whole country, suggesting that the markets for wage and self-employment are increasingly becoming integrated in Vietnam. In the remainder of this section we first discuss the measurement of regional shadow wages., followed by an analysis of labor market integration on the basis of the estimated shadow wages.

Measurement of regional shadow wages using crop production functions

A very significant part of the labor force in Vietnam consists of farm self-employment (see Table 1). Also about two-thirds of all the poor live in a household in which the main activity of the head of the household is in agriculture (World Bank 2012, Table 3.2). Moreover, most of Vietnam's labor surplus is found in agriculture. The marginal productivity of farm labor is therefore a good measure of the real value of labor time in Vietnam, and in particular for the poor. As an additional indicator one could also estimate the marginal value of labor time in non-farm self-employment. The estimation of the returns to non-farm self-employment is far more difficult, however, because the calculation of profits suffers from severe measurement problems (Vijverberg 1992, De Mel *et al*. 2009) and the non-farm household enterprise sector is highly heterogenous (cf.

Elbers and Lanjouw 2001). For this reason we limit the estimation of shadow wages to farm self-employment.

The marginal productivity of farm labor can be calculated from an agricultural production function as its first-order derivative with respect to labor. A number of studies have therefore estimated agricultural production functions to derive household-specific shadow wages (Jacoby 1993, Skoufias 1994). In this paper we follow the same approach, but unlike previous studies, our main interest is not household-specific shadow wages but the regional variation across these wages.

The estimated agricultural production function has the Translog specification[11]:

$$\ln(Y) = \alpha + \beta \ln(X) + Z\gamma + \varepsilon \quad (1)$$

where $\ln(Y)$ is the (log) output of crop production, $\ln(X)$ is a vector of (log) inputs *including square and interaction terms*, Z is a vector of farm, household and community characteristics, and ε is an error term. The model has been estimated for 1993, 1998, 2002, 2004, 2006, 2008 and 2010 at the household-level.[12] Crop output was measured as the total monetary value of all crops produced in the past 12 months (including the monetary value of the harvest which was self-consumed). We did not include outputs from livestock production in our output measure because crop and livestock production have presumably quite different technologies.

As inputs we include measures for land, labor, expenditures on other inputs (seeds, fertilizers, insecticides, small tools and other). Land is defined as total land area in square meters that the household actually cultivated in the last 12 months. Land is calculated by the multiplication of cultivated area of each crop and the number of croppings in the last 12 months. Cultivated land areas of foodstuff and annual industrial crops have been

[11] We tested whether a Cobb Douglas specification was also appropriate but found that some of the interaction terms were strongly significant. However, we also note that the estimated shadow wages are quite similar across the Cobb Douglas and Translog specifications.

[12] It was not possible to estimate the model at the plot-level because inputs and outputs have only been measured at the household-level.

reported as squared meters. Cultivation areas of perennial industrial and fruit crops have been reported as either square meters or the number of trees. In case of the latter, the number of trees was converted into an estimated number of square meters cultivated.[13]

Total labor input is the sum of family labor and hired labor. In household surveys, family labor is measured by the number of working hours that was spent on agricultural activities over the last twelve months. A distinction was also made between male and female family labor. Hired labor is measured by the amount of money that the household paid for and this amount has been converted into annual hourly labor input based on the estimated hourly agricultural wage at the province level. Because labor productivity may vary across gender as well as between family and hired labor (e.g. because of monitoring problems), we include labor shares for female and hired labor among the vector of variables Z.[14]

It should be noted that the amount of labor has been measured for all agricultural activities, and that it is not possible to separate labor for cultivation from husbandry (livestock) activities. In order to correct for this bias, we also include in the regressions the percentage of income from livestock production over the total income of crop production and husbandry activities.[15]

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[13] The conversion was done by the following procedure:
1. The value of each crop is calculated.
2. Yields of each crop (each tree) at household level, district level, provincial level, regional level and country level are computed based on the households reporting the cultivation area in square meters.
3. For those households who reported the cultivation area in the number of trees, we calculate the number of square meters by taking the values of each crop divided by its yield at district level. If it's still missing (meaning that no households in the district reported the area in square meters), we used the yield at next level for which it is available (provincial, regional or country level)

[14] Let $\bar{L} = L^M + L^F + L^H$ denote the total labor input, with L^M male family labor, L^F female family labor, L^H hired labor. Assume that these types of labor input may vary in terms of labor efficiency units, for instance because of differences in physical capacity (e.g. male versus female labor) and effort or seasonality (family versus hired labor). Let the total amount in terms of labor efficiency units be given by $L^M + \alpha^F L^F + \alpha^H L^H$, where α^F, α^H indicate the labor efficiency of female family respectively hired labor respectively relative to male family labor. The logarithm of total labor efficiency units, $\ln(L^M + \alpha^F L^F + \alpha^H L^H)$, can be rewritten as $\ln(L^M + \alpha^F L^F + \alpha^H L^H) = \ln\left(\bar{L}\frac{L^M+\alpha^F L^F+\alpha^H L^H}{\bar{L}}\right) = \ln(\bar{L}) + \ln(s^M + \alpha^F s^F + \alpha^H s^H) = \ln(\bar{L}) + \ln(1 + (\alpha^F - 1)s^F + (\alpha^H - 1)s^H) \approx \ln(\bar{L}) + \breve{\alpha}^F s^F + \breve{\alpha}^H s^H$, where s^i, $i = M, F, H$, are the shares of respectively male family, female family and hired labor in total labor input, and $\breve{\alpha}^i = \alpha^i - 1$, $i = F, H$.

[15] Let L_C, L_L indicate respectively the labor inputs for crop production and livestock. Then given that our measure of labor input, $\bar{L}$, is given by the sum of L_C and L_L, we can write $\ln(L_C) = \ln(\bar{L} - L_L) = \ln(\bar{L}(1 -$

Besides land and labor which are considered to be the most important factors for crop production, we also control for other inputs, namely i) seeds, ii) fertilizers, iii) insecticide, iv) small tools, and v) other. All these inputs are measured by the sum of their expenditure values over the last twelve months. However, because the impact of spending may vary across spending categories, we include the share of spending on fertilizer/insecticides in total expenditure as a control variable as well.

Apart from the input variables (X) the production model also includes controls for household and location characteristics (Z). Household characteristics are captured by characteristics of the household head (age in years, gender, and highest official educational degree), as well as age and education composition of the household. The age composition variables measures the proportion of household members whose ages belong to a particular age range, namely 0-15; 15-25; 25-35; 35-45; 45-55; 55-65; and above 65 years. The education composition variables measure the proportions of household members with the different education levels. In terms of location characteristics, dummies for each province are included to control for differences in climate (such as rainfall) as well as province-differences in input prices. Standard errors are clustered at the commune level.

Because we regard land, labor and other inputs as essential inputs for the agricultural production process, we have estimated the production function only for households for which land, labor and expenditures on other inputs are positive.[16]

The model has been estimated for each of the 7 surveys in the period 1993-2010. The descriptive statistics of the model variables are reported in appendix A. We first present estimates using a Cobb-Douglas production function specification, which omits the square and interaction terms in $\ln(X)$ from the Translog production function. Unlike the

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$\frac{L_L}{\bar{L}}) \approx \ln(\bar{L}) - \frac{L_L}{\bar{L}}$. As we don't observe $\frac{L_L}{\bar{L}}$, the share of livestock income in total income is included as a proxy for $\frac{L_L}{\bar{L}}$, and we expect a negative coefficient.

[16] The number of observations excluded was 203, 182, 64, 23, 19, 24 and 21 for 1993, 1998, 2002, 2004, 2006, 2008 and 2010 respectively.

coefficients in a Translog production function, the Cobb-Douglas coefficients can be interpreted directly as input-output elasticities. Table 3 reports the estimates for each of the surveys in the 1993-2010 period.

The amount of labor inputs has a positive and significant impact on crop output with an elasticity of around 0.09-0.13. Female and male labor inputs are about equally productive on the farm, as the share of female labor is insignificant in each year. However, hired labor is more productive than family labor, across all years. The coefficient for the share of hired labor is between 0.19 and 0.55, suggesting that hired labor is between 21-73% more productive.[17] This is not surprising, given that hired labor is typically hired during the peak season, when labor productivity is at its highest.

The coefficients for non-labor inputs, namely land and expenses on other inputs, are also statistically significant in each of the survey years. There appears to be a declining trend in the land elasticity and an increasing trend in the elasticity for other inputs (although not completely monotonously but this may also be due to sampling error). This is an interesting finding, as it suggests that farmers in Vietnam are increasingly relying on non-traditional inputs (i.e. fertilizers, high yield seeds, insecticides, equipment) next to the traditional inputs of land and labor.[18]

Within the category of other inputs besides land and labor, we also observe a shift over time, as the coefficient for the share of spending on fertilizers/insecticides is decreasing over time. This probably reflects that farmers are increasingly relying on other non-traditional inputs than fertilizers/insecticides, such as mechanization.

The coefficient for the share of income from livestock in total input is negative as expected. As discussed before, this variable was included because the surveys do not distinguish between labor spent on crop and husbandry activities.

[17] exp(0.19)-1=0.21 and exp(0.55)-1=0.73.
[18] Note that the elasticity equals the factor share if farmers use a Cobb Douglas production technology.

The Cobb-Douglas regression results are already plausible and show remarkable consistency over time. Nevertheless, the Translog production is a more flexible specification which can be seen as providing a second-order approximation to any production frontier (Berndt and Christensen 1973). Therefore we reestimate the crop production model but now with square and interaction terms for labor, land and other inputs. The results are reported in Table 4.

Table 3: Cobb-Douglas Agricultural production function estimates, 1993-2010

Dependent variable: log of crop income	**1993**	**1998**	**2002**	**2004**	**2006**	**2008**	**2010**
Log on-farm working hours	0.10***	0.10***	0.09***	0.13***	0.13***	0.10***	0.11***
	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Log cultivating areas (m2)	0.51***	0.35***	0.26***	0.14***	0.13***	0.22***	0.24***
	(0.03)	(0.03)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
Log expenses on other inputs	0.27***	0.35***	0.51***	0.55***	0.61***	0.57***	0.54***
	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)
Share of income from livestock in total output	-0.28***		-0.27***	-0.21***	-0.28***	-0.21***	-0.21***
	(0.05)		(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
Share of fertilizer/insecticide in input expenses	0.16***	0.10	0.02	0.02	-0.11**	-0.16***	-0.05
	(0.05)	(0.06)	(0.04)	(0.05)	(0.05)	(0.05)	(0.05)
Share of female working hours	0.02	0.01	0.003	-0.02	0.01	0.02	-0.01
	(0.04)	(0.04)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)
Share of hired labor working hours	0.42***	0.25***	0.19***	0.32***	0.37***	0.55***	0.40***
	(0.11)	(0.08)	(0.03)	(0.05)	(0.05)	(0.06)	(0.04)
Constant	1.19***	1.92***	1.89***	2.32***	2.67***	2.27***	2.45***
	(0.17)	(0.17)	(0.07)	(0.09)	(0.09)	(0.09)	(0.08)
Observations	3,297	3,696	16,533	5,451	5,412	5,403	4,760
R-squared	0.79	0.77	0.870	0.89	0.91	0.92	0.92

Source: Authors' calculation using V(H)LSS data

Table 4: Translog Agricultural production function estimates, 1993-2010

Dependent variable: log of crop income	**1993**	**1998**	**2002**	**2004**	**2006**	**2008**	**2010**
Log on-farm working hours	0.16	-0.04	0.01	0.14*	0.16**	0.08	0.11**
	(0.14)	(0.11)	(0.03)	(0.07)	(0.07)	(0.07)	(0.05)
Log on-farm working hours squared	-0.01	0.02**	-0.00	-0.00	0.00	0.00	0.00
	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)	(0.00)
Interaction: log labor & log area	0.04	-0.04*	0.02***	0.00	0.01	0.01	0.01
	(0.03)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Interaction: log labor & log expense	-0.03**	0.02	-0.02**	0.00	-0.02**	-0.01	-0.02*
	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)
Log cultivating areas (m2)	-0.22	0.06	0.04	0.08	0.03	-0.03	0.13**
	(0.20)	(0.11)	(0.07)	(0.09)	(0.06)	(0.06)	(0.06)
Log expenses on other inputs	0.46***	-0.17	0.37***	0.12	0.33***	0.44***	0.31***
	(0.11)	(0.12)	(0.07)	(0.11)	(0.09)	(0.09)	(0.07)
Log cultivating areas squared	0.04**	0.05***	0.06***	0.05***	0.03***	0.04***	0.05***
	(0.02)	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)
Log expenses on other inputs squared	0.04***	0.05***	0.10***	0.08***	0.05***	0.04***	0.06***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Interaction: log area & log expense	-0.05***	-0.03	-0.13***	-0.09***	-0.04***	-0.05***	-0.08***
	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Share of income from livestock in total output	-0.27***		-0.22***	-0.17***	-0.24***	-0.19***	-0.21***
	(0.05)		(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
Share of fertilizer/insecticide in input expenses	0.27***	0.18***	0.11***	0.09**	0.01	-0.07	0.12**
	(0.05)	(0.06)	(0.03)	(0.04)	(0.05)	(0.05)	(0.05)
Share of female working hours	0.01	0.01	0.01	-0.01	0.02	0.02	-0.00
	(0.04)	(0.04)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)
Share of hired labor working hours	0.29***	0.09	0.13***	0.23***	0.16***	0.36***	0.22***
	(0.11)	(0.08)	(0.03)	(0.05)	(0.05)	(0.06)	(0.04)
Constant	3.39***	4.87***	3.41***	3.63***	3.69***	3.59***	3.48***
	(0.88)	(0.43)	(0.24)	(0.36)	(0.36)	(0.39)	(0.33)
Observations	3,297	3,696	16,533	5,451	5,412	5,403	4,760
R-squared	0.81	0.80	0.88	0.91	0.92	0.93	0.93

Source: Authors' calculation using V(H)LSS data

The *F*-tests reject the Cobb-Douglas specification for each year at a p-value of 0.001 or lower. This suggests that, at least statistically, that the Translog production function provides a better fit of the data. Because of the inclusion of the square and interaction terms, the coefficients on the input variables can no longer be interpreted as simple elasticities. However, we note that the estimated coefficients for the other variables are similar, except that the productivity advantage of hired labor is somewhat reduced.

Calculation of shadow wages

Based on the Translog production function results of Table 4, we can calculate the shadow wage for male and female labor as the expected marginal product of male respectively female labor in each household.

We can write the Translog production function as

$$(2) \quad \ln(Y) = \beta_0 + \beta_1 \ln(\bar{L}) + \beta_2 \ln(\bar{L})^2 + \beta_3 \ln(\bar{L}) \ln(A) + \beta_4 \ln(\bar{L}) \ln(S) + \beta_5 s^F + \beta_6 s^H + \varepsilon$$

where $\bar{L}$ is total labor input, *A* is land, *S* is expenditure on other inputs than land and labor, s^F, s^H are the shares of female (L^F) respectively hired labor (L^H) in total labor input ($s^F = L^F/\bar{L}$, $s^H = L^H/\bar{L}$), and β_0 includes all terms not involving labor inputs (except for the error term), and ε is the error term.

Taking the exponent of equation (2) and then the first derivative with respect to male family labor, L^M, gives[19]

$$(3) \qquad \frac{\partial Y}{\partial L^M} = \frac{Y}{\bar{L}} (\beta_1 + 2\beta_2 \ln(\bar{L}) + \beta_3 \ln(A) + \beta_4 \ln(S)) - \beta_5 \frac{s^F}{\bar{L}} - \beta_6 \frac{s^H}{\bar{L}}$$

[19] Note that $\bar{L} = L^M + L^F + L^H$.

The expected shadow wage is then given by

$$(4) \qquad E[\tfrac{\partial Y}{\partial L^M}] = \tfrac{E[Y]}{\bar{L}}(\beta_1 + 2\beta_2 \ln(\bar{L}) + \beta_3 \ln(A) + \beta_4 \ln(S)) - \beta_5 \tfrac{s^F}{\bar{L}} - \beta_6 \tfrac{s^H}{\bar{L}}$$

where $E[Y] = e^{\beta_0+\beta_1 \ln(\bar{L})+\beta_2 \ln(\bar{L})^2+\beta_3 \ln(\bar{L}) \ln(A)+\beta_4 \ln(\bar{L}) \ln(S)+\beta_5 s^F+\beta_6 s^H} E[e^{\varepsilon}]$. The estimated Translog production function provides the estimates $\hat{\beta}_0, \hat{\beta}_1, \hat{\beta}_2, \hat{\beta}_3, \hat{\beta}_4, \hat{\beta}_5, \hat{\beta}_6$ and $E[e^{\varepsilon}]$ can be estimated by $\frac{1}{N}\sum e^{\hat{\varepsilon}}$.[20]

Similarly, the expected marginal productivity of female labor, L^F, is given by

$$(5) \qquad E[\tfrac{\partial y}{\partial L^F}] = \tfrac{E[Y]}{\bar{L}}(\beta_1 + 2\beta_2 \ln(\bar{L}) + \beta_3 \ln(A) + \beta_4 \ln(S)) + \beta_5 \tfrac{1-s^F}{\bar{L}} - \beta_6 \tfrac{s^H}{\bar{L}}$$

In the next table we present the estimated shadow wages for male and female labor averaged by region (using sampling weights to make them representative). Shadow wages are in constant January 2010 prices and have been corrected for regional price differences.[21]

[20] Note that we assume that the *expected* marginal productivity of labor is the relevant indicator of the marginal value of labor time for a farm household member. Alternatively we can use the actual labor productivity, but this will vary strongly over time because of factors unrelated to household labor decisions (such as unexpected weather variations, price changes, crop diseases and pests, etc.).

[21] We have also applied the BACON algorithm to identify and exclude a small number of outliers (Weber 2010) . The removal of these outliers did not affect the results in any serious way except for Red River Delta in 2010, which showed a very (too) high estimated shadow wage of 4.34 for both males and females otherwise. For consistency, the BACON algorithm was applied to each year, resulting in the removal of 2.0%, 0.2%, 0.4%, 0.4%, 0.4%, 0.5%, and 0.8% of the predicted shadow wages in 1993, 1998, 2002, 2004, 2006, 2008 and 2010 respectively.

Table 5. Shadow wages estimated from Translog production functions (January 2010 price)														
	1993		1998		2002		2004		2006		2008		2010	
Region	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Red River Delta	0.39	0.39	0.63	0.63	0.80	0.80	0.86	0.86	1.57	1.57	1.25	1.25	2.83	2.83
North East	0.23	0.23	0.40	0.40	0.41	0.41	0.47	0.47	0.74	0.74	0.61	0.61	0.97	0.97
North West	0.43	0.43	0.44	0.44	0.27	0.27	0.40	0.40	0.56	0.56	0.50	0.50	0.80	0.80
North Central Coast	0.34	0.34	0.47	0.47	0.48	0.48	0.55	0.55	1.04	1.04	0.88	0.88	1.06	1.06
South Central Coast	0.39	0.39	0.59	0.59	1.02	1.02	1.00	1.00	1.57	1.57	1.44	1.44	1.36	1.36
Central Highlands	0.47	0.47	0.79	0.79	0.64	0.64	0.90	0.90	1.14	1.14	1.22	1.22	1.30	1.30
South East	0.42	0.42	1.04	1.04	1.30	1.30	1.19	1.19	1.84	1.84	1.67	1.67	2.21	2.21
Mekong River Delta	0.78	0.78	1.22	1.22	1.91	1.91	1.66	1.66	2.56	2.56	2.68	2.68	3.09	3.09
Mean	0.44	0.44	0.70	0.70	0.89	0.89	0.90	0.90	1.48	1.48	1.37	1.37	1.89	1.89
Standard deviation (log)	0.34	0.34	0.41	0.41	0.64	0.64	0.49	0.49	0.50	0.50	0.55	0.55	0.51	0.51

Table 5 shows us number of interesting findings. First, shadow wages appear to be increasing over time, reflecting that the marginal value of labor time in Vietnam is increasing as well. This suggests that labor markets are at least integrated to some extent, as market wages have been increasing over the same period as well. Second, we do not find any noticeable difference in the marginal value of labor time for male and female family workers. This is what one would expect if labor is allocated efficiently within the household under the assumption that the marginal opportunity cost of family labor (leisure) does not vary across gender. Third, shadow wages vary strongly across regions in any given year, with the highest marginal value of labor time in the Mekong River Delta and South East, and the lowest in the North West, North East and North Central Coast. This is as expected, as these latter are also the relatively poor regions in Vietnam. Fourth, regional shadow wages exhibit σ-divergence. The standard deviation of the log of shadow wages has been increasing from 0.34 in 1993 to 0.51 in 2010 in Table 5.

One may argue that regional variation in shadow wages reflects regional variation in human capital and therefore that regional shadow wage differentials cannot be interpreted as lack of labor market integration. We have therefore recalculated the shadow wages but by assigning the mean household characteristics (which includes age, gender and education variables) to all households. We found that this does not affect the estimated regional shadow wages in any significant way.[22]

Hence, the above results shows plausible patterns for the estimated shadow wages in Vietnam. However, these estimates do not show how the value of labor time on the farm compares to the value of labor time in employment (wage), nor whether there is increasing integration of wage and self-employment in Vietnam. With developing labor markets one would expect that shadow and market wages are converging *for similar* types of labor. It is therefore not sufficient to compare our estimated shadow wages (Table 5) with observed market wages (Table 2), as any differences between these may not only reflect labor market segmentation but also human capital differentials. Therefore

[22] The standard deviations of the log of shadow wages based on the mean household characteristics rises similarly from 0.41 in 1993 to 0.57 in 2010.

we will now proceed to estimate the market wages that the farmers could have earned if they would have been employed in wage employment instead.

Estimation of (counterfactual) market wages

In order to estimate the counterfactual market wage that farmers could have earned, we estimate a Mincer regression for all workers in wage employment in each survey year in the survey period:

$$w_i = E_i\beta + \epsilon_i \tag{6}$$

where w_i is the (log) hourly wage of individual i, E_i a vector of individual determinants of wages (such as education, experience (squared) and gender), and ϵ_i an error term. Table 6 reports the Mincer regressions for each of the 7 waves of household surveys. The dependent variable is the logarithm of hourly wages from the main job for individuals between 15 and 65 years. Hourly wages are corrected for regional price differences and are in January 2010 prices. The regressions control for years of education and experience (measured as age minus years of schooling), gender (dummy for female), industry (with agriculture as the reference group), ownership of employer (with private firms as the reference group), and regions (with North Central Coast as the reference group). An interaction term is included for years of education and gender because earlier studies have found that the returns to education are different between males and females in Vietnam (Liu 2004). Also a Heckman sample selectivity correction term is included to control for the fact that the regression is estimated for individuals with wage employment only.[23] Appendix B provides the descriptive statistics of the model variables and Appendix C reports the estimates for the selectivity models.

The results of table 6 show a number of interesting findings. First the returns to education have increased during the period 1993 and 2010. Second, females earn significantly less

[23] The participation regression includes the following variables: age, years of education, gender, the share of children in the household, the household size and the amount of land owned by the household. See Appendix C for the results of the participation regression.

than males, but the gender gap is declining with education. Third, there are large estimated industry-wage differentials. Fourth, workers in the private sector tend to be paid less than similar workers (in terms of human capital) in Government, SOEs and FDIs. In fact, the earnings advantage of government workers appears to increase over time, while the earnings advantage of SOE workers appears to decline.

These tendencies may reflect the outcome of the restructuring efforts of SOEs and of the salary increase policy of the Government. Since 2002, the number of workers in SOES has been reduced substantially due to the reorganization of state enterprises[24]. In the Government service sector, however, workers have consistently pushed for salary increases. Accordingly, the Government of Vietnam has implemented a wage reform for the period 2003-2007. Since 2004, wage increase has been taken place two times, one in 2005 and the other in 2006.[25]

The inverse Mill's Ratio is statistically insignificantly different from zero in all years but in 1998. This suggests that sample selectivity does not affect the estimates in any significantly way (apart from 1998 possibly). However, we have verified that the main results in the following remain valid if we do not include the Heckman sample selectivity correction term in the Mincer regressions.

We predicted the counterfactual market wage for all farmers in the survey samples for each survey year based on the Mincer regression results in table 6. Table 7 reports these predicted market wages for males and females averaged across region. We also include the ratio of the estimated shadow wage and market wage by region, gender and year. This shows that shadow wages are significantly below market wages, suggesting that the agricultural self-employment sector suffers from significant surplus labor and that the wage and self-employment sectors remain poorly integrated in Vietnam. However, shadow wages (as a ratio of market wages) have increased between 1993 and 2010 for the

[24] The policy is stated in Decree No. 41/2002/ND-CP of the Government.
[25] Minimum wages were increased from 290 thousands VND/month to 350 thousands VND/month in 2005 (Decree No. 118/2005/NĐ-CP) and from 350 thousands VND/month to 450 thousands VND/month in 2006 (Decree No. 94/2006/NĐ-CP).

whole country. For males the ratio has increased from 0.11 in 1993 to 0.18 in 2010, while for females the ratio increased from 0.14 in 1993 to 0.23 in 2010. This suggests that the markets for wage and self-employment are increasingly becoming integrated in Vietnam. And finally, there are clear regional differences in the degree of labor market integration. Shadow wages as a ratio of market wages are the highest in the Red River Delta, Mekong River Delta and the South East regions which are the closest to the two main urban centers in Vietnam, Hanoi and Ho Chi Minh City.

These findings are as expected in a Lewis-type model of structural transformation, with an upward pressure on rural wages with increasing demand for (rurally produced) food from urban consumers as well as a reduction of rural surplus labor due to rural-urban migration. The ratio of shadow to market wages remains very low in the Central Coast and Central Highlands regions and there has been no substantial increase in this ratio (unlike in the other regions) over the period 1993-2010. This suggests that these regions are still characterized by surplus labor with a very low marginal productivity of labor and no obvious upward pressure so far.

Table 6: Mincer regressions 1993-

Dependent variable: log hourly	**1993**	**1998**	**2002**	**2004**	**2006**	**2008**	**2010**
Female	-0.39***	-0.32***	-0.23***	-0.29***	-0.25***	-0.29***	-0.30***
	(0.10)	(0.05)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
Years of schooling	0.02*	0.03***	0.04***	0.04***	0.04***	0.05***	0.05***
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Female x years of schooling	0.02**	0.01*	0.01***	0.02***	0.01***	0.02***	0.02***
	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Experience	0.01**	0.01	0.03***	0.03***	0.03***	0.02***	0.03***
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Experience squared (10-3)	-0.15	-0.10	-0.42***	-0.44***	-0.45***	-0.41***	-0.50***
	(0.11)	(0.08)	(0.03)	(0.05)	(0.04)	(0.04)	(0.04)
Mining	-0.30**	0.42***	0.24***	0.27***	0.26***	-0.29***	0.28***
	(0.14)	(0.09)	(0.02)	(0.05)	(0.05)	(0.02)	(0.06)
Manufacturing	0.06	-0.05	-0.00	-0.04*	-0.05**	-0.13***	-0.09***
	(0.05)	(0.03)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)
Electricity, construction	0.20***	0.16***	0.11***	0.08***	0.06***	-0.04**	0.05**
	(0.07)	(0.04)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)
Commerce	-0.02	-0.08	0.01	-0.01	-0.11***	-0.03	-0.07***
	(0.09)	(0.05)	(0.02)	(0.03)	(0.02)	(0.05)	(0.03)
Transportation, communication	0.05	0.12**	0.21***	0.22***	0.17***	-0.04	0.11***
	(0.09)	(0.06)	(0.02)	(0.03)	(0.03)	(0.06)	(0.03)
Finance, other services	-0.12*	-0.31***	0.04**	-0.16***	-0.15***	-0.26***	-0.18***
	(0.07)	(0.11)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
Government	0.02	-0.11	0.11***	0.39***	0.35***	0.34***	0.33***
	(0.06)	(0.07)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
SOE	0.10**	0.02	0.19***	0.10***	0.04*	0.05*	-0.06*
	(0.05)	(0.03)	(0.01)	(0.02)	(0.02)	(0.03)	(0.03)
FDI	0.13	0.20***	0.28***	0.28***	0.18***	0.20***	0.18***
	(0.23)	(0.04)	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)
Inverse Mill's Ratio	-0.08	0.14***	-0.03	-0.03	-0.00	-0.02	-0.02
	(0.10)	(0.05)	(0.03)	(0.03)	(0.03)	(0.04)	(0.02)
Constant	-0.01	0.66***	0.40***	0.59***	0.91***	1.33***	1.70***
	(0.24)	(0.10)	(0.05)	(0.06)	(0.06)	(0.08)	(0.04)
Observations	1,841	2,229	19,194	5,885	6,818	6,167	7,326
R2	0.11	0.16	0.31	0.36	0.32	0.34	0.31

Robust p values in parentheses. The

Table 7. Market versus shadow wages, 1993 - 2010

Panel A. Market wages predicted from Mincer regressions (January 2010 prices)

	1993		1998		2002		2004		2006		2008		2010	
Region	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Red River Delta	3.12	2.52	4.86	3.66	5.17	4.33	6.45	5.65	6.93	5.90	9.60	7.97	10.07	8.58
North East	3.69	2.87	4.77	3.58	5.17	4.35	6.30	5.41	7.20	6.05	9.13	7.51	9.63	7.92
North West	11.93	9.43	7.52	5.59	4.62	3.70	5.83	4.55	6.15	4.80	7.94	6.03	10.72	7.93
North Central Coast	3.60	2.87	6.36	4.82	5.19	4.46	6.27	5.50	7.28	6.25	9.03	7.66	10.06	8.44
South Central Coast	3.22	2.43	5.48	4.03	5.74	4.62	7.00	5.59	7.29	5.84	10.30	7.97	10.57	8.40
Central Highlands	5.65	4.32	6.55	4.75	5.27	4.21	6.80	5.41	7.37	5.98	10.98	8.67	11.09	8.78
South East	3.66	2.75	5.22	3.79	6.17	5.07	7.67	6.30	7.56	6.24	9.88	7.74	11.37	8.93
Mekong River Delta	3.69	2.75	5.50	4.00	6.09	4.92	7.16	5.68	7.39	5.92	10.24	8.03	10.83	8.25
Mean	3.94	3.03	5.46	4.07	5.48	4.48	6.65	5.54	7.20	5.95	9.64	7.74	10.42	8.34

Panel B. Shadow wages as a proportion of market wages

	1993		1998		2002		2004		2006		2008		2010	
Region	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Red River Delta	0.13	0.16	0.13	0.17	0.15	0.18	0.13	0.15	0.23	0.27	0.13	0.16	0.28	0.33
North East	0.06	0.08	0.08	0.11	0.08	0.09	0.07	0.09	0.10	0.12	0.07	0.08	0.10	0.12
North West	0.04	0.05	0.06	0.08	0.06	0.07	0.07	0.09	0.09	0.12	0.06	0.08	0.07	0.10
North Central Coast	0.10	0.12	0.07	0.10	0.09	0.11	0.09	0.10	0.14	0.17	0.10	0.11	0.11	0.13
South Central Coast	0.12	0.16	0.11	0.15	0.18	0.22	0.14	0.18	0.21	0.27	0.14	0.18	0.13	0.16
Central Highlands	0.08	0.11	0.12	0.17	0.12	0.15	0.13	0.17	0.15	0.19	0.11	0.14	0.12	0.15
South East	0.11	0.15	0.20	0.28	0.21	0.26	0.15	0.19	0.24	0.30	0.17	0.22	0.19	0.25
Mekong River Delta	0.21	0.29	0.22	0.31	0.31	0.39	0.23	0.29	0.35	0.43	0.26	0.33	0.29	0.37
Mean	0.11	0.14	0.13	0.17	0.16	0.20	0.14	0.16	0.21	0.25	0.14	0.18	0.18	0.23

5. Regional Labor Market Integration and Poverty

The empirical analysis in the previous section has shown that labor markets in Vietnam are increasingly becoming integrated, both regionally for wage employment and within regions between the segments of wage employment and farm self-employment. A well-functioning labor market is important for efficiency reasons but also from the point of poverty reduction (World Bank 2013). Labor is the single most important asset possessed by the poor and to the extent that imperfect labor market integration reduces the returns to labor, the poor will be disproportionally affected.

It is not clear a priori, however, to which extent labor market integration and poverty have been actually related in Vietnam. This will depend on the extent to which the poor are disproportionally employed in low productivity segments of the economy, i.e. either in low paying regions or in farm self-employment rather than wage employment. In this section we will introduce a decomposition technique to capture the contribution of labor market segmentation to the difference in the value of labor time between poor and non-poor workers in Vietnam over the period 2002-2010. The value of labor time will be measured by wages in case of wage employment and the shadow wage in case of farm self-employment.

Before we continue we need to discuss two issues. First, differences in the value of labor time between the poor and non-poor may not only reflect different returns to labor but also differences in their quality of labor, i.e. differences in human capital. Poor workers in Vietnam have less education and less work experience than non-poor workers, and this is undoubtedly an important reason why they earn less. However, we are interested to which extent *labor market integration* affects poverty in Vietnam, that is, how differences in returns to the *same* type of labor (e.g. across regions or type of employment) are related to poverty. For this reason we focus on the question how labor market integration has affected poor versus non-poor workers assuming that they receive market and shadow wages at the mean level of human capital in Vietnam.

The second issue is the distinction between 'poor' versus 'non-poor' workers. Here a worker is identified as poor if his or her household per capita expenditures are below the official Vietnam poverty line and non-poor otherwise. Therefore, we do not attempt to 'explain' the poverty level (expenditure level) of workers, but ask how labor market integration affects the value of labor time of workers in non-poor and poor households. Rama *et al.* (2003) have shown that the poverty status in Vietnam is strongly affected by the employment status, and therefore a higher value of labor time for poor workers can be expected to have a strong poverty impact as well.

Let $\ln(w_R^{NP})$ and $\ln(w_R^{P})$ be the mean (log) value of labor time for respectively non-poor and poor workers in region *R*. The difference in the mean (log) value of labor time of non-poor ($\overline{\ln(w^{NP})}$) and poor ($\overline{\ln(w^{P})}$) workers is given by

$$\overline{\ln(w^{NP})} - \overline{\ln(w^{P})} = \sum_{\mathrm{R}} \mathrm{p}_{\mathrm{R}}^{\mathrm{NP}} \ln(w_R^{NP}) - \sum_{R} \mathrm{p}_{\mathrm{R}}^{\mathrm{P}} \ln(w_R^{P}) \tag{7}$$

where $\mathrm{p}_{\mathrm{R}}^{\mathrm{i}}$ is the proportion of workers of type *i* ($i = NP, P$) in region *R* ($\sum_{\mathrm{R}} \mathrm{p}_{\mathrm{R}}^{\mathrm{i}} = 1$).

The mean (log) value of labor time for respectively non-poor and poor workers in region *R* can be further written in terms of wage differences between market wages in employment and shadow wages in farm self-employment. As before, we ignore (shadow) wages from non-farm self-employment given that the measurement of returns to labor in self-employment is fraught with difficulties and prone to large measurement error (Vijverberg 1992, De Mel *et al*. 2009). This does not mean, however, that non-farm employment is unimportant for poverty alleviation (Elbers and Lanjouw 2001, Oostendorp *et al.* 2009), but only that we do not analyze this aspect here to avoid additional data concerns.

Let w_R^M, w_R^S denote the market wage in wage employment and the shadow wage in farm self-employment respectively, and let $\lambda_R^{NP}, \lambda_R^{P}$ be the proportion of non-poor and poor workers in wage employment in region *R* respectively (as a proportion of the total of wage and farm self-employment). Then equation (7) can be rewritten as

(8) $$\overline{\ln(w^{NP})} - \overline{\ln(w^{P})} = \sum_R (\theta_R^w \ln(w_R^M) + \theta_R^S \ln(w_R^S))$$

where $\theta_R^w = p_R^{NP}\lambda_R^{NP} - p_R^P\lambda_R^P$, $\theta_R^S = p_R^{NP}(1-\lambda_R^{NP}) - p_R^P(1-\lambda_R^P)$ and given that $\overline{\ln(w^{\iota})} = \sum_R p_R^i\left(\lambda_R^i \ln(w_R^M) + \left(1-\lambda_R^i\right)\ln(w_R^S)\right), i = NP, P$. The parameter θ_R^w (θ_R^S) indicates the difference in the proportion of non-poor versus poor workers that is employed in wage employment (farm self-employment) in region *R*. Hence, if there are an equal proportion of non-poor and poor workers in wage employment and in farm self-employment within each region ($\theta_R^i = 0, i = w, S$), then there is no difference in the mean (log) value of labor time between these two types of workers ($\overline{\ln(w^{NP})} - \overline{\ln(w^{P})}) = 0$). This follows from the fact that we have assumed that the (log) regional market ($\ln(w_R^M)$) and shadow wages ($\ln(w_R^S)$) do not differ between non-poor and poor workers. This is not unreasonable, given that we look at workers with the same (average) levels of human capital and therefore it is assumed that (shadow) wages between non-poor and poor workers do not differ simply because of their poverty status.

We can rewrite equation (8) as

(9) $$\overline{\ln(w^{NP})} - \overline{\ln(w^{P})} = \sum_{\mathrm{R}}\{\theta_R \ln(\mathrm{w_R^M}) + \theta_R^S[\ln(w_R^S/w_R^M)]\}$$

where $\theta_R = \theta_R^w + \theta_R^S$ indicates the difference in the proportion of non-poor and poor workers in region *R*.

Equation (9) shows that the value of labor time differential between non-poor and poor workers can be decomposed into two components. The first component captures the contribution of regional market wage differences (given that $\sum_R \theta_R \ln(\mathrm{w_R^M}) = 0$ if $\ln(\mathrm{w_R^M}) = \ln(\mathrm{w_{R'}^M})$ for $\forall R, R'$). It can also be interpreted as the covariance of regional market wages with regional differences in employment patterns of non-poor and poor workers.[26] If non-poor workers tend to be employed in regions with relatively high market wages ($cov(\theta_R \ln(\mathrm{w_R^M}) > 0$), then the first component is positive.

[26] Because $\sum_R \theta_R = 0$.

The second component captures the extent to which differences in the value of labor time between non-poor and poor workers are due to wage differences in wage employment and farm self-employment. If shadow wages equal market wages ($\ln(w_R^S/w_R^M) = 0$), then the second component will be zero. If shadow wages are larger relative to market wages ($\ln(w_R^S/w_R^M)$ is larger), then this implies a smaller overall gap in the value of labor time between non-poor and poor workers if poor workers are relatively more often employed in farm self-employment ($\theta_R^S < 0$).

The next table presents the results from the decomposition, using equation (9).

Table 8. Decomposing the mean (log) gap in the value of labor time between non-poor and poor workers

Period	Difference in mean (log) value of labor time of non-poor versus poor workers* $\overline{\ln(w^{NP})} - \overline{\ln(w^{P})}$	Contribution of between-region market wage differences $\sum_R \theta_R \ln(w_R^M)$	Contribution of differences between market and shadow wages $\sum_R \theta_R^S ln(w_R^S/w_R^M)$	Regional mean of θ_R^S
	(1)	(2)	(3)	(4)
1993	0.60	-0.01	0.61	-0.03
1998	0.69	-0.05	0.74	-0.03
2002	0.91	0.06	0.85	-0.04
2004	0.95	0.07	0.88	-0.04
2006	0.79	0.03	0.76	-0.04
2008	0.93	0.04	0.89	-0.04
2010	1.06	0.04	1.02	-0.05

* Evaluated at mean level of human capital.

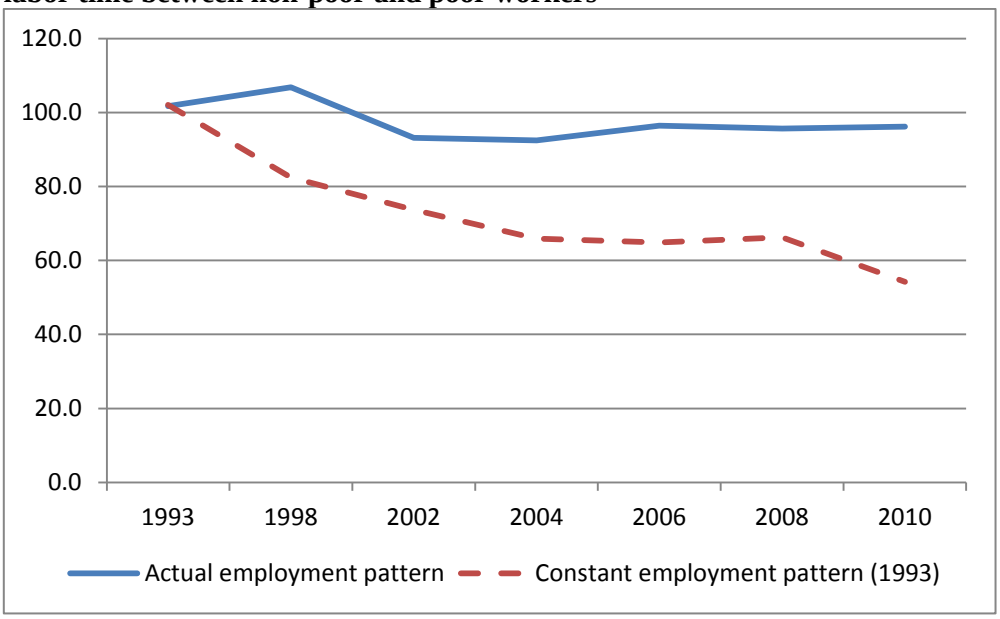
The table shows that differences between market and shadow wages explain almost all of the difference in the value of labor time between non-poor versus poor workers (compare columns 2 and 3 with column 1). From the perspective of labor market segmentation, poor workers have a lower return to labor primarily because they are more likely to be self-employed earning (shadow) wages below market wages rather than because markets lack regional integration. A shift of poor workers from self-employment into wage employment and/or a smaller gap between shadow and market wages[27] will reduce the contribution of

[27] θ_R^S and/or $ln(w_R^S/w_R^M)$ becomes smaller in absolute value.

differences between market and shadow wages to the gap in the value of labor time between poor and non-poor workers. However, column (4) shows that poor workers are increasingly concentrated in self-employment (relative to non-poor workers), and therefore θ_R^S is becoming larger in absolute value.

Therefore, in the next figure we show the contribution of the wage gap between self- and wage employment to the overall gap in the value of labor time for the period 1993-2010, using both the actual employment patterns (as captured by θ_R^S) and keeping employment patterns constant.[28] The figure shows that for the actual employment patterns that the contribution from the wage gap between self- and wage employment has been somewhat declining since 1993, from 102% to 96% in 2010. However, if we keep employment patterns constant, the decline is considerable, from 102% in 1993 to 54% in 2010. This shows that the increasing integration of the labor markets in Vietnam (as evidenced by the closing gap between shadow and market wages) reduces the overall gap in the value of labor time between the poor and non-poor workers.

Figure 2. Contribution of gap between shadow and market wage to overall gap in value of labor time between non-poor and poor workers



[28] Keeping θ_R^S constant at its 1993 values.

6. Conclusions and Policy Implications

This paper has shown that regional labor markets in Vietnam have become increasingly integrated when one considers market wages over the period 1993-2010. This is an interesting finding showing that the wage labor market is becoming increasingly efficient in the wake of the market reforms which started in the 1980s with 'Doi Moi' and which continued in the 1990s and afterwards.

However, this paper also shows that labor markets remain poorly integrated in Vietnam otherwise, especially between (farm) self- and wage employment. Shadow wages are at most a quarter of market wages, suggesting that there is still a large amount of surplus labor in the country. Also, it is precisely this lack of integration between the labor segments of self- and wage employments that primarily explains the gap in the value of labor time between poor and non-poor workers, rather than regional differences in market wages. This implies that labor market integration studies should not only focus on observed market wages but also on shadow wages in order to understand the relationship between labor market integration and the returns to labor for poor workers.

This finding that the self- and wage employment segments of the labor market are poorly integrated in Vietnam is also in line with earlier studies showing that a transition from farm self-employment into wage employment is often linked with a transition out of poverty. For this reason policy-makers have correctly been considering and implementing policies to increase wage employment, for instance through the introduction of the New Enterprise Law in 2005.

However, we also find that there has been an improvement in the extent of integration between the segments of self- and wage employment in Vietnam over the period 1993-2008. This means that together with the increasing regional integration of labor markets in Vietnam, integration is also proceeding between these segments within regions. This is important given that this type of integration is especially important for raising the returns to labor for poor workers.

Therefore policies that target the segmentation of the labor market between self- and wage employment, as compared to policies targeting regional segmentation, should be relatively effective in terms of improving the efficiency of the labor market and increasing the returns of labor for poor workers in Vietnam. This implies, for instance, that migration policies should be more focused on encouraging rural-urban migration (within regions) rather than interregional migration. And labor market policies should be less focused on the functioning of the wage employment segment and more on the self-employment segment. So for instance, the returns of labor for poor workers will depend less on policies that increase the minimum wage or improve labor conditions in the wage employment sector, but more on policies that increase the returns to labor in the agricultural sector.

In the analysis we have ignored another important labor market segment in Vietnam, namely the non-farm self-employment sector. It would be interesting to analyze to which extent this additional segment is (increasingly) integrated into the labor market in Vietnam and how this affects the returns to labor of poor workers. In so far as the segments for non-farm and farm self-employment are integrated (and these segments have similar proportions of poor and non-poor workers), the results will be unaffected. However, if the returns to labor are higher in non-farm than in farm self-employment, then increasing integration between the segments of farm and non-farm self-employment and between the segments of non-farm self- and wage employment can have important implications for the returns to labor of poor workers as well. Also this would have obvious policy implications as this might suggest additional policies encouraging the development of the non-farm self-employment sector. This is left for future work.

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Appendix A. **Descriptive statistics of the variables in the agricultural production models**

Table A1: Summary statistics of variables based on VLSS 1993 data

	Unit	Obs	Mean	s.d	Min	Max
Output						
Values of crop production	000 VND	3297	5836.71	6296.90	7.36	87471.84
Inputs						
Land sown area	M2	3297	9230.87	10154.33	4.83	171000.00
# working hours of males		3297	1727.07	1606.95	0.00	13212.00
# working hours of females		3297	1873.71	1581.36	0.00	13648.00
# working hours of hired labor		3297	143.83	454.70	0.00	8086.41
Expenses on seeds	000 VND	3297	48.51	231.84	0.00	5200.00
Expenses on fertilizers	000 VND	3297	706.90	1050.52	0.00	14752.88
Expenses on insecticide	000 VND	3297	97.57	227.06	0.00	4500.00
Expenses on small tools	000 VND	3297	17.26	47.67	0.00	1470.00
Expenses on other inputs	000 VND	3297	50.30	149.62	0.00	2674.00
Household characteristics						
Age of head in years	Years	3297	44.53	14.60	17.00	92.00
Percentage of member age in 0-15	%	3297	0.38	0.23	0.00	0.83
Percentage of member age in 15-25	%	3297	0.18	0.21	0.00	1.00
Percentage of member age in 25-35	%	3297	0.16	0.19	0.00	1.00
Percentage of member age in 35-45	%	3297	0.09	0.15	0.00	1.00
Percentage of member age in 45-55	%	3297	0.06	0.13	0.00	1.00
Percentage of member age in 55-65	%	3297	0.07	0.17	0.00	1.00
Percentage of member age over 65	%	3297	0.06	0.17	0.00	1.00
Percentage of non-educated people	%	3297	0.22	0.23	0.00	1.00
Percentage of primary-educated people	%	3297	0.31	0.25	0.00	1.00
Percentage of secondary-educated people	%	3297	0.22	0.22	0.00	1.00
Percentage of high-school-educated people	%	3297	0.16	0.20	0.00	1.00
Percentage of vocationally educated people	%	3297	0.03	0.10	0.00	1.00
Percentage of professionally educated people	%	3297	0.03	0.09	0.00	1.00
Percentage of university-educated people	%	3297	0.00	0.03	0.00	0.50

Note: Mean weighted by sampling weights. Obs column shows the number of positive observation in the dataset.
Source: Own calculations based on 1993 VLSS.

Table A2: Summary statistics of variables based on VLSS 1998 data

	Unit	Obs	Mean	s.d	Min	Max
Output						
Values of crop production	000 VND	3696	7430.56	7619.03	9.45	72275.95
Inputs						
Land sown area	M2	3696	9779.94	10578.65	1.37	90519.87
# working hours of males		3696	1305.42	1193.99	0.00	10304.00
# working hours of females		3696	1528.45	1266.32	0.00	12320.00
# working hours of hired labor		3696	191.63	530.76	0.00	8000.00
Expenses on seeds	000 VND	3696	138.67	383.66	0.00	10050.00
Expenses on fertilizers	000 VND	3696	1154.51	1755.37	0.00	16366.33
Expenses on insecticide	000 VND	3696	239.45	526.21	0.00	6800.00
Expenses on small tools	000 VND	3696	33.06	69.66	0.00	1600.00
Expenses on other inputs	000 VND	3696	198.07	359.83	0.00	8069.00
Household characteristics						
Age of head in years	Years	3696	46.80	13.53	16.00	90.00
Percentage of member age in 0-15	%	3696	0.34	0.23	0.00	0.86
Percentage of member age in 15-25	%	3696	0.17	0.20	0.00	1.00
Percentage of member age in 25-35	%	3696	0.14	0.19	0.00	1.00
Percentage of member age in 35-45	%	3696	0.12	0.17	0.00	1.00
Percentage of member age in 45-55	%	3696	0.07	0.15	0.00	1.00
Percentage of member age in 55-65	%	3696	0.08	0.19	0.00	1.00
Percentage of member age over 65	%	3696	0.08	0.20	0.00	1.00
Percentage of non-educated people	%	3696	0.15	0.22	0.00	1.00
Percentage of primary-educated people	%	3696	0.17	0.18	0.00	1.00
Percentage of secondary-educated people	%	3696	0.46	0.29	0.00	1.00
Percentage of high-school-educated people	%	3696	0.14	0.19	0.00	1.00
Percentage of vocationally educated people	%	3696	0.03	0.09	0.00	0.75
Percentage of professionally educated people	%	3696	0.04	0.12	0.00	1.00
Percentage of university-educated people	%	3696	0.00	0.04	0.00	1.00

Note: Mean weighted by sampling weights. Obs column shows the number of positive observation in the dataset.
Source: Own calculations based on 2002 VHLSS.

Table A3: Summary statistics of variables based on VHLSS 2002 data

	Unit	Obs	Mean	s.d	Min	Max
Output						
Values of crop production	000 VND	16533	7316.52	5971.33	10.32	43460.09
Inputs						
Land sown area	M2	16533	8250.08	7786.95	10.00	60000.00
# working hours of males		16533	1171.37	1288.26	0.00	12012.00
# working hours of females		16533	1560.94	1325.56	0.00	12012.00
# working hours of hired labor		16533	100.54	215.59	0.00	3293.79
Expenses on seeds	000 VND	16533	0.94	0.23	0.00	1.00
Expenses on fertilizers	000 VND	16533	1127.66	1251.49	0.00	12670.32
Expenses on insecticide	000 VND	16533	0.91	0.29	0.00	1.00
Expenses on small tools	000 VND	16533	0.83	0.37	0.00	1.00
Expenses on other inputs	000 VND	16533	1188.03	1190.07	0.00	11831.89
Household characteristics						
Age of head in years	Years	16533	47.45	14.21	17.00	102.00
Percentage of member age in 0-15	%	16533	0.31	0.22	0.00	0.86
Percentage of member age in 15-25	%	16533	0.18	0.20	0.00	1.00
Percentage of member age in 25-35	%	16533	0.14	0.20	0.00	1.00
Percentage of member age in 35-45	%	16533	0.14	0.18	0.00	1.00
Percentage of member age in 45-55	%	16533	0.09	0.18	0.00	1.00
Percentage of member age in 55-65	%	16533	0.06	0.16	0.00	1.00
Percentage of member age over 65	%	16533	0.09	0.20	0.00	1.00
Percentage of non-educated people	%	16533	0.40	0.31	0.00	1.00
Percentage of primary-educated people	%	16533	0.27	0.25	0.00	1.00
Percentage of secondary-educated people	%	16533	0.24	0.26	0.00	1.00
Percentage of high-school-educated people	%	16533	0.06	0.13	0.00	1.00
Percentage of vocationally educated people	%	16533	0.01	0.04	0.00	1.00
Percentage of professionally educated people	%	16533	0.01	0.07	0.00	1.00
Percentage of university-educated people	%	16533	0.01	0.05	0.00	1.00

Note: Mean weighted by sampling weights. Obs column shows the number of positive observation in the dataset.
Source: Own calculations based on 2002 VHLSS.

Table A4: Summary statistics of variables based on VHLSS 2004 data

	Unit	Obs	Mean	s.d	Min	Max
Output						
Values of crop production	000 VND	5451	8191.84	7237.87	19.59	53918.78
Inputs						
Land sown area	M2	5451	8034.18	7802.66	0.15	60162.15
# working hours of males		5451	1053.72	1087.17	0.00	12564.00
# working hours of females		5451	1380.61	1175.28	0.00	9840.00
# working hours of hired labor		5451	90.37	205.56	0.00	4097.12
Expenses on seeds	000 VND	5451	1.28	0.59	0.00	2.00
Expenses on fertilizers	000 VND	5451	1560.58	1746.31	0.00	15303.21
Expenses on insecticide	000 VND	5451	1.54	0.66	0.00	2.00
Expenses on small tools	000 VND	5451	0.88	0.32	0.00	1.00
Expenses on other inputs	000 VND	5451	1295.56	1365.73	0.00	12521.49
Household characteristics						
Age of head in years	Years	5451	48.70	13.81	15.00	98.00
Percentage of member age in 0-15	%	5451	0.28	0.22	0.00	0.80
Percentage of member age in 15-25	%	5451	0.18	0.20	0.00	1.00
Percentage of member age in 25-35	%	5451	0.13	0.19	0.00	1.00
Percentage of member age in 35-45	%	5451	0.14	0.19	0.00	1.00
Percentage of member age in 45-55	%	5451	0.11	0.20	0.00	1.00
Percentage of member age in 55-65	%	5451	0.07	0.17	0.00	1.00
Percentage of member age over 65	%	5451	0.09	0.20	0.00	1.00
Percentage of non-educated people	%	5451	0.36	0.30	0.00	1.00
Percentage of primary-educated people	%	5451	0.27	0.25	0.00	1.00
Percentage of secondary-educated people	%	5451	0.24	0.26	0.00	1.00
Percentage of high-school-educated people	%	5451	0.07	0.14	0.00	1.00
Percentage of vocationally educated people	%	5451	0.02	0.09	0.00	1.00
Percentage of professionally educated people	%	5451	0.02	0.09	0.00	1.00
Percentage of university-educated people	%	5451	0.01	0.06	0.00	0.75

Note: Mean weighted by sampling weights. Obs column shows the number of positive observations in the dataset.
Source: Own calculations based on 2004 VHLSS.

Table A5: Summary statistics of variables based on VHLSS 2006 data

	Unit	Obs	Mean	s.d	Min	Max
Output						
Values of crop production	000 VND	5412	20788.09	33692.79	53.46	804416.69
Inputs						
Land sown area	M2	5412	13531.40	24092.47	0.05	583200.00
# working hours of males		5412	1084.02	1126.12	0.00	11124.00
# working hours of females		5412	1325.20	1122.55	0.00	12408.00
# working hours of hired labor		5412	153.76	556.11	0.00	20486.96
Expenses on seeds	000 VND	5412	1.27	0.62	0.00	2.00
Expenses on fertilizers	000 VND	5412	2752.83	4847.60	0.00	73684.08
Expenses on insecticide	000 VND	5412	1.59	0.65	0.00	2.00
Expenses on small tools	000 VND	5412	0.90	0.30	0.00	1.00
Expenses on other inputs	000 VND	5412	2145.75	6032.35	0.00	303389.30
Household characteristics						
Age of head in years	Years	5412	48.59	13.11	17.00	96.00
Percentage of member age in 0-15	%	5412	0.26	0.22	0.00	0.80
Percentage of member age in 15-25	%	5412	0.19	0.21	0.00	1.00
Percentage of member age in 25-35	%	5412	0.12	0.18	0.00	1.00
Percentage of member age in 35-45	%	5412	0.14	0.19	0.00	1.00
Percentage of member age in 45-55	%	5412	0.13	0.22	0.00	1.00
Percentage of member age in 55-65	%	5412	0.07	0.19	0.00	1.00
Percentage of member age over 65	%	5412	0.08	0.20	0.00	1.00
Percentage of non-educated people	%	5412	0.33	0.30	0.00	1.00
Percentage of primary-educated people	%	5412	0.27	0.25	0.00	1.00
Percentage of secondary-educated people	%	5412	0.26	0.27	0.00	1.00
Percentage of high-school-educated people	%	5412	0.08	0.15	0.00	1.00
Percentage of vocationally educated people	%	5412	0.02	0.09	0.00	1.00
Percentage of professionally educated people	%	5412	0.03	0.10	0.00	1.00
Percentage of university-educated people	%	5412	0.01	0.06	0.00	0.83

Note: Mean weighted by sampling weights. Obs column shows the number of positive observation in the dataset.
Source: Own calculations based on 2006 VHLSS.

Table A6: Summary statistics of variables based on VHLSS 2008 data

	Unit	Obs	Mean	s.d	Min	Max
Output						
Values of crop production	000 VND	5403	26898.69	53712.84	29.35	1450000.00
Inputs						
Land sown area	M2	5403	15364.36	30987.48	0.15	900041.00
# working hours of males		5403	1051.59	1132.02	0.00	10548.00
# working hours of females		5403	1269.20	1144.79	0.00	13152.00
# working hours of hired labor		5403	154.42	552.44	0.00	18925.93
Expenses on seeds	000 VND	5403	1.28	0.62	0.00	2.00
Expenses on fertilizers	000 VND	5403	4597.24	11076.69	0.00	430378.37
Expenses on insecticide	000 VND	5403	1.61	0.65	0.00	2.00
Expenses on small tools	000 VND	5403	0.91	0.29	0.00	1.00
Expenses on other inputs	000 VND	5403	2851.65	6684.59	0.00	243482.11
Household characteristics						
Age of head in years	Years	5403	49.46	13.02	16.00	97.00
Percentage of member age in 0-15	%	5403	0.23	0.22	0.00	0.80
Percentage of member age in 15-25	%	5403	0.19	0.20	0.00	1.00
Percentage of member age in 25-35	%	5403	0.11	0.17	0.00	1.00
Percentage of member age in 35-45	%	5403	0.14	0.20	0.00	1.00
Percentage of member age in 45-55	%	5403	0.14	0.23	0.00	1.00
Percentage of member age in 55-65	%	5403	0.09	0.21	0.00	1.00
Percentage of member age over 65	%	5403	0.09	0.21	0.00	1.00
Percentage of non-educated people	%	5403	0.32	0.30	0.00	1.00
Percentage of primary-educated people	%	5403	0.26	0.25	0.00	1.00
Percentage of secondary-educated people	%	5403	0.26	0.27	0.00	1.00
Percentage of high-school-educated people	%	5403	0.10	0.17	0.00	1.00
Percentage of vocationally educated people	%	5403	0.03	0.11	0.00	1.00
Percentage of professionally educated people	%	5403	0.02	0.08	0.00	1.00
Percentage of university-educated people	%	5403	0.01	0.07	0.00	1.00

Note: Mean weighted by sampling weights. Obs column shows the number of positive observation in the dataset.
Source: Own calculations based on 2008 VHLSS.

Table A7: Summary statistics of variables based on VHLSS 2010 data

	Unit	Obs	Mean	s.d	Min	Max
Output						
Values of crop production	000 VND	4760	41773.32	89437.41	139.04	3620000.00
Inputs						
Land sown area	M2	4760	13625.22	22920.24	0.11	500000.00
# working hours of males		4760	996.50	1079.50	0.00	10010.00
# working hours of females		4760	1178.89	1058.69	0.00	9453.00
# working hours of hired labor		4760	144.06	1312.99	0.00	73725.39
Expenses on seeds	000 VND	4760	1.23	0.61	0.00	2.00
Expenses on fertilizers	000 VND	4760	5921.56	13518.14	0.00	376915.23
Expenses on insecticide	000 VND	4760	1.64	0.63	0.00	3.00
Expenses on small tools	000 VND	4760	0.88	0.32	0.00	2.00
Expenses on other inputs	000 VND	4760	4144.11	8019.99	0.00	187514.06
Household characteristics						
Age of head in years	Years	4760	48.03	13.22	18.00	99.00
Percentage of member age in 0-15	%	4760	0.24	0.21	0.00	0.83
Percentage of member age in 15-25	%	4760	0.19	0.21	0.00	1.00
Percentage of member age in 25-35	%	4760	0.13	0.19	0.00	1.00
Percentage of member age in 35-45	%	4760	0.14	0.20	0.00	1.00
Percentage of member age in 45-55	%	4760	0.15	0.24	0.00	1.00
Percentage of member age in 55-65	%	4760	0.08	0.20	0.00	1.00
Percentage of member age over 65	%	4760	0.08	0.19	0.00	1.00
Percentage of non-educated people	%	4760	0.33	0.30	0.00	1.00
Percentage of primary-educated people	%	4760	0.25	0.25	0.00	1.00
Percentage of secondary-educated people	%	4760	0.26	0.27	0.00	1.00
Percentage of high-school-educated people	%	4760	0.10	0.17	0.00	1.00
Percentage of vocationally educated people	%	4760	0.03	0.11	0.00	1.00
Percentage of professionally educated people	%	4760	0.02	0.08	0.00	1.00
Percentage of university-educated people	%	4760	0.02	0.08	0.00	1.00

Note: Mean weighted by sampling weights. Obs column shows the number of positive observation in the dataset.
Source: Own calculations based on 2010 VHLSS.

Appendix B. Descriptive statistics of the variables in the Mincer models and participation regression

Table B1: Summary statistics of variables based on VLSS 1993 data

Variable	Obs	Mean	Std. Dev	Min	Max
log hourly wage	1841	0.04	0.72	-1.92	2.00
Female	1841	0.43	0.50	0.00	1.00
Years of schooling	1841	8.88	3.71	0.00	18.00
Female x years of schooling	1841	3.89	5.09	0.00	18.00
Experience	1841	16.49	10.47	0.00	55.00
Experience squared (10^{-3})	1841	0.38	0.46	0.00	3.02
Mining	1841	0.01	0.11	0.00	1.00
Manufacturing	1841	0.32	0.47	0.00	1.00
Electricity, construction	1841	0.09	0.29	0.00	1.00
Commerce	1841	0.06	0.23	0.00	1.00
Transportation, communication	1841	0.05	0.22	0.00	1.00
Finance, other services	1841	0.30	0.46	0.00	1.00
Government	1841	0.25	0.43	0.00	1.00
SOE	1841	0.18	0.38	0.00	1.00
FDI	1841	0.01	0.07	0.00	1.00
Red R Delta	1841	0.12	0.33	0.00	1.00
NorthEast	1841	0.09	0.29	0.00	1.00
NorthWest	1841	0.01	0.07	0.00	1.00
N Central Coast	1841	0.07	0.26	0.00	1.00
S Central Coast	1841	0.12	0.32	0.00	1.00
Central Highland	1841	0.01	0.08	0.00	1.00
Southeast	1841	0.09	0.29	0.00	1.00
Mekong Delta	1841	0.22	0.42	0.00	1.00
Hanoi	1841	0.08	0.27	0.00	1.00
HCMC	1841	0.18	0.39	0.00	1.00

Source: Own calculations based on 1992/93 VLSS.

Table B2: Summary statistics of variables based on VLSS 1998 data

Variable	Obs	Mean	Std. Dev	Min	Max
log hourly wage	2229	0.95	0.59	-0.65	2.80
Female	2229	0.37	0.48	0.00	1.00
Years of schooling	2229	7.56	3.89	0.00	22.00
Female x years of schooling	2229	2.70	4.25	0.00	19.00
Experience	2229	17.17	10.56	0.00	58.00
Experience squared (10^{-3})	2229	0.41	0.48	0.00	3.36
Mining	2229	0.02	0.14	0.00	1.00
Manufacturing	2229	0.38	0.48	0.00	1.00
Electricity, construction	2229	0.17	0.38	0.00	1.00
Commerce	2229	0.09	0.29	0.00	1.00
Transportation, communication	2229	0.08	0.27	0.00	1.00
Finance, other services	2229	0.01	0.12	0.00	1.00
Government	2229	0.04	0.20	0.00	1.00
SOE	2229	0.20	0.40	0.00	1.00
FDI	2229	0.08	0.27	0.00	1.00
Red R Delta	2229	0.15	0.35	0.00	1.00
NorthEast	2229	0.03	0.18	0.00	1.00
NorthWest	2229	0.01	0.07	0.00	1.00
N Central Coast	2229	0.08	0.28	0.00	1.00
S Central Coast	2229	0.11	0.31	0.00	1.00
Central Highland	2229	0.00	0.06	0.00	1.00
Southeast	2229	0.14	0.35	0.00	1.00
Mekong Delta	2229	0.23	0.42	0.00	1.00
Hanoi	2229	0.05	0.21	0.00	1.00
HCMC	2229	0.20	0.40	0.00	1.00

Source: Own calculations based on 1997/98 VLSS.

Table B3: Summary statistics of variables based on VHLSS 2002 data

Variable	Obs	Mean	Std. Dev	Min	Max
Log hourly wage	19194	1.25	0.60	-0.49	3.08
Female	19194	0.38	0.49	0.00	1.00
Years of schooling	19194	8.39	4.91	1.00	22.00
Female x years of schooling	19194	3.22	5.18	0.00	22.00
Experience	19194	18.39	10.91	0.00	56.00
Experience squared (10^{-3})	19194	0.46	0.48	0.00	3.14
Mining	19194	0.02	0.14	0.00	1.00
Manufacturing	19194	0.24	0.42	0.00	1.00
Electricity, construction	19194	0.16	0.37	0.00	1.00
Commerce	19194	0.08	0.27	0.00	1.00
Transportation, communication	19194	0.05	0.22	0.00	1.00
Finance, other services	19194	0.24	0.43	0.00	1.00
Government	19194	0.20	0.40	0.00	1.00
SOE	19194	0.14	0.35	0.00	1.00
FDI	19194	0.03	0.17	0.00	1.00
Red R Delta	19194	0.17	0.38	0.00	1.00
NorthEast	19194	0.08	0.27	0.00	1.00
NorthWest	19194	0.01	0.11	0.00	1.00
N Central Coast	19194	0.08	0.27	0.00	1.00
S Central Coast	19194	0.09	0.29	0.00	1.00
Central Highland	19194	0.03	0.18	0.00	1.00
Southeast	19194	0.12	0.32	0.00	1.00
Mekong Delta	19194	0.24	0.43	0.00	1.00
Hanoi	19194	0.07	0.25	0.00	1.00
HCMC	19194	0.11	0.31	0.00	1.00

Source: Own calculations based on 2002 VHLSS.

Table B4: Summary statistics of variables based on VHLSS 2004 data

Variable	Obs	Mean	Std. Dev	Min	Max
log hourly wage	5885	1.50	0.59	-0.20	3.04
Female	5885	0.38	0.49	0.00	1.00
Years of schooling	5885	9.21	4.19	0.00	22.00
Female x years of schooling	5885	3.60	5.32	0.00	22.00
Experience	5885	18.14	11.20	0.00	58.00
Experience squared (10^{-3})	5885	0.45	0.48	0.00	3.36
Mining	5885	0.02	0.13	0.00	1.00
Manufacturing	5885	0.26	0.44	0.00	1.00
Electricity, construction	5885	0.17	0.38	0.00	1.00
Commerce	5885	0.08	0.28	0.00	1.00
Transportation, communication	5885	0.06	0.23	0.00	1.00
Finance, other services	5885	0.28	0.45	0.00	1.00
Government	5885	0.23	0.42	0.00	1.00
SOE	5885	0.13	0.33	0.00	1.00
FDI	5885	0.05	0.22	0.00	1.00
Red R Delta	5885	0.20	0.40	0.00	1.00
NorthEast	5885	0.09	0.28	0.00	1.00
NorthWest	5885	0.01	0.12	0.00	1.00
N Central Coast	5885	0.08	0.28	0.00	1.00
S Central Coast	5885	0.09	0.28	0.00	1.00
Central Highland	5885	0.03	0.18	0.00	1.00
Southeast	5885	0.10	0.30	0.00	1.00
Mekong Delta	5885	0.19	0.39	0.00	1.00
Hanoi	5885	0.07	0.26	0.00	1.00
HCMC	5885	0.12	0.33	0.00	1.00

Source: Own calculations based on 2004 VHLSS.

Table B5: Summary statistics of variables based on VHLSS 2006 data

Variable	Obs	Mean	Std. Dev	Min	Max
log hourly wage	6818	1.66	0.55	0.15	3.21
Female	6818	0.40	0.49	0.00	1.00
Years of schooling	6818	9.49	4.19	0.00	22.00
Female x years of schooling	6818	3.82	5.46	0.00	18.00
Experience	6818	18.10	11.81	0.00	57.00
Experience squared (10^{-3})	6818	0.47	0.50	0.00	3.25
Mining	6818	0.02	0.12	0.00	1.00
Manufacturing	6818	0.27	0.45	0.00	1.00
Electricity, construction	6818	0.17	0.37	0.00	1.00
Commerce	6818	0.10	0.30	0.00	1.00
Transportation, communication	6818	0.05	0.22	0.00	1.00
Finance, other services	6818	0.25	0.43	0.00	1.00
Government	6818	0.20	0.40	0.00	1.00
SOE	6818	0.12	0.32	0.00	1.00
FDI	6818	0.06	0.23	0.00	1.00
Red R Delta	6818	0.19	0.39	0.00	1.00
NorthEast	6818	0.08	0.27	0.00	1.00
NorthWest	6818	0.01	0.12	0.00	1.00
N Central Coast	6818	0.08	0.28	0.00	1.00
S Central Coast	6818	0.09	0.29	0.00	1.00
Central Highland	6818	0.04	0.19	0.00	1.00
Southeast	6818	0.12	0.32	0.00	1.00
Mekong Delta	6818	0.21	0.41	0.00	1.00
Hanoi	6818	0.06	0.23	0.00	1.00
HCMC	6818	0.11	0.32	0.00	1.00

Source: Own calculations based on 2006 VHLSS.

Table B6: Summary statistics of variables based on VHLSS 2008 data

Variable	Obs	Mean	Std. Dev	Min	Max
log hourly wage	6167	2.06	0.58	0.37	3.79
Female	6167	0.40	0.49	0.00	1.00
Years of schooling	6167	10.03	4.79	0.00	24.00
Female x years of schooling	6167	4.13	5.98	0.00	22.00
Experience	6167	18.38	12.19	0.00	58.00
Experience squared (10^{-3})	6167	0.49	0.53	0.00	3.36
Mining	6167	0.13	0.33	0.00	1.00
Manufacturing	6167	0.19	0.39	0.00	1.00
Electricity, construction	6167	0.20	0.40	0.00	1.00
Commerce	6167	0.02	0.14	0.00	1.00
Transportation, communication	6167	0.02	0.14	0.00	1.00
Finance, other services	6167	0.29	0.45	0.00	1.00
Government	6167	0.21	0.41	0.00	1.00
SOE	6167	0.10	0.31	0.00	1.00
FDI	6167	0.07	0.26	0.00	1.00
Red R Delta	6167	0.21	0.41	0.00	1.00
NorthEast	6167	0.08	0.28	0.00	1.00
NorthWest	6167	0.01	0.12	0.00	1.00
N Central Coast	6167	0.07	0.26	0.00	1.00
S Central Coast	6167	0.09	0.28	0.00	1.00
Central Highland	6167	0.03	0.18	0.00	1.00
Southeast	6167	0.12	0.32	0.00	1.00
Mekong Delta	6167	0.22	0.41	0.00	1.00
Hanoi	6167	0.05	0.22	0.00	1.00
HCMC	6167	0.11	0.31	0.00	1.00

Source: Own calculations based on 2008 VHLSS.

Table B7: Summary statistics of variables based on VHLSS 2010 data

Variable	Obs	Mean	Std. Dev	Min	Max
log hourly wage	7326	2.48	0.57	0.64	4.14
Female	7326	0.40	0.49	0.00	1.00
Years of schooling	7326	10.06	4.36	0.00	22.00
Female x years of schooling	7326	4.14	5.80	0.00	22.00
Experience	7326	18.47	12.01	0.00	55.00
Experience squared (10^{-3})	7326	0.49	0.53	0.00	3.02
Mining	7326	0.01	0.10	0.00	1.00
Manufacturing	7326	0.27	0.44	0.00	1.00
Electricity, construction	7326	0.19	0.39	0.00	1.00
Commerce	7326	0.11	0.32	0.00	1.00
Transportation, communication	7326	0.05	0.22	0.00	1.00
Finance, other services	7326	0.25	0.43	0.00	1.00
Government	7326	0.20	0.40	0.00	1.00
SOE	7326	0.08	0.27	0.00	1.00
FDI	7326	0.07	0.26	0.00	1.00
Red R Delta	7326	0.16	0.36	0.00	1.00
NorthEast	7326	0.08	0.27	0.00	1.00
NorthWest	7326	0.01	0.12	0.00	1.00
N Central Coast	7326	0.09	0.28	0.00	1.00
S Central Coast	7326	0.09	0.29	0.00	1.00
Central Highland	7326	0.04	0.19	0.00	1.00
Southeast	7326	0.13	0.34	0.00	1.00
Mekong Delta	7326	0.19	0.39	0.00	1.00
Hanoi	7326	0.10	0.30	0.00	1.00
HCMC	7326	0.12	0.32	0.00	1.00

Source: Own calculations based on 2010 VHLSS.

Appendix C. Estimated sample selectivity equations, 1993-2010

Dependent variable: log of crop income	1993	1998	2002	2004	2006	2008	2010
Female	-0.68***	-0.43***	-0.59***	-0.70***	-0.70***	-0.70***	-0.67***
	(0.08)	(0.06)	(0.02)	(0.05)	(0.04)	(0.04)	(0.04)
Year of schooling	0.06***	0.03***	0.05***	0.05***	0.05***	0.06***	0.06***
	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Gender x Year of schooling	0.06***	0.01	0.02***	0.04***	0.04***	0.04***	0.03***
	(0.01)	(0.01)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)
Age (in years)	-0.00	-0.02***	-0.00***	0.00	-0.00***	-0.00	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Proportion of children	-0.04	-0.23***	0.23***	0.23***	0.21***	0.48***	0.59***
	(0.07)	(0.07)	(0.03)	(0.05)	(0.05)	(0.05)	(0.05)
Household size	-0.03***	0.02**	-0.01**	0.00	0.01	-0.00	-0.03***
	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
Land areas	-0.00***	-0.00***	-0.00***	-0.00***	-0.00***	-0.00***	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Red River Delta	0.04	-0.05	0.18***	0.25***	0.24***	0.43***	0.23***
	(0.06)	(0.06)	(0.02)	(0.04)	(0.03)	(0.04)	(0.04)
North East	-0.00	-0.32***	0.02	0.10**	0.05	0.12***	-0.06*
	(0.07)	(0.07)	(0.02)	(0.04)	(0.04)	(0.04)	(0.04)
North West	-0.39**	-0.24	-0.00	0.08	-0.00	-0.04	-0.11*
	(0.16)	(0.16)	(0.04)	(0.06)	(0.06)	(0.06)	(0.05)
South Central Coast	0.42***	0.35***	0.43***	0.44***	0.41***	0.45***	0.34***
	(0.07)	(0.06)	(0.02)	(0.04)	(0.04)	(0.04)	(0.04)
Central Highlands	-0.03	-0.51***	0.34***	0.26***	0.29***	0.11**	0.06
	(0.15)	(0.12)	(0.03)	(0.05)	(0.05)	(0.05)	(0.04)
South East	0.39***	0.66***	0.81***	0.61***	0.66***	0.70***	0.60***
	(0.07)	(0.06)	(0.02)	(0.04)	(0.04)	(0.04)	(0.04)
Mekong Delta	0.33***	0.37***	0.67***	0.54***	0.56***	0.65***	0.40***
	(0.06)	(0.06)	(0.02)	(0.04)	(0.03)	(0.04)	(0.03)
Hanoi	0.61***	0.48***	0.57***	0.63***	0.49***	0.47***	0.24***
	(0.08)	(0.08)	(0.03)	(0.06)	(0.06)	(0.06)	(0.05)
Ho Chi Minh city	0.87***	0.94***	0.70***	0.65***	0.64***	0.67***	0.52***
	(0.07)	(0.06)	(0.03)	(0.05)	(0.05)	(0.05)	(0.05)
Constant	-1.29***	-0.50***	-1.09***	-1.11***	-0.99***	-1.41***	-1.00***
	(0.10)	(0.09)	(0.03)	(0.06)	(0.06)	(0.06)	(0.06)
Observations	1,841	2,229	19,194	5,885	6,818	6,167	7,326

Source: Authors' calculation using V(H)LSS data