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Market Access and Specialization in Cash Crops:

Vietnam's Expected Gains from WTO Accession

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Contents

Abstract

This paper discusses the link between trade liberalization and farmers' decisions to specialize in cash crops. Farmers are differentiated between subsistence-oriented farmers and export-oriented cash crop producers. Amongst the latter, using a panel survey from 2002 to 2004, we can identify export-oriented farmers, farmers exiting the export market and those entering the market. An agricultural trade index is computed that captures access to the export market according to each province's specialization in cash crops. The decision to enter, exit or remain in the export market is then related to the trade index while controlling for household and farm characteristics. The gain in agricultural income due to changes in foreign market access is estimated. Finally, the impact of an improvement of market access abroad is then simulated.

Introduction

Since the mid - 1990s, Vietnam has experienced a surge in agricultural and manufacturing exports, largely as a result of the "Doi Moi" structural reforms. These introduced new land - use rights, with greater freedom being accorded to farmers to determine crop production, and the diminution of price distortions.[1] The result of the reforms has been startling; over the 1993-2004 period, the national incidence of poverty decreased by almost 39 percentage points, to 19 percent in 2004 (Vietnamese Academy of Social Sciences, 2006).

Over the same period, Vietnam had a comparative advantage in agricultural products and with protective barriers in place it had relatively little to fear in terms of import competition.[2] Moreover, as the country began importing raw materials and exporting farm products, new commercial opportunities emerged in domestic and international markets. This enabled Vietnam to become a major worldwide exporter and producer of certain agricultural commodities including rice, coffee, cashews, black pepper and tea. Now, with Vietnam's accession into the WTO, it is expected that this position will be consolidated and that the country's market potential will considerably increase.[3] With the agriculture sector still accounting for more than 50 percent of employment, agricultural trade liberalization is likely to have a strong impact on household income. However, surprisingly little is known about the distribution of export gains across households.

This paper focuses on agricultural households. It seeks to identify how foreign market access has influenced household specialization in export crops. More broadly, it seeks to assess the impact of trade liberalization on Vietnamese farmers using 2002-2004 household survey. We define export-oriented households as agricultural households cultivating the country's primary cash crops (coffee, pepper, rubber, tea and cashews). In the survey, we distinguish between households that were export-oriented throughout the survey period, households that were subsistence-oriented for the period, households that began cultivating cash crops and households that ceased production. We attempt to identify the determinants of these transitions into or out of the export market. Among these determinants, changes to market access abroad (computed at the provincial level) play a significant role. Using a propensity score matching method, we estimate the agricultural income gains of entering into or remaining in the export market, compared with subsistence agriculture or exiting the export market.[4] These estimations are then used to simulate the impact of an improvement in foreign market access on Vietnam.

This paper contributes to the large body of empirical literature about the impact of trade liberalization on wage inequality. Broadly, previous studies have focused on the effect of trade liberalization on wages in the import-competing manufacturing sector. A great many studies also draw on the Latin American experience (Feliciano, 2001; Hanson *et al.*, 1999; Goldberg *et al.*, 2005; Attanasio *et al.*, 2004). In Asia, the pattern of trade liberalization differs somewhat, with greater emphasis on agricultural exports. Here, trade liberalization was first studied through variations in rice prices (Benjamin *et al.*, 2002; Edmonds *et al.*, 2004). However, in recent years, other cash crops have played a significant role and merit further study. Our methodology is close to that of Balat *et al.* (2006), which investigates the

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[1] See Paquet, 2004 and Lavigne, 1999 for details of the economic reforms.

[2] During this period the government implemented policies that limited imports in competitive sectors (through ad valorem tariffs and non-tariff barriers, such as quantitative restrictions, duty quotas, prohibitions, licensing and special regulations). The government also promoted exports with the creation of Export Processing Zones (EPZ) in 1991, tax exemption for exporters and the elimination of tariffs on imported fertilizers (Auffret, 2003).

[3] Vietnam became the 150th member of the WTO on 11 January 2007.

[4] For a theoretical description of the various matching methods (particularly Local Linear Propensity score matching) and an empirical application to labor markets, see Heckman *et al.* (1997).

constraints on Malawian farmers in entering commodity export markets. Pham (2007) examines the impact of trade policy on non-farm employment in Vietnamese rural households. These papers, however, are based on repeated cross sections. The originality of our work is to look at a household panel that allows us to follow the same households over the time.

This paper is laid out as follows: section 2 presents the data; section 3 compares export-oriented households and other households and looks at the determinants of transitions into or out of the export market; section 4 estimates the income gains of a specialization in export crops after households with similar characteristics have been matched. Section 5 simulates the impact of an improvement in foreign market access for Vietnamese agricultural products; section 6 conducts robustness analyses; and section 7 concludes the study.

1.   Data

1.1   Dataset

The paper uses data from the 2002 and 2004 Vietnam Household Living Standard Survey (VHLSS) based on samples of 30,000 and 9,000 households, respectively. Both surveys collected information on household and community characteristics. The household questionnaire includes information on basic demographics on all household members (age, sex, relationship to head); household expenditure (food, education, health, etc.); household income, employment and labor force participation, education (literacy, highest diploma, fee exemption); health (use of health services, health insurance); housing (type of housing, electricity, water source, toilet, etc.); assets and durable goods and participation in poverty programs. The VHLSS 2004 also included an expanded agricultural component that included information on land transactions (renting in/out in past 12 months, changes in land and land use rights in last 10 years), produce sales, crop changes in last 10 years and access to farm extension services (Phung *et al*., 2006).

The surveys include 20,156 agricultural households in 2002 and 6,300 agricultural households in 2004. Local information on infrastructure was collected separately in a community questionnaire. In the following, we focus on the panel component of 4355 households and more precisely we restrained our analysis on the panel subset of 2,640 agricultural households.[5] In Table 1 we can see that 2,640 house-

Table 1. Description of VHLS 2002-2004 Data

	2002	2004
Household Cross Section	20,156	6,300
Household Panel		
Hslds present each year in farming	2,640	2,640
Hslds exiting from farming	169	
Hslds entering into farming		224
Total	2,809	2,864

Household-Crop Panel	2002	2004
Crops present each year	11,164	11,164
Crops exiting	5,342	
Crops entering		6,185
Total	16,506	17,349

holds remained in cash-crop agriculture over the 2002-2004 period, 169 households exited and 224 households began producing cash-crops that will be exported. For our purposes, an agricultural household is defined as a household reporting a positive harvest value in any crop in the VHLSS household questionnaire.[*]

Summing things up, the 2,640 farmers cultivated a total of 16,506 crops in 2002 and 17,349 in 2004. of which the 11,164 are cultivated in both years, providing original panel of household-crops. Within the 16,506 crops cultivated in 2002, 5,342 crops were abandoned in 2002 and out of the 17,349 crops cultivated, 6,185 crops were introduced in 2004.

1.2   Cash Crop Producers

In 1990, rice accounted for 80.2 percent of agricultural exports (Table 2). Over the course of the decade, this share continued to drop, reaching 32.7 percent in 2004. Other crops emerged such as rubber, coffee and to a lesser extent, cashews. Overall, the trade balance has been positively driven by primary products and among them, food products (General Statistical Office, 2006).

The United Nations Commodity Trade Statistics Database (COMTRADE) provides data for trade flows between Vietnam and the rest of the world. Based on these data,

[5] The panel linkage dataset was provided by Brian McCaig (please refer to http://www.chass.utoronto.ca/~bmccaig/notes for more information) as the one produced by the Government Statistical Office shows some inconsistency.

[6] 38 crops are reported in the survey. More crops are actually grown but are not identified separately in the survey.

Table 2.   Agricultural Export Composition in Vietnam 1990-2004

	1990	1995	2000	2004
Share of Agricultural Products in Total non-oil Exports	**80**	**46**	**25**	**22**
Composition of agricultural exports:				
Rubber	4.7	12	9.4	20.5
Coffee	7.3	37.4	28.4	22
Tea	0.6	9.8	4	3.3
Rice	80.2	40.7	37.8	32.7
Cashew	3.8	0.8	9.5	15
Black pepper	3.5	4.5	8.3	5.2
Cinnamon	na	na	0.3	0.3
Groundnut	na	0.7	2.3	0.9
	100	100	100	100

Source: Athukorala et al. 2007 based on GSO data.

Vietnam appears as a net exporter or a net importer for a given crop. Among crops that are exported, data from the General Statistics Office (GSO) are used to identify the most important ones.

"Cash crops" thus include Vietnam'smajor exports such as tea, coffee, rubber, pepper and cashews. "Other" crops can either be exported on a minor scale or simply subsistence-oriented crops for local consumption. We leave aside rice, because rice is exported, imported and domestically consumed. The decision to begin growing rice thus differs from the decision to begin producing cash crops. Moreover, rice production has been extensively examined in other studies (see above). Table 3 shows the classification of the 38 crops in the dataset according to their market orientation.

Map 1 (see Appendices) shows the geographical distribution of cash crop producers and gives the average per capita agricultural income per province. The eight administrative regions of Vietnam are presented in Map 2. The Southeast provinces have a high average agricultural income and a concentration of cash crop producers. The Central Highlands also have many cash crop producers, but with lower per capita income, ranging from 2,136,000 Vietnam Dong (gr.cap) to 1,827,000 gr.cap. The Central Highlands includes Dak Lak province where coffee production was successfully begun in the mid-1990s. The Mekong River Delta is the richest region, although not solely due to cash crops. Conversely, the North Central Coast is the poorest region, with provincial per capita agricultural income ranging between 872,000 gr.cap and 1,827,000 gr.cap and

Table 3.   Crop Definitions from VHLSS Dataset

		Water morning glory	Litchi, logan, rambutan	Sapodilla (large berry)	Custard apple	
	Indian corn	Potatoes	Other leafy greens	Fresh legumes (beans)	Plums
	Tomatoes	Sugar cane	Tobaco	Jute, ramie (textile fiber)	
	Mulberry	Oranges, limes, mandarins	Apples	Grapes	Jackfruit, durian
Other	Kohlrabis, Cabbages, cauliflower	Specialty rice	Sweet potatoes	Cassava manioc	Glutinous rice
	Soy beans	Peanuts	Sesame seeds	Cotton	Coconut
	Pineapple	Bananas	Mango	Papaya	Rice
Cash crops	Tea	Coffee	Rubber	Black pepper	Cashew

Table 4.   Share of Produce Sold on Markets, 2002-2004

|	2002		2004	
	Average	**Std. Dev.**	**Average**	**Std. Dev.**
Other	0.2977	0.3915	0.3069	0.3944
Cash crops	0.7865	0.3793	0.7967	0.3724
Rice	0.2461	0.3167	0.2470	0.3020

with cash crop farmers equally distributed throughout the region. Finally, the Northeast is the more heterogeneous region in terms of income and localization of cash crop producers.

Table 4 shows the proportion of the harvest sold on markets, by crop type. For example, in 2004, farmers growing other crops sent 31 per cent of their harvest to market on average. In the case of rice production, the majority was self-consumed with only a quarter of production going to market. In 2002, almost 79 percent of the produce of cash crop farmers went to market.

This paper examines specialization patterns in cash crops versus subsistence farming and aims to capture the effects of trade liberalization. Thus, households are defined as export-oriented if they produce any of the "cash crops" listed in Table 3. A subsistence household, however, is more difficult to define. In order to ensure that the target and control groups remain distinct, we define subsistence oriented households as those which: (i) are not growing any cash crops; and, (ii) sell no more than 50 per cent of their total production. For example, a household that sells less than 50 per cent of its total soybean production on local markets would be categorized as subsistence oriented. Accordingly to this definition, households are either cash crop producers (export-oriented), labeled as 1, or subsistence oriented, labeled as 0.

Figure 1 plots a kernel density of the variation in agricultural income between 2002 and 2004 according to household production. The mode of the density function is at zero, meaning that most households earned the same agricultural income in 2002 and 2004. However, the curve for cash crops farmers shows a gap on the right, meaning that many cash crop farmers enjoyed a higher increase in their agricultural income than did domestic-orientated farmers.

Figure 1.   Kernel Density Distribution of Agricultural Income Gains by Farmer Classification (2002-2004)[7]

(1) Gaussian kernel density
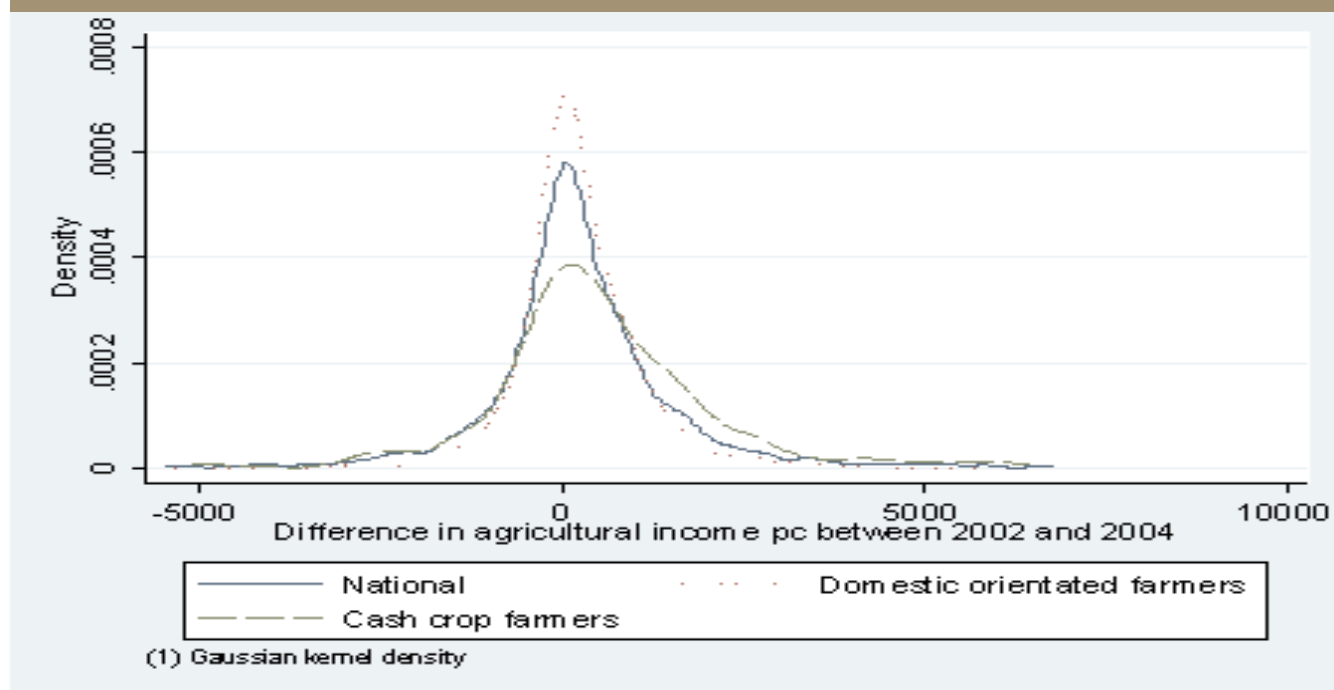
[7] Household agricultural income data has been recomposed from the agriculture section of the VHLSS. Harvests of each crop are valued by a provincial price computed from unit values at the household level. This unit value is obtained by taking the ratio of values sold on the market over quantity, deflated by a month and a year deflator. The base period is January 2002. These unit values are then averaged by crop and by province. The highest and lowest percentiles are dropped.

1.3   The Dynamics of Crop Specialization

Turning to crop specialization decisions between 2002 and 2004, of 2,640 households in the panel, Table 1 shows that 347 households produced cash crops in both years (1 to 1) and 1,347 households remained in subsistence oriented crops (0 to 0). 160 households entered cash crop production (0 to 1) and 82 exited cash crop production (1 to 0). For simplicity, these farmers are respectively referred to as cash crops (or exporters),

subsistence oriented, newcomers and quitters. The same classification can be carried out for each cash crop separately, except rubber, for which no mobility is observed.[8]

The probability of exiting the export market is 8.21 percents, greater than the probability of entering (6.63 percent) despite the favorable context for exports (Table 6). This is the case for all cash crops, except pepper.

Table 5.   Household Crop Dynamics (Number of Households)

2002 to 2004	Cash crops	Tea	Coffee	Pepper	Cashew
0 to 1	160	72	20	43	37
1 to 0	82	35	23	8	18
1 to 1	347	127	133	75	64
0 to 0	1348	1292	1432	1425	1438

(Key: 0 = subsistence farming, 1 = cash crops).

Table 6.   Probabilities of Transition

2002 to 2004	Cash crops	Tea	Coffee	Pepper	Cashew
0 to 1	6.63	5.27	0.41	0.83	0.66
1 to 0	8.21	17.53	6.99	0.83	5.88
1 to 1	91.79	82.47	93.01	98.68	94.12
0 to 0	93.37	94.73	99.59	99.17	99.34

(Key: 0 = subsistence farming, 1 = cash crops).

[8] Thus, rubber is ruled out from the specific analysis of cash crops (but still included in the cash crops category).

2. Barriers to Entry

Several factors could influence a household's decision to specialize in export crops. A first set of factors relates to household characteristics such as the number of children and the gender, age education level and marital status of head household. Another set relates to the characteristics of the farm: its size, the use of pesticides, and the type of entitlement (ownership of a land certification). Other factors could include household access to transport (vehicle ownership, for instance). A last factor arises directly from trade policy. Where the market access provided by Vietnam's partner countries to agricultural exports from Vietnam is considered.

2.1 Modeling Market Access

The starting point is the international tariffs faced by Vietnamese "cash crops" collected in the UNCTAD TRAINS[8bis] dataset. Because it takes households time to react to information on market conditions abroad,[9] and because households are heterogeneous with respect to risk, we use lagged tariffs variations. During a field survey in Binh Phuoc province,[10] most farmers reported in interviews that they "will change their cropping patterns because someone they know has already done so and is doing well". In other words, the first household that enters the export market may be self-selected in terms of risk aversion and credit constraint. As we do not want to restrict our study to these pioneering households, we construct a lagged index of tariff variations that occurred in the 1990s.[11]

While market access variations were implemented on a national level, only those provinces with suitable climatic and soil conditions could benefit from improved access by growing the internationally demanded crop. We capture the differential effect of trade liberalization across Vietnamese provinces based on the opportunity to grow a certain crop. Thus, in line with Topalova (2005), we construct an *ex ante* national distribution of crops and then compare the household probability of starting cash crop production based on provincial natural resource endowment. Then, using GSO data, we create a provincial acreage share for each cash crop from 2000.[12] The provincial agricultural trade openness index is defined as follows:

$$I_{p,e} = \left(\frac{A_{e,p,00}}{\sum_p A_{e,p,00}} \right) \Delta t_e \qquad \text{(Eq 1)}$$

where Δt_e is the average tariff variation for cash crop e, $A_{e,p,00}$ is the acreage of crop e in province p and year 2000.

[8bis] define UNLTAO TRAINS.

[9] This is primarily due to information asymmetry.

[10] Conducted by Loren Brandt for a survey on land redistribution (World Bank). Here, those households changing crosp were mostly adopting cashew production.

[11] The ad valorem tariffs applied to Vietnamese cash crops on foreign markets were highly erratic throughout the period. Moreover data for some years was missing. So we constructed a consistent index over all cash crops and years based on the variation between 1997-2000 using 1992-1995 average values.

[12] Unpublished GSO data from the author's participation in a joint project with the World Bank and the Center of Agricultural Policy (CAP) at IPSARD, Hanoi, Vietnam.

2.2 Modeling Participation in Cash Crop Production

A probit was run in order to model the probability of transitions amongst cash crop farmers (the treatment group).[13] If (1) denotes a cash-crop producer, and (0) denotes a subsistence farmer, a household (h) can be in four distinct situations (i): it can be an exporter over the whole period (11); a subsistence oriented farmer (00); it can enter into the cash crop sector (01); or, leave it (10). We are first interested in comparing households that remain stable producers over the period. In a first specification (k=1), we estimate the probability of participating in export production relative to subsistence-oriented farming: i.e., we compare the (11) group to the (00) group. The second specification (k=2) compares newcomers (01) with subsistence-oriented farmers (00). The third specification (k=3) compares quitters (10) to stable exporters (11).[14] The transitional households are then compared to their initial group. The regression includes three sets of repressors: household demographic characteristics (X_{h02},), characteristics of the agricultural plot (Z_{h04}), and the trade index ($I_{p,e}$):

$$C_{h(e)}(k) = \alpha + \beta_1.I_{p,e} + \beta_2.X_{h02} + \beta_3.Z_{h04} + \varepsilon_{h(e)} \text{ (Eq 2)}$$

Index $I_{p,i}$ will take a value of zero in provinces where no acreage was devoted to crop e, in 2000. This will allow us to estimate the probability of being (or becoming) an export producer given equal agronomy endowment.[15] While there are data constraints for creating detailed plot characteristics (Z_h) from the 2002 household panel, the 2004 survey included a dedicated agricultural module. Thus, it was possible to create variables such as the share of land held under long-term certificate, land quality or irrigation type. Moreover, some data is retroactive, such as variables relating to the history of plots under long-term certificates.

2.3 Results

Table 7 shows that variations in tariffs abroad on Vietnamese cash crops are negatively correlated with being or becoming an exporter relative to being or becoming subsistence-oriented.[16] In other words, the probability of starting to grow a cash crop is higher if market access abroad for that crop improves (columns 1 and 3). This result holds for each crop individually with a substantially larger effect for cashew and coffee. On average and *ceteris paribus*, a one percentage point reduction in the agricultural trade index (as defined in Eq 1) increases the probability of remaining in tea production by 1.432 percentage points and of beginning tea production by 0.69 of a percentage point. Conversely, reduced market access abroad drives households out of the production of cash crops (column 2).

Table 8 gives the results for the group of cash crops as a whole. A deterioration of market access abroad decreases the probability of becoming a cash crop grower. All else being equal, a one percentage point reduction in the agricultural trade index will decrease the probability of households participating in cash crop production by 0.115 of a percentage point.

In line with Balat *et al.* (2006), we find that owning a means of transportation (such as a car) is correlated with export orientation. Being part of an ethnic minority (not Kinh) operates in the opposite direction depending on the crop: It decreases the probability of becoming a pepper or cashew producer, while it increases the probability of becoming a tea producer. The education of the head household also has a mixed effect. If he (she) has a secondary education, it lowers the probability of entering coffee and pepper production, while it increases the probability of becoming a tea grower.

Other less intuitive factors are correlated with entry into the export market: land tenure, irrigation and the distance to the land plot. The use of chemical pesticides is correlated to tea and coffee production; although organic pesticides are also correlated to coffee production.[17] More intuitively, a high quality of land is correlated to tea production.

[13] The standard errors of the estimators are corrected for the correlation of the residuals between different observations of the same province (intra cluster).

[14] These three specifications k=1, 2 and 3 appear in the columns of7 and 8 tables.

[15] We will test the robustness of this hypothesis in section 6.

[16] For specification 3, there were insufficient observations for pepper to run a probit. For a further description of the data used in the regression please refer to Table 1 in the Appendix.

[17] This might be due to the fact that as world coffee prices fall, farmers substitute partially organic pesticides for chemical pesticides (Ha, 2008).

Table 7. Determinants of Participation in Each Cash Crop (Specifications 1, 2 and 3)

	Tea			Coffee			Pepper		Cashew		
	Exporters	Newcomers	Quitters	Exporters	Newcomers	Quitters	Exporters	Newcomers	Exporters	Newcomers	Quitters
	1	2	3	1	2	3	1	2	1	2	3
Trade Index :	-1.432 [0.146]**	-0.685 [0.202]**	0.889 [0.275]**	-3.433 [1.106]**	-2.508 [0.568]**	0.252 [0.202]	-1.91 [0.458]**	-1.933 [0.352]**	-2.148 [0.358]**	-3.02 [0.463]**	0.468 [0.152]**
Ethnicity	-0.002 [0.245]	0.371 [0.182]*	0.528 [0.312]	0.132 [0.258]	0.259 [0.287]	-0.37 [0.379]	-0.427 [0.242]	-0.948 [0.277]**	-0.241 [0.200]	-1.195 [0.345]**	-0.458 [0.688]
Poor	0.047 [0.178]	0.247 [0.209]	0.343 [0.325]	-0.068 [0.141]	-0.154 [0.153]	0.047 [0.280]	-0.145 [0.144]	-0.08 [0.145]	-0.034 [0.207]	-0.01 [0.223]	0.455 [0.493]
Rich	0.008 [0.160]	-0.114 [0.126]	-0.487 [0.405]	0.247 [0.152]	0.054 [0.156]	-0.108 [0.389]	0.3 [0.180]	0.4 [0.220]	0.373 [0.199]	-0.908 [0.333]**	-0.971 [0.503]
Gender	-0.078 [0.222]	-0.631 [0.189]**	0.615 [0.463]	0.527 [0.286]	-0.429 [0.261]	0.43 [0.778]	0.335 [0.283]	0.215 [0.351]	0.198 [0.451]	0.13 [0.420]	-0.838 [0.682]
Married	0.497 [0.207]*	0.17 [0.204]	-0.008 [0.704]	-0.407 [0.181]*	-0.01 [0.237]	-0.994 [0.435]*	-0.356 [0.253]	-0.253 [0.374]	1.774 [1.219]	1.975 [1.055]	-1.096 [1.052]
Technical diploma	0.429 [0.280]	0.553 [0.216]*	-0.043 [0.769]	-0.532 [0.372]		-0.027 [0.578]	-0.377 [0.271]	-0.47 [0.447]	-0.633 [0.472]	-2.476 [0.958]**	0.755 [0.941]
Secondary & upper	0.37 [0.218]	0.618 [0.181]**	-0.106 [0.417]	-0.421 [0.188]*	-0.193 [0.320]	0.216 [0.277]	-0.162 [0.205]	-0.65 [0.215]**	-0.221 [0.192]	-0.381 [0.288]	-0.379 [0.582]
Primary	0.259 [0.165]	0.233 [0.176]	-0.234 [0.364]	0.187 [0.164]	0.435 [0.233]	-0.118 [0.284]	0.25 [0.189]	-0.398 [0.211]	0.176 [0.193]	-0.61 [0.282]*	-0.763 [0.487]
Age squared	0.025 [0.139]	0.164 [0.131]	0.073 [0.237]	-0.208 [0.123]	-0.063 [0.098]	0.08 [0.239]	-0.091 [0.123]	0.105 [0.142]	0.086 [0.145]	0.063 [0.183]	0.139 [0.556]
Size of household	-0.064 [0.187]	0.549 [0.234]*	-0.325 [0.336]	0.12 [0.107]	0.452 [0.288]	0.583 [0.328]	0.482 [0.216]*	0.365 [0.311]	0.01 [0.239]	-0.505 [0.300]	0.312 [0.545]
Share of male	0.425 [0.400]	0.319 [0.319]	0.042 [0.653]	0.299 [0.356]	-0.024 [0.385]	-0.137 [0.798]	-0.06 [0.367]	0.131 [0.699]	-0.081 [0.381]	0.727 [0.630]	2.6 [0.983]***
Land tenure	-0.261 [0.171]	-0.023 [0.195]	0.101 [0.331]	-0.441 [0.273]	-0.327 [0.260]	0.371 [0.293]	-0.414 [0.194]*	-0.22 [0.203]	-0.534 [0.195]**	-0.286 [0.228]	1.217 [0.427]**
Car	0.213 [0.460]	-0.325 [0.499]	0.063 [0.964]	1.152 [0.261]**		-0.865 [0.449]	1.272 [0.389]**	0.582 [0.452]	0.707 [0.381]	2.117 [0.604]**	0.158 [0.735]
Varicertif	-0.206 [0.197]	-0.131 [0.181]	-0.448 [0.469]	-0.099 [0.192]	0.172 [0.337]	0.229 [0.447]	-0.319 [0.207]	-0.193 [0.164]	-0.396 [0.280]	-0.976 [0.537]	0.332 [0.723]
Urban	-0.079 [0.369]	0.061 [0.273]	0.348 [0.534]	0.667 [0.280]*	0.518 [0.290]	-0.254 [0.435]	0.264 [0.165]	0.441 [0.297]	-0.255 [0.451]	0.983 [0.320]**	0.671 [0.460]
Organic pesticides	-.298 [2.726]	0.503 [2.263]	6.907 [4.626]	5.364 [2.169]*	-1.089 [3.801]	-6.009 [4.498]	2.838 [1.962]	3.064 [3.077]	4.179 [2.502]	4.843 [3.486]	-13.888 [4.809]**
Chemical pesticides	1.432 [0.601]*	1.022 [0.756]	-1.079 [1.129]	1.379 [0.463]**	0.585 [1.060]	-3.679 [1.269]**	0.582 [0.566]	1.905 [0.628]**	-0.034 [0.979]	1.693 [0.866]	0.732 [2.118]
Land distance	0.039 [0.072]	-0.047 [0.048]	-0.054 [0.106]	0.035 [0.043]	-0.014 [0.110]	-0.025 [0.071]	-0.07 [0.043]	0.153 [0.054]**	-0.018 [0.067]	0.062 [0.052]	-0.083 [0.105]
Quality of land	0.665 [0.131]**	0.69 [0.153]**	-0.406 [0.435]	0.006 [0.136]	0.256 [0.266]	-0.175 [0.243]	0.067 [0.229]	0.286 [0.177]	0.022 [0.267]	-0.075 [0.246]	0.009 [0.322]
Irrigation	-0.661 [0.235]**	-0.432 [0.199]*	0.412 [0.321]	0.334 [0.133]*	-0.048 [0.235]	-0.828 [0.378]*	-0.056 [0.159]	0.315 [0.199]	-0.025 [0.202]	-0.618 [0.206]**	-0.489 [0.519]
Constant	-3.537 [1.178]**	-4.491 [1.026]**	-0.275 [2.147]	-1.15 [1.003]	-2.509 [1.030]*	-0.674 [2.121]	-1.565 [0.928]	-4.739 [1.503]**	-4.431 [1.513]**	-4.579 [1.761]**	-0.931 [4.802]
Observations	1412	1357	162	1557	1354	155	1493	1461	1494	1468	81
Pseudo R²	0.36	0.18	0.22	0.47	0.29	0.15	0.44	0.39	0.56	0.63	0.4

Note: Standard errors appear in italics.

Table 8: Determinants of Cash Crop Production[18]

	All Cash Crops		
	1	**2**	**3**
	Exporters	**Newcomers**	**Quitters**
Trade Index:	-0.69	-0.565	0.115
	[0.163]**	[0.130]**	[0.068]
Chemical pesticides	2.008	0.976	-2.286
	[0.502]**	[0.597]	[0.698]**
Land distance	0.003	-0.031	-0.021
	[0.039]	[0.028]	[0.037]
Quality of land	0.406	0.475	-0.009
	[0.123]**	[0.136]**	[0.173]
Irrigation	-0.177	-0.158	-0.166
	[0.155]	[0.128]	[0.191]
Constant	-1.891	-3.036	-1.293
	[0.695]**	[0.831]**	[1.118]
Observations	1686	1534	407
Pseudo R^2	0.34	0.2	0.11

[18] Only selected variables are shown, but regressions are run on all variables listed in Table 7. Standard errors are in brackets and *refers to a level of signifiance at 5%; and ** a level of 1%. (MOV)

3. Gains from Specialization in Export Crops

3.1 Inference from Observed Income

Figure 2 illustrates agricultural income gains and losses according to changing crop specializations. The change in the density distribution of newcomers in the cash crop sector is slightly to the right relative to the others, but this is not so at all points along the distribution. Some of the farmers who quit the export market lose more than those who remained export-oriented or who became exporters. But this holds only at the lowest part of the distribution. For the upper part of the distribution, some quitters gain more than exporters.

Map 3 (see Appendices) shows the number of newcomers and the provincial average agricultural gain. Three observations can be highlighted. First, most of the provinces with

newcomers were initially comprised of cash crop producers.[19] Second, the Central Highland region experienced both the greatest increase in the number of cash crop producers as well as the greatest increase in income. This region, moreover, already had the highest level of exporters and income (see Map 1). In contrast, the North Central Coast performed second best and was one of the poorest regions in 2002.

Thus far, the possibility that export and subsistence oriented households could be different for other reasons that might explain the differences in income gains. Has not been accounted for, 50 propenity score watching wil be applied.

Figure 2. Kernel Density Distribution of Agricultural Income Gains according to transitions (2002-2004)
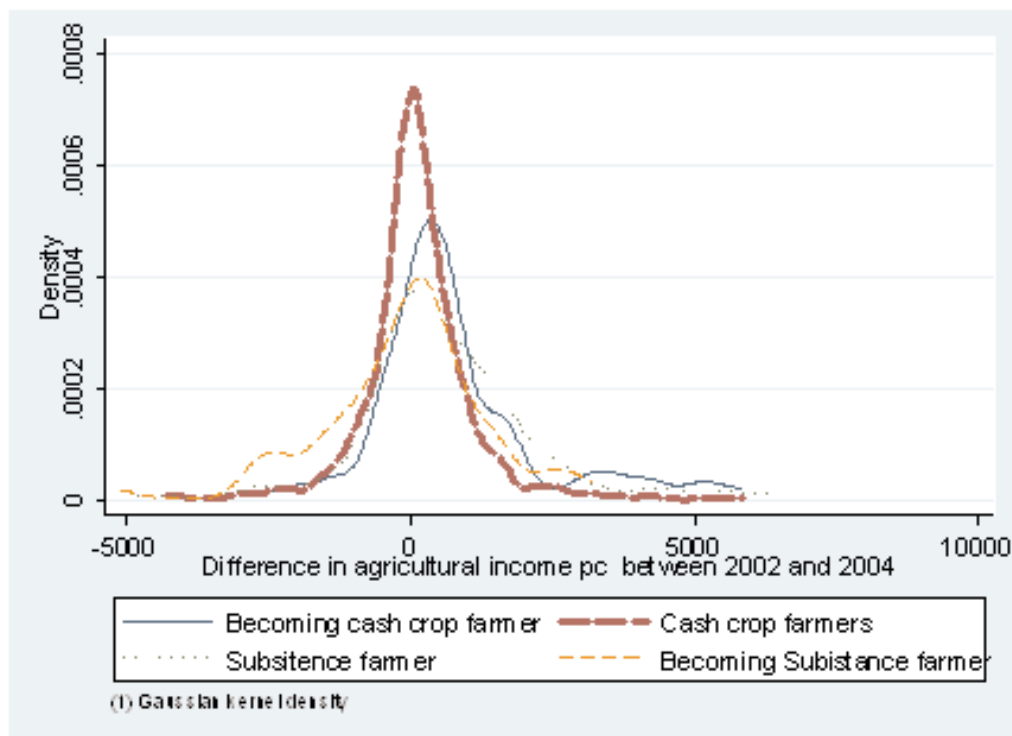
[19] This finding reinforces the idea that natural endowment, measured by the provincial share of acreage in 2000, which is a component of the agricultural trade openness index (defined in Section 2.1), plays a role.

3.2   Comparing Comparables

Starting with the agricultural income Y_h^i of farmers (h). Those involved in cash crop production will have an agricultural income defined as (i=1) and those who are subsistence-oriented as (i=0) to estimate the expected income differential of export-oriented households versus subsistence-orientated households.[20] That is, to measure the average "treatment effect" of being an export-oriented household:

$$E[Y_h^1 - Y_h^0 | i = 1]$$
$$E[Y_h^1 | i = 1] - E[Y_h^0 | i = 1]$$

The two incomes are not observed at the same time. In order to compare the two groups of households, which may differ in their characteristics, a propensity score is calcula-

ted that summarizes the households. Export-oriented households are then matched with other households, based on their propensity score, using kernel matching. Then all treated households are matched with a weighted average of all controls with weights that are inversely proportional to the distance between the propensity scores of treated households and controls.

The propensity score indicates the probability of a household participating in cash crop production based on the observables defined in Equation 1 (Section 2.2). A necessary assumption is that households with a given propensity score have the same distribution of observables as households growing cash crops and those growing subsistence crops. Thus, we need to impose a balancing property.[21]

3.3   Results

First results for household income are examined and then household expenditure results. In both cases the procedure suggested by Dehejia et al., 2002, is used. Most of the crops' specifications satisfy the balancing property. The standard errors are bootstrapped where this is not satisfied, results appear in braces in Table 9 and Table 10. In general, farmers entering into cash crops

are expected to gain 645,600 VND per capita more on average than comparable subsistence-oriented farmers. This represents 24.5 percent of the average total per capita expenditure of the panel in 2002. Another interesting illustration of the magnitude is that it represents a third of the 2002 poverty line, which is set at 1,916,000 VND per person.[22]

Table 9.   Estimated Agricultural Income Gains Per Capita, 2002-2004

Situation		Gain in Agricultural Income (1000 VND)				
2002	2004	Tea	Coffee	Pepper	Cashew	Cash crops
0	1					
	vs.	267.03	{967.024}	{751.1573}	1480.27	645.60
0	0	103.093	302.2621	365.707	1180.284	150.0269
1	0					
	vs.	-458.04	-1122.06		546.04	-496.96
1	1	271.4207	353.8763		614.9614	198.3714
1	1					
	vs.	256.99	{782.1451}	99.80507	{1320.919}	405.15
0	0	149.2251	213.566	358.041	1375.874	159.0539

Note: Standard errors appear in italics.

[20] This specification corresponds to k=1 as defined in section 2.2. We will alternatively examine the three specifications (k=1,2,3).

[21] This means that sufficient treated and non-treated comparable households exist in order to control for all households covariates.

[22] At January 2002, $1 US (or 1.12 EUR) was equivalent to 15,000 VND.

However, these results are attenuated if we look at the gain in per capita expenditure (Table 10). Newcomers earn only 70,930 VND per capita more than subsistence-oriented farmers and the difference is no longer significant. Cash crop producers have an average treatment effect that is only about 158,450 VND per capita in terms of expenditure compared to subsistence-oriented farmers. This discrepancy exists because agricultural income is just one part of household income, and because the Vietnamese have been increasing their rate of savings.

Table 10. Estimated Per Capita Expenditure Gains, 2002-2004

Situation		Gain in Total Expenditure (1000 VND)				
2002	**2004**	**Tea**	**Coffee**	**Pepper**	**Cashew**	**Cash crops**
0	1					
	vs. -83,77	{-144.5616}	{276.7958}	25.12	70.93	
0	*0*	*113.5906*	*255.9959*	*313.1941*	*512.7541*	*107.0576*
1	0					
	vs.	103.01	-553.28		-147.40	-256.18
1	*1*	*274.504*	*323.9543*		*371.9192*	*130.1842*
1	1					
	vs.	-119.99	{267.4252}	472.79	{150.7766}	158.45
0	*0*	*144.886*	*202.7004*	*356.5388*	*557.8921*	*136.8423*

Note: Standard errors appear in italics.

4.   Simulating an Improvement in Market Access Abroad

First, Table 11 gives a breakdown of national crop acreages in 2002 and 2004.[23] After cereals (principally rice), perennials are the second largest category of crop, accounting for 9.6 percent of total acreage in 2002 and 10 percent in 2004.

In this section the impact of an improvement in market access for Vietnamese cash crops is simulated. Table 12 shows that a one percentage point decrease in tariffs applied to exports will result, *ceteris paribus*, in a 12.5 percent increase in the number of households involved in cash crop production on average. It increases by 6.8 percent the number of households entering into cash crop production and decreases the number of cash crop producers switching to subsistence crops by 3.1 percent.[24]

Table 11.   Proportional Crop Acreage, 2002 and 2004

National Share of Acreage by Type of Crop	2002	2004
Cereals	74.53	73.46
Vegetables & beans	5.46	5.81
Annual industrials	5.48	5.37
Perennials	9.68	10.03
Fruits	4.85	5.32
Total	100	100

Source: GSO, 2006.

Table 12.   Estimated Effect of an Improvement in Market Access

	[1]	[2]	[3]
Predicted acreage (ha)	2,346,611	1,588,016	3,525,792
As percentage of the total	17.8%	12.0%	26.8%
Predicted number of farmers	20,249	13,703	30,424
Improvement of Market Access			
Effect on acreage (ha)	1,619,161	897,229	-405,466
Effect on number of farmers	13,972	7,742	-3,499
As percentage of the total	12.3%	6.8%	-3.1%

(Done for Specifications 1, 2 and 3).

[23] Perennials include the cash crops tea, coffee, pepper, cashew and rubber, as well as coconut.

[24] The predicted acreage is calculated by multiplying the predicted probability (obtained in the estimation of the propensity score) by the total national acreage (GSO, 2006). The number of farmers is reached by dividing the predicted acreage by the average plot size (GSO, 2006). Next, the effect on acreage of an improvement in market access is obtained by multiplying the marginal effect of a one percentage point reduction in tariffs applied to Vietnamese cash crops in the rest of the world by the predicted acreage. Finally, the predicted effect in terms of the number of farmers is obtained by dividing the predicted effect in terms of acreage by the average Vietnamese plot acreage. The percentage is the share of the latter over the total number of farms (GSO, 2006).

5. Robustness of the Results

In order to test the robustness of the results, we created an alternative agricultural index based on the VLHSS 1997-1998 commune data. This survey reported national sub-aggregate (i.e. perennials) crop acreages as well as agricultural holdings by commune. This information was used to compute the provincial breakdown of cash crop production. Results are reported in Table 13. The signs and order of magnitude of coefficients remain unchanged compared to Table 8, despite a higher coefficient rate in the alternative trade index.

The validity of the trade index was tested by including the distance from each province to the nearest maritime port in the regression.[25] This last variable was created as a proxy for the provincial distance to international markets, as in Nicita (2004). The results in Table 13 once again confirm the robustness of the agricultural trade index measure. The coefficient of the distance variable is counter-intuitive: The farther a household is from any maritime port, the higher the probability that it is or becomes a cash crop producer. This can be due to the fact that the relatively isolated Central Highland region has a concentration of cash crop growers (See Appendices Map 1).

Finally, the exogeneity of the explanatory variables was tested (more particularly, the use of chemical pesticides by producers); that seems to have strong impact on the estimates. Table 13 shows that the coefficient of interest does not change significantly. This gives confidence in the exogeneity of the independent variables are dropped. Of course, as some of the independent variables, some explicative power is lost as indicated in the drop in Rsquared.

Table 13. Robustness of Determinants of Participation in Cash Crop Production

On all Cash Crops	Specification 1			Specification 2			Specification 3		
	1 Exporters	2 Newcomers	3 Quitters	1 Exporters	2 Newcomers	3 Quitters	1 Exporters	2 Newcomers	3 Quitters
Trade Index				-0.669	-0.571	0.102	-0.705	-0.546	0.149
				[0.163]**	[0.132]**	[0.068]	[0.177]**	[0.130]**	[0.062]*
Trade Index 2	-8.407	-7.007	0.869						
	[2.701]**	[1.944]**	[0.999]						
Distances				0.097	-0.022	-0.093			
				[0.048]*	[0.037]	[0.053]			
Chemical pesticides	2.505	1.369	-2.291	1.901	0.998	-2.116			
	[0.643]**	[0.552]*	[0.661]**	[0.494]**	[0.587]	[0.698]**			
Land distance	-0.035	-0.039	-0,008	0.003	-0.031	-0.021			
	[0.035]	[0.032]	[0.037]	[0.038]	[0.029]	[0.037]			
Quality of land	0.464	0.512	0.02	0.396	0.481	-0.004			
	[0.124]**	[0.135]**	[0.177]	[0.124]**	[0.138]**	[0.169]			
Irrigation	-0.192	-0.133	-0.263	-0.166	-0.16	-0.174			
	[0.162]	[0.127]	[0.205]	[0.155]	[0.128]	[0.186]			
Constant	-1.709	-2.996	-1.316	-2.389	-2.917	-0.792	-1.322	-2.654	-1.958
	[0.778]*	[0.826]**	[1.156]	[0.707]**	[0.792]**	[1.165]	[0.743]	[0.754]**	[1.127]
Observations	1626	1488	388	1686	1534	407	1695	1541	409
Rsquared	0.27	0.18	0.1	0.35	0.2	0.11	0.29	0.17	0.06

[25] Only the results on all cash crops are shown and described, but the robustness check was also carried out at the crop level and can be provided upon request.

Conclusion

Over the past decade, Vietnam has considerably increased its agricultural exports thus making a significant contribution to the national trade surplus. In addition to having a real comparative advantage, Vietnamese agricultural products have enjoyed better market access over the last decade. Moreover, rural development in Vietnam relative to other developing countries (China in particular) has been described as a success story, featuring falling poverty rates and stable, low inequality.

We explored the impact of an improvement in foreign market access for Vietnamese cash-crop producers. We proceeded in three steps. First, we identified the determinants of crop specialization, distinguishing between cash crop producers, newcomers, quitters and subsistence farmers. Then we matched households using a propensity score in order to compare gains in agricultural income according to crop choice over the 2002-2004 period. Finally, we simulated the impact of improved market access on crop choice.

Our results show that farmers were more likely to become cash crop producers, rather than remain subsistence farmers, when they had greater opportunities to sell on foreign markets. Our study focuses on the trade policies of Vietnam's trade partners. Other determinants might have also influenced farmer choices, such as prices on national and international markets. In a previous paper we showed that in the 1990s national and local prices converged towards international prices, considerably increasing the income of farmers who were already involved in crops that could be exported (Coello, 2007).

We found that the characteristics of agricultural holdings seem to matter more for crop specialization than households' own characteristics. In particular, households with better quality land and high use of chemical pesticides were more likely to be export-orientated.

However, Vietnamese agriculture appears to have been overusing chemical pesticides, at levels far higher than the optimal level for profit maximization (Nguyen *et al*., 2003). Thus, even if in the short run the use of chemical pesticides improves yields, it may have an inverse negative effect over time. Industrialized countries, such as France, have experienced negative effects due to overuse of chemical pesticides over the last decades.[26]

We also find that agricultural income gains have been larger for newcomers relative to subsistence farmers. While we focus on producers here and do not examine the effect of trade liberalization on Vietnamese consumers, it is reasonable to acknowledge that consumers are negatively affected when agricultural prices reach a threshold, as demonstrated by food riots that took place around the world in 2008. In Vietnam, one indication that high agricultural prices have negatively affected consumers was the introduction of an export tax on rice designed to ensure food security in April 2008.

The panel survey enabled us to track individuals, crop types and income gains. However, the time span of the survey was too short to allow us to assess if cash crop farmers are more vulnerable to the volatility of international markets.

In the last section, we found that a one percentage point decrease in the tariff applied to Vietnamese exports will, *ceteris paribus*, increase the number of cash crop producers by 12.3 percent on average. In a dynamic perspective, it will increase the number of households entering into cash crop production by 6.8 percent. A caveat of these results is that there is no general equilibrium effect here. We would think, for example, that an increase in the number of cash crop producers would impact the demand for inputs and thus lower the expected increase in income.

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[26] One negative effect is a decrease in land quality (Nicolino, 2007).

This paper highlights the impact of trade liberalization on exports. However, following Vietnam's accession to the World Trade Organization, foreign imports might also affect the national economy. For instance, maize producers, who are mainly poor households from ethnic minorities, may have some difficulties competing with subsidized maize imports.

Finally, even if we show a positive impact of cash crop pro- duction on agricultural income gains, a long-term perspec- tive should also be taken into account. This success may lead to a shortage of arable land, deforestation and soil ero- sion, as was the case in 1999 when coffee farmers cleared more than 74,000 hectares of forest in Dac Lak province alone when coffee prices were booming (World Rainforest Movement, 2001). Increases in international crop prices could also lead to such ecological effects.

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Appendices

eAppendix 1. Description of Variables

Variable	Brief description	Average	Std. Dev.
Distances	Log of distance to the main maritime port	4.549	1.711
Size of the household	Logarithm of the size of the household	1.465	0.377
Household head age	Logarithm of the age of the head of household	3.815	0.286
Age squared	Logarithm of the age squared	7.630	0.573
Share of males	Share of males	0.508	0.187
Chemical pesticides	Share of the amount spent on Chemical pesticides of total agricultural expenditures	0.151	0.103
Organic pesticides	Share of the amount spent on Organic pesticides of total agricultural expenditures	0.008	0.033
Land distance	Log of Distance to their land	5.945	1.873
Land tenure	Share of land owned with a land tenure before 2000	0.466	0.468
Varicertif	Variation in "Land Tenure" between 2000 and 2004	0.227	0.393
Gender	=1 if male,=0 otherwise	0.842	0.365
Married	=1 if married,=0 otherwise	0.864	0.342
Primary	=1 if having primary education ,=0 otherwise	0.264	0.441
Secondary & upper	=1 if having secondary or upper education,=0 otherwise	0.369	0.483
Technical diploma	=1 if having technical education,=0 otherwise	0.046	0.210
Ethnicity	=1 if none-kinh,=0 otherwise	0.198	0.399
Land tenure	=1 if households do not have a land tenure, =0 otherwise	0.466	0.468
Car	=1 if households own a car,=0 otherwise	0.022	0.147
Quality of land	=1 high quality land, =0 otherwise	0.575	0.494
Irrigation	=1 if pump system, =0 otherwise	0.312	0.463
Urban	=1 if urban, =0 otherwise	0.077	0.266
Trade Index :	See Section 1 for more details		
Tea	Cash crop	-0.166	0.421
Coffee	Cash crop	-0.047	0.180
Pepper	Cash crop	-0.100	0.304
Cashew	Cash crop	-0.116	0.405
All crops GSO	All crops with GSO source for acreage provincial data	-0.444	0.996
All crop VHLSS	All crops with 1997common VHLSS source for acreage provincial data	-0.012	0.029
Poor	Lower 30% of expenditure distribution	0.300	0.458
Rich	Upper 30% of expenditure distribution	0.300	0.458
(Middle class)	Omitted variable	0.400	0.490

Map 1.   Agricultural Per Capita Income in 2002 and Cash Crop Producers

2002 agricultural pc income
(In thousand Vietnam Dong)

	3827,73
	2714,33
	2136,81
	1827,01
	1475,86
	1282,37
	872,62

Cash crop producers

54	Daklak
39	Lamdong
16	Quangtri
8	Sonla
5	Backan
1	Quangngai
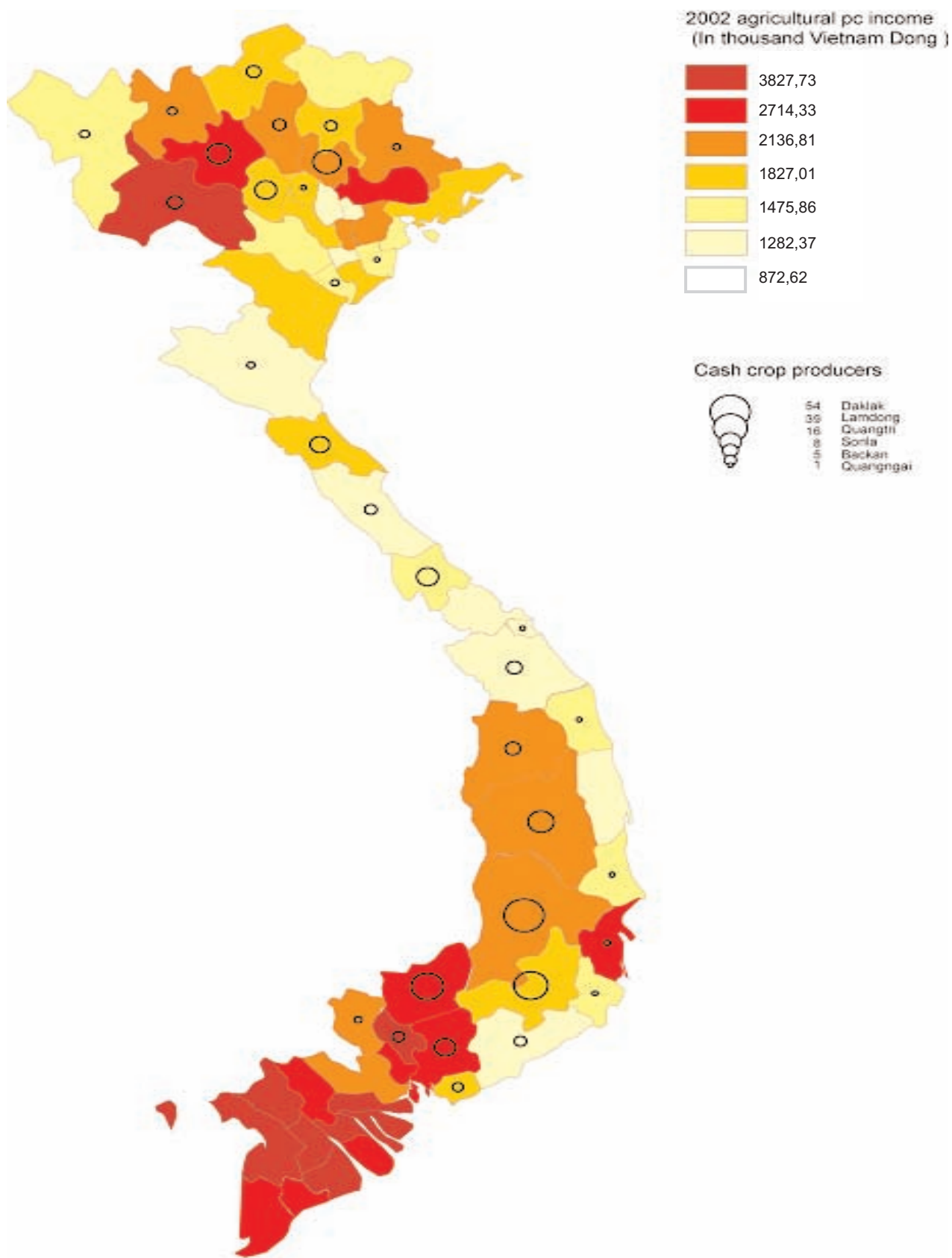
Map 2.   The Eight Administrative Regions of Vietnam
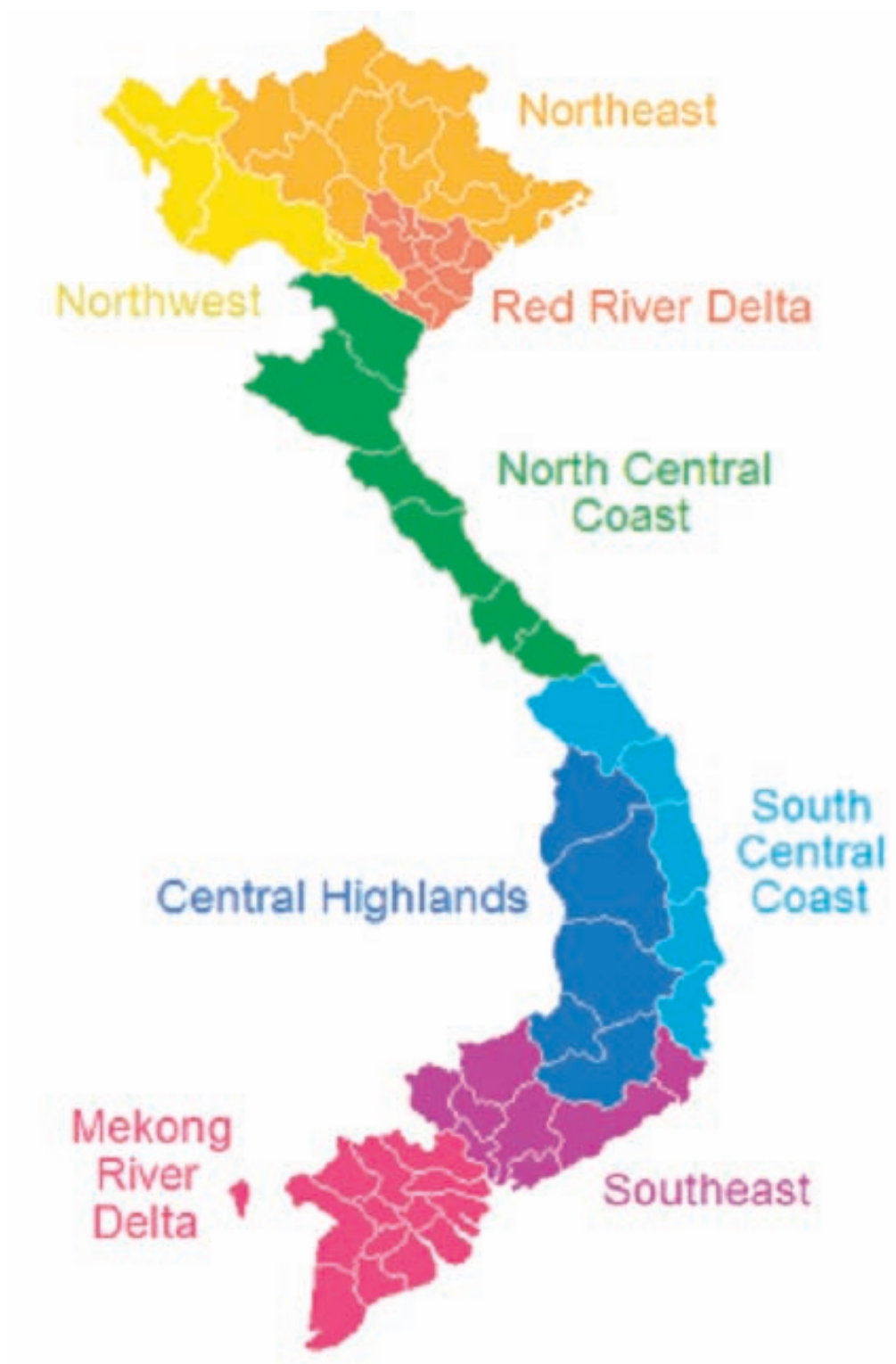
Map 3.   Agricultural Income Variation (2002-2004) and Newcomers

Variation of pc agricultural income 2002-2004
(In thousand Vietnam Dong)

	1358,62
	664,60
	322,27
	222,97
	137,71
	0
	- 2067,29

New comers in cash crops

18	Daklak
15	Dongnai
7	Gialai
6	Quangnam
3	Thanhhoa
1	Danang
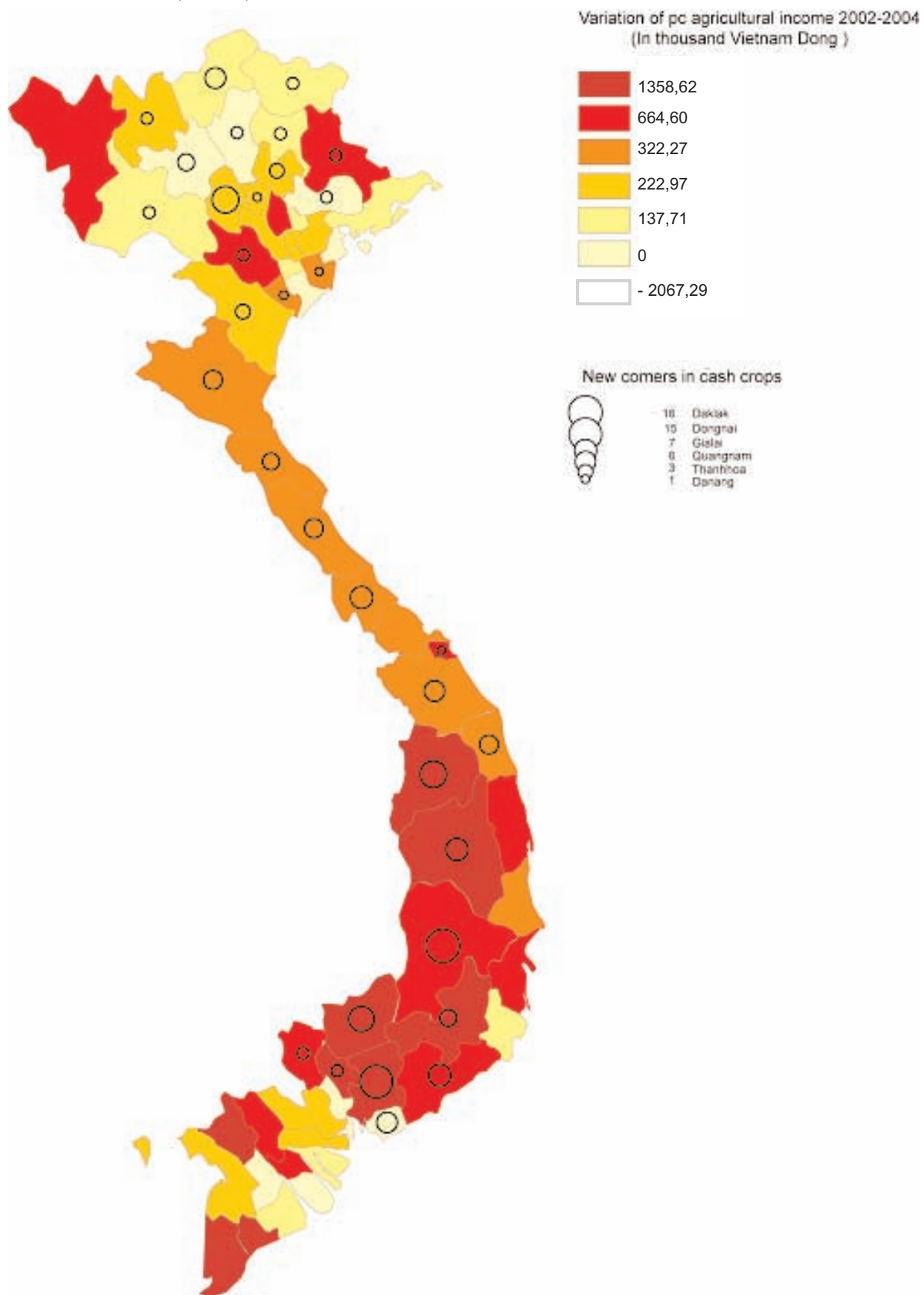
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