A Linkage between Firm Agglomeration and Poverty Reduction

First evidence in Vietnam

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Abstract

In this paper, we examine the linkage between the firm agglomeration and welfare of local households in Vietnam. We measured the firm agglomeration by per capita firm outputs at the district level, and household welfare by per capita income, expenditure and poverty. We find that the firm agglomeration helps households move from the informal sector to the formal sector. As a result, there is a positive effect of the firm agglomeration on per capita income, per capita expenditure, and poverty reduction, albeit at a small and time-decreasing magnitude. The effect of the firm agglomeration on per capita expenditure tends to be higher for households with male, younger and more educated heads than households with female, older and less educated heads. Households who live in rural areas and do not have crop land are more likely to benefit from the firm agglomeration than those living in urban areas and having cropland.

JEL classification codes: L11, I31, I30

Keywords: agglomeration, firm performance, poverty, household survey, panel data, Vietnam.

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1. Introduction

In developing countries, poor households often derive their income from multiple sources such as smallholder agriculture, casual labour or self-employment. Such low and unstable sources have a significant effect on poverty and household welfare (ANDE, 2012). All over the world, there is evidence that one of the most effective ways to increase incomes is the generation of more, and more stable, jobs. While over a billion people earn less than $1 a day, and over 2.5 billion earn less than $2 a day, it is not only due to the low level of income, but the variation of income that characterizes the lives of the poor (Banerjee & Duflo, 2007). It can be seen that stable employment with a relatively high wage that can help reduce poverty where they have done in several countries over the past decades (McKenzie, 2011). Evidence shows that enterprises, especially small and medium enterprises contribute the largest proportion of formal employment and job creation in both developed and developing countries (Ayyagari, Demirgüç-Kunt, & Maksimovic, 2011). It suggests that firm can help improve household welfare and reduce poverty, via their positive effect on employment and wage incomes. However, evidence of their positive impact on household wellbeing and poverty is still limited (Ayyagari et al., 2011).

By contrast, there are arguments that firm might not help reduce poverty because the majority of firms in developing countries are small and micro-small enterprises, which create few jobs, and pay low wages relative to self-employment and other sectors (ANDE, 2012). In addition, the growth of enterprises does not necessarily lead to employment and poverty reduction of households. Fierce competition from large enterprises as well as foreign ones can cause difficulties or even bankruptcy for local SMEs and households, thereby unemployment and poverty for local households (Gardiner, 2000). Through firms, economic shocks from the global economy can have adverse effects on households (e.g., Easterly & Kraay, 2000; Winters, McCulloch, & McKay, 2004). Thus, the effect of firm growth on households' income growth and poverty reduction is unknown a priori.

One of the main factors for economic growth is the development of enterprises. There is a positive association between agglomeration of firms and productivity. Localization economies are the benefits for firms from the same industry to locate close to

one another, and the productivity of firms can be increased. Marshall (2004) points out three central causes for economies to scale, namely labour pooling, input sharing and knowledge spillover. The New Economic Geography literature (Fujita, Krugman, & Venables, 2001)combines consumer availability, natural advantage and transport cost to explain self-reinforcing agglomeration. The development and agglomeration of firms affect growth. Since the economic growth can lead to poverty reduction (Demery & Squire, 1996), so firms can affect households' welfare and poverty.

However, while there are a large number of studies on the role of enterprises on growth of an economy (e.g., DFID, 2000; Green, Kirkpatrick, & Murinde, 2006; Moran, 2011; Moran, Graham, & Blomström, 2005), few studies look at the effects of the geographical agglomeration of enterprises on employment and poverty reduction of households (e.g., Gohou & Soumaré, 2009). Furthermore, to the best of our knowledge, no econometric evidence exists on these effects in Vietnam. A thorough understanding of how and to what extent the firm agglomeration has affected local households is much of importance, when designing policy interventions to reduce poverty and improve household welfare.For this reason, the current study was conducted to fill in this gap in the literature.

The main objective of this study is to estimate various impacts of firm agglomeration (measured by per capita firm output at the district level) on local households in terms of nonfarm employment, poverty, income and consumption expenditure. The effects of different firm sizes were also examined. In addition, we investigate whether the effects of firm agglomeration differ for different groups of households: urban/rural, Kinh/Ethnic minorities, female/male headed households, households with different education levels. Therefore, the study is expected to contribute to the literature by offering a new empirical assessment of the impact of firm agglomeration on poverty alleviation and household welfare. Vietnam is an interesting case, since it has been successful in both firm growth and poverty reduction. The finding can also be relevant for other developing countries, especially some Asian developing countries such as the Philippines, Indonesia, Lao, and Cambodia, with a similar economic structure as Vietnam.

This paper is structured in six sections as follows. The second sections review the economic theories and literature related to linkage between firms and household welfare. The third section presents the data set and descriptive analysis of firms and household

welfare in Vietnam. The fourth and fifth sections present the estimation methods and empirical results of the firm effects on household welfare. Finally, the sixth section concludes the paper.

2. Economic Theory and Literature Review

This part provides the potential impact of firms and firm agglomeration on local households. As figure 1 below mentioned, firms operating in a region can affect local people through various channels, and the final effect on reducing poverty.

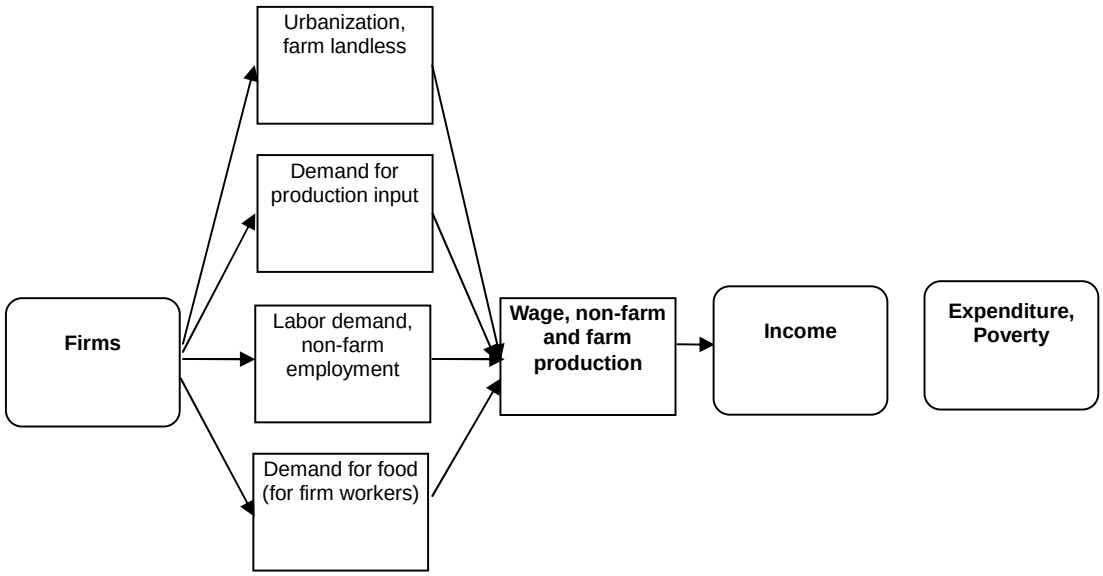


Figure 1: Potential impacts of firms on local households

Source: Authors' preparation

Note: Demand for production input means firms might buy households' output for firm productions.

Based on theoretical and empirical studies, we summarize in Figure 1 several main channels though which firms can affect wages and household income. First, setting up a firm or factory often requires land. As a result, more and more land has been taken to provide space for industrial clusters and zones in developing countries(Tuyen, 2014). On the one hand, the loss of land for building factories or firms results in the loss of agricultural job and income, increasing the risk of falling into poverty. On the other hand,

factories or firms can offer more jobs for local people, which enable local people to diversify livelihoods and improve their welfare. In China, for example, rapid expansion of township and village enterprise development offered new non-farm livelihood opportunities for farmers (Chen, 1998; Parish, Zhe, & Li, 1995). It was estimated that nearly 100 million new jobs were created by township and village enterprises in China between 1985 and 2002 (Johnson, 2002). A study in Bangladesh showed that despite a vast amount of farmland being converted for urban expansion and industrial zones, a wide portfolio of new non-farm employment was created for farmers (Toufique & Turton, 2002). However, mixed impacts of losing land to industrial zones have been found in Vietnam. It was estimated that about two thirds of land-losing households benefited from higher job opportunities and upgraded infrastructure; for the rest, land losing resulted in serious economic interruption, particularly if all productive land was acquired or family members did not attain suitable education or vocational skills to switch to new jobs (ADB, 2007). The discussion suggests that firms can have both positive and negative effects on rural households, via their impact on losing land and providing more non-farm jobs for local people.

The other direct impact of setting up new enterprises or expansion of existing firms on home households is through higher demand for food for workers and input factors for production. For example, a recent study by Jofre-Monseny, Marín-López, and Viladecans-Marsal (2011) reveals that buiding up firms in a dense region requires sharing input factors and suppliers.

Evidence show that stable employment with a relatively high wage offered by firms that can help reduce poverty where they have done in several countries over the past decades (McKenzie, 2011). Nevertheless, firms in developing countries might not help the poor escape poverty because the majority of them are small and micro-small enterprises, which create few jobs, and pay low wages relative to self-employment and other sectors (ANDE, 2012). Although SMEs contribute the largest proportion of formal employment and job generation in developing countries, the evidence on their impact on poverty and household welfare is still limited (Ayyagari et al., 2011).

In another line of interest, the association of firm agglomeration with income and poverty of households is explained through figure 2.As shown in this figure, there are some

important theoretical mechanisms to explain the improvement in productivity and knowledge as a result of the agglomeration of firms. The first, drawing inspiration from pioneering work is by Marshall (2004)who stated that if firms co-locate nearby, the flow of knowledge and ideas moves more easily between firms and employees. In addition, Jofre-Monseny, Marín-López, and Viladecans-Marsal (2011) indicates that greater concentrations of firms in a region will lead to a rise in knowledge spillover. Knowledge itself is not rival, and returns from knowledge spillover and diffusion are more effective in concentrated regions of firms (Andersson & Karlsson, 2007).

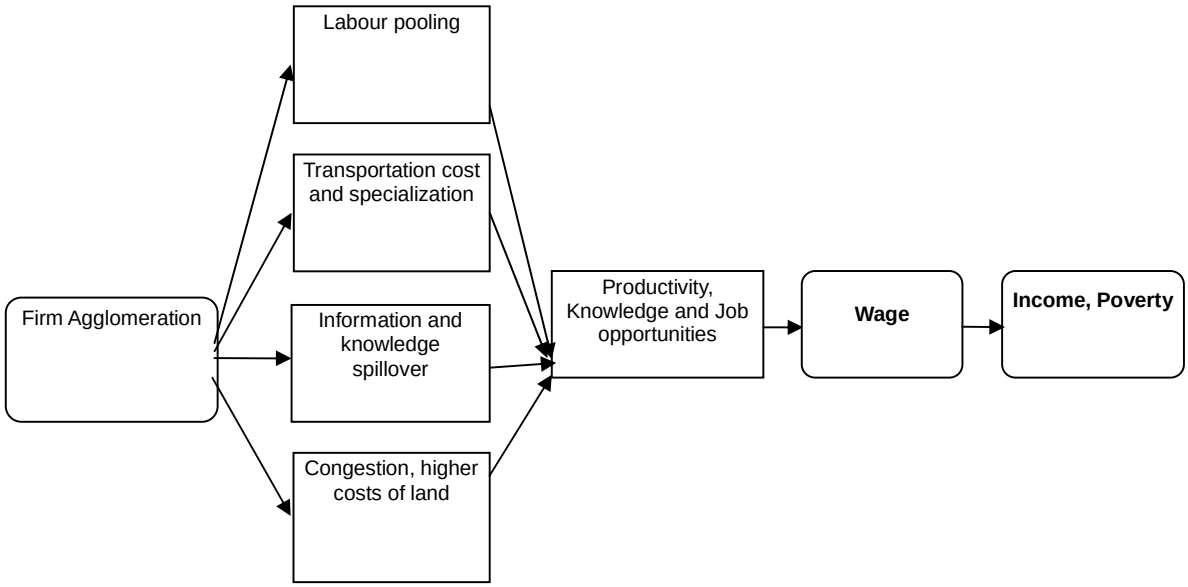


Figure 2: Potential impacts of firm agglomeration on local households

Source: Authors' preparation

Second, agglomeration of firms provides a pooling in labor market. This implies that firms and employees can gain many advantages from this pooling. Enterprises gain higher productivity when they may find employees having the exact skills as they need quicker and easier in a large and dense labour market (Swanson, Rognlien, Davies, Czauderna, & Triadou, 2008), while labour pooling offers and improves opportunities for job seekers (Fan & Scott, 2003). Previous studies also show that movement of labour in concentrated regions among firms is greater, and this stimulates the diffusion, and the

accumulation of knowledge of local people (Almeida & Kogut, 1999; Fallick, Fleischman, & Rebitzer, 2006; Møen, 2005).

A further mechanism of the impact of agglomeration on productivity is also provided by Bartelsman, Caballero, and Lyons (1994), Holmes (1999), Holmes and Stevens (2002), Li and Lu (2009) who argued that firms locating geographically in dense region may help themselvesreduce the transaction or transportation costs in buying inputs and selling outputs occurred per unit of distance. In addition, specialization of firms is supported when firms in industrial agglomeration or densely populated areas(Lin, Li, & Yang, 2011). Consequently, these generate information spillover and improve the productivity.

However, other studies (e.g., Lin et al., 2011) argue that when urbanisation developed strongly, this may create disadvantageous environments for firms located in spatially concentrated regions. For example, traffic jam, higher costs of land when many firms need lands for building up their headquarters. It also leads to competition in output markets. As a result, these increased expenditures caused by agglomeration diseconomies may have a negative impact on firm level productivity.

While there are various arguments towards the mechanisms about the impact of firm agglomeration on productivity, the majority of empirical findings indicate that firm agglomeration has a positive effect on productivity. For example, using a panel dataset in the period 1975-99 for Swedish manufacturing and service sectors, Braunerhjelm and Borgman (2004)found that more concentrated sectors lead to the growth in higher productivity. Their findings were replicated across many countries, including highly industrialized countries, the US (Ciccone & Hall, 1996), New Zealand (Maré & Economic, 2005), Asian countries, e.g., India (Lall, Shalizi, & Deichmann, 2004). However, a recent study in China shows that there is an inverted U-shape linkage between agglomeration and firm productivity (Lin et al., 2011). They conclude that industrial agglomeration impact positively firms' productivity. However, a very high level of agglomeration leads to agglomeration diseconomies that may have a negative effect on productivity.

Beyond this, other studies (e.g., Mortensen, 2005) show that there are a strong relationship between firm productivity and wages of employees. For instance, Carlsson, Messina, and Nordstrom Skans (2011) found that a firm's productivity have a positive impact on wages of employees. This may be because firms with higher productivity often have better financial capability to scrutinise their workforce and exclude workers of low ability. Hence, employees in high productivity enterprises often have greater than average ability and are paid more than those in firms with low productivity.

In summary, through knowledge spillover, improvement in productivity and job opportunities, firm agglomeration can affect wages of employees, and finally impact income and poverty of households.

3. Data set and descriptive analysis

3.1. Data sets

Two dataset were utilized for this study. The first dataset was drawn from Vietnam Household Living Standard Surveys (VHLSS) in 2004, 2006, 2008, 2010 and 2012, which were conducted by the General Statistics Office of Vietnam (GSO). Both household and commune data were collected for the surveys. Data on households consist of basic demography, employment and labour force participation, education, health, income, expenditure, housing, fixed assets and durable goods, and the participation by households in poverty reduction programs. Commune data include demography and general socio-economic conditions of communes and aid programs, farm and nonfarm production, local infrastructure and transportation, education, health, and social affairs. Commune data can be merged with household data. The sample of 9,189 households was covered in each of the VHLSSs. The survey samples are representative for urban/rural and eight geographic regions as well. It is useful that the surveys contain panel data.

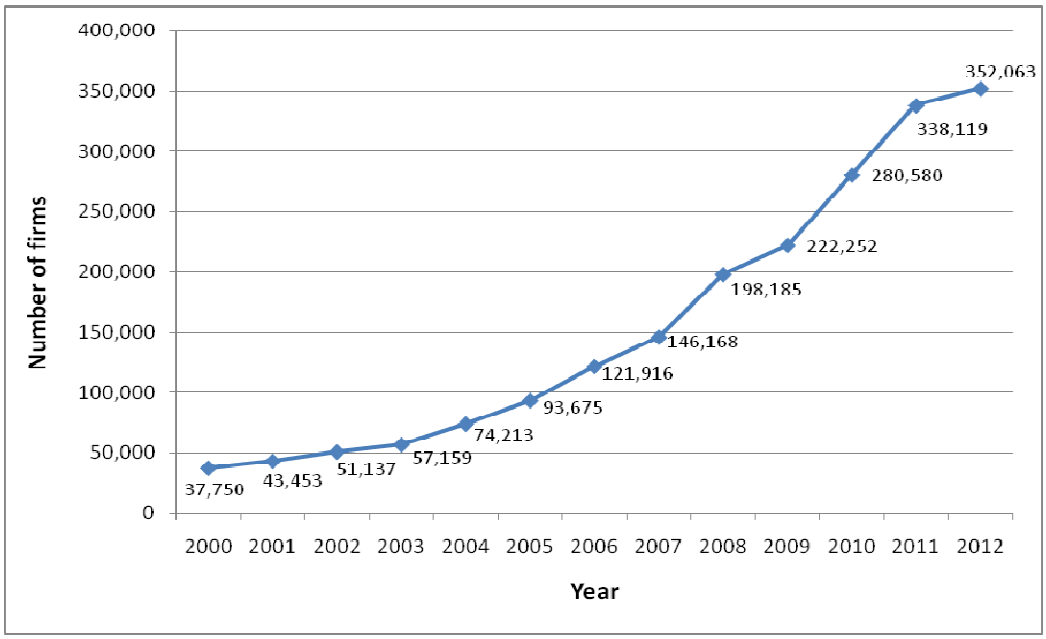
The second data set were from Annual Enterprise Censuses of Vietnam (EC) from 2003 to 2012 (10 surveys). GSO conducts annual census of all the enterprises all over the country using their network of offices in provinces and districts. The censuses include all

types of enterprise, including state owned enterprises, collectives, private and foreign enterprises. It is helpful that these censuses set up panel data. The Enterprise Censuses gathered quite detailed information on firms' business activities. The information consist of type of firms, main business industries, the number of workers, male and female workers, workers having social insurance, labour cost, assets, turnover and profit of firms. The firm data are employed to construct firm variables at the commune level. These firm variables were merged with the household data to investigate the relationship between firms and households.

3.2. Descriptive analysis

In Vietnam, the industrial sector has been expanded quickly. The number of firms increased annually by around 18 percent during the past 12 years from nearly 38 thousand in 2007 to 352 thousand in 2012 (Figure 1).

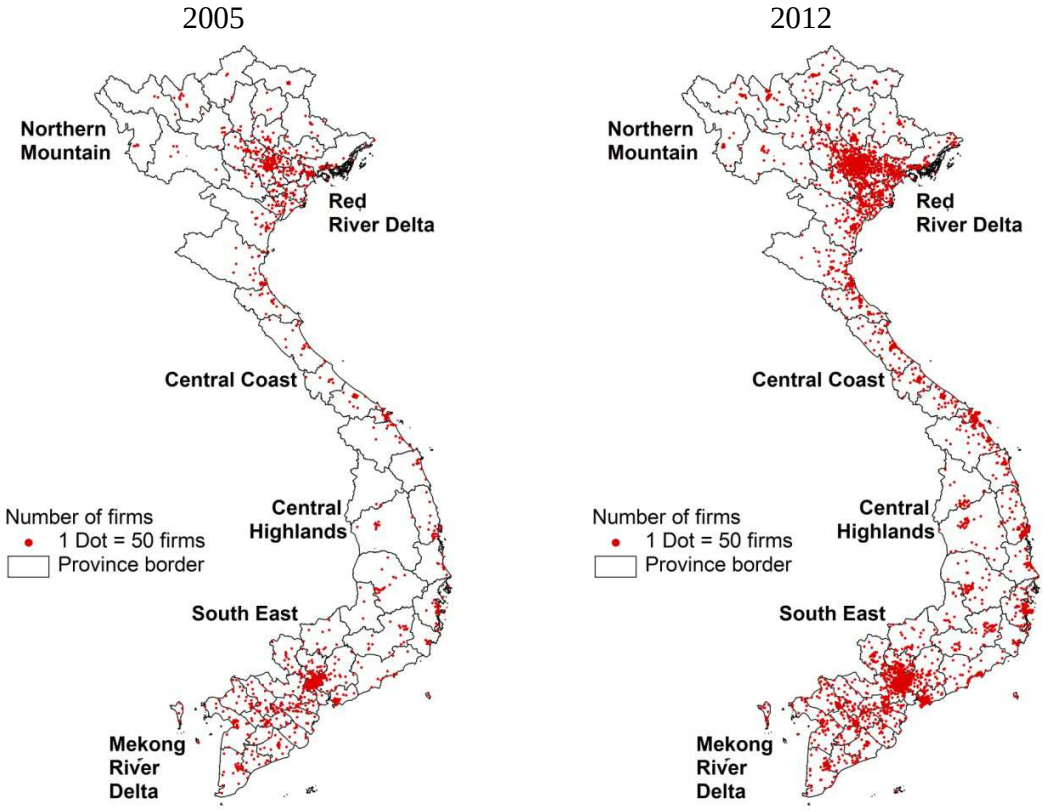
Figure 1: The number of firms during 2000-2012



Source: Authors' estimation from VHLSSs and ECs data.

Figure 2 presents the geographic distribution of firms. For each district, we compute the number of firms within the districts and graph this number. Each dot represents 50 firms, and the dots are randomly plotted within districts. We do not know the exact coordinates of firms, and hence the dots just reflect which districts the firms are located. In Figure 2 we present the provincial boundary instead of district boundary. It shows that the number of firms increased in most provinces during 2005-2012 and are highly concentrated in Red River Delta, South East and costal areas.

Figure 2: The number of firms by geographic areas



Source: Authors' estimation from ECs data.

According to Government of Vietnam (2009), in this study we define firms by very small (from 1 to 10 workers), small (from 10 to 200 workers), medium (from 201 to 300 workers), and large scale (from 301 workers and above). Table 1 shows that the proportion of very small size firms in all the firms tends to increase overtime, from 54% in 2000 to 68% in 2012. However, the share of revenues from the very small-size firms in total revenues of all firms has been stable, at around 10%. Firms with the number of workers from 10 and above have the decreasing share in the number but quite stable shares in the total firm revenues over time.

Table 1: The number and share of firms by labor size during 2000-2012

Years	Very small-size firms		Small-size firms		Medium-size firms		Large-size firms	
	% in total number of firms	% in total revenue of firms	% in total number of firms	% in total revenue of firms	% in total number of firms	% in total revenue of firms	% in total number of firms	% in total revenue of firms
2000	54.2	10.6	38.0	32.2	2.5	8.8	5.2	48.4
2001	53.0	9.2	39.5	34.0	2.5	7.9	5.0	48.9
2002	51.9	8.6	41.0	31.8	2.3	14.2	4.8	45.4
2003	51.2	8.6	42.1	32.5	2.1	13.5	4.6	45.4
2004	51.4	8.2	42.3	32.4	1.9	6.8	4.4	52.6
2005	54.1	8.4	40.8	32.9	1.5	5.7	3.6	53.0
2006	60.9	11.7	35.2	36.1	1.2	5.9	2.7	46.3
2007	63.2	10.7	33.1	36.3	1.2	6.8	2.5	46.1
2008	62.7	14.8	34.3	36.1	1.0	6.8	1.9	42.3
2009	65.0	11.3	32.3	38.1	0.9	8.1	1.8	42.5
2010	66.5	11.4	31.1	37.2	0.8	8.4	1.5	43.1
2011	66.3	10.6	31.3	34.2	0.8	5.7	1.5	49.5
2012	68.2	10.3	29.6	32.7	0.8	7.6	1.4	49.4

Source: Authors' estimation from VHLSSs and ECs data.

Vietnam has been successful in economic growth and poverty reduction during the past two decades. Table 2 shows that real per capita income increased during the period 2004-2010. To understand the income structure, we divide total household income into farm income, wage income, and self non-farm income, and non-employment income such as private and publish transfers and rental. Table 2 presents the share of income from farm, wages and non-farm activities in total household income. The non-employment income share is not presented, since it is equal to 100 percent minus the share from the three employment income sources. It shows that workers tend to move from the farm (informal)

sectors to formal sectors. The share of farm income in total income of households decreased from 36.8% in 2004 to 27.2% in 2012, while the share of wages increased from 29.3% to 42.7% during the same period. The share of non-farm income is rather stable over the share, at around 17%.

Table 2: Household welfare and poverty during 2004-2012

Year	Per capita income (thousand VND in price 2004)	Share of farm income in household income	Share of wage in household income	Share of non-farm income in household income	Per capita expenditure (thousand VND in price 2004)	Poverty rate (in percent)
2004	5926.6	36.8	29.3	17.3	4441.6	19.5
	(94.5)	(0.6)	(0.4)	(0.4)	(66.8)	(0.6)
2006	6650.7	34.3	31.4	17.6	4867.3	16.0
	(93.4)	(0.6)	(0.4)	(0.4)	(67.0)	(0.6)
2008	7971.0	34.3	32.6	17.3	5519.1	14.6
	(170.4)	(0.6)	(0.5)	(0.4)	(81.5)	(0.6)
2010	9628.8	28.9	40.2	18.2	7412.1	14.0
	(223.3)	(0.5)	(0.5)	(0.4)	(111.0)	(0.5)
2012	10148.7	27.2	42.7	17.1	7849.3	11.6
	(176.4)	(0.5)	(0.5)	(0.4)	(99.1)	(0.5)
Total	8142.5	32.1	35.5	17.5	6082.3	15.0
	(90.9)	(0.4)	(0.3)	(0.2)	(57.4)	(0.3)

Standard errors in parentheses.
Source: Authors' estimation from VHLSSs and ECs data.

Higher income was transmitted to higher expenditure and lower poverty. The percentage of people living below the expenditure poverty line which is constructed by the World Bank and General Statistics Office of Vietnam decreased from 19.5% in 2004 to 11.6% in 2012.

Table 3 present the income, expenditure and poverty rate of households by different demographic characteristics. Compared with Kinh majority people, Ethnic minority people depend more heavily on farm production.[2] They have lower income, consumption expenditure and remarkably higher poverty rate than Kinh people. Rural households and households with lower education heads have higher poverty than urban households and those with higher education heads.

[2] Vietnam has 54 ethnic groups, of which Kinh (Vietnamese) people account for around 85% of the total population. [2] Compared with other ethnic minorities, Kinh people tend to live in delta and high population density areas and have higher living standards and lower poverty.

Table 3: Household welfare and poverty during by demographic variables

Groups	Per capita income (thousand VND in price 2004)	Share of farm income in household income	Share of wage in household income	Share of non-farm income in household income	Per capita expenditure (thousand VND in price 2004)	Poverty rate (in percent)
Ethnicity						
Kinh majority	8801.3	27.5	37.4	19.5	6544.3	9.3
	(100.8)	(0.4)	(0.3)	(0.3)	(62.8)	(0.2)
Ethnic minorities	4000.4	61.5	23.3	4.8	3177.2	51.3
	(65.6)	(0.7)	(0.6)	(0.2)	(48.5)	(1.1)
Urbanity						
Rural	6693.2	41.4	30.9	13.8	4823.1	19.5
	(75.8)	(0.4)	(0.3)	(0.2)	(35.6)	(0.4)
Urban	11944.4	7.9	47.6	27.2	9385.6	3.4
	(221.5)	(0.4)	(0.5)	(0.5)	(142.9)	(0.3)
Gender of hh. head						
Female	9411.5	18.3	42.7	18.7	7186.5	11.0
	(180.4)	(0.5)	(0.5)	(0.4)	(112.8)	(0.4)
Male	7784.7	36.0	33.5	17.2	5771.0	16.2
	(91.8)	(0.4)	(0.3)	(0.3)	(53.5)	(0.4)
Education of hh. head						
< Primary	5616.3	39.3	32.3	12.5	4212.8	29.2
	(72.3)	(0.6)	(0.5)	(0.4)	(47.4)	(0.7)
Primary	6909.1	37.1	31.7	18.1	5141.9	16.1
	(86.3)	(0.5)	(0.5)	(0.4)	(52.0)	(0.5)
Lower-secondary	7667.2	35.1	31.8	19.2	5729.9	10.8
	(102.8)	(0.5)	(0.4)	(0.4)	(59.0)	(0.4)
Upper-secondary	9989.2	24.2	35.4	25.5	7592.3	5.4
	(304.5)	(0.7)	(0.8)	(0.8)	(153.3)	(0.5)
Technical degree	11492.1	16.2	44.6	21.6	8342.9	3.3
	(366.7)	(0.5)	(0.7)	(0.6)	(124.9)	(0.3)
Post-secondary	18747.2	4.3	68.0	10.6	14262.9	0.3
	(659.5)	(0.4)	(0.8)	(0.6)	(380.1)	(0.2)
Total	8142.5	32.1	35.5	17.5	6082.3	15.0
	(90.9)	(0.4)	(0.3)	(0.2)	(57.4)	(0.3)

Standard errors in parentheses.
Source: Authors' estimation from VHLSSs and ECs data.

Next, we examine association between the firm agglomeration and household welfare. In this study, we measure the firm agglomeration by the firm output at the district level. For each district, we aggregate revenues of all firms, and compute the firm revenue per capita by dividing the total revenues by the population. We estimate the firm revenue per capita for all the districts overtime. We use the firm revenue instead of the firm number, since the revenue is measurement of the firm performance which is more related to the local GDP. In Vietnam, there are a large proportion of very small firms and many of them are not active. For example, according to the Enterprise Census 2012, around 10 percent of

firm report zero revenues. In Table 4, the districts are divided into 5 quintiles of the firm output (revenue) per capita. It shows a strong association between the district firm outputs per capita and household welfare. Households in districts with high per capita firm revenues have significantly higher income and consumption, and lower poverty rate than those in districts with low per capita firm revenues.

Table 4: Household welfare and poverty during by firm revenue quintiles

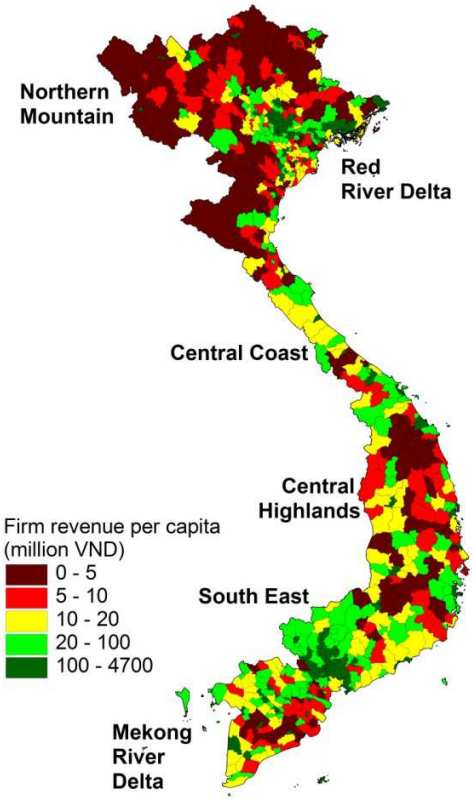
Quintiles	Per capita income (thousand VND in price 2004)	Share of farm income in household income	Share of wage in household income	Share of non-farm income in household income	Per capita expenditure (thousand VND in price 2004)	Poverty rate (in percent)
Lowest	4716.5	50.4	23.2	11.7	3477.6	30.7
	(62.1)	(0.6)	(0.4)	(0.4)	(38.1)	(0.9)
Near lowest	6166.3	42.4	28.9	14.3	4529.7	19.9
	(83.0)	(0.5)	(0.4)	(0.4)	(45.7)	(0.7)
Middle	7371.4	35.6	33.3	17.4	5459.6	13.6
	(97.8)	(0.6)	(0.5)	(0.5)	(54.9)	(0.5)
Near highest	9167.7	22.9	41.0	21.0	6741.6	7.3
	(204.2)	(0.6)	(0.5)	(0.5)	(79.8)	(0.4)
Highest	13792.5	6.9	52.8	23.8	10595.6	1.9
	(283.8)	(0.4)	(0.7)	(0.6)	(176.6)	(0.2)
Total	8142.5	32.1	35.5	17.5	6082.3	15.0
	(90.9)	(0.4)	(0.3)	(0.2)	(57.4)	(0.3)

Standard errors in parentheses.
Source: Authors' estimation from VHLSSs and ECs data.

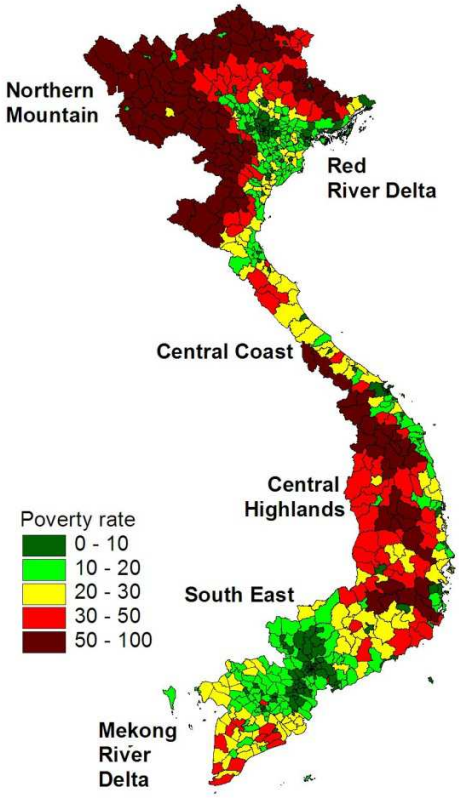
Figure 3 presents the firm agglomeration and poverty rate at the district level. The poverty rates are obtained from Lanjouw et al. (2013). There is a strongly negative geographic association between the firm agglomeration and poverty rate. Areas with high level of firm agglomeration tend to have lower poverty.

Figure 3: The firm agglomeration and poverty rate

District firm agglomeration 2009



District poverty rate 2009



Source: Authors' estimation from ECs data and poverty rate from Lanjouw et al. (2013).

4. Econometric Model

4.1. Effect on household income and consumption

The main method used in this study will be econometric regressions that are used to measure the effect of firms on households' welfare and poverty. We assume a household welfare indicator is a function of characteristics of households as follows (Glewwe, 1991)

$$\ln(Y_{ijt}) = \beta_0 + X_{ijt}\beta_1 + \ln(F_{jt})\beta_2 + G_t\beta_3 + \varepsilon_{ijt}, \qquad (1)$$

where Y_{ijt} is an welfare indicator (e.g., per capita income or per capita expenditure) of household *i* in district*j* in the year *t*; X_{ijt} is a vector of characteristics of households such as demographical variables and assets; F_{jt} is the measurement of the geographical agglomeration of enterprises; G_t is the dummy variable of years. The effect of firm agglomeration on households is measured by parameter β_2. The equation (1) can include interactions between the firm variable and explanatory variables to allow the effect of firm agglomeration to vary across different households.

We use different indicators of household welfare including the income share from wages and non-farm activities, income and consumption of households. We use similar specifications as equation (1) for different dependent variables. A key issue is how to measure the firm agglomeration. In this study, we measure the firm agglomeration by the firm output at the district level. For each district, we aggregate revenues of all firms, and compute the firm revenue per capita by dividing the total revenues by the population. We estimate the firm revenue per capita for all the districts overtime. We use the firm revenue instead of the firm number, since the revenue is measurement of the firm performance which is more related to the local GDP. In Vietnam, there are a large proportion of very small firms and many of them are not active. For example, according to the Enterprise Census 2012, around 10 percent of firm report zero revenues.

Another issue in defining the variable of the firm agglomeration is that we use the district-level variable instead of province-level or commune-level. According to the administrative structure, Vietnam is divided into 63 provinces (some provinces are called cities). Each province is divided into districts and each district is further divided into communes. There are 684 districts and 11,112 communes (General Statistic Office of Vietnam, 2009). Communes tend to have small areas, and people can easily move across communes to work and live. Many communes do not have any firms, and people in a commune can work in other communes. Thus, using district-level firm variables allows the spill-over effects across communes. It assumes that firms in a district can have the same effects on all households in that district. On the contrary, provinces have very large size,

and the number of provinces is smaller. Using province-level firm variables can reduce the variation in firm variables.

We will use the firm revenue per capita by different types: small scale, medium scale, and large scale firms, where the scale or size of firm is measured by the number of workers in firms. According to Government of Vietnam (2009), we define firms by very small (from 1 to 10 workers), small (from 10 to 200 workers), medium (from 201 to 300 workers), and large scale (from 301 workers and above).

A problem is estimating the effect of the geographical agglomeration of enterprises is the endogeneity of enterprise agglomeration. The traditional method to deal with endogeneity is instrumental variable regression. However, finding absolutely exogenous instrumental variables for firm variables is difficult. Our firm variables are the district-level variables, and they are more likely to be correlated with unobserved district-level variables. The unobserved district-level variables can be decomposed into time-variant and time-invariant district -level variables. In this study, we use the district fixed-effect regression to eliminate unobserved time-invariant district-level variables. We do not have panel household data over 2004-2010, and therefore cannot apply household fixed-effects regressions.

District fixed-effects estimators can be associated with bias if the district-level firm variables are correlated with time-variant unobserved variables. However, it is expected that the endogeneity bias will be negligible after the elimination of unobserved time-invariant variables and the control of observed variables.

4.2. Effect on household poverty

To estimate the effect of the enterprise agglomeration on poverty of households, we can use logit or probit regressions in which the dependent variable is the poverty status of households. However, there are no available fixed-effects probit estimators due to a so-called incidental parameter problem in maximum likelihood methods (Greene, 2004). A fixed-effects logit estimator can be used, but it is not efficient since it drops observations

with fixed values of the dependent variable. To estimate the effect of firms on poverty, we use the probability of being poor as follows (Elbers, Lanjouw, & Lanjouw, 2003; Hentschel, Lanjouw, Lanjouw, & Poggi, 2000):

$$E[P_{ijt} \mid Y_{ijt}, \sigma^2] = \Phi\left[\frac{\ln z - \ln Y_{ijt}}{\sigma_{ijt}}\right], \qquad (2)$$

where P_{ijt} is probability of being poor; Y_{ijt} is consumption; z is poverty line; Φ is the cumulative standard normal function; σ_{ijt} is the standard deviation of error terms in equation (1) (ε_{ijt}). The partial effect of firm variable $\ln(F_{jt})$ on the poverty probability is the partial derivative of the poverty probability with respect to $\ln(F_{jt})$ as follows:

$$PE = \frac{\partial E[P_{ijt} \mid X_{ijt}, F_{jt}]}{\partial F_{jt}} = -\phi\left[\frac{\ln z - \ln(Y_{ijt})}{\sigma_{ijt}}\right]\frac{\partial \ln(Y_{ijt})}{\partial F_{jt}} = -\beta_2\phi\left[\frac{\ln z - \ln(Y_{ijt})}{\sigma_{ijt}}\right], \qquad (3)$$

where ϕ is the probability density function of the standard normal distribution. The average partial effect of $\ln(F_{jt})$ on poverty rate in year t can be estimated:

$$A\hat{P}E_t = -\frac{1}{M}\sum_{ijt} H_{ijt}\hat{\beta}_2\phi\left[\frac{\ln z - \ln(Y_{ikt})}{\hat{\sigma}_{ikt}}\right] \qquad (4)$$

Where H_i is the size of household i, M is the total number of people in the data sample, which is equal to $\sum_{ikt} H_i$. The summation is taken over households in each year. $\hat{\beta}_2$, $\hat{\varepsilon}_{ijt}$ and $\hat{\sigma}_{ijt}$ are estimated from the fixed-effects regression of log of per capita expenditure. The standard errors of the average partial effect estimators can be calculated using non-parametric bootstrap with 500 replications ((Deaton, 1997)).

5. Empirical Results

As discussed in section 2, firm agglomeration process can create more non-farm employment and wage for local people if they are involved in this process. We first regress

the share of income from farm and non-farm production, and wages of households on the firm variables and other control variables. In all the regression models, household's outcomes are considered as earning variables, depending on a set of community and household characteristics which can be grouped into five categories (Glewwe, 1991): (i) Household composition, (ii) District variables, (iii) Human assets, (iv) Physical assets. Thus, the explanatory variables include household demography, education of household head, lands, urban dummy. Variables such as regional dummies, province and district dummies that are time-invariant are eliminated in fixed-effects regressions. Since, explanatory variables should not be affected by the firm variable ; (Angrist & Pischke, 2008; Heckman, LaLonde, & Smith, 1999), we tend to use a small set of more exogenous explanatory variables. The summary statistics of variables is presented in Table A.1 in Appendix.

To examine the robustness of the estimate of firms to the selection of explanatory variables, we tried two model specifications: the first specification includes only explanatory variables of firm output and year dummies, and the second one include all the available explanatory variables. Both the specifications produce quite similar results. In this section, we use the large model for interpretation. In addition, tables in this section present only the coefficients of the firm variables of interest. The full regression results are presented in Tables in Appendix.

It should be noted that we tried lagged variables of the firm agglomeration, and the lagged effects are not significant. Thus, in this study, we focus on the short-term effect of the firms on household welfare.

Table 5 shows that the firm output per capita tend to reduce the share of farm income and increase the share of wage in total income. The income share is measured in percent. One percent increase in the district firm revenue per capita can reduce the share of farm income by 0.69 percentage point, but it increases the share of wages in total income by the same amount. However, the effect on the non-farm income share is very small and not statistically significant.

Table 5. District fixed-effects regressions of income share

Explanatory variables	Share of farm income in household income	Share of non-farm income in household income	Share of wage in household income
Log of district firm revenue per capita	-0.6893*	-0.0670	0.6927**
	(0.3523)	(0.3832)	(0.3344)
Control variables	Yes	Yes	Yes
Constant	18.2469***	15.6302***	48.4435***
	(1.8297)	(2.4399)	(2.0638)
Observations	44,927	44,927	44,927
R-squared	0.392	0.084	0.143
Number of districts	680	680	680

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1.
Source: Authors' estimation from VHLSSs and ECs data.

Although the firm agglomeration tends to help households move from farm to wage employment, it's unclear whether it can help households increase the aggregate income and consumption expenditure. Table 6 shows a positive effect of the per capita firm output on log of per capita income and log of per capita expenditure, albeit at a small magnitude. A one percent increase in the per capita firm revenue at the district level increases per capita income and per capita expenditure of households by only around 0.023 percent and 0.03 percent, respectively.

Table 6. District fixed-effects regressions of log of per capita income and expenditure

Explanatory variables	Log of per capita income		Log of per capita expenditure	
	Model 1	Model 2	Model 1	Model 2
Log of district firm revenue per capita	0.0226**		0.0315***	
	(0.0093)		(0.0076)	
Log of district very small-size firm revenue per capita		0.0136**		0.0110**
		(0.0062)		(0.0051)
Log of district small-size firm revenue per capita		0.0067		0.0088
		(0.0078)		(0.0065)
Log of district medium-size firm revenue per capita		0.0016		-0.0020
		(0.0038)		(0.0033)
Log of district large-size firm revenue per capita		0.0050		-0.0070*
		(0.0044)		(0.0038)
Control variables	Yes	Yes	Yes	Yes
Constant	8.3347***	8.3661***	8.0402***	8.0794***
	(0.0429)	(0.0422)	(0.0396)	(0.0395)
Observations	44,927	44,927	44,927	44,927
R-squared	0.524	0.524	0.661	0.661
Number of districts	680	680	680	680

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1.
Source: Authors' estimation from VHLSSs and ECs data.

In Table 7, we interact the firm variable with several explanatory variables and include these interactions in the regressions of log of per capita expenditure to examine whether the effect of firms differ for different households. We do not include all interaction terms in one regression, since it can result in multicollinearity and high standard errors of these interactions. It shows that the effect of the firm agglomeration differs for households with different characteristics of heads. Households with male, younger and more educated heads are more likely to benefit from the firm agglomeration process than households with female, older and less educated heads. Households in rural areas as well as households with crop lands tend to benefit from the firm agglomeration more than urban households and those without cropland. This finding reflects that the transition from the informal sector to the formal sector happens more strongly in rural areas than urban areas.

The interactions between the firm variables and year dummies are all negative and significant (the reference year is 2004). In addition, their absolute values gradually increase over the period 2006-2010. The findings suggest that the effect of the firm agglomeration on household welfare and poverty tends to decrease overtime.

Table 7. District fixed-effects regressions of log of per capita expenditure with interactions

Explanatory variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Log of district firm revenue per capita	0.0557***	0.0255***	0.0213***	0.0311***	0.0333***	-0.0013	0.0385***
	(0.0088)	(0.0082)	(0.0082)	(0.0081)	(0.0076)	(0.0087)	(0.0077)
Interaction with age of head	-0.0005***						
	(0.0001)						
Interaction with Gender of head		0.0071**					
		(0.0033)					
Interaction with Head schooling years			0.0016***				
			(0.0005)				
Interaction with Ethnic minority				0.0012			
				(0.0082)			
Interaction with Urbanity					-0.0391***		
					(0.0063)		
Interaction with Having crop land						0.0567***	
						(0.0185)	
Interaction with Log of crop land						-0.0025	
						(0.0024)	
Interaction with Dummy year 2006							-0.0104**
							(0.0040)
Interaction with Dummy year 2008							-0.0244***
							(0.0049)
Interaction with Dummy year 2010							-0.0326***
							(0.0061)
Interaction with Dummy year							-0.0374***
							(0.0065)

Explanatory variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
	(0.0220)	(0.0220)	(0.0220)	(0.0221)	(0.0212)	(0.0212)	(0.0265)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	7.9895***	8.0564***	8.0623***	8.0407***	8.0421***	8.1265***	8.0352***
	(0.0405)	(0.0405)	(0.0401)	(0.0400)	(0.0394)	(0.0396)	(0.0394)
Observations	44,927	44,927	44,927	44,927	44,927	44,927	44,927
R-squared	0.661	0.661	0.661	0.661	0.662	0.662	0.662
Number of districts	680	680	680	680	680	680	680

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1.
Source: Authors' estimation from VHLSSs and ECs data.

Since firms increase household expenditure, it is expected to reduce the expenditure poverty rate of households. Thus, in Table 8, we estimate the effect of firms on rural poverty using formula (4). Similar to the effect on per capita expenditure, the effect of firm agglomeration on the poverty rate is small and tends to be smaller overtime. In 2004, a one percentage point increase in the firm output per capita of districts results in a 0.41 percentage point reduction in the expenditure poverty rate. This reducing-poverty effect of the firm output is reduced to 0.31 percentage points in 2012.

Table 8: Marginal effect on poverty rate

Year	Effect estimates	Std. Err.
2004	-0.405***	0.075
2006	-0.354***	0.065
2008	-0.347***	0.064
2010	-0.335***	0.062
2012	-0.320***	0.059

*** p<0.01, ** p<0.05, * p<0.1.
Source: Authors' estimation from VHLSSs and ECs data.

6. Conclusions

This study provide the first econometric evidence for the impact of firm agglomeration on local households in Vietnam using panel data spanning from 2004 to 2010. In the study, the firm agglomeration is measured by the per capita firm outputs at the district level. We

found that the agglomeration of firms has various impacts on the share of income, income and expenditure per capita, and poverty among local households.

The agglomeration of firms was found to reduce the share of farm income and to increase that of wage income. This implies that the firm agglomeration can help local households diversify their livelihood towards off-farm activities, which in turn might help households improve their welfare and escape poverty. We also found evidence that firm agglomeration has a positive effect on per capita income and per capita expenditure, albeit at a small magnitude. This might be explained by the fact that only a very fraction of local households have involved in the agglomeration in the form of taking up formal or informal employment. Also, this might be that wages offered by local firms are not relatively high as compared to other sectors.

In addition, the results reveal that the effect of firm agglomeration on household welfare was different according to the characteristics of heads. Households with male, younger and more educated heads are more likely to benefit from the firm agglomeration process than those with female, older and less educated heads. This might reflect the fact that heads that are young males and better educated have more chance to seize relatively high-paid jobs offered by local firms. Interestingly, rural households and households with crop land have a higher likelihood of receiving benefit from the agglomeration of firms than urban households and households without crop land, respectively. This finding reflects the fact that the transition from the informal sector to the formal sector might have taken place more strongly in rural areas than urban areas.

The interactions between the firm variables and year dummies are all negative and significant (the reference year is 2004). It means the effect of the firm agglomeration tends to decrease overtime.Since firms increase household expenditure, it is expected to reduce the expenditure poverty rate of households. Similar to the diminishing effect of firm agglomeration on per capita expenditure, we found that the effect of firm agglomeration on the poverty rate tends to be smaller overtime. The larger effects on expenditure and poverty for previous years might reflect the fact that the poverty rates in those years were higher so that they might be easier to reduce.

This finding implies that policies that promote the development of firms, especially the very small size firms can have indirect positive effects on welfare of local people. Firms

also help poverty reduction of local households. However, since the effect of firm agglomeration on poverty reduction is small, other support policies and programs that are targeted at the poor households such as cash transfers and vocational training are needed to decrease poverty effectively.

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Appendix

Table A.1. Descriptive summary of variables

Variables	Type	Mean	Std. Dev.	Min	Max
Log of per capita expenditure	Continuous	8.961	0.824	5.52	13.22
Log of per capita income	Continuous	9.186	0.877	0	14.81
Share of farm income in household income	Continuous	30.267	32.884	0	100
Share of wage in household income	Continuous	34.672	34.769	0	100
Share of non-farm income in household income	Continuous	16.924	28.821	0	100
Log of district firm revenue per capita	Continuous	2.359	1.995	-6.41	8.45
Log of district very small-size firm revenue per capita	Continuous	0.632	1.764	-6.74	5.63
Log of district small-size firm revenue per capita	Continuous	1.430	2.011	-5.43	7.23
Log of district medium-size firm revenue per capita	Continuous	0.166	1.644	-11.45	6.37
Log of district large-size firm revenue per capita	Continuous	1.088	2.146	-6.93	8.04
Household size	Discrete	4.054	1.631	1	20
Proportion of children in household	Continuous	0.210	0.208	0	1
Proportion of elderly in household	Continuous	0.133	0.265	0	1
Ethnic minority (minorities=1, Kinh=0)	Dummy	0.117	0.322	0	1
Age of household head	Discrete	49.706	13.993	15	99
Gender of head (male=1, female=0)	Dummy	0.742	0.437	0	1
Schooling years of head	Discrete	7.250	3.676	0	12
Having crop land (yes=1, no=0)	Dummy	0.617	0.486	0	1
Log of crop land areas	Continuous	4.967	4.008	0	13.12
Urbanity (urban=1, rural=0)	Dummy	0.282	0.450	0	1
Number of observations		44927			

Source: Authors' estimation from VHLSSs and ECs data.

Table A.2. Regressions of log of per capita income and expenditure

Explanatory variables	Log of per capita income		Log of per capita expenditure	
	Small model	Large model	Small model	Large model
Log of district firm revenue per capita	0.0246**	0.0226**	0.0335***	0.0315***
	(0.0104)	(0.0093)	(0.0089)	(0.0076)
Household size		-0.0635***		-0.0655***
		(0.0024)		(0.0019)
Proportion of children in household		-0.5229***		-0.4905***
		(0.0186)		(0.0160)
Proportion of elderly in household		-0.2538***		-0.2135***
		(0.0184)		(0.0149)
Ethnic minority (minorities=1, Kinh=0)		-0.2958***		-0.2921***
		(0.0169)		(0.0169)
Age of household head		0.0056***		0.0077***
		(0.0015)		(0.0014)
Square age of household head		-0.0000**		-0.0000***
		(0.0000)		(0.0000)
Gender of head (male=1, female=0)		-0.0099		-0.0180***
		(0.0081)		(0.0065)
Schooling years of head		0.0562***		0.0515***
		(0.0011)		(0.0009)
Having crop land (yes=1, no=0)		-1.1131***		-0.6668***
		(0.0517)		(0.0350)
Log of crop land areas		0.1279***		0.0749***
		(0.0068)		(0.0046)
Urbanity (urban=1, rural=0)		0.0998***		0.1471***
		(0.0126)		(0.0113)
Dummy year 2006	0.3002***	0.2737***	0.2681***	0.2414***
	(0.0106)	(0.0101)	(0.0093)	(0.0085)
Dummy year 2008	0.5437***	0.4978***	0.5195***	0.4734***
	(0.0172)	(0.0155)	(0.0155)	(0.0137)
Dummy year 2010	0.9739***	0.9165***	1.0453***	0.9842***
	(0.0237)	(0.0210)	(0.0210)	(0.0183)
Dummy year 2012	1.3225***	1.2604***	1.3810***	1.3133***
	(0.0284)	(0.0254)	(0.0249)	(0.0220)
Constant	8.4046***	8.3347***	8.1469***	8.0402***
	(0.0114)	(0.0429)	(0.0101)	(0.0396)
Observations	44,927	44,927	44,927	44,927
R-squared	0.381	0.524	0.515	0.661
Number of districts	680	680	680	680

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1.
Source: Authors' estimation from VHLSSs and ECs data.

Table A.3. Regressions of log of per capita income and expenditure

Explanatory variables	Log of per capita income		Log of per capita expenditure	
	Small model	Large model	Small model	Large model
Log of district very small-size firm revenue per capita	0.0106	0.0136**	0.0089	0.0110**
	(0.0070)	(0.0062)	(0.0058)	(0.0051)
Log of district small-size firm revenue per capita	0.0053	0.0067	0.0074	0.0088
	(0.0094)	(0.0078)	(0.0079)	(0.0065)
Log of district medium-size firm revenue per capita	0.0011	0.0016	-0.0027	-0.0020
	(0.0041)	(0.0038)	(0.0037)	(0.0033)
Log of district large-size firm revenue per capita	0.0075	0.0050	-0.0054	-0.0070*
	(0.0049)	(0.0044)	(0.0042)	(0.0038)
Household size		-0.0636***		-0.0654***
		(0.0024)		(0.0019)
Proportion of children in household		-0.5230***		-0.4910***
		(0.0186)		(0.0160)
Proportion of elderly in household		-0.2537***		-0.2133***
		(0.0185)		(0.0149)
Ethnic minority (minorities=1, Kinh=0)		-0.2959***		-0.2922***
		(0.0169)		(0.0169)
Age of household head		0.0056***		0.0077***
		(0.0015)		(0.0014)
Square age of household head		-0.0000**		-0.0000***
		(0.0000)		(0.0000)
Gender of head (male=1, female=0)		-0.0098		-0.0178***
		(0.0081)		(0.0065)
Schooling years of head		0.0562***		0.0515***
		(0.0011)		(0.0009)
Having crop land (yes=1, no=0)		-1.1130***		-0.6677***
		(0.0517)		(0.0350)
Log of crop land areas		0.1279***		0.0750***
		(0.0068)		(0.0046)
Urbanity (urban=1, rural=0)		0.0998***		0.1472***
		(0.0126)		(0.0113)
Dummy year 2006	0.3014***	0.2710***	0.2782***	0.2480***
	(0.0113)	(0.0105)	(0.0099)	(0.0089)
Dummy year 2008	0.5490***	0.4955***	0.5441***	0.4910***
	(0.0182)	(0.0162)	(0.0171)	(0.0152)
Dummy year 2010	0.9825***	0.9155***	1.0822***	1.0121***
	(0.0242)	(0.0209)	(0.0229)	(0.0199)
Dummy year 2012	1.3324***	1.2581***	1.4289***	1.3497***
	(0.0295)	(0.0257)	(0.0274)	(0.0243)
Constant	8.4339***	8.3661***	8.1860***	8.0794***
	(0.0094)	(0.0422)	(0.0086)	(0.0395)
Observations	44,927	44,927	44,927	44,927
R-squared	0.381	0.524	0.515	0.661
Number of districts	680	680	680	680

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1.
Source: Authors' estimation from VHLSSs and ECs data.

Table A.4. Regressions of income share

Explanatory variables	Small model			Large model		
	Share of farm income in household income	Share of non-farm income in household income	Share of wage in household income	Share of farm income in household income	Share of non-farm income in household income	Share of wage in household income
Log of district firm revenue per capita	-0.7410*	-0.1157	0.7721*	-0.6893*	-0.0670	0.6927**
	(0.4348)	(0.4086)	(0.4598)	(0.3523)	(0.3832)	(0.3344)
Household size				-1.3197***	1.0184***	3.1257***
				(0.1067)	(0.1075)	(0.1092)
Proportion of children in household				5.7808***	2.8927***	-13.9225***
				(0.7395)	(0.9773)	(0.8977)
Proportion of elderly in household				-0.2268	-7.3013***	-21.6163***
				(0.7482)	(0.7752)	(0.8307)
Ethnic minority (minorities=1, Kinh=0)				4.0256***	-7.9152***	2.0440***
				(0.8312)	(0.6439)	(0.6513)
Age of household head				0.4056***	0.1767**	-0.7910***
				(0.0677)	(0.0834)	(0.0742)
Square age of household head				-0.0049***	-0.0026***	0.0065***
				(0.0006)	(0.0007)	(0.0007)
Gender of head (male=1, female=0)				4.2253***	1.8687***	-2.6829***
				(0.3118)	(0.3939)	(0.3635)
Schooling years of head				-0.9342***	0.1609**	0.6260***
				(0.0480)	(0.0633)	(0.0485)
Having crop land (yes=1, no=0)				-78.3031***	13.5846***	60.8129***
				(1.9160)	(1.7530)	(1.6585)
Log of crop land areas				13.5060***	-3.2624***	-9.3193***
				(0.2406)	(0.2140)	(0.1985)
Urbanity (urban=1, rural=0)				-7.7039***	7.7865***	0.6681
				(0.5745)	(0.7556)	(0.4929)
Dummy year 2006	-2.0550***	0.1606	1.4895***	-2.1295***	0.4351	1.7655***
	(0.4477)	(0.4169)	(0.4866)	(0.3801)	(0.4106)	(0.4902)
Dummy year 2008	-1.1596	-0.2261	1.6688**	-0.4478	-0.0782	1.8690***
	(0.7267)	(0.6684)	(0.7873)	(0.5784)	(0.6365)	(0.6214)
Dummy year 2010	-6.6914***	0.8936	9.4415***	-3.9752***	0.3299	8.7520***
	(0.9453)	(0.8890)	(0.9983)	(0.7635)	(0.8355)	(0.7471)
Dummy year 2012	-7.7059***	0.1823	10.5907***	-5.0569***	-0.0247	10.5586***
	(1.1480)	(1.0649)	(1.2171)	(0.9063)	(1.0100)	(0.8839)
Constant	38.2431***	16.4076***	26.5556***	18.2469***	15.6302***	48.4435***
	(0.4946)	(0.4451)	(0.5102)	(1.8297)	(2.4399)	(2.0638)
Observations	44,927	44,927	44,927	44,927	44,927	44,927
R-squared	0.016	0.001	0.023	0.392	0.084	0.143
Number of districts	680	680	680	680	680	680

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1.
Source: Authors' estimation from VHLSSs and ECs data.

Table A.5. Regressions of log of per capita expenditure with interactions

Explanatory variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Log of district firm revenue per capita	0.0557***	0.0255***	0.0213***	0.0311***	0.0333***	-0.0013	0.0385***
	(0.0088)	(0.0082)	(0.0082)	(0.0081)	(0.0076)	(0.0087)	(0.0077)
Age of head * Log of district firm revenue per capita	-0.0005***						
	(0.0001)						
Gender of head * Log of district firm revenue per capita		0.0071**					
		(0.0033)					
Schooling years of head * Log of district firm revenue per capita			0.0016***				
			(0.0005)				
Ethnic minority * Log of district firm revenue per capita				0.0012			
				(0.0082)			
Urbanity * Log of district firm revenue per capita					-0.0391***		
					(0.0063)		
Having crop land * Log of district firm revenue per capita						0.0567***	
						(0.0185)	
Log of crop land * Log of district firm revenue per capita						-0.0025	
						(0.0024)	
Dummy year 2006 * Log of district firm revenue per capita							-0.0104**
							(0.0040)
Dummy year 2008 * Log of district firm revenue per capita							-0.0244***
							(0.0049)
Dummy year 2010 * Log of district firm revenue per capita							-0.0326***
							(0.0061)
Dummy year 2012 * Log of district firm revenue per capita							-0.0374***
							(0.0065)
Household size	-0.0653***	-0.0652***	-0.0655***	-0.0655***	-0.0654***	-0.0657***	-0.0653***
	(0.0019)	(0.0019)	(0.0019)	(0.0019)	(0.0019)	(0.0019)	(0.0019)
Proportion of children in household	-0.4869***	-0.4917***	-0.4910***	-0.4905***	-0.4880***	-0.4876***	-0.4896***
	(0.0162)	(0.0160)	(0.0160)	(0.0160)	(0.0160)	(0.0160)	(0.0160)
Proportion of elderly in household	-0.2140***	-0.2126***	-0.2147***	-0.2135***	-0.2122***	-0.2150***	-0.2134***
	(0.0149)	(0.0149)	(0.0149)	(0.0149)	(0.0149)	(0.0149)	(0.0148)
Ethnic minority (minorities=1, Kinh=0)	-0.2917***	-0.2913***	-0.2949***	-0.2938***	-0.2862***	-0.2882***	-0.2924***
	(0.0169)	(0.0169)	(0.0170)	(0.0198)	(0.0169)	(0.0169)	(0.0169)

Explanatory variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Age of household head	0.0086***	0.0076***	0.0077***	0.0077***	0.0077***	0.0074***	0.0076***
	(0.0014)	(0.0014)	(0.0014)	(0.0014)	(0.0014)	(0.0014)	(0.0014)
Square age of household head	-0.0000***	-0.0000***	-0.0000***	-0.0000***	-0.0000***	-0.0000***	-0.0000***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Gender of head (male=1, female=0)	-0.0177***	-0.0357***	-0.0181***	-0.0180***	-0.0179***	-0.0186***	-0.0175***
	(0.0065)	(0.0104)	(0.0065)	(0.0065)	(0.0065)	(0.0065)	(0.0065)
Schooling years of head	0.0515***	0.0515***	0.0481***	0.0515***	0.0514***	0.0515***	0.0515***
	(0.0009)	(0.0009)	(0.0013)	(0.0009)	(0.0009)	(0.0009)	(0.0009)
Having crop land (yes=1, no=0)	-0.6654***	-0.6699***	-0.6644***	-0.6669***	-0.6829***	-0.8067***	-0.6730***
	(0.0349)	(0.0350)	(0.0351)	(0.0349)	(0.0345)	(0.0483)	(0.0350)
Log of crop land areas	0.0748***	0.0752***	0.0746***	0.0749***	0.0768***	0.0821***	0.0755***
	(0.0046)	(0.0046)	(0.0047)	(0.0046)	(0.0046)	(0.0063)	(0.0046)
Urbanity (urban=1, rural=0)	0.1475***	0.1471***	0.1469***	0.1471***	0.2403***	0.1493***	0.1476***
	(0.0113)	(0.0113)	(0.0113)	(0.0113)	(0.0181)	(0.0112)	(0.0113)
Dummy year 2006	0.2422***	0.2416***	0.2411***	0.2415***	0.2446***	0.2463***	0.2529***
	(0.0085)	(0.0085)	(0.0085)	(0.0085)	(0.0084)	(0.0084)	(0.0090)
Dummy year 2008	0.4748***	0.4740***	0.4723***	0.4736***	0.4819***	0.4833***	0.5179***
	(0.0137)	(0.0138)	(0.0138)	(0.0138)	(0.0134)	(0.0133)	(0.0153)
Dummy year 2010	0.9857***	0.9850***	0.9825***	0.9845***	0.9962***	0.9986***	1.0597***
	(0.0183)	(0.0183)	(0.0183)	(0.0183)	(0.0177)	(0.0176)	(0.0216)
Dummy year 2012	1.3159***	1.3144***	1.3110***	1.3137***	1.3297***	1.3322***	1.4167***
	(0.0220)	(0.0220)	(0.0220)	(0.0221)	(0.0212)	(0.0212)	(0.0265)
Constant	7.9895***	8.0564***	8.0623***	8.0407***	8.0421***	8.1265***	8.0352***
	(0.0405)	(0.0405)	(0.0401)	(0.0400)	(0.0394)	(0.0396)	(0.0394)
Observations	44,927	44,927	44,927	44,927	44,927	44,927	44,927
R-squared	0.661	0.661	0.661	0.661	0.662	0.662	0.662
Number of districts	680	680	680	680	680	680	680

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1.
Source: Authors' estimation from VHLSSs and ECs data.