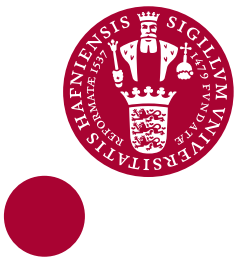

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Commodity Prices and Intra-Household Labor Allocation

Ulrik Beck, Saurabh Singhal, and Finn Tarp

Volatility in commodity markets poses a distinct risk to farmers in developing countries who rely on cash crop agriculture. We combine a time series of international coffee prices with a long-running panel on coffee-growing households in Vietnam to investigate coping mechanisms employed by farmers in a transitioning economy. We find that households cope with lower coffee prices by increasing wage labor of adults, with children and adolescents substituting for adults on the farm. Heterogeneity analysis indicates a stronger substitution pattern among women, ethnic minorities, and households with fewer assets. A variety of robustness checks corroborate these findings. Account of this finding should be taken in formulating and implementing social protection and inclusive growth policies.

Key words: Commodity prices, income shocks, intra-household allocation, labor supply, Vietnam.

JEL codes: J22, O12, Q02.

Volatility in commodity markets poses an inherent risk to small farming households in developing countries. Agricultural commodity prices have been more volatile in the 2000s relative to preceding decades, raising concern among policy makers and various international organizations (World Bank 2008; Food and Agriculture Organization of the United Nations et al. 2011). To formulate policies to insulate farmers from these risks, it is essential to understand the welfare effects of commodity price volatility and subsequent household responses.

Rural households in developing countries engage in a number of production activities, with off-farm income often being a large part of household income (Dercon 2002). In addition to farming, households may have off-farm wage employment, operate household enterprises, tend to livestock, and produce household goods, with the labor required for these activities being spread over various household members. In the absence of well-developed credit markets, shocks that close one avenue of income will typically lead to the reallocation of household members' labor as the household attempts to maintain consumption. What is the extent of such intra-household spillovers? In particular, what is the burden borne by children and adolescents? To address this question, using a panel of rural Vietnamese households from 2006 to 2014, we exploit exogenous variation in the international price of coffee—a key export commodity—to identify the effects of temporary income fluctuations on welfare and intra-household labor allocation decisions.

Adult and child labor supply overlap in a variety of activities, and the reallocation of time across various work alternatives and members in the face of an income loss depends, in part,

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on the degree of substitutability between the two. For example, Doran (2013) finds that exposure to the PROGRESA conditional cash transfer program in Mexico induced a simultaneous reduction in children's participation in farm work and an increase in adult labor supply, indicating that adults substituted for child labor. Similarly, Duryea, Lam, and Levison (2007) find that 16-year-old girls are more likely to enter the labor market in the event of their fathers becoming unemployed in Brazil. In related work from Peru, Field (2007) finds that land-titling reduced child labor as titling freed up adult labor (which has a comparative advantage in security provision) from guard duties, and enabled them to substitute for children in the labor market.[1] While most of the existing literature has studied the labor supply response of adults and children in isolation, this paper examines the labor supply adjustment behavior of adults and children jointly and in the same families. This allows us to provide a better picture of the dynamics of intra-household labor supply decisions in the event of fluctuations in household income.

We first show that international prices are transmitted to small coffee growers (in the form of farm-gate prices). It emerges that coffee farmers are not able to perfectly smooth consumption when faced with a fall in the price of coffee, even though their households rely on several strategies to counteract the negative price change, such as selling assets and taking loans. Coffee price movements are strongly associated with *ex-post* (re)distribution of work within the household. Our results indicate countercyclical wage employment in coffee-growing households in Vietnam, such that households are more likely to engage in wage employment when coffee prices are low. These results are driven by working-age adults and, to a lesser degree, by adolescents. While children do not engage in wage employment, we find strong evidence that children and adolescents substitute for adults on the farm in low-price periods. Furthermore, adults are less likely to engage in household production and chores during periods of low coffee prices.

Such labor market effects can have implications for health and educational outcomes of children both directly (via child labor) and indirectly (via parent time allocation). Theoretically, the net effect of a commodity price increase is ambiguous due to countervailing income and substitution effects, heterogeneous capital markets, opportunity costs of attending school, expected returns to schooling, and other factors. Indeed, in their review, Ferreira and Schady (2009) find that empirical results are mixed, and depend on the country context and type of shock studied. For example, Miller and Urdinola (2010) find an increase in coffee prices to be associated with an increase in infant mortality in Brazil due to parents substituting away from child care and towards coffee cultivation. Similarly, Kruger (2007) finds strong substitution effects with children in coffee-growing regions of Brazil being withdrawn from school when coffee prices increased. However, Cogneau and Jedwab (2012) find investments in children to be pro-cyclical to cocoa prices in Cote d'Ivoire. Our results indicate that while there is an increase in farm work for children and wage and farm work for adolescents when coffee prices decrease, there is no effect on educational outcomes.

This study sits within a broader body of literature that investigates the welfare impacts of commodity price shocks in an increasingly globalized world (Goldberg and Pavcnik 2007). As supply chains stretch across the world, shocks at one end reverberate to the other end with important distributional consequences both within and across households (Ivanic and Martin 2008; Lederman and Porto 2016). Adoption of high-value cash crops is promoted by policy makers in developing countries as a potential pathway out of poverty (World Bank 2008). However, while the shift from subsistence to cash crops can bring substantial income gains, it also leaves households vulnerable to vagaries of the international commodity markets.[2] As Vietnam is one of the largest producers of coffee in the world and most of the coffee is produced by small farmers, our study is well-suited to examine the effects of commodity price fluctuations on household and individual welfare.

This study is also related to the research on coping mechanisms in the face of negative income shocks (Morduch 1995; Dercon 2002). The literature has identified various other coping mechanisms such as wage employment and migration (Kochar 1999; Hirvonen 2016),

[1] In related work, Filipski et al. (2017) simulate the intra-household labor allocation effects of volatility in saffron prices in Morocco using a local economy-wide impact evaluation model.

[2] For example, see Harou, Walker, and Barrett (2017) on the welfare effects of pineapple adoption in Ghana.

sale of assets and livestock (Rosenzweig and Wolpin 1993), self-insurance through savings and other informal insurance arrangements (De Weerdt and Dercon 2006). In a related paper, Adhvaryu, Kala, and Nyshadham (2015) find that Tanzanian coffee farmers coped with low coffee prices from 1991 to 1994 by resorting to small-scale enterprise activity. While Vietnamese households frequently set up and shut down non-farm household enterprises (McCaig and Pavcnik 2016), we do not find household business formation to be systematically linked to coffee prices. Rather, we find that households resort to different coping mechanisms—intermittent wage employment by adults and adolescents, selling assets, and borrowing.

Finally, in the context of Vietnam, Edmonds and Pavcnik (2005, 2006) find that greater integration with the world economy (resulting from the removal of trade restrictions from 1993 to 1998), increased rice prices that in turn led to more off-farm work for adults and decreased reliance on child labor among rice producers. While related to our paper, there are two key distinctions to bear in mind. First, we consider changes in the price of coffee instead of rice. Smallholder farmers typically consume rice, which adds additional channels through which household behavior is affected by prices. Coffee, on the other hand, is almost entirely produced for sale and the estimated effects are not confounded by substitution and income effects through consumption. Second, while Edmonds and Pavcnik (2005, 2006) use data collected from 1993 to 1998, our period of analysis covers the period 2006 to 2014. Vietnam has experienced rapid economic transformation during this period (Tarp 2017). For example, GDP per capita in 2013 was four times that of 1993; the poverty headcount fell from 58% in the early 1990s to below 10% in 2010; and Vietnam moved from being one of the poorest countries in the region to a lower middle-income country in this period (World Bank 2012). It is therefore of interest to explore whether price changes had similar effects in the 1990s and in the post-2000 period, or whether behavior changed in the process.

Background

Coffee production in Vietnam has increased significantly since the beginning of the 1990s. In 1989, Vietnam produced just 1.2% of world coffee output. A decade later, Vietnam was the world's second-largest supplier, with a global market share of 12.4%. So far, the majority of the coffee grown has been of the "robusta" variety. Compared to "arabica", which is the other main variety, robusta is more resilient to variations in growing conditions and weather shocks and typically has higher yields, but also fetches a lower price in the international market. More than 85% of coffee in Vietnam is grown by smallholder farmers. In 2006, coffee accounted for around 17% of the country's commodity exports and provided a livelihood for an estimated four million people (Luong and Tauer 2006).

International coffee prices are quite volatile and are driven by a mix of weather conditions in the largest coffee-producing countries, expectations about future prices, changes in demand and interest rates, as well as speculation (Deaton 1999). This means that future coffee prices are difficult to estimate and, for the smallholder farmer, virtually impossible to predict. The fluctuations in the world price for robusta over time are illustrated in figure 1. The vertical bars indicate the months where the data collection for the survey employed in this paper took place (details regarding the data and the survey are provided in the following section). For the year preceding the survey rounds of 2006, 2010, and 2014, coffee prices were relatively low, while coffee prices were higher for the year preceding the survey rounds of 2008 and 2012. The changes in prices are substantial: the price in the 12 months preceding the 2008 survey was almost 50% higher than the price in 2006; the 2012 price was around 30% higher than the 2010 price.

Vietnamese coffee production primarily takes place in the Central Highlands region. Coffee trees have a life span of more than 50 years, and it is a labor-intensive task to cut the trees to make plots suitable for other types of agricultural production. In 2004, the price of removing a single coffee tree was estimated to be 2,000 Vietnamese Dong (VND) or around $0.15 (Giovannucci et al. 2004). Since the farmers in our sample have on average about one hectare of land dedicated to coffee production, and assuming plantations consist of 1,100 trees per hectare (D'haeze et al. 2003), it is a very costly task to stop coffee production and switch to other crops. This means that we do not expect many farmers to abandon coffee production when coffee prices are low. In an analysis of

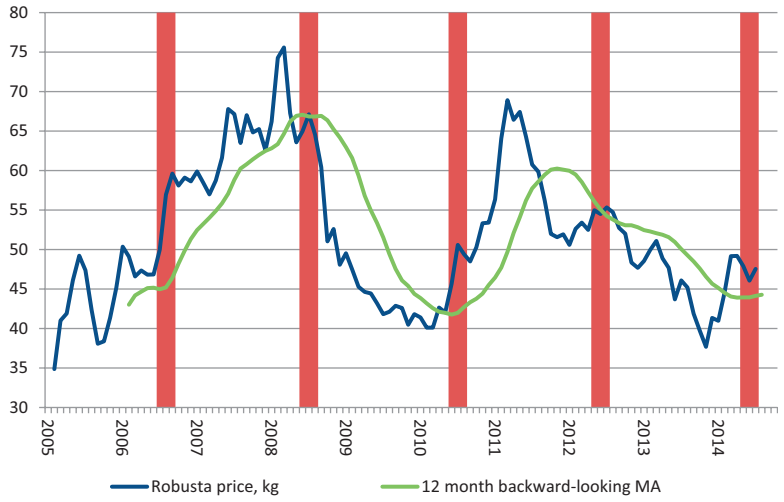

Figure 1. World market coffee prices, '000 real June 2014 VND/kg

Note: The vertical bars denote the three-month periods of the Vietnam Access to Resources Household Survey (VARHS) survey rounds.
Source: Authors' illustration based on International Coffee Organization (2015) and the survey data.

Ugandan coffee farmers' decisions to invest in (or abandon) coffee trees, Hill (2010) finds that farmers respond very slowly to price changes. Indeed, our results substantiate this assumption. The inability to adjust the area dedicated to coffee trees in the short term means that households must instead use other strategies, such as reallocation of labor, when faced with low coffee prices. Further, since coffee is a cash crop, households consume very little of their own production. This implies that on the consumption side, household responses are almost entirely undertaken through changes in household income and not through changes in relative prices of consumption items. These two factors make this setting very useful for identifying the impact of commodity price shocks on on-farm and off-farm responses.

Data

Our study relies on data collected under five waves of the Vietnam Access to Resources Household Survey (VARHS hereafter; see CIEM 2015) conducted from 2006 to 2014. This panel survey has been collected in the months of June–September every second year since 2006 among rural households from 12 provinces of Vietnam.[3] In 2012, the sample was expanded to compensate for the aging of the panel sample relative to the existing household structure in Vietnam. We combine these data with a sample of approximately 1,000 households that have been surveyed since 2008 along with the VARHS households (using the same survey instrument).[4] Both the samples are independently representative at the level of the province.

The VARHS data includes three of the four provinces in the Central Highlands—Dak Lak, Dak Nong, and Lam Dong. To first establish that there is a pass-through effect of international coffee prices on coffee farmers, we use a sample of coffee growing households—"coffee sample"—that consists of households that reside in the Central Highlands and report having harvested coffee at least once from 2006 to 2014 (which is approximately 75% of the sample from the Central Highlands).[5] This gives us an unbalanced panel of households where the sample size varies from 209 households in 2006 to 562 households in 2012, and the total sample consists of 2,355 household-year observations. For the rest of the analysis we use the full sample of households, which consists of 16,044

[3] The timing of the survey has shifted slightly over time. The 2006 round was collected in July, August, and September; the 2008 and 2010 rounds were collected in June, July, and August; the 2012 and 2014 rounds were collected in June and July.

[4] These households were added to evaluate an aid program that was ultimately not implemented.

[5] We also observe 18 households outside the Central Highlands that grow coffee (equal to 0.6% of the sample outside the Central Highlands). These households are excluded from this "coffee sample".

household-year observations. Despite spanning almost a decade, we find a very low attrition rate in the survey (in the range of 0 to 1.8% from round to round in the survey). This is partly due to rural-to-urban migration being lower than in many other countries in the region.

To investigate the effect of coffee price fluctuations we merge the survey data with monthly international robusta coffee prices from the International Coffee Organization (ICO). The ICO publishes monthly indicator (or spot) prices for robusta coffee which are a function of the average demand and supply of robusta in key global markets.[6] These prices are converted from U.S. cents into real 2014 VND. To take into account that it is not the coffee price at the time of the interview that matters, but rather the coffee prices faced by the household in the year preceding the survey (the time period over which the survey asked questions), we use a 12-month backward-looking moving average. Thus, the relevant coffee price for a household surveyed in month m is the average coffee price over the months from m—13 to m—1. Our key explanatory variable is constructed by dividing this lagged coffee price by its standard deviation over the survey period (2006 to 2014). Our results are robust to alternative definitions of the key explanatory variable.

The outcome variables and the remainder of the control variables come from the survey data. The summary statistics of these variables for the "coffee sample" and the full sample are presented in table 1. In the agricultural module of the survey, households are asked questions regarding the production of various crops in the 12 months preceding the survey. In the "coffee sample", most depend on coffee for a substantial share of their agricultural production with households, on average, dedicating slightly under half of their land (typically consisting of several plots) to coffee production. The mean farm size of coffee farmers is 1.7 hectares (17,000 square meters) and the average coffee output is 2,316 kg. Farm-gate prices faced by farmers are calculated from sales revenue and quantity sold and converted to June 2014 prices.

The survey gathers information on food expenditures made during the last 28-day period before the survey and we also convert these to June 2014 prices.[7] As shown in table 1, average real food expenditure is VND 1.33 million for the full sample and VND 1.54 million for the coffee farmers. The average household size for the full sample is 4.6% and 66% of the households belong to the ethnic majority group (Kinh). We also construct an asset index as a composite index of a range of different asset indicators. Specifically, we conduct a principal component analysis of the asset indicators, retain the first factor, and then standardize the value of this factor with respect to the non-coffee growing regions (i.e., non-Central Highlands).[8] Many households supplement agricultural income with a wage job—on average, 59% of the households in the full sample have at least one member that engages in wage work. Most wage work consists of unskilled jobs in agriculture and forestry (33% of job observations in the full sample), followed by unskilled jobs in mining and construction (22%).

To investigate intra-household responses, we construct a panel of individuals who reside in the household sample used in our analysis. This gives us an unbalanced panel of 62,809 individual-level observations, which are then split into three age groups: children (aged 6–14; 12,763 observations), adolescents (aged 15–19; 9,717 observations) and adults (20–54; 40,329 observations).[9,10] To study intra-household allocation of labor we consider three major categories of work: wage employment, work on the household farm, and household chores (cooking, cleaning, collecting firewood, etc.).[11] The outcome

[6] The International Coffee Organization (ICO) also publishes monthly indicator prices for three other major types of coffee—Colombian mild arabica, other mild arabica, and Brazilian naturals. Further details are available at www.ico.org.

[7] Due to some outliers in the food expenditure variable, we have opted to winsorize this variable by replacing all values above the 99th percentile with the value of food expenditures at the 99th percentile.

[8] The asset index is based on the following variables: number of cows, number of buffaloes, number of pigs, number of chickens, number of color TVs, number of video/DVD machines, number of telephones, number of motorcycles, number of bicycles, number of cars, number of pesticide sprayers owned by the household; square meterage of the household's house; and indicator variables equal to one if the household has access to an improved water supply, a modern form of lighting, and improved toilet facilities.

[9] Children aged 5 or below are excluded from the individual level panel since the survey only asked work status of those aged 6 and above. We also exclude adults over the age of 54.

[10] Individuals move across age groups as they age over the survey rounds. The sum of the age group-specific observations is slightly smaller as the age group level analysis only considers individuals who appear at least twice over the course of the survey period in the same age group.

[11] We define child labor as work done by household members who are 14-years old or younger. This is in keeping with the International Labour Organization (ILO) definition of "child"

Table 1. Summary Statistics

Variable	Full Sample		Coffee Sample		Diff (1-3)
	Mean (1)	SD (2)	Mean (3)	SD (4)	(5)
Panel A: Household characteristics					
Real food exp. (monthly, '000 VND)	1,331.97	1,033.89	1,540.09	1,055.19	−208.12***
Asset Index	0.00	1.66	0.52	1.38	−0.52***
Household size	4.59	1.89	4.88	1.74	−0.29***
Household head is Kinh	0.66	0.47	0.61	0.49	0.05***
Natural shock	0.19	0.39	0.26	0.44	−0.07***
Health shock	0.10	0.31	0.11	0.31	−0.00
Pest attack	0.28	0.45	0.28	0.45	0.00
Household engages in wage work	0.59	0.49	0.58	0.49	0.01
Area of plots (m^2)	8,778.67	16,562.97	17,334.00	16,469.68	−8,555.33***
International coffee price ('000 VND/kg)			51.24	9.48	
Farm-gate coffee price ('000 VND/kg)			37.43	27.57	
Share of area dedicated to coffee			0.48	0.41	
Coffee produced, kg			2,385	4,176	
Panel B: Individual work status					
B.1: Children					
Wage work	0.01	0.07	0.01	0.09	−0.00
Agricultural work	0.20	0.40	0.24	0.43	−0.04***
Housework	0.41	0.49	0.53	0.50	−0.12***
B.2: Adolescents					
Wage work	0.08	0.27	0.09	0.29	−0.01
Agricultural work	0.48	0.50	0.59	0.49	−0.11***
Housework	0.58	0.49	0.69	0.46	−0.12***
B.3: Adults					
Wage work	0.29	0.45	0.30	0.46	−0.01*
Agricultural work	0.61	0.49	0.74	0.44	−0.13***
Housework	0.60	0.49	0.68	0.47	−0.09***
Panel C: Schooling					
C.1: Children					
Attending school	0.92	0.28	0.94	0.24	−0.03***
Over-age	0.10	0.30	0.10	0.29	0.00
C.2: Adolescents					
Attending school	0.60	0.49	0.64	0.48	−0.04*
Over-age	0.18	0.38	0.17	0.37	0.02
Number of household 2006	2,265		209		
Number of household 2008	3,241		518		
Number of household 2010	3,208		515		
Number of household 2012	3,668		562		
Number of household 2014	3,642		553		
Number of household-year observations	16,044		2,355		

Note: Children refers to individuals in the age group of 6–14 years in Panel B (work status) and those in the age group of 7–14 years in Panel C (schooling); adolescents are those in the age group of 15–19 years; adults are in the age group of 20–54 years. In Panel C, "Attending school" is a dummy which is equal to one if the child is currently attending school. Over-age is a dummy which is equal to one if age-grade distortion (AGD), defined as AGD=grade-(age-7), is less than 0 for those attending school. Data in Panel C is for the period 2008–2014. Asterisks indicate the following: *= significant at 10%; **= significant at 5%; ***= significant at 1%.

variables take the value of 1 if an individual reports undertaking the respective work category in the year preceding the survey, and 0 otherwise. Summary statistics in panel B of table 1 show that one-quarter of households employ child labor in agriculture. In contrast, only around 1% of households utilize child labor in wage employment.

Lastly, panel C of table 1 reports summary statistics of schooling outcomes for children

for employment purposes, and also reflects the minimum legal working age in Vietnam of 15 years (International Labour Organization 1973; Ministry of Labour, Invalids and Social Affairs, Vietnam 2013a, 2013b).

and adolescents.[12] We find that over 90% of children report attending school, reflecting the impressive increase in the enrollment rate in Vietnam since the 1990s (Dang and Glewwe 2017). School enrollment is lower for adolescents—60% for the full sample and 64% for the coffee sample. For children that report attending school we also construct an indicator for age-grade distortion, similar to the method used by Patrinos and Psacharopoulos (1997), and Dammert (2008), where the outcome variable takes the value 1 if the child is over-age relative to the child's grade (as measured by the index).[13] Conditional on attending school, we find that approximately 10% of children and 18% of adolescents are over-age for their grade.

Estimation Strategy

To evaluate the effects of coffee prices on coffee growing households, we rely on a two-step approach. First, we establish that international coffee prices matter for coffee farmers in Vietnam. Put differently, does the international robusta coffee price affect the farm-gate price received by farmers, and their coffee growing and selling behavior? To do this, we estimate the following household-level equation using a linear model with fixed effects for the sample of coffee-growing households in the Central Highlands:

$$(1) \quad y_{jt} = \alpha + \beta p_t + \boldsymbol{\lambda}\cdot\mathbf{x}_{jt} + \eta_j + \delta_c t + \epsilon_{jt}$$

where y_{jt} is the outcome of interest for household j at time t and p_t is the international coffee price, which varies by month and year. As discussed earlier, p_t is the average international coffee price in the 12 months preceding the survey, divided by its standard deviation, and this is the same for all households surveyed in the same month of a particular survey round. The coefficient of interest, β, measures the marginal effect of a one standard deviation change in price. The vector $\mathbf{x}_{jt}$ includes time-varying control variables such as household size, household size squared, and dummy indicators to control for household exposure to shocks in the preceding two years (since the previous survey). Specifically, we control for three kinds of shocks: natural disasters (floods, droughts, etc.), pest attacks, and health shocks (death of a household member or illness). All household-specific time-invariant characteristics are captured by the household fixed effect, η_j. To avoid any spurious correlation caused by underlying time-variant effects, we include a linear time trend variable. Further, to allow for spatial heterogeneity in time trends, we use province-specific time trends (δ_c). Finally, we cluster the standard errors at the level of the commune to allow household decisions to be correlated within a commune and also over time.

Second, we turn to our primary objective, that is, to assess how coffee prices affect household welfare and coping strategies. One common concern in analyses such as this is that macroeconomic trends other than international coffee prices could affect both household income and labor supply decisions, and coffee prices. This is indeed a possibility given the high correlation between international commodity price series (Deaton and Laroque 1992; Byrne, Fazio, and Fiess 2013). To account for such unobserved macroeconomic trends we use Vietnamese provinces outside the Central Highlands where coffee is not grown as control regions. The intuition of the identification strategy is that, after controlling for macroeconomic conditions, households in the coffee-producing areas of the Central Highlands should experience (and respond to) changes in the price of coffee, while households outside this region are unaffected. Thus, we augment equation (1) above by including an interaction of price and a dummy indicator for the Central Highlands (CH), and a survey month-year fixed effect and estimate the following model at the household-level:

$$(2) \quad y_{jt} = \alpha + \gamma p_t * CH + \boldsymbol{\lambda}\cdot\mathbf{x}_{jt} + \eta_j + \phi_t + \delta_c t + \epsilon_{jt}$$

where survey month-year fixed effects, denoted by ϕ_t, control for any unobserved country-wide macroeconomic conditions at the time of the survey (including the international coffee price). The coefficient of interest is γ, which captures the effect of temporal variation in the price of coffee for a

[12] This information is not available for 2006.

[13] More precisely, we specify the age-grade distortion as AGD=grade-(age-7). The overage indicator takes the value of 1 if AGD <0. Children usually start school at the age of 6, so if they are older than 7 after having completed the first year of primary school then they are over-age for their grade level.

household residing in the Central Highlands (CH) relative to households outside CH.[14] Note that γ measures the intent to treat effects (ITT) on all households residing in the Central Highlands (coffee and non-coffee growers) and include any spillovers within the coffee growing areas (e.g., through the local labor markets).

Finally, to investigate individual-level effects we estimate the following variant of equation (2):

$$y_{ijt} = \alpha + \gamma p_t * CH + \boldsymbol{\lambda} \cdot \mathbf{x}_{jt} + \eta_i + \phi_t + \delta_c t + \epsilon_{ijt} \quad (3)$$

where i denotes individual and j denotes the household of individual i, and the term η_i denotes individual fixed effects that control for individual-specific time-invariant characteristics. We continue to cluster the error term, ϵ_{ijt}, at the level of the commune to allow individual decisions to be correlated within a commune (and household) and over time. Finally, in all the equations above, wherever the outcome of interest is a dummy variable, we use linear probability models to avoid the incidental parameter problem.

One may be concerned that differential returns to education may explain the labor allocation decisions for children. Glewwe and Jacoby (2004) argue that school enrollment in Vietnam is driven by increases in income rather than changes in the returns to education. Further, in all our specifications, we include province-specific time trends to control for unobserved province-specific time-varying factors. Similarly, our results could overestimate the effect of coffee prices on schooling and labor market decisions related to children if the supply of schooling also changed with the price of coffee. This could happen, for example, if the provision of local schooling depended on local tax revenue. While school funding is nominally allocated to the provinces and to the districts within each province from the state budget, the reality is more complicated as funding is often complemented by local funding, which is dependent on tax revenues (Cobbe 2011).[15]

Results

Coffee Prices and Household Welfare

We begin by checking the validity of our study design. For this purpose we estimate equation (1) for the sample of coffee-growing households and the results are presented in table 2. The first column shows, as expected, that the international price is highly correlated with the farm-gate price received by farmers. An increase in the international price of one standard deviation increases the farm-gate price by 8.7%. While one might have expected a higher correlation, other things such as local weather and crop disease conditions can affect the quality of coffee beans and the farm-gate price. Further, intermediate traders—and transactions costs more generally—absorb a share of the price changes (Giovannucci et al. 2004; Fafchamps and Hill 2008).[16] Similarly, in column 2 we find that a standard deviation increase in international coffee prices increases coffee revenue by 13.5%.

Next, the international coffee price may not matter for welfare if farmers could hold onto coffee in low-price years and wait for prices to increase. Results from columns 3 and 4 show that is not the case. In column 3 the outcome variable is an indicator that takes the value of 1 if the household sold coffee that year, and 0 otherwise. In column 4, the outcome variable is the change in the amount of stored coffee from the preceding year. Both these variables are not affected by prices, indicating that farmers are severely constrained in that they have limited holding capacity and tend to sell their output at prevailing prices. Households could also try *ex-ante* to buffer against movements in coffee prices using strategies such as making pre-harvest contracts with traders and/or growing other crops. We find that pre-harvest contracts are uncommon, with less than 1% of the coffee sample reporting using this modality.[17] On the other hand, we find that 76% of the coffee sample reports growing at least one crop other than coffee, either by intercropping or growing crops on other plots.

[14] The level effect of residing in the Central Highlands does not appear in equation (2) as it is absorbed by the household fixed effects, η_j.

[15] Taxes where revenue accrues at least partly to the provincial governments include land taxes, VAT, and personal income taxes (World Bank 2011).

[16] On using log international coffee price as the key explanatory variable, we find that a 1% increase in international coffee price increases farm-gate price by 0.6%.

[17] Farmers were asked if they made "a contract with the main buyer of your crop in advance of the harvest". This information is only available between 2010 and 2014.

Table 2. International Coffee Prices and Coffee Farmers in Vietnam

	Log Farm-Gate Price (1)	Log Coffee Revenue (2)	Sold Coffee (3)	Change in Stored Coffee (kg) (4)	HH Grows Other Crops (5)	Area Under Coffee (m^2) (6)	Amt. Coffee Produced (kg) (7)
Coffee price	0.087***	0.135***	−0.002	−61.758	−0.007	−189.860	−5.268
	(0.009)	(0.018)	(0.005)	(53.605)	(0.005)	(125.638)	(44.115)
Mean of dep. var.	3.47	10.41	0.82	−354.25	0.76	8,398.65	2,385.26
HH controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
HH fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province time trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1,894	1,894	2,355	2,144	2,355	2,193	2,144

Note: Coffee price and farm-gate prices are both in real terms. Coffee price has been standardized by dividing by its standard deviation. The farm-gate price and revenue from coffee can only be calculated for households that report selling positive amounts of coffee in a given year, thereby reducing the sample in columns 1 and 2. Coffee revenues are measured in '000 VND. Sold coffee is a dummy variable that equals 1 if the household sold coffee in the year preceding the survey. HH grows other crops is a dummy variable that takes the value 1 if a household grew a crop other than coffee in the year preceding the survey. Household controls include pest, natural disaster, illness/death shock variables, household size and its squared term. Standard errors clustered at the commune level are reported in parentheses. Asterisks indicate the following: *= significant at 10%; **= significant at 5%; ***= significant at 1%.

However, as shown in column 5, we do not find any evidence that the probability of growing other crops is systematically affected by international coffee prices. The last two columns report two other validity checks. Column 6 in table 2 indicates that the area under coffee is unresponsive to coffee prices, underpinning our assumption that coffee cultivation is a long-term investment. It is difficult to enter and exit in response to temporary fluctuations in prices. Finally, international coffee prices could be endogenous as local weather conditions could affect domestic production, and given that Vietnam is one of the largest producers of robusta coffee, this could in turn affect international coffee prices. To check for this potential source of endogeneity in column 7, we regress coffee output on international coffee prices. We do not find a significant relationship between international coffee prices and coffee production, giving further credence to our assumption of exogeneity.

Having established the validity of our empirical strategy, we turn to investigating the effects of coffee price fluctuations on the welfare of households residing in the coffee growing region of Vietnam. We estimate equation (2) for the full sample of households, using households residing outside the Central Highlands as controls. The results are presented in table 3. Column 1 shows that relative to households residing outside the Central Highlands, the monthly household food expenditure of households in the Central Highlands is positively affected by coffee prices. We find that a one standard deviation increase in coffee prices increases the monthly food expenditure by 4.3% (or approximately VND 42,000 from a mean of

Table 3. Coffee Prices and Household Welfare

	Log Real Food Expenditure (1)	Asset Index (z-Score) (2)	Wage Work (3)
Coffee price*CH	0.043**	0.031**	−0.017*
	(0.019)	(0.014)	(0.009)
Control mean	6.88	0.00	0.59
HH controls	Yes	Yes	Yes
HH fixed effects	Yes	Yes	Yes
Month-year fixed effects	Yes	Yes	Yes
Province time trend	Yes	Yes	Yes
N	15,993	16,044	16,044

Note: Food expenditure is measured in '000 VND for the month preceding the survey. Wage work is a dummy variable that equals 1 if at least one member of the household undertook wage work. Household controls include pest, natural disaster, illness/death shock variables, household size and its squared term. Coffee price has been standardized by dividing by its standard deviation. CH is a dummy variable for the Central Highlands. Standard errors clustered at the commune level are reported in parentheses. Asterisks indicate the following: *= significant at 10%; **= significant at 5%; ***= significant at 1%.

Table 4. Coffee Prices and Intra-Household Labor Responses by Age

	All (1)	Ages 6–14 (2)	Ages 15–19 (3)	Ages 20–54 (4)
Panel A: Wage work				
Coffee price*CH	−0.010**		−0.013*	−0.017***
	(0.004)		(0.007)	(0.007)
Control mean	0.20		0.07	0.28
Panel B: Agricultural work				
Coffee price*CH	−0.015**	−0.032**	−0.054***	0.002
	(0.007)	(0.015)	(0.015)	(0.005)
Control mean	0.49	0.19	0.46	0.58
Panel C: Housework				
Coffee price*CH	0.035***	0.019	0.014	0.047***
	(0.009)	(0.017)	(0.014)	(0.009)
Control mean	0.53	0.37	0.54	0.57
HH controls	Yes	Yes	Yes	Yes
Indiv. fixed effects	Yes	Yes	Yes	Yes
Month-year fixed effects	Yes	Yes	Yes	Yes
Province time trend	Yes	Yes	Yes	Yes
N	62,809	12,763	9,717	40,329

Note: Household controls include pest, natural disaster, illness/death shock variables, household size and its squared term. Coffee price has been standardized by dividing by its standard deviation. CH is a dummy variable for the Central Highlands. Standard errors clustered at the commune level are reported in parentheses. Asterisks indicate the following: *= significant at 10%; **= significant at 5%; ***= significant at 1%.

VND 973,000). This indicates that households are not able to perfectly smooth consumption when faced with price volatility in the coffee market. Similarly, column 2 shows that the index of durable assets is also significantly and positively affected by the international coffee price. A standard deviation increase in coffee prices increases the asset index by 0.03 standard deviations relative to controls. Overall, these results indicate that fluctuations in international prices translate into transitory income changes, affecting household food expenditure and asset ownership.

Lastly, we examine whether international coffee prices affect the probability that coffee-growing households participate in the labor market. These results are presented in column 3 of table 3. Coffee prices negatively affect the probability that at least one member of the household engages in off-farm wage employment. A one standard deviation increase in coffee prices results in a 1.7 percentage point drop in the propensity to engage in wage work. Given a mean of 59% for non-coffee growing households, this translates into a 2.9% decrease. This negative effect indicates that wage work is used as a coping mechanism—in periods when coffee prices are low, household members engage in wage work to sustain income. This in turn could have implications for the allocation of labor within the household. As the incentives for the distribution of labor within the household change, it is particularly important to understand the burden borne by children and adolescents.

Coffee Prices and Individual Labor Allocation

To explore individual-level responses to transitory income shocks, we construct three age groups: children (aged 6–14 years); adolescents (aged 15–19); and working age adults (aged 20–54). The children age group is consistent with the age group used to define child labor, and the adolescent age group corresponds with the typical age of senior high-school students in Vietnam. We examine intra-household labor complementarities and substitution across three primary activities: off-farm wage employment, farm work, and house work. Equation (3) is estimated separately for each age group and work category, and the results are presented in table 4. Since we see a very low incidence of wage employment among children (1% on average) we do not examine this work category for children.

Panel A examines whether coffee price shocks affect the probability of engaging in wage employment. The result in column 1 corresponds to the household-level result in the last column of table 2—an increase in

coffee prices reduces the probability that an individual engages in wage work. On disaggregating by age groups we find that coffee prices strongly affect the probability that adolescents and adults engage in wage employment. A one standard deviation increase in the international coffee price decreases the probability of undertaking wage work by 1.3 percentage points for adolescents and by 1.7 percentage points for adults in the Central Highlands. As, on average, 7% of adolescents and 28% of adults engage in wage work in the non-coffee growing regions, this translates into decreases of 18.5% and 6% for adolescents and adults, respectively. This provides evidence of counter-cyclical wage employment among the adolescents and working-age adults such that when coffee prices are high, adolescents and working age adults are less likely to engage in wage employment.

In Panel B we examine the decision to work on the farm. In column 1 we find that an increase in coffee prices significantly reduces the probability that household members work on the farm. On examining the effects across age groups, it emerges that a one standard deviation increase in coffee price reduces the probability of engaging in farm work by 3.2 percentage points for children, and by 5.4 percentage points for adolescents. This corresponds to reductions of 16.8% and 11.7%, respectively. Column 4 indicates that, on the extensive margin, adult work on the farm is not sensitive to coffee prices.

Finally, we turn to participation in housework in Panel C, which shows that engagement of children and adolescents in housework is not sensitive to movements in international coffee prices. On the other hand, adults are more likely to take part in housework when prices are high. This ties in with the results noted for wage employment and farm work above—when coffee prices are high, adults are less likely to spend time outside the house (in wage employment) and are more likely to have time available for housework.

To summarize, within-household variation in coffee prices over time affects intra-household labor allocation decisions. When prices fall, we find increased participation in wage work for adults, and they become less involved in housework. The labor supply of adolescents is also sensitive to changes in the coffee price as we find increased participation rates in both wage work and agriculture. This is worrying if it means that adolescents are taken out of upper school to work for a wage and on the farm, which we test below. Perhaps even more worrying, we find an increase in child labor on the farm when coffee prices are low.

Robustness Checks

We test the robustness of our main results reported in table 4 to a variety of alternative assumptions. First, one may speculate that the province-specific trends are not sufficient to control for potential spurious correlation caused by changes in the underlying province-specific policies. We alleviate this concern by replacing linear province-specific time trends in equation (3) with quadratic trends and do not find our results to be sensitive to this change (results available in table A1 in the online supplementary appendix).

Second, the province-specific time trends may hide within-province variation if local labor or coffee markets exhibit different trends. One such possibility arises from the fact that coffee traders are assigned licenses at the district level. We check this by re-estimating our models with district-specific trends. The results, shown in table A2 in the online supplementary appendix, are qualitatively and quantitatively comparable to those of the main specification.

Third, it might be that outcomes are correlated at a higher level than the commune level. More specifically, if labor markets clear at the district level, the labor market participation decisions may be correlated within the district. To account for this, we estimate standard errors clustered at the district level. Once again, we find that our results are robust to this alternative clustering strategy (table A3 in the online supplementary appendix).

Fourth, while we have used the mean international coffee price faced by farmers in the preceding year, it is possible that household labor decisions are primarily driven by prices during harvest. In Vietnam, coffee is normally harvested once per year between November and February. Allowing for a month-long delay in payments, we compute harvest price as the average coffee price faced by the farmer during November–March, divided by standard deviation of

coffee prices and replace this in equation (3). As results in table A4 in the online supplementary appendix show, our results are robust to this alternative definition of coffee prices. Additionally, the results are qualitatively comparable when we use the log of the international coffee price instead of the standardized prices (see table A5 in the online supplementary appendix). Overall, we find that our main conclusions continue to hold using a wide range of alternative identification strategies and definitions of the key dependent variable, providing strong robust evidence on the effect of coffee price volatility on intra-household labor allocation decisions.

Additional Analysis

This section explores the implications of our main results further. First, we investigate whether there is any heterogeneity in response between different groups of households and different types of household members. Second, we also examine if household response in low price periods differs from that in high price periods. Third, we explore the implications of the reallocation of labor within the household on the schooling of children and adolescents. Finally, we investigate other mechanisms such as credit and migration that could have been used by households to smooth consumption.

Heterogeneity in Response by Household Characteristics

We begin by exploring the degree to which household labor allocation responses to international coffee prices vary by the characteristics of the household. Table 5 presents the results of heterogeneity of responses along three dimensions: (*a*) gender in Panel A; (*b*) household wealth in Panel B; and (*c*) ethnicity (measured by an indicator variable that takes the value 1 if the household head belongs to a minority group, i.e., non-Kinh) in Panel C. To minimize endogeneity concerns we measure household wealth by the asset index at the point when the household is first observed in the data.

Columns 1 and 2 of table 5 show heterogeneity with respect to wage employment. We find that wage employment of adult females is more sensitive to fluctuations in coffee prices such that in periods of high prices, women are less likely than men to undertake wage work. Consistent with wage work being a coping mechanism, we find that households with a higher asset index are less likely to resort to the labor market to tide over low coffee price periods. These results align with anecdotal evidence that higher asset holdings help Vietnamese farmers mitigate the effects of temporary coffee price fluctuations (Giovannucci et al. 2004). Further, adolescents and adults in non-Kinh minority households are more likely to seek wage employment in low coffee price periods. As with marginalized groups in other countries, non-Kinh households are systematically worse off compared to Kinh households, including in access to credit (Baulch et al. 2004; Singhal and Beck 2017). Our results indicate that excluding non-Kinh households from alternative coping mechanisms has resulted in increased vulnerability to vagaries of the commodity markets.

Looking at heterogeneity in agricultural work in columns 3–5, we find that while children work on the farm in low price periods, this effect is slightly muted for girls. In Panel B we find that adults in asset rich households are less likely to do farm work during high coffee price periods. This could be due to a greater reliance on hired labor than unpaid family labor during high price periods in wealthier households.

Finally, heterogeneity of responses in the context of household work is examined in columns 6–8. While adults are more likely to spend time at home in high price periods, this response is weaker for females. Taken together, the results indicate a "double burden" on women, relative to men. In periods of low coffee prices, women are more likely to engage in the labor market and less likely to stop undertaking household chores. Similar vulnerability is noted for minority households.

Heterogeneity in Response by Coffee Prices

In the analysis so far we have estimated the average effect of coffee prices on households residing in coffee-producing regions relative to those residing outside. However, household responses to low and high coffee prices may not be symmetric, and the average effect may mask this heterogeneity. To investigate this we split the coffee price variable into 3 categories—an indicator variable for low price (if price is in the first quartile), an

Table 5. Heterogeneity in Intra-Household Labor Response by Socio-Economic Characteristics

	Wage Work		Agricultural Work			Housework		
	Ages 15–19 (1)	Ages 20–54 (2)	Ages 6–14 (3)	Ages 15–19 (4)	Ages 20–54 (5)	Ages 6–14 (6)	Ages 15–19 (7)	Ages 20–54 (8)
Panel A: Gender								
Coffee price *CH	−0.010 (0.010)	−0.005 (0.007)	−0.045** (0.018)	−0.050*** (0.018)	0.003 (0.006)	0.020 (0.017)	0.036** (0.018)	0.075*** (0.013)
Female*Coffee price*CH	−0.005 (0.012)	−0.025** (0.010)	0.025* (0.014)	−0.007 (0.016)	−0.003 (0.005)	−0.001 (0.015)	−0.042*** (0.016)	−0.055*** (0.011)
Panel B: Assets								
Coffee price *CH	−0.012* (0.007)	−0.016** (0.006)	−0.038** (0.015)	−0.051*** (0.015)	0.002 (0.005)	0.026 (0.017)	0.020 (0.014)	0.051*** (0.009)
Asset*Coffee price*CH	0.017*** (0.005)	0.008*** (0.003)	−0.008 (0.007)	−0.003 (0.008)	−0.005** (0.002)	0.005 (0.007)	0.005 (0.006)	0.001 (0.003)
Panel C: Ethnicity								
Coffee price *CH	0.008 (0.008)	−0.006 (0.007)	−0.030* (0.016)	−0.050** (0.020)	−0.000 (0.006)	0.026 (0.020)	0.042** (0.017)	0.053*** (0.008)
Nonkinh* Coffee price*CH	−0.049*** (0.013)	−0.027*** (0.007)	−0.003 (0.017)	−0.008 (0.025)	0.005 (0.007)	−0.013 (0.020)	−0.065*** (0.022)	−0.018* (0.010)
HH controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Indiv. fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province time trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	9,717	40,329	12,763	9,717	40,329	12,763	9,717	40,329

Note: Household controls include pest, natural disaster, illness/death shock variables, household size and its squared term. Asset refers to the value of asset index of the household at baseline. Coffee price has been standardized by dividing by its standard deviation. CH is a dummy variable for the Central Highlands. Standard errors clustered at the commune level are reported in parentheses. Asterisks indicate the following: *= significant at 10%; **= significant at 5%; ***= significant at 1%.

indicator variable for high price (if price is in the fourth quartile), and one for normal price (reference category)—and re-estimate the analysis presented in tables 3 and 4.

Results corresponding to table 3 are shown in table A6 in the online supplementary appendix. We find that relative to normal price periods, households significantly draw down their assets in low price periods (negative income shocks). However for all the outcome variables—food expenditure, asset index, and wage employment—we are unable to reject the null hypothesis that the absolute value of the coefficients are equal.

Next we check if individual labor supply in low price periods is symmetric to that in high price periods in table 6. In contrast to changes at the household-level, we find that labor supply decisions differ in low and high price periods. In Panel A we find that adolescents and adults are more likely to withdraw from wage employment when coffee prices are high. Further, the magnitude of this response is significantly different from that in low price periods (in terms of absolute value). Similarly, in Panel B we find that farm work by children and adolescents is more sensitive to low coffee prices than to high prices. Finally, in Panel C we find that adult participation in household chores is affected by both high and low coffee prices, but that the magnitude of the effect is stronger in low price periods. Taken together, the results presented in table 6 and online supplementary appendix table A6 indicate that household response to positive and negative price shocks may differ in at least some dimensions.

School Attainment

The main results of table 4 imply that a decline in international coffee prices leads to greater participation in agriculture (by children and adolescents) and labor markets (by

Table 6. Heterogeneity in Intra-Household Labor Response by High and Low Price Periods

	All (1)	Ages 6–14 (2)	Ages 15–19 (3)	Ages 20–54 (4)
Panel A: Wage work				
Low coffee price*CH	−0.005		−0.028	0.002
	(0.016)		(0.025)	(0.024)
High coffee price*CH	−0.047***		−0.074***	−0.068***
	(0.014)		(0.028)	(0.021)
p-value $abs(\beta[Low\ Coffee\ Price * CH]) = abs(\beta[High\ Coffee\ Price * CH])$	0.01		0.09	0.09
Panel B: Agricultural work				
Low coffee price*CH	0.074***	0.142***	0.181***	0.019
	(0.019)	(0.035)	(0.055)	(0.015)
High coffee price*CH	0.008	0.009	−0.028	0.016
	(0.018)	(0.044)	(0.040)	(0.014)
p-value $abs(\beta[Low\ Coffee\ Price * CH]) = abs(\beta[High\ Coffee\ Price * CH])$	0.01	0.02	0.04	0.86
Panel C: Housework				
Low coffee price*CH	−0.068***	0.043	−0.018	−0.132***
	(0.024)	(0.045)	(0.054)	(0.021)
High coffee price*CH	0.071***	0.116**	0.031	0.055**
	(0.022)	(0.049)	(0.044)	(0.024)
p-value $abs(\beta[Low\ Coffee\ Price * CH]) = abs(\beta[High\ Coffee\ Price * CH])$	0.93	0.27	0.88	0.01
HH controls	Yes	Yes	Yes	Yes
Indiv. fixed effects	Yes	Yes	Yes	Yes
Month-year fixed effects	Yes	Yes	Yes	Yes
Province time trend	Yes	Yes	Yes	Yes
N	62,809	12,763	9,717	40,329

Note: Household controls include pest, natural disaster, illness/death shock variables, household size and its squared term.Low Coffee Price is a dummy variable that takes the value 1 if price is in the first quartile. High Coffee Price is a dummy variable that takes the value 1 if price is in the fourth quartile. CH is a dummy variable for the Central Highlands. Standard errors clustered at the commune level are reported in parentheses. Asterisks indicate the following: *= significant at 10%; **= significant at 5%; ***= significant at 1%.

adolescents). This could adversely affect the educational attainment of these age groups both directly (dropping out of school) and indirectly (e.g., less time for homework may lead to grade repetition).

We explore the impacts on schooling in table 7 where the dependent variable, in the first column for each age group, takes the value of 1 if the child is "currently attending school" at the time of the survey. We do not find coffee prices to affect school attendance for either age group.[18] In the second column for each age group, we check if children are more likely to repeat grades using an indicator that takes the value of 1 if the child is over-age relative to the child's grade. Once again, we do not find strong evidence that coffee prices have affected educational attainment. Overall, our results indicate that the re-allocation of labor within households does not seem to come at the cost of children's schooling. A possible explanation is that children and adolescents are cutting back on leisure time in low coffee price periods, and/or that some amount of work is compatible with schooling (Basu 1999; Edmonds 2007). For example, Ravallion and Wodon (2000) find that a school subsidy in Bangladesh increased enrollment more at the expense of child leisure than a decline in the incidence of child labor. Similarly, Attanasio et al. (2010) find that a conditional cash transfer scheme in Colombia increased school enrollment without affecting participation in income generating activities. Furthermore, at the intensive margin while time spent in domestic work fell, these authors find that it reduced less than the increase in time in school, suggesting a reduction in leisure time. Our findings reinforce these authors' findings that

[18] Schools typically break for summer during June–August, when a large part of the VARHS data are collected. Our results could be an underestimate if, during low-price periods, parents intend to withdraw children from school in the next academic year that begins in September.

Table 7. Coffee Prices and Schooling

	Ages 7–14		Ages 15–19	
	Attending School (1)	Over-Age (2)	Attending School (3)	Over-Age (4)
Coffee price*CH	−0.010	0.010	−0.021	0.014
	(0.007)	(0.007)	(0.016)	(0.011)
Control mean	0.91	0.10	0.59	0.18
HH controls	Yes	Yes	Yes	Yes
Indiv. fixed effects	Yes	Yes	Yes	Yes
Month-year fixed effects	Yes	Yes	Yes	Yes
Province time trend	Yes	Yes	Yes	Yes
N	8,460	7,746	6,554	3,937

Note: "Attending school" is a dummy which is equal to 1 if the child is currently attending school. Over-age is a dummy which is equal to 1 if age-grade distortion (AGD), defined as AGD=grade-(age 7), is less than 0 for those attending school. Data are for the period 2008–2014. Household controls include pest, natural disaster, illness/death shock variables, household size and its squared term. Coffee price has been standardized by dividing by its standard deviation. CH is a dummy variable for the Central Highlands. Standard errors clustered at the commune level are reported in parentheses. Asterisks indicate the following: * = significant at 10%; ** = significant at 5%; *** = significant at 1%.

Table 8. Coffee Prices, Credit, Household Enterprises, and Migration

		Loan Type			
	HH Took Loan (1)	Investment Loan (2)	Other Loan (3)	Migration (4)	HH Enterprise (5)
Coffee price*CH	0.013	0.038***	−0.026**	−0.659	0.007
	(0.014)	(0.014)	(0.010)	(2.993)	(0.008)
Control mean	0.38	0.22	0.16	0.07	0.22
HH controls	Yes	Yes	Yes	Yes	Yes
HH fixed effects	Yes	Yes	Yes	Yes	Yes
Month-year fixed effects	Yes	Yes	Yes	Yes	Yes
Province time trend	Yes	Yes	Yes	Yes	Yes
N	13,779	13,779	13,779	7,330	16,044

Note: Comparable information on credit is not available for 2006, reducing the sample in columns (1)–(3). Effect on migration in column 4 is for the period 2012 to 2014. Household controls include pest, natural disaster, illness/death shock variables, household size and its squared term. Coffee price has been standardized by dividing by its standard deviation. CH is a dummy variable for the Central Highlands. Standard errors clustered at the commune level are reported in parentheses. Asterisks indicate the following: *= significant at 10%; **= significant at 5%; ***= significant at 1%.

children's school and work participation are not perfectly substitutable.

Other Coping Mechanisms

Table 2 illustrates that household consumption is affected by coffee prices, meaning that smoothing of consumption is less than perfect. Faced with volatility in international coffee prices, we have shown that coffee-growing households in Vietnam primarily rely on wage employment and increased labor from children and adolescents in agriculture to smooth consumption. With well-functioning credit markets this would not be the case. It is therefore relevant to ask whether this is caused by credit constraints.

In column 1 of table 8, we examine the effect of coffee prices on whether the household took a loan in the two years preceding the interview.[19] The result indicates that there is no significant effect of coffee prices on households' borrowing activity in the Central Highlands. However, we find contrasting effects when we split the loan indicator into investment loans (i.e., loans with the stated purpose of building a house, buying land or other assets, etc.) and other types of loans (mainly consumption loans) in columns 2 and 3, respectively. Results indicate that households are more likely to take investment loans in high coffee price periods and borrow money for consumption purposes in low price years.

[19] The sample size is smaller as the 2006 VARHS did not collect information on credit that is strictly comparable with subsequent survey rounds.

Households could also respond to dips in international coffee prices by sending members to work in urban areas.[20] We have limited information to investigate this channel as the VARHS contains a module on migrants only for the 2012 and 2014 survey rounds. Nevertheless, we examine this in column 4 of table 8. We find that households are less likely to have a migrant when international coffee prices are high but this effect is not statistically significant. Finally, operating a household enterprise can be another channel through which households may attempt to diversify income (Adhvaryu, Kala, and Nyshadham 2015). However, as shown in the last column of table 8, we do not find any evidence of this in our context.

Conclusion

In this study we found that households in the Central Highlands of Vietnam were unable to fully smooth consumption in the face of coffee price fluctuations from 2006 to 2014. In addition to the sale of assets and an uptake of credit for consumption, households also attempted to cope with the loss of income via intra-household labor reallocation. More specifically, our results show that a decline in coffee prices leads to a significant increase in wage employment for adults and adolescents. While children do not engage in wage employment, we found strong evidence that children and adolescents substitute for adults on the farm during low price periods. Adults are also less likely to engage in household chores; and these results are robust to different checks.

We did not find evidence that the uptake of agricultural work in low price periods by children affected school enrollment or grade repetition. However, it is possible that their welfare is negatively affected in dimensions not assessed here, such as health (O'Donnell, Rosati, and Van Doorslaer 2005), and that such effects can persist into adulthood and result in chronic poverty (Beegle, Dehejia, and Gatti 2009).

While the shift from subsistence to cash crops can bring substantial income gains, it also leaves households vulnerable to vagaries of the international commodity markets. From a public policy perspective there is a need for social safety nets that protect household consumption in lean years and help children and adolescents transition safely to adulthood. Access to insurance schemes or cash transfer programs are some of the policy instruments that could help insulate households from volatile commodity markets. For example, while the cash transfer scheme in Nicaragua (Red de Protección Social) was not explicitly designed to respond to shocks, Maluccio (2005) finds that the program protected small coffee farmers from a sharp decline in coffee prices in the early 2000s. More generally, in a recent review De Hoop and Rosati (2014) find broad evidence that both conditional and unconditional cash transfer schemes reduce households' reliance on child labor as a coping strategy.

In contrast, our intra-household labor substitution results suggest that a public works program approach might be of limited benefit as it could lead to children spending more time on the family farm. Indeed, recent analysis of India's workfare program, the Mahatma Gandhi National Rural Employment Guarantee Scheme, finds that access to the program negatively affects schooling outcomes as children take up activities to compensate for parental participation in the program (Shah and Steinberg 2015).

Supplementary Material

Supplementary material are available at *American Journal of Agricultural Economics* online.

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