Commodity price volatility and the psychological wellbeing of farmers*

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Abstract

We examine the effects of income uncertainty on mental health in Vietnam. We assess this issue using volatility in the price of coffee, a key export commodity, that exposes small coffee farmers to income uncertainty. Using household panel data collected over 2016-2020, we find an increase in volatility of the international coffee price to be positively associated with psychological distress among coffee farmers. The magnitude is greater for males and the findings are robust to several checks. These results are further substantiated by corresponding estimates for related health measures and self-reported happiness. Channels include an increase in mental stress due to pessimistic expectations of future economic well-being, increased cognitive load and alcohol consumption, and reduced social capital. The results highlight the psychological toll of living with income uncertainty and provide support for the provision of social safety nets that protect farmers from frequent commodity price fluctuations.

Keywords: Income Uncertainty; Mental Health; Depression; Vietnam

JEL classification codes: I3; I15; O12; D91; Q12

Running head: Commodity prices and psychological wellbeing

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Poor mental health and associated disorders is one of the most important components of the disease burden in the world (WHO, 2017). Moreover, this burden is disproportionately borne by low-income countries due to a robust relationship between mental illness and poverty (Haushofer & Fehr, 2014; Ridley et al., 2021). For example, it is estimated that 80 percent of the global disease burden due to depressive disorders occurs in low- and middle-income countries (WHO, 2017). Given the concerns over the growing socio-economic costs of mental diseases, it is imperative to examine the underlying sources and formulate appropriate policy responses (Patel et al., 2016).

This study shows that not just poverty, but also the *vulnerability to poverty* imposes a psychological burden in developing countries (Ligon & Schechter, 2003; Calvo & Dercon, 2013). Uncertainty over future income can induce substantial worries, anxiety, and a sense of defencelessness and loss of control, triggering (or leading to a continuation of existing) mental health problems. Such psychological effects are distinct from - and in addition to - those associated with living with limited financial means (stress of living in poverty, balancing a limited household budget, limited access to public services, etc.). We assess how income uncertainty stemming from short-term volatility in the price of coffee, a key export commodity, affects mental wellbeing of small coffee farmers in rural Vietnam.

Vietnam is one of the largest coffee producers in the world. Coffee is a perennial crop and production primarily takes place in the Central Highlands region, on small family run farms. Coffee trees have a life span of more than 50 years, and it is a costly and labor-intensive task to cut down the trees to make plots suitable for other types of agricultural production. This implies that when coffee prices are low (high), farmers are unable to abandon (increase) coffee production. This inability to adjust the area dedicated to coffee trees in the short term means that farmers are exposed to volatility in the international commodity market prices.[1] This setting is very useful for identifying the impact of income uncertainty stemming from

commodity price volatility on farmers' mental health in a developing country. We find that a one standard deviation increase in international coffee price volatility increases the incidence of depressive symptoms by 12.3 to 15 percent. This finding is robust to a variety of controls and robustness checks. An examination of the underlying mechanisms suggests that price volatility leads to greater mental stress through a complex set of intersecting channels, that include onset of pessimistic expectations of future economic well-being, increased cognitive load and alcohol consumption, and reduced social capital.

Adoption of high-value cash crops is often 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, specialisation in cash crops often leaves households vulnerable to vagaries of the international commodity markets (Kuma et al., 2019). Using household panel data from Ethiopia, Bellemare et al. (2013) estimate that the average household is willing to pay up to 18 percent of its income to stabilise prices. Other research finds price volatility to be associated with lower farm investments (Gallenstein & Dougherty, 2023), greater out-migration (Lee, 2021) and lesser deforestation (Lundberg and Abman, 2022). Overall, despite increased volatility in agricultural markets in the 21st century, the effects of price risk on farmers in developing countries has received limited attention from researchers and policy makers (Boyd and Bellemare, 2020).

This study is also related to the broader literature examining the effects of economic uncertainty on individual behavior. For example, volatility in stock market indices can affect expectations of economic uncertainty, which in turn can influence individual behavior and choices. Ratcliffe and Taylor (2015) find volatility in the FTSE 100 stock price index to be negatively related to mental well-being in the UK. Other studies find macroeconomic uncertainties to be linked with an increase in car accidents, smoking, drinking, opioid usage, and worsening of adult and child health (e.g., Carlson, 2015; Cotti et al., 2015; Pierce and

Schott, 2020; Staudigel, 2016). However, rigorous examination of the psychological implications of economic uncertainty in developing countries is limited. We add to this literature by examining the effects of income insecurity stemming from international commodity price volatility on the mental health of small farmers in a low-income setting.

Finally, we also contribute to the emerging literature on the determinants of poor mental health in developing countries.[2] Christian et al. (2019) find negative income shocks increase depressive symptoms and suicide in Indonesia. Concomitantly, positive income shocks (such as cash transfers) have been found to reduce depression and anxiety (Haushofer and Shapiro, 2016; Baird et al., 2013). Adverse early-life conditions or concurrent exposure to poor socioeconomic conditions such as conflict and corruption can harm mental health (Adhvaryu et al., 2019; Singhal, 2019; Sharma et al., 2021). However, for those at the margins of poverty, the anticipation of an income shock may matter as much, if not more, for mental wellbeing as the actual occurrence of the shock. Explicit examinations of this role of economic uncertainty in such settings are limited. We highlight two notable exceptions. Haushofer et al. (2020), using a randomized experiment, find providing free health insurance to informal workers in Kenya reduced stress and cortisol levels relative to those receiving an unconditional cash transfer of the same value and a control group. The results suggest that the insurance provided "peace of mind", reducing worries associated with *potential* health problems. Relatedly, Alem and Colmer (2022) find increases in rainfall variability to be associated with reductions in subjective well-being in rural Ethiopia.

Background and conceptual framework

Background

Coffee production in Vietnam has accelerated over the last three decades; from accounting for just 1.2 percent of world output in 1989, Vietnam is currently the second largest coffee producer in the world (after Brazil). There are three key features of coffee production in Vietnam. First, the majority of the coffee grown in the country is the 'robusta' variety. Compared to 'arabica' (the other main variety grown globally), 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.

Second, there is a stark difference between the Central Highlands and other regions of Vietnam with respect to coffee production. In the Vietnam Access to Resources Household Survey (VARHS) data used in this paper (details regarding the data are provided in the following section), while 75 percent of the households residing in the Central Highlands report producing coffee, less than 0.5 percent of the households outside the Central Highlands did the same.[3] Furthermore, the coffee sector plays an outsized role not just in agriculture but in the labor markets of the Central Highlands as well. As per the 2022 Vietnam Labor Force Surveys, the coffee sector provided employment to 34.3 percent of individuals between the ages of 15-64 in the Central Highlands, and only 35 percent of these were farming. The coffee sector provided employment for less than 0.2 percent of individuals in non-Central Highlands provinces.

Third, more than 85 percent of coffee in Vietnam is grown by smallholder farmers, with the average size of the holding being between 1-2 hectares (Luong and Tauer, 2006). So while in aggregate the country is a large producer, individual farmers are 'price takers' in the international markets.

International coffee prices are quite volatile and 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). Together this implies that future coffee prices are difficult to predict, especially for the smallholder farmer. The fluctuations in the world price for robusta coffee over the period 2004-2020 are illustrated in Figure 1 (details regarding the data are provided in the following section).

[Figure 1 about here]

This volatility in coffee prices has important implications for farmers: newly planted coffee trees take about 3-4 years to bear fruit and tend to have a life span of more than 50 years. The trees are also costly to cut down (Giovannucci et al. 2004), altogether making it very difficult for farmers to abandon/invest in coffee trees in response to short-term fluctuations in coffee prices. The inability of coffee farmers to adjust the area dedicated to coffee trees quickly to international coffee prices has been well documented for countries such as Vietnam (Beck et al. 2019) and Uganda (Hill 2010). Results presented later under the identification sub-section further substantiate this assumption. In sum, small Vietnamese coffee farmers are uniquely exposed to the vagaries of the international coffee markets, providing an appropriate setting to examine the effects of price volatility on the mental health of farmers.

Conceptual framework

Our central hypothesis is that volatility in coffee prices increases uncertainty of future economic prospects as farmers do not know what revenue to expect at the time of harvest. In this sub-section, we discuss six - potentially intersecting - reasons why one would expect income uncertainties to increase depressive symptoms.

The first theory is that constant worries about income can exhaust mental resources or "mental bandwidth" (Dean et al. 2019). Increased cognitive load can impair memory,

attention spans, and overall cognitive functioning (Mani et al. 2013; Lichand and Mani 2020; Ridley et al. 2021), which in turn have been found to predict diagnosis of depression (Phillips et al. 2010).

Second, a consistent body of evidence finds that an increased cognitive load can inhibit self-control (Spears 2011; Dean et al. 2019). For example, Cotti et al. (2015) find fluctuations in the Dow Jones Industrial Average index increased engagement in risky health behavior such as binge drinking and cigarette smoking, that have strong associations with mental disorders.[4]

Third, income uncertainty could also lead to pessimistic expectations of future economic prospects and aspirations. For example, constant financial worries may change the perceived probability of future events such that higher probabilities are placed on bad states of the world materialising in the future. Such expectations can then lead to pessimistic views, which play an important role in the etiology and continuation of depression (de Quidt and Haushofer 2019; Lybbert & Wydick 2018).

Fourth, impending financial scarcity and the associated stress could lead individuals to withdraw from social events - either as a way to curtail expenses, or due to an increase in antisocial behavior or reduction in social trust in the community (Prediger et al. 2014; Haushofer et al. 2023). Social isolation and low interpersonal trust have been shown to be significant predictors of depression (Cacioppo et al. 2006; Kim et al. 2012).

Fifth, looming financial distress may lead to a lower locus of control (i.e., whether one believes one's life outcomes are determined by their own actions or luck/fate), which is an important determinant of mental health (e.g., Churchill et al. 2020). Lastly, increased financial worries and associated cognitive load may reduce the utility derived from present consumption (Schofield and Venkataramani 2021). Reduced gratification from consumption - not just of goods and services but also that of personal relationships and experiences - is

a well-established symptom of depression (de Quidt and Haushofer 2019).

In light of the above observations, we hypothesize that coffee price volatility will negatively affect the mental wellbeing of small coffee farmers in rural Vietnam. The underlying pathways discussed here are empirically tested later in the mechanisms section.

Data and estimation strategy

Data

We use the 2016, 2018 and 2020 waves of the Vietnam Access to Resources Household Survey (VARHS hereafter). The VARHS is a long-running panel survey of almost 2,600 rural households conducted between May-July every second year since 2006 in 12 provinces across Vietnam.[5,6] The data were representative at the level of the province in 2012 (see Ayala-Cantu et al., 2017 for details). The VARHS data includes three of the four provinces in the Central Highlands - Dak Lak, Dak Nong, and Lam Dong. The sample size declined slightly during the analysis period: from 2,669 in 2016, to 2,605 in 2018 and 2,583 in 2020. For the primary analysis, we use the balanced panel of 2,581 households and discuss concerns related to attrition later in the robustness sub-section.

We use the last three waves of the VARHS as mental health was only measured in these waves. Mental health is measured in the VARHS using the 10-item Center for the Epidemiological Studies of Depression scale (CES-D). The original CES-D scale consisting of 20 items was developed by Radloff (1977) as a screening tool to measure depressive symptoms and a number of epidemiological studies show that it strongly predicts clinical diagnoses of depression and anxiety disorders (Weissman et al., 1977). We use the modified 10-item short-form version developed by Andresen et al. (1994).[7] This version of the CES-D has been shown to have good psychometric properties in a variety of contexts (Andresen et al.,

1994; Björgvinsson et al., 2013; Boey 1999).

The CES-D is only administered to the primary respondent of the household - the household head or his/her spouse in most cases. Respondents were asked to indicate how often they had certain feelings in the last week on a 0-3 scale - 'never (0 days in a week)', 'sometimes (1-2 days of the week)', 'often (3-4 days of the week)', and 'all the time (5-7 days of the week)'. A higher CES-D score reflects poorer mental health. We use the CES-D scale to construct two dependent variables. First, we use the composite score of the 10 questions (ranging from 0 to 30). Second, the cutoff of 10 (out of a maximum of 30) has been recommended as an indicator for the presence of significant depressive symptoms (Andresen et al., 1994; Björgvinsson et al., 2013; Boey, 1999). We use this threshold to construct a dummy variable, 'severe depressive symptoms', that takes the value 1 for CES-D scores greater than or equal to 10, and 0 otherwise. This latter measure of mental health has been used widely in other studies (e.g., Singhal, 2019; Sharma et al., 2020).

To investigate the effect of coffee price volatility we merge the household survey data with the monthly international robusta coffee prices published by 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.[8] These are shown in Figure 1 for the period 2004-2020. We convert the international coffee price from US cents to 1,000 VND in real December 2018 prices and capture volatility faced by the household leading up to the survey interview, by defining our key explanatory variable ("coffee price volatility") as the standard deviation in the international coffee price in the two years preceding the survey month (the survey takes place every two years).[9] Fluctuations in the standard deviation of prices over the study period of 2016-2020 are shown in Figure 2. the mean coffee price volatility during the VARHS survey months in 2016 is 4.75 SD, 4.16 SD in 2018 and 3.37 SD in 2020. We also control for the level effect of the coffee price using

the average coffee price in the preceding two years.

The remainder of the control variables come from the household survey data. We report the summary statistics for the main variables from the balanced panel dataset in Table 1. Panel A shows that the average score on the CES-D is 7.28 for the sample and 28 percent of the sample exhibits severe depressive symptoms. Figure A3 in the online appendix presents the distribution of the CES-D scores for each year of the VARHS. The Cronbach's α is 0.77 for 2016, 0.80 for 2018 and 0.81 for 2021, which indicates a high level of internal consistency.

[Table 1 about here]

The average age of the respondent is 54, and 41 percent are female. Some 71 percent have at least completed primary school, and nearly 80 percent are married. The survey also asks whether the household experienced any natural disasters (floods, droughts, etc.), pest attacks, and health shocks (death or illness of a household member) in the preceding two years. Exposure to these shocks ranges from 6 to 9 percent. Table 1 also shows the summary statistics separately for households residing in and outside the Central Highlands. Column 4 shows that respondents in the Central Highlands are more likely to exhibit severe depressive symptoms. They also differ significantly on several pre-determined characteristics and exposure to shocks; we account for these in the analysis that follows.

Estimation strategy

As coffee prices are the same for everyone and can also be highly correlated with other commodity price series (such as oil prices), one may be concerned that unobserved macroeconomic trends could affect both coffee prices and mental well-being of farmers. We mitigate such concerns by using provinces outside the Central Highlands as the control group. We use the VARHS panel data to estimate the following household fixed effects model:

$$Y_{ict} = \beta_0 + \beta_1 Coffee\ PriceVolatility_t * CH + \beta_2 Coffee\ Price_t * CH + \sum_{l=3}^{K} \beta_l X_{it} + \phi_t + \eta_i + \nu_{ict} \quad (1)$$

where, Y_{ict} is the outcome of the primary respondent in household i, residing in commune c at time t. In the main results the outcome will be mental health as measured by the individual's total score on the CESD-10 scale, and a dummy variable that takes value 1 if the individual's score is 10 and above, indicating presence of significant depressive symptoms. CH is an indicator for the Central Highlands and $Coffee\ Price\ Volatility_t$ is measured by the standard deviation of the international coffee price in the 24 months preceding the survey (varies by month and year). The intuition of the identification strategy is that while the international coffee price is the same for everyone in a given month-year, after controlling for macroeconomic conditions, it affects households living in the coffee producing region (the Central Highlands) more relative to those who live outside. We focus on variation in regional exposure as coffee is almost exclusively produced in the Central Highlands of Vietnam and most of the households either grow coffee or are involved in other aspects of the value chain of coffee as discussed earlier in the background section. Thus the coefficient of interest β_1, captures the effect of temporal variation in the price of coffee for a household residing in the Central Highlands (CH) relative to households outside CH. Note that β_1 measures the intent to treat effects (ITT) on rural households residing in the Central Highlands (coffee and non-coffee growers) and includes any spillovers within the coffee growing areas (e.g., through the local labor markets or the coffee production supply chain).[10]

The vector X_{it} includes respondent characteristics (gender, age, age squared, marital status, primary school completion dummy), and time-varying indicator variables to control for household exposure to the following shocks in the preceding two years: natural disasters

(floods, droughts, etc.), pest attacks, and health shocks (death of a household member or illness). In addition to the dispersion in the coffee prices, the level of coffee price could also affect mental health. To account for this possibility, we also include $Coffee\ Price_t$, defined as the mean international coffee price in the two years preceding the survey, interacted with the Central Highlands indicator. All household-specific time-invariant characteristics are captured by the household fixed effect, η_i. We also control for any other unobserved country-wide macroeconomic conditions at the time of the surveys using month-by-year fixed effects (ϕ_t). They also control for seasonality. Lastly, ν_{ict} is an idiosyncratic error term. Following Abadie et al. (2023), we cluster the standard errors at the level of the commune to account for the cluster sampling process of the VARHS (random sampling of communes within provinces, followed by random sampling of households within the communes).[11]

We also test the validity of our study design (i.e., farmers are unable to adjust coffee production to short-run price movements), by estimating the following for the sub-sample of coffee growing households:

$$Y_{icmy} = \delta_0 + \delta_1 Coffee\ PriceVolatility_{my} + \delta_2 Coffee\ Price_{my} + \sum_{l=3}^{K} \delta_l X_{imy} + \alpha_m + \gamma_y + \eta_i + \nu_{ict} \tag{2}$$

where, Y_{icmy} are outcomes related to coffee production of household i, residing in commune c at month m and year y. In addition to the vector of controls (X_{imy}) discussed above, we separately control for survey month and survey year fixed effects (α_m and γ_y, respectively).

Identification assumptions

Before proceeding to the results, we discuss the validity of our study design. First, for international robusta coffee prices to matter, they must sufficiently transmit down to the farmgate prices received by farmers. We assess this assumption by comparing the international robusta coffee prices to the average monthly farmgate coffee prices observed in Dak Lak province in the Central Highlands during 2016-2022.[12] We find the monthly international coffee price to be highly correlated with the monthly farmgate price in Dak Lak (pairwise correlation coefficient = 0.93). Next, we test the transmission mechanism by regressing log of the farmgate price on log international prices and month and year fixed effects. Results presented in Table A2 of the online appendix show that a 10 percent increase in international prices translates into a significant increase of 7.1 percent in farmgate prices in Dak Lak province.

Next, we test the assumption that coffee farmers are uniquely exposed to volatility in the international coffee markets due to their inability to significantly alter production decisions (at least in the short-run). We limit the VARHS sample to all households that report harvesting coffee at least once in the three-year panel and estimate equation 2 for the following measures of production: (i) amount of coffee produced (tons); (ii) area under coffee cultivation (hectares); (iii) share of coffee in total area cultivated; and (iv) value of inputs used in the production of all crops.[13] As results presented in columns 1-4 of Table A3 in the online appendix show, the scale of coffee production is unresponsive to coffee price volatility, underpinning our assumption that coffee cultivation is a long-term investment.

We also examine the possibility that farmers could adjust the timing of sales in an effort to smoothen the revenue received from coffee. In column 5 the outcome variable is an indicator that takes the value of 1 if the household sold coffee that year, and 0 otherwise. In column 6, the outcome variable is the change in the amount of stored coffee from the preceding year. Once again, we do not find these variables to be affected by coffee price volatility.

Taken together, these results suggest that coffee farmers have limited ability to adjust coffee production at both the intensive (input use) and extensive (production scale) margins in response to short-run price movements. They also have limited capacity to hold onto output in periods of price uncertainty.

The study design could be undermined if farmers can anticipate future prices based on past price fluctuations. While there often are swings in coffee prices (see Figure 1), we believe it is unlikely that smallholder farmers in rural Vietnam can anticipate changes in future international prices that are determined by international supply and demand factors (Deaton, 1999; Bazzi and Blattman, 2014) and forecasting of commodity prices is difficult (Ghoshray, 2011). Furthermore, results from the Phillips-Perron test indicate that the coffee price time series is non-stationary, making predictions based on this difficult.

Lastly, self-reported mental health measures can be a cause for concern as respondents may understate mental health issues due to social stigma against mental health or if they do not wish to be viewed in a negative light by the enumerator (social desirability bias). If this measurement error is random, then it will only reduce the precision of the estimates, without biasing the results. However, systematic bias in responses can occur if, for example, richer households care more about their social image and do not want to be perceived as depressed/unhappy (e.g., Reisinger, 2022). A recent study on the impacts of cash transfers tests this by randomly telling some respondents that a lower/higher self-report of depression was expected from them. This did not affect responses, indicating social desirability bias may not be a substantial issue in developing country settings (Haushofer et al., 2020). We also include a wide range of individual and household-level controls along with household fixed effects to capture sources of reporting bias.

Results

Main Results

Table 2 shows our key results using equation 1. The dependent variable in column 1 is the CES-D index. We find that an increase in coffee price volatility reduces mental health in CH relative to households residing outside the CH. The point estimates show that an increase of one standard deviation of 1,000 VND prices increases the CES-D score by 0.9 units; given the control mean of 7.3, this translates into a 12.3 percent increase in depressive symptoms of individuals in CH relative to individuals residing outside the CH. To put the effect size into perspective, we note that 1 SD of coffee price is approximately 5,800 VND. In the VARHS sample of coffee producers the average production of coffee is 3,132 kg (Table A3, col 1), so assuming no additional costs, an increase in 1 SD of coffee price translates into 18.1 million VND or 11 percent of the household income of coffee cultivating households, which reflects a substantial risk to the household. The outcome variable in column 2 is an indicator variable for the presence of significant depressive symptoms. While statistically insignificant, the sign of the coefficient is consistent with our hypothesis and with the estimates of the impact on the CES-D index noted in column 1.

[Table 2 about here]

Results in columns 3 and 4 show that these results are robust to the addition of control variables. Column 3 shows that a one standard deviation increase in international coffee prices is associated with a 1.127 unit increase in the CES-D index (15 percent of the control mean). Results in the second row show that the mean level of international coffee prices does not affect mental health. We also find that females have lower mental health relative to males. This is supported by global evidence on the female mental health penalty (WHO, 2017) and other studies in Vietnam (Giang et al. 2010; Sharma et al. 2021).

Robustness

The results in Table 2 are also robust to a number of sensitivity checks. First, we check the robustness of the results to alternative definitions of coffee growing regions in Table A4 of the online appendix: (i) we construct a district-level dummy variable that takes value 1 if the district reported coffee cultivation in 2020, and 0 otherwise;[14] (ii) we use the Global Agro-Ecological Zones version 4 (GAEZv4) database that estimates the suitability of land for various crops to compute the mean coffee suitability index for every district, and then proxy the potential exposure of a district to coffee price variability by constructing an indicator variable that takes the value 1 if the mean district suitability index for coffee is either "high" or "very high".[15] We find that the results are robust to these alternative specifications.

Second, we show that the results are robust to using several alternative measures of volatility in Table A5 of the online appendix as follows. (i) In columns 1-2 of Panel A we compute volatility as the standard deviation of the logarithm of prices (1,000 VND) in the 24 months preceding the survey; (ii) in columns 3 and 4 of Panel A we use the coefficient of variation; and (iii) in columns 5 and 6 we use the interquartile range. We then, (iv) allay any concerns that realized coffee prices in the recent harvest months may be biasing the results, by recomputing coffee price volatility as the standard deviation of international coffee prices in the 24 months preceding the survey excluding the harvest months of October-December (Columns 1 and 2 of Panel B).[16] For all these alternative measures we find that an increase in volatility in international coffee prices is significantly related to worse mental health.

Next, (v) we conducted a placebo analysis using volatility in palm and crude oil prices (two commodities produced only at small scale in Vietnam), to test whether we are picking up the effects of international coffee price volatility or a more general effect of volatility in commodity markets. For both palm oil and crude oil, we do not find volatility in these commodity markets to be associated with mental wellbeing (columns 3-6 of Panel B).[17]

In Panel C of Table A5, (vi) we report the results from using smaller time windows to calculate coffee price volatility. Instead of calculating volatility over the 24 months preceding the survey (the time between VARHS rounds), we iteratively reduce the time span to 22 months, 20 months, and 18 months. We find that while the results hold for price volatility over 22 months preceding the survey, the coefficient loses statistical significance upon reducing the window further.[18]

Third, in Table A7 of the online appendix, we undertake a series of robustness checks to confirm that recently realized coffee price shocks are not driving the effects of coffee price volatility. While the preferred specification reported in columns 3-4 of Table 2 controls for the average price of coffee in the two years preceding the survey, one may be concerned that coffee prices observed in the 12 months preceding the survey (including the most recent harvest season) matter more for the mental health of the farmer. We find that the results are robust to controlling for the average coffee price during the last 12 months leading up to the survey (columns 1-2 of Panel A).

Alternatively, it may be the case that rather than the average coffee price, farmers are affected by large price movements (shocks). We test this by constructing the following indicators of price shocks: (i) we use data on coffee prices over 2004-2020 to calculate the deviation of average monthly coffee prices in the year preceding the survey from the historical mean (normalized using the historical standard deviation of coffee prices); and (ii) we generate a dummy variable that takes value 1 for every month where the coffee price faced by the farmer falls below 1 SD of the historical mean, and then calculate the proportion this occurs during the 12 months preceding the survey. Controlling for these measures of price shocks does not change the results (columns 3-6 of Panel A, Table A7).

Further, in the context of coffee price shocks, it maybe the case that farmers are more concerned about price shocks during the harvest months of October-December rather than

other times in the year. We test this by constructing the following three separate indicators of price shocks during the harvest months: (i) we compute the average coffee prices faced by farmers during the harvest months in the year preceding the survey; (ii) we compute the (normalized) deviation of the coffee prices during the harvest months in the year preceding the survey from the historic mean of coffee prices during harvest months; and (iii) we generate a dummy variable that takes value 1 for the months where the coffee prices experienced during harvest months in the preceding year fall below 1 SD of the historic mean of coffee prices during harvest months. We then calculate the proportion this occurs during the 12 months preceding the survey. Results reported in columns 1-6 of Panel B, Table A7 show that the effects of volatility continue to hold, demonstrating that price shocks are not driving the results.

Fourth, we also conducted several analyses to examine if the results are sensitive to alternative formulations of the CES-D index. In particular, cardinal treatment of an ordinal dependent variable (such as the CES-D index) in a linear regression can lead to biased conclusions if the empirical findings are not robust to monotonic increasing transformations of the dependent variable (Schröder and Yitzhaki, 2017). Therefore, we examine the robustness of the results to (i) a wide range of smooth convex and concave monotonic transformations of the CES-D index recommended in Bloem (2022); and (ii) using the inverse hyperbolic sine transformation of the CES-D index. The results continue to hold for all these transformations, suggesting that cardinal treatment of the CES-D index may not be biasing the results (Figure A4 and Table A8, in the online appendix). Table A8 shows that the result is also robust to a principal component analysis of the CES-D questions, where we retain the first component and use the standardized value of this component as the dependent variable.

Fifth, we check whether the results are affected by attrition. Across 2016-2020, the VARHS

sample experienced a 3 percent attrition. While this is small, it may bias the results if attrition is driven by volatility in the international coffee markets. For example, if households with greater depressive symptoms were more likely to drop out of the VARHS when faced with increasing coffee price volatility, then we may be underestimating the true relationship between coffee price volatility and mental health. We investigated the extent of this bias in the following way: (i) we check if coffee price volatility drives attrition by regressing a dummy variable that takes value 1 if the household is missing in the next survey round (i.e., at $t+1$) on all the right hand side variables in equation 1. We find that coffee price volatility does not significantly affect the probability of attrition from the VARHS sample (column 1 of Table A9 of the online appendix); and (ii) we re-estimate the results using the unbalanced panel. Results reported in columns 2 and 3 of Table A9 of the online appendix are similar to those in Table 2. Taken together, these checks suggest that our results are not biased due to attrition.

Sixth, we check whether some unobserved factors are driving the results. In addition to the vector of controls mentioned in Equation 1, we control for a host of other time-varying variables that can matter for mental health: household size, land owned, real value of livestock owned, real yearly household income, asset index, and respondent's risk aversion.[19] While these are potentially 'bad controls', comparing results with and without these variables can allay concerns that other factors are driving the results. Results reported in Table A10 of the online appendix show that the effects of coffee price volatility are qualitatively similar to those reported in columns 3-4 of Table 2.

Relatedly, differences in current mental well-being could be due to unobserved unequal access to health care. We check if this is the case by using distance of the household to the nearest hospital (in Km) as an outcome variable. Results indicate that unequal access to health care does not explain our findings (column 1 of Table A11 of the online appendix). One

may also be concerned that using the 2020 VARHS survey contaminates the results due to the COVID-19 pandemic. However, it is important to highlight that Vietnam had a tight control over the spread of COVID-19 during 2020. By the end of 2020, Vietnam had only experienced 1,465 cases and zero deaths. Nonetheless, the month-year fixed effects should account for any time varying effects of COVID-19 (e.g., announcement of successful vaccine trials) on mental health. We also drop all communes that detected COVID-19 or were placed under a lockdown before the VARHS 2020 and find that the results are robust to this change (column 2 and 3 of A11 of the online appendix).

Additional Analysis

This sub-section explores the implications of our main results further. First, we investigate whether the results vary by the characteristics of the respondent and the household. Second, we examine additional effects on related health and other well-being indicators. Third, we assess various mitigation strategies undertaken by households.

[Table 3 about here]

Heterogeneity in Response by Household Characteristics: In Table 3, we begin by exploring the degree to which the effect of international coffee prices on mental health varies by gender of the respondent or ethnicity of the household. Columns 1 and 2 show heterogeneity with respect to gender of respondent. We find that mental health of females is less sensitive to volatility in coffee prices. This result implies that while on average females have poorer mental health than males (Table 2), a marginal increase in income uncertainty has a larger negative effect on the mental health of males. This in line with previous findings such as those of Kopasker et al. (2018) who, using the British Household Panel Survey, find employment-related uncertainty to adversely affect mental health of males but not females. A potential explanation is that in the Vietnamese context, where patriarchal norms are strong, males

are more likely to view themselves as the "pillar of the family" - being the breadwinner and responsible for the well-being of the household members (Hoang and Yeoh, 2011), and the assumed responsibilities of this role drive the observed larger effects on males.[20]

Columns 3 and 4 show how the effects vary with respect to the ethnicity of the household. We find that mental health of Kinh (ethnic majority) households is more sensitive to volatility in coffee prices. The mechanisms underlying this result are not immediately clear, however it is possible that relative economic wellbeing plays a role. The Kinh consistently enjoy relatively higher income than the ethnic minorities (Singhal and Beck, 2017), and therefore, the risk of a diminished social status may adversely affect their mental health (Ridley et al. 2021).

[Table 4 about here]

Effects on other related outcomes: Next, we check if exposure to coffee price volatility also affects adult health in a number of other dimensions.[21] Respondents were asked how often in the 30 days preceding the survey, they (i) had difficulty sleeping, (ii) did not feel like eating, (iii) had bodily aches and pains, and (iv) had difficulty remembering things (in the context of regular day-to-day activities). The responses are coded on a scale of 1 to 4 (none of the time, some of the time, most of the time, and all the time) such that a higher number indicates worse health outcomes. We reestimate equation 1, considering these new outcomes in columns 1-4 of Table 4. We find that while there is no effect on difficulties in sleeping and appetite, an increase in coffee price volatility significantly increases experiences of bodily aches and pains, and difficulties in remembering things. These results are in line with existing literature that finds economic insecurity to be associated with reduced pain tolerance and greater experience of physical pain (Chou et al., 2016) and impaired cognitive functioning (Mani et al., 2013).

To assess overall health, the survey also asked the question: "In general, how is your health?",

with respondents choosing their answers from four categories - very healthy, somewhat healthy, somewhat unhealthy, and very unhealthy. The responses are again coded on a scale of 1 to 4 such that a higher number indicates worse health. Results using this general health indicator variable are shown in column 5 of Table 4 and indicate that coffee price volatility increases self-reported ill-health.

Lastly, the VARHS also measures subjective happiness by asking respondents about their overall level of happiness on a 4 point Likert scale (very unhappy, unhappy, happy, very happy), where a higher score indicates more happiness.[22] Results using this variable are shown in column 6, and indicate that coffee price volatility significantly reduces self-reported happiness. Taken together, these results provide some evidence of a more general adverse effect of coffee price volatility on adult health and wellbeing.

Before moving on, we comment on the time costs associated with the effects of coffee price volatility on mental health. In the survey, the respondents also reported how many days of the week they were unable to perform their usual activities (work, study, chores, etc.) due to depressive symptoms discussed in Table 2. Using this as a measure of the burden of disease in column 7 of Table 4, we find that a one standard deviation increase in international coffee prices is associated on average with a loss of 0.63 days in a week. Back of the envelope calculations suggest that, as the average daily wage for common activities such as harvesting, plowing, construction, seeding, household chores, etc. is 188,000 VND during this period in the VARHS communes, this approximates a loss of 474,000 VND per month (or 4.4 percent of the average annual household income). While substantial, this is less than the 36 percent loss of earnings for individuals affected by depression in Denmark (Biasi et al., 2021).[23]

Coping mechanisms: When faced with increasing volatility in international coffee prices, we have shown that coffee-growing households in Vietnam experience a deterioration in mental health and other health indicators. In Table 5 we investigate some of the coping mechanisms

that households could use to mitigate these effects.[24]

In column 1 of Table 5, we examine the effect of coffee price volatility on whether the household took a loan in the two years preceding the survey. Results suggest that a one standard deviation increase in coffee price volatility leads to an approximately 13 percentage points significant increase in the likelihood of taking a loan. This appears to be modest in magnitude, but given that an average household residing outside the central highlands has only a 23 percent likelihood of taking a loan, this corresponds to approximately a 56 percent increase over the baseline. Columns 2 and 3 show results separately for formal and informal loans. The results indicate that households are largely able to secure loans from formal institutions. In columns 4 and 5 we split the credit data into investment loans (i.e., loans for buying land or other assets, investment in farm and non-farm activities, etc.) and consumptions loans. Results indicate that when faced with increasing coffee price volatility, households are more likely to take consumption loans. Altogether, these results suggest that while credit markets are functioning, it is likely that household demand remains unmet.

In columns 6 and 7 we investigate whether coffee price volatility drives households to diversify income sources by sending a migrant (as found in the case of Ethiopia and Vietnam by Lee (2021) and Narciso (2020), respectively), or establishing a non-farm household enterprise. We do not find evidence for either of these in our context.[25]

Mechanisms

Our central hypothesis is that volatility in coffee prices increases uncertainty of future economic prospects. The underlying assumption - validated earlier - is that farmers have limited ability to adjust the scale of coffee production or smoothen revenue by holding onto output for better prices. Farmers could also *ex-ante* try to stabilise revenue by (i) insuring against price movements and (ii) insuring against crop loss. Signing pre-harvest contracts with

traders that specify the selling price has been found to be an effective method of protecting against adverse price movements. For example, in a recent study with 1,200 farmers in Madagascar, Bellemare et al. (2021) find participation in contract farming to be associated with lower income variability, due to the transfer of price risk from growers to processors. However, we find participation in contract farming is very uncommon among coffee farmers in Vietnam: in our VARHS sample none of the coffee farmers report signing a pre-harvest contract with traders in 2016, and only nine households did so in 2020. Furthermore, of the nine households that had a pre-harvest contract in 2020, only two had contracts that pre-specified the selling price.[26] While contract farming is uncommon, we find that farmers are more concerned about crop loss when coffee prices are uncertain. In the VARHS, farmers are asked if they would be willing to purchase insurance against crop damage/loss. In column 1 of Panel A, Table 6, we find that a one standard deviation increase in coffee price volatility leads to a 12 percentage points significant increase in the willingness to purchase crop insurance.

Altogether, the discussion above implies that volatility in coffee prices creates substantial economic uncertainty for coffee farmers, as they do not know what revenue they can expect at the time of harvest (assuming they have a reasonable expectation of output), generating stress and adversely affecting their mental health. We now empirically test the underlying pathways discussed in the conceptual framework.

First, given the previous result that coffee price volatility increases problems with remembering things (Table 4, col 4), we note that coffee price volatility possibly increases cognitive load. Second, we investigate the role of reduced self-control by examining the effects of coffee price volatility on alcohol and tobacco consumption. In the VARHS, the respondents are asked about daily consumption of wine and beer and whether they smoke. The results are reported in Panel A of Table 6. Column 2 shows that an increase in coffee price volatility sig-

nificantly increases the probability of consuming beer daily by 14.3 percentage points (or 35 percent of the sample mean). We do not find any significant effects on the daily consumption of wine or the likelihood of smoking (columns 3 and 4, respectively).[27]

Next, we check whether coffee price volatility leads to pessimistic expectations of future economic outcomes. In the VARHS respondents were asked to report what quantile their household falls into based on the income distribution in their commune at the time of the survey. Following this, they are asked what position they would like their household to be at after two years. The difference between these two responses can be viewed as the expectation of the household's income mobility over the next two years, which we call "aspired income mobility". We report the effects on this variable in column 5 of Panel A, Table 6. Results show that an increase in coffee price volatility significantly reduces aspired income mobility.

Fourth, we examine the role of reduced social participation and social trust in depth in Panel B of Table 6. The first three columns examine the effects of coffee price volatility on the household's participation in festivals, weddings and funerals in the community. We find that the likelihood of participating in at least one festival and a funeral in the commune in the last 12 months preceding the survey falls significantly with an increase in coffee price volatility (columns 1 and 3).[28] The next two columns examine the role of social capital. The VARHS measures interpersonal trust by asking respondents about their agreement with the statement that "most people are basically honest and can be trusted" on a 4 point Likert scale (strongly disagree, disagree, agree, strongly agree), where higher values indicate higher trust in others. Results reported in column 4 show that an increase in coffee price volatility significantly reduces interpersonal trust. The VARHS respondents are also asked to state how many people they could turn to for help if they needed money in an emergency.[29] Using this as the outcome variable in the last column, we find that an increase in coffee price

volatility is associated with a significant reduction in the number of people who could help in case of a financial emergency.

Fifth, fluctuations in international coffee prices could result in a lower internal locus of control. We measure locus of control based on responses to four statements ('I feel hopeless in dealing with problems in life?; 'what happens to me in the future mostly depends on me?; 'I have little control over things that happen to me?; 'there is little I can do to change many of the important things in my life'). Responses were coded on a 1-4 Likert scale, where a higher score indicates more internal locus of control, i.e., the respondents believe that events in their life are more under their control. We construct an index by summing up the responses to these four statements. Results in column 1 of Table A14 of the online appendix show that an increase in coffee price volatility is associated with a decline in locus of control, although this is marginally insignificant ($p - value = 0.105$). The results for each statement are shown separately in Columns 2-5; all coefficients are negative but not statistically significant.

Lastly as discussed in the conceptual framework, it could be the case that coffee price volatility and the associated financial worries, reduce utility from consumption thereby contributing to mental distress. We do not, however, have data to examine the importance of this pathway.

Conclusion

Socio-economic burdens associated with mental health disorders are of increasing public health concern in developing countries. In this study we examined whether an increase in income uncertainty can lead to depressive symptoms. Combining household-level panel data on coffee growing households in Vietnam over the period 2016-2020 with international coffee price data, we find that an increase in coffee price volatility has substantial negative effects

on mental health. These findings stand up to a number of robustness tests.

These results contribute to the emerging literature on the causal effects of poverty on mental well-being. Specifically, these results highlight that in addition to the effects of poverty on mental health, the vulnerability to poverty (income uncertainty) can also have a detrimental effect on psychological well-being. Looking at the mechanisms behind this main result we find that price volatility leads to greater mental stress through a complex set of intersecting channels. They include pessimistic expectations of future economic well-being, increased cognitive load and alcohol consumption, and reduced social capital. We also find psychological reaction to perceived future economic distress to be stronger among males (those more likely to assume responsibilities of being the breadwinner of the family) and those belonging to the ethnic majority group (at greater risk of losing a relatively higher socioeconomic status). These findings are relevant in light of the ongoing 'cost-of-living' crisis where worries about future economic prospects could translate into poor mental health and add to the public health burden. Future work could investigate whether these adverse mental health effects persist in the long-term, with associated socio-economic consequences.

The findings of this study also add to our understanding of how global agricultural markets play a role in determining mental health of populations in low and middle income countries. While the shift from subsistence to cash crops can bring substantial income gains, it also leaves small farmer households vulnerable to vagaries of the international commodity markets. From a public policy perspective there is need for social safety nets that protect small farmers from price volatility. Some developing countries have tried to stabilize prices via marketing boards that manipulate supply by building strategic buffer stocks and restricting exports, with little evidence of impact. Market based instruments for commodity price risk management - such as futures, forward contracts, price/revenue insurance - maybe more beneficial for small farmers but are generally unavailable in developing countries (Boyd &

Bellemare, 2020). Governments could explore opportunities to leverage such market instruments to stabilize farmer incomes by increasing access to and providing training on how to use these tools. Our results imply that cost-benefit analyses of such government policies should take into account the associated mental health benefits as well.

Notes

[1]We define volatility as the standard deviation in the international coffee price in the 2 years preceding the survey in the main analysis. The results are robust to alternative definitions as discussed in the robustness sub-section.

[2]See Ridley et al. (2021) and Haushofer & Fehr (2014) for a broader discussion on the two-way relationship between poverty and mental health.

[3]Similarly at the commune level, coffee is reported to be among the top 3 most important crops for the commune by 93 percent of the VARHS communes in the Central Highlands. This is true for less than 0.5 percent of the non-Central Highlands commune sample.

[4]Other related findings include an increase in food intake and obesity among Russian women due to economic insecurity (Staudigel 2016) and increase in fatal drug overdoses (so called 'deaths of despair') due to income and unemployment concerns stemming from trade liberalization in the US (Pierce and Schott 2020).

[5]A map of the VARHS provinces is presented in Figure A1 of the online appendix.

[6]There were a few exceptions to the survey months such as postponements due to inaccessibility of households under heavy rainfall/landslides; and local travel restrictions due to outbreak of infectious diseases like dengue etc. The distribution of the survey months over the years is presented in Figure A2 of the online appendix.

[7]The CES-D questions are shown in Table A1 in the online Appendix.

[8]The 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.

[9]There is no consensus in the literature on the measure of producer price risk (Boyd and Bellemare, 2020). We show later that the results are robust to using alternative measures of dispersion such as the coefficient of variation, interquartile range, and the standard deviation of the logarithm of prices.

[10]The level effect of residing in the Central Highlands does not appear in equation 1 as it is absorbed by the household fixed effects, η_i. Similarly, the level effects of coffee price volatility and the mean coffee price are absorbed by the month-year fixed effects (ϕ_t).

[11]There are 477 communes in the VARHS data.

[12] We thank the Ministry of Agriculture and Rural Development (MARD) for providing these data.

[13]Crop specific data on input use is not available in the VARHS.

[14]We thank the Ministry of Agriculture and Rural Development (MARD) of Vietnam for providing data on district-level coffee cultivation in 2020.

[15]The GAEZv4 database classifies the potential suitability of land for coffee production (and 52 other crops), combining the soil and terrain characteristics of land units with agro-climatic potential yields. The crop suitability index for every 9x9 Km grid cell ranges from 0 to 10,000 and scores over 8500 are classified as "very high", while those between 7000-8500 are considered "high" (Fischer et al., 2021).

[16]Relatedly, we note that some of the household surveys in 2020 were conducted in October, the start of the coffee harvest season (see Figure A2). To address any concerns that realised coffee prices may be driving the results, we show that dropping these data does not affect the results (Table A6 in the online appendix.)

[17]Data obtained from the World Bank Commodities database `https://www.worldbank.org/en/research/commodity-markets`.

[18]This is likely due to reduction in the variation of coffee prices as the time window becomes smaller.

[19]Risk preferences were elicited using hypothetical questions about lottery rewards where the respondent was asked to choose between a sure amount and a probability-based alternative. Our measure of risk aversion is a dummy indicating whether the respondent chose the most risk averse option throughout the risk preference module.

[20]A recent mixed method study on masculinity in Vietnam found that Vietnamese men viewed providing

for the family and having a well-paid job to be an important symbol of masculinity. Consequently, over a quarter of the study sample admitted feeling the pressure of living up to masculinity ideals, overwhelmingly driven by concerns over financial status (ISDS, 2020).

[21]The underlying mechanisms are explored later in greater length in the mechanisms section.

[22]The question asked is "Taken all things together how would you say things are these days - would you say you were very happy, pretty happy, or not too happy?"

[23]474,000 VND is approximately equal to 20.2 USD at the current exchange rate of 1 USD = 23,500 VND.

[24]The results are robust to controlling for price shocks during the harvest months in the preceding year (coffee price less than 1SD of historical harvest month prices) as shown in Table A12 of the online appendix.

[25]Our result may differ from that of Narciso (2020) either because Narciso (2020) considers individual level migration decisions or due to different time periods.

[26]Field reports suggest this is due to both limited availability and understanding of such contracts.

[27]The results are similar when controlling for price shocks during the harvest months in the preceding year (coffee price less than 1SD of historical harvest month prices) as shown in Table A13 of the online appendix.

[28]Since we do not know the exact month in the past 12 months when the household participated in these social events, it is possible that the price volatility variable captures some volatility after the event occurred. However, this concern is not relevant for the other measures of social capital.

[29]This question was only asked in the 2016 and 2018 rounds and we are unable to conduct further robustness checks with this measure in Table A13.

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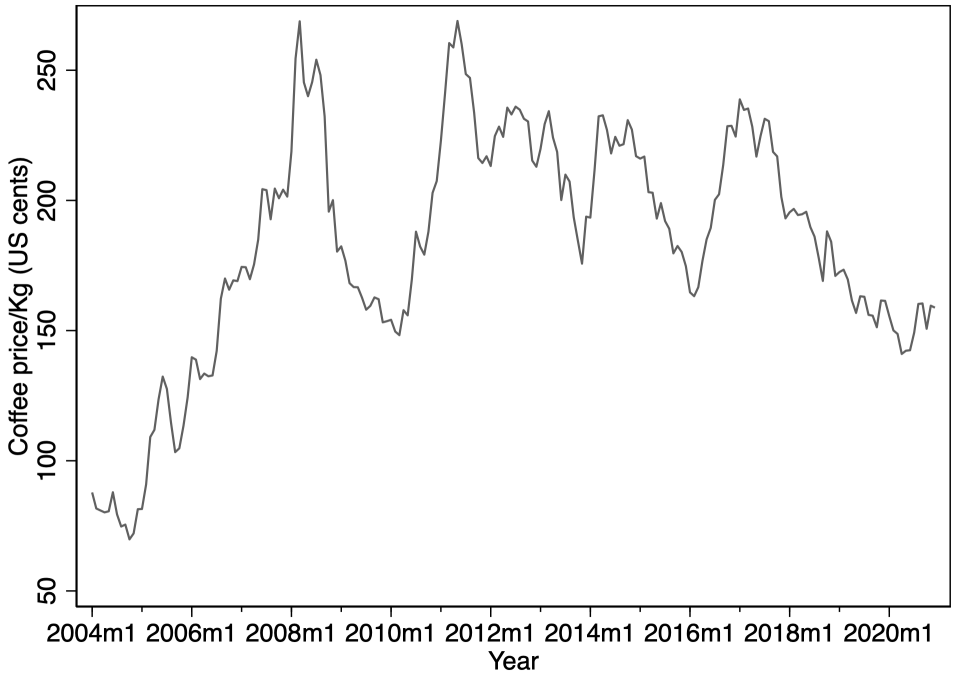
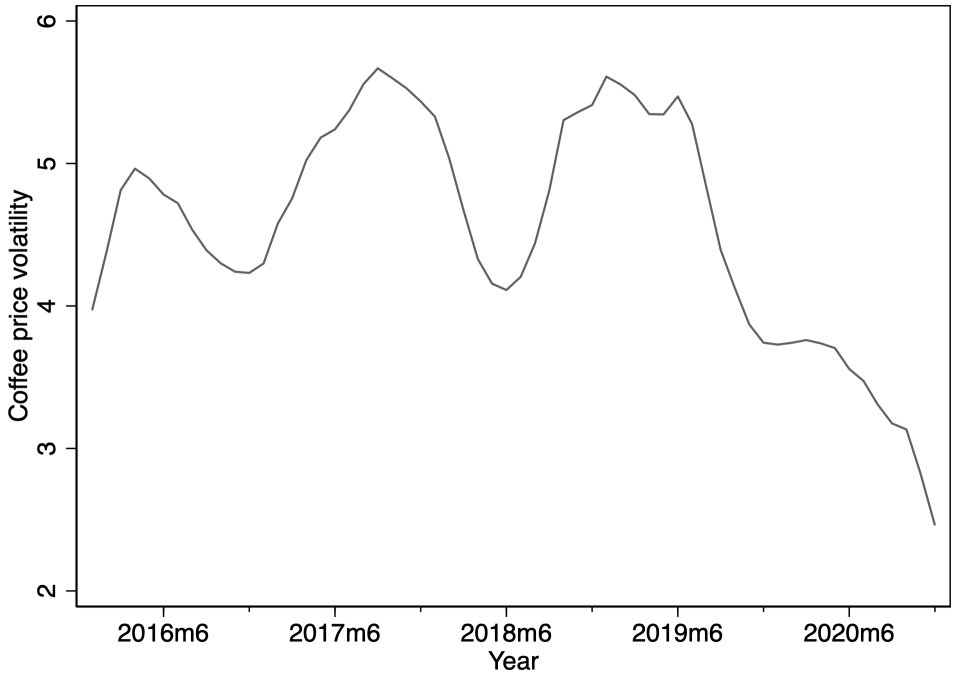
Figures and Tables

Figure 1: International Robusta Coffee Prices



Notes: The international robusta coffee price is shown in US$/kg for the period 2004-2020. This is based on data from the International Coffee Organization.

Figure 2: International Robusta Coffee Price Volatility



Notes: This figure shows the monthly coffee price volatility (measured as the standard deviation of '000 VND prices in the preceding 2 years) for the period 2016-2020.

Table 1: Summary statistics

	Full Sample (1)	Central Highlands (2)	Outside Central Highlands (3)	Difference: (3)-(2) (4)
Panel A: Mental health outcomes				
CESD-10 index	7.28	7.31	7.27	-0.03
	(4.44)	(4.31)	(4.46)	
Severe depressive symptoms	0.28	0.33	0.27	-0.06***
	(0.45)	(0.47)	(0.44)	
Panel B: Control variables				
Real Coffee price/kg (1000 VND)		40.89		
		(5.79)		
Coffee price volatility		4.03		
		(0.64)		
Female	0.41	0.38	0.42	0.04**
	(0.49)	(0.48)	(0.49)	
Age	54.05	50.38	54.63	4.25***
	(14.12)	(12.46)	(14.28)	
Primary school education	0.71	0.70	0.71	0.01
	(0.46)	(0.46)	(0.45)	
Married	0.78	0.81	0.78	-0.03**
	(0.41)	(0.39)	(0.41)	
Natural shock	0.09	0.16	0.08	-0.09***
	(0.29)	(0.37)	(0.27)	
Health shock	0.06	0.04	0.06	0.02***
	(0.24)	(0.20)	(0.24)	
Pest attack	0.08	0.05	0.09	0.04***
	(0.27)	(0.21)	(0.28)	
Observations	7743	1065	6678	7743

Notes: The maximum possible score on CES-D index is 30. Severe depressive symptoms is an indicator for CES-D index $\geq$10. * significant at 10%,** significant at 5%,*** significant at 1%

Table 2: Commodity price volatility and mental health

	CES-D Index	Severe Depressive Symptoms	CES-D Index	Severe Depressive Symptoms
	(1)	(2)	(3)	(4)
Coffee price volatility*CH	0.904**	0.047	1.127**	0.078
	(0.387)	(0.039)	(0.509)	(0.057)
Coffee price*CH			-0.016	-0.003
			(0.056)	(0.005)
Female			0.363**	0.033**
			(0.144)	(0.015)
Age			0.023	-0.002
			(0.042)	(0.004)
Age squared			0.000	0.000
			(0.000)	(0.000)
Primary school education			0.141	0.004
			(0.189)	(0.020)
Married			-0.680**	-0.038
			(0.326)	(0.032)
Natural shock			0.136	0.030
			(0.250)	(0.024)
Health shock			1.722***	0.115***
			(0.282)	(0.028)
Pest attack			-0.174	-0.024
			(0.213)	(0.022)
Household Fixed Effects	Yes	Yes	Yes	Yes
Month-Year Fixed Effects	Yes	Yes	Yes	Yes
Mean of control dep. var.	7.27	0.27	7.27	0.27
N	7743	7743	7743	7743

Notes: Severe depressive symptoms is an indicator for CES-D index $\geq$10. CH is a dummy variable for the Central Highlands. Standard errors clustered at the commune level are reported in parentheses. * significant at 10%,** significant at 5%,*** significant at 1%.

Table 3: Commodity price volatility and mental health

	CES-D Index	Severe Depressive Symptoms	CES-D Index	Severe Depressive Symptoms
	(1)	(2)	(3)	(4)
Coffee price volatility*CH	1.154**	0.079	1.406**	0.096
	(0.512)	(0.058)	(0.550)	(0.060)
Female*volatility*CH	-0.165*	-0.008		
	(0.093)	(0.010)		
Minority*volatility*CH			-1.196*	-0.124
			(0.710)	(0.076)
Household controls	Yes	Yes	Yes	Yes
Household Fixed Effects	Yes	Yes	Yes	Yes
Month-Year Fixed Effects	Yes	Yes	Yes	Yes
N	7743	7743	7743	7743

Notes: Severe depressive symptoms is an indicator for CES-D index $\geq$10. CH is a dummy variable for the Central Highlands. Controls include respondent's age, age squared, gender, primary school completion, marital status, and household exposure to pests, natural disasters, and illness/death shocks. All regressions also include an interaction between the Central Highlands dummy and the average coffee price in the 24 months preceding the survey. Standard errors clustered at the commune level are reported in parentheses. * significant at 10%,** significant at 5%,*** significant at 1%.

Table 4: Commodity price volatility and general health

	In the last 30 days had problems with...				Poor Health	Happiness	Days Lost: depressive symptoms
	Sleeping	Eating	Body aches	Memory			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Coffee price volatility*CH	-0.014	0.044	0.146*	0.217**	0.171**	-0.241***	0.634***
	(0.082)	(0.082)	(0.087)	(0.108)	(0.068)	(0.069)	(0.217)
Household controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Household Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month-Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean of control dep. var.	1.79	1.61	1.76	1.65	2.15	1.83	1.37
N	7738	7741	7741	7741	7740	7742	7743

Notes: CH is a dummy variable for the Central Highlands. Controls include respondent's age, age squared, gender, primary school completion, marital status, and household exposure to pests, natural disasters, and illness/death shocks. All regressions also include an interaction between the Central Highlands dummy and the average coffee price in the 24 months preceding the survey. Standard errors clustered at the commune level are reported in parentheses. * significant at 10%,** significant at 5%,*** significant at 1%.

Table 5: Commodity price volatility and mitigation strategies

	Took a loan	Source of credit		Purpose of credit		Migration	Household Enterprise
		Formal	Informal	Investment	Consumption		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Coffee price volatility*CH	0.134***	0.131**	0.047	0.067	0.067*	0.011	-0.029
	(0.051)	(0.052)	(0.032)	(0.042)	(0.038)	(0.038)	(0.028)
Household controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Household Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month-Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean of control dep. var.	0.23	0.18	0.06	0.13	0.10	0.16	0.25
N	7743	7743	7743	7743	7743	7743	7743

Notes: CH is a dummy variable for the Central Highlands. *Migration* (col 6) is a dummy variable that takes value 1 if the household has at least 1 migrant, and 0 otherwise. *Household Enterprise* (col 7) is a dummy variable that takes value 1 if the household operates at least 1 household enterprise, and 0 otherwise. Controls include respondent's age, age squared, gender, primary school completion, marital status, and household exposure to pests, natural disasters, and illness/death shocks. All regressions also include an interaction between the Central Highlands dummy and the average coffee price in the 24 months preceding the survey. Standard errors clustered at the commune level are reported in parentheses. * significant at 10%,** significant at 5%,*** significant at 1%.

Table 6: Mechanisms: Commodity price volatility and behavior

Panel A	Willing to buy insurance	Daily consumption of....		Smoking	Aspired income mobility
		Beer	Wine		
	(1)	(2)	(3)	(4)	(5)
Coffee price volatility*CH	0.122**	0.143**	-0.101	0.061	-0.523***
	(0.059)	(0.067)	(0.064)	(0.054)	(0.149)
Mean of control dep. var.	0.14	0.41	0.53	0.47	1.15
N	7743	7743	7743	7743	7295

Panel B	Household participated in....			Interpersonal Trust	Number of people who can help
	Festival	Wedding	Funeral		
	(1)	(2)	(3)	(4)	(5)
Coffee price volatility*CH	-0.115**	-0.004	-0.128***	-0.266**	-13.932*
	(0.047)	(0.007)	(0.030)	(0.108)	(8.039)
Mean of control dep. var.	0.12	0.98	0.97	2.99	4.26
N	7743	7743	7743	7741	4992
Household controls	Yes	Yes	Yes	Yes	Yes
Household Fixed Effects	Yes	Yes	Yes	Yes	Yes
Month-Year Fixed Effects	Yes	Yes	Yes	Yes	Yes

Notes: CH is a dummy variable for the Central Highlands. Controls include respondent's age, age squared, gender, primary school completion, marital status, and household exposure to pests, natural disasters, and illness/death shocks. All regressions also include an interaction between the Central Highlands dummy and the average coffee price in the 24 months preceding the survey. The number of people who can help in case of a monetary emergency (Panel B, col. 5) was only measured in VARHS 2016-2018. Standard errors clustered at the commune level are reported in parentheses. * significant at 10%,** significant at 5%,*** significant at 1%.