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**EARLY LIFE CIRCUMSTANCE AND ADULT MENTAL
HEALTH**

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Early Life Circumstance and Adult Mental Health*

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Abstract

We show that psychological well-being in adulthood varies substantially with circumstance in early life. Combining a time series of real producer prices of cocoa with a nationally representative household survey in Ghana, we find that a one standard deviation rise in the cocoa price in early life decreases the likelihood of severe mental distress in adulthood by 3 percentage points (or half the mean prevalence) for cohorts born in cocoa-producing regions relative to those born in other regions. Impacts on related personality traits are consistent with this result. Maternal nutrition, reinforcing childhood investments, and adult circumstance are operative channels of impact.

Keywords: mental health, subjective well-being, early life, fetal origins, endowments, commodity prices

JEL Classification Codes: I12, I15, I31, Q02, O12

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1 Introduction

Mental health disorders account for 13 percent of the overall global disease burden (Collins et al., 2011). The economic losses due to these disorders in low-income countries are staggeringly large: for example, depression is estimated to generate losses of 55.5 million disability-adjusted life years (DALYs) in low- and middle-income countries, compared to 10 million DALYs in high-income countries (Mathers et al., 2008).¹ Despite these costs, both in terms of health and economic development, investment in prevention and treatment remains relatively low (Collins et al., 2011).

It is crucial, then, given the burden of mental health disorders in low-income countries, to gain a better understanding of their origins. Though there has been progress on documenting the determinants of psychological well-being (and relatedly, satisfaction and happiness), open questions still linger (Easterlin, 1974; Stevenson and Wolfers, 2008). Much of the recent work in this literature studies the complex relationship between income and subjective well-being (Haushofer and Shapiro, 2013; Kahneman and Deaton, 2010; Kahneman and Krueger, 2006; Sacks et al., 2012; Stevenson and Wolfers, 2013). A few studies have investigated contemporaneous effects of life choices such as family and career status or residential environment (Bertrand, 2013; Katz et al., 2001). Still, relatively little is known about long-run determinants of mental health.

In this study, we ask: how does circumstance in early life affect psychological distress in adulthood? We focus our attention on early life influences because of the growing evidence that shocks and interventions in the early period of life have large, lasting impacts on health and human capital formation (Almond and Currie, 2011; Heckman, 2006, 2007). We examine this relationship using a nationally representative household survey from Ghana. This includes a module comprising the Kessler Psychological Distress Scale (K10), an internationally validated measure of anxiety-depression spectrum mental distress (Andrews and Slade, 2001; Kessler et al., 2002). We exploit variation in early life conditions induced by changes in the real producer price of cocoa. Cocoa is Ghana's chief agricultural export commodity, and its price is a key determinant of household incomes in the regions where it is grown.²

We show that in cocoa-producing regions of Ghana, low cocoa prices at the time of birth substantially increase the incidence of severe mental distress, as classified by the Kessler Scale. A one standard deviation drop in the cocoa price increases the probability of severe mental distress by 3 percentage points, or nearly 50 percent of mean severe distress incidence,

¹In Ghana, where our study is based, Canavan et al. (2013) estimate that the productivity loss associated with mental illness is equivalent to 7 percent of the country's GDP.

²Poverty reduces nutritional availability *in utero*, as well as mothers' cognitive functioning, both of which affect fetal programming (Almond and Currie, 2011; Mani et al., 2013).

in cohorts born in cocoa-producing regions relative to those born in other regions of Ghana. Effects on related personality traits show remarkable consistency with the Kessler Scale results. The impact on mental health is robust to changes in specification, type of shock, and choice of aggregation of the K10 survey questions.

What drives the long-lasting impacts on mental health we find? Beyond the obvious direct physiological effects of nutritional availability in infancy, we examine several possible mechanisms. We look first to the most proximate outcome: maternal health. Using Demographic and Health Survey (DHS) data from Ghana, we show that cocoa prices positively predict (contemporaneous) maternal weight and BMI, which are highly correlated with birth weight and health in infancy (Gunnsteinsson et al., 2014). Additionally, we find that parents reinforce these increases in initial endowments by increasing vaccination rates and breastfeeding for longer.³ Next, we look at adult physical health and economic outcomes. We find mixed evidence here: health stock, as measured by adult height, significantly improves with higher cocoa prices at birth, but indicators of economic circumstance (savings and occupation type) are not significantly higher.

Finally, we check for selective mortality and fertility as possible explanations for the estimated mental health effects. We find evidence that both mortality and fertility responds to price shocks. In particular, better educated, non-agricultural women are the most likely to have births during high-price periods, and children born to self-employed farmers are less likely to die if born during cocoa booms. Given this evidence, we study the extent to which selective mortality and fertility might be driving our results on mental health outcomes. We control for maternal and paternal characteristics (educational attainment and occupation dummies) and find no change in the size of the estimated impacts on mental health. Moreover, we compute Altonji et al. (2005) implied ratios and find that selection on unobservables would have to be about 9 to 14 times as strong as selection on observable parental characteristics and 61 to 145 times as strong as selection on individual characteristics to generate our estimated effects completely. Last, we use a household fixed effects strategy to control for unobservable determinants of selection that vary at the (present-day) household level, and find that the effect on severe mental distress gets stronger when controlling for these effects.

Our study is closely related to the “fetal origins” literature in economics. Barker’s original hypothesis – that access to nutrition in early life has long-run effects on health and well-being – has been affirmed and extended by a large body of empirical evidence in economics.⁴

³This reinforcement behavior is consistent with recent results from both developed and developing countries (Adhvaryu and Nyshadham, 2013; Almond et al., 2009).

⁴Barker’s original contributions and the subsequent literature in economics are nicely reviewed in Almond and Currie (2011) and Currie and Vogl (2012).

These studies show that changes in fetal programming can affect a wide variety of outcomes, including physical health (Currie, 2009; Hoynes et al., 2012); IQ, educational performance and attainment (Aizer and Cunha, 2012; Bharadwaj et al., 2013; Bleakley, 2007); and labor market outcomes (Almond, 2006; Bhalotra and Venkataramani, 2012; Bleakley, 2010; Gould et al., 2011).

Though this literature has expanded in many directions, ours is to our knowledge the first “fetal origins” study in economics to focus on long-run impacts on mental health.⁵ Apart from being a key determinant of utility and an important endpoint in its own right (Daly et al., 2013; Kahneman and Deaton, 2010), mental health is also a potential mechanism through which some of the previously documented “fetal origins” impacts on human capital and earnings may arise (Kubzansky et al., 1997, 1998; Whang et al., 2009). Moreover, medical evidence suggests that some components of mental health are coded during fetal development (Shonkoff, 2011; Shonkoff et al., 2012). Changes to the fetal environment, if they alter or disrupt this coding process, may have long-lasting impacts on mental health (Buckles and Hungerman, 2013; Huttunen and Niskanen, 1978; Mednick et al., 1988; Neugebauer et al., 1999).

Our focus on psychological well-being is related to a growing literature on the determinants of personality and non-cognitive skill formation (Cunha et al., 2010; Heckman, 2007). Recent studies emphasize the importance of early investments in children for the formation of non-cognitive skills like motivation, perseverance, and dependability (Heckman, 2006). Indeed, these personality traits are linked to economic outcomes independent of traditional cognitive ability measures such as intelligence quotients (Heckman and Rubinstein, 2001; Heckman et al., 2006). We add to this work by demonstrating that early life conditions have large (causal) effects on psychological well-being and related personality traits. We also expand the body of evidence in this area by looking in a developing country setting; most previous studies use data from the United States.

As a growing segment of the fetal origins literature has already documented, early life trauma can have outsized impacts in low-income populations whose income smoothing and coping mechanisms are often limited. In particular, smallholder farm households in the developing world are exposed to a high degree of income uncertainty (Maccini and Yang, 2009; Townsend, 1994). The households we focus on (cocoa farmers), and millions like them, are commodity suppliers to the global market (Deaton, 1999). The wide and persistent price fluctuations that characterize these markets directly affect the livelihoods of smallholder

⁵Related to but distinct from this, Almond and Mazumder (2011) find large impacts on mental and learning disabilities of children in Uganda and Iraq whose gestation periods overlapped with the observation of the Islamic holy month of Ramadan.

suppliers, leaving households (and young children in particular) vulnerable to the deleterious effects of shocks (Adhvaryu et al., 2013; Benjamin and Deaton, 1993; Cogneau and Jedwab, 2012; Kruger, 2007; Miller and Urdinola, 2010). It is crucial, then, to study whether income shocks and their consequences constitute part of the origins of mental distress in low-income contexts, in order to devise policy solutions that address this problem.⁶

Finally, we contribute a methodological point related to selection that many fetal origins studies, especially those in developing countries, should consider and contend with (Currie and Vogl, 2012). As Dehejia and Lleras-Muney (2004), Miller and Urdinola (2010), Baird et al. (2011) and others have argued, there is good reason to suspect that both infant health and maternal fertility behaviors respond to health or economic shocks. If this is true, then it follows that both selective mortality and selective fertility patterns could explain some portion of the long-run impacts of early life shocks. The extent to which selection explains these effects, and whether discernible impacts of early life shocks remain after accounting for selection, is thus of first-order importance to the fetal origins literature. We show that even in settings in which shocks significantly affect fertility behavior and mortality, accounting for and testing for the extent of selection on unobservables, as well as household fixed effect-type strategies, could help to empirically evaluate the validity of selection-based threats to identification.

The rest of the paper is organized as follows. In section 2, we outline our empirical strategy. Section 3 describes the cocoa price data and our survey data. Section 4 discusses our results, and section 5 concludes.

2 Empirical strategy

In this section, we describe the empirical approach that we use to test for effects of cocoa price shocks at birth on adult mental health outcomes.

2.1 Intuition

The intuition for our identification strategy is that households in the cocoa-producing regions of Ghana experience changes in the real producer price of cocoa as income shocks, while households in regions that do not produce cocoa are unaffected by these fluctuations. Children born into households in cocoa-growing regions during periods of high cocoa prices will have more resources, owing both to the higher incomes of cocoa-producing households

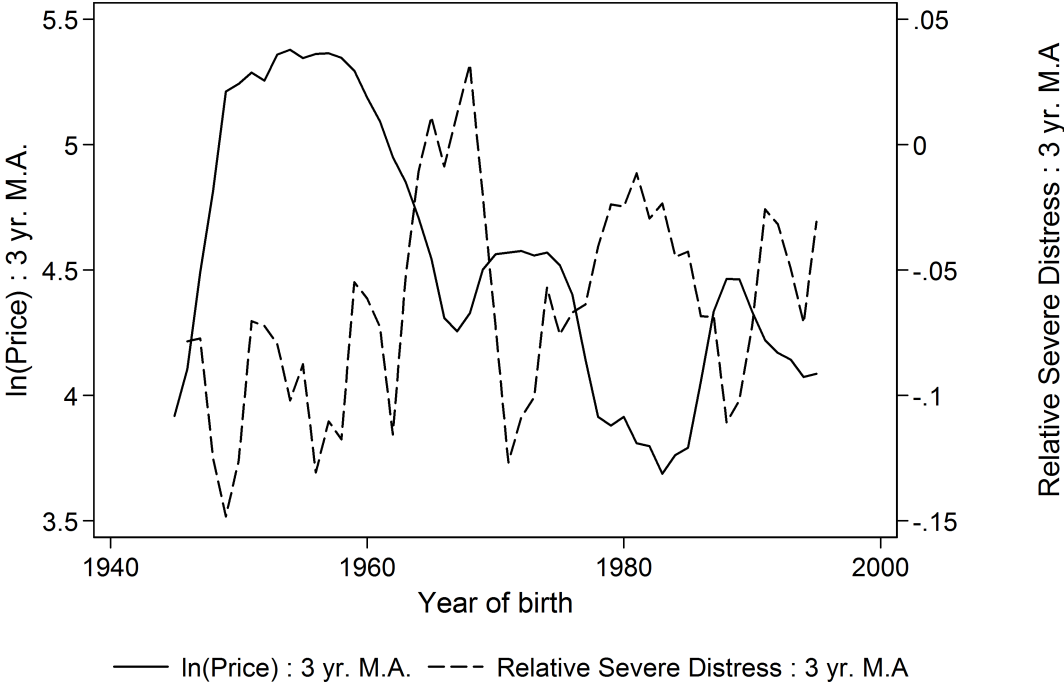
⁶In this respect, our study is related to recent work documenting the short- and medium-run mental health impacts of natural disasters and crises (Frankenberg et al., 2008; Friedman and Thomas, 2009; Paxson et al., 2012; Rhodes et al., 2010).

and to the dependence of non-agricultural activities in these regions on the cocoa sector. These resource booms could have large and lasting impacts on mental health through their effects during both gestation and infancy.

2.2 Motivation

To motivate this identification strategy, we present a graph in Figure 1 that depicts the strong correlation between cocoa price shocks during an individual’s year of birth and his mental health in later life. The solid line is the 3-year moving average of the log of the real producer price of cocoa. The dotted line is the 3-year moving average of the difference between the incidence of severe mental distress among individuals born in Ghana’s cocoa-producing regions and its incidence among individuals born in the rest of Ghana. A clear negative correlation between the two time series is evident. That is, individuals born in the cocoa-producing regions of Ghana when incomes of cocoa-producers are high show low rates of severe mental distress relative to individuals born in the same year but in parts of Ghana that do not grow cocoa. When incomes in cocoa-producing regions fall, the pattern is reversed.

FIGURE 1: COCOA PRICES AT BIRTH AND SEVERE DISTRESS



2.3 Specification

To test for the effects of cocoa price fluctuations in the year of birth on later-life mental health, we estimate the following equation:

$$Outcome_{irt} = \alpha + \beta \ln(CocoaPrice_t) \times CocoaProducer_r + x'_{irt} \gamma + \delta_r + \eta_t + \epsilon_{irt}. \quad (1)$$

Here, $Outcome_{irt}$ is the outcome for individual i , born in region r in year t . In the main results reported in Table 2 below, we will use either the natural log of the individual’s response on the 10-question Kessler Psychological Distress Scale or, in keeping with the convention when analyzing Kessler scores, a dummy for whether the individual’s score was 30 or above as an indicator for severe distress. $CocoaPrice_t$ is the real producer price of cocoa in year t . We describe the source of the price data used and how the real producer price is calculated in section 3. $CocoaProducer_r$ is an indicator for whether cocoa is produced in region r . We discuss how this indicator is defined in section 3. β is the coefficient of interest. We anticipate that the effect of beneficial shocks to parental income will reduce adult mental illness, leading to negative estimates of β . Throughout, we will refer to this composite variable $\ln(CocoaPrice_t) \times CocoaProducer_r$ as the “Price Shock.”

x_{irt} is a vector of controls. In our preferred specification, this will include female, household head, the interaction of female and head, dummies for religion, and dummies for ethnicity. δ_r and η_t are vectors of fixed effects for year and region of birth, respectively; and α is an intercept. In our baseline, we will cluster standard errors by enumeration area. This is the primary sampling unit of the outcome variables. As robustness checks, we will cluster, alternately, by region of birth or by year of birth. In addition to these, we also report Cameron et al. (2011) standard errors clustered both by enumeration area and year of birth, or alternately by region of birth and year of birth.

Our preferred specification includes an additional vector of controls: $\delta_r \times t$. This set of controls interacts the vector of region of birth fixed effects δ_r with a continuous year of birth variable t to allow for region-of-birth-specific time trends. We also add quadratic region-of-birth-specific time trends in subsequent robustness checks.

We include rainfall and temperature measures in the region as additional controls in a later specification. To the degree that the price shock variable is picking up region-specific fluctuations in temperature or rainfall, effects on mental health outcomes could be due to direct effects of these fluctuations on health of the mother or other members of the household, in addition to household income fluctuations.

3 Data

In this section, we describe the data sources used in the analysis. Additionally, where necessary, we describe the construction of the variables of interest.

3.1 Cocoa prices and production

Our source of data for real producer prices of cocoa is Teal (2002). He calculates these using the following:

$$\frac{P_X^P}{P^C} = \frac{P_X}{P_M} \frac{P_M ER}{P^C} (1 - t).$$

Here, P_X^P is the cedi price received by cocoa producers, which is deflated by P^C , the price of domestic goods. This can be re-expressed as a function of P^X , the export price in foreign currency, P^M , the price of imports in foreign currency, ER , the official exchange rate, and the tax rate t , which encompasses both export duties and the difference between world cocoa prices and the lower prices often set by the monopolistic cocoa board. This real producer price represents a time-varying income opportunity available to households in the cocoa-growing regions of Ghana, but not available in other regions of the country.⁷

In our baseline specification, we interact these price shocks with an indicator variable for whether cocoa is produced in the respondent's region of birth. The data on cocoa production that we use to produce this baseline measure is computed directly from the EGC-ISSER Socioeconomic Panel Survey. These data were collected by the Economic Growth Center at Yale University and the Institute for Statistical, Social and Economic Research at the University of Ghana, Legon.

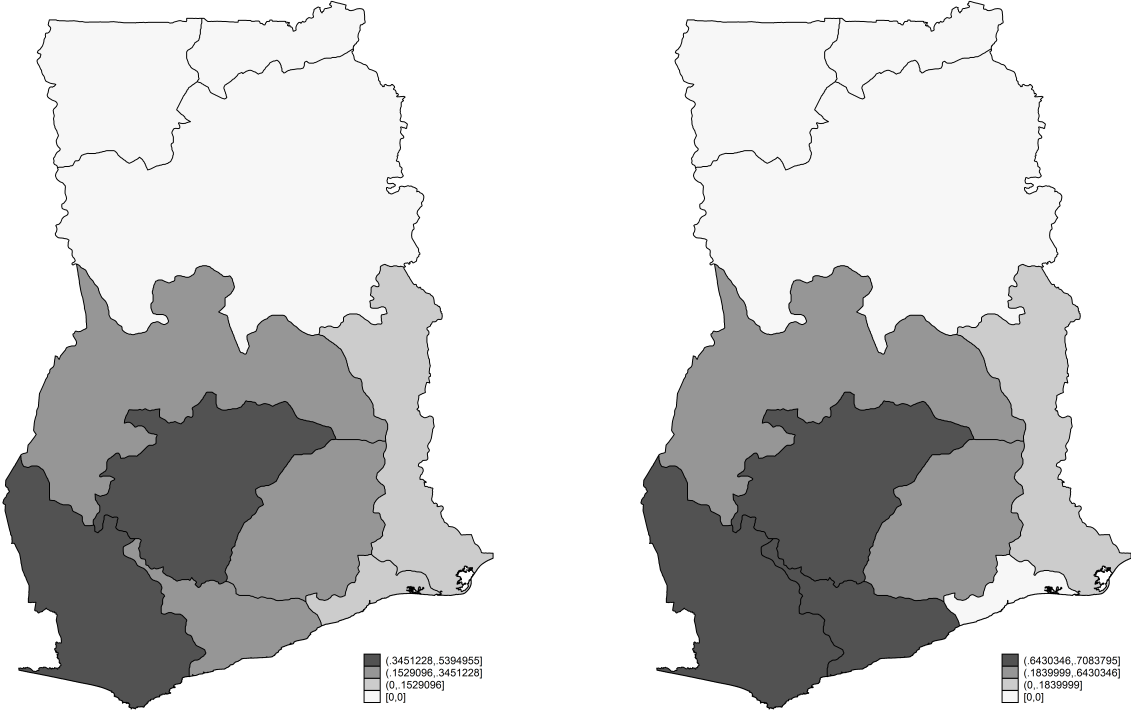
The data consist of a single cross-section, collected between November 2009 and April 2010, covering all of Ghana. Individuals were asked to list all plots of land, and what crops were grown on these plots. In Figure 2 below, we present a map of Ghana in which the 10 regions are shaded according to the percentage of farm acreage devoted to cocoa-growing. As a robustness check, we discard Greater Accra and Volta from the analysis, as less than 20% of farm land in these regions is planted to cocoa.

Our baseline measure is an indicator for the presence of cocoa in a region. This overlaps closely with the area classified as suitable for cocoa production in the 1958 Survey of Ghana Classification Map of Cocoa Soils for Southern Ghana. Produced for the Survey of Ghana,

⁷Note, whereas the global export price of cocoa might be the first choice as a measure of an exogenous determinant of household incomes in cocoa growing regions, such a price series may not reflect the true, farm-gate price faced by cocoa-growing households and is also unavailable for the full range of birth years in the household sample.

this map classified Ochrosols, Oxysols and Intergrades as suitable for cocoa production, conditional on climatic suitability. We plot the fraction of households in each region that grow cocoa (left panel) and the fraction of land in the region suitable for cocoa production (right panel) in Figure 2. The similarity between the maps in the two panels validate our classification of regions to cocoa-producing and non-cocoa-producing.

FIGURE 2: COCOA PRODUCTION AND COCOA SUITABLE SOILS BY REGION



The figure on the left depicts the fraction of land in the EGC-ISSER survey planted to cocoa in each region. The figure on the right depicts the share of all land in the region that is suitable for cocoa.

3.2 Mental health

Our principal measure of mental health is computed using the 10-question Kessler Psychological Distress Scale, or K10. These data were collected as part of the EGC-ISSER Socioeconomic Panel Survey, and are described in greater detail by Canavan et al. (2013). The K10 was developed by Ron Kessler and Dan Mroczek in 1992 as a measure of anxiety-depression spectrum mental distress (Kessler et al., 2002). The questionnaire consists of 10 questions about negative emotional states experienced during the past 4 weeks. Respondents give 5-point answers ranging from “none of the time” to “all of the time.” In particular, respondents are asked:

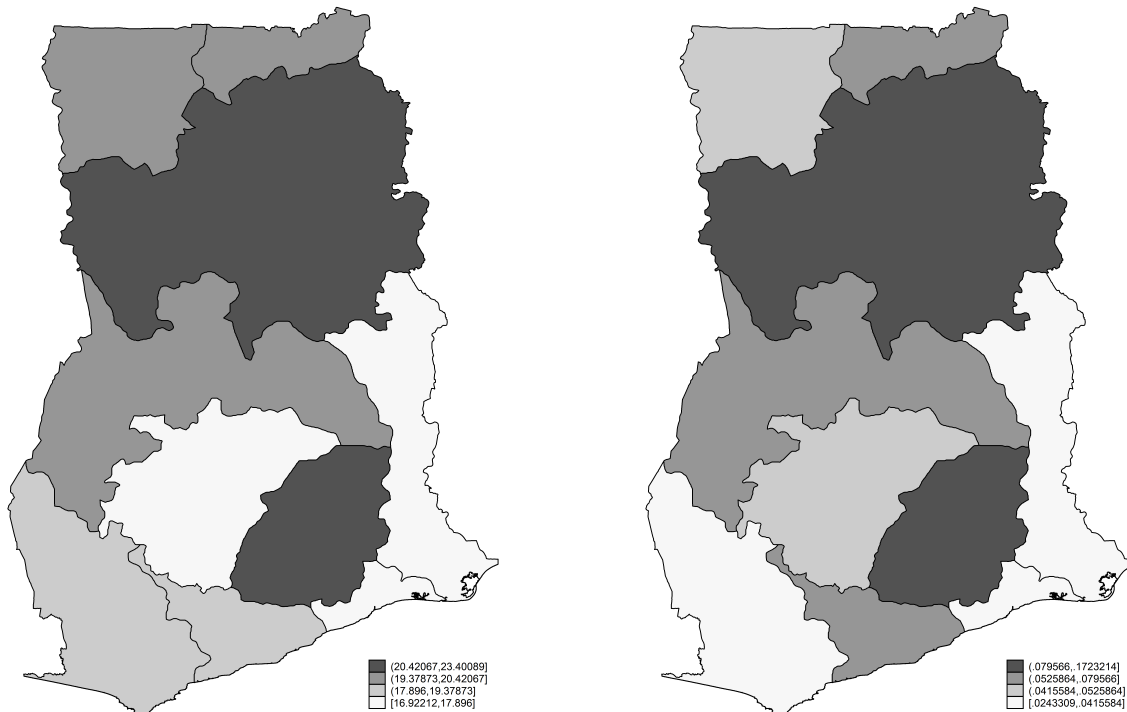
1. About how often did you feel tired out for no good reason?
2. About how often did you feel nervous?
3. About how often did you feel so nervous that nothing could calm you down?
4. About how often did you feel hopeless?
5. About how often did you feel restless or fidgety?
6. About how often did you feel so restless you could not sit still?
7. About how often did you feel depressed?
8. About how often did you feel that everything was an effort?
9. About how often did you feel so sad that nothing could cheer you up?
10. About how often did you feel worthless?

The survey methodology was developed and initially validated in the United States. It has since been administered in a variety of contexts around the world, including in low-income populations in Australia and South Africa (Kilkkinen et al., 2007; Myer et al., 2008). Responses to the K10 have been shown to correlate with the Composite International Diagnostics Interview and with the probability of a mental disorder as defined by the Diagnostic and Statistical Manual for Mental Disorders (DSM-IV) (Kessler et al., 2003). It is conventional to take a K10 score greater than or equal to 30 as an indicator for severe distress. Classifications of distress as measured by the K10 have been shown to be stable over time, suggesting that the scale captures a long run component of mental health (Lovibond, 1998).

In addition to the K10 questionnaire, individuals were asked several additional questions about their mental state. We use these to validate the K10 measures in section 4. These ask respondents to agree or disagree on a five-point scale with statements such as “I am someone who is depressed, blue” or “I am someone who is relaxed, handles stress well.” We show that responses to these alternative measures of mental health follow the same response to early life shocks as the more structured K10.

We retain individuals for our analysis who were born in Ghana, who have nonmissing responses on the region of birth and K10 questions, who are aged between 15 and 65 at the time of the survey, and whose self-reported ages are consistent with their self-reported years of birth within 5 years. This leaves us with a base sample of 7,741 individuals. We show means for individuals’ K10 scores and the indicator for severe distress by region of birth in Figure 3. Greater levels of distress correspond to darker shades of grey.

FIGURE 3: MEAN K10 SCORE AND SEVERE DISTRESS BY REGION OF BIRTH



The figure on the left depicts the mean K10 score over individuals in the sample. The figure on the right depicts the fraction of respondents whose scores indicate severe distress.

3.3 Additional controls

The bulk of our additional control variables are taken from the EGC-ISSER data. These include our principal individual controls – fixed effects for region and year of birth, an indicator for female, an indicator for household head, the intersection of female and head, dummies for religion, and dummies for ethnicity.

In addition to these controls, other variables that we interact with early life shocks are also collected from the EGC-ISSER data. These include indicators for whether an individual’s father was in agriculture or whether either of an individual’s parents had any education. We test whether early life shocks predict additional outcomes also recorded in the EGC-ISSER data, including height in centimeters, body mass index (BMI), an individual’s own education, whether an individual has migrated away from his or her region of birth, and the value of a household’s savings.

In a robustness check, we control for rainfall and temperature shocks experienced during a respondent’s year of birth. We take data on temperature and rainfall from the standard Willmott and Matsuura series available at climate.geog.udel.edu/~climate/. We merge

this to the regions of Ghana by taking the average over grid points within a region. Regions not containing a grid point in the climate data are merged to the nearest point.

3.4 Demographic and health survey data

In section 4.5, we test several mechanisms that might explain our results. To do this, we make use of additional data from the Ghanaian DHS datasets. These were collected in 1988, 1993, 1998, 2003 and 2008. The data come in three formats:

1. *Individual Recodes*: These are nationally representative cross-sections of women aged 15 through 49 at the time of the survey. The surveys contain information on each woman’s year of birth, region of residence, years of education, rural residence, age, occupation, partner’s occupation, religion, ethnicity, and anthropometric outcomes such as height and weight.
2. *Births Recodes*: The women surveyed in the individual recodes are asked to provide a complete history of all births. These data include the child’s year of birth, birth order, multiple birth, gender, whether the child is still alive and, if not, how long the child lived. In addition to using these birth histories directly, we reshape them into an artificial panel of data for each woman in the data, recording whether she experienced a birth in each year of life up to age 45.
3. *Children’s Recodes*: The women surveyed in the individual recodes are also asked a detailed set of questions about all births within the last five years. Like the births recodes, these contain information on the child’s year of birth, birth order, multiple birth, gender, and the child’s current age in months. Crucially, mothers are asked about early life investments such as the vaccination histories of these children and how long they were breastfed. Mothers are also asked about prenatal investments, such as doctors visits, additional vaccines, and the circumstances of the delivery of the child.

3.5 Summary statistics

Summary statistics on our variables of interest and principal controls are presented in Table 1. The statistics show that there is a great deal of variability in mental health. The mean respondent has mean K10 score of 19.44, and the mean of the $\ln(K10)$ score is 2.92. The median K10 score is similar, at 18. This is equivalent to a respondent who replies “a little of the time” to 8 of the 10 items in the questionnaire. 20.14% of our respondents are classified as “moderately distressed” according to the K10. These respondents have a score of at least

25. A respondent who replied “some of the time” to 8 of 10 questions would meet this cutoff. 7.4% of the sample appear severely distressed. These are individuals who score 30 and above. These rates are similar to those experienced in rural Australian and in South Africa (Kilkkinen et al., 2007; Myer et al., 2008). We show a histogram of K10 scores in Figure A.1, in the appendix.

Although cocoa prices in the first decades of the twentieth century were higher than those experienced by our birth cohorts (1943 to 1997), the real producer price of cocoa does fluctuate substantially in our sample. The maximum observed price is 8 times the minimum and more than twice the mean. As indicated in Figure 2, cocoa production is concentrated in Southwestern Ghana.

Our mean respondent was born in 1973. 17% of the sample is Muslim, 7% follows a traditional religion, 5% follows no religion, and the remainder is divided almost entirely among several Christian denominations. Roughly 70% of our respondents ever attended school. 37% report that their fathers had any education, while 20% report the same for their mothers. Two thirds have a father who worked in agriculture. Roughly half the sample was not born in their current village of residence.

4 Results

In this section, we present and discuss the results of the empirical analysis proposed in section 2.

4.1 Mental Distress

We report our main estimates of equation (1) in Table 2. There is a negative impact of the price shock at birth on the log of the respondent’s K10 score in adulthood. This effect is statistically significant once time trends are added for each region-of-birth and survives the addition of individual controls. The negative effect of cocoa prices on severe mental distress is robust across specifications. As discussed in section 2, the most rigorous specifications including region-of-birth time trends and individual controls, reported in columns 3 and 6, are the preferred specifications.

The magnitudes of the effects on the log of the *K10* score are moderate, while the impacts on severe distress are large. The real producer price of cocoa has varied widely over time, and a one standard deviation increase in the log price is equivalent to 0.55 log points. In column (3), this would reduce the log *K10* score for an individual born in a cocoa-producing region by $-0.045 \times 0.55 = 0.025$. This is roughly 0.08 standard deviations, or 1% of the mean. For

severe distress, a one-standard-deviation price shock leads to a roughly 3 percentage point reduction in severe distress, which is nearly half the mean.

We also report in Table 2 alternative estimates of the standard error of the impact of the price shock. First, we report standard errors clustered by region of birth or by year of birth. Second, we report Cameron et al. (2011) standard errors clustered by both enumeration area and year of birth or by both region of birth and year of birth. Third, because the number of possible regions of birth is small, we report Moulton-corrected standard errors clustered by enumeration area or by region of birth (see Angrist and Pischke (2008)). Our estimates of the standard error do not change noticeably across specifications.

4.2 Personality Outcomes

We show in Table 3 that, in addition to mental health as measured by the K10 questionnaire, the impact of early life cocoa price shocks is apparent for a variety of similar outcomes. This helps establish the validity of the K10 as a measure of mental illness, and the statistical robustness of our results.

First, individuals who received beneficial cocoa price shocks in their year of birth are less likely to report that they are the sort of person who is depressed, or “blue.” Similarly, they are more likely to self-identify as relaxed. They are less likely to state that they tend to start quarrels, are disorganized, are moody, or are cold and aloof. These are traits we would expect from individuals who are less likely to experience mental distress as a result of favorable early life events. These personality results are generally robust across specifications and are statistically significant at conventional levels, particularly in the preferred specification reported in columns 3 and 6.

Similarly, although the K10 questions are designed to be used as an index, we show in Appendix C that several individual components respond to early-life cocoa prices. That is, the results on K10 scores and severe distress are not driven primarily by responses to singular questions.

4.3 Robustness

We demonstrate the statistical robustness of our main result in Table 4. First, we add quadratic trends by region of birth to the linear trends, and show that there is little change in the results. Second, we discard the Volta and Greater Accra regions from our data. Cocoa is grown in both regions, but in small amounts, making it unclear whether these can be cleanly included in the treatment or control groups. This too does little to diminish our main result.

Third, we find that replacing the price shock in an individual’s year of birth with the three-year moving average of the price of cocoa neither improves nor worsens the precision of our main result. Fourth, following on Figures 4 and 5, we show that cocoa prices averaged over the year of birth and first two years of an individual’s life predict later-life mental health.

Fifth, including other early life shocks that might be correlated with cocoa prices does not diminish our main results. Here, we control for region-level rainfall and temperature experienced in an individual’s year of birth. Rainfall and temperature in the year of birth are themselves plausibly exogenous. While rainfall and temperature might have effects on a child’s later-life outcomes through mechanisms other than parental income (e.g. maternal health), the stability in the effect of the price shock after controlling for rainfall and temperature supports the interpretation of the price shock as working through parental income. In Appendix B we show also that controlling for changes in Ghanaian political economy over time does not affect our results.

Finally, because individuals may only know their ages imprecisely, we discard all individuals whose ages are divisible by 5. This reduces the sample by a third, and leads the estimated impact on the log K10 score to become insignificant, though the sign and magnitude of the coefficient is similar the main results in Table 2. Estimates of the effect of price shocks on severe mental distress, by contrast, remain significant and become larger in magnitude than in the baseline.

In Appendix C, we show that early-life shocks do not predict incomplete responses on the K10. We also show in Appendix C that we can find no evidence that migration into cocoa-producing regions responds to cocoa price shocks.⁸

4.4 Timing of Impact

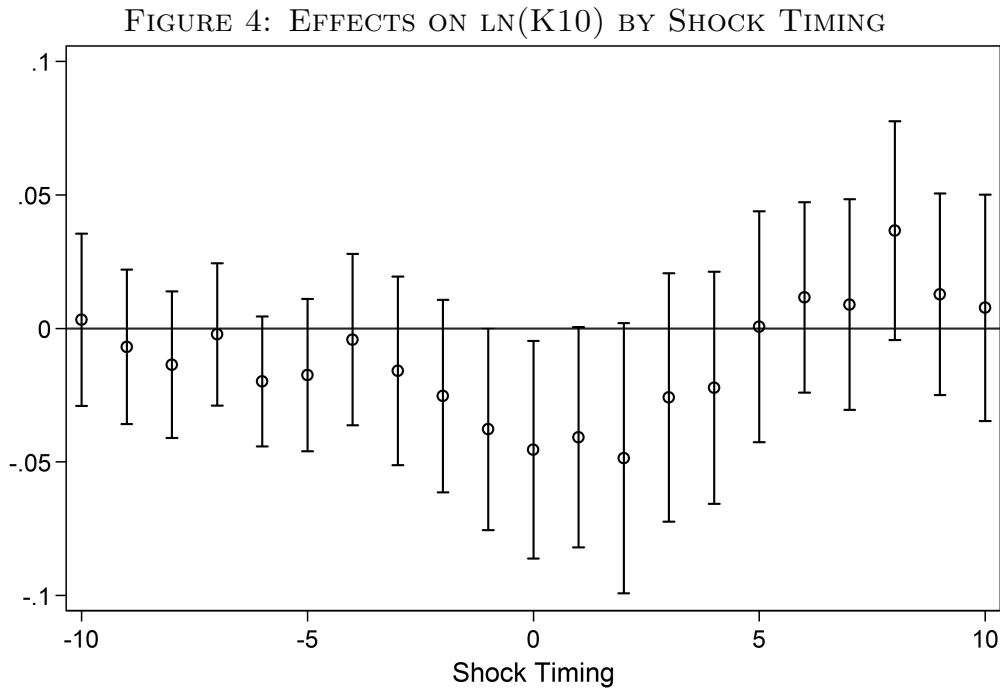
Although our baseline specification focuses on cocoa prices during an individual’s year of birth, this is not necessarily the only age during which we would expect to find impacts

⁸We conduct additional robustness checks that are not reported here. These results are available upon request. Our main results survive when we remove individuals born before 1960 or those who are less than 18 years old at the time of the survey. Using the real producer price without taking its logarithm still yields a significant effect on adult mental health. Defining cocoa-producing regions as those containing land suitable for cocoa changes little. Greater Accra moves to the control group, and the estimated effects are similar to the baseline. Similarly, if we interact the log real producer price of cocoa with the fraction of land in a region that is planted to cocoa, we find a negative coefficient; cocoa prices matter more where cocoa is more important. As additional solutions to possible age heaping, we collapse ages into three-year bins and use 2009 minus self-reported year of birth as an alternative to self-reported year of birth. Our results survive including fixed effects for each region intersected with birth during the rule of Jerry Rawlings. We find significant effects of early life cocoa price shocks even if the estimation is performed separately for household heads and non-heads. The effect on severe distress remains significant even when controlling for household fixed effects that compare two members of the same household.

on later-life mental health. For example, it is possible that parental incomes throughout childhood exert an influence later in life. If parents find it difficult to recover from adverse income shocks, shocks experienced before a child is born may also affect later-life outcomes.

In Figures 4 and 5, we test whether shocks in years other than an individual’s year of birth affect later life mental health. We re-estimate our baseline specification including both region-specific trends and controls. We replace the year-of-birth shock with price shocks experienced in other years. We report point estimates and 95% confidence intervals as a function of shock timing.

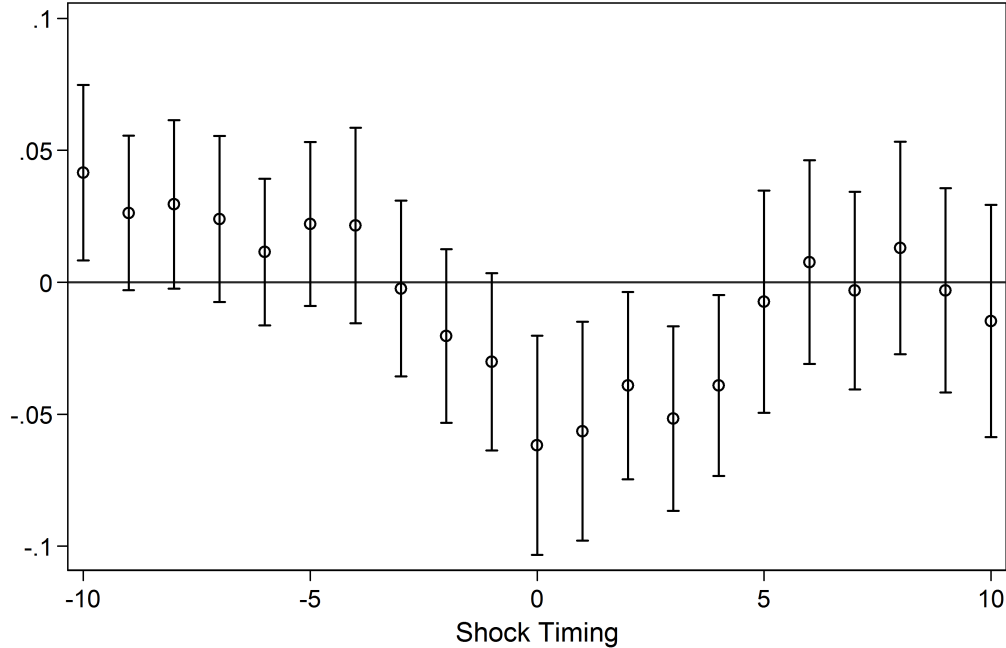
For both measures of mental health, these results suggest that shocks experienced in the first four years of an individual’s life affect later-life mental health. The precision of these estimates is greater for severe mental distress than for the log of the individual’s K10 score. In both cases, the effect is largest in an individual’s year of birth. Although our point estimates suggest beneficial effects exist for higher prices experienced before birth, these are not statistically significant.



This figure depicts coefficient estimates and the 95% confidence interval for the main specification with region trends, controls, and standard errors clustered by enumeration area. The timing of the shock is in years relative to the year of birth.

The ages at which cocoa prices affect mental health in adulthood provide information about the mechanism through which this impact is realized. For example, the evidence presented above that the impact is strongest in the year of birth suggests a direct, biological

FIGURE 5: EFFECTS ON SEVERE DISTRESS BY SHOCK TIMING



This figure depicts coefficient estimates and the 95% confidence interval for the main specification with region trends, controls, and standard errors clustered by enumeration area. The timing of the shock is in years relative to the year of birth.

effect of household incomes during gestation, at-birth, or by way of maternal nutrition and health. On the other hand, the fact that cocoa prices in the few years directly after birth also affect later-life outcomes indicates that investments made during the child’s infancy could be an additional mechanism. Early life investments could be affected by persistent year-of-birth price shocks, contemporaneous price shocks in the first few years of the child’s life, or indirectly by way of parental responses to augmented endowments (Adhvaryu and Nyshadham, 2013). In the section below, we investigate several possible mechanisms.

4.5 Mechanisms

Having shown strong and robust evidence of impacts of year-of-birth cocoa price shocks on mental distress and personality traits in adulthood, we next investigate the mechanisms by which these impacts are realized.

4.5.1 Agricultural Incomes

First, we provide additional evidence that the year-of-birth price shocks are indeed operating through parental income at the time of birth. We show evidence in Table 5 that the impacts

of the price shock on adult mental health are strongest among children of farmers and among the Akan, the ethnic group most associated with cocoa-production. In columns 1 and 2 of Table 5, we also explore heterogeneity by gender. The results suggest that females are slightly less impacted by positive shocks, though the magnitude of this heterogeneity is quite small relative to the main effect of the shock.

4.5.2 Parental Health

We next investigate the role of parental health during gestation and early life investments in the child as the mediating mechanisms for our main results. That is, it is possible that children born during cocoa booms receive greater nutrition during gestation by way of greater maternal nutrition. To test whether early life price shocks operate through greater maternal health, we cannot use the EGC-ISSER data, because it is a single cross-section. Instead, we test whether the observable health outcomes of women in the DHS individual recodes respond to contemporary price shocks. We estimate:

$$Outcome_{irt} = \alpha + \beta \ln(CocoaPrice_t) \times CocoaProducer_r + x'_{irt} \gamma + \delta_r + t_r + \eta_t + \epsilon_{irt}. \quad (2)$$

Here, $Outcome_{irt}$ is a health outcome (weight or BMI) for woman i , living in region r in year t . The cocoa price shock variable $\beta \ln(CocoaPrice_t) \times CocoaProducer_r$ is measured in year t . δ_r is a vector of region fixed effects. t_r is a vector of region-specific time trends. η_t is a vector of year fixed effects and α is an intercept. The vector of controls x_{irt} includes years of education, rural, age, age squared, dummies for religion, and dummies for ethnicity. Standard errors are clustered by region. We discard outliers with reported weights outside the range 35-140kg and BMIs outside the range 15-35. Columns 1 and 2 of Table 6 show that parental weight and BMI are improved by contemporaneous positive cocoa-price shocks. We interpret these results as evidence of maternal nutrition as channel of the estimated impacts of early life income shocks on adult mental health.

4.5.3 Investments

Adult outcomes of children born during cocoa booms might also be affected by investments made after birth such as duration of breastfeeding and vaccinations. Investments, even if they are made after birth, might be affected by year-of-birth price shocks by way of the household's intertemporal budget. Investments may also respond to the child's endowment, which was augmented by the year-of-birth shock. We are able to use the DHS children's

recodes to test whether a broad number of investments respond to cocoa price shocks. We estimate:

$$Investment_{irt} = \alpha + \beta \ln(CocoaPrice_t) \times CocoaProducer_r + x'_{irt} \gamma + \delta_r + t_r + \eta_t + \epsilon_{irt}. \quad (3)$$

Here, $Investment_{irt}$ is a measure of investment in child i , living in region r , and born in year t . Examples include the duration of breastfeeding and receipt of various vaccinations. The cocoa price shock variable $\beta \ln(CocoaPrice_t) \times CocoaProducer_r$ is measured in the child's year of birth. δ_r is a vector of region fixed effects. t_r is a vector of region-specific time trends. η_t is a vector of year-of-birth fixed effects and α is an intercept. The vector of controls x_{irt} includes both maternal characteristics (years of education, rural, mother's age, mother's age squared, dummies for religion, and dummies for ethnicity) and predetermined child characteristics (birth order, multiple birth, female, and age in months at time of survey). Standard errors are clustered by region.

In our selection of investment outcomes, we follow Adhvaryu and Nyshadham (2013), who find evidence that parents reinforce stronger endowments with more investment. Specifically, we estimate impacts of year-of-birth price shocks on number of vaccination doses received and duration of breastfeeding. We also consider at-birth and antenatal investments such as doctor-attended delivery and 0 dose vaccinations. The results of these regressions are reported in Table 6.

Consistent with the results in Adhvaryu and Nyshadham (2013), we find evidence of reinforcing investment in terms of breastfeeding and vaccinations in early life, but little evidence of effects on at-birth or prenatal investments. Estimates reported in the middle panel of Table 6 show both increases in vaccinations and breastfeeding. The bottom panel shows some weak evidence of an increase in the likelihood of a prenatal doctor visit, but no evidence of an increased likelihood of receiving at-birth vaccination doses (i.e. polio 0 and BCG) nor an increased likelihood of the child being delivered under formal health care. We find no evidence that prenatal investments respond to cocoa prices in the year before birth (not reported).

This pattern is consistent with impacts on investments being driven by responses to improved endowments rather than by budget constraint slackness during cocoa booms. That is, if investment effects were driven by increased incomes, we would expect at-birth and prenatal investments to reflect the increased household income in the child's year of birth. Although not reported here for the sake of brevity, we also regress the same early life investment outcomes on price shocks in the first and second year of the child's life and find

no evidence of effects. We interpret this as further evidence against effects on investments being driven by increased incomes.

4.6 Other Adult Outcomes

Finally, we also explore the degree to which impacts on mental health and personality traits are accompanied by impacts on other outcomes in adulthood. Specifically, we regress measures of adult health (height and BMI) and economic status (savings and occupation) on the same year-of-birth price shocks using the same specification as reported in columns 3 and 6 of Tables 2 and 3. These results are reported in Table 7 and provide evidence of impacts on height and partner’s occupation, but no evidence of impacts on BMI, savings, or own occupation. We interpret these results as suggestive evidence that impacts on mental health are due in part to improved health and match satisfaction in adulthood.

4.7 Selection

As our last exercise, we investigate the degree to which fertility decisions and infant mortality are affected by cocoa price shocks. Specifically, we might suspect that babies born during cocoa booms are born to different families than those born during busts, as shown in Dehejia and Lleras-Muney (2004), or that infant mortality varies with economic conditions, as shown in Miller and Urdinola (2010) and Baird et al. (2011).

4.7.1 Mortality

Using the DHS birth recodes, we test for selective mortality by estimating

$$Mortality_{irt} = \alpha + \beta \ln(CocoaPrice_t) \times CocoaProducer_r + x'_{irt} \gamma + \delta_r + t_r + \eta_t + \epsilon_{irt}. \quad (4)$$

Here, $Mortality_{irt}$ is an indicator for whether child i , who was born in year t , and whose mother lives in region r died in the first five years of life. The cocoa price shock variable $\beta \ln(CocoaPrice_t) \times CocoaProducer_r$ is measured in the child’s year of birth. δ_r is a vector of region fixed effects. t_r is a vector of region-specific time trends. η_t is a vector of year-of-birth fixed effects and α is an intercept. The vector of controls x_{irt} includes both maternal characteristics (years of education, rural, mother’s year of birth, mother’s year of birth squared, dummies for religion, and dummies for ethnicity) and predetermined child characteristics (birth order, multiple birth, and female). Standard errors are clustered by region. Results are reported in columns 1 through 4 of Table 8.

We find only limited evidence of selective mortality in childhood. Greater cocoa prices predict greater mortality, an effect that appears to be weaker among children of farmers. We replace child mortality with infant mortality in Table A3, in the appendix. We find no evidence of selective infant mortality, nor of heterogeneity in the relationship between infant mortality and cocoa prices. We investigate the degree to which selection on individual or parental characteristics in child mortality might explain our main results in Table 9, described below.

4.7.2 Fertility

To test whether fertility responds to cocoa prices, we construct an artificial panel of women using the births recodes of the DHS. Each observation is a year of a woman’s life, up to age 45. We use OLS to estimate:

$$Birth_{irat} = \alpha + \beta \ln(CocoaPrice_t) \times CocoaProducer_r + x'_{irat} \gamma + \delta_r + t_r + \theta_a + \eta_t + \epsilon_{irat}. \quad (5)$$

We find, as shown in column 5 of Table 8, that higher cocoa prices predict greater fertility. We confirm this result using an exercise similar to that in Maccini and Yang (2009). We count the number of respondents in the EGC-ISSER data born in each region in each year, and test whether the number of individuals from cocoa-growing regions rises when cocoa prices are higher. These results (not reported) also suggest a similar increase in fertility in response to greater cocoa prices.

We then include, as in columns 2 through 4, variables measuring parental economic status and their interactions with the price shock in order to investigate the degree to which this pro-cyclicality in fertility is uniform or concentrated among specific demographic groups. The results reported in columns 6 through 8 of Table 8 suggest that those with more education and with skilled occupations are more likely to time their fertility around economic downturns.

Lastly, we investigate the degree to which selection on individual or parental characteristics might explain our main results. That is, do we have reason to believe that our estimates of the impacts of year-of-birth price shocks on mental health are generated entirely through selective mortality and fertility? We attempt to address this concern in three ways: 1) we include directly the parental characteristics from Table 8 (i.e. parents’ education and occupations) as observable determinants of selection in the regression specification; 2) we estimate the “implied ratio” of selection on unobservables to selection on the included observables (both individual and parental characteristics) (Altonji et al., 2005) that would

be necessary to fully account for our main results; 3) and we re-estimate the main results including an additional household fixed effect under the assumption that adults living in the same household now were also likely to be born into households with similar unobservables.

The results from all three robustness checks are reported in Table 9. Columns 1 and 2 show that the our main results are robust to the inclusion of controls for parents' education and occupations. We report two sets of Altonji et al. (2005) implied ratios. The first considers the change in estimates as individual controls are added. The second considers the change in parameter estimates as parental controls are added. Both sets of estimates of the implied ratio indicate that selection on unobservables would have to be between 8.7 and 144.5 times as large as selection on observables in order to fully account for the results.

Estimates in columns 3 and 4 also generally show robustness to the inclusion of household fixed effects, though the estimate from the log K10 specification is no longer significant at conventional levels. We interpret the results from Table 9 as evidence that selective fertility cannot fully account for the magnitude and significance of our estimates of the impact of year-of-birth cocoa price shocks on mental health in adulthood.

5 Conclusion

In this study, we estimate the impacts of early life income shocks on adult mental health. We show, among a nationally representative sample of households in Ghana, that a one standard deviation increase in the cocoa price in early life reduces the likelihood of severe mental distress in later life by roughly 3 percentage points for individuals born in cocoa-producing regions relative to the same birth cohort born in other regions. This is nearly half the mean. Expanding our analysis to price shocks in each of the 10 years before and after birth, we find that income shocks during the first 4 years of life matter for adult mental health, though effects are largest for the shocks during an individual's year of birth. The impact we estimate is driven by individuals from the Akan ethnic group that has been historically predominant in the production of cocoa, and are stronger for children born into agricultural households.

Recent studies from the mental health literature have estimated that treatment, either by medication or therapy, can reduce the prevalence of mental distress by between 70 and 93.5 percent in low-income countries (Patel et al., 2007). We show that insulating households from a one standard deviation drop in agricultural output prices can reduce the prevalence of mental distress by roughly 50 percent. Given that studies have calculated the cost effectiveness ratio of treatment of mental disorders in low-income settings to be US\$500-1000 per averted disability-adjusted life-year (Patel et al., 2007), roughly commensurate with treat-

ment and prevention of chronic illness such as HIV/AIDS and diabetes, policies to protect households against income fluctuations as a means of preventing later-life mental distress might prove relatively more cost-effective. This argument is likely made even stronger once the economic costs of mental distress are more comprehensively measured.

In addition to being direct determinants of utility, psychological traits have been linked to physical and economic health and decision-making in adults (Heckman and Rubinstein, 2001; Heckman et al., 2006). That is, psychological well-being is important both as an outcome in its own right, as well as as a potential mechanism for some of the large, later-life impacts of early life factors measured in the literature to date. As Heckman (2006, 2007) and Cunha et al. (2010) have recently shown, personality outcomes are formed early and are likely greatly influenced by factors in early life. We demonstrate that these impacts continue to persist in the long-run, suggesting that intervention at early ages to blunt the effects of trauma (economic and otherwise) could spare some fraction of adults from severe psychological distress and its economic consequences.

Our results suggest two mutually compatible interpretations of the impacts on mental health. First, mental health could be a mechanism that partly explains other economic impacts of early life shocks. Second, mental health is a final outcome that depends partly on these economic and health-related outcomes. In this case, the indirect effects of health and economic welfare on mental illness would be in addition to direct effects we have estimated. Previous measurements of the welfare importance of early life factors, while already large, are underestimated to the degree that they do not include mental health.

This study complements a growing set of studies in the development economics literature that regard economic outcomes as incomplete measurements of welfare (Angelucci et al., 2013; Baird et al., 2013; Devoto et al., 2012; Haushofer and Shapiro, 2013). Measures such as mental health add to the richness of research on the efficacy of welfare interventions and should be increasingly measured, reviewed, and addressed in policy recommendations. This is particularly true in developing contexts where these dimensions of welfare have received less attention and where resources for improving mental health are most limited.

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Table 1. Summary Statistics

	(1)	(2)	(3)	(4)	(5)
	Mean	s.d.	Min	Max	N
<i>Mental Health</i>					
ln K10	2.92	0.31	2.30	3.91	7,815
Severe distress	0.074	0.26	0	1	7,815
<i>Cocoa Price Shocks</i>					
ln(Cocoa price) X Region any cocoa: Year of birth	3.30	2.01	0	5.52	7,741
<i>Controls</i>					
Female	0.55	0.50	0	1	7,815
Year of birth	1,973	13.7	1,943	1,997	7,815
Head	0.49	0.50	0	1	7,815
Female X Head	0.15	0.36	0	1	7,815
<i>Real Producer Price Series (1943-1997)</i>					
Real Cocoa Price	105	60.1	31.1	251	55
ln(Cocoa Price)	4.50	0.55	3.44	5.52	55
<i>Fraction of Farm Area Under Cocoa, By Region</i>					
Ashanti	44.36%				
Brong Ahafo	31.80%				
Central	34.51%				
Eastern	26.20%				
Greater Accra	0.09%				
Northern	0.00%				
Upper East	0.00%				
Upper West	0.00%				
Volta	4.38%				
Western	53.95%				

Table 2. Impacts of Y.O.B. Price Shock on Mental Distress

	(1)	(2)	(3)	(4)	(5)	(6)
		<i>ln(K10)</i>			<i>Severe Distress</i>	
Price shock (Y.O.B.)	-0.023 (0.017)	-0.045** (0.021)	-0.045** (0.021)	-0.052*** (0.017)	-0.061*** (0.021)	-0.062*** (0.021)
<i>S.E. clustered by</i>						
<i>R.O.B.</i>	(0.021)	(0.016)	(0.016)	(0.005)	(0.014)	(0.013)
<i>Y.O.B.</i>	(0.012)	(0.019)	(0.018)	(0.013)	(0.018)	(0.019)
<i>C.G.M.: E.A. & Y.O.B.</i>	(0.015)	(0.022)	(0.022)	(0.015)	(0.021)	(0.023)
<i>C.G.M.: R.O.B. & Y.O.B.</i>	(0.021)	(0.019)	(0.019)	(0.005)	(0.021)	(0.018)
<i>Moulton: E.A.</i>	(0.019)	(0.026)	(0.026)	(0.014)	(0.019)	(0.019)
<i>Moulton: R.O.B.</i>	(0.015)	(0.020)	(0.020)	(0.013)	(0.018)	(0.018)
<i>Moulton: Y.O.B.</i>	(0.015)	(0.020)	(0.020)	(0.013)	(0.018)	(0.018)
Observations	7,741	7,741	7,741	7,741	7,741	7,741
Y.O.B. Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
R.O.B. Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
R.O.B. Trends	No	Yes	Yes	No	Yes	Yes
Controls	No	No	Yes	No	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. Standard errors clustered by enumeration area in parentheses, unless otherwise indicated. All regressions are OLS. Controls are female, head, female X head, ethnicity dummies, and religion dummies, unless otherwise indicated.

Table 3. Impacts of Y.O.B Price Shock on Related Personality Outcomes

	(1)	(2)	(3)	(4)	(5)	(6)
	<i>I am someone who is depressed, blue</i>			<i>I am someone who is relaxed, handles stress well.</i>		
Price shock (Y.O.B.)	-0.223*** (0.060)	-0.278*** (0.093)	-0.280*** (0.091)	0.168*** (0.057)	0.121 (0.076)	0.142* (0.074)
Observations	6,973	6,973	6,973	7,005	7,005	7,005
	<i>I am someone who starts quarrels with others</i>			<i>I am someone who tends to be disorganized</i>		
Price shock (Y.O.B.)	-0.085** (0.042)	-0.087** (0.042)	-0.100** (0.041)	-0.235*** (0.058)	-0.134** (0.064)	-0.141** (0.066)
Observations	6,998	6,998	6,998	6,987	6,987	6,987
	<i>I am someone who can be moody</i>			<i>I am someone who can be cold and aloof</i>		
Price shock (Y.O.B.)	-0.254*** (0.063)	-0.261*** (0.097)	-0.275*** (0.096)	-0.248*** (0.069)	-0.288*** (0.096)	-0.292*** (0.097)
Observations	6,989	6,989	6,989	7,000	7,000	7,000
Y.O.B. Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
R.O.B. Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
R.O.B. Trends	No	Yes	Yes	No	Yes	Yes
Controls	No	No	Yes	No	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. Standard errors clustered by enumeration area in parentheses, unless otherwise indicated. All regressions are OLS. Controls are female, head, female X head, ethnicity dummies, and religion dummies, unless otherwise indicated.

Table 4. Robustness of Impacts on Mental Distress

	(1)	(2)	(3)	(4)
	<i>ln(K10)</i>	<i>Severe Distress</i>	<i>ln(K10)</i>	<i>Severe Distress</i>
	<i>Drop regions with 0-25% of farmland under cocoa</i>			
	<i>Quadratic region trends</i>			
Price shock (Y.O.B.)	-0.035*	-0.035*	-0.043*	-0.064***
	(0.021)	(0.021)	(0.022)	(0.022)
Observations	7,741	7,741	6,243	6,243
	<i>Price measured as 3 year moving average</i>		<i>Price averaged over ages 0-2</i>	
Price shock (Y.O.B.)	-0.042*	-0.042**	-0.056**	-0.066***
	(0.021)	(0.020)	(0.025)	(0.024)
Observations	7,741	7,741	7,741	7,741
	<i>Control for rainfall and temperature shocks</i>		<i>Discard possible age heaping</i>	
Price shock (Y.O.B.)	-0.049**	-0.062***	-0.036	-0.096***
	(0.021)	(0.021)	(0.024)	(0.025)
Observations	7,741	7,741	5,375	5,375
Additional Regressors	Y.O.B & R.O.B. Fixed Effects; R.O.B. Trends; Controls		Y.O.B & R.O.B. Fixed Effects; R.O.B. Trends; Controls	

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. Standard errors clustered by enumeration area in parentheses, unless otherwise indicated. All regressions are OLS. Controls are female, head, female X head, ethnicity dummies, and religion dummies, unless otherwise indicated.

Table 5. Heterogeneous Impacts on Mental Distress

	(1)	(2)	(3)	(4)	(5)	(6)
	<i>ln(K10)</i>	<i>Severe Distress</i>	<i>ln(K10)</i>	<i>Severe Distress</i>	<i>ln(K10)</i>	<i>Severe Distress</i>
	<i>Interact with "Female"</i>		<i>Interact with "Father in Agriculture"</i>		<i>Interact with "Akan"</i>	
Price shock (Y.O.B.)	-0.046** (0.021)	-0.063*** (0.021)	-0.042* (0.022)	-0.052** (0.023)	-0.034 (0.021)	-0.048** (0.022)
Shock X Interaction	0.000 (0.003)	0.005* (0.003)	-0.010 (0.007)	-0.009* (0.005)	-0.020 (0.013)	-0.021** (0.008)
Observations	7,741	7,741	7,047	7,047	7,719	7,719
Additional Regressors	Y.O.B & R.O.B. Fixed Effects; R.O.B. Trends; Controls		Y.O.B & R.O.B. Fixed Effects; R.O.B. Trends; Controls		Y.O.B & R.O.B. Fixed Effects; R.O.B. Trends; Controls	

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. Standard errors clustered by enumeration area in parentheses, unless otherwise indicated. All regressions are OLS and include the uninteracted "Interaction" variable. Controls are female, head, female X head, ethnicity dummies, and religion dummies, unless otherwise indicated.

Table 6. Maternal Health and Investment Responses (DHS)

	(1)	(2)	(3)	(4)	(5)
<i>Parental Health (Individual Recode)</i>					
	<i>Weight (no outliers)</i>		<i>BMI (no outliers)</i>		
Contemporaneous Price Shock	3.538*** (0.861)	1.044*** (0.319)			
Observations	14,411	14,022			
Additional Regressors	Y.O.B & R.O.B. Fixed Effects;				
<i>Early-life Investments (Child Recode)</i>					
	<i>No. of Polio doses received</i>	<i>No. of DPT doses received</i>	<i>Received Measles</i>	<i>No. of Total Vaccinations</i>	<i>Months of Breastfeeding</i>
Price shock (Y.O.B.)	0.218** (0.076)	0.317*** (0.063)	0.034 (0.054)	0.528*** (0.137)	0.989* (0.510)
Observations	11,903	11,829	11,809	11,725	13,134
<i>Antenatal and At-birth Investments (Child Recode)</i>					
	<i>Prenatal Doctor Visit</i>	<i>Received BCG Vaccination</i>	<i>Received Polio 0 dose</i>	<i>Home Delivery</i>	<i>Doctor Attended Delivery</i>
Price shock (Y.O.B.)	0.085* (0.042)	-0.034 (0.042)	-0.010 (0.107)	0.028 (0.066)	-0.017 (0.021)
Observations	9,582	11,886	9,067	11,101	11,090
Additional Regressors	Y.O.B & R.O.B. Fixed Effects; R.O.B. Trends; Controls				

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. Standard errors clustered by region in parentheses, unless otherwise indicated. All regressions are OLS. Controls in the individual recode are years of education, rural, age, age squared, dummies for religion, and dummies for ethnicity. Controls in the child recode with year of birth shocks are maternal characteristics (years of education, rural, mother's age, mother's age squared, dummies for religion, and dummies for ethnicity) and predetermined child characteristics (birth order, multiple birth, female, and age in months at time of survey). Controls in the individual recode with contemporary shocks are years of education, rural, age, age squared, dummies for religion, and dummies for ethnicity.

Table 7. Impacts of Y.O.B Price Shocks on Adult Outcomes

	(1)	(2)	(3)	(4)	(5)
	<i>Height in cm</i>	<i>BMI</i>	<i>Value of savings</i>	<i>No Occupation (DHS)</i>	<i>Partner's Occupation (DHS): Professional / Technical / Managerial</i>
Price shock (Y.O.B.)	1.234** (0.547)	-0.118 (0.259)	118.621 (108.694)	-0.036 (0.021)	0.047*** (0.008)
Observations	7,374	7,374	7,741	19,831	18,292

Additional Regressors

Y.O.B & R.O.B. Fixed Effects; R.O.B. Trends; Controls

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. Standard errors clustered by enumeration area in parentheses, unless otherwise indicated. All regressions are OLS. Controls are female, head, female X head, ethnicity dummies, and religion dummies, unless otherwise indicated. Controls for DHS specifications are dummies for religion and ethnicity.

Table 8. Selection Checks (DHS)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	<i>Selective Mortality (Births Recode)</i>				<i>Selective Fertility (Constructed Birth Panel)</i>			
	<i>Died as child</i>				<i>Birth</i>			
Price shock	0.017*	0.013	0.012	0.015	0.046***	0.034***	0.030***	0.032***
	(0.009)	(0.008)	(0.008)	(0.008)	(0.009)	(0.009)	(0.006)	(0.006)
Shock X Any Education		0.010				0.023***		
		(0.006)				(0.002)		
Any Education		-0.056*				-0.120***		
		(0.026)				(0.010)		
Shock X Agr. Self-Employed Occupation			-0.025**				-0.013**	
			(0.011)				(0.004)	
Agr. Self-Employed Occupation			0.115**				0.080***	
			(0.046)				(0.021)	
Shock X Professional Occupation				0.030				0.044***
				(0.029)				(0.008)
Professional Occupation				-0.145				-0.197***
				(0.124)				(0.038)
Observations	67,356	67,356	53,037	53,037	452,110	452,110	349,103	349,103
Additional Regressors	Y.O.B & R.O.B. Fixed Effects; R.O.B. Trends; Controls				Age, Year & Region Fixed Effects; Region Trends; Controls			

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. Standard errors clustered by region in parentheses, unless otherwise indicated. All regressions are OLS. Controls are stock of past male births, stock of past female births, years of education, rural, dummies for religion, and dummies for ethnicity, unless otherwise indicated. Controls in the births recode are maternal characteristics (years of education, rural, mother's year of birth, mother's year of birth squared, dummies for religion, and dummies for ethnicity) and predetermined child characteristics (birth order, multiple birth, and female).

Table 9. Robustness of Mental Health Impacts to Selective Fertility Controls

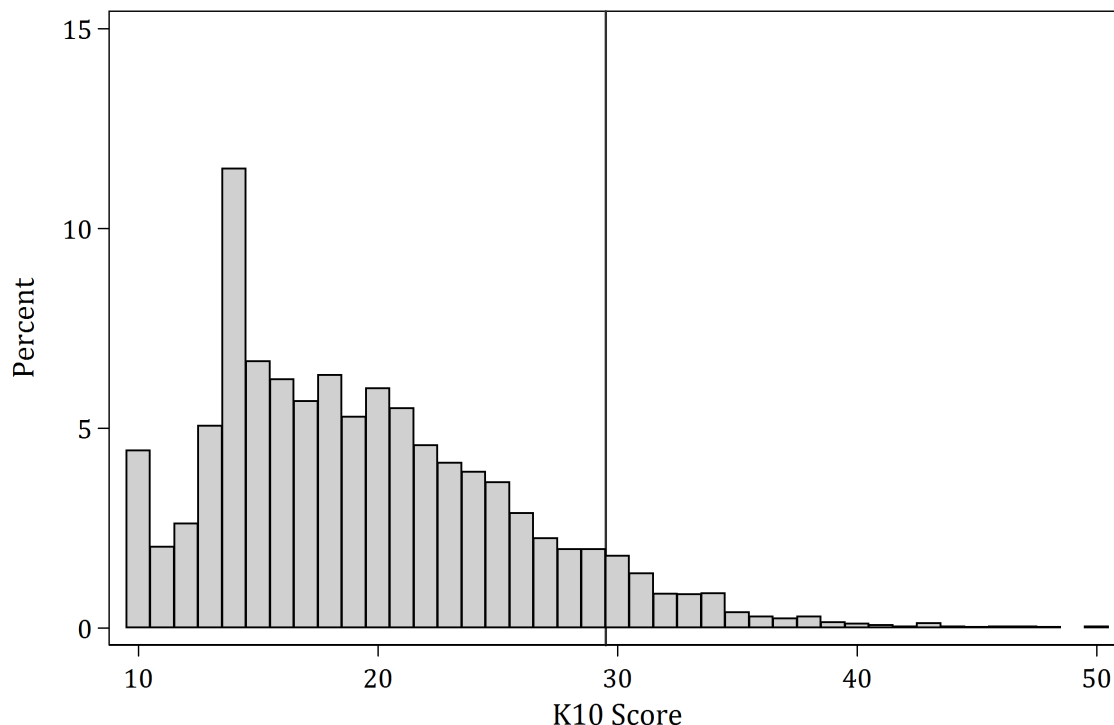
	(1)	(2)	(3)	(4)
	<i>ln(K10)</i>	<i>Severe Distress</i>	<i>ln(K10)</i>	<i>Severe Distress</i>
Price shock (Y.O.B.)	-0.051** (0.020)	-0.058*** (0.021)	-0.026 (0.020)	-0.086*** (0.031)
Observations	7,741	7,741	7,741	7,741
Selective Fertility Controls	Parents' Education Levels & Occupations		Household Fixed Effects	
Additional Regressors	Y.O.B & R.O.B. Fixed Effects; R.O.B. Trends; Controls		Y.O.B & R.O.B. Fixed Effects; R.O.B. Trends; Controls	
Altonji, Elder, Taber (2005) Implied Ratio: Adding individual controls	-61.14	-144.5		
Altonji, Elder, Taber (2005) Implied Ratio: Adding parental controls	-8.776	13.84		

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. Standard errors clustered by enumeration area in parentheses, unless otherwise indicated. All regressions are OLS and include the uninteracted "Interaction" variable. Controls are female, head, female X head, ethnicity dummies, and religion dummies, unless otherwise indicated.

Appendix: Not for publication.

A Histogram of K10 scores

FIGURE A.1: HISTOGRAM OF K10 SCORES



The vertical line in the figure represents the cutoff for severe distress.

B Controlling for political economy shocks

We demonstrate that our results survive controlling for additional shocks that might affect Ghana’s regions unevenly in an individual’s year of birth. First, we show that controlling for whether an individual shared the ethnicity of Ghana’s political leader in his year of birth does not diminish our main result.⁹ Results are presented in Table A1. Although there is some evidence that individuals benefit from sharing the ethnicity of the leader in early life, (Franck and Rainer, 2012) this does not diminish our main result.

⁹We select the ethnic group of the leader who held power for the longest period of time during any given year. In particular, we assign “British” to years before 1960, “Akan” for 1960 through 1965, “Ga-Dangbe” for 1966 through 1968, “Akan” for 1969 through 1979, “Grusi” for 1980 and 1981, “Ewe” for 1982 through 2000, and “Akan” for years after 2001.

Similarly, we show that our result survives including political regime fixed effects specific to each region. This allows us to remove any unobserved heterogeneity due to favoritism towards specific regions at different periods in Ghana’s political history.¹⁰ Results are presented in Table A1. The effect of early life cocoa prices on adult mental health remains.

C Incomplete responses and specific indicators

It is possible that those individuals suffering most from mental distress are simply unable to complete the K10 questionnaire. To test for this, create a dummy variable indicating whether an individual was administered the K10 but did not complete it. We show in Table A2 that non-response does not diminish in response to early-life beneficial price shocks.

We also use Table A2 to show that it is not only one specific item in the K10 questionnaire that responds to early-life income shocks. We find that both indicators of nervousness, restlessness, and the feeling of being unable to cheer up all are improved by beneficial early-life price shocks. Although other indicators move insignificantly in response to price shocks, 9 of 10 have negative signs.

In addition, we use Table A2 to show that parental migration into cocoa-growing regions cannot explain our main result. As a proxy for parental migration, we create a dummy for “misplaced ethnic group” that equals one if an individual was not born in the modal Ghanaian region for his ethnic group. If ethnic groups from non-cocoa-growing regions migrated into cocoa-growing regions in response to cocoa price shocks, we would expect a positive effect of price shocks on our misplaced ethnic group measure. The coefficient estimate we find is negative and insignificant.

¹⁰In particular, we code years before 1960 as “Colonial,” years from 1960 to 1965 as “First Republic,” years from 1966 to 1969 as “First Military Rule,” years from 1970 to 1971 as “Second Republic,” years from 1972 to 1979 as “Second Military Rule,” years from 1980 to 1981 as “Third Republic,” years from 1982 to 1992 as “Third Military Rule,” and years from 1993 on as “Fourth Republic.”

Table A1. Controlling for early life political economy

	(1)	(2)	(3)	(4)	(5)	(6)
	<i>ln(K10)</i>			<i>Severe Distress</i>		
<i>Control for ethnic match with president in year of birth</i>						
Price shock (Y.O.B.)	-0.026 (0.016)	-0.047** (0.021)	-0.048** (0.021)	-0.052*** (0.017)	-0.062*** (0.021)	-0.062*** (0.021)
Ethnic match with president (Y.O.B.)	-0.059*** (0.012)	-0.057*** (0.013)	-0.049*** (0.010)	-0.007 (0.009)	-0.007 (0.010)	-0.005 (0.009)
<i>Control for regime X region fixed effects</i>						
Price shock (Y.O.B.)	-0.051** (0.023)	-0.057** (0.024)	-0.057** (0.024)	-0.049** (0.024)	-0.058** (0.024)	-0.059** (0.025)
Observations	7,741	7,741	7,741	7,741	7,741	7,741
Y.O.B. Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
R.O.B. Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
R.O.B. Trends	No	Yes	Yes	No	Yes	Yes
Controls	No	No	Yes	No	No	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. Standard errors clustered by enumeration area in parentheses, unless otherwise indicated. All regressions are OLS. Controls are female, head, female X head, ethnicity dummies, and religion dummies, unless otherwise indicated.

Table A2. Incomplete responses, specific survey items, and migration

	(1)	(2)	(3)	(4)	(5)	(6)
	K10 Incomplete	A1 About how often did you feel tired out for no good reason	A2 About how often did you feel nervous	A3 About how often did you feel so nervous that nothing could calm you down	A4 About how often did you feel hopeless	A5 About how often did you feel restless or fidgety
Price shock (Y.O.B.)	0.010 (0.009)	-0.041 (0.070)	-0.112* (0.062)	-0.159*** (0.057)	-0.051 (0.078)	-0.101 (0.065)
Observations	9,902	8,109	8,100	8,093	8,097	8,032
	A6 About how often did you feel so restless you could not sit still	A7 About how often did you feel depressed	A8 About how often did you feel that everything was an effort	A9 About how often did you feel so sad that nothing could cheer you up	A10 About how often did you feel worthless	Misplaced ethnic group
Price shock (Y.O.B.)	-0.153** (0.069)	-0.086 (0.080)	0.047 (0.105)	-0.164** (0.064)	-0.056 (0.072)	-0.023 (0.019)
Observations	8,080	8,092	8,073	8,038	8,027	7,442
Y.O.B. Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
R.O.B. Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
R.O.B. Trends	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. Standard errors clustered by enumeration area in parentheses, unless otherwise indicated. All regressions are OLS. Controls are female, head, female X head, ethnicity dummies, and religion dummies, unless otherwise indicated.

Table A3. Heterogeneous Infant mortality

	(1)	(2)	(3)	(4)
	<i>Selective Mortality (Births Recode)</i>			
	<i>Died as infant</i>			
Price shock	0.003 (0.009)	0.001 (0.008)	0.004 (0.010)	0.005 (0.010)
Shock X Any Education		0.005 (0.006)		
Any Education		-0.028 (0.026)		
Shock X Agr. Self-Employed Occupation			-0.011 (0.009)	
Agr. Self-Employed Occupation			0.051 (0.039)	
Shock X Professional Occupation				0.016 (0.024)
Professional Occupation				-0.076 (0.099)
Observations	67,356	67,356	53,037	53,037
Additional Regressors	Y.O.B & R.O.B. Fixed Effects; R.O.B. Trends; Controls			

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. Standard errors clustered by region in parentheses, unless otherwise indicated. All regressions are OLS. Controls are maternal characteristics (years of education, rural, mother's year of birth, mother's year of birth squared, dummies for religion, and dummies for ethnicity) and predetermined child characteristics (birth order, multiple birth, and female).