CENTRE FOR THE STUDY OF AFRICAN ECONOMIES

CSAE Working Paper WPS/2014-03

Early Life Circumstance and Mental Health in Ghana*

Achyuta Adhvaryu†

James Fenske‡

Anant Nyshadham§

January 2014

Abstract

We study the origins of adult mental health using early life income fluctuations. Combining a time series of real producer prices of cocoa with a nationally representative household survey in Ghana, we show 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 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: early life, mental health, endowments, commodity prices, Ghana
JEL Classification Codes: I12, I15, O12

*We thank Manuela Angelucci, Prashant Bharadwaj, Jing Cai, Namrata Kala, Mari Kondo, Andrew Oswald, John Strauss, Dean Yang, and seminar participants at the University of Michigan, University of Warwick, and Johns Hopkins University (Molecular Psychiatry Group) for their helpful comments. Extra thanks are due to Francis Teal for sharing cocoa price data and Christopher Udry for making the EGC-ISSER survey data available to us. Adhvaryu gratefully acknowledges funding from the NIH/NICHD (5K01HD071949).

†University of Michigan, adhvaryu@umich.edu, achadhvaryu.com

‡University of Oxford, james.fenske@economics.ox.ac.uk, jamesfenske.com

§University of Southern California, nyshadha@usc.edu, anantnyshadham.com

UNIVERSITY OF OXFORD

Centre for the Study of African Economies

Department of Economics · University of Oxford · Manor Road Building · Oxford OX1 3UQ

T: +44 (0)1865 271084 · F: +44 (0)1865 281447 · E: csae.enquiries@economics.ox.ac.uk · W: www.csae.ox.ac.uk

1 Introduction

Mental health disorders account for 13 percent of the overall global disease burden (Collins et al., 2011). The economic losses due to mental health 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 the costs of these disorders, both in terms of health and economic development, investment in prevention and treatment remains relatively low (Collins et al., 2011).

Given the burden of mental health disorders in low-income countries, it is crucial to gain a better understanding of their origins. In this study, we ask: how does circumstance in early life affect psychological distress in adulthood? 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.

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, 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? 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 likely in turn predict birthweights or other child endowments. Additionally, we find that parents reinforce these increases in initial endowments by increasing vaccination rates and breastfeeding for longer.[2] Next, we look at adult physical health and economic outcomes. We find mixed evidence here: health, as measured by adult height, sig-

[1]In 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.

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

nificantly improves with higher cocoa prices at birth, but measures of economic circumstance (savings and occupation type) are not significantly better.

Finally, we check for selective mortality and fertility as possible explanations for the estimated mental health effects. We find little support for selective mortality, but find compelling evidence that fertility responds to price shocks. In particular, better educated, non-agricultural women are the most likely to have births during high-price periods. Given this evidence, we study the extent to which selective 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 observables 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.[3] These studies show that changes in fetal programming can affect a wide variety of outcomes, including physical health (Currie, 2009; Hoynes et al., 2012); educational performance and attainment (Bharadwaj et al., 2013a,b; Bleakley, 2007); and labor market outcomes (Almond, 2006; Bhalotra and Venkataramani, 2012; Bleakley, 2010; Gould et al., 2011).

Though this literature has grown in many directions, to our knowledge no "fetal origins" study in economics has examined long-run impacts on mental health. 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).

As a growing segment of the fetal origins literature has already documented, early life

[3] Barker's original contributions and the subsequent literature in economics are nicely reviewed in Almond and Currie (2011) and Currie and Vogl (2012).

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 suppliers, leaving households (and young children in particular) vulnerable to the deleterious effects of shocks (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.[4]

Finally, we contribute a methodological point related to selection that future fetal origins studies should consider and contend with. 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, 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.

[4]In 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).

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 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.

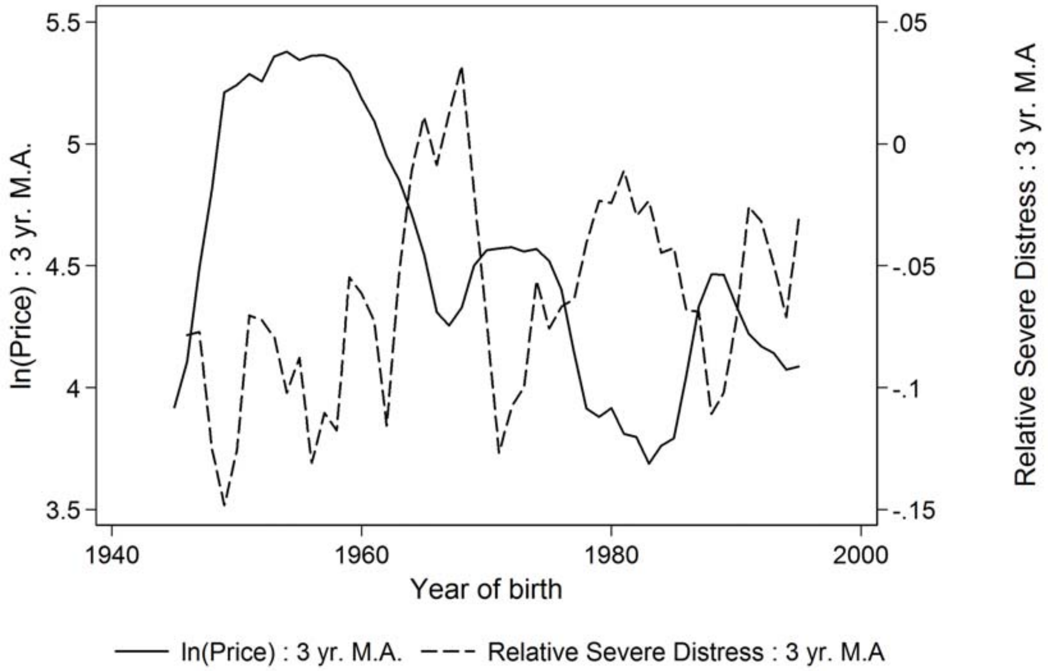
2.3 Specification

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

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

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 a dummy for whether the individual's score was above 30, 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

Figure 1: Cocoa Prices at Birth and Severe Distress



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. 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. In subsequent robustness checks, we add quadratic region-of-birth-specific time trends. In an additional specification, we include rainfall and temperature measures in the region. 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.

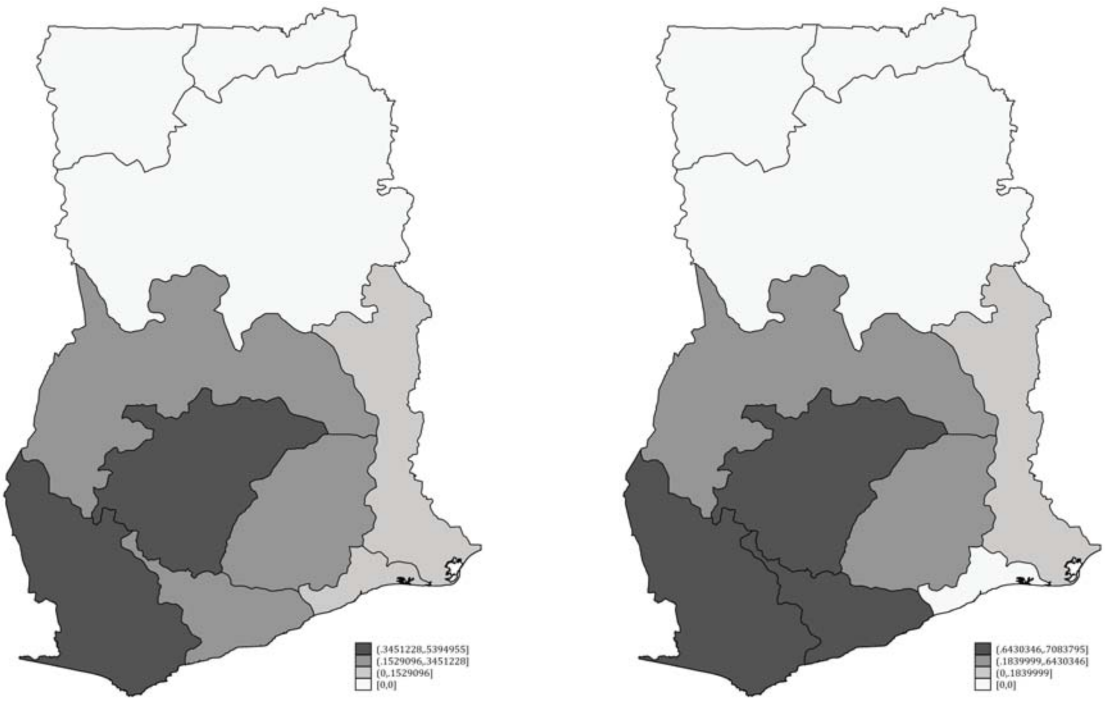
In our baseline specification, we interact these price shocks with an indicator variable for whether cocoa is produced in the respondent's region of birth. The data on cocoa production that we use to produce this baseline measure is computed directly from the EGC-ISSER Socioeconomic Panel Survey. These 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, 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.

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:

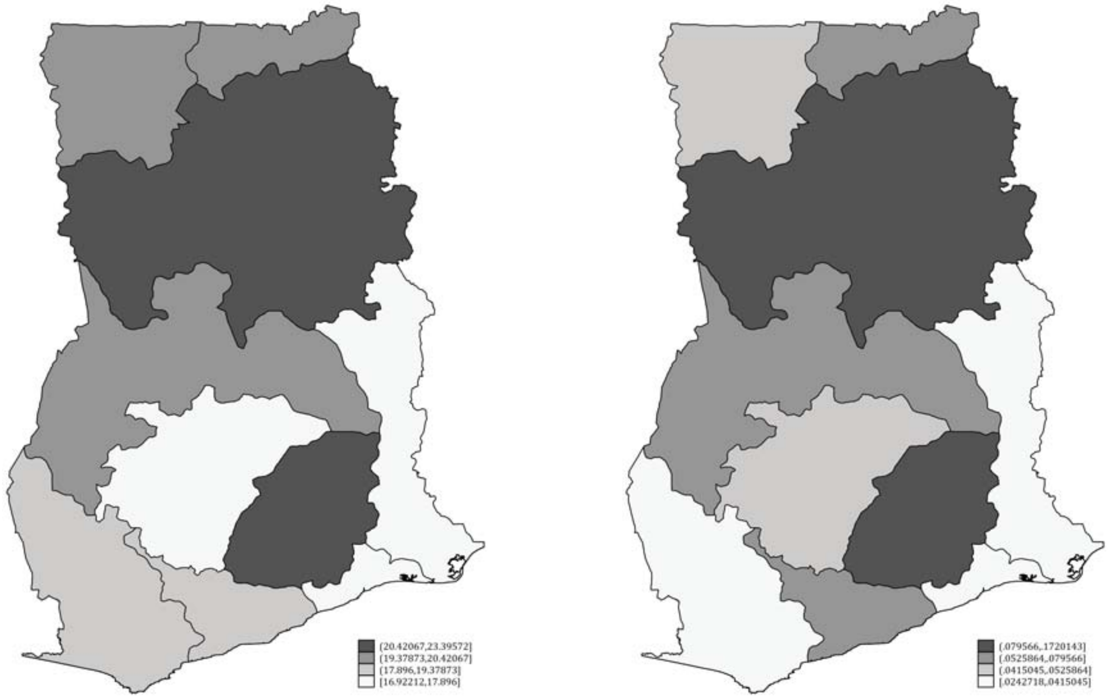
1. About how often did you feel tired out for no good reason?
2. About how often did you feel nervous?
3. About how often did you feel so nervous that nothing could calm you down?
4. About how often did you feel hopeless?
5. About how often did you feel restless or fidgety?
6. About how often did you 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 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 Diagnostic and Statistical Manual for Mental Disorders (DSM-IV) mental disorder (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).

Although cocoa prices in the first decades of the twentieth century were higher than those experienced 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 (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 becomes 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. The most rigorous specifications 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.

4.3 Robustness

We demonstrate the statistical robustness of our main result in Table 4. First, we replace the linear trends by region of birth with quadratic 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.

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. Estimates of the effect of price shocks on severe mental distress, by contrast, remain significant and become larger in magnitude than in the baseline.

We conduct additional robustness checks that are not reported here.[5] 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.

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 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.

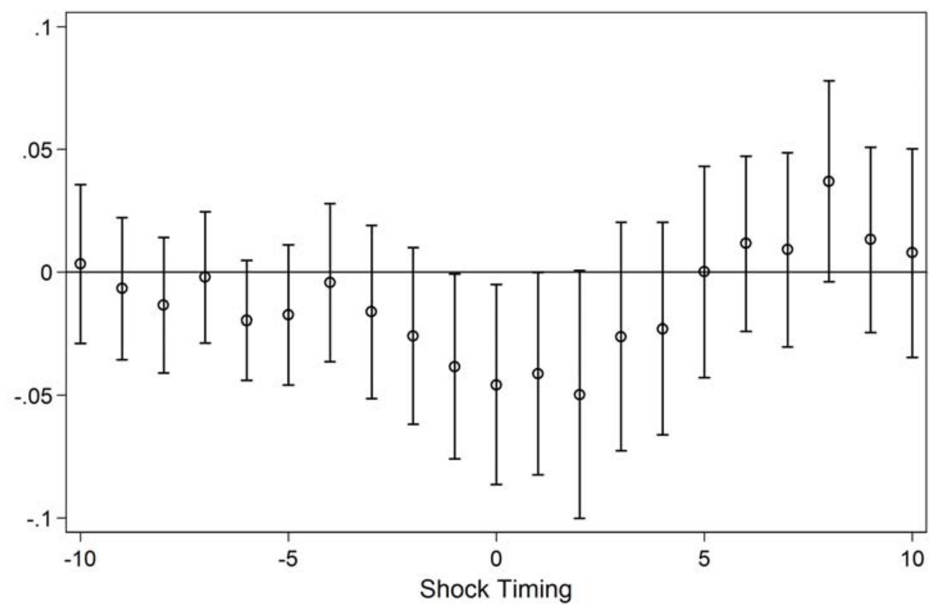
In Figures 4 and 5, we test whether shocks in years other than an individual's year of birth affect later life mental health. We re-estimate our baseline specification including both region-specific trends and controls. We replace the year-of-birth shock with price shocks

[5] These results are available upon request.

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.

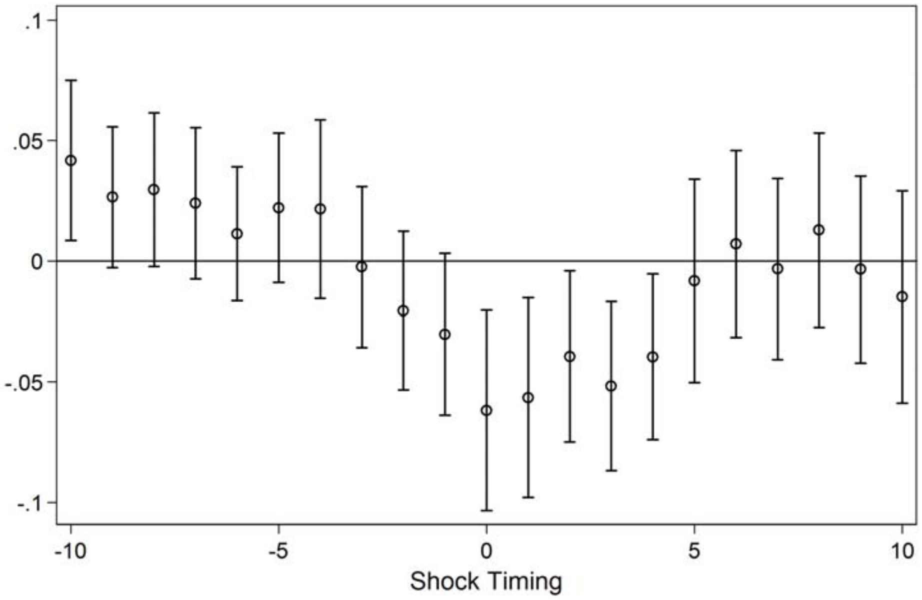
Figure 4: Effects on ln(K10) by Shock Timing



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.

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 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

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.

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.

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, perhaps 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 cross-section. Instead, we test whether the observable health outcomes of women in the DHS individual recodes respond to contemporary price shocks. We estimate:

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

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. 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.

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:

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

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 an indicator for having received any vaccine. 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. 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 top panel of Table 6 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.

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 of impacts on health stock and marriage matching. These results suggest that impacts on mental health are due 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

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

Here, $Mortality_{irt}$ is an indicator for whether child i, who was born in year t, and whose mother lives in region r died, either in the first five years of life or in the first year 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. 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 and 2 of Table 8. We find little evidence of selective mortality, particularly in infancy.

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:

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

We find, as shown in column 3 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 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 4 through 6 of Table 8 suggest that the more educated and those with skilled occupations are more likely to time their fertility around economic down-turns.

Lastly, we investigate the degree to which selection on 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 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 (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, and estimates of the implied ratio indicate that selection on unobservables would have to be between 8.7 and 13.8 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 seek to extend the literature on long-term impacts of early life factors to include the study of adult mental health outcomes. 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 rest of their 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. Effects are largest for the shocks during an individual's year of birth. The effects are 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.

In addition to being of first-order importance for welfare or utility determination and measurement, mental health is potentially a key determinant of productivity, physical health, and economic decision-making. That is, mental health is important both as an outcome of economic shocks in its own right and as a potential mechanism for some of the large, later-life impacts of early life factors measured in the literature to date.

Our results suggest two interpretations of the impacts on mental health. These are mutually compatible. 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 other economic and health variables. In this case, we would also expect the mental health impacts of shocks that were considered by other studies to be greater than the ones we have found. 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 (e.g. Devoto et al. (2012)) that regard economic outcomes as incomplete measurements of welfare. 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.

References

Adhvaryu, A. and Nyshadham, A. (2013). Endowments at Birth and Parents' Investments in Children. *Working Paper*.

Almond, D. (2006). Is the 1918 Influenza pandemic over? Long-term effects of in utero Influenza exposure in the post-1940 US population. *Journal of Political Economy*, 114(4):672–712.

Almond, D. and Currie, J. (2011). Killing me softly: The fetal origins hypothesis. *The Journal of Economic Perspectives*, 25(3):153–172.

Almond, D., Edlund, L., and Palme, M. (2009). Chernobyl's subclinical legacy: Prenatal exposure to radioactive fallout and school outcomes in Sweden. *The Quarterly Journal of Economics*, 124(4):1729–1772.

Altonji, J. G., Elder, T. E., and Taber, C. R. (2005). Selection on Observed and Unobserved Variables: Assessing the Effectiveness of Catholic Schools. *Journal of Political Economy*, 113(1):151–184.

Andrews, G. and Slade, T. (2001). Interpreting scores of the Kessler Psychological Distress Scale (K10). *Australian and New Zealand Journal of Public Health*, 25(6):494–497.

Angrist, J. D. and Pischke, J.-S. (2008). *Mostly harmless econometrics: An empiricist's companion*. Princeton University Press.

Baird, S., Friedman, J., and Schady, N. (2011). Aggregate income shocks and infant mortality in the developing world. *Review of Economics and Statistics*, 93(3):847–856.

Benjamin, D. and Deaton, A. (1993). Household Welfare and the Pricing of Cocoa and Coffee in Côte d'Ivoire: Lessons from the Living Standards Surveys. *The World Bank Economic Review*, 7(3):293–318.

Bhalotra, S. and Venkataramani, A. (2012). Shadows of the captain of the men of death: Early life health interventions, human capital investments, and institutions. *Unpublished manuscript, Univ. Bristol*.

Bharadwaj, P., Eberhard, J., and Neilson, C. (2013a). Health at Birth, Parental Investments and Academic Outcomes. *Working Paper*.

Bharadwaj, P., Løken, K., and Neilson, C. (2013b). Early life health interventions and academic achievement. *American Economic Review*, 103(5):1862–1891.

Bleakley, H. (2007). Disease and development: Evidence from hookworm eradication in the American South. *The Quarterly Journal of Economics*, 122(1):73–117.

Bleakley, H. (2010). Malaria eradication in the americas: A retrospective analysis of childhood exposure. *American Economic Journal: Applied Economics*, 2(2):1–45.

Buckles, K. S. and Hungerman, D. M. (2013). Season of birth and later outcomes: Old questions, new answers. *Review of Economics and Statistics*, 95(3):711–724.

Cameron, A. C., Gelbach, J. B., and Miller, D. L. (2011). Robust inference with multiway clustering. *Journal of Business & Economic Statistics*, 29(2):238–249.

Canavan, M. E., Sipsma, H. L., Adhvaryu, A., Ofori-Atta, A., Jack, H., Udry, C., Osei-Akoto, I., Bradley, E. H., et al. (2013). Psychological distress in Ghana: Associations with employment and lost productivity. *International Journal of Mental Health Systems*, 7(1):9.

Cogneau, D. and Jedwab, R. (2012). Commodity Price Shocks and Child Outcomes: The 1990 Cocoa Crisis in Côte d'Ivoire. *Economic Development and Cultural Change*, 60(3):507–534.

Collins, P. Y., Patel, V., Joestl, S. S., March, D., Insel, T. R., Daar, A. S., Bordin, I. A., Costello, E. J., Durkin, M., Fairburn, C., et al. (2011). Grand challenges in global mental health. *Nature*, 475(7354):27–30.

Currie, J. (2009). Healthy, wealthy, and wise: Is there a causal relationship between child health and human capital development? *Journal of Economic Literature*, 47(1):87–122.

Currie, J. and Vogl, T. (2012). Early-life health and adult circumstance in developing countries. *National Bureau of Economic Research Working Paper No. w18371.*

Daly, M. C., Wilson, D. J., and Johnson, N. J. (2013). Relative Status and Well-Being: Evidence from US Suicide Deaths. *Forthcoming in the Review of Economics and Statistics.*

Deaton, A. (1999). Commodity prices and growth in Africa. *The Journal of Economic Perspectives*, 13(3):23–40.

Dehejia, R. and Lleras-Muney, A. (2004). Booms, Busts, and Babies' Health. *The Quarterly Journal of Economics*, 119(3):1091–1130.

Devoto, F., Duflo, E., Pariente, W., and Pons, V. (2012). Happiness on Tap: Piped Water Adoption in Urban Morocco. *American Economic Journal: Economic Policy*, 4(4):68–99.

Frankenberg, E., Friedman, J., Gillespie, T., Ingwersen, N., Pynoos, R., Rifai, I. U., Sikoki, B., Steinberg, A., Sumantri, C., Suriastini, W., et al. (2008). Mental health in Sumatra after the tsunami. *American Journal of Public Health*, 98(9):1671–1677.

Friedman, J. and Thomas, D. (2009). Psychological health before, during, and after an economic crisis: Results from Indonesia, 1993–2000. *The World Bank Economic Review*, 23(1):57–76.

Gould, E. D., Lavy, V., and Paserman, M. D. (2011). Sixty years after the magic carpet ride: The long-run effect of the early childhood environment on social and economic outcomes. *The Review of Economic Studies*, 78(3):938–973.

Hoynes, H. W., Schanzenbach, D. W., and Almond, D. (2012). Long run impacts of childhood access to the safety net. *National Bureau of Economic Research Working Paper No. w18535*.

Huttunen, M. O. and Niskanen, P. (1978). Prenatal loss of father and psychiatric disorders. *Archives of general psychiatry*, 35(4):429.

Kahneman, D. and Deaton, A. (2010). High income improves evaluation of life but not emotional well-being. *Proceedings of the National Academy of Sciences*, 107(38):16489–16493.

Kessler, R. C., Andrews, G., Colpe, L. J., Hiripi, E., Mroczek, D. K., Normand, S.-L. T., Walters, E. E., and Zaslavsky, A. M. (2002). Short screening scales to monitor population prevalences and trends in non-specific psychological distress. *Psychological medicine*, 32(6):959–976.

Kessler, R. C., Barker, P. R., Colpe, L. J., Epstein, J. F., Gfroerer, J. C., Hiripi, E., Howes, M. J., Normand, S.-L. T., Manderscheid, R. W., Walters, E. E., et al. (2003). Screening for serious mental illness in the general population. *Archives of general psychiatry*, 60(2):184.

Kilkkinen, A., Kao-Philpot, A., O'Neil, A., Philpot, B., Reddy, P., Bunker, S., and Dunbar, J. (2007). Prevalence of psychological distress, anxiety and depression in rural communities in Australia. *Australian Journal of Rural Health*, 15(2):114–119.

Kruger, D. I. (2007). Coffee production effects on child labor and schooling in rural Brazil. *Journal of Development Economics*, 82(2):448–463.

Kubzansky, L. D., Kawachi, I., Spiro, A., Weiss, S. T., Vokonas, P. S., and Sparrow, D. (1997). Is worrying bad for your heart? A prospective study of worry and coronary heart disease in the Normative Aging Study. *Circulation*, 95(4):818–824.

Kubzansky, L. D., Kawachi, I., Weiss, S. T., and Sparrow, D. (1998). Anxiety and coronary heart disease: a synthesis of epidemiological, psychological, and experimental evidence. *Annals of Behavioral Medicine*, 20(2):47–58.

Lovibond, P. F. (1998). Long-term stability of depression, anxiety, and stress syndromes. *Journal of Abnormal Psychology*, 107(3):520–526.

Maccini, S. and Yang, D. (2009). Under the weather: Health, schooling, and economic consequences of early-life rainfall. *American Economic Review*, 99(3):1006–1026.

Mathers, C. D., Fat, D. M., and Boerma, J. (2008). *The global burden of disease: 2004 update*. World Health Organization.

Mednick, S. A., Machon, R. A., Huttunen, M. O., and Bonett, D. (1988). Adult schizophrenia following prenatal exposure to an influenza epidemic. *Archives of General Psychiatry*, 45(2):189–192.

Miller, G. and Urdinola, B. P. (2010). Cyclicality, mortality, and the value of time: The case of coffee price fluctuations and child survival in Colombia. *The Jurnal of Political Economy*, 118(1):113–155.

Myer, L., Stein, D. J., Grimsrud, A., Seedat, S., and Williams, D. R. (2008). Social determinants of psychological distress in a nationally-representative sample of South African adults. *Social Science & Medicine*, 66(8):1828–1840.

Neugebauer, R., Hoek, H. W., and Susser, E. (1999). Prenatal exposure to wartime famine and development of antisocial personality disorder in early adulthood. *JAMA: the journal of the American Medical Association*, 282(5):455–462.

Paxson, C., Fussell, E., Rhodes, J., and Waters, M. (2012). Five years later: Recovery from post traumatic stress and psychological distress among low-income mothers affected by Hurricane Katrina. *Social Science & Medicine*, 74(2):150–157.

Rhodes, J., Chan, C., Paxson, C., Rouse, C. E., Waters, M., and Fussell, E. (2010). The Impact of Hurricane Katrina on the Mental and Physical Health of Low-Income Parents in New Orleans. *American journal of orthopsychiatry*, 80(2):237–247.

Shonkoff, J. P. (2011). Protecting brains, not simply stimulating minds. *Science*, 333(6045):982–983.

Shonkoff, J. P., Garner, A. S., Siegel, B. S., Dobbins, M. I., Earls, M. F., McGuinn, L., Pascoe, J., Wood, D. L., et al. (2012). The lifelong effects of early childhood adversity and toxic stress. *Pediatrics*, 129(1):e232–e246.

Teal, F. (2002). Export growth and trade policy in Ghana in the twentieth century. *The World Economy*, 25(9):1319–1337.

Townsend, R. M. (1994). Risk and insurance in village india. *Econometrica: Journal of the Econometric Society*, pages 539–591.

Whang, W., Kubzansky, L. D., Kawachi, I., Rexrode, K. M., Kroenke, C. H., Glynn, R. J., Garan, H., and Albert, C. M. (2009). Depression and risk of sudden cardiac death and coronary heart disease in women: Results from the nurses' health study. *Journal of the American College of Cardiology*, 53(11):950–958.

Table 1. Summary Statistics

	(1) Mean	(2) s.d.	(3) Min	(4) Max	(5) N
Mental Health					
ln K10	2.92	0.31	2.30	3.91	7,815
Severe distress	0.074	0.26	0	1	7,815
Cocoa Price Shocks					
ln(Cocoa price) X Region any cocoa: Year of birth	3.30	2.01	0	5.52	7,741
Controls					
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
Real Producer Price Series (1943-1997)					
Real Cocoa Price	105	60.1	31.1	251	55
ln(Cocoa Price)	4.50	0.55	3.44	5.52	55
Fraction of Farm Area Under Cocoa, By Region					
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.OB. Price Shock on Mental Distress

	(1)	(2)	(3)	(4)	(5)	(6)
		ln(K10)			*Severe Distress*	
Price shock (Y.O.B.)	-0.023	-0.045**	-0.045**	-0.052***	-0.061***	-0.062***
	(0.017)	(0.021)	(0.021)	(0.017)	(0.021)	(0.021)
S.E. clustered by						
R.O.B.	(0.021)	(0.016)	(0.016)	(0.005)	(0.014)	(0.013)
Y.O.B.	(0.012)	(0.019)	(0.018)	(0.013)	(0.018)	(0.019)
C.G.M.: E.A. & Y.O.B.	(0.015)	(0.022)	(0.022)	(0.015)	(0.021)	(0.023)
C.G.M.: R.O.B. & Y.O.B.	(0.021)	(0.019)	(0.019)	(0.005)	(0.021)	(0.018)
Moulton: E.A.	(0.019)	(0.026)	(0.026)	(0.014)	(0.019)	(0.019)
Moulton: R.O.B.	(0.015)	(0.020)	(0.020)	(0.013)	(0.018)	(0.018)
Moulton: Y.O.B.	(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 am someone who is depressed, blue			*I am someone who is relaxed, handles stress well.*		
Price shock (Y.O.B.)	-0.223***	-0.278***	-0.280***	0.168***	0.121	0.142*
	(0.060)	(0.093)	(0.091)	(0.057)	(0.076)	(0.074)
Observations	6,973	6,973	6,973	7,005	7,005	7,005
	I am someone who starts quarrels with others			*I am someone who tends to be disorganized*		
Price shock (Y.O.B.)	-0.085**	-0.087**	-0.100**	-0.235***	-0.134**	-0.141**
	(0.042)	(0.042)	(0.041)	(0.058)	(0.064)	(0.066)
Observations	6,998	6,998	6,998	6,987	6,987	6,987
	I am someone who can be moody			*I am someone who can be cold and aloof*		
Price shock (Y.O.B.)	-0.254***	-0.261***	-0.275***	-0.248***	-0.288***	-0.292***
	(0.063)	(0.097)	(0.096)	(0.069)	(0.096)	(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)
	ln(K10)	*Severe Distress*	*ln(K10)*	*Severe Distress*
	Quadratic region trends		*Drop regions with 0-25% of farmland under cocoa*	
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
	Price measured as 3 year moving average		*Price averaged over ages 0-2*	
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
	Control for rainfall and temperature shocks		*Discard possible age heaping*	
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)
	ln(K10)	*Severe Distress*	*ln(K10)*	*Severe Distress*	*ln(K10)*	*Severe Distress*
	Interact with "Female"		*Interact with "Father in Agriculture"*		*Interact with "Akan"*	
Price shock (Y.O.B.)	-0.046**	-0.063***	-0.042*	-0.052**	-0.034	-0.048**
	(0.021)	(0.021)	(0.022)	(0.023)	(0.021)	(0.022)
Shock X Interaction	0.000	0.005*	-0.010	-0.009*	-0.020	-0.021**
	(0.003)	(0.003)	(0.007)	(0.005)	(0.013)	(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)
	Parental Health (Individual Recode)				
	Weight (no outliers)	*BMI (no outliers)*			
Contemporaneous Price Shock	3.538***	1.044***			
	(0.861)	(0.319)			
Observations	14,411	14,022			
Additional Regressors	Y.O.B & R.O.B. Fixed Effects;				
	Early-life Investments (Child Recode)				
	No. of Polio doses received	*No. of DPT doses received*	*Received Measles*	*No. of Total Vaccinations*	*Months of Breastfeeding*
Price shock (Y.O.B.)	0.218**	0.317***	0.034	0.528***	0.989*
	(0.076)	(0.063)	(0.054)	(0.137)	(0.510)
Observations	11,903	11,829	11,809	11,725	13,134
	Antenatal and At-birth Investments (Child Recode)				
	Prenatal Doctor Visit	*Received BCG Vaccination*	*Received Polio 0 dose*	*Home Delivery*	*Doctor Attended Delivery*
Price shock (Y.O.B.)	0.085*	-0.034	-0.010	0.028	-0.017
	(0.042)	(0.042)	(0.107)	(0.066)	(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)
	Height in cm	*BMI*	*Value of savings*	*No Occupation (DHS)*	*Partner's Occupation (DHS): Professional / Technical / Managerial*
Price shock (Y.O.B.)	1.234**	-0.118	118.621	-0.036	0.047***
	(0.547)	(0.259)	(108.694)	(0.021)	(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)
	Selective Mortality (Births Recode)		*Selective Fertility (Constructed Birth Panel)*			
	Died as infant	*Died as child*	*Birth*			
Price shock	0.003	0.017*	0.046***	0.034***	0.030***	0.032***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.006)	(0.006)
Shock X Any Education				0.023***		
				(0.002)		
Any Education				-0.120***		
				(0.010)		
Shock X Agr. Self-Employed Occupation					-0.013**	
					(0.004)	
Agr. Self-Employed Occupation					0.080***	
					(0.021)	
Shock X Professional Occupation						0.044***
						(0.008)
Professional Occupation						-0.197***
						(0.038)
Observations	67,356	67,356	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) *ln(K10)*	(2) *Severe Distress*	(3) *ln(K10)*	(4) *Severe Distress*
Price shock (Y.O.B.)	-0.051**	-0.058***	-0.026	-0.086***
	(0.020)	(0.021)	(0.020)	(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	-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.