Income shocks and conflict: Evidence from Nigeria

This paper examines the relationship between income shocks and conflict across Nigerian states over the 2000s. By matching consumption, production, commodity prices and conflict data, the analysis captures two opposite channels linking agricultural price changes to conflict. Consistently with the opportunity cost mechanism of conflict, price increases of commodities produced by the households have a conflict-reducing effect, while the opposite is true for prices of consumed commodities. The net impact of agricultural price increases is conflict inducing albeit quantitatively small. These results underscore the importance of modelling both production and consumption effects to get consistent estimates of the impact of price changes on conflict.

Keywords: conflict, Nigeria, income shocks, commodity prices

JEL classification: D74, Q02, Q11, Q34

1. Introduction

Agricultural commodity price changes are key economic shocks affecting the risk and the intensity of civil conflicts. They change *real* income for producers, consumers and the state thus affecting the relative returns of engaging in conflict activities. The literature has focused on the impact of price changes of exported agricultural commodities, such as cocoa, banana and coffee, on producers/workers. Price increases of agricultural commodities are often associated with a reduction in conflict (Dube and Vargas, 2013; Berman and Couttenier, 2015; Guardado, 2018). This is consistent with an increase in the opportunity cost of conflict associated producers/workers' incomes.

While analytically convenient, the focus on exported commodities provides only a partial representation of the reality, which may undermine the validity of some of the estimated effects. Commodity price changes can affect real incomes also through the price of households' consumption basket. As the changes in real incomes through consumption go in the opposite direction to the production channel, consumption price shocks are a potentially important omitted variable. In addition, many local producers of agricultural goods serve domestic rather than international markets. These characteristics are especially salient in a context like sub-Saharan Africa, where agricultural products represent a large share of the consumption basket and where agriculture is often geared towards serving local markets. The strength of this contrasting effect may vary over time with changes in the institutional and conflict context, thus potentially biasing the estimated effects of price changes.

This paper addresses these issues by modelling the effects of commodity price changes via both households' production and consumption in the context of one of the most conflict-

ridden African countries in the 2000s, i.e. Nigeria. In doing that it complements McGuirk and Burke (2020) who have provided such evidence across sub-Saharan African countries.

Focusing on a single country allows us to make four main contributions. First, we consider a wide range of commodities produced by the households including also several commodities that are mainly sold in local markets. This allows to isolate the 'opportunity cost' from the 'state deterrence' effect. Second, unlike other studies across countries, which rely on satellite-based maps of crop production (Berman and Couttenier, 2015; McGuirk and Burke, 2020), we model the variation in consumption and production across space on the basis of household survey data. Specifically, we construct detailed baskets of produced and consumed commodities for each household and aggregate them at the state level, the only sub-national unit at which household data is representative. This approach allows to get reliable estimates across space of production and consumption patterns, overcoming the limitation of maps-based data particularly for consumption patterns, which cannot be observed through satellite imagery.[1] Hence each commodity in the price indices is weighted by its importance in households' expenditures or income at the beginning of the period in each state. Third, we mainly use

[1] McGuirk and Burke (2020) use more coarse country-level data (from FAO balance sheets) in order to indirectly estimate consumption baskets across space. Other studies have tried to model consumption effects by using international commodity prices weighted by the commodity's share in the import basket (Arezki and Brückner, 2011; Bellemare, 2015; Janus and Riera-Crichton, 2017, Calì and Muladbic, 2017; Maystadt, Trinh Tan and Breisinger, 2014). However, these import weights are likely to be more of a reflection of purchases by firms, elites, and governments than actual household consumption (Bazzi and Blattman, 2014). Indeed, a disproportionate share of consumption comes from domestic production in developing countries, and Nigeria is no exception to this rule (data from FAO suggests that only 8 out of the main 43 agricultural commodities have shares of imports in domestic consumption above than 20%).

domestic rather than international commodity prices commonly considered in the literature as the source of local price shocks. That is because international prices have two main limitations in our context, which are likely common across countries in sub-Saharan Africa. The first is the limited transmission of international to domestic prices in Nigeria (Abidoye et al., 2015; Hatzenbuehler et al., 2017). As a result, international prices may not accurately measure the size of the price shock at the local level. This is consistent with the weak power of international prices to predict domestic price changes, particularly for consumption goods. In addition, international prices are available for a significantly smaller portion of households' production and consumption than domestic prices data. This reflects the fact that many agricultural commodities consumed and produced in Nigeria do not have relevant international markets (e.g. yam and cassava).

The advantages of using domestic prices come at the cost of the endogeneity of these prices with respect to local conflict due to both omitted variable and reverse causality bias. Besides using a full set of time invariant and time-varying controls, we address this concern by instrumenting local prices with prices in faraway states, in the spirit of Jacoby (2016). We argue that conditional on controls these prices are exogenous to the conflict in the state in question and address several potential challenges to this assumption. Hence, we can use the indices based on them as instruments for the local price indices instead of those based on international prices.

Finally, this is one of the first studies to systematically look at the drivers of conflict in Nigeria.[2] In doing so this paper fills an important gap given the strategic importance of the country as the largest country in SSA in terms of population and oil production and its role in the

[2] Bertoni et al. (2018) look at the socio-economic impact of conflict in Nigeria, by examining the impact of conflict episodes linked to the Boko Haram conflict on various educational outcomes in north-East Nigeria.

stability of the West African and African region.[3] Conflict is prevalent at the local and regional level and its scale is significant. Nigeria is the African country with the third largest number of conflict episodes in the 2003-2013 period. Importantly for our analysis, Nigeria's conflicts are highly regionalized with different types of conflicts in different regions.

The results of the analysis support the opportunity cost mechanism of conflict. Price increases of commodities produced by the households have a conflict-reducing effect, while the opposite is true for prices of commodities consumed by the households. As the magnitude of the consumption effect is larger in absolute terms, agricultural price changes have an overall (but quantitatively small) conflict-inducing impact. This is the opposite finding of recent studies focusing on the export channel of agricultural price shocks (e.g. Dube and Vargas, 2013; Berman and Couttenier, 2017).

Analyzing the effects for the different types of conflict reveal that price shocks to consumers and producers affect more protests – plausibly from the general public – rather than organized forms of violence by non-state actors. Importantly, failure to include the consumption effect biases (towards zero) the conflict reducing effect of price increase of produced agricultural commodities and vice-versa. Such biases are consistent with co-movement of commodity prices working in the opposite direction with respect to their conflict effect. This is a relevant finding as the literature mainly focus on the effects of prices of produced goods on conflict.

The paper is organized as follows. The next section reviews the trends and the types of (regional) conflicts in Nigeria over the past decade. Section 3 presents the channels linking price changes to conflict; section 4 and 5 discuss the data and the empirical methods; section 6 presents the results; and section 7 concludes.

[3] For example, Nigeria provides one of the largest troop contingents to continental peacekeeping missions.

2. Background on civil conflicts in Nigeria since 2000

Although it is not considered officially fragile according to the World Bank and the regional development banks (World Bank, 2018), Nigeria has had a recent history of acute conflict-related violence. According to the Armed Conflict Location and Events Dataset (ACLED), Nigeria has been the second most violent country in Africa since 2003 in terms of both number of conflict episodes and fatalities. While the country has not experienced a full-blown civil war and the state's monopoly of the force does not appear to be challenged, local conflicts have been a major challenge for the country's development over the past decades.

The violence varied substantially both across space and over time. We focus here on 2003-13 which is the period our data allows to analyze.[4] As figure 1 shows, conflict in Nigeria is highly regionalized. Different types of violence (battles, protests, riots, and violence against civilians) are dominant in different areas, and the underlying determinants of the conflicts are also different. The conflicts can be categorized by type and associated geographic regions:

North Central, Northwest, Northeast	**South South / Southeast**	**Urban (primarily Abuja and Lagos)**
Fulani herdsman / land tenancy issue Boko Haram insurgency	Oil industry vandalism and related uprisings	Political protests

[4] As explained below, the highly disaggregated price data needed to construct the main regressors is not available in recent years.

Violence in the so-called middle belt, and particularly in Plateau state, has been mainly in the form of communal violence in the past decade. While much of the recent violence has occurred between Muslim and Christian communities (though some violence also has occurred within Muslim communities), unequal access to land appears to be a core driver of the conflict in the middle belt.[5] In Kwara state for instance, the conflicts in Offa/Erin Ile can be attributed to disputes over land ownership and grazing rights.[6] In other states, minor disputes have escalated owing to improper handling. One example is the conflict in Ekiti State over the permanent site of a social amenity within the neighboring towns of Ise and Emure Ekiti.

Violence increased since 2010 (figure 1), particularly in the north-eastern parts of the country, in large part due to the activities of the Islamic militant group Boko Haram. Indeed, the government declared a state of emergency in the three most north-eastern states of Borno, Yobe and Adamawa in May 2013.[7] These areas also experienced some of the greatest intensification in

[5] The land rights related to indigenous rights are of particular concern for Fulani pastoralist in Plateau (and other states) as pastoralists by definition do not own the land their herds graze upon when they are on the move. Expanding cities and agriculture in addition to the uttermost Northern pastoralist routes become irregularly dry, has led the Fulani pastoralist to clash with, often indigene farmers. This is not exclusive to Plateau State as the recent violent spats in 2013 in Benue State sadly accentuate (Human Rights Watch, 2013).

[6] There was tension in the state in October 2013 following bloody clashes between Fulani herdsmen and Yoruba inhabitants at Alapa/Onire in Asa Local Government Area of the state.

[7] According to the International Crisis Group (2014) Boko Haram (usually translated loosely as "Western education is forbidden") emerged in the early 2000s as an Islamic movement in Northern Nigeria led by the charismatic cleric Mohammed Yusuf. Its aim is to establish an Islamic state in the north with strict adherence to Sharia law as it "believes that corrupt, false Muslims control northern Nigeria" (p. i). The clashes between the group – which wanted to change the political and religious order of the region - and the police started in 2009 and quickly escalated into an armed insurrection.

conflict in the country (figure 1). However, other parts of the country, particularly the middle belt states of Plateau, Kano and Kaduna, have also experienced an intensification of longstanding conflicts.

In addition, political demonstrations (particularly on fuel subsidies and corruption) have increased in recent years and have expressed themselves in violence. In Abuja and Lagos, over 40% of conflict activity is made up of rioting or protesting. Over the course of the dataset (1997-2013), over one-third of riot and protest events have involved violence (ACLED, 2013).

At the same time, conflict in other areas of the country has subsided. In particular, violence by the militant groups in the Niger Delta states, which was among the most violent parts of the country in the 2000s, was significantly reduced after the agreement of 2009, whereby the state provided amnesty for local militants along with a disarmament, demobilization, rehabilitation and reintegration (DDRR) program. Under the amnesty, which ran from August to October 2009, militants who handed in their weapons were pardoned for their crimes, trained in non-violence, and offered vocational training in various activities in Nigeria or overseas. After attending non-violence training, they are paid US$410 per month until they find work. Just over 26,000 young militants took the amnesty package (Irin, 2011b).

3. Income shocks and conflict: mechanisms

There are at least three main mechanisms through which price changes of agricultural commodities can affect political instability. First, the shock can change an individual's real income, for example by reducing the price of a good that the individual produces or consumes. A decline in an individual's real income can reduce the opportunity cost of engaging in conflict, thus increasing the potential for using violence to address tensions within society. Second, civil

conflicts are also fought over the control of valuable economic resources, i.e. the 'prize' of conflict. To the extent that price swings affect the potential value of these resources, these changes may also affect the incentive for fighting. The higher the value of the prize, the higher is the incentive for fighting. Third, if the state can extract the value of these resources, increases in this value can also raise fiscal revenues. As civil conflicts usually involve a confrontation between the state and groups of citizens, such revenues could be used by the state to repress rebellions or to 'buy-off' the rebels.

In order to illustrate the opportunity cost mechanism, consider a simple formulation of a household's real income as total income divided by the average price level faced by the household. Real income increases (decreases) with a price change if the good is produced more (less) than it is consumed. To the extent that changes in real income translate in changes in the opportunity cost of participating in conflict, price changes of consumed and/or produced goods should affect conflict intensity. Indeed within country, evidence consistently shows that changes in incomes in a region have a negative association with conflict intensity in that region (Dube and Vargas, 2013; Berman and Couttenier, 2015; Maystadt and Ecker, 2014).[8]

While the evidence so far has focused on the (nominal) income side of the equation, it is also important to model the effects of a commodities' price changes on conflict via the cost of living, which affects the denominator in the real income equation. Smith (2014) provides evidence that rising domestic consumer food prices are a contributing cause of sociopolitical unrest in urban areas of Africa; and Bellemare (2015) provides similar evidence globally. In the

[8] Blattman and Annan (2016) also confirm this evidence at the individual level by finding that Liberian post-combatants targeted by a successful agricultural training and input program were less likely to engage with mercenary recruiters when war erupted nearby.

empirical analysis below, we do that by computing two price indices that separately capture the effects on conflict via the production and the consumption channels.

The price of commodities can also affect the incentive for fighting by changing the resources that can be siphoned through violence. This is particularly the case for so-called 'point-source' commodities such as oil, which is contestable, highly valuable, capital-intensive, and geographically-concentrated resources (Dal Bó and Dal Bó, 2011 and Dube and Vargas, 2013).[9] Indeed much of the civil unrest in the Niger Delta has been linked to the desire of rebels to appropriate part of the value of the oil production (Asuni, 2009). In the empirical analysis, we control for this mechanism by using exogenous changes in the value of the oil production (relative to the local economy).

4. Data and variables

The main type of data used in this paper includes conflict, food and non-food prices, and household data for agricultural production and consumption. The data on conflict used in this study comes from the Armed Conflict Location & Event Data Project (ACLED), which include data from all countries on the African continent since 1997. ACLED definitions mainly concern actors and events. ACLED collects and codes reports from the developing world with a focus on the African continent on civil and communal conflicts, militia interactions, violence against civilians, rioting, and protesting. ACLED covers both activities that occur within and outside the context of a civil war. The data are coded by a range of experienced researchers who collect

[9] At the other end of the spectrum, 'diffuse' commodities (often agricultural commodities) are produced over wide areas, labor intensive, and more difficult (though not impossible) to control.

information primarily from secondary source information – mainly news media and other organizations' reports.[10] ACLED codes information by date, location, agent and event type; this means that a battle occurring throughout a weekend will be recorded as two events, one on each day. Every event is coded using the same rules on who, what, where, and when, to maximize comparability and validity, thorough information.

The calculation of consumption and production price indices is essential to the model estimation. While there are several surveys in Nigeria, we use the Nigeria Living Standards Survey (NLSS) 2003/2004. This is the first survey of the income and expenditure patterns of Nigerian households with sufficient data to analyze conflict over time.[11] Before describing the survey itself, we summarize the methodology used in calculating the price indices.

4.1. Price indices

The consumption price index *CI* for state s at time t is constructed as a geometric average of prices weighted by the budget shares (computed from the 2003/04 NLSS):

[10] ACLED data are collected on a weekly basis. After individual coders have scrutinized the information from reports, that is then aggregated and revised by the first coding reviewer, investigated and cross-checked by the second reviewer and then event notes and details are inspected by the third and final reviewer. The process is designed to assure (1) validity through intra- and inter-coder checks; (2) accuracy to correct mistakes in coding; and (3) relevance by determining whether each compiled event constitutes an act of political violence or protest (see more details on https://www.acleddata.com/resources/methodology/).

[11] The Living Standard Measurement Survey for Nigeria 2010/2011 is not appropriate for the purpose of our analysis for two reasons: the survey is only representative at the geo-political zone and not at the state level, and the period 2010/2011 covers periods after the Niger Delta conflict but before the core of the Boko Haram crisis.

$$CI_{st} = \left[\prod_{j=1}^{N}\left((p_{jst})^{Expshr_{sj}^{2003}}\right)\right] \times \frac{\sum_{j=1}^{N} Exptot_{sj}^{2003}}{TotExp_{s}^{2003}} \qquad (1)$$

where p_{jst} is the price of good j in state s at time t and $Expshr^{2003}$ is the share of *j* in total expenditures in 2003/04 across households in *s* on all the *N* items for which price data are available. In this way the sum of the shares always equal to 1. As we can only match a subset of consumed items with prices, we scale this index by the importance of those expenditure items (*ExpTot*) in total household expenditures in the state *TotExp* (the latter term).[12]

The main advantage of the geometric over the arithmetic average is that it allows the index to incorporate some substitution effect across commodities as relative prices change. This type of formulation is common in the literature on commodity prices and conflict (e.g. Arezki and Bruekner, 2011; Bazzi and Blattman, 2014).

The domestic price data come from Nigeria's National Bureau of Statistics (NBS), which collect monthly data for 143 food and nonfood items by state in both rural and urban areas. The price data we use covers 2000 to 2010.[13] Our analysis relies on the urban data, assuming that rural prices will be a markup / discounted value of the urban prices. The rural data are not used because the Nigerian classification of the areas into urban and rural has not been updated since 1991, and thus they are not representative of the current division in urban and rural. We use two

[12] Available domestic price data will need to be matched with food and non-food items in the survey in order to estimate the indices. Items not matched will not be used in the indices but will all contribute to the weight as described.

[13] Though another batch of data is available for 2010 to 2013, there are a number of inconsistencies in the data that makes it difficult to use at this point. The NBS changed methodology of data collection for the prices in those periods and some of the prices were totally different when compared to the 2000 – 2010 data set. Also, the items in the 2010 to 2013 data sets were different with more items included and disaggregated.

approaches to determining which price index from the NBS data is matched to which production or consumption item from the household survey. The first is a narrow price match, where the good is matched to price data with exactly the same name. However, the limited number of items in the price data means that relying on a narrow price match alone could exclude potentially important consumption items that have no exact match in the price data. The second approach is a broad price match, where the price of a food crop is also applied to products which are complements of or derived from that food crop (e.g. the price of cassava is used for its extract gari).[14] Appendix Table A1 reports the value of the scaling factor for both consumption and production indices by state for the narrow and broad match.

We construct the production price index in a similar fashion to the consumption price index with the difference that we use the underlying bundle of produced goods to weigh the prices:

$$PI_{st} = \left[\prod_{j=1}^{K}\left((p_{jst})^{Prodhsr_{sj}^{2003}}\right)\right] \times \frac{\sum_{j=1}^{K} Prodtot_{sj}^{2003}}{TotInc_{s}^{2003}} \qquad (2)$$

where *Prodshr* is the share of good *j* in the total value of households' sales of own produced goods in state s. We consider here only the products between 1 and K for which price data are available in state *s* (thus the shares sum to 1). Finally, *TotInc* is the total household income from all sources in the state. Similarly, to the consumption price index, the latter term scales the index by the importance of those items produced and sold by the households (*Prodtot*) in total household income in the state *TotInc*. Because the prices may refer to different units of measurement of the commodities, in order to standardize them, we normalize the price of every

[14] The broad matching procedure relies on subjective judgments, based on our understanding of the country and the consumption items.

commodity to 100 in 2003 and then construct the price index on the basis of the normalized series.

The variation in these price indices across states comes from both the different changes in state-level prices over time and the initial difference in consumption and production baskets. While we focus on the former below, figures A1 and A2 in the Appendix illustrate the latter, by focusing on the two most important consumption items in Nigeria, beans and rice. The variation in production and consumption is large. For example, in Benue and Ebonyi rice accounts for over 30% of total household production while in Ondo is less than 3%. Similarly, rice constitutes over 10% of total expenditures in Sokoto but only 2% in Kwara. A similar degree of variation exists for beans as well.

As explained earlier, oil plays a key role in Nigerian conflict, especially in the Niger Delta states. The evidence within countries suggests that price hikes of minerals and oil increase the risk of conflict by raising the value of resources to fight over ('state prize' hypothesis) (e.g. Berman et al., 2017; Maystadt et al., 2014). To control for its direct effect on conflict, we also construct an oil price index by interacting the oil production value in 2003 with the international oil price ($P_{st}^{oil} = oil_s \times oilpr_t$).[15] We use oil production data published in the Nigerian National Petroleum Corporation (NNPC) Annual Statistical Bulletin. However, because this data is only reported at the oil well level and not at the state level, we used a combination of online google search and geo-mapping to systematically map the oil wells to a state.[16] Given the absence of

[15] Unlike consumption and production price indices, international price is the appropriate price for the oil price index as the vast majority of the oil produced in Nigeria is eventually exported in world markets.

[16] The oil index variable should be exogenous to conflict. First, Nigeria is a price taker in the international oil market as it is a small producer (Nigeria produced approximately 2.8% of world oil production 2012). In addition, oil

GDP data by state we normalize the production by state-wise receipts of Value Added Tax (VAT) in 2003 (Source: NBS, 2010). The VAT is a tax levied on products and services, based on the contribution to output at each stage of production. Thus, low levels of VAT receipts indicate low levels of economic activity, and vice versa.

4.2. Survey description and summary

The survey was designed to collect household characteristics such as demography, education, health, and migration, primarily for poverty analysis. The survey covered the urban and rural areas of all the 36 States of the Federation and the Federal Capital Territory. Ten Enumeration Areas (EAs) were studied in each of the States every month while 5 EAs were covered in Abuja. Information on food expenditure and production by 18770 households was considered. Household expenditure is categorized into non-food and food expenses.[17] The former is, in turn, divided into frequently and less frequently purchased items.

Table 1 shows that the mean per capita food expenditure is highest in the South-South and South-East regions, which house the major oil producing wells. The South-East region had mean total per capita expenditure of N 45,216, which is well above the national average. However, the more urban South West region had the highest levels of per capita noon-food expenditures. We also note the disparity in food expenditures, food expenditures in the south are

production at the beginning of the period should not be influenced by subsequent conflict, especially as we control for past conflict level (in case there is persistence over time).

[17] The expenditure on food by household is a sum of expenditure on each individual food item over 6 visits. That is, aggregation of the response to the question, "How much was spent on … since my last visit?"

broadly greater than in the north, greater consumption of own production in the north, and, for a related reason, higher prices for some foods in the south.

The agricultural production section of the survey collects information on agricultural income and assets; land, livestock and equipment; harvest and disposal of crops; seasonality of sales and purchases (key staples only); and other agricultural income (both in cash and kind). Information on household produce sales during the last 12 months is collected for certain items, such as staple grains, field crops and cash crops, including the value of sales from hunting, honey, fruit/berries, milk, other dairy products, eggs, hides, wool and skin, and mushrooms output. On the other hand, for roots, fruits, vegetables, and other crops harvested piecemeal, respondents are asked how much the household sold in the past two weeks. We converted these two week estimates to a yearly value of sales.[18]

5. Empirical framework

We use these indices in the regression framework to measure the impact of price shocks on conflict. To do that, we differentiate between producer and consumer prices. In line with Bruckner and Ciccone (2010) and Ciccone (2011) we use the lagged percentage growth of the price indices. The basic specification reads as follows:

[18] One way of converting this is to multiply the two weeks estimate by 26 to get a total of 52 weeks' value of sale. However, inconsistency in the values reported for cassava, yam and plantain, which reported data on both two weeks and annual sales, shows that multiplication of the two-week value by 26 is not a consistent estimate of the yearly value. We therefore elected to predict the yearly value produced by each household, by applying an average of the relationships between the yearly value and the two-week value reported for cassava, yam and plantain to the other items.

$$C_{st} = \alpha_s + \gamma_t + \beta_1 GCI_{st-1} + \beta_2 GPI_{st-1} + \mathrm{A}X_{st} + \varepsilon_{st} \qquad (3)$$

where C is a measure of conflict (e.g., number of conflict episodes, number of violent episodes, number of conflict-related fatalities) and *GCI* and *GPI* are the growth rate of consumer and producer prices. , α are region-time fixed effects, which capture any time varying effect in each of the six macro-regions in Nigeria.

The vector X includes a number of key time-varying state-level covariates of conflict. First, it includes the oil price index and its interaction between a post-2009 dummy, which captures the period after the amnesty deal between the state and the militant groups in the Niger Delta. Second it includes controls for ethnicity issues, which are particularly salient in Nigeria's conflicts (Nnoli, 2003). In the absence of traditional measures, such as ethnic fractionalization (Alesina et al., 2003) and polarization (Montalvo and Reynal-Querol, 2005), at the state level, we construct two ethnic measures of the relation between the state's dominant ethnic group(s) and the ethnic group holding the presidency. The first (*president*) equals 1 if the ethnicity of the nation's president is the same as that of one of the state's dominant groups. This variable captures the idea that federal policies towards the states may be driven, in part, by ethnic allegiance which can attenuate conflict in that region. The second is a dummy variable for those states in which the president variable equals 1 and has only one dominant ethnic group. This allows us to differentiate the *president*'s effect between these two types of states.

The coefficients of interest in (3) are the βs. Given the discussion above, we would expect $\beta_1 > 0$ and $\beta_2 < 0$ in line with the opportunity cost mechanism.

The nature of the conflict data makes applying an ordinary linear regression model problematic. The conflict measures are all positive integers, so they will likely exhibit non-normal distribution. This is confirmed by a summary of the state-year level conflict measures

(Table 2). The yearly number of conflict events and yearly number of conflict events with fatalities range from 0 to 118 and 0 to 70, respectively. There is only an average of 6.9 and 2.8 conflict events and conflict events with fatalities per year.

The Poisson and Negative Binomial models are the two commonly used models for this kind of data characteristic (count data), because they ensure a positive conditional mean of the conflict variables. The Poisson model has the advantage that it does not require that the data be distributed Poisson for it to be used – that is, the model requires a weaker distributional assumption than the negative binomial model. However, the data is over-dispersed with a standard deviation much larger than mean values. For the cross-sectional data, ordinarily, the negative binomial model would have been appropriate as it is designed to handle over-dispersion in our data and will lead to higher efficiency in estimation. However, with longitudinal data, the fixed effect Poisson provides an unbiased estimate of the parameters. According to Cameron and Trivedi (2013), estimates of count models for longitudinal data results are most easily obtained for the Poisson. Extensions to the negative binomial do not always work, and when they do work, they do so only for some methods for the negative binomial model. Given that a common reason for such extensions in using cross-section data is to control for unobserved heterogeneity, the longitudinal data methods already control for heterogeneity, and Poisson longitudinal models may be enough.

5.1. Endogeneity of price indices

State-level prices are likely to be endogenous to the conflict measure in the state. For instance, high levels of conflict may reduce local production, and if markets are imperfectly integrated across space, this may boost local prices. Conflict may also reduce local demand, which would have the opposite effect on prices. This endogeneity would bias the relationship

between the price indices and conflict. Note that lagging the price indices is not likely to adequately address the endogeneity given the persistence of prices over time. We instrument for the price index variables to address this issue.

We propose four sets of indices - two for the consumption and two for the production indices - as instruments. These indices are constructed in the same way as *CI* and *PI*, but using prices which are arguably more exogenous to the conflict at the state level. The first set of price indices is the standard one based on international prices that the literature usually employs as a direct regressor in the absence of domestic price data (e.g. Bazzi and Blattman, 2014; Dube and Vargas, 2013). The instrument is constructed as follows:

$$C_{st}^{Intl} = \left[\prod_{j=1}^{I}\left(p_{jt}^{Intl}\right)^{Exps_{sj}^{2003}}\right] \times \frac{\sum_{j=1}^{I} Exptot_{sj}^{2003}}{TotExp_{s}^{2003}} \qquad (4)$$

where $p_{jt}^{Intl}$is the international price of good j at time t. This approach has several difficulties. Replacing domestic with international prices requires changing the set of goods included in the index. The range of goods for which international prices are available (from 1 to *I*) is more limited than the N or K goods included in equations (1) and (2). International prices are available only for internationally-traded commodities, which often do not include many local products important for consumption and production in Nigeria (e.g. yam and cassava). Appendix Table A2 lists the matched items between international prices and survey data. This matching is more limited than with domestic prices. The same applies to the *PI* instrument as well. Moreover, international prices do not account for the price transmission from international to domestic markets, which is often limited. Thus, international prices may not provide an ideal representation of the size of the price shock at the local level.

The most important limitation of using the international price in the case of Nigeria is the relationship between the CI domestic and international. The first stage regressions show that the

CI international is not a good instrument for the domestic CI with the parameter estimate not significant. Also, when it is added to the model with PI in the first stage, the parameter estimate has a counter-intuitive sign showing divergence in the domestic and international price indices.

Because of these limitations, we also propose another set of instruments to address both issues. The instruments are based on the domestic prices of faraway states, defined as those with a state capital further than 11 hours of vehicle travel time from the capital of the state in question. This distance is above the median bilateral road distance between Nigerian states. As argued by Jacoby (2016) in the Indian context, the distance would reduce the possible correlation of shocks across states, which is a key condition to obtain unbiased estimates of *GPI* and *GCI* in (3). We argue that this threshold excludes all the states that are close to the state's geopolitical zone of influence. The price of good *j* for a set of states X which are far from state Y should capture (i) the exogenous component of the international price of *j* which is transmitted to the domestic market, (ii) time-varying shifts in national demand and supply of *j* and (iii) shocks specific to states X which influence the price of *j*. We argue that none of these three components is influenced by the dynamics in Y. In particular, component (i) is common across states and depends on the conditions in the international market, on national trade policy, and on the characteristics of the domestic distribution industries.

The main threat to the validity of this assumption for components (ii) and (iii) would be if shocks in state Y would affect the price of *j* nationally and/or in states X. In fact, if shocks in Y did not affect *j*'s national price, then they are also unlikely to affect its price in X, as the latter are the furthest states from Y. A shock that is particularly relevant in this context is obviously conflict. If conflict events in Y affected the supply and demand conditions at the national level, this would invalidate our exclusion restrictions. We argue that this is unlikely as conflicts in

Nigeria are largely regionalized as discussed in section 2, and there is no evidence of them turning into nation-wide scale. Even if that were to be the case though, it is plausible to think that such nation-wide shock would affect prices similarly across commodities. That would not generate a bias in our estimation as the effect of such shock would be absorbed by the region-time effects. To be on the safe side, we also control for a measure of conflict intensity (i.e. the number of conflict episodes) in the set of faraway states X.

However, it could still be the case that state Y were price makers in Nigeria for a specific commodity *j*. In particular, if Y is a relatively large producer or consumer of a particular commodity, then shocks in Y may affect the prices of that commodity everywhere in the country. Two factors reduce the severity of this concern reinforcing the claim of exogeneity of the instrument. First, the high intra-national barriers to trading in Nigeria (Atkin and Donaldson, 2015) suggest that domestic markets are not well integrated. Second, the household survey data we use in the analysis indicates that no state appears to be a key producer or consumer in any of the main commodity markets. The share of production value by an individual state in total domestic consumption is generally low and in no instance higher than 13% for any of the major commodities in the sample (Tables A3 and A4 in the Appendix). However, for consumption value, Kaduna and Kano have larger shares. For robustness check we exclude these two states in the calculation of both consumption and production index. As shown below our results remain robust to these exclusions.

In practice, we are arguing that rather than affecting prices of *j* in state Y, these instruments capture the co-movements in the price of *j* between Y and X, which are due to underlying factors common across states including trade policies and the characteristics of the national distribution sectors. This would allow improvement on the power of the instruments vis-

à-vis the international price-based instruments while maintaining the validity of the exclusion restrictions.

For each state *s*, we compute the weighted average of prices of states located beyond a certain travel distance (*D*) to the capital of state *s* – weighted by the inverse of *D*:

$$p_{jst}^{other} = \sum_{m=1}^{N_s} \frac{1}{D_m} \times p_{jmt} \qquad (5)$$

where p_{jmt} is the price of *j* in state *m* at time *t* for all the N_s states whose capital is located beyond 11 hours travel distance. On average, about 10 states are included based on this threshold. Differently from Jacoby (2016), we penalize far away state's prices, conditional on being more than 11 hours away, by applying the inverse distance weight. This ensures that within the set of states beyond 11 hours, those relatively closer to the state in question have a greater weight.[19]

We then replace the p_{jst} in equation (1) with p_{jst}^{other} to obtain the instrument CI_{st}^{oth}. We also do the same for *PI*. Note that the rest of equation (1) is unchanged, as the goods *j* are the same in equations (5) and (1) since the price data come from the same source (Nigeria Bureau of Statistics). That is, of course, the case for both the broad and the narrow matching of goods between the price and the survey data. It is also the case for the production indices defined in equation (2).

We follow Wooldridge (2015) and Cameron and Trivedi (2009) that recommend the use of control function approach to implement the IV estimation in non-linear models such as the one we use here. This approach is particularly appealing with these estimators compared with

[19] The results do not change without weights. We also experiment with different distance thresholds, i.e. 3, 4, 6 and 7 hours obtaining similar results (results available upon request).

other approaches such as "plug- in" methods or joint maximum likelihood, which can be computationally challenging.[20] Hence we use these instruments to extract the endogenous component of G*CI* and G*PI* through the first stage regressions:

$$GCI_{st} = \alpha_s + \gamma_t + \delta_1^{oth} GCI_{st}^{oth} + \delta_2^{oth} GPI_{st}^{oth} + X_{st} + \mu_{st} \quad (6)$$

$$GPI_{st} = \alpha_s + \gamma_t + \delta_1^{intl} GCI_{st}^{oth} + \delta_2^{intl} GPI_{st}^{oth} + X_{st} + \nu_{st} \quad (7)$$

and retrieve the respective estimated residual components of the price indices $\widehat{\mu_{st}^{oth}}$ and $\widehat{\nu_{st}^{oth}}$ from equations (6) and (7). The exogenous variation induced by the excluded instruments provides separate variation in the residuals. These residuals should contain the endogenous component of GCI_{st} and would serve as the control functions in equation (2) (Wooldridge, 2015), which then becomes (when using the domestic price indices of faraway states as instruments):

$$GC_{st} = \alpha_s + \gamma_t + \beta_1 GCI_{st-1} + \beta_2 GPI_{st-1} + BX_{st} + \widehat{\mu_{st}^{oth}} + \widehat{\nu_{st}^{oth}} + \varepsilon_{st} \quad (3')$$

The coefficients of *GCI* and *GPI* should not suffer from endogeneity bias as the residuals from the first stage will purge the endogenous component of the price indices. This formulation ensures the computation of consistent standard errors (Cameron and Trivedi, 2009). The signs of the residuals (not reported in the tables but available upon request) confirm the direction of the endogeneity bias, which is negative for *GCI* and positive for G*PI*. In other words, by reducing the demand for products, conflict reduces the prices of consumed goods, and thus it generates a

[20] Cameron and Trivedi (2009) presented two distinct methods to control for endogeneity – a structural-model approach and a less parametric instrumental-variables (IV) approach. The two-step estimator is the IV approach that we applied in this paper.

spurious negative correlation between *GCI* and conflict. The opposite is true for *GPI*. Therefore, in both cases, the endogeneity biases the *GCI* and G*PI* coefficient towards zero.[21]

As it turns out, the growth in the price indices of faraway states is a good predictor of the (endogenous) changes in the price indices (Table 3). That is the case for both GCI_{NAR} and GPI_{NAR} as individual regressors (columns 1-2) and jointly (columns 3-4). The strong predictive power of the instruments also extends to the broad indices (columns 5-6). On the other hand, the international price of the consumption index has a much weaker predictive power, and in fact GCI_{NAR}^{intl} coefficient is not a significant predictor of GCI_{NAR} (column 7), a result that applies to the broad index as well (column 9). That is consistent with the two problems described above (limited transmission of international to domestic prices and limited number of items matched) when using international prices to capture price shocks at the local level in Nigerian markets, as also documented by Abidoye et al. (2015) and Hatzenbuehler et al. (2017).[22] This limited transmission is shown for two important consumed commodities (beans and imported rice) in figures A3 and A4 in the Appendix. The figures show that the pattern of state-level endogenous prices over 2003-10 is closer to that of exogenous state-level prices (computed based on faraway states) than to that of international prices.[23] The international price of the production index is instead significantly correlated to *GPI* (columns 8 and 10), which is consistent with the

[21] Given the some of the commodities are common across the two indices, one may also be concerned about potential multicollinearity between GPI and GCI. However, their correlation conditional of the controls is 0.59, well below a worrying level for multicollinearity.

[22] The limited transmission of international to domestic prices is a common feature of countries in sub-Saharan Africa (Minot (2011).

[23] A similar pattern is available for other main commodities for which both domestic and international prices are available, such as bean (figures available upon request).

important role Nigeria's agriculture plays in the West African region. Because of the weak predictive power of GCI^{intl} we base our instrumentation strategy only on the price indices of faraway states.

6. Results

Table 4 presents the summary statistics for the main price variables in the analysis for the 2004-11 period. *GPI* based on national level price data has a slightly larger mean and a larger standard deviation than *GCI*. That is the opposite than for the price indices using international prices. The difference in mean values between the domestic and international price indices is larger for *GCI* than for *GPI* consistently with the more limited passthrough of the price of consumed commodities documented above.

Table 5 presents the results of the baseline specification in equation (3). To check for the possible bias of omitting production or consumption price indices, we first employ a parsimonious specification with only the (narrow version of) G*CI* along with the residual $\widehat{\mu_{srt}^{oth}}$ (from the first stage using the other states' prices index), and the full set of controls. The result in column (1) shows a non-significant impact of G*CI* on conflict events in Nigeria. In column 2 we only use the *GPI* variable along with its residual $\widehat{v_{srt}^{oth}}$ in place of the consumption index. The *GPI* coefficient is negative and significant at the 10% level – a doubling of commodity prices faced by producers reduces conflict events by 0.23, or 3.3% when evaluated at the mean.

The *GCI* result runs counter to the theoretical priors, according to which an increase in consumption prices faced by the households should - other things being equal - reduce their real income and hence their opportunity cost of engaging in conflict. It turns out that this result is in fact capturing also the concomitant and inverse conflict effect of the (omitted) producer price increases. When both *GCI* and *GPI* are included in the same specification, the *GCI* coefficient

becomes highly significant and remains positive (column 3): a doubling in the consumption price index generates an additional 1.75 conflict events, or an increase by 25% relative to the mean. The *GPI* coefficient also becomes larger in absolute magnitude than in column 2, with a doubling in production price index leading to a reduction by 1.17 in conflict events, or a 17% reduction from the mean.

As the two effects work in opposite directions, the net impact of price increases is smaller in absolute terms than that of the individual price indices. A doubling of all agricultural prices leads to an increase in conflict events in a state by 8.3% relative to the mean, significant at 5% level. This positive net effect is consistent with McGuirk and Burke (2020), who also find that the consumption channel of food price changes dominates the production channel across sub-Saharan Africa.

Another way of representing these results is to use changes expressed in standard deviation terms. That is relevant as the standard deviation is larger for *GPI* than *GCI* as shown in Table 4. A one standard deviation increase in *GCI* causes 0.36 additional conflict events in the state. This is remarkably similar to the reduction in conflict events caused by a one standard deviation increase in *GPI* (0.35). The resulting net effect is a negligible increase in conflict events (0.11% relatively to the mean).

The results are qualitatively similar also when using the broad definition of price indices, although the estimates are less precise so the net positive impact of price increases on conflict is not statistically significant (column 4). In columns (5) and (6) we regress the conflict variable directly on the two instruments, obtaining similar results as in columns (3) and (4) respectively.[24]

[24] The results for the oil price index – available from the authors upon request – also suggest that the growth in oil prices increases conflict events until 2009. This effect is in line with the growing evidence of the conflict inducing

6.1. Conflict types

So far, we have lumped all conflict events into one single indicator. However different income shocks may generate different types of conflict. To explore this heterogeneity, in Table 6 we use the various categories of conflict measures available in the ACLED data. The key distinction here is between episodes proxying for social unrest by the general public, measured through protests and riots events, and more violent episodes typically involving militant groups and at times the state, including events with violence against civilians and battles. We also use the number of conflict-related fatalities as a direct measure of the intensity of conflict related violence. For each dependent variable, we use both the narrow (odd columns) and broad definitions (even columns) of price indices.

This breakdown shows that price shocks on consumed commodities have the largest impacts on protests and riots (columns 1-2). A unit increase of both GCI ad GPI leads to 1.7-1.8 additional conflict events, more than doubling relative to the mean. The net impact is again much smaller when expressed in standard deviation terms (0.14 additional events, or a 9-10% increase from the mean value).

The net impact is also positive but smaller for battles, although it is only mildly significant when using the broad version of the price indices (columns 3 and 4). A doubling of agricultural prices (using the narrow definition) leads to an additional battle event, or a 42%

effects of the increased value of point-source commodities (Dube and Vargas, 2013; Maydstadt et al., 2014; Berman et al., 2017; Calì and Mulabdic, 2017). On the other hand, this effect turns negative after the amnesty deal in 2009, consistent with the idea that the deal was effective in curbing violence in the Niger Delta states (Sayne, 2013).

increase relative to the mean. The net effect is a 6% increase when using the change in standard deviation.

On the other hand, the impact is not distinguishable from zero for violent events, including episodes of violence against civilians (column 5 and 6), with the positive *GCI* impact neutralizing the negative *GPI* impact and number of fatalities (columns 7 and 8). These results support the hypothesis that in Nigeria price shocks to consumers mainly affect protests – plausibly from the general public – rather than organized forms of violence by non-state actors. On the other hand the production channel is relatively more important to explain the impact of agricultural commodity price shocks on violent events.

7. Discussion and conclusions

Do income shocks affect conflict? We have addressed this question by analyzing the effects of agricultural price shocks to consumers and producers on conflict across Nigerian states. The results support the opportunity cost mechanism of conflict: price increases of agricultural commodities produced by the households have a conflict-reducing effect, while the opposite is true for prices of commodities consumed by the households. The net impact of agricultural price increases is conflict inducing although quantitatively small.

These results depart from the literature focusing on exported agricultural commodities, which typically captures the opportunity cost effect for producers. As a result the most common finding is that of a negative relation between agricultural price changes and conflict (Dube and Vargas, 2013; Berman and Couttenier, 2015; Guardado, 2018).[25] To the extent that the price changes of these commodities co-move with that of other commodities consumed by the

[25] Differently from other studies, Crost and Felter (2019) found that price increases of banana, Philippines' largest export crop, raised conflict intensity in the country. But this effect was driven by insurgents' extortion of agricultural export firms to fund their operations rather than to the consumption channel which the study doesn't explore.

households, the focus on the production channel may over-estimate the conflict-reducing impact of agricultural price increases. Consistently with our findings, increases in *GPI* may raise real incomes (and thus the opportunity cost of fighting) for households that are predominantly affected through the goods they produce. At the same time, they will lower real incomes for households that are predominantly affected through the goods they consume.

The use of household surveys and the focus on one country have allowed us to consider a large variety of agricultural commodities. Many of them, such as beans, millet and yam, are mainly domestically traded and are produced and consumed by a large share of households across Nigerian states. The domestic prices of these commodities have relatively limited relation with international prices, underscoring the importance of relying on domestic price series for the analysis.

The fact that the consumption effect appears quantitatively more important than the production effect is in line with the evidence across sub-Saharan Africa in McGuirk and Burke (2020). Future research may help shed light on whether this is an empirical regularity or whether this type of result emerges only under certain conditions. One hypothesis is that in contexts like Nigeria where agriculture is mainly domestically oriented and its value added limited, the opportunity cost via the production channel may be relatively limited. At the end of our period of analysis in 2010, agriculture represented around 41 percent of the employment, but agricultural exports amounted to less than 4% of merchandise exports and less than 1% of GDP.

From a policy point of view, these findings suggest that in conflict prone environments, it is important to assist populations to cope with consumption and production price shocks to avert negative political externalities. There are various options to do that, including, for instance, targeted transfers, price subsidies, and even temporary trade insulation. A discussion of the

relative merits of the different options is beyond the scope of the paper, but the evidence suggests that targeted transfers appear to be a useful policy tool to shelter poorer households from adverse production or consumption price shocks (Anderson et al., 2013; Attanasio et al., 2013).

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Tables

Table 1: Household per capita expenditure on food and non-food by zone

	Per Capita Food Expenditure	Per Capita Non-Food Expenditure	Total Per Capita Expenditure
South South	17,287	19,199	36,486
South East	22,314	22,902	45,216
South West	16,533	26,696	43,229
North Central	14,740	15,067	29,806
North East	15,364	12,171	27,535
North West	16,907	11,176	28,083
National	17,094	18,506	35,600

Source: National Bureau of Statistics (2004)

Table 2: Summary statistics of the dependent variables (2004-11)

	Obs	Mean	Std. Dev.	Min	Max	% of Zeroes
Nr. of conflict events	296	6.9	12.8	0	118	21.3
Nr. of battles	296	2.4	5.2	0	45	41.7
Nr. of protest and riots	296	1.5	3.2	0	26	56.9
Nr. of events with violence against civilians	296	2.8	6.4	0	70	40.3
Nr. of fatalities from conflict events	296	18.4	85.6	0	1001	41.4

Source: ACLED

Table 3: First Stage Regression estimates of prices on instruments

	(1) GCI_{NAR}	(2) GPI_{NAR}	(3) GCI_{NAR}	(4) GPI_{NAR}	(5) GCI_{BR}	(6) GPI_{BR}	(7) GCI_{NAR}	(8) GPI_{NAR}	(9) GCI_{BR}	(10) GPI_{BR}
GCI_{NAR}^{oth}	0.908***		1.173***	0.148						
	(0.068)		(0.149)	(0.219)						
GPI_{NAR}^{oth}		0.802***	-0.160*	0.725***						
		(0.052)	(0.068)	(0.125)						
GCI_{BR}^{oth}					1.365***	0.437**				
					(0.179)	(0.199)				
GPI_{BR}^{oth}					-0.234***	0.611***				
					(0.076)	(0.108)				
GCI_{NAR}^{intl}							0.054			
							(0.103)			
GPI_{NAR}^{intl}								0.926***		
								(0.098)		
GCI_{BR}^{intl}									-0.016	
									(0.093)	
GPI_{BR}^{intl}										0.867***
										(0.092)
Obs	295	295	295	295	295	295	295	295	295	295
R-sq.	0.510	0.690	0.516	0.691	0.441	0.697	0.017	0.134	0.006	0.131
States	37	37	37	37	37	37	37	37	37	37

*Cluster robust standard errors in parentheses at the state level; *** p<0.01, ** p<0.05, * p<0.1; dependent variables are the consumption and production price indices all regressions are estimated using the fixed effect OLS estimator and include all of the controls in Table 5 column (3).*

Table 4: Summary statistics of the main variables (2004-11)

	Obs	Mean	Std Dev	Min	Max
GCI_{NAR}	295	.0973	.2034	-.8063	.9626
GPI_{NAR}	295	.1108	.2969	-.7786	.9158
GCI_{NAR}^{oth}	295	0.1054	0.1771	-0.5856	0.7219
GPI_{NAR}^{oth}	295	0.1165	0.3161	-0.6889	0.7585
GCI_{BR}	295	0.0986	0.1756	-0.7352	0.8901
GPI_{BR}	295	0.1083	0.2779	-0.7287	0.8239
GCI_{BR}^{oth}	295	0.1064	0.1399	-0.4987	0.6390
GPI_{BR}^{oth}	295	0.1137	0.2955	-0.6406	0.6897
GCI_{NAR}^{Intl}	295	0.1207	0.1403	-0.2175	0.4254
GPI_{NAR}^{Intl}	295	0.0947	0.1083	-0.1334	0.3112

Table 5: The impact of price shocks on conflict events in Nigeria (2004-11)

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Variable	Nr of conflict events in state-year					
GCI_{NAR} (t-1)	0.021		1.749***			
	(0.287)		(0.599)			
GPI_{NAR} (t-1)		-0.230*	-1.173***			
		(0.125)	(0.337)			
GCI_{BR} (t-1)				1.135*		
				(0.664)		
GPI_{BR} (t-1)				-0.756**		
				(0.334)		
GCI^{oth}_{NAR}(t-1)					1.662***	
					(0.475)	
GPI^{oth}_{NAR}(t-1)					-1.042***	
					(0.247)	
GCI^{oth}_{BR}(t-1)						1.003
						(0.670)
GPI^{oth}_{BR}(t-1)						-0.654***
						(0.301)
GCI + GPI			0.576**	0.379	0.620***	0.349
(Prob > chi2(1))			0.043	0.301	0.010	0.365
Instruments	GCI^{oth}_{NAR}	GPI^{oth}_{NAR}	$GCI^{oth}_{NAR}, GPI^{oth}_{NAR}$	$GCI^{oth}_{BR}, GPI^{oth}_{BR}$	None	None

*Dependent variable is the number of any conflict events in the state in year t; *, **, *** indicate statistical significance at the 10, 5, and 1 percent level, respectively. Data are for 37 states for the period 2004-11. All regressions include fixed effects (state), year and various controls (oil price index, its interaction with a post-2009 dummy, a dummy for whether the federal president is of the same ethnicity as the dominant group in the state and the interaction between this variable and the multiple dominant groups dummy). Regressions 1-4 include the residuals from specifications (6) and (7) to purge the endogeneity of the price indices variables. GCI (t-1) and GPI (t-1) are the commodity price growth indices between t-2 and t-1. The models are estimated through the fixed effect Poisson estimator for panel data with cluster robust standard errors at the state level. Estimates are Average Marginal Effect (AME).*

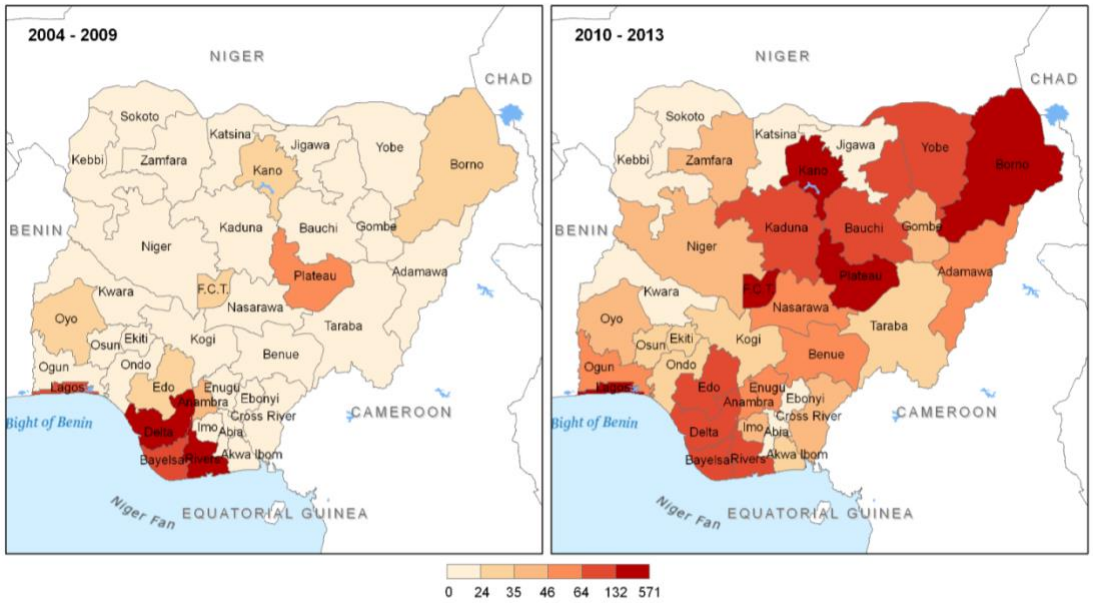
Table 6: The impact of price shocks on various types of conflict in Nigeria (2005-11)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Protest and riots		*Battles*		*Violence vs. civilians*		*Fatalities*	
GCI_{NAR} *(t-1)*	3.774***		1.772***		1.209		-1.204	
	(1.217)		(0.589)		(0.834)		(1.845)	
GPI_{NAR} *(t-1)*	-2.109***		-0.768**		-1.363***		0.735	
	(0.702)		(0.379)		(0.512)		(1.104)	
GCI_{BR} *(t-1)*		3.540***		1.268		0.216		-2.278
		(1.186)		(0.872)		(0.933)		(2.313)
GPI_{BR} *(t-1)*		-1.718***		-0.363		-0.823		1.141
		(0.586)		(0.433)		(0.528)		(0.945)
GCI + GPI	1.665***	1.822***	1.004***	0.905*	-0.154	-0.607	-0.469	-1.137
(Prob > chi2(1))	0.003	0.005	0.0001	0.057	0.715	0.252	0.627	0.466
Instruments	CI_{NAR}^{oth} PI_{NAR}^{oth}	CI_{BR}^{oth} PI_{BR}^{oth}	CI_{NAR}^{oth} PI_{NAR}^{oth}	CI_{BR}^{oth} PI_{BR}^{oth}	CI_{NAR}^{oth} PI_{NAR}^{oth}	CI_{BR}^{oth} PI_{BR}^{oth}	CI_{NAR}^{oth} PI_{NAR}^{oth}	CI_{BR}^{oth} PI_{BR}^{oth}

*Dependent variable is the number of conflict events (by type) in the state in year t; *, **, *** indicate statistical significance at the 10, 5, and 1 percent level, respectively. Data are for 37 states for the period 2004-11. All regressions include fixed effects (state), year and all control variables as in column 3, Table 5. The models are estimated through the fixed effect Poisson estimator for panel data with cluster robust standard errors* at the state level. *Estimates are Average Marginal Effect (AME).*

Figures

Figure 1: Conflict intensity across states in Nigeria



Source: ACLED. Note: the darker the color the higher the number of (any) conflict events in the period

Appendices: Only for online publication

Table A1: Percentage expenditure and production merged by state

State	% of Total Exp. Matched Narrow	% of Total Exp. Matched Broad	% of Total prod. Matched Narrow	% of Total prod. Matched Broad
Abia	53.2455	55.9737	0.4565	0.5000
Adamawa	61.1469	63.7800	0.4667	0.5111
Akwa Ibom	52.0054	54.1582	0.4651	0.5116
Anambra	57.5641	61.3373	0.4783	0.5000
Bauchi	60.9677	64.0052	0.5385	0.5641
Bayelsa	62.5000	64.0851	0.5152	0.5758
Benue	54.3033	56.1817	0.5116	0.5349
Borno	55.9343	60.6061	0.5128	0.5385
Cross-rive	52.2466	54.1623	0.4545	0.4773
Delta	63.8527	66.2442	0.4054	0.4595
Ebonyi	61.9289	63.9594	0.4667	0.5111
Edo	59.7893	63.5874	0.4324	0.4595
Ekiti	63.4338	65.7929	0.4872	0.5128
Enugu	59.7952	62.7684	0.4889	0.5111
Gombe	61.4429	64.8947	0.4884	0.5349
Imo	55.0372	57.9898	0.4545	0.5000
Jigawa	56.6094	66.3900	0.5000	0.5278
Kaduna	61.0935	63.5499	0.4889	0.5333
Kano	63.7941	69.9496	0.4524	0.5000
Katsina	51.1571	55.7856	0.5116	0.5349
Kebbi	61.0268	65.2244	0.5143	0.5429
Kogi	63.4422	69.7236	0.5116	0.5581
Kwara	47.8157	52.3799	0.5263	0.5789
Lagos	51.1937	54.0241	0.5000	0.5294
Nassarawa	62.8445	65.7846	0.4565	0.5000
Niger	63.9581	66.4974	0.5588	0.5882
Ogun	55.8953	57.7191	0.5429	0.5714
Ondo	65.6560	66.6110	0.5000	0.5263
Osun	49.7748	59.2342	0.5263	0.5526
Oyo	55.3316	62.8739	0.5135	0.5135
Plateau	64.0244	67.5087	0.5000	0.5227
Rivers	59.8634	61.3050	0.4706	0.5000
Sokoto	62.9969	66.2589	0.5405	0.5676
Taraba	52.9840	54.1485	0.4889	0.5111
Yobe	64.8601	67.5255	0.5588	0.5882
Zanfara	59.1468	62.8108	0.5000	0.5476
FCT	59.2188	61.3188	0.5366	0.5854

Source: Authors' elaboration on NLSS 2003/04

Table A2: Broad matching of international price data with survey items

Consumption International		Production Intl
Akara	Groundnut oil	Cocoa
Baby milk	Groundnuts	Coconut
Banana	Maize (white)	Coffee
Beef (fresh cattle)	Maize (yellow)	Cotton
Bread	Maize flour	Kernel
Brown beans	Milk powder	Rubber
Bush meat	Moimoi	Wood
Cassava	Orange	G'nut/Peanut
Cassava (akpu)	Orange juice	Maize
Cassava flour	Palm kernel oil	Rice
Chicken	Red palm oil	Millet
Cigarette	Rice (agric)	Guinea Corn
Coconut oil	Rice (imported)	Beans
Coffee	Rice (local)	Tobacco
Cooked rice/stew	Smoked fish	Bananas
Crabs/lobsters	Suya beans	Oil Palm
Dried fish	Tobacco (processed)	Oranges
Fish fresh	Vegetable oil	Cassava
Fish frozen	White bean	Yam
Fresh milk	Yam	palm wine
Fried fish	Yam Flour	milk
Gari (white)		
Gari (yellow)		
Gari and soup		

Table A3: Overall production percentage by state - Top 10 states by major commodities (2003/04)

Rankings	State	beans	State	maize	State	millet	State	rice	State	yam
1	Katsina	2.35	Ogun	4.95	Sokoto	12.93	Benue	2.60	Benue	1.42
2	Bauchi	2.11	Katsina	4.83	Kano	10.80	Niger	0.90	Enugu	1.13
3	Jigawa	1.82	Anambra	4.69	Katsina	10.68	Taraba	0.88	Edo	1.02
4	Kano	1.79	Delta	4.66	Yobe	8.68	Kaduna	0.76	Ondo	0.83
5	Gombe	1.70	Kaduna	4.08	Bauchi	6.36	Bauchi	0.65	Cross-rive	0.82
6	Kebbi	1.66	Oyo	3.55	Borno	6.24	Katsina	0.54	Oyo	0.76
7	Borno	1.60	Taraba	3.03	Niger	5.67	Nassarawa	0.41	Nassarawa	0.73
8	Sokoto	1.15	Rivers	2.83	Kaduna	5.06	Borno	0.39	Rivers	0.73
9	Yobe	1.14	Akwa Ibom	2.12	Gombe	4.98	Adamawa	0.33	Abia	0.68
10	Niger	0.90	Imo	1.99	Kebbi	4.86	Ebonyi	0.29	Kaduna	0.65

Source: Authors' elaboration on NLSS 2003/04

Table A4: Overall consumption percentage by state - Top 10 states by major commodities (2003/04)

Rankings	State	beans	State	maize	State	millet	State	rice	State	yam
1	Kano	10.53	Kaduna	13.64	Kano	27.85	Kaduna	5.29	Oyo	11.36
2	Katsina	4.08	Oyo	7.55	Sokoto	8.86	Niger	3.44	Ondo	5.27
3	Jigawa	2.61	Katsina	6.13	Katsina	8.46	Borno	3.18	Rivers	5.24
4	Borno	2.38	Taraba	2.31	Borno	6.07	Katsina	2.54	Edo	4.68
5	Niger	2.28	Anambra	1.92	Kebbi	5.47	Benue	2.46	Kaduna	4.46
6	Bauchi	1.80	Ogun	1.11	Bauchi	5.46	Bauchi	2.11	Abia	4.14
7	Sokoto	0.98	Imo	0.72	Yobe	5.20	Nassarawa	1.26	Enugu	3.51
8	Gombe	0.87	Akwa Ibom	0.59	Kaduna	4.09	Adamawa	1.00	Cross-rive	1.76
9	Yobe	0.61	Rivers	0.41	Niger	3.64	Ebonyi	0.94	Benue	1.66
10	Kebbi	0.44	Delta	0.28	Gombe	2.10	Taraba	0.79	Nassarawa	1.07

Source: Authors' elaboration on NLSS 2003/04

Appendix 2: Additional figures

Figure A1: Production by state - beans and rice shares (share in total state's production)

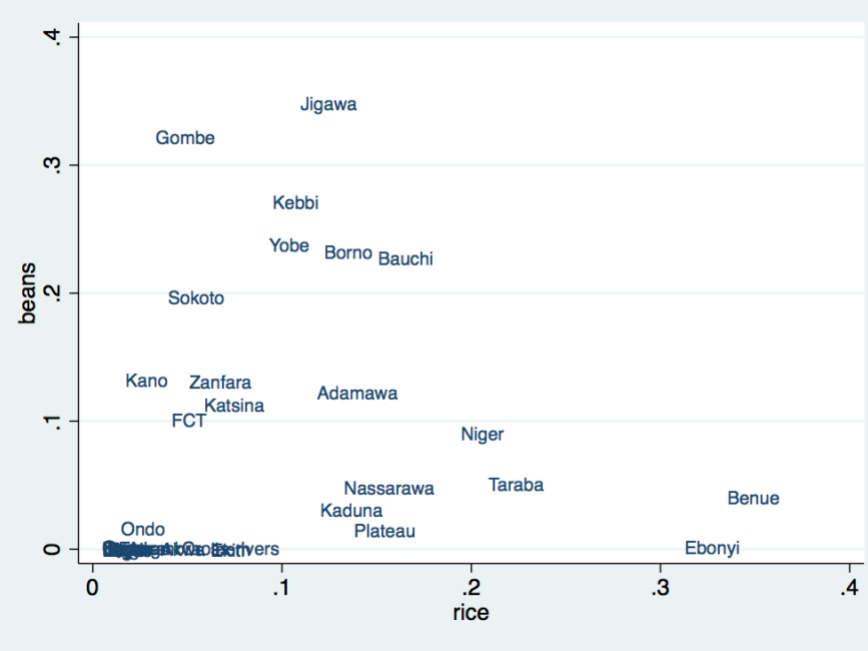
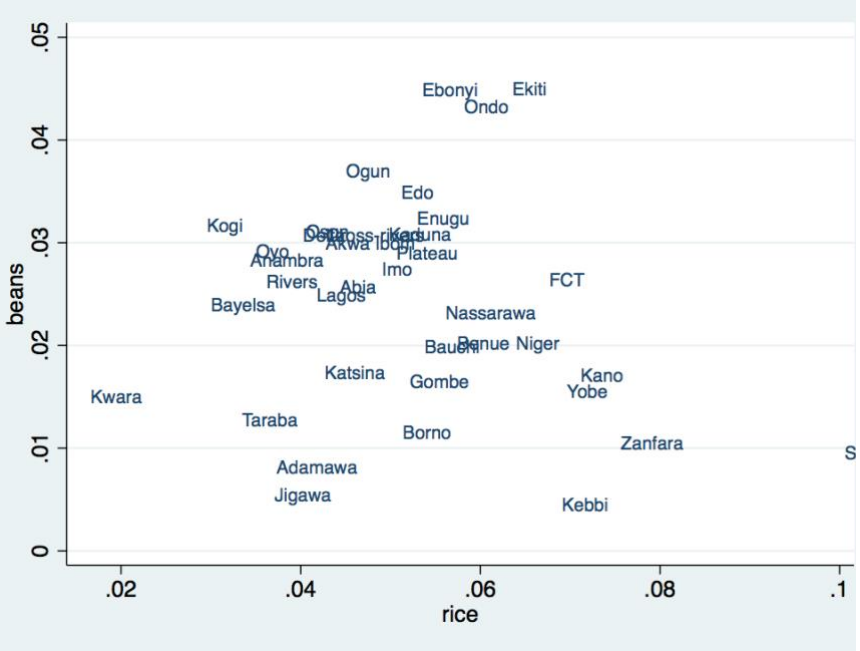


Figure A2: Consumption by state - beans and rice shares (share in total state's expenditures)



Source: Authors' calculation on the basis of the NLSS 2003/04

Figure A3: International and domestic prices of beans across Nigerian states, 2003-10 (Prices = 100 in 2003)

Note: figures for all states but Abuja; source: Authors' elaboration on World Bank pink sheets (for int'l prices) and Nigerian Bureau of Statistics.

Figure A4: International and domestic prices of imported rice across Nigerian states, 2003-10 (Prices = 100 in 2003)

Note: figures for all states but Abuja; source: Authors' elaboration on World Bank pink sheets (for int'l prices) and Nigerian Bureau of Statistics.