# Income shocks and conflict: Evidence from Nigeria[*]

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Preventing civil conflicts is one of the most defining challenges of our time and it is crucial to reach ambitious poverty goals, especially in Africa. Unfortunately our understanding of the drivers of conflict is still limited. This paper contributes to this understanding by studying the relationship between income shocks and conflict across states within Nigeria over the past decade. We use an innovative empirical strategy matching household survey, oil production and domestic and international price data to capture three separate channels linking income changes to conflict. Price increases of consumed items have a significant conflict-inducing effect consistently with the hypothesis that they reduce real incomes and thus the opportunity cost of fighting. Failure to include this consumption impact severely biases (towards zero) the conflict-reducing effect of price rises of agricultural commodities via production. In addition, oil price hikes increase conflict intensity in oil producing areas, consistent with the 'state prize' hypothesis. However, this effect is reversed for the period after the agreement granting amnesty to militant groups in oil-producing areas. We also discuss the importance of some factors mediating the impact of the shocks on conflict and a number of policy implications following the analysis.

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## 1. Introduction

Preventing civil conflicts is one of the most defining challenges of our time. In addition to exacting a huge toll on human life and properties, conflicts are key constraints to poverty reduction in many developing countries. While the number of poor has drastically declined over the last 20 years worldwide, it has increased in fragile countries, the majority of which have been or still are affected by civil conflicts (Kharas and Rogerson, 2012). The challenge is particularly daunting in sub-Saharan Africa (SSA) where most countries at risk of conflict are concentrated.[1]

Unfortunately our understanding of the drivers of conflicts is still limited. The evidence suggests that income shocks are one such key driver (Blattman and Miguel, 2010). However the direction of the effect is contentious. On the one hand a positive income shock may reduce the conflict risk by increasing the opportunity cost of individuals to rebel and/or by increasing the state's ability to repress or buy off rebels (Fearon and Laitin, 2003). On the other hand a positive shock to a country's resources (e.g. oil discovery) could also raise the value of the state's control to fight over (the so–called 'state prize' hypothesis). Disentangling these channels is difficult, which may explain the lack of consensus of the cross-country evidence on the effects of international commodity prices on conflict (e.g. Bruckner and Ciccone, 2010; Miguel et al., 2004; Bazzi and Blattman, 2014; Calì and Muladbic, 2014).

Our paper contributes to the understanding of the drivers of conflict by studying the relationship between income shocks and conflict across Nigerian states over the past decade. We use an innovative empirical strategy matching household survey, oil production and domestic and international price data to capture three separate channels linking income changes to conflict (i.e. household consumption, household production and natural resources wealth). In this way the paper contributes to the relatively thin empirical literature exploiting the variation across sub-national units to identify the effects of exogenous income shocks on conflict (e.g. Dube and Vargas, 2013; Berman and Couttenier, 2014; Maydstadt and Ecker, 2014).

Our strategy allows us to make a number of contributions to the literature. First, to the best of our knowledge this is the first paper that measures the effect of price changes on conflict via consumption.[2] We do so by constructing a consumption price index based on exogenous price movements of various goods weighted by their importance in household expenditures at the beginning of the period. Price increases of consumed items turn out to have a significant conflict inducing effect in Nigeria. In fact, we show that failure to include this consumption impact severely biases (towards zero) the conflict reducing effect of price rise of produced agricultural

[1] According to the Failed States Index 2013 (Fund for Peace, 2013), three quarter of the twenty countries most at risk of conflict are in SSA.

[2] Some papers have tried to model these effects by using international commodity prices weighted by the commodity's share in the imports basket (Arezki and Brückner, 2011; Calì and Muladbic, 2014; Maystadt, Trinh Tan and Breisinger, 2014). However as Bazzi and Blattman (2014) these import weights are likely to be more of a reflection of purchases by firms, elites, and governments than actual household consumption.

commodities. That is an important finding as the literature tends to focus only on the effects of prices of produced goods on conflict.

Second, we add to the evidence distinguishing between the effects of changes in prices of agricultural commodities, which are labor intensive diffused commodities, and prices of point-source capital intensive oil. While Dube and Vargas (2013) focus on the case of exported agricultural commodities, we consider a wide range of commodities produced by the households and mostly sold in local markets. These types of commodities should be more relevant for many countries in SSA, where agricultural income for most households is not related to exports. In addition we also test for the effect of a policy shock (the amnesty agreement between the state and the rebels in the oil producing Niger Delta region in 2009) on the relationship between the value of oil and conflict intensity. While this relationship was positive and significant between 2004 and 2009 confirming previous evidence on the 'state prize' hypothesis (Dube and Vargas, 2013), it turned negative after the peace deal. This finding provides support to the short-run effectiveness of the policy of 'buying off' militants.

Third, in a significant departure from the literature, our (consumption and production) price indices are constructed using an arguably more suitable measure of local price shocks than international commodity prices. The latter have two main limitations. First, they are available only for internationally traded commodities, which often do not include many local products important for consumption and production in developing countries (e.g. yam and cassava in the case of Nigeria). Second, international prices do not account for the price transmission from international to domestic markets, which is often limited. Thus international prices may not accurately measure the size of the price shock at the local level. Our indices improve on both problems by using domestic prices of faraway states, in the spirit of Jacoby (2013). These prices are likely to be exogenous to the conflict in the state in question, so we can use the indices based on them as an instrument for the local price indices. Using this type of instrument, instead of that based on international prices, has important implications for the results.

Fourth, we identify some of the conditions under which these price shocks are particularly prone to conflict. In doing so, we draw from the literature on the drivers of conflict and apply it to the case of Nigeria. Our results suggest that the magnitude of the effects of price shocks, particularly affecting consumption goods and oil, on conflict is amplified in election years. Ethnic divisions and income inequality appear to substantially increase the conflict-inducing effect of the rise in oil prices, but not to affect the other economic shocks we consider. Surprisingly, we also find that a recent history of past conflict does not magnify the effects of price shocks on violent conflict.

Finally, to the best of our knowledge this is the first study systematically looking at the drivers of conflict in Nigeria. In doing so this paper helps to fill an important gap as Nigeria is the largest country in SSA in terms of population and oil production and is key to the stability of the West

African region and possibly of the entire continent.[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 violence from conflict has escalated since 2010 especially through the surge in activities by the Islamic militant group Boko Haram. This has led to the government declaring the state of emergency in the three north-eastern states of Adamawa, Borno and Yobe in May 2013.

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.

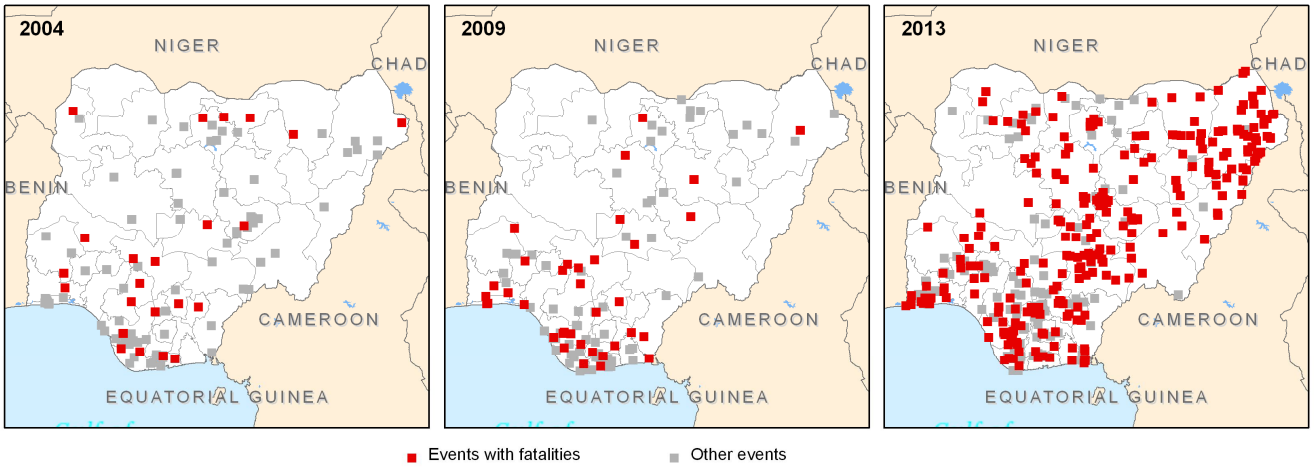
## 2. Nigeria's civil conflicts in the past decade

Although it is not considered officially fragile according to the World Bank and the regional development banks, 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 third most violent, and suffered the fourth-highest deaths from conflict, among African countries in the last ten years (2003-2013). 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 has varied substantially both across space and over time. As figures 1, 2 and 3 show, 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. 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.[4] In Kwara state for instance, the conflicts in Offa/Erin Ile can be attributed to disputes over land ownership and grazing rights.[5] 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.

[3] For example Nigeria provides one of the largest troop contingents to continental peacekeeping missions.
[4] 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).
[5] 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.

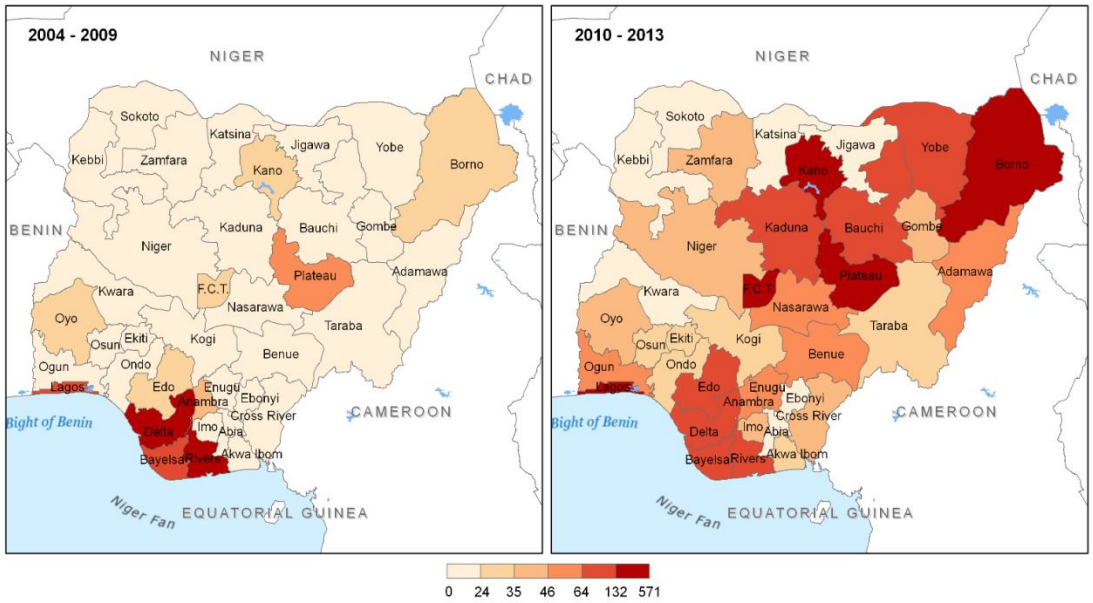
**Figure 1: The geography of conflict in Nigeria (2004-13)**




*Source: ACLED*

Violence has increased since 2010 (figures 1, 2 and 3), particularly in the north-western 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. These areas also experienced some of the greatest intensification in conflict in the country (figures 2 and 3). However, other parts of the country, particularly the middle belt states of Platteau, Kanu and Kaduna, have also experienced an intensification of longstanding conflicts.

**Figure 2: Conflict intensity across states in Nigeria**

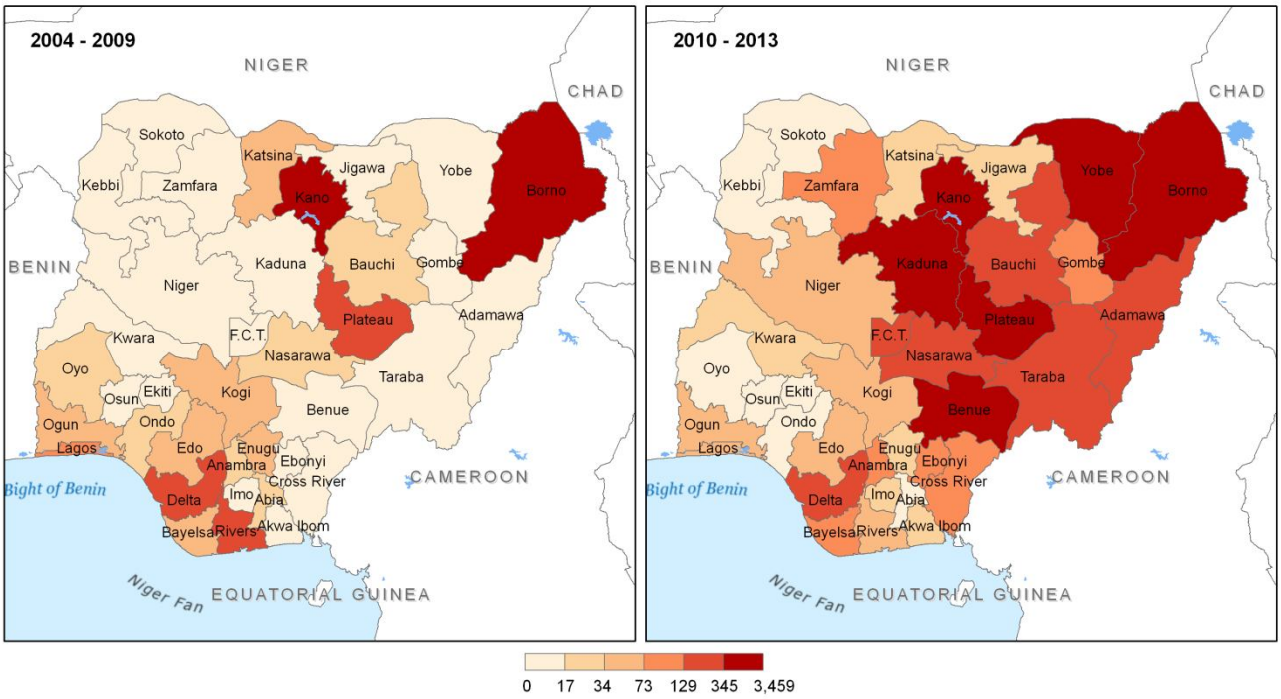



*Source: ACLED. Note: the darker the color the higher the number of (any) conflict events in the period*

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 rebel 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. While this agreement has been criticized for failing to treat the root causes of conflict, and for promoting 'warlordism', it seems to have gone a long way towards reducing conflict in the short run (Sayne, 2013).

**Figure 3: Violence intensity across states in Nigeria**




*Source: ACLED. Note: the darker the color the higher the number of fatalities in the period*

## 3. Trade shocks and conflict: channels

There are at least three main mechanisms through which price shocks 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 is able to 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 see the opportunity cost mechanism, consider a very stylized partial equilibrium model of an economy producing one good using one factor of production, e.g. labor. This good (number 2) is consumed along with a fixed supply of another good (number 1) with which the economy is endowed.[6] Labor can also be used by a conflict sector to appropriate part of good 1 with a technology that yields decreasing marginal returns to labor.[7] In equilibrium, labor earns the same amount across the two activities. An increase in the price of good 2 would raise the real wage in the economy. This in turn would reduce the amount of labor allocated to the conflict sector ($L_C$), given the concavity of the predation function with respect to labor and that the returns to labor must equalize across sectors. Appendix 1 presents a stylized partial equilibrium model with two goods and one factor as in Dal Bó and Dal Bó (2012), that formalizes this intuition.[8]

This framework suggests that all commodities were not created equal when it comes to their effects on conflict. In fact, increases in the prices of some commodities whose control can be relatively easily appropriated can actually foster conflict by increasing the potential 'prize' of the conflict, thus raising the incentive for fighting. This is usually the case for so-called 'point-source' resources such as minerals and fuels, which are contestable, highly valuable, capital-intensive and geographically-concentrated resources. 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.

In order to see the difference in the effects on conflict of price changes across these types of commodities, it is useful to consider a general equilibrium extension of the above framework in the spirit of Dal Bó and Dal Bó (2011). The formal model along with the proof of the main result is presented in Appendix 2. Building on the partial equilibrium model described above, the economy now also produces good 1, which is capital intensive relative to good 2. Therefore, good 1 can be thought of as the diffused commodity (e.g. rice), while good 2 is the point-source, capital-intensive commodity (e.g. oil). The conflict sector can now reap a share of both goods produced with the same technology, demonstrating the marginal decreasing returns to labor from predation. The wage earned by the individuals in the goods sector is now also reduced by the predation.

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[6] One can think of good 1 as part of the fuel obtained from the processing of domestic oil reserves by foreign capital and left as a form of payment to the country.

[7] This assumption captures the congestion costs that predation generates on further predation.

[8] The opportunity cost hypothesis of conflict via commodity prices has received mixed empirical support in the cross-country literature (e.g. Brukner and Ciccone, 2010; Besley and Persson, 2008; Bazzi and Blattman, 2014; Calì and Muladbic, 2014). Conversely this hypothesis is generally supported in recent within-country work (e.g. Dube and Vargas, 2013; Berman and Couttenier, 2014; Maydstadt and Ecker, 2014).

When the price of the capital-intensive good rises, the rental rate of capital rises relative to the wage (the Stolper-Samuelson effect), so the capital-intensive sector expands and the labor-intensive sector shrinks. This increases the amount of wealth in the economy (i.e. the 'prize' of the conflict) relative to wages that is vulnerable to looting, which leads to an expansion of the appropriative conflict sector. On the other hand, an increase in the price of the labor-intensive good drives wages up and the rental rate down, so the labor-intensive sector expands and the capital-intensive sector contracts. The net effect is that wages rise relative to contestable wealth in the economy, which reduces the incentive to engage in conflict (i.e. the opportunity cost resulting from the wage increase outweighs the conflict 'prize' effect). In other words, what drives these differing results is how the shocks affect the relative cost of labor, which is the factor most intensively used by the conflict sector in the model. This is a key assumption that seems to resonate with the experience in most modern civil conflicts.

The 'prize' mechanism is part of the explanation for the eruption and/or the escalation of violence in many modern conflicts. As in the case of the opportunity cost mechanism, the evidence in support of the prize effect is stronger within countries (e.g. Maydstadt et al., 2014; Dube and Vargas, 2013; Bellows and Miguel, 2009) than across them (e.g. Lin and Michaels, 2011; Cotet and Tsui, 2013; Bazzi and Blattman, 2014). One reason for these mixed results could be that increases in value of disputable resources can generate higher fiscal revenues. The state could use these revenues to strengthen its military capacity to repress rebel groups' activities and/or to buy off support, thus favoring political stability.

This mechanism is captured in the conceptual framework above by introducing the possibility of the state employing part of the labor force ($L_E$) to enforce property rights, thus reducing the potential for predation. The share of value that can be appropriated now depends positively on $L_C$ and negatively on $L_E$. The latter can be financed through a tax levied on the capital intensive good 1. The increase in the price of good 1 now has an ambiguous effect on conflict. On one hand, it increases the disputable wealth relative to the wage thus providing more incentive to participate in the conflict sector. On the other hand, the price hike increases the funding for $L_E$. The net effect would depend on the relative effectiveness (per unit of labor) of the appropriation by the conflict sector and of the enforcement by the state.[9]

The framework (and the economic literature) so far has focused on the impact on conflict of price changes of commodities via the production channel. Nevertheless, commodities are also consumed and thus their price affects real incomes as well. The mechanisms at play are similar to those for commodity exports, but with opposite 'signs'. In terms of the conceptual framework above, we would have to introduce a third type of good that is imported and consumed by the workers. An increase in the price of this good would reduce real wages in the country and, as a

[9] The findings in Bazzi and Blattman (2014) mildly support the hypothesis that price increases in point-source commodities are associated with larger increases in $L_E$ than in $L_C$.

result, the opportunity cost of engaging in violence as well. Thus the conflict sector would expand, other things being equal. An important element in this context is the extent to which changes in international prices are actually transmitted to domestic prices, which we discuss in the analysis.[10]

The empirical analysis will test to what extent these various mechanisms are at play in the Nigerian conflicts using different variables. In particular we use a consumption and an agricultural production price indices to test for the opportunity cost of conflict via consumption and production respectively. We use an oil index to capture the state prize hypothesis. Finally we can test for the state capacity hypothesis by examining the differential impact of the oil index post-amnesty in the Niger Delta.

## 4. Data and variables

The data on conflict we use in this study is the Version 4 (1997 – 2013) of the ACLED (Armed Conflict Location & Event Data Project). ACLED Version 4 data cover all countries on the African continent from 1997. ACLED definitions mainly concern actors and events. ACLED collects and codes reports from the developing world on civil and communal conflicts, militia interactions, violence against civilians, rioting, and protesting. ACLED covers both activity that occurs within and outside the context of a civil war.

The calculation of consumption and production price indices is essential to the model estimation. While there are a number of 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. 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):

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

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

[10] Little evidence is available on the effect of price shocks via consumption. Bellemare (2011) shows for instance that monthly spikes in international food prices between January 1990 and January 2011 led to increased political unrest worldwide.

consumed items with prices (see table A1 in the Appendix for the list of all items matched), we scale this index by the importance of those expenditure items in total household expenditures in the state *TotExp* (the latter term).[11]

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; Calì and Mulabdic, 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.[12] 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 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 gavi).[13] Appendix Table A2 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:

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

Where *Prodshr* are the shares of *j* in all *K* products for which price data are available (thus the shares sum to 1) and TotInc is the total household income from all sources in the state.

[11] 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.

[12] 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.

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

Because the prices may refer to different units of measurement of the commodities, in order to standardize them, we normalize the price of every commodity to 100 in 2003 and then construct the price index on the basis of the normalized series.

As explained above, oil plays a key role in Nigerian conflict, especially in the Niger Delta states. To test for its direct effect on conflict via the state prize hypothesis, we construct an oil price index by interacting the oil production value in 2003 with the international oil price ($P_{st}^{oil} = oil_s \times oilpr_t$). We use oil production data published in the Nigerian National Petroleum Coporation (NNPC) Annual Statistical Bulletin. However, because this data is only reported at the oil well level and not at the state level, we had to manually map the oil wells to a state. To do that we use a combination of online google search and geo-mapping using longitude and latitudes of the oil well mapped to the state.

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).[14] In addition, oil 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). Given the absence of 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 demographic, education, health, and migration, for the purpose of 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.

Part B of the questionnaire asked respondents questions on household's consumption, including both expenditures and agricultural activities at the household level. Household expenditure is categorized into non-food and food expenses.[15] 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

[14] http://www.eia.gov/countries/country-data.cfm?fips=NI. Accessed April 29, 2014.
[15] 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?"

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.

**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 |
| Total | 17,094 | 18,506 | 35,600 |

Source: National Bureau of Statistics (2004)

The agricultural production section of the survey collects information on agriculture 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 the production of agricultural food is collected at a different frequency. 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 last two weeks. We converted these two week estimates to a yearly value of sales.[16]

## 5. Empirical framework

We use these indices in the regression framework to measuring the impact of price shocks on conflict. The basic specification reads as follows:

$$C_{srt} = \alpha_r + \gamma_t + \beta_1 CI_{st-1} + \beta_2 PI_{st-1} + \beta_3 P^{oil}_{st-1} + \mathrm{A}Z_s + \mathrm{B}X_{st} + \varepsilon_{st} \qquad (3)$$

where C is a measure of conflict (e.g. number of conflict episodes, number of violent episodes, number of conflict-related fatalities), $P^{oil}$ is the oil price index, Z and X are vectors of time

[16] One way of converting this is to multiply the two week 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 include data on both two weeks and annual sales, shows that multiplication of the two weeks 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 weeks value reported for cassava, yam and plantain to the other items.

invariant and time varying state-level covariates of conflict respectively, α are region effects and γ are time effects.

The nature of the data on conflict 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 conflict measures (Table 2). The number of conflict events in a year and number of conflict events with fatalities range from 0 to 118 and 0 to 79, respectively. There are only an average of 6.9 and 2.2 conflict events and conflict events with fatalities per year.

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

| Variable | Obs | Mean | Std. Dev. | Min | Max | % of Zeroes |
|---|---|---|---|---|---|---|
| Nr. of fatalities from conflict episodes | 296 | 18.4 | 85.5 | 0 | 1001 | 41.6 |
| Nr. of conflict events in a year | 296 | 6.9 | 12.7 | 0 | 118 | 21.3 |
| Number of conflict events with fatalities | 296 | 2.2 | 6.0 | 0 | 79 | 41.6 |

*Source: ACLED*

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 model be Poisson distributed to use it – that is, the model requires a weaker distributional assumption than the negative binomial model. However, the negative binomial model is designed to handle over-dispersion in our data and will lead to higher efficiency in estimation. [17]

Among the controls, Z includes a number of important variables measured at the beginning of the period of analysis (from the NSS), i.e. population, population density, and measures of poverty and inequality, including the headcount poverty rate, poverty gap and the gini index of inequality. Z also includes the cost of travelling to Lagos (Nigeria's main trading centre), the number of conflict events between 1997 and 2003, and ethnic variables. Ideally we would use measures of ethnic divisions traditionally used in the conflict literature, such as ethnic fractionalization (Alesina et al., 2003) and polarization Montalvo and Reynal-Querol (2005). However in the absence of state-level data on the ethnic composition of the population, the next

[17] Within the negative binomial model option in STATA, we use the population-averaged (PA) option that relaxes the assumption of independence of $C_{srt}$ to allow for different correlations over time of the conflict. The relaxation of this assumption is useful for the purpose of our analysis so the influence of conflict in 2003 is not restricted to be the same on all the other years. The other two options, Random effect (RE) and fixed effect (FE), are attractive but do not adequately capture our data and impose additional structure on the data that cannot be validated. Also, they attempt to model over dispersion rather than capturing fixed effects at the state level and may have convergence issues given the size of our data.

best variable we can construct is a dummy for whether there are more than two ethnic minorities in the state.[18]

We also construct two time-varying ethnic measures of the relation between the state's dominant ethnic group(s) and the ethnic group holding the presidency, which are included in X. 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. The second is a dummy variable for those states in which the president variable equals 1 and which have only one dominant ethnic group. This allows us to differentiate the *president*'s effect between these two types of states.

This wide range of state-level covariates, along with region effects, should compensate for the absence of state fixed effects in the regressions. As an additional check we also show the robustness of the results to estimating equation (3) through OLS with state fixed effects.

**5.1. Endogeneity of price indices**

Importantly, 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 an opposite effect on prices. This endogeneity would bias the relationship between the price indices and conflict. 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 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 prices data (e.g. Bazzi and Blattman, 2014; Dube and Vargas, 2013). The instrument is constructed as follows:

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

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

[18] We also tried a dummy for whether the state has more than one dominant ethnic group, but its effect was never significant in explaining conflict.

important for consumption and production in Nigeria (e.g. yam and cassava). Appendix Table A3 lists the matched items between international prices and survey data. This matching is more limited than with domestic prices, i.e. the scaling term for these instruments is smaller than in the *CI* and *PI* in equation (1). 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.

We propose another set of instruments to address both issues. The instruments are constructed using domestic prices of faraway states, following the same logic of Jacoby (2013) for changes in rice prices in Indian districts. The price data for the other Nigerian states should reflect exogenous international price changes, their transmission to the domestic market, and shifts in demand and supply in the large domestic market outside of the particular state. We exclude neighboring states that may be affected by the conditions in the state in question, to ensure the exogeneity of the instruments.

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*:

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

where $p_{jrt}$ 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. The eleven hours threshold is based on both the mean and median bilateral distance between the state capitals. We argue that this threshold excludes all the states that are close to the state's geopolitical zone of influence. On average, about 10 states are included on the basis of this threshold. Differently from Jacoby (2013), 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 (4) and (1) since the price data come from the same source (Nigeria Bureau of Statistics). That is, of course, the case for both the narrow and the broad matching of goods between the price and the survey data. It is also the case for the production indices defined in equation (2).

[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).

We use these instruments to retrieve the exogenous component of *CI* and *PI* through the first stage regressions. We use the instruments in separate regressions:

$$CI_{srt} = \alpha_r + \gamma_t + \delta_1 CI_{st}^{oth} + \delta_2 PI_{st}^{oth} + \delta_3 P_{st}^{oil} + Z_s + X_{st} + \varepsilon_{st} \quad (6)$$

$$CI_{srt} = \alpha_r + \gamma_t + \delta_1 CI_{st}^{intl} + \delta_2 PI_{st}^{intl} + \delta_3 P_{st}^{oil} + Z_s + X_{st} + \varepsilon_{st} \quad (7)$$

and retrieve the respective predicted consumption price indices $\widehat{CI_{srt}^{oth}}$ and $\widehat{CI_{srt}^{intl}}$, which should be orthogonal to $C_{srt}$. We do the same for *PI* and then replace the endogenous CI and PI with $\widehat{CI_{srt}^{oth}}$ and $\widehat{PI_{srt}^{oth}}$, or $\widehat{CI_{srt}^{intl}}$ and $\widehat{PI_{srt}^{intl}}$.

As it turns out, the international price indices have a relatively weak predictive power for *CI* and *PI* because of the different composition of the items' basket and the limited transmission of international commodity prices to the Nigerian market. This limited transmission is shown for two important consumed and produced commodities (maize and imported rice) in figures A1 and A2 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 on the basis of faraway states) than to that of international prices.[20] However, the international price indices are useful as an alternative measure of exogenous shock.

Equation (3) is then modified to incorporate the predicted values of CI and PI (from the first stage), which replace the endogenous price indices:

$$C_{srt} = \alpha_r + \gamma_t + \beta_1 \widehat{CI_{srt-1}^{oth}} + \beta_2 \widehat{PI_{srt-1}^{oth}} + \beta_3 P_{st-1}^{oil} + \mathrm{A}Z_s + \mathrm{B}X_{st} + \varepsilon_{st} \quad (3')$$

## 6. Results

Table 3 presents the summary statistics for the regressors in the analysis for the 2004-11 period.

Table 4 presents the results of the baseline specification in equation (3'). To check the possible omitted variable bias across price indices, we first employ a parsimonious specification with only the predicted (narrow version of) *PI* instrumented through the other states' prices index along with the full set of controls. The result in column (1) shows no significant impact of PI on conflict events in Nigeria. That is the case also when we add the oil index along with its post-2009 interaction (column 2). The signs of the oil variables support both the state prize and the state capacity hypotheses. The oil index has a positive and significant effect on the number of conflict events the following year, in line with the state prize hypothesis: exogenous increases in

[20] 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).

the value of oil raise the incentive for fighting in the production areas. On the other hand, this effect is reversed after the amnesty deal in 2009, confirming that the deal was effective in curbing violence in the Niger Delta states. In fact, the negative association between the oil price index and conflict intensity after 2009 is consistent with the idea that the oil funds may have been used to buy off militant groups in these areas (Sayne, 2013).

**Table 3: Summary statistics of the regressors (2004-11)**

| | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| CI | 296 | 77.40 | 23.98 | 21.92 | 137.72 |
| PI | 296 | 66.28 | 26.67 | 21.19 | 138.08 |
| $CI_{NAR}^{oth}$ | 296 | 87.44 | 24.46 | 45.27 | 143.69 |
| $PI_{NAR}^{oth}$ | 296 | 75.76 | 25.62 | 28.62 | 127.31 |
| $CI_{BR}^{oth}$ | 296 | 70.55 | 27.18 | 23.42 | 142.07 |
| $PI_{BR}^{oth}$ | 296 | 83.22 | 25.41 | 27.30 | 149.43 |
| $CI_{NAR}^{Intl}$ | 296 | 69.43 | 21.34 | 30.18 | 132.61 |
| $PI_{NAR}^{Intl}$ | 296 | 56.33 | 13.00 | 31.43 | 84.29 |
| Oil index | 296 | 60.27 | 155.41 | 0 | 925.30 |
| President | 296 | 0.28 | 0.45 | 0 | 1 |
| Pop (2003) ln | 296 | 8.15 | 0.40 | 7.25 | 9.15 |
| Pop dens. (2003) ln | 296 | 5.26 | 0.89 | 3.93 | 7.90 |
| Past conflict event | 296 | 29.86 | 49.31 | 2 | 264 |
| Past fatalities | 296 | 202.46 | 344.81 | 1 | 1892 |
| Past event with fat. | 296 | 17.19 | 29.59 | 1 | 156 |
| Past battle events | 296 | 12.76 | 21.52 | 1 | 99 |
| Past protest | 296 | 5.70 | 10.20 | 0 | 60 |
| Past civil. violence | 296 | 10.84 | 18.35 | 0 | 103 |
| Poverty gap 2003 | 296 | 18.46 | 11.07 | 5 | 54 |
| Headcount Poverty 2003 | 296 | 48.78 | 17.90 | 21 | 87 |
| Multiple dominant groups dummy | 296 | 0.32 | 0.47 | 0 | 1 |
| Ethnic minorities>2 | 296 | 0.68 | 0.47 | 0 | 1 |

Adding the predicted CI to the model makes the PI negative and significant at the 1% level (column 3). This suggests that failure to include this consumption impact severely biases (towards zero) the conflict-reducing effect of increases in prices of agricultural commodities produced by the households. The issue here is that the prices used in construction of the production index involve goods that are both consumed in, and produced by, households. Thus increases in PI may raise real incomes (and thus the opportunity cost of fighting) for households that are predominantly affected through the goods they produce, and lower real incomes for households that are predominantly affected through the goods they consume. Once we control for this (positive) consumption effect through *CI*, we are able to isolate the true (negative) production effect of PI on conflict. This is an important finding, as the literature has tended to focus solely on the impact of prices of produced goods on conflict, thus potentially suffering

from an important omitted variable bias. This may also help explain the lack of consensus on the effects of agricultural commodity prices on conflict.

**Table 4: The impact of price shocks on conflict events in Nigeria (2004-11)**

| | (1) Any event | (2) Any event | (3) Any event | (4) Any event | (5) Any event | (6) Any event |
|---|---|---|---|---|---|---|
| $\widehat{CI_{NAR}^{oth}}$(t-1) | | | 0.050*** | | | |
| | | | (0.013) | | | |
| $\widehat{PI_{NAR}^{oth}}$(t-1) | 0.052 | 0.021 | -0.045*** | | | |
| | (0.053) | (0.053) | (0.011) | | | |
| Oil ind. (t-1) | | 0.002** | 0.003*** | 0.003*** | 0.003*** | 0.003*** |
| | | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| *Oil ind. (t-1) x post-09* | | -0.003*** | -0.003*** | -0.003*** | -0.003*** | -0.003*** |
| | | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| $\widehat{CI_{BR}^{oth}}$(t-1) | | | | 0.039*** | | |
| | | | | (0.012) | | |
| $\widehat{PI_{BR}^{oth}}$(t-1) | | | | -0.036*** | | |
| | | | | (0.012) | | |
| $\widehat{CI_{NAR}^{Intl}}$(t-1) | | | | | 0.047* | |
| | | | | | (0.026) | |
| $\widehat{PI_{NAR}^{Intl}}$(t-1) | | | | | -0.005 | |
| | | | | | (0.025) | |
| $\widehat{CI_{BR}^{Intl}}$(t-1) | | | | | | 0.068* |
| | | | | | | (0.036) |
| $\widehat{PI_{BR}^{Intl}}$(t-1) | | | | | | -0.014 |
| | | | | | | (0.026) |
| Marginal effects: change in conflict events caused by a 10% increase in price index | | | | | | |
| *CI* | | | 2.85 | 2.36 | 2.53 | 3.94 |
| *PI* | - | - | -2.19 | -1.88 | -0.24 | -0.68 |
| *Oil ind.* | | 0.09 | 0.14 | 0.15 | 0.12 | 0.14 |
| *Oil ind. x post-09* | | -0.02 | -0.02 | -0.02 | -0.02 | -0.02 |

*Dependent variable is the number of any conflict events in the state in year t; robust standard errors in parentheses; *, **, *** indicate statistical significance at the 10, 5, and 1 percent level, respectively. Data are for 37 states for 8 years (2004-11). All regressions include year and region effects as well as region specific time trends and various controls (the log of population in 2003, the log of population density in 2003, the number of conflict events in 1997-2003, the poverty gap and headcount poverty in 2003, a dummy for multiple dominant ethnic groups, a dummy for more than 2 ethnic minorities, 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). The models are estimated through the population-averaged negative binomial estimator for panel data.*

The effect of CI is positive and significant in line with the idea that increases in the price of commodities heavily consumed reduce real incomes and increase the propensity to engage in conflict.

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

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Method | Nbreg | Nbreg | Nbreg | Nbreg | Nbreg | Poisson |
| Period | 2004-10 | 2004-10 | 2004-11 | 2004-11 | 2004-11 | 2004-11 |
| $\widehat{CI_{NAR}^{oth}}(t)$ | 0.024** | -0.025 | | | | |
| | (0.012) | (0.034) | | | | |
| $\widehat{PI_{NAR}^{oth}}(t)$ | -0.010 | 0.024 | | | | |
| | (0.011) | (0.046) | | | | |
| $\widehat{CI_{NAR}^{oth}}$(t-1) | | 0.084 | 0.061** | | | 0.038** |
| | | (0.053) | (0.027) | | | (0.016) |
| $\widehat{PI_{NAR}^{oth}}$(t-1) | | -0.029 | -0.029 | | | -0.024 |
| | | (0.075) | (0.047) | | | (0.015) |
| $CI_{NAR}^{oth}$ (t-1) | | | | 0.051*** | | |
| | | | | (0.009) | | |
| $CI_{NAR}^{oth}$ (t-1) | | | | 0.015 | | |
| | | | | (0.012) | | |
| $CI_{NAR}^{Intl}$ (t-1) | | | | | 0.013* | |
| | | | | | (0.008) | |
| $PI_{NAR}^{Intl}$ (t-1) | | | | | -0.001 | |
| | | | | | (0.024) | |
| *Oil ind. (t)* | 0.003*** | 0.001 | | | | |
| | (0.001) | (0.001) | | | | |
| *Oil ind. (t-1)* | | 0.002*** | 0.003*** | 0.002*** | 0.002*** | 0.003*** |
| | | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| *Oil ind. (t) x post-09* | -0.001 | | | | | |
| | (0.001) | | | | | |
| *Oil ind. (t-1) x post-09* | | | -0.003*** | -0.004*** | -0.003*** | -0.004*** |
| | | | (0.001) | (0.001) | (0.001) | (0.001) |
| Controls | YES | YES | YES | YES | YES | YES |
| Observations | 259 | 259 | 296 | 296 | 296 | 296 |
| CI+ CI (t-1) | | 0.059** | | | | |
| PI+ PI (t-1) | | -0.005 | | | | |
| Oil + Oil(t-1) | | 0.003*** | | | | |

*Dependent variable is the number of any conflict events in the state in year t; robust standard errors in parentheses; *, **, *** indicate statistical significance at the 10, 5, and 1 percent level, respectively. Data are for 37 states for 8 years (2004-11). All regressions include year and region effects as well as region specific time trends. The models are estimated either through the population-averaged negative binomial estimator or the population-averaged poisson estimator for panel data.*

These results are robust to using the instrumented PI and CI constructed through the broad matching of the items (column 4). However, the results for production are not robust to using the PI instrumented through the international prices whether through the narrow (column 5) or the broad matching (column 6). On the other hand, the result for CI holds although the coefficient is less significant. These weaker results suggest that the two problems described above (limited transmission of international to domestic prices and limited number of items matched) in using international prices to capture price shocks at the local level may be important in the case of

Nigeria.[21] The oil index coefficients are unaffected by the use of international prices for CI and PI.

While we do not report the coefficients of the control variables (full results are available upon request), an interesting result is that the ethnicity of the president matters in determining the level of conflict in the states. When the president's ethnicity is the same as that of the dominant group in a state, conflict intensity subsides in that state, confirming the importance of ethnic allegiance in state politics. This result is weaker for those states with more than one dominant ethnic group.

The lower part of Table 4 presents the estimates similar to marginal effect of the impact of consumption, producer and oil prices on the likelihood of conflict. For ease of interpretation, what we present is by how many conflict is either reduced or increased when the variables are increased by 10%. For instance, we find that a 10% increase in consumption prices increases conflict by about 2.5 while a 10% increase in production price reduces conflict by about 2.2 using model 3. By contrast, the influence of a 10% increase in the oil index only increases conflict by about 0.14 – for conflict to increase by one due to increase in oil price index, it will have to be a 100% increase in the index. This smaller average effect is at least in part due to two factors. First the effect only applies to a few states (in the Niger Delta) thus the average across states is lower. Second the oil price index varies more than the production and consumption price indices, thus a 10% variation is smaller relatively to the other indices.

In Table 5 we check the robustness of the results. In column (1) we use the contemporaneous value of the indices. The effect of the consumption and oil index, but not of the production index or the post-2009 oil effect, are robust to this specification. The latter result is a by-product of the restricted sample, which now only includes one year (instead of two) after the agreement. On the other hand, the weak result for PI is more likely to do with the timing of the effect of price changes on conflict, which appear to occur with a lag. Even the contemporaneous prices of consumption goods appear to exert a weaker effect on conflict than their lagged values. In column (2) we include both the contemporaneous and the lagged values, to control for potential negative autocorrelation of prices over time periods (Bazzi and Blattman, 2014). Once again the results for consumption and the oil index (as measured by the sum of the contemporaneous and the lagged coefficients) are robust to this specification, while the cumulative effect of PI is not significant. The results are also robust to the inclusion of the lagged unemployment rate as a further control, which however makes the PI coefficient less significant (column 3).

[21] Indeed in parallel preliminary work we document the limited pass-through from international to domestic prices in Nigeria for various agricultural items.

**Table 6: The impact of price shocks on various types of conflict in Nigeria (2004-11)**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Events with fatalities** | | | **Battle events** | | | **Protests/riots** | | | **Violence against civilians** | | | **Fatalities** |
| $\widehat{CI_{NAR}^{oth}}$*(t-1)* | 0.057*** | | | 0.051*** | | | 0.061*** | | | 0.038** | | | 0.034* |
| | (0.015) | | | (0.014) | | | (0.016) | | | (0.015) | | | (0.020) |
| $\widehat{PI_{NAR}^{oth}}$*(t-1)* | -0.024** | | | -0.039*** | | | -0.050*** | | | -0.034** | | | 0.006 |
| | (0.010) | | | (0.013) | | | (0.015) | | | (0.014) | | | (0.017) |
| $\widehat{CI_{BR}^{oth}}$*(t-1)* | | 0.042*** | | | 0.042*** | | | 0.044*** | | | 0.029** | | |
| | | (0.014) | | | (0.012) | | | (0.016) | | | (0.014) | | |
| $\widehat{PI_{BR}^{oth}}$*(t-1)* | | -0.014 | | | -0.034** | | | -0.037** | | | -0.028** | | |
| | | (0.011) | | | (0.013) | | | (0.016) | | | (0.014) | | |
| $\widehat{CI_{NAR}^{Intl}}$*(t-1)* | | | 0.053* | | | 0.017 | | | 0.008 | | | 0.036 | |
| | | | (0.028) | | | (0.029) | | | (0.036) | | | (0.031) | |
| $\widehat{PI_{NAR}^{Intl}}$*(t-1)* | | | -0.001 | | | 0.009 | | | 0.030 | | | -0.019 | |
| | | | (0.022) | | | (0.027) | | | (0.028) | | | (0.027) | |
| *Oil ind. (t-1)* | 0.003*** | 0.003*** | 0.003*** | 0.004*** | 0.004*** | 0.003*** | 0.000 | 0.000 | -0.000 | 0.003*** | 0.003*** | 0.003*** | 0.003*** |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| *Oil ind. (t) x post-09* | -0.004*** | -0.004*** | -0.004*** | -0.004** | -0.005** | -0.004*** | -0.003 | -0.003 | -0.003* | -0.002** | -0.002*** | -0.002*** | -0.007*** |
| | (0.001) | (0.001) | (0.001) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.001) | (0.001) | (0.001) | (0.001) |

*Robust standard errors in parentheses; *, **, *** indicate statistical significance at the 10, 5, and 1 percent level, respectively. Data are for 37 states for 8 years (2004-11). All regressions include year and region effects, region specific time trends and a full set of controls as in Tables 4 and 5. The models are estimated through the population-averaged negative binomial estimator for panel data.*

In column (4) and (5) we regress the conflict variable directly on two sets of instruments. Once again, the effects on conflict survive for consumption but not for production. The CI effect is weaker with the international price instrument, consistent with the limited ability of this instrument to capture shocks at the local level. Finally, the results are robust to using the poisson estimator (column 6), which is also suitable to deal with count variables with large numbers of zeros, although it is less efficient than the negative binomial estimator as argued above. The effects are robust to the use of this estimator, although the PI is only significant at the 15% level.

Overall these results suggest important effects of consumption, production and oil prices on conflict events, although production effects are somewhat less robust than the others.

In table 6 we check to what extent these results apply also to other conflict measures using the categorization of the ACLED data into various types of conflict. All the effects appear to apply to all types of conflict events, including events that result in fatalities, battle events, protests and riots, and violence against civilians. The consumption and oil price effect, but not the production price effect, also are robust to using the number of fatalities as the dependent variable (column 13).[24]

This analysis also shows an important dichotomy in the effect of the price shocks. While the effect of CI and PI is particularly large for protests/riots, oil price shocks have no effect on this type of conflict event (and that is the only type of conflict event which oil does not affect). This result is in line with the hypothesis that oil extraction spurred a type of violence mainly organized around militant groups, which was unrelated to popular protests.

**6.1. Heterogeneity of the effects**

These price shocks appear to be important determinants of conflict on average across Nigerian states. However states may be vulnerable to the same shocks to different degrees. In particular, the presence of deep-seated roots of conflict is usually a necessary condition for any economic shock, including prices, to have an impact on violence. A better understanding of what conditions matter in this respect could help direct policy interventions to address the vulnerability to increases in conflict from trade shocks. We use a series of interaction terms in order to test for some of this heterogeneity of the price effects on conflict across states. We interact each of the three trade variables with some potentially important factors that may drive conflict resilience to the shocks in the Nigerian context.

We use three types of factors that have been identified as important to mediate the effect of trade shocks on conflict, i.e. politics, conditions affecting the transmission of prices, and issues that affect grievances (Calì and Muladbic, 2014). The role of politics is represented by the

[24] Note we are unable to run the model with fatalities using indices based on broad matching and on international prices due to lack of convergence.

interaction between a dummy variable for an election year and the price shock. As in other African countries (Ksoll et al., 2010) elections are perilous times in Nigeria.

**Table 7: Mediating factors affecting the impact of price shocks on conflict**

| | Any events | Events with fat. | Battles | Protests and riots | civ. violence |
|---|---|---|---|---|---|
| election x CI (t-1) | 0.028** | 0.032** | 0.028* | -0.009 | 0.028** |
| election x PI (t-1) | -0.017 | -0.030* | 0.011 | -0.018 | -0.041*** |
| election x Oil Ind (t-1) | 0.002*** | 0.001 | 0.002** | 0.001 | 0.002** |
| cost_lagos x CI (t-1) | -0.000 | -0.000 | -0.001 | -0.001** | -0.000 |
| cost_lagos x PI (t-1) | 0.001* | 0.000 | 0.001** | 0.001** | 0.001 |
| president x CI (t-1) | -0.002 | -0.015 | -0.020 | 0.009 | 0.019 |
| president x PI (t-1) | -0.002 | 0.005 | 0.011 | -0.020 | -0.013 |
| president x Oil Ind (t-1) | -0.000 | 0.001 | -0.002 | 0.002* | 0.002 |
| unem03 x CI (t-1) | 0.000 | -0.001 | 0.000 | 0.000 | 0.000 |
| unem03 x PI (t-1) | -0.001 | 0.000 | -0.001 | -0.000 | -0.000 |
| unem03 x Oil Ind (t-1) | 0.000 | 0.000 | 0.000 | 0.000 | -0.000 |
| mult_domin x CI (t-1) | -0.019 | 0.017 | -0.012 | -0.002 | -0.010 |
| mult_domin x PI (t-1) | -0.006 | -0.032* | -0.025 | -0.013 | -0.011 |
| mult_domin x Oil Ind (t-1) | 0.004*** | 0.003*** | 0.005*** | -0.001 | 0.003*** |
| many_minor x CI (t-1) | -0.013 | 0.029 | -0.014 | -0.056* | 0.007 |
| many_minor x PI (t-1) | 0.013 | -0.027 | 0.012 | 0.039 | 0.003 |
| many_minor x Oil Ind (t-1) | 0.004*** | 0.004*** | 0.005*** | -0.003* | 0.005*** |
| pov03 x CI (t-1) | 0.000 | -0.001* | -0.000 | 0.000 | 0.000 |
| pov03 x PI (t-1) | -0.000 | 0.000 | -0.000 | -0.000 | -0.000 |
| pov03 x Oil Ind (t-1) | -0.000 | -0.000 | -0.000 | -0.000 | -0.000 |
| gini03 x CI (t-1) | -0.144 | -0.150 | -0.069 | -0.072 | -0.472*** |
| gini03 x PI (t-1) | 0.115 | 0.172 | 0.041 | 0.088 | 0.482** |
| gini03 x Oil Ind (t-1) | 0.044*** | 0.048*** | 0.070*** | -0.009 | 0.037*** |
| Past conflict x CI (t-1) | -0.000** | -0.000 | -0.001** | 0.002* | -0.001*** |
| Past conflict x PI (t-1) | 0.000 | 0.000 | 0.000 | -0.002** | 0.001** |
| Past conflict x Oil ind (t-1) | 0.000 | -0.000 | -0.000 | -0.000 | 0.000* |

*The table reports the coefficients of the interaction terms between the price indices and various conditioning factors obtained from different regressions; *, **, *** indicate statistical significance at the 10, 5, and 1 percent level respectively (based on robust standard errors). Data are for 37 states for 8 years (2004-11). All regressions include year and region effects, region specific time trends and a full set of controls as in Tables 4 and 5. The models are estimated through the population-averaged negative binomial estimator for panel data.*

The degree of transmission of international prices to the domestic markets is measured by the distance to Lagos, interacted with CI and PI. Intra-national trade costs are high in Nigeria (Atkin and Donaldson, 2014). As Lagos is the largest market and the international gateway for the country's trade, distance to Lagos could affect the extent to which exogenous price shocks translate at the local level. We do not follow the same procedure for the oil index, as price transmission should not be an issue for oil.

Data availability allows us to construct more variables to capture the extent to which grievances mediate the impact of price shocks on conflict. Among the factors affecting grievances, ethnic divisions feature prominently in African conflicts and in Nigeria in particular (NNoli, 2003). We test for the role of ethnic divisions in mediating the impact of price shocks on conflict by interacting the three variables used so far as controls with the price indices. These are the president variable, a dummy for more than two ethnic minorities, and a dummy for multiple dominant ethnic groups in the state.

We use poverty measures, including the poverty gap, the poverty headcount, the gini index of inequality, and the unemployment rate (all computed at the beginning of the period in 2003/04) to reflect the potential for economic conditions contributing to grievances.Finally, we use the level of past conflict intensity to generate three interaction terms. The level of past conflict is an important predictor of future violence by generating grievances (World Bank, 2011), a finding that has been confirmed in this analysis as well.

We run the baseline regression as in column (3) table 4 adding three interaction terms from an individual mediating factor (one for each price shock) at a time. We use the different types of conflict as dependent variable. The results of this analysis are presented in table 7, which reports only the coefficient of the interaction terms from the separate regressions along with their degree of significance.

Various findings emerge. First the magnitude of the price effects on conflict is amplified in election years, especially the consumption and oil shock. Second, the effects of the shocks on protests are reduced, the further one moves away from Lagos. Third, various factors related to grievances significantly magnify the conflict-inducing effect of a rise in the price of oil. That is particularly the case for ethnic factors and economic inequality.

On the other hand, and more surprisingly, most past conflict events do not magnify the effects of price shocks on conflict. Past protests are an exception (i.e. the impact of price shocks on protests is higher in states with a past history of protests). In addition, neither unemployment nor poverty appear to mediate the effects of price shocks.

## 7. Conclusions

Do income shocks affect conflict? We have addressed this question by analyzing the effects of price shocks on conflicts across Nigerian states in the past decade. Our results show that price changes are important determinants of conflict through consumption and production. In particular, hikes in consumption prices have a conflict-inducing effect, while the opposite is true for production prices. Both results are consistent with the opportunity cost hypothesis of conflict. Importantly, not including consumption effects, which previous studies usually do not consider, severely biases the estimation of the production effect as well.

Increases in the international price of oil, the most important Nigerian export, raise the level of conflict in oil-producing regions in line with the state prize theory. However, this effect is reversed when considering the period of time after the amnesty deal was signed between the state and the militant groups in the Niger Delta, suggesting that the state may have been able to use oil revenues to pacify the region.

These effects apply to all types of conflict events, including events with fatalities, battles, protests, and events with violence against civilians. In addition the magnitude of the price effects on conflict is amplified in election years, especially the consumption and oil shock. Similarly oil shocks are amplified in states with many ethnic minorities, with more than one dominant ethnic group and with high economic inequality. The effects of the shocks on protests are also reduced the further one moves away from Lagos, consistently with more limited transmission of the shock in more remote locations.

These findings may bear a number of important policy implications. First in conflict prone environments it is important to assist populations to cope with consumption and production 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 consumption and production price shocks (Anderson et al., 2013; Attanasio et al., 2013).

Second, to the extent that the oil rent is appropriable through fighting, the management of oil revenues is a key tool to prevent conflict in oil rich fragile countries. This points towards the need to deepen our understanding of conflict sensitive institutions of oil management.

Third our findings do suggest that in the case of Nigeria the state has been more successful in quelling the conflict by using the oil revenues to buy off the insurgents rather than to fight them. In the absence of more evidence from other contexts, the external validity of this finding is unclear. In addition there are questions about the long term sustainability of this strategy (Sayne,

2013). However it may be worth considering this option as a temporary tool to create more sustainable conditions for peace.

Finally, our analysis suggests the importance of undertaking a within country rather than a cross-country analysis to understanding the possible conflict risks associated with different income shocks. On one hand such analysis allows to model more shocks, which often occur simultaneously and with different effects. On the other hand it also enables to understand the conditions under which these shocks are particularly risky for conflict.

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**Appendix 1: A basic partial equilibrium model of commodity prices and conflict**

We present here the stylized partial equilibrium model in Dal Bó and Dal Bó (2012) to illustrate the opportunity cost mechanism through which a price shock can affect conflict.

Consider an economy which consumes two goods 1 and 2. Labor is the only production factor and the economy only produces good 2, as it has a fixed endowment of good 1 equal to *F*, which is available for consumption. One can think of that as part of the fuel obtained from the processing of domestic oil reserves by foreign capital and left as a form of payment to the country. Good 2 is produced competitively by many firms which employ constant returns to scale technology. Labor is paid its marginal productivity, which is equal to $\varphi$. The price of one unit of labor is *w* and the total endowment of labor is $\overline{L}$. Goods are sold in the market at price $p_1$ and $p_2$. To save clutter, $p_2$ is the numeraire, so any change in $p_2$ will be reflected in a symmetric and opposite change in $p_1$.

Conflict in the economy is modeled through an additional sector which predates part of the stock *F* by employing an amount $L_C$ of labor. The technology underlying the predation is such that the conflict sector appropriates a share $C(L_C)$ of the good 1 stock, with $\frac{\partial C}{\partial L_C} > 0$ and $\frac{\partial^2 C}{\partial L_C} < 0$ and $C(0) \geq 0$. The strict concavity of $C(L_C)$ captures the idea that there are congestion costs to predation. $L_C$ is the direct measure of the degree of conflict in the country. Individuals have homothetic preferences which give rise to aggregate demand functions $c_1(p_1, M)$ and $c_2(p_1, M)$. These are obtained by individuals' maximization of their utility given relative prices and income M. The equilibrium in the model is composed of four sets of conditions.

The first is that firms earn zero profits, thus they have to pay a wage equal to the marginal product of labor:

$$w=\varphi. \qquad \text{(A1)}$$

The second is that the factor markets have to clear. As there is only one factor, labor, the condition states that labor demand must equal labor supply:

$$\frac{q_2}{\varphi} = \overline{L} - L_C \qquad \text{(A2)}$$

In addition, individuals have to be indifferent in equilibrium between allocating their labor to the productive or to the conflict sector. In other words, the returns from predation per unit of labor need to be equal to those from productive activity:

$$\frac{C(L_C)p_1F}{L_C} = w \qquad \text{(A3)}$$

where the left hand-side is the value of predation per unit of labor and the right hand-side is the value of a unit of labor to produce good 2. This is the key relationship linking the wage to the size of $L_C$, conditional on factor markets clearing and the factor endowment.

Finally, in a small open economy domestic prices have to be equal to international prices, and the economy is unable to affect the international price $p_1^*$. Given that $p_2$ is the numeraire, this condition translates to:

$$p_1 = p_1^* \qquad \text{(A4)}$$

Restricting the equilibrium to positive levels of conflict but with $\overline{L} > L_C$, let us consider the effects of a positive international price shock for the labor good 2, produced by the country. That is an increase in $p_2^* = p_2$. As $p_2$ is the numeraire, this increase can be modeled as a reduction in $p_1^*$. In order to study the effect of this price change on conflict, we have to compute $\frac{\partial L_C}{\partial p_1}$ (taking into account (A4)). Combining equations (A1) and (A3), the amount subject to predation in conflict can be expressed as:

$$C(L_C) = \frac{\varphi L_C}{p_1 F} \qquad \text{(A5)}$$

Using the implicit theorem function, $L_C$ can be expressed as a function of $p_1$. Therefore differentiating both terms of the equation (A5), we obtain: $\frac{\partial C}{\partial L_C}\frac{\partial L_C}{\partial p_1} = \frac{\varphi}{p_1 F}\frac{\partial L_C}{\partial p_1} - \frac{\varphi L_C}{(p_1)^2 F}$, which can be reduced to:

$$\frac{\partial L_C}{\partial p_1} = \frac{-\frac{\varphi L_C}{(p_1)^2 F}}{\frac{\partial C}{\partial L_C} - \frac{\varphi}{p_1 F}} \qquad \text{(A6)}$$

This value turns out to be positive as $\frac{\partial C}{\partial L_C} < \frac{\varphi}{p_1 F}$ (due to the concavity of $C(L_C)$ and taking into account (A6)) and as the numerator is negative. Therefore an increase in the price of the good 2 (i.e. reduction of $p_1$) produced by the country leads to a reduction in conflict. The intuition behind this result can be seen by looking at equation (A3), given here for convenience as: $\frac{C(L_C)F}{L_C} = \frac{w}{p_1}$. A decrease in $p_1$ raises the real wage in the economy (the right hand-side of the expression). This raises the equilibrium amount of resources subject to predation per unit of labor in the conflict sector. Given the concavity of $C(L_C)$, such amount corresponds to a lower level of $L_C$.

**Appendix 2: A general equilibrium model of commodity prices and conflict**

Here we present the extension of the partial equilibrium model in Appendix 1, which embeds that model into a general equilibrium framework with two production factors. The model is from Dal Bó and Dal Bó (2011) and illustrates the different effects of price shocks on conflict across two types of goods.

The economy is as that described in Appendix 1, except that it now has an additional factor of production, capital K (with total endowment $\overline{K}$) and it produces competitively good 1 as well. Good 2 remains the relatively labor-intensive good, while good 1 is relatively capital intensive. Now the conflict sector can appropriate a share of both goods produced, which makes the analysis more realistic and establishes a clearer link between the two sectors. Each good is produced using both factors with $a_{ij}$ being the amount of factor $j$ in the production of a unit of good $i$ at minimum cost given the technology and the unit factors prices $r$ (for capital) and $w$. It follows from the above assumption that $\frac{a_{1K}}{a_{1L}} > \frac{a_{2K}}{a_{2L}}$. The exogenous parameters of the model are the technology, the preferences, the output prices (set internationally) and the factor endowments $\overline{L}$ and $\overline{K}$. The equilibrium is now characterized by three set of conditions: in product and factor markets as well as the no arbitrage condition.

First, the zero profit condition holds in equilibrium for both sectors:

$$ra_{1K} + wa_{1L} = p_1 \qquad \text{(A7)}$$
$$ra_{2K} + wa_{2L} = p_2 = 1 \qquad \text{(A8)}$$

Second, factors' markets clear:

$$q_1 a_{1K} + q_1 a_{1K} = \overline{K} \qquad \text{(A9)}$$
$$q_2 a_{2K} + q_2 a_{2L} = \overline{L} - L_C \qquad \text{(A10)}$$

Finally, labor must be indifferent between being employed in the conflict sector and in the productive sectors:

$$\frac{C(L_C)[r\overline{K}+w(\overline{L}-L_C)]}{L_C} = w(1 - C(L_C)) \qquad \text{(A11)}$$

The equation (A11) illustrates two important differences with the partial equilibrium model in Appendix 1. First, the conflict sector predates both goods so the total potential lootable value by the conflict sector is now $r\overline{K} + w(\overline{L} - L_C)$. Second, the wage earned by the individual is now also reduced by the conflict predation.

How do changes in international goods' prices affect conflict in this setting? As in the partial equilibrium model above, let us differentiate the equation for the no arbitrage condition (A11) with respect to $p_1$. Re-writing (A11) as $C(L_C) = \frac{L_C}{\frac{r}{w}\overline{K}+\overline{L}}$ and using the implicit theorem as above, we have that

$$\frac{\partial L_C}{\partial p_1} = \frac{-\frac{\overline{K}L_C}{\left(\frac{r}{w}\overline{K}+\overline{L}\right)^2}\times\frac{\partial\left(\frac{r}{w}\right)}{\partial p_1}}{\left(\frac{\partial C}{\partial L_C}-\frac{1}{\frac{r}{w}\overline{K}+\overline{L}}\right)} \qquad \text{(A12)}$$

Given the concavity of $C(L_C)$, the fact that $C(0) \geq 0$ and the equilibrium condition (A11), the denominator of (A12) is negative. The term $\frac{\overline{K}L_C}{\left(\frac{r}{w}\overline{K}+\overline{L}\right)^2} > 0$ as all terms are positive. Therefore (A12) has the sign of $\frac{\partial\left(\frac{r}{w}\right)}{\partial p_1}$, which is the change in the return to capital relative to labor induced by a change in the price of the capital intensive good. The Stolper-Samuelson theorem proves that $\frac{\partial r}{\partial p_1} > 0$ and $\frac{\partial w}{\partial p_1} < 0$, therefore $\frac{\partial\left(\frac{r}{w}\right)}{\partial p_1} > 0$.

It follows that $\frac{\partial L_C}{\partial p_1} > 0$, which implies that the increase in the international price of the capital-intensive good raises conflict (all else constant), while an increase in the price of the labor-intensive good decreases it (all else constant).

## Appendix 3: Items matching between price and household survey data

**Table A1: Matching between survey items and domestic prices**

| Broad Consumption | | | Narrow Consumption | | |
|---|---|---|---|---|---|
| **A2 non food freq matched** | **A1 matched non food less freq** | **Food** | **A2 non food freq matched** | **A1 matched non food less freq** | **Food** |
| Gas for cooking | Cotton | Guinea corn | Gas for cooking | Cotton | Guinea corn |
| Kerosene | Silk | Millet | Kerosene | Silk | Millet |
| Washing powder | Handloom (aso_oke) | Maize (white) | Washing powder | Handloom (aso_oke) | Maize (white) |
| Matches | Ankara | Maize (yellow) | Matches | Ankara | Maize (yellow) |
| Toilet paper | Polyester material | Rice (local) | Toilet paper | Polyester material | Rice (local) |
| Candles | Wool | Rice (agric) | Candles | Wool | Rice (agric) |
| Pain killers | Other clothing material | Rice (imported) | Pain killers | Other clothing material | Rice (imported) |
| Antibiotics | Men tailoring | Maize flour | Antibiotics | Shoes Leather | Bread |
| Anti-malaria medicines | Women tailoring | Biscuits | Anti-malaria medicines | Sandals Leather | Buns |
| Petrol | Boys tailoring | Yam Flour | Petrol | Shoes Canvas | Yam Flour |
| Other (rail, air) | Girls tailoring | Cassava flour | Other (rail, air) | Sandals rubber | Cassava flour |
| Books, magazines, etc | Suits | Plantain flour | Books, magazines, etc | Other footwear | Plantain flour |
| Writing & drawing | Other ready-made clothing | Corn flour | Writing & drawing | Basic Rent | Corn flour |
| | Hand-woven cloth | Cassava | | Mattress, pillow | Cassava |
| | Blouses, shirts | Cocoyam | | Refridgerators | Plantain |
| | Boys dress | Plantain | | Electric Iron | Yam |
| | Men dress | Yam | | Tyres | Fufu |
| | Girls dress | Fufu | | Battery | Gari (white) |
| | Shoes Leather | Gari (white) | | TV sets, video | Other starchy products |
| | Sandals Leather | Gari (yellow) | | | White bean |
| | Shoes Canvas | Cassava (akpu) | | | Moimoi |
| | Sandals rubber | Brown beans | | | Akara |
| | Other footwear | White bean | | | Groundnuts |
| | Basic Rent | Moimoi | | | Other pulses |
| | Mattress, pillow | Akara | | | Kulikuli |
| | Refridgerators | Groundnuts | | | Dawadawa |
| | Electric Iron | Kulikuli | | | Palm nut |
| | Tyres | Kola nut | | | Cashew nut |
| | Battery | Groundnut oil | | | Coconut oil |
| | TV sets, video | Palm kernel oil | | | Groundnut oil |
| | | Red palm oil | | | Palm kernel oil |
| | | Magarine | | | Red palm oil |
| | | Vegetable oil | | | Shear butter |
| | | Banana | | | Magarine |

| | | |
|---|---|---|
| | Orange | Vegetable oil |
| | Orange juice | Avocado pear |
| | Chicken | Banana |
| | Agric eggs | Mango |
| | Local eggs | Pineapple |
| | Other eggs (not chicken) | Pineapple juice |
| | Milk powder | Orange |
| | Baby milk | Orange juice |
| | Smoked fish | Other fruit (not canned) |
| | Dried fish | Fruit canned |
| | Beef (fresh cattle) | Fruits juice |
| | Corned beef | Chicken |
| | Garden eggs | Duck |
| | Okro fresh | Guinea Fowl |
| | Okro dry | Other poultry |
| | Onions/shallot | Agric eggs |
| | Pepper green | Local eggs |
| | Tomatoes | Other eggs (not chicken) |
| | Tomato puree | Fresh milk |
| | Coffee | Milk powder |
| | Chocolate drinks | |
| | Tea | |
| | Other food items | |
| | Malt drinks | |
| | Minerals | |
| | Beer (local/imported) | |
| | Stout (local/imported) | |
| | Palm Wine | |
| | Other wine (local/imported) | |
| | Other alcoholic beverage | |
| | Cigarette | |
| | Pepper | |

**Table A2: Percentage expenditure and production merged by state**

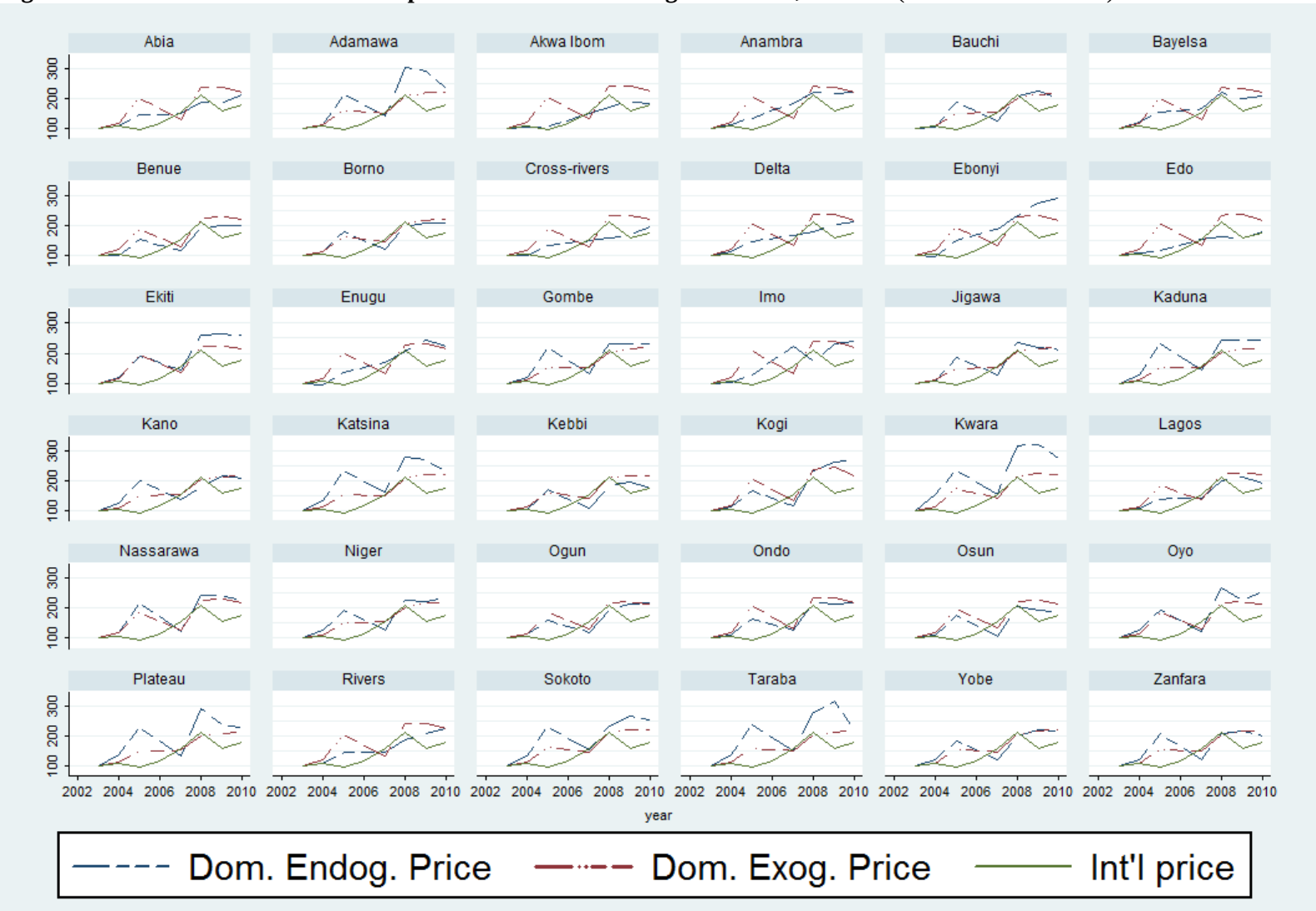
| State | % of Total Exp. Matched Narrow | % of Total Exp. Matched Broad | % of Total prod. Matched Narrow | % of Total prod. Matched Broad |
|---|---|---|---|---|
| Abia | 53.2455 | 55.9737 | 0.4565 | 0.5000 |
| Adamawa | 61.1469 | 63.7800 | 0.4667 | 0.5111 |
| Akwa Ibom | 52.0054 | 54.1582 | 0.4651 | 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 |

## Table A3: 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 | | |

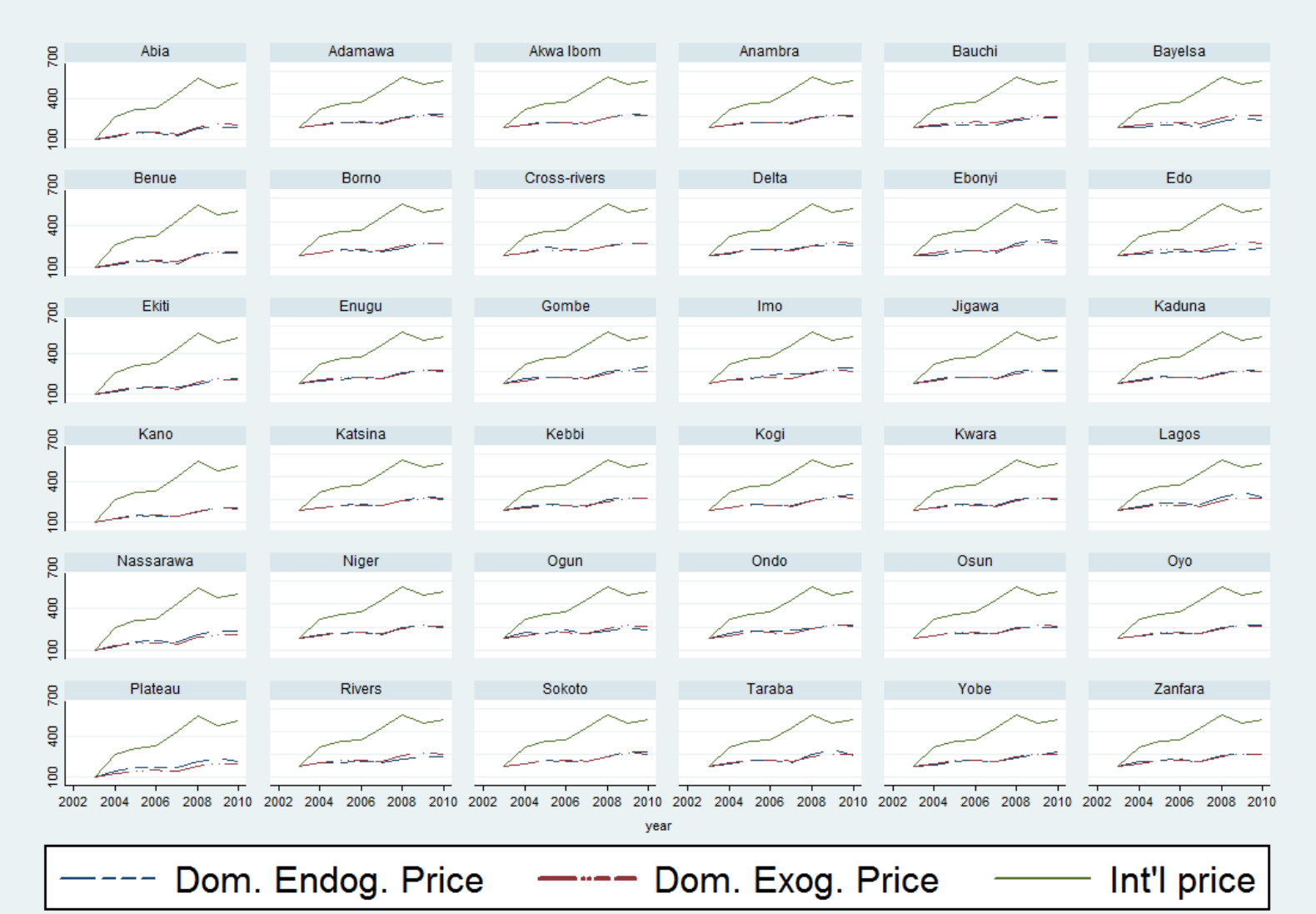
## Appendix 4: International to domestic price transmission

**Figure A1: International and domestic prices of maize 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 A2: 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*