Internal Borders:
Ethnic Diversity and Market Segmentation in Malawi

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Abstract

Ethnic diversity is associated with slower economic growth, but why? I argue that diversity is detrimental to development when ethnic groups are geographically segregated, trust is concentrated within ethnic groups, and trust is necessary for economic exchange. Under these conditions, individuals will trade primarily within ethnically homogeneous regions, resulting in market segmentation. I evaluate this argument using maize price data from seventy Malawian markets and the spatial distribution of ethnic groups. I find that maize price differences – an indicator of market segmentation – are indeed larger for ethnically dissimilar markets, even after taking sub-national administrative borders and geographic barriers into account. These findings suggest that ethnic diversity, and ethno-regional segregation in particular, can have a negative impact on market integration, an important driver of long-term economic development.

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African states are among the poorest in the world, with per capita incomes only half of those in Asia, the next poorest continent, and less than five percent of the per capita incomes in North America (Heston et al., 2012). Since the beginning of the era of cross-sectional growth models, scholars have tried to explain why African countries lag behind the rest of the world, even after accounting for many correlates of economic development (Englebert, 2000). A key contender in the race to explain the "Africa dummy" has been the continent's high levels of ethnic, linguistic, and cultural diversity, with Easterly and Levine (1997) famously arguing that such diversity is responsible for "Africa's growth tragedy." Subsequent studies have gone on to show that diverse societies do indeed tend to experience slower economic growth than more homogeneous societies (Zak and Knack, 2001; Alesina and La Ferrara, 2005).

But how does ethnic diversity *actually* impact economic development in diverse societies? Existing explanations tend to focus on top-down mechanisms of elite behavior, including macroeconomic policy distortions (Easterly and Levine, 1997), the under provision of public goods (Alesina et al., 1999; Alesina and La Ferrara, 2005), divergent policy preferences (Lieberman and McClendon, 2012), competitive rent-seeking (Shleifer and Vishny, 1993), and opposition buy-off (Annett, 2001). In contrast, I propose a bottom-up mechanism linking ethnic diversity to poor economic growth via mass-level behavior: market segmentation along ethnic lines.

In many ethnically diverse African societies, aggregate measures of ethnic diversity result from the combination of multiple ethnically homogeneous regions within the same country. Furthermore, the geographic segregation of ethnic groups tends to result in the concentration of trust within ethnic groups (Robinson, 2013). Given the importance of interpersonal trust for trade in weakly institutionalized settings, individuals tend to engage in trade primarily within sub-national, ethnically homogeneous regions (or pay higher transaction costs for trading across ethnic lines). As a result, diverse, segregated countries will fail to establish national market integration. Market integration is important for growth, as integrated markets have less price volatility, larger gains from trade, and the efficient movement of goods. In short, if ethnic differences pose intra-national barriers to trade, then the economies of ethnically diverse states will suffer inefficiencies and grow more slowly in the long run.

I evaluate the impact of ethnic segregation on market segmentation in the context of Malawi, an ethnically diverse country in southern Africa. Past research has shown that

markets are poorly integrated in Malawi (Goletti and Babu, 1994; Fafchamps et al., 2005; Zant, 2012), and qualitative and survey data both suggest that a major barrier to greater market integration is a lack of trust among traders and farmers (Fafchamps and Gabre-Madhin, 2006; Jayne et al., 2010). I add to this literature by empirically connecting patterns of market segmentation to the spatial distribution of ethnic groups within Malawi.

To evaluate whether or not regional ethnic segregation explains the way in which markets are segmented within Malawi, I combine fourteen years of monthly maize prices from across seventy markets with fine-grained census data on the spatial distribution of ethnic groups. Maize price differentials between pairs of markets – the standard measure of market segmentation – are estimated as a function of the degree of ethnic difference between the two markets, while controlling for the physical distance between them. The results demonstrate that there is indeed a positive relationship between ethnic difference and market segmentation: being separated by an "ethnic border" is equivalent to separating markets by an additional 150 kms, and market pairs with no ethnic overlap are segmented to the same degree, on average, as ethnically identical markets separated by an additional 245 kms.

The demonstrated relationship between ethnic differences and market segmentation is robust to controlling for potential omitted variables, including sub-national administrative borders and geographic separation, which are likely to be correlated with both ethnic geography and market segmentation. In addition, by taking advantage of variation in the degree to which ethnic borders are associated with price dispersion across both time and space, I am also able to speak to the mechanism relating ethnic differences to market segmentation. The results suggest that cultural differences between members of different ethnic groups are more consequential for ethno-regional market segmentation than the top-down, political mobilization of ethnicity by elites.

In sum, the findings of this paper suggest that within-country ethnic diversity, and ethno-regional segregation in particular, has important implications for national market integration. These findings are likely to generalize to other contexts in which ethnic groups are geographically segregated, trust is conditional on shared ethnicity, and markets rely on informal contract enforcement. Given the ubiquity of these conditions in much of Sub-Saharan Africa, the bottom mechanism proposed here may help account for economic under-development across the continent, as well as offering a link between

ethnic diversity and economic growth more broadly.

Market Segmentation and Economic Development

In theory, the integration of markets – globally, regionally, and within countries – is conducive to economic growth by reducing the volatility of prices, allowing gains from trade based on regional comparative advantages, and facilitating the efficient movement of goods from areas of surplus to areas of deficit. Thus, barriers to trade, and, as a result, barriers to market integration, are detrimental to economic development (Frankel and Romer, 1999; Keller and Shiue, 2007a).

In the study of international trade, market integration has typically been studied by observing price equalization, or, when prices are aggregated across items, purchasing power parity. This focus on prices reflects the fact that for most markets in the world, information on prices are the only data available through which to explore market integration. Inferring market behavior from price differentials across space, an approach called spatial price analysis, stems from the very definition of a market: the geographic extent to which the same good demands the same price at the same time in all areas (Fackler and Goodwin, 2001). Price equalization, or the Law of One Price (LOP), is achieved through trade, although integration does not necessarily require direct trade between all points within the market, as long as all points within the integrated market are part of the same trading network. Within such integrated markets, the difference in prices of the same good in two different locations will be, at most, equal to the cost of moving that good from the area with the lower price to the area with the higher price (Fackler and Goodwin, 2001). If the price difference exceeds the cost of transport, then a market inefficiency exists, and some barrier must exist to prohibit the profitable trade of that good.

In one line of research, scholars argue that the presence of an international border is one such barrier to market integration. In the seminal piece within this "border effects" literature, Engel and Rogers (1996) estimate the impact of the international border between the United States and Canada on price disparities. They find, as expected under the Law of One Price, that distance, a proxy for transport costs, increases price dispersion. However, holding distance constant, they find that being separated by the international border also increases market segmentation between pairs of cities. They

translate this "border effect" into its distance equivalent, finding that the international border is equal in impact to 75,000 miles of separation. Many follow up studies have focused on this and other borders as barriers to market integration (Helliwell, 1997; Nitsch, 2000; Parsley and Wei, 2001; Anderson and Van Wincoop, 2002; Engel et al., 2003; Engel and Rogers, 2004; Broda and Weinstein, 2008; Gopinath et al., 2011; Aker et al., 2014).

Analogous to the literature on international trade, *intra*-national market integration via inter-regional trade is also thought to be conducive to economic development. In addition to the fact that inefficient markets result from market segmentation, there are additional negative implications of market segmentation in developing economies. For agricultural markets in Africa, for example, Fafchamps (1992) argues that greater market integration would facilitate economic growth by shifting small-scale agriculture from subsistence farming to export-oriented crop production. When markets are geographically segmented, the price of agricultural products are volatile and dependent on local conditions. Under such conditions, farmers will protect themselves from volatility in food prices by growing their own food (subsistence farming) instead of investing in the production of cash crops. However, if markets are nationally-integrated, food prices would be significantly more stable, and even small-scale farmers will rationally invest in growing cash crops. In the aggregate, as more farmers shift from subsistence to income-generating farming, agricultural productivity and exports would increase, positively impacting economic growth.

A large literature has focused on understanding why national market integration sometimes fails in developing countries (see Fackler and Goodwin, 2001, for a review), and has identified three main barriers to national market integration: high transport costs due to poor infrastructure, government control of trade and pricing, and the lack of formal contract enforcement, all of which are chronic problems in Sub-Saharan Africa. First, in terms of high transport costs, scholars cite the lack of well-maintained road networks, and the extreme isolation of many rural markets as culprits in prohibitive transport costs. In Malawi and Madagascar, Fafchamps et al. (2005) finds that transport costs could be reduced by organizing larger loads, but that the dominance of small-scale trading and the dearth of motorized transport in some areas leads to the inefficient use of low-volume transport.

Second, many African states use, or have used, state-controlled agricultural marketing

boards with monopoly buying rights to restrict the private trade of agricultural goods. These policies were ostensibly implemented to protect small-scale farmers from price volatility by guaranteeing a minimum price for their excess harvest, but in practice they often resulted in below-market prices for farmers. As a result, in the 1980s and 1990s, international organizations began tying financial assistance to the implementation of market liberalization policies, which were often part of a larger package of policy reforms collectively referred to as "structural adjustment programs." There is some empirical evidence that market integration did indeed increase following such liberalization policies in several Africa countries (see Goletti and Babu, 1994; Dercon, 1995; Badiane and Shively, 1998, on Malawi, Ethiopia, and Ghana, respectively).

Third, most trade in Sub-Saharan Africa operates in the absence of formal avenues for contract enforcement. Fafchamps (2004) attributes this to the facts that most transactions are too small to justify the cost of legal action and that most offending parties are too poor to have assets that could be seized in court settlements. Without legal contract enforcement, trade in much of Africa is limited to face-to-face transactions that carry little risk, or to transactions in which business partners trust one another to complete a transaction in good faith. The resulting small-scale and very localized nature of trade means that markets are fragmented and increasing returns to scale are not realized.

All three of these barriers to trade are likely to be operating in the agricultural markets of Sub-Saharan Africa. In the next section, I focus on how one solution to the lack of formal contract enforcement – namely, ethnically defined trade networks – combined with the regional segregation of ethnic groups within diverse states is itself an additional barrier to market integration.

Ethnic Barriers to Market Integration in Africa

Interpersonal trust is crucial for the operation of agricultural trade within Sub-Saharan African countries,[1] because contracts cannot be enforced by law. As a result, markets in Africa operate similarly to ancient overseas trade practices in which the risk of exploitation was overcome by restricting trade to members of a particular network within which collective enforcement of cheating is expected (Greif, 1989, 1993). While

[1]Along with Fafchamps (2003), I define trust as the belief that an agreement will not be breached in bad faith.

the personalized nature of such trade relations allows for economic transactions to proceed despite such risky conditions, the adverse effects of these closed networks of trust are to restrict the scale or scope of mutually beneficial transactions, and to limit the development of impersonal forms of contract enforcement (Greif, 1994).

In personalized trading systems, trust can arise from repeated interactions, resulting in networks of suppliers and clients within which trade occurs exclusively. However, when those networks tend to be defined along ethnic lines, then expectations of trustworthiness can come to be inferred from one's ethnic identity, even if the individual is not personally known. This seems to be case for ethnic groups in many Sub-Saharan African countries. For example, evidence suggests cooperation is higher among coethnics because sanctioning of non-cooperation is more likely within ethnic groups than across ethnic lines (Miguel and Gugerty, 2005; Habyarimana et al., 2009), and public opinion data show that across most African countries, coethnics enjoy a trust premium (Robinson, 2013).

Because trust lowers the transaction costs of trade, and trust tends to be concentrated within ethnic groups in Africa, then we should expect that trade will be more common among coethnics. Perhaps not surprisingly then, there is ample evidence that ethnicity is a central component of trade relations in Sub-Saharan African markets (e.g., Marris, 1971; Macharia, 1988; Himbara, 1994; Fafchamps, 2004). But, the implications of this link between ethnicity and trade for economic growth are dependent on the geographic distribution of ethnic groups. For non-indigenous minorities, such as the Lebanese in West Africa or Asians in East Africa, the ethnic concentration of trade, while exclusionary, may still offer efficient integration of geographically disparate markets if the ethnic group is not geographically clustered. More generally, if members of different ethnic groups are evenly distributed across an ethnically diverse country, then the concentration of trust and trade within ethnic communities would not result in geographic market segmentation. However, in most Sub-Saharan African countries, the majority of ethnic groups are regionally concentrated with a high degree of ethnic segregation (Matuszeski and Schneider, 2006).

Thus, I argue that it is the particular combination of ethnic-based institutions for trade on the one hand, with the geographic segregation of ethnic groups on the other, which contributes to the negative relationship between ethnic diversity and economic growth in Sub-Saharan Africa. While much empirical work has tied levels of ethnic diversity

to both lower trust and poorer economic outcomes, there has been less scholarship demonstrating the impacts of diversity on economically-relevant behavior. Thus, the goal of this paper is to evaluate the degree to which ethno-regional segregation influences trade relations and national market integration in the case of Malawi.

This project contributes to the nascent body of work empirically linking ethnicity to trade in Africa.[2] First, Hamaguchi (2010) argues that in addition to improving physical infrastructure, policy makers must focus on overcoming ethnic tensions that hamper economic integration in Kenya. Rather than trade, Hamaguchi focuses on income, showing that the degree to which poverty in neighboring districts "spills over" into bordering areas is related to their ethnic similarity. Second, also working in Kenya, Versailles (2009) relates the ethnic composition of cities to their degree of economic integration. He uses maize price data disaggregated by city and finds that price shocks are more easily transferred between markets the closer they are to each other, in terms of both geographic distance and ethnic makeup. Finally, Aker et al. (2014) applies the border effects literature to market integration in Africa, by evaluating the impact of the Niger-Nigeria border on agricultural trade. Consistent with the literature, they find that the international border increases price dispersion; however, their primary contribution is in showing that this border effect is smaller where a single ethnic group straddles the international border. They take this as an indication that coethnicity facilitates trade, which they then confirm by evaluating integration between markets within northern Niger. By identifying markets with high ethnic diversity that separate markets with low ethnic diversity in the northern region of Niger, home to two ethnic groups (the Hausa and the Zarma), they find that price dispersion is lower within ethnically homogeneous regions than between Hausa-dominated and Zarma-dominated markets.

Together, these three studies provide evidence that ethnic differences do indeed pose some barrier to economic integration in Africa. My study of market integration in Malawi improves on these studies in two important ways. First, my use of fine-grained census data on ethnic demographics allows for more precise measures of ethnic differences between market places. In contrast, both Hamaguchi and Versailles make use of information about ethnic groups at the district level in Kenya, which potentially masks important intra-district ethnic boundaries. Second, my study of market integration across multiple ethnic regions within Malawi allows me to disaggregate the average

[2]All three of the existing papers on this topic are unpublished manuscripts.

ethnic border effect by different ethnic borders. This, in turn, enables me to evaluate the factors that give rise to ethnic barriers to trade, including the political mobilization of some ethnic groups and not others, the timing of national elections, and the degree of cultural distance between different ethnic pairings.

Maize Trade in Malawi

Malawi is a small, densely populated, landlocked country in south-central Africa, bordered by Mozambique, Zambia, and Tanzania. It is home to eleven major ethnic groups, and members of these groups are, by and large, geographically segregated. Across the nearly 13,000 Census Enumeration Areas, less than 20% do not have an ethnic majority, and over half have an ethnic majority larger than 80%. In other words, while Malawi is a very diverse country at the national level, most Malawians live in highly homogeneous settings. Further, survey data suggest that trust in Malawi is particularly ethnically-defined. The third round of the Afrobarometer public opinion surveys asked individuals in several Africans states about their degree of trust in different types of individuals, including coethnics and members of other ethnic groups within the country (Afrobarometer, 2006). Across the sixteen states in the sample, Malawi ranks 15^{th} in terms of the rate at which non-coethnics were trusted relative to coethnics. In short, Malawi offers a particularly appropriate setting in which to study the impact of ethnic based trust and ethnic segregation on market integration.

In order to observe market integration over time, I focus on a single agricultural good: maize. Maize is the primary staple crop in Malawi, with an estimated 97% of households growing maize each year (Jayne et al., 2010). There is one maize harvest per year, typically in late April or early May. While most farmers grow maize only for their own household needs, a sizable portion (around 20%) of smallholders sell some portion of their maize harvest for cash (Jayne et al., 2010). This maize is typically sold right after the harvest, giving farmers access to cash in order to settle debts or pay school fees. Such farmers sell to a variety of sources, including other households within their village, local small-scale traders, mobile small-scale traders, agents for large trading companies, or the Agricultural Development and Marketing Corporation of Malawi (ADMARC). In an average year, maize sold by small-scale farmers accounts for almost 60% of maize traded (Jayne et al., 2010).

Despite privatization of the maize market in the late 1980s, and widespread participation by the rural population, the Malawian maize market is not well integrated (Goletti and Babu, 1994; Zant, 2012). Lack of trust may be one reason for such poor market integration (Fafchamps and Gabre-Madhin, 2006), since interpersonal trust is crucial for the maize trade at several stages. When farmers wish to sell their excess maize, the decision of whom to sell it to often comes down to whom they trust, since farmers are vulnerable to being cheated by traders and agents because of asymmetric price information. Mobile traders – typically using bicycles, but sometimes small trucks – who travel through villages buying maize are appreciated by farmers because they save them the cost of transporting their excess maize to the local market. However, this service is risky, since the farmer may be offered prices much lower than the current price of maize plus the cost of transport. Even in contexts where the farmers have some idea about current prices, traders are often able to convince a farmer in desperate need of cash that the price of maize has fallen dramatically (Jayne et al., 2010).

Even when farmers transport their maize to the local market place, and have options from amongst different traders and company agents, trust still plays a role. According to the ethnographic work of Jayne et al. (2010), many small-scale traders and buying agents operating in local markets use faulty weights in order to pay less for a product. Similarly, many buyers refuse to allow the farmer to see the reading on the scales, forcing the farmer to trust that the trader or agent is honestly reporting the weight. Finally, while purchasing on credit is not very common in Malawi (Fafchamps and Gabre-Madhin, 2006), when it does occur farmers must simply trust that that credit will be repaid by the traders (Jayne et al., 2010).

Once the maize is sold from the farmer to a trader, interpersonal trust remains central to the functioning of markets. In a survey of small-scale traders in Malawi, Fafchamps and Gabre-Madhin (2006) find that a lack of trust among traders was a key impediment to trade. In the case of agricultural products, many traders were only willing to buy after visual inspection of the product because they did not trust the seller to accurately convey the quality of the good. Due to the high cost of individual transport, this lack of trust severely limits traders to transactions within a small geographic area. The radius is expanded through networks of trust, such that individuals may ask someone they do trust, who is local to the product, to inspect it on their behalf. Evidence suggests that such networks of trust exist and facilitate trade in Malawi (Fafchamps and Minten, 2001; Fafchamps and Gabre-Madhin, 2006), and that these networks function by sharing

information about cheating and by group-based punishment of defection.

In sum, interpersonal trust is central to the functioning of the maize trade in Malawi. Because trust tends to be concentrated within ethnic groups, and ethnic groups are geographically segregated, I have argued that maize market integration is likely to be ethnically bounded.

Empirical Approach

In order to evaluate the impact of ethnic difference on market segmentation in Malawi, I combine three sources of data: the location of 70 maize markets within Malawi, monthly maize price data from each of those markets between 1998 and 2005, and fine-grained census data on spatial distribution of ethnic groups across Malawi. The resulting market pair – month dataset includes a measure of maize price dispersion between market pairs, the degree to which markets are ethnically different, and the distance between them. Following common approaches in the study of market integration, I use a market pair regression analysis to determine the degree to which ethnic differences precipitate maize market fragmentation, controlling for the distance between markets.

Data

Geographic Location of Malawian Markets

Geographic location data are made available for over 10,000 locations in Malawi by the National Geospatial-Intelligence Agency.[3] From this list of places, I reduced the dataset to the 70 places that matched the location of markets for which price data is available (see below). This resulted in a dataset of the latitude and longitude of the main maize markets in Malawi. Figure 1 maps the location of these markets across Malawi.

[Figure 1 about here.]

[3]Toponymic information is based on the Geographic Names Database, containing official standard names approved by the United States Board on Geographic Names and maintained by the National Geospatial-Intelligence Agency. More information is available at the Maps and Geodata link at www.nga.mil.

From this market-level geographic data, I produce a dataset of market pair dyads with geocoded locations for both markets in each pair. With 70 markets there are 2,451 possible market pair dyads ($n(n-1)/2$). To calculate the geodesic distance between each pair of markets, I use the Stata program *vincenty*. The average distance between markets is 253 kms (SD=165), ranging from 8 kms to 830 kms.

However, because the maize trade in Malawi is extremely localized and small-scale, most analyses are limited to market pairs within 100 kms of each other. This restriction limits the dataset to 478 of the possible 2,415 market pairs. Limiting the geographic scope of the analyses reduces the number of unobserved heterogeneities between markets that might otherwise confound the impact of internal ethnic borders on market segmentation. In other words, by focusing on markets that are relatively close to one another, I am able to hold constant many of the kinds of geographic and climatic characteristics that might affect maize production, demand, and, thus, prices.

Monthly Price of Maize in Malawian Markets

Monthly maize price data is made available by the Famine Early Warning System Network from data collected by the Malawi Ministry of Agriculture and Food Security. I use monthly maize prices between January 1998 and December 2011 (168 months) for 70 different markets. The starting date of 1998 was chosen for two reasons. First, many additional markets were added to the data collection efforts in 1998. Second, while agricultural markets were officially liberalized beginning in 1987, the parastatal ADMARC dominated the markets until the early to mid-1990s (Goletti and Babu, 1994). Table 10 in Appendix B lists the 70 markets by region, district, months of price observations (N), and summary statistics of maize prices within each market.

From these market-level price data, I produce a dataset of market pair dyads with maize price data for both markets in each month. However, this a high degree of missingness: for the 478 market pairs within 100 kms of each other, of the 80,304 possible monthly observations, there are only 31,040 actual observations. This missingness comes from markets being added to the price data collection efforts over the 13 years, from 24 markets in 1998 to 70 markets in 2011. To make sure that results are not driven by this missingness, robustness tests are also run on the sample from 2005–2011, in which most markets had been added to the dataset and missingness is less of a problem.

To capture the degree of market segmentation between each pair of markets in each month, I use a conventional measure of price dispersion:

$$PD_{ijt} = |\ln(p_{it}/p_{jt})|$$

where p_{it} is the price of a kilogram of maize (in Malawian Kwacha) in market i in month t and p_{jt} is the price in market j for the same month.[4] The greater the price difference, the less integrated are the two markets.

Figure 2 graphs the average price dispersion (PD_{ijt}) between market dyads between 1998 and 2011. The graph shows a secular decrease in price dispersion over time, suggesting increased market integration between 1998–2011. To be sure that this fall in price dispersion reflects actual increase in market integration rather than solely reflecting the addition of smaller markets in 2005, Figure 2 also plots average price dispersion for only those market pairs for which we have price data for the full series ("Since 98" sample). The trend is essentially the same, although there is slightly less price dispersion between these larger markets. Finally, Figure 2 shows the average price dispersion only for market pairs within 100 kms of each other. As we would expect, these markets are better integrated, with lower levels of price dispersion, on average, although the trend over time is similar.

[Figure 2 about here.]

Ethnic Composition of Malawian Markets

Data on the distribution of ethnic groups across Malawi is made available by the National Statistics Office of Malawi and is based on the 2008 Malawian census. The total number of residents, as well as the numbers of individuals from each of the main ethnic groups in Malawi, is available for all 12,567 Enumeration Areas (EA) within Malawi.[5]

[4]Price dispersion could be measured in a number of different ways. This particular measure of price dispersion was chosen because it has been employed in much of the existing literature, deals well with change in the real value of the kwacha over time, and is not directional (the price dispersion between p_{it} and p_{jt} remains the same if you switch the assignment of i and j to the two markets).

[5]Of the over thirteen million people in the census, only 2.5% chose "other" for their ethnic group rather than one of the eleven main groups. For the calculations of ethnic difference between markets, these individuals are dropped.

The EA is the smallest unit of observation within the census data: on average, EAs have 1,036 residents (SD = 550) residents and cover six square kilometers (SD = 7.5). Figure 3 shows a map of the distribution of ethnic groups across Malawi based on the underlying EA-level ethnic group data.

[Figure 3 about here.]

I relate this spatial distribution of ethnic groups to particular markets in two ways. First, I use the underlying spatial distribution of ethnic groups within Malawi to identify the location of "ethnic borders." In particular, borders represent the point at which the largest group within an EA changes. Figure 4 shows the location of these borders, with regions enclosed by such borders labeled by the majority tribal group within that ethnic region. Market pairs are then coded for whether or not they are separated by an ethnic border. Slightly over 40% of markets within 100 kms of each other, are located in different ethnic regions, meaning that goods and/or traders moving between those two markets must cross at least one ethnic border.

[Figure 4 about here.]

This focus on the largest ethnic group within each enumeration area gives us a good sense of the regional concentration of groups across Malawi. However, it masks import ethnic overlap between markets in different ethnic regions. In particular, while two markets may be located in areas dominated by different ethnic groups, if minorities of each of those groups exist in large enough numbers within the market pair, there may still be enough ethnic overlap to facilitate integration between those markets. Thus, the second measure of ethnic differences between markets considers not just the largest group, but the degree to which the ethnic composition of each market pair overlap.

To do this, I first establish each market's ethnic make-up by observing the ethnic make-up of the EA in which the market is located.[6] For each market pair, I then measure the degree of ethnic difference between the two markets by calculating a Herfindahl index reflecting the probability that a randomly selected individual from one market is from a different ethnic group than a randomly selected individual from the other market using

[6]Fafchamps and Gabre-Madhin's (2006) data on 400 traders from a subset of markets in Malawi confirms that traders' ethnicity are strongly related to the ethnic make-up of the population surrounding a market.

the following formula:

$$EthDiff_{ij} = 1 - \sum_{g=1}^{12}(p_{gi} \times p_{gj})$$

where p_{gi} is the proportion of residents in market i from group g, p_{gj} is the proportion of residents in market j from group g, and the product of those proportions is summed across all eleven ethnic groups and subtracted from one. As a result, $EthDiff_{ij}$ is a number between 0 and 1 representing the ethnic difference between markets i and j, with higher numbers representing greater ethnic difference.[7] Among markets within 100 kms of each other, the average degree of ethnic difference is 0.64 (SD = 0.30) meaning that, on average, individuals randomly selected from two different markets will be from different ethnic groups 64% of the time.

Across the 478 market pairs under consideration, these two measures of ethnic overlap are highly correlated ($r = 0.61, p < 0.001$). For the 283 market pairs located within the same ethnic region, the degree of ethnic difference is only 0.45, compared to an average of 0.85 for market pairs separated by an ethnic border.

Regression Framework

Following the convention in the border-effects literature, I use a market pair regression analysis to determine the degree to which ethnic borders are related to maize price dispersion. In these models, the unit of observation is the market pair – month.

The market pair regression estimated is the following:

$$PD_{ijt} = \beta_0 + \beta_1 EthBorder_{ij} + \beta_2 Distance_{ij} \ + \mu_i + \delta_j + \eta_t + \epsilon_{ijt} \quad (1)$$

where PD_{ijt} is the relative price difference (price dispersion) for maize in markets i and j in month t, $EthBorder_{ij}$ a dummy variable indicating whether markets i and j are separated by an ethnic border, $Distance_{ij}$ is the natural log of kilometers between markets i and j,[8] μ_i and δ_j are market fixed effects for market i and j, η_t is the

[7] Versailles (2009) uses the same measure to indicate ethnic similarity between cities using district-level data. This is essentially the same formula as the more commonly used Ethno-Linguistic Fractionalization (ELF), which calculates probabilities within a single unit instead of between two units.

[8] I use the natural log of distance with the expectation that the marginal effect of distance on price

monthly time effect, and ϵ_{ijt} is the error term. Because the key independent variable – separation by an ethnic border – does not vary over time, a market dyad fixed effect cannot be included. However, standard errors are clustered by market pair dyad in order to account for dependence between observations of the same market pair over time.

The coefficient of interest is β_1, which estimates the percent change in the price ratio for markets within the same ethnic region compared to markets separated by an ethnic boundary, controlling for the road distance between those two markets. If ethnic borders do impede market integration, as hypothesized, then we expect the estimate of β_1 to be positive.

We can similarly estimate the impact of the degree of ethnic difference with the following equation:

$$PD_{ijt} = \beta_0 + \beta_1 EthDiff_{ij} + \beta_2 Distance_{ij} \ + \mu_i + \delta_j + \eta_t + \epsilon_{ijt} \tag{2}$$

where $EthDiff_{ij}$ is the degree of ethnic difference between markets i and j. Here β_1 estimates the percent change in the price ratio when we move from a market pair in which there is complete ethnic overlap ($EthDiff_{ij} = 0$) to a market pair in which there is no ethnic overlap ($EthDiff_{ij} = 1$), controlling for the road distance between those two markets. Again, we expect β_1 to be positive.

Results

Table 1 presents the estimates of the market pair regression analyses. Model 1 estimates that ethnic boundaries have a positive and statistically significant impact on price dispersion, increasing price dispersion, on average, 8%, compared to markets of equal distance apart but within a single ethnic region. Comparing the coefficient on the ethnic border indicator to the impact of distance, the results suggest that being separated by an ethnic boundary increases market segmentation to same degree as an increase in distance of around 150 kms.

Model 2 of Table 1 estimates the impact of the degree of ethnic difference between

dispersion is decreasing with distance. The main results are robust to including distance and distance squared instead (Table 11 of Appendix A).

market pairs on price dispersion. Here we see that compared to market pairs with complete ethnic overlap ($EthDiff = 0$), markets in which there is no commonality in ethnic group make-up ($EthDiff = 1$) have, on average, a 15% increase in price dispersion. In terms of distance, this corresponds to the same impact as around 245 kms of geographic separation.

[Table 1 about here.]

These results suggest that ethnic differences do indeed matter for market integration, implying that ethnic barriers to trade exist in Malawi. However, there are several potential threats to the validity of these results, each of which will be discussed in turn. First, Harriss (1979) focuses on the problems of missing data and data inaccuracies that come from using price data, particularly in the developing world. For this to be problematic for the results presented above, the missingness and mismeasurement would need to be systematically related to ethnicity. Given that the price data are collected by a single agency nation-wide, the Malawian Ministry of Agriculture, differences in measurement across markets should be minimized. To determine whether the results are driven by missing data, the analyses are re-estimated using only data from 2005-2011, in which all 70 markets had entered the dataset and missing data are reduced dramatically. Table 2 presents these results for the 2005-2011 sub-sample of the data, which are qualitatively similar. While the impacts of both ethnic borders and ethnic difference are slightly reduced in this later sub-sample, both remain statistically significant.

[Table 2 about here.]

Second, Fackler and Goodwin (2001) outline a number of issues with using spatial price relations as an indicator of market integration. In particular, they worry that inflation, population growth, and climate patterns that affect all markets will cause prices to be highly correlated, even if those markets are not integrated. All of these may lead to an overestimate of the degree to which markets are integrated, but they cannot explain the impact of ethnic differences on integration unless these factors affect markets in different ethnic regions differently. Because I am looking at price relations between market pairs in a fairly localized setting (within 100 kms), this seems unlikely.

Third, both Fackler and Goodwin (2001) and Conforti (2004) suggest a number of conditions that might lead to an underestimate of market integration, such that price dispersion is high even though markets are well integrated. First, the Law of One Price assumes that the quality of the product is homogeneous: if the product is different

in different regions, then price dispersion will simply reflect that difference. For the results above to suggest ethnic market segmentation, it needs to be the case that the maize grown and sold is similar throughout the different ethnic regions of Malawi. The primary source of variation in maize results from "local" maize and "hybrid" maize, which is subsidized by the government. A general predilection for local maize over the hybrid variety is reflected in expressed preferences of consumers, and in relative prices. However, there is no variation within the two types of maize across regions, confirmed through in-depth interviews with both producers and consumers of maize in all three regions of Malawi between 2011 and 2013. However, the heterogeneity of maize across regions of Malawi is reduced by the fact that the Ministry of Agriculture collects price data only for hybrid maize. Second, price dispersion may occur if government policies affect prices differently across regions. In the case of Malawi, this could occur if the parastatal ADMARC, which used to have monopoly buying rights and still operates as the buyer of last resort, has differential influence on markets in different ethnic regions. However, such differential policies would be hard to implement with the kind of precision that would produce ethnic impacts among markets within 100 kms of each other.

Fourth, and perhaps most importantly, the analyses may suffer from omitted variable biases. In particular, we should worry about any omitted variables that are related to both greater ethnic difference and greater market segmentation. Here, I discuss two potentially consequential omitted variables: administrative borders and geographic accessibility.

First, if intra-national administrative borders pose barriers to trade, and different administrative districts are associated with different ethnic groups, then we will observe a spurious correlation between ethnic differences and price dispersion. There is some historical evidence that subnational administrative boundaries inhibited trade in Europe (Wolf, 2009), and Zant (2012) presents evidence that subnational units are associated with greater market fragmentation within Malawi. In Malawi, the 28 districts represent the lowest level of administration, with each headed by a district commissioner. Maize trade may be hampered across these district lines through exclusive access to stalls in the main district markets or by local authorities who grant permission for traders to operate in a given area. In line with previous studies, I too find that markets that are separated by an district border are less integrated (Table 3, Model 1).

There are also good reasons to expect that district borders will also tend to fall along ethnic lines. The division of countries into ethnically distinct subnational units has long been believed to be a strategy for combatting ethnic conflict (Suberu, 1991; Hale, 2004), and colonial powers preferred to demarcate administrative units along ethnic lines (Berman, 1997). In addition, recent trends towards greater political and economic decentralization have encouraged the creation of new subnational units for local ethnic minorities (Treisman, 2007; Grossman and Lewis, 2013). Malawi has not seen the same kind of rapid proliferation as many other African states, with only four new districts being created since 1998, but ethnicity may have been an important component of the original district delineation. Using the 2008 census data underlying my measures of both $EthBorder_{ij}$ and $EthDiff_{ij}$, I find that the 77 markets out of 478 that are separated by a district border are more likely to be separated by an ethnic border ($t = 15.9$, $df = 476$, $p < 0.001$) and have a significantly higher degree of ethnic difference ($t = 4.7$, $df = 476$, $p < 0.001$).

Because there is a large degree of overlap in administrative and ethnic borders, and administrative borders are associated with less market integration, then I may be incorrectly attributing price dispersion to ethnic differences. To make sure this is not the case, I re-estimate the main results controlling for administrative borders. Models 2 and 3 of Table 3 show that the results presented in Table 1 are robust to controlling for administrative borders, with the coefficients only decreasing very slightly in size. Thus, while district borders do appear to segment markets, the impact of ethnic borders and ethnic differences pose additional barriers to market integration.

[Table 3 about here.]

A second omitted variable worth considering is the role of geographic barriers to trade. Geographic heterogeneity may give rise to both ethnic differences (Michalopoulos, 2012) *and* difficulty trading (Keller and Shiue, 2007b). For example, imagine two contemporary markets that are separated by a mountain range. The historical separation of these two areas by mountains would likely give rise to linguistic and cultural divergences, observed today as ethnic differences, and would make trade between areas on either side of the range very difficult. If most ethnic differences result from geographic isolation, then we would observe a correlation between ethnic difference and market segmentation today, but that correlation would be spuriously driven by the independent effects of isolation on both cultural differences and market segmentation.

One way to operationalize geographic barriers is to look at the degree to which travel distances are farther than geodesic distances, based on the assumption that geographic features pose barriers to trade by effectively increasing travel time between markets. Using this approach, I calculate the actual travel distance between markets along roadways using Google's mapping software.[9] As expected, I find that geographic barriers are indeed related to ethnic differences. Among the 478 market pairs within 100 kms of each other, the ratio of geodesic distance to travel distance is significantly lower in the 194 market pairs separated by an ethnic border than in the 284 market pairs within a single ethnic region ($t = 3.86$, $df = 476$, $p < 0.001$). In other words, it takes longer to travel between ethnically distinct markets than between ethnically similar markets with the same degree of geodesic separation.

To make sure that geography alone is not driving the results, I replicate the main analyses presented in Table 1 using the natural log of travel distance, rather than geodesic distance, in Table 4. The results are remarkably similar, increasing our confidence that ethnic differences produce market segmentation, even after controlling for geographic barriers.

[Table 4 about here.]

The results of this section suggest that the principal finding of this paper – that ethnic differences are associated with greater market segmentation – is not driven by the division of ethnic groups and markets into administrative units, or by geographic barriers causing both ethnic difference and market divergence. In the next section I turn to understanding if and how political and cultural factors influence the relationship between diversity and trade.

The Role of Politics and Cultural Differences

The results above show that the maize market in Malawi tends to be fragmented along ethno-regional lines, replicating the findings of similar studies in other African countries (Versailles, 2009; Hamaguchi, 2010; Aker et al., 2014). However, in contrast to existing work, my focus on many different ethnic borders over a significant period of time allows

[9] In particular, I use the *travel time* command within Stata, which interfaces with Google Maps, to measure both the road distance (in kms) and travel time (in minutes) between each market pair.

me to speak to the potential mechanisms, both political and cultural, in linking ethnic differences to market segmentation.

National Politics and the Politicization of Ethnicity

Much of the scholarship on the impact of ethnic diversity on political and economic outcomes has focused on the role of political elites in increasing the salience of ethnic differences. For example, Posner (2004b) finds that inter-ethnic hostility is more pronounced in Malawi than Zambia for two ethnic groups straddling the international boundary. He argues that this difference results from the fact that the particular ethnic cleavage is politically useful within Malawi because of relative group sizes, while in Zambia the same two groups make up a relatively small proportion of the country, making them electorally irrelevant. If similar processes are driving market segmentation along ethnic lines within Malawi, we would expect to observe certain patterns in the data. First, to the degree that ethnicity is made particularly salient during national elections (Eifert et al., 2010), we should see the impact of ethnic differences on market segmentation increase in the run up to national elections. Second, given different sizes of ethnic groups, and the particular history of interethnic relations within Malawi, some ethnic identities are more politically salient than others. Each of these observable implications are evaluated in turn.

National elections occurred three times during the period covered by the data: June 1999, May 2004, and May 2009. Secondary sources suggest that ethno-regional identities were politically salient in all three elections, but especially in 1999 and 2004 (Ferree and Horowitz, 2010). To evaluate whether or not the impact of ethnic borders and ethnic differences increased in the six months prior to national elections, I interact each of the indicators of ethnic difference with an indicator for election timing.[10] Table 5 presents the results of these analyses. Model 1 again shows that, in non-election years, separation by an ethnic border increases market segmentation. On average, price dispersion increased in the lead-up to elections, but the interaction term suggests that this election-season increase in price dispersion is not larger for markets separated by

[10]Due to collinearity, models that include indicators for election timing do not include monthly fixed-effects. To make sure that dropping the time effects was not driving the results, I first compared the base model (without election timing or the interaction term) with and without monthly time effects. The coefficients on the both indicators of ethnic difference were unchanged, with the standard errors increasing and the R^2 decreasing in the models without time fixed effects.

an ethnic border. We see a similar pattern for ethnic difference (Model 2). These results suggest that the relationship between ethnic differences and price dispersion is not driven by the political mobilization of ethnic groups, or the increased salience of ethnic divisions, in the lead-up to national elections.

[Table 5 about here.]

It may be the case, though, that the politicization of ethnicity is so perennial that it does not vary in relation to election timing. In this case, we might instead expect variation across different ethnic borders, depending on their political relevance. If ethnic differences impact political and economic outcomes through the politicization of ethnicity at the elite level (e.g., Posner, 2004b), then we should expect more politically relevant ethnic boundaries to pose a greater barrier to trade than politically irrelevant ethnic borders.

Using data collected by Posner (2004a), I code each of the twelve ethnic borders as either politically relevant or politically irrelevant. An ethnic border is coded as politically relevant if both groups separated by the ethnic border are considered politically relevant *and* they are not part of the same ethnic umbrella. According to Posner, there are three politically relevant ethnic groups in Malawi: the Chewa, the Tumbuka, and the Yao, with the Ngoni considered part of the Tumbuka and the Lomwe considered part of the Yao. The resulting coding of the political relevance of different ethnic borders is presented in Table 6 and mapped in Figure 4.

[Table 6 about here.]

To evaluate whether politically relevant ethnic borders increase price dispersion more than politically irrelevant ethnic borders, I interact the indicator for separation by an ethnic border with the indicator of political relevance.[11] Table 7 presents the results of estimating the model with this interaction term included. The coefficient on *EthnicBorder* shows again that markets separated by an ethnic border have higher price dispersion than markets within the same ethnic region. However, there is no additional impact of such ethnic borders when they separate two different politically relevant ethnic groups. These results, in conjunction with the null effect of national elections reported above, suggest that the mechanism relating ethnic differences to market segmentation is not primarily driven by the top-down politicization of ethnicity by

[11] The indicator of political relevance is not included as an independent variable because of collinearity (political relevance is not coded for market-dyads within a single ethnic region).

elites.

[Table 7 about here.]

Cultural Distance

Results above suggest that the top-down processes of ethnic politicization are not useful for understanding variation in the importance of ethnic differences for market integration. In this section, I consider the possibility that cultural differences inherent to interethnic interactions are driving the market segmentation along ethnic lines. Cultural similarity is expected to moderate the relationship between ethnic differences and trust, with more culturally similar groups exhibiting greater intergroup trust (Guiso et al., 2009). If cultural differences are indeed driving market segmentation along ethnic lines, then we should observe that variation in the degree of cultural difference should influences the volume of interethnic trade and, ultimately, the extent of market integration.

To quantify the degree of cultural overlap across dyads separated by an ethnic border, I use the measure of cultural distance developed by Fearon (2003), which relies on similarities in language classification to serve as a proxy for cultural similarities. In particular, the more distantly related two languages are – based on the distance between those languages in language classification trees – the more culturally distinct the groups speaking those languages are assumed to be. Cultural "borders" are calculated as

$$\text{CultBorder}_{ij} = 1 - \frac{l_{ij}}{m} \tag{3}$$

where CultBorder_{ij} is the cultural distance between markets in ethnic region i and ethnic region j, l is the number of language classifications in common between the language spoken in those two ethnic regions, and m is the total number of language classifications. Thus, for each ethnic border, I calculate the cultural distance between the two ethnic groups it separates. In other words, instead of markets that are separated by an ethnic border being coded as $EthBorder_{ij} = 1$, they will be coded by the degree of cultural distance represented by that border ($CultBorder_{ij} = (0, 1]$): for markets within the same ethnic region (i.e., not separated by an ethnic border), the cultural border is equal to zero. Table 8 presents the degree of cultural distance for all ethnic dyads.

[Table 8 about here.]

To estimate the impact of cultural differences on price dispersion, I substitute this measure of $CultBorder_{ij}$ for $EthBorder_{ij}$ in Equation 1. The results, presented in Model 1 of Table 9, show that cultural distance has a positive and statistically significant impact on price dispersion. In terms of magnitude, a move from no cultural border to the largest cultural distance ($CultBorder_{ij} = 0.2$) is associated with a 0.01 increase in price dispersion (an increase of almost 10% for markets separated by the average distance).

[Table 9 about here.]

Next, I calculate a measure of cultural *difference* for each market pair, analogous to my measure of ethnic difference, which takes into the account the aggregate cultural fractionalization between two markets, i and j, using the following measure:

$$\text{CultDiff}_{ij} = \sum_{a=1}^{11} \sum_{b=1}^{11} 1 - (\frac{l_{ab}}{m}) p_{ai} p_{bj} \tag{4}$$

where $CultDiff_{ab}$ is an index ranging from zero to one, representing the cultural distance between markets i and j, l is the number of language classifications in common between the language spoken by members of group a and the language spoken by members of group b, m is the total number of language classifications, p_{ai} is the proportion of market i made up of members of ethnic group a, and p_{bj} is the proportion of market j made up of members of ethnic group b. Cultural distances for all possible ethnic dyads are presented in Table 8.

Model 2 of Table 9 reports the results of substituting this measure of cultural distance ($CultDiff_{ij}$) for the measure of ethnic difference ($EthDiff_{ij}$) in Equation 2. Compared to market pairs with full cultural overlap, markets with the highest degree of cultural difference ($CultDiff_{ij} = 0.2$) is associated with an increase in price dispersion equal to 0.03 (or a 16% increase, on average).

Taken together, this set of results suggests that cultural differences are more consequential for ethno-regional market segmentation than the political mobilization of ethnicity. This is an important finding in light of the dominant view in comparative politics that ethnicity in Africa has little impact beyond its instrumental political value (Posner, 2005; Habyarimana et al., 2009), and the larger trend in social science to see ethnicity

as politically "constructed" (Brubaker, 2004). While these trends have drastically improved our understanding of how ethnicity influences many outcomes of interest, one consequence has been a lack of appreciation for the critical influence of ethnicity via mechanisms that have nothing to do with political competition. Thus, the fact that cultural factors appear to matter more for ethnic market segmentation in Malawi than political forces reminds us that there are some spheres of social interaction in which a more primordial approach to ethnicity may be appropriate.

Conclusion

It has been well documented that ethnically diverse polities – cities, states, and countries – tend to have worse economic outcomes than more homogeneous ones (Alesina and La Ferrara, 2005). Given that African states are among the most diverse in the world, many scholars attribute poor economic outcomes on the continent to their high levels of diversity (Easterly and Levine, 1997). However, much less work has been done to understand how ethnic diversity actually leads to poor economic performance. The dominant view seems to be that ethnic diversity at the national level leads to poor economic policies in a top-down manner, because ethnically diverse politicians cannot cooperate to enact growth-enhancing policies.

In contrast, this paper lays out a mechanism relating diversity to poor growth from the bottom-up, based on the economic behavior of regular citizens. This mechanism is expected to operate when three conditions are met: trust is ethnically conditioned, with individuals trusting coethnics more than non-coethnics; members of different ethnic groups are geographically segregated; and there is formal contract enforcement. Because interpersonal trust is crucial for market transactions in the absence of formal contracts, small-scale trade will tend to be concentrated within ethnic groups, resulting in the segmentation of markets along sub-national, ethnic lines. Such segmentation contributes to slower economic growth by forgoing the growth-promoting benefits of national market integration: less price volatility, gains from inter-regional trade resulting from different comparative advantages, and the efficient distribution of goods across space.

By combining data on the price of maize across Malawian markets with fine-grained data on the spatial distribution of ethnic groups across Malawi, I show that markets

are indeed segmented along ethnic lines. In particular, the results show that price dispersion – a common indicator of market segmentation – is higher when markets are separated by an ethnic border and when the degree of ethnic overlap between markets is small, with effects equal to 150-245 kms of geographic separation. This effect does not appear to be driven by the top-down, national-level political mobilization of ethnicity, as price dispersion between ethnically dissimilar markets does not increase with national elections, or vary by the degree to which some groups are more politically salient than others. Instead, greater cultural differences between ethnic groups are associated with larger effects of ethnic difference on market integration, suggesting that it is the cultural differences in diverse countries, and their impact on levels of trust, that are responsible for impeding interethnic trade, and, ultimately, national market integration.

While the empirical evidence presented comes from Malawi, we should expect to observe ethno-regional market segmentation whenever ethnic-based trust is combined with ethnic segregation. Unfortunately, these two conditions typically occur together – ethnic group segregation is strongly associated with ethnic-based trust across African states (Robinson, 2013). Given that most African states, while extremely diverse at the aggregate level, are made up of multiple ethnically homogeneous regions, and that coethnicity is a strong predictor of trust, market segmentation along ethnic lines is likely to be a contributing factor in the negative relationship between diversity and development in Sub-Saharan Africa.

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Table 1: Ethnic Difference and Market Segmentation, 1998–2011

DV=Price Dispersion	Model 1	Model 2
Ethnic Border	0.012***	
	(0.004)	
Ethnic Difference		0.022**
		(0.009)
Ln of Distance (100 kms)	0.008**	0.009***
	(0.003)	(0.003)
Constant	0.159***	0.147***
	(0.008)	(0.011)
Observations	31,040	31,040
Adjusted R^2	0.163	0.163

OLS regressions.

Market and month fixed-effects included (coefficient estimates not shown).

Robust standard errors, clustered by market pair, in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2: Ethnic Difference and Market Segmentation, 2005–2011

DV=Price Dispersion	Model 1	Model 2
Ethnic Border	0.007**	
	(0.003)	
Ethnic Difference		0.017**
		(0.008)
Ln of Distance (100 kms)	0.010***	0.010***
	(0.003)	(0.003)
Constant	0.155***	0.144***
	(0.007)	(0.010)
Observations	27,205	27,205
Adjusted R^2	0.162	0.162

OLS regressions.

Market and month fixed-effects included (coefficient estimates not shown).

Robust standard errors, clustered by market pair, in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3: Administrative Borders, Ethnic Difference, and Market Segmentation, 1998–2011

DV=Price Dispersion	Model 1	Model 2	Model 3
Administrative Border	0.011**	0.010**	0.010**
	(0.005)	(0.004)	(0.004)
Ethnic Border		0.011***	
		(0.004)	
Ethnic Difference			0.020**
			(0.009)
Ln of Distance (100 kms)	0.008**	0.004	0.006
	(0.004)	(0.004)	(0.004)
Constant	0.156***	0.147***	0.137***
	(0.009)	(0.009)	(0.012)
Observations	31,040	31,040	31,040
Adjusted R^2	0.163	0.163	0.163

OLS regressions.

Market and month fixed-effects included (coefficient estimates not shown).

Robust standard errors, clustered by market pair, in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Geographic Barriers, Ethnic Difference, Market Segmentation, 1998–2011

DV=Price Dispersion	Model 1	Model 2
Ethnic Border	0.011***	
	(0.004)	
Ethnic Difference		0.021**
		(0.009)
Ln of Travel Distance (100 kms)	0.009**	0.010***
	(0.004)	(0.004)
Constant	0.158***	0.147***
	(0.008)	(0.011)
Observations	31,040	31,040
Adjusted R^2	0.163	0.163

OLS regressions.

Market and month fixed-effects included (coefficient estimates not shown).

Robust standard errors, clustered by market pair, in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: National Election Impacts:
Ethnic Difference and Market Segmentation, 1998–2005

DV=Price Dispersion	Model 1	Model 2
Ethnic Border	0.012**	
	(0.004)	
Ethnic Difference		0.023**
		(0.009)
Election Year	0.018***	0.023**
	(0.005)	(0.009)
Ethnic Border × Election	−0.011	
	(0.007)	
Ethnic Difference × Election		−0.016
		(0.012)
Ln of Distance (100 kms)	0.009**	0.010***
	(0.004)	(0.004)
Constant	0.156***	0.143***
	(0.008)	(0.012)
Observations	31,040	31,040
Adjusted R^2	0.068	0.068

OLS regressions.

Market fixed-effects included (coefficient estimates not shown).

Standard errors, clustered by market pair, in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Political Relevance and Cultural Distance, by Ethnic Border

Ethnic Border	Politically Relevant
Lambya-Ngonde	No
Ngonde-Tumbuka	No
Lambya-Tumbuka	No
Tumbuka-Tonga	No
Tumbuka-Chewa	Yes
Tonga-Chewa	No
Chewa-Ngoni	Yes
Ngoni-Yao	Yes
Ngoni-Lomwe	Yes
Ngoni-Sena	No
Yao-Lomwe	No
Lomwe-Sena	No

Table 7: Politically Relevant Ethnic Borders and Market Segmentation, 1998–2005

DV=Price Dispersion	Model 1
Ethnic Border	0.015***
	(0.004)
Politically Relevant Ethnic Border	−0.005
	(0.005)
Ln of Distance (100 kms)	0.008**
	(0.003)
Constant	0.159***
	(0.008)
Observations	31,040
Adjusted R^2	0.163

OLS regressions.

Market and month fixed-effects included (coefficient estimates not shown).

Robust standard errors, clustered by market pair, in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Cultural Distance, by Ethnic Dyads

	Lambya	Lomwe	Ngonde	Ngoni	Nyakyusa	Nyanja	Sena	Senga	Tonga	Tumbuka	Yao
Chewa	0.2	0.2	0.2	0.2	0.2	0	0.1	0.1	0.1	0.1	0.2
Lambya		0.2	0.1	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2
Lomwe			0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1
Ngonde				0.2	0	0.2	0.2	0.2	0.2	0.2	0.2
Ngoni					0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nyakyusa						0.2	0.2	0.2	0.2	0.2	0.2
Nyanja							0.1	0.1	0.1	0.1	0.2
Sena								0.1	0.1	0.1	0.2
Senga									0.1	0	0.2
Tonga										0.1	0.2
Tumbuka											0.2

Table 9: Cultural Distance and Market Segmentation, 1998-2011

DV=Price Dispersion	Model 1	Model 2
Cultural Border	0.067***	
	(0.021)	
Cultural Difference		0.127***
		(0.045)
Ln of Distance (100 kms)	0.008**	0.009***
	(0.004)	(0.003)
Constant	0.160***	0.149***
	(0.008)	(0.010)
Observations	31,040	31,040
Adjusted R^2	0.163	0.163

OLS regressions.

Market and month fixed-effects included (coefficient estimates not shown).

Standard errors, clustered by market pair, in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure 1: Major Maize Markets in Malawi

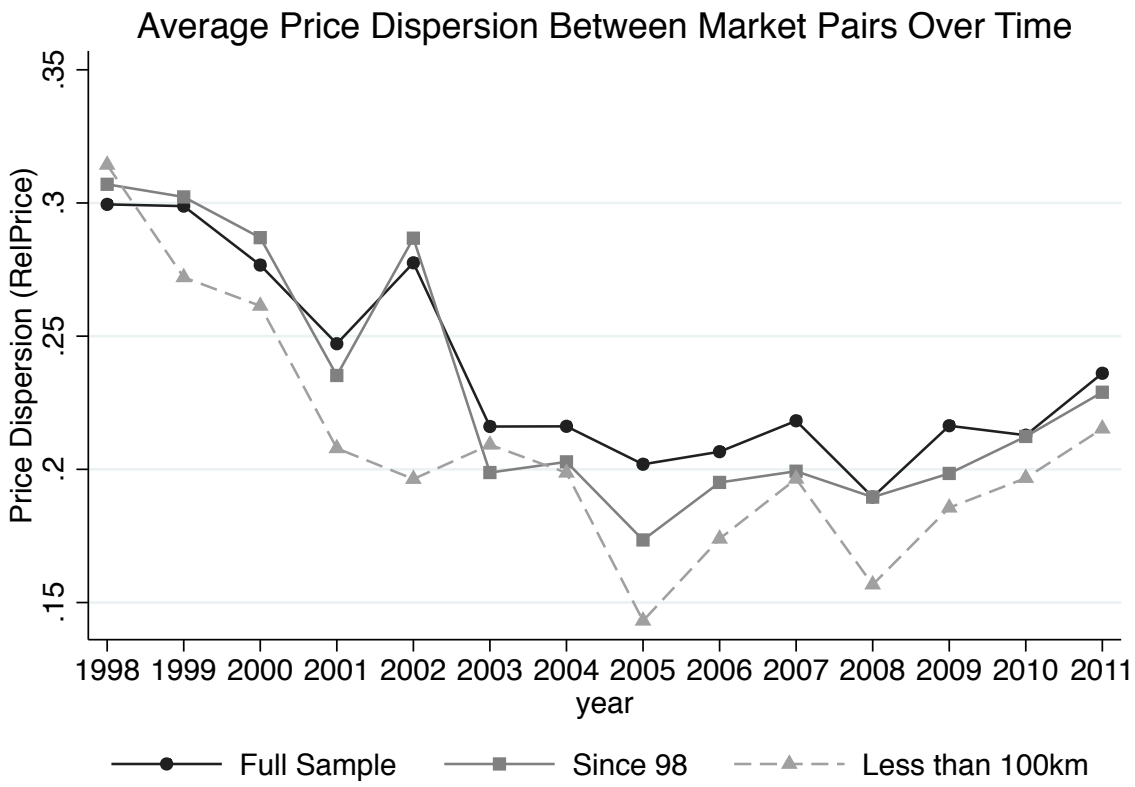

Figure 2: Market Segmentation Over Time

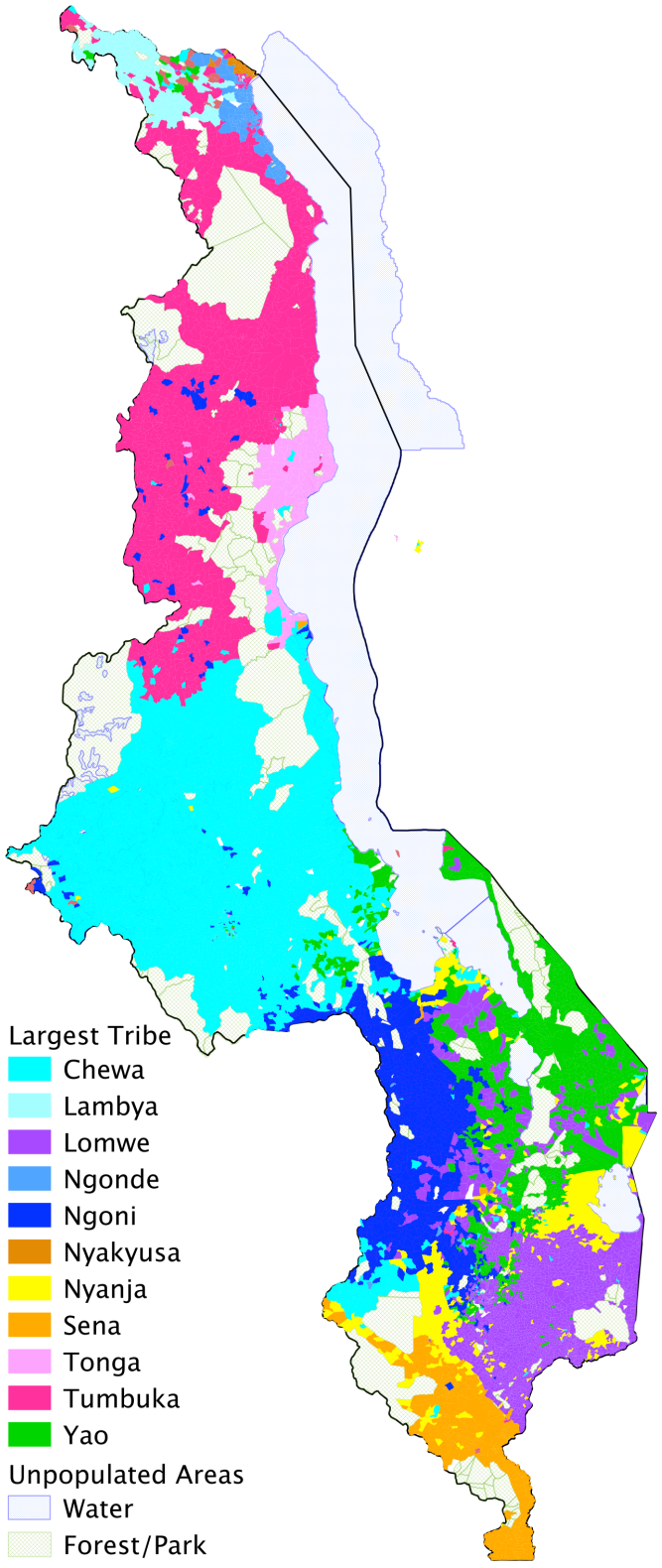

Figure 3: Spatial Distribution of Ethnic Groups in Malawi

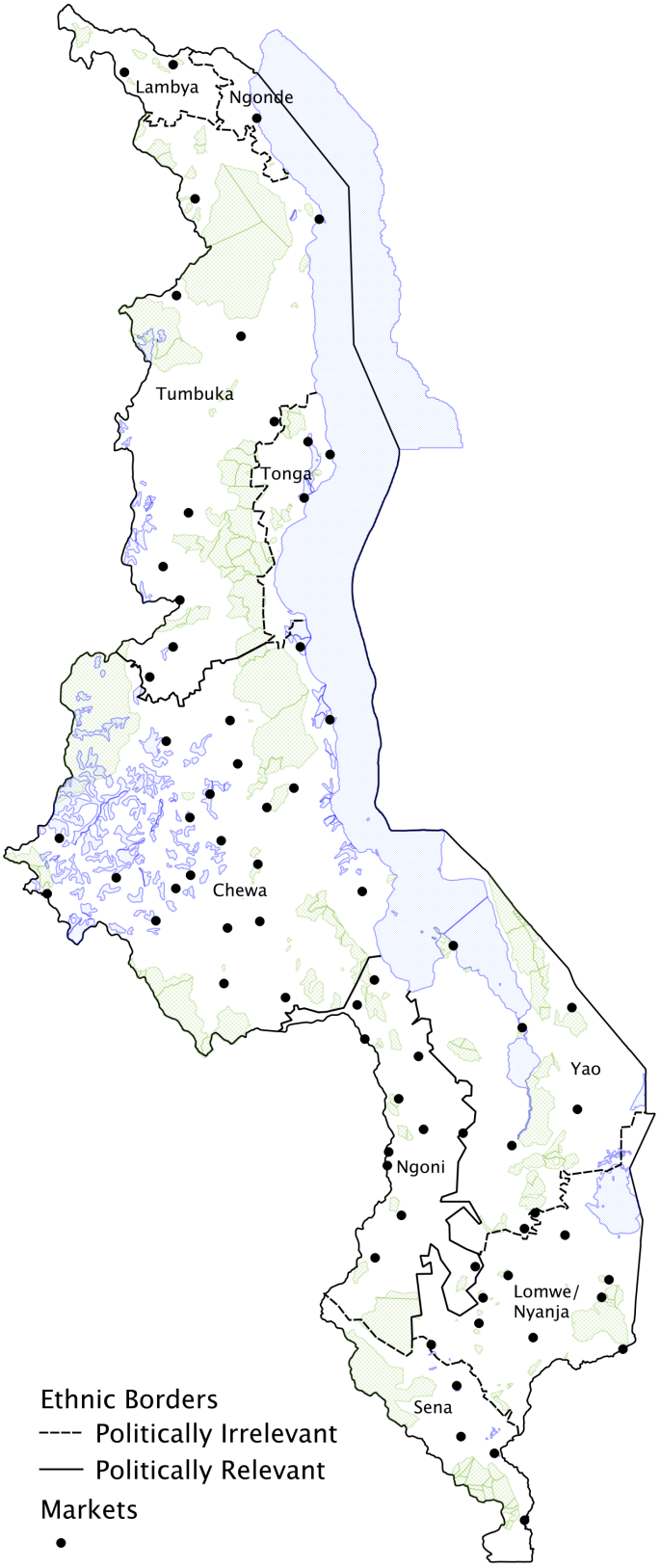

Figure 4: Ethnic Borders within Malawi

Appendices to:

Robinson, Amanda Lea. 2012. "Internal Borders: Ethnic Diversity and Market Segmentation in Malawi." Working Paper, Stanford University.

Available at `www.stanford.edu/~alrobins/Amanda_Lea_Robinson/Research`

Appendix A Robustness

[Table 10 about here.]

Appendix B Maize Price Data by Market

Table 10: Maize Prices by Market, in MWK

Region	District	Market	N	Mean	SD	Min	Max
Northern	Chitipa	Chitipa	160	20.15	14.81	2.78	66.73
		Misuku	77	22.83	8.70	9.51	51.05
		Nthalire	66	29.59	10.89	11.07	56.75
	Karonga	Karonga	144	19.88	15.29	3.83	64.22
		Chilumba	51	31.68	10.73	17.33	56.88
	Mzimba	Embangweni	82	26.14	13.32	7.00	55.00
		Jenda	49	30.80	12.56	13.17	62.76
		Mzimba	154	22.96	15.42	3.44	62.33
		Mzuzu	159	22.57	14.52	3.88	60.75
	Nkata Bay	Chintheche	78	32.64	12.02	15.91	56.82
		Mpamba	70	31.40	15.10	11.72	67.34
		Nkhatabay	110	27.80	14.11	5.12	58.46
	Rumphi	Hewe	75	26.57	12.28	11.50	57.06
		Rumphi	162	23.90	17.45	2.81	89.33
Central	Dedza	Bembeke	71	33.00	15.53	11.76	77.78
		Mtakataka	81	33.23	18.64	9.39	82.59
		Thete	93	26.62	14.19	9.00	78.25
	Dowa	Bowe	40	35.98	13.95	14.13	60.88
		Dowa	147	24.17	15.72	3.11	66.25
		Madisi	58	33.23	13.37	15.00	80.00
		Mponela	90	29.05	13.10	12.21	69.19
		Nambuma	70	31.92	14.22	12.30	69.87
	Kasungu	Chamama	4	30.91	4.84	24.58	35.00
		Kasungu	97	23.86	16.03	4.16	69.50
		Nkhamenya	49	30.36	14.29	13.03	68.50

Table 10 – continued from previous page

Region	District	Market	N	Mean	SD	Min	Max
Central		Nkhoma	89	28.23	14.51	9.83	74.78
	Lilongwe	Kasiya	58	38.18	14.77	13.23	80.53
		Lilongwe	119	24.65	15.53	5.82	72.00
		Mitundu	162	19.97	14.53	2.29	68.85
		Nanjiri	94	29.89	15.14	10.56	72.90
		Santhe	71	29.66	12.05	12.40	60.13
	Mchinji	Mchinji	166	22.69	14.38	3.94	63.97
		Mkanda	38	28.38	12.10	11.00	57.57
		Nsundwe	91	28.86	13.76	10.77	65.82
	Nkhotakota	Dwangwa	83	31.08	15.96	12.68	81.08
	Nkhotakota	Mwansambo	54	33.19	18.32	7.81	85.55
		Nkhotakota	153	23.69	15.90	5.73	79.50
	Ntcheu	Chimbiya	156	22.35	14.97	3.53	69.21
		Lizulu	165	21.24	15.93	1.98	76.39
		Ntcheu	90	30.84	17.08	10.36	88.55
		Ntonda	46	33.97	17.83	12.00	80.00
		Sharpevaley	28	37.89	19.07	13.13	77.08
		Tsangano Turn Of	65	32.03	16.63	11.80	81.21
	Ntchisi	Malomo	49	35.96	19.21	11.54	83.63
		Ntchisi	157	24.30	16.52	6.42	75.49
	Salima	Salima	149	22.74	17.20	2.59	81.04
Southern	Balaka	Balaka	88	31.88	15.51	13.47	80.46
	Blantyre	Limbe	88	31.13	19.79	4.55	106.62
		Lunzu	146	24.52	17.15	4.38	79.86
	Chikwawa	Chikwawa	88	32.58	14.50	13.30	79.92
		Nchalo	157	23.45	16.60	2.25	78.63
		Ngabu	91	33.14	16.39	10.99	77.86
	Chiradzulu	Chiradzulu	90	29.94	13.92	9.25	70.00
	Machinga	Liwonde	164	23.82	16.39	3.49	75.94
		Ntaja	147	22.23	14.91	2.35	74.19
	Mangochi	Mangochi	154	23.11	16.66	4.29	81.83
		Monkey Bay	66	35.99	18.37	10.36	82.52

Table 10 – continued from previous page

Region	District	Market	N	Mean	SD	Min	Max
		Namwera	117	26.12	15.55	9.05	95.00
	Mulanje	Muloza	75	34.69	15.42	11.80	78.18
	Mwanza	Mwanza	91	34.33	17.01	13.39	92.04
	Neno	Neno	58	33.83	14.49	11.11	82.32
	Nsanje	Bangula	141	23.08	18.04	2.21	94.84
		Nsanje	106	29.51	17.80	4.45	91.30
	Phalombe	Migowi	46	27.46	13.08	8.40	64.42
		Phalombe	74	35.07	16.16	10.92	85.12
	Thyolo	Bvumbwe	76	36.49	15.27	16.50	79.00
		Luchenza	157	22.37	16.93	3.77	95.45
	Zomba	Jali	62	31.02	15.20	10.75	69.47
		Thondwe	57	35.82	16.02	11.50	81.60
		Zomba	94	26.43	17.73	4.29	78.78

Table 11: Ethnic Difference and Market Segmentation, 1998–2011

DV=Price Dispersion	Model 1	Model 2
Ethnic Border	0.012***	
	(0.004)	
Ethnic Difference		0.022**
		(0.009)
Distance (100 kms)	0.039	0.037
	(0.030)	(0.030)
Distance Squared (100 kms)	−0.018	−0.016
	(0.024)	(0.025)
Constant	0.138***	0.126***
	(0.011)	(0.013)
Observations	31,040	31,040
Adjusted R^2	0.163	0.163

OLS regressions.

Market and month fixed-effects included (coefficient estimates not shown).

Robust standard errors, clustered by market pair, in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$