Impact of Grain Trade Policies on Prices and Welfare

Evidence from Malawi

Habtamu Fuje

Hemant K Pullabhotla

WORLD BANK GROUP

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Abstract

Restricting cross-border trade through export bans in an attempt to stabilize domestic prices has been a particularly popular policy tool used by many sub-Saharan countries in recent years. However, little is known about how the variability in harvests and seasonality—two critical dimensions of smallholder agriculture in Africa—mediate the effects of export bans on household welfare. This study assesses the short-term impact of export bans on prices and welfare of households in Malawi, accounting for these heterogeneities. It uses monthly panel data on maize prices from 152 markets in Malawi and neighboring countries. To identify the impacts of the bans, the study compares the change in price dispersion between a domestic market in Malawi and another market in a neighboring country, relative to the

price dispersion between the domestic market and other markets within Malawi that are at a similar distance as the domestic-foreign market pair. The findings show that export bans, in the short run, are associated with lower domestic prices, lower relative prices, and less seasonality in prices in Malawi. This is after accounting for harvest levels and the existence of trade restrictions in neighboring countries. The short-run effects of the export bans help explain why policymakers are likely to engage in the use of such policies. However, the welfare analysis shows that the welfare gains and poverty reduction effects are small in magnitude and likely to be offset by the long-run distortionary effects of restrictive trade policies.

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Impact of Grain Trade Policies on Prices and Welfare: Evidence from Malawi

Habtamu Fuje^{*} and Hemant K Pullabhotla[†]

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^{*}Economist, Poverty and Equity Global Practice, The World Bank Group (hfuje@worldbank.org)

[†] Postdoctoral fellow, Center on Food Security and the Environment, Stanford University (hemantpk@stanford.edu)

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1. Introduction

As a crucial staple crop in Eastern and Southern Africa, the production and marketing of maize have been the focus of governments' food security and poverty alleviation strategies. Restricting cross-country trade through export bans in an attempt to stabilize domestic prices has been a particularly popular policy tool used by many sub-Saharan African (SSA) countries in recent years. Previous studies have shown that such export bans could have adverse medium-long-term impacts on prices by creating market uncertainty and on grain production by discouraging investment in agriculture. However, we know little about how the variability in harvests and seasonality – two critical dimensions of smallholder agriculture in Africa – mediate the effects of export bans on household welfare. In this study, we assess the short-term impact of export bans on prices and welfare of households in Malawi, accounting for these heterogeneities and complement the existing evidence on the topic.

A challenge in identifying the impact of export bans on maize is that the timing of these policies is likely to be driven by domestic market conditions and harvest conditions. In order to isolate the effect of the policy separately from other drivers of prices, we use a novel identification strategy that borrows from the gravity model of trade literature. We compare the change in price dispersion between a domestic market in Malawi and another market in a neighboring country, relative to the price dispersion between the domestic market and other markets within Malawi that are at a similar distance as the domestic-foreign market pair. Measuring this relative difference between periods with and without export bans allowing us to capture the effect of the policy change. The fundamental assumption underlying our analysis is that export bans do not affect within-country price dispersions. Our model and data allow us to test this assumption, and we provide empirical evidence to show that the assumption holds.

Malawi is not an exception when it comes to grain market controls. Historically, developing countries, including Malawi's neighbors (Zambia and Tanzania), have intervened in grain markets whenever they experience significant food inflation or face a server production deficit for their major staples. In the wake of the 2007-08 food price spike, these countries renewed their efforts to intervene and regulate agricultural markets with the objectives of ensuring domestic food security and price stability. Such measures included a slew of trade of controls such as temporary restrictions on exports of food grains and other staples (Sharma, 2011) as well as active interventions in the grain markets through price regulation, direct purchases, storage, and other discretionary policies (Chapato and Jayne, 2009). Maize has been the focus of these policies within SSA, given that maize is of strategic importance for both producers and consumers in these countries. These policies generally aim to maintain affordable prices for consumers of maize, and simultaneously also attempt to ensure viable prices for maize farmers and seek to reduce the volatility of prices. Given the multitude of objectives, governments often engage in a mix of policies, and measuring the net impacts of such policy measures on prices and welfare can be challenging, both theoretically and empirically. An additional empirical challenge arises due to the simultaneous existence of restrictive trade regimes in neighboring countries.

The data and the empirical strategy that we use in this study allows us to overcome these challenges and isolate the short-run effects of the trade policies on maize prices and, subsequently, the welfare implications for maize producers and consumers in Malawi. We assemble a panel dataset of monthly market prices from 152 markets in Malawi and neighboring Tanzania, Mozambique, and Zambia from 2006 to 2018. We

combine the price information with detailed data on the location of these markets as well as the road network connecting these markets in order to measure the travel-time between each potential market pair. In order to account for changes in maize harvest per capita, we use annual maize production and population data during 1960–2018 and deviation of maize harvest levels from the long-term average in these four countries. Using data on households' maize production, consumption, and sales patterns from the Integrated Household Surveys (HIS), we assess the welfare effects of export bans.

Information on trade restrictions is compiled from government and media reports. During the study period, Malawi had imposed and lifted maize export bans three times. Zambia and Tanzania also imposed similar bans for varying periods, and we account for the policy regimes in the neighboring countries in the analysis. The effects of export bans on relative prices are likely to be heterogeneous across years and over seasons. For example, given the structure of the grain market in Malawi, where farmers typically sell their produce immediately after harvest, the impact of the export ban could be different during harvest time and lean seasons of a given year. The impacts are also likely to vary between good and bad harvest years. The monthly panel structure of the data, along with the variation in the export policy regimes, allows us to examine the heterogeneous effects of export bans across years and over seasons.

The results suggest that export bans, in the short run, are associated with lower domestic prices, lower relative prices, and less seasonality in prices in Malawi, after accounting for harvest levels and the existence of trade restrictions in neighboring countries. The welfare analysis we undertake suggests that the majority of Malawian households' gain, albeit small in magnitude, from low maize prices due to export bans. Even though most of the net-buyers enjoyed gains, net-selling farmers experienced losses due to lower maize prices. On average, Malawians receive a welfare gain equivalent to just 0.81 percent of their total household consumption as a result of lower maize prices from export bans alone. That is equivalent to an annual transfer of around MK1,690 (\$2.3) per person, or MK7,607 (\$10.4) per household. Net sellers of maize, on the other hand, experience a welfare loss equivalent to 0.88 percent of their total consumption as a result of the drop in prices. The poverty reduction attributable to these welfare gains is also small. Around 51.5 percent of Malawi's population is moderately poor, and a further 20.1 percent is ultra-poor. The welfare analysis suggests that the decrease in maize prices brought about by bans reduces these rates by just 0.55 and 0.64 percentage points, respectively.

Though small in magnitude, these short-run effects of the export bans may help explain why policymakers and politicians are likely to engage in the use of such policies. However, given the long-run distortionary effects of trade restrictions, policymakers could address market failures and achieve the food security objectives by investing in storage, improving access to finance, and investing in rural infrastructure (road, market information, and other infrastructure).

We present a background of trade policies in Malawi and neighboring countries, and a summary of relevant literature in the next section. Following this, we discuss the data and methodology. The subsequent section presents the results of the analysis, and we conclude with a discussion and policy implications in the final section.

2. Background and Literature Review

2.1 Context: Trade policies in Malawi and neighboring countries

Agriculture continues to be a dominant sector of the Malawian economy, contributing about a third of the GDP and accounting for about 80 percent of export revenue. The agriculture sector provides livelihoods for about 85 percent of the Malawians residing and engaged in agriculture to some extent. Agriculture is the biggest employer and source of income for households as it employs about 64.1 percent of the labor force (World Bank, 2018). Therefore, changes to regulations in marketing and trade could have significant implications for household welfare and poverty for the bulk of the Malawi population dependent on agriculture.

The government of Malawi (GoM) enacted the Control of Goods Act (COGA) in 1968. The COGA was intended to protect indigenous enterprises and the nascent industry as a way of making them more competitive. Since early 2000, GoM has used this act to impose trade restrictions, in particular, export bans, to control trade flows for maize, soy, and other crops. The stated objectives for most of these bans were to ensure national food security and to protect domestic agro-industry, such as vegetable oil processors (Edelman and Baluch, 2016). However, most of these policy changes and their implementation have been opaque and idiosyncratic. Various studies in Malawi and elsewhere, have found that arbitrary and unpredictable licensing restrictions or bans are likely to harm trade, and are detrimental to the commercialization of agriculture. A recent World Bank Systematic Country Diagnostic (SCD) report notes that Malawi's maize policies have had a distortionary effect on maize markets, potentially leading to higher volatility and lower private investments (World Bank, 2018). Within the southern African region, there is also the possibility that these arbitrary restrictions lead to the escalation of informal and illegal cross-border trade due to imperfect enforcement of trade controls. In 2018, the Malawian parliament passed the Control of Goods Bill (2018) with an attempt towards creating a more predictable trade environment with transparency in the regulation of agricultural trade and production.

While the Control of Goods Bill may be a step in the right direction, the maize markets in Malawi are not only influenced by Malawi's trade policies, but also by policies in the neighboring countries, particularly given the existence of informal trade channels across Malawi and its neighbors. Analyzing the effects of maize export bans, therefore, needs to consider the policy regimes at the regional level. Amongst Malawi's neighbors, both Tanzania and Zambia have had a long history of imposing export bans (Porteus, 2017). Mozambique, on the other hand, has had a relatively liberal maize economy since instituting market reforms during the 1990s (Tostao and Brorsen, 2005). No systematic information on the imposition and lifting of export bans across Malawi, Tanzania, and Zambia exists. In the absence of official data, we compile a timeline on the export policy regimes since the early 2000s using information from previous studies, media reports, and periodic outlook reports from the Famine and Early Warning System Network (FEWS NET). Table 1 presents the start and end dates for the observed export bans in these three countries. Overall, for our sample period from 2002 to 2017, we observe 16 export ban periods, with an average ban duration of 16 months.

Table 1: Timing of export bans

Country	Start of ban	End of ban
Malawi	July 2005	Feb 2007
Malawi	April 2008	August 2009
Malawi	December 2011	October 2017
Zambia	July 2002	July 2003
Zambia	March 2005	July 2006
Zambia	May 2008	July 2009
Zambia	May 2012	Nov 2012
Zambia	October 2013	October 2014
Zambia	April 2016	May 2017
Tanzania	July 2003	January 2006
Tanzania	March 2006	January 2007
Tanzania	January 2008	May 2008
Tanzania	January 2009	October 2010
Tanzania	May 2011	October 2011
Tanzania	January 2012	September 2012
Tanzania	June 2017	November 2017

2.2 Theoretical background and review of literature

Globally, many countries continue to employ a variety of trade controls, which include measures such as complete bans, export taxes, or quotas/licenses restricting the export quantities in agricultural markets. In most cases, the motivation for restricting exports is to protect consumers by stabilizing domestic markets and redistributing the potential gains from high prices away from farmers towards consumers (Abbott, 2012). The underlying theoretical intuition is that export controls increase the availability of the commodity in domestic markets and result in lower prices. However, as Mitra and Josling (2009) note, export bans result in an aggregate welfare loss, with the loss being higher when the commodity in question is a relatively inelastic good such as maize in Malawi. The distributive welfare effects and the potential gains for consumers would depend on the demand elasticity in the short-run. The long-run effects would also depend on the supply responsiveness of the producers (Mitra and Josling, 2009). The reduction in domestic prices, and consequently, the welfare implications of export controls, is also a function of the degree to which world prices are transmitted to the local markets (Minot, 2011). Further, enforcement and implementation issues may result in unintended consequences as well. Weak enforcement may shift trade to the informal sector, reducing the price difference across borders (Porteous, 2017), while ad hoc policy announcements add to unpredictability and may exacerbate volatility of prices (Kilima *et al.*, 2008).

At the household level, *a priori*, the net welfare implication of interventions in staple grain markets is theoretically ambiguous for agricultural households and depends on the households' net supply and consumption of the good (Deaton, 1989). Theoretically, net-seller farmers would likely experience welfare losses if export bans increase domestic supply in the short run and reduce local prices. However, the long-

run effect of export restrictions is likely less straightforward. As farmers respond to disincentives and start reducing investment on agriculture inputs or switch to other crops, the national production, and supply to markets might decrease over time. As a result, such long-run supply adjustments could defeat the purpose of the market intervention and possibly exacerbate food insecurity.

The most common methodological approach for analyzing trade policy effects is the use of time-series techniques to measure the impact of such policies on prices.¹ Many of the studies using these methods focus on the impact of trade restrictions on price transmission across countries or markets within a country. Other studies extended these methods to examine the effects on price volatility as well. The law of one price (LOP) motivates much of the price analysis literature. Under LOP, for a homogenous product with many small agents in the market, assuming perfect information, no lags in trading and no policy barriers to trade, the equilibrium condition across two markets that trade the good would be

$$P_{it} - P_{jt} = C_{ijt} \quad (1)$$

with P_{it} as the price in market j (the origin market) at time t , P_{jt} being the price in the destination market j , and C_{ijt} is the full cost of transacting (includes transportation, duties, and markups) between market i and j . In this situation, when the two market prices are in equilibrium, any movements in the price of the good in one market will show up in the form of equivalent changes in price in the other market, implying co-movement or integration in the prices (Minot, 2011). The assumption underlying the study of price transmission is that co-movement in prices across different markets (measured through estimating the long-run cointegration) is interpretable as a sign of efficient, competitive markets. In contrast, the absence of co-movement indicates the presence of market failures. Impediments to trade such as lack of infrastructure, high transportation costs, imperfect information as well as regulatory barriers are expected to result in a lower degree of price transmission.

A primary concern for policymakers and researchers after the 2007-08 food price spike was to understand the degree to which world prices transmit to domestic grain markets in African countries, many of whom were dependent on food imports. One of the early studies examining this question used agricultural monthly market price data from 62 markets in 11 African countries and applied an error correction model to estimate the price transmission between world prices to these markets (Minot, 2011). The market price data included a mix of retail and wholesale prices, and the results suggested that rice markets in Africa were more closely linked to world prices, while only 10 percent of the maize markets were found to show co-integration with world prices. In particular, for Malawi, the author finds that the price increases for rice and maize during 2007-08 was the highest amongst the sample of southern African countries in the study. In terms of links to world prices, three out of the eight markets considered in Malawi exhibited a significant long-run integration with world maize prices. These markets were: Chitipa (located in the north, close to maize regions in Tanzania), Lilongwe (the capital city) and Nkhata, a principal port on the coast of Lake Malawi (Minot, 2011); all of which are likely to be the leading trade markets for maize in Malawi.

¹ Several studies have also employed computable general equilibrium (CGE) models and their variants to estimate the effect of trade policies changes on welfare outcomes in various contexts (Sadoulet and de Janvry (1992), Minot and Goletti (1998), Nogue and Wodon (2008), Arndt et al. (2008), Dorosh, Dradri and Haggblade (2009), Xinshen and Kennedy (2016), and Arague, Pauw and Pernechele (2018)).

Following the price shocks in 2007-08, governments within many African economies started to intervene more regularly in agricultural markets. It has been argued that these government actions, which include discretionary trade controls, potentially contribute to exacerbating the food crisis (Tschirley and Jayne, 2010). This concern has prompted many researchers to examine the impact of trade controls on the efficiency and the degree of price transmission between markets within countries and across neighboring economies in Africa using a variety of statistical approaches. Davids, Meyer, and Westhoff (2017) use an autoregressive distributed lag model (ARDL) to look at price transmission between maize markets in Zambia, Zimbabwe, and South Africa. They find that under open trade policies, efficient price transmission occurs between the Zambia and Zimbabwe markets. However, this relationship breaks down during the period when Zambian export bans were in place. Ihle, von Cramon-Taubadel and Zorya (2009) arrive at similar conclusions using a Markov-switching vector autoregressive (MS-VAR) model to examine the maize price transmission between Kenya and Tanzania. The MS-VAR approach allows for a data-driven approach to detect the presence of different regimes in the price movements. Their MS-VAR model suggests the existence of two regimes defined by the high and low levels of the mean price margins between Kenya and Tanzania. They find that the occurrence of many of the high-margin episodes corresponds well with periods of export bans in Tanzania.

The role of informal maize trade across national borders in influencing the outcomes of export bans is further explored in Porteous (2017). This study uses a fixed-effects approach to estimate the impact of export bans on the price gaps between pairs of cross-border markets across five countries. The results indicate that the export bans have no significant effect on the price gaps suggesting that export controls are imperfectly enforced, and informal trade is likely to grow when such policies are in place. However, the study also finds suggestive evidence that the bans lead to higher prices and increased volatility in the imposing country, leading to increased instability in the domestic market.

Specifically, in the case of Malawi, Edelman, and Baluch (2016), in a descriptive study, note that export bans tend to limit access to food and artificially raise the cost of food for consumers. They are also likely to divert food from markets where there is high demand and send mixed signals to farmers as they make planting decisions (*ibid.*). It was further reported that export bans also tend to misdirect agricultural investments and encourage hoarding resulting in distorting the markets. Simulation models examining the economy-wide effects of Malawi's long-term maize export ban and oilseed export levy from 2012-2017 found that these policies benefited the urban non-poor in the short-run, while poor farmers' incomes and maize consumption levels declined in the longer run. The oilseed export levy also failed to achieve its long-run objectives (Aragie, Pauw and Pernechele, 2018).

The overall evidence from both CGE based studies as well price transmission analysis seems to suggest that export controls may not often be the right policy response to stabilize domestic food markets in Africa. Unpredictability in the announcement of such policies and imperfect enforcement may result in inefficient market outcomes in the short-run. Results from model-based studies also indicate that households engaged in the agricultural sector are likely to experience welfare losses in the aggregate. However, previous work in this area within the SSA context has usually ignored the potential spillover effects of trade policies within neighboring countries. This study builds upon and adds to previous work in several ways by using price transmission analysis methods in conjunction with spatially disaggregated price data from market locations across Malawi as well as within the neighboring countries.

3. Empirical Approach

The primary empirical strategy employs a reduced form difference-in-difference regression to empirically test for the effect of trade bans on the price gap between markets in Malawi and markets in nearby neighboring countries. We motivate our central difference-in-difference estimation by first examining the association between domestic prices in Malawi and export bans. Here, we analyze how domestic maize prices respond to export ban when the harvest is not accounted for, and then we bring harvest levels (and deviation from the long-term average) into consideration. Following this, the difference-in-difference approach compares the price dispersion for market pairs within Malawi against that of a market in Malawi and another market across the border when there is an export ban in place versus when there is no ban. The analysis takes advantage of the fact that when an export ban is imposed in Malawi, it would likely have no direct effect on grain trade between markets within the country. However, it does affect trade with markets outside Malawi. Therefore, comparison of trading margins for market pairs within Malawi and margins for markets at the same distance but across the national border before and after the export ban could provide a reasonable estimate of the impact of the export bans. The analysis is conducted by accounting for harvest levels in Malawi as well as the harvest in Tanzania, Zambia, and Mozambique. Finally, we use the price impact estimates to examine the welfare implications of changes in maize prices using standard welfare analysis framework.

3.1 Domestic prices and export bans

To start with, we focus on the domestic markets and examine the association between domestic prices and export bans. We also undertake a descriptive analysis of the degree to which the policy regimes in neighboring countries and harvest conditions affect the relationship between domestic prices and export bans. To do so, we specify the following regressions:

$$P_{it} = \lambda_{it} + \alpha_1 Ban_t + \varepsilon_{it} \quad (1)$$

$$P_{it} = \lambda_{it} + \alpha_2 Ban_t + H_t + \varepsilon_{it} \quad (2)$$

$$P_{it} = \lambda_{it} + \alpha_3 Ban_t + H_t + Ban_t^{TZ} + Ban_t^{ZM} + \varepsilon_{it} \quad (3)$$

where, P_{it} is the log of maize price (kwacha /kg) in market i in Malawi at time t ; λ_{it} are market-by-year fixed effects; H_t is the volume of harvest per capita in Malawi (available annually at the national level); Ban_t is the indicator for Malawi's export ban in time t ; and Ban_t^{TZ} and Ban_t^{ZM} are respectively indicators of the Tanzania's and Zambia's export ban. A negative sign on the coefficient on Ban_t , with the magnitude being $\alpha_1 > \alpha_2 > \alpha_3$ (possibly insignificant α_3) could be evidence that export bans are associated with reduced domestic prices (conditional on harvest).

In the next step, we examine the role of the interaction between export bans and harvest in affecting domestic prices. To do so, we extend the above specifications by including the interaction between harvest and export bans:

$$P_{it} = \lambda_{it} + \tilde{\alpha}_1 Ban_t * H_t + \tilde{\alpha}_2 Ban_t + \tilde{\alpha}_3 H_t + \varepsilon_{it} \quad (4)$$

$$P_{it} = \lambda_{it} + \tilde{\alpha}_1^b Ban_t * H_t + \tilde{\alpha}_1^{nb} NoBan_t * H_t + \tilde{\alpha}_2 Ban_t + \varepsilon_{it} \quad (5)$$

where $NoBan_t$ is an indicator for no export ban in Malawi during t , and the remaining variables are the same. $\tilde{\alpha}_1$ in equation 4 measures difference in the association of export ban and price between a period of export ban and a period with no export ban. A negative sign on this coefficient would suggest that improved

harvests would reduce the price effect of export bans. $\tilde{\alpha}_1^b$ and $\tilde{\alpha}_1^{nb}$ measure the extent of association between price and harvest when there is a ban (b) and no ban (nb). We would expect a negative sign for $\tilde{\alpha}_1^b$ since, if there is a ban, surplus output does not leave the country, and hence domestic prices are likely to reduce. When there is no export ban, increased harvest will have a lower impact, if any, on domestic prices since any surplus has the potential to be exported to neighboring markets, and the sign on $\tilde{\alpha}_1^{nb}$ is likely to depend on the market conditions in export destination markets.

We finally examine the seasonal variation in the association of export ban with domestic prices and harvest by extending the specifications to include interactions with seasonal (Q_q) dummies in equations 6 below:

$$P_{it} = \lambda_{it} + \sum_{q=1}^{q=4} [Q_q \times (\hat{\alpha}_1^q Ban_t \times H_t + \hat{\alpha}_2^q Ban_t + \hat{\alpha}_3^q H_t + 1)] + \hat{\alpha}_2 Ban_t + \hat{\alpha}_3 H_t + \varepsilon_{it} \quad (6)$$

3.2 Difference-in-difference estimation: Cross-border price dispersion and export bans

The difference-in-difference estimation strategy relies on the assumption that export bans in Malawi are less likely to affect grain trade between markets within the country directly, but it will affect trade with markets outside Malawi. We apply this intuition in the following gravity model like framework. We examine the effect of Malawi's export bans on price dispersion within Malawi markets relative to that of neighboring markets using the following initial regression specifications:

$$P_{ijt} = \lambda_{ct} + \beta_1 nonMW_{ij} \times ExpBan_t^{MW} + \sum_c (\gamma_{c \neq MW} ExpBan_t^c) + \alpha_d dist_{ij} + \varepsilon_{ijt} \quad (7.1)$$

$$P_{ijt} = \lambda_{ct} + \beta_1 nonMW_{ij} \times ExpBan_t^{MW} + \sum_c (\gamma_{c \neq MW} ExpBan_t^c) + \sum_c \delta_c H_{ct} + \alpha_d dist_{ij} + \varepsilon_{ijt} \quad (7.2)$$

$$P_{it} = \lambda_{ct} + \beta_1 nonMW_{ij} \times ExpBan_t^{MW} + \beta_2 (1 - nonMW_{ij}) \times ExpBan_t^{MW} + \sum_c (\gamma_{c \neq MW} ExpBan_t^c) + \alpha_d dist_{ij} + \sum_c \delta_c H_{ct} + \varepsilon_{it} \quad (7.3)$$

where P_{ijt} is price dispersion (%) at time t between market pair (i, j), where market i is MW market, j is MW or non-MW, and P_{ijt} is defined as:²

$$P_{ijt} = 100 \times (P_{it}^{MW} - P_{jt}^c) / (P_{it}^{MW}) \quad (8)$$

The binary variable $nonMW_{ij}$ is the indicator for the MW and non-MW market pair; $ExpBan_t^{MW}$ is the indicator for Malawi's export ban in time t ; $ExpBan_t^c$ is the indicator for export bans in neighboring countries; $dist_{ij}$ is the distance between market i and j ; H_{ct} is the volume of harvest per capita (annual) in each country; λ_{ct} are country-pair by year FEs. In equation (7.3) β_1 captures the change in the price gap between a market in Malawi and another market in a neighboring country following the export ban. If the ban is imposed during drought periods, β_1 is expected to be positive (that is, relative prices become higher in Malawi). Because the distance between the markets is accounted for in equations 7.1-7.3, the analysis compares the change in price dispersion between market i in Malawi and another market in a neighboring country, relative to markets within Malawi that are at a similar distance as the former market pairs. The coefficient β_2 measures the association between an export ban and price dispersion among domestic markets. Therefore, the failure to reject the null of zero on β_2 provides a direct empirical test for the assumption underlying the difference-in-difference estimation strategy.

² We convert all prices from domestic currency to USD using exchange rate data for comparison.

Second, we examine the role of harvest in mediating the effect of an export ban on relative price dispersion by extending the above specification to include interactions with harvest levels:

$$P_{ijt} = \lambda_{ct} + \tilde{\beta}_1 nonMW_{ij} \times ExpBan_t^{MW} \times H_{MW,t} + \sum_{c \neq MW} (\gamma_c ExpBan_t^c) + \sum_c \delta_c H_{ct} + \alpha_d dist_{ij} + \varepsilon_{ijt} \quad (9)$$

where $\tilde{\beta}_1$ measures difference in the responsiveness of prices to harvest increase during a period with a ban and a period without a ban. If better harvest reduces the impact of an export ban on relative price dispersion, we expect the sign on $\tilde{\beta}_1$ to be negative. Finally, analogous to specifications examining the seasonal variation in the domestic price effects, we also analyze this variability in the cross-border price dispersion effects as well.

$$P_{ijt} = \lambda_{ct} + \sum_{q=1}^{q=4} [Q_q \times \{\hat{\beta}_1^q (nonMW_{ij} \times ExpBan_t^{MW} \times H_{MW,t}) + \hat{\beta}_2^q nonMW_{ij} \times ExpBan_t^{MW} + \hat{\beta}_3^q H_{MW,t} + 1\}] + \hat{\beta}_2 (nonMW_{ij} \times ExpBan_t^{MW}) + \hat{\beta}_3 H_t^{MW} + \sum_{c \neq MW} (\gamma_c ExpBan_t^c) + \sum_{c \neq MW} \delta_c H_{ct} + \alpha_d dist_{ij} + \varepsilon_{ijt} \quad (10)$$

3.3 Welfare Effects

After estimating the price effects of trade controls, the next logical step is assessing the welfare implications of the price impact (if any) on farmers and urban consumers. We employ the classical static welfare analysis framework that uses measures of compensating variation or equivalent variation to estimate changes in household welfare due to price changes based on Deaton (1989):

$$\frac{CO}{Y_0} = \sum_{i=1}^n (s_{io} - q_{io}) \hat{p}_i \quad (11)$$

where CO is the compensating variation for a proportional change in price of good i ($\hat{p}_i$); Y_0 is the initial income; q_i the budget share of consumption good, i.e. $q_i = \frac{Q_i p_{io}}{Y_0}$; and $s_i = \frac{S_i p_{io}}{Y_0}$ is the value of output i as a share of income. Note that Q_i is the household demand for good i , S_i is the output supply produced for i by the household. The parameter $(s_{io} - q_{io})$ is often referred to as the net benefit ratio/NBR. It is also known as the net consumption ratio/NCR, which is the ratio of the net sales of commodity i to the household income (Minot and Dewina 2013).

A caveat to be noted is that the above measure of welfare captures a static view of the welfare implications of price increases. Past research has found that the NBR measure can provide a reasonable approximation of the welfare effects in the short run. However, it fails to account for dynamic adjustments that a household might undertake in response to price increases over the long run. Such adjustments include changes in demand through substitution, income effects through changes in the labor market, or supply responses to the maize price changes, such as switching to other crops or investing less on agriculture inputs.

4. Data and Descriptive Statistics

We secured and organized monthly price data from more than 150 markets across Malawi and its neighboring countries of Zambia, Tanzania, and Mozambique from government sources as well as from FEWS NET. The prices are at the retail level, except for Tanzania, wherein we have data only on wholesale prices. The starting time for the price data varies by country, but we have consistent data for all four

countries beginning from January 2006. Figure 1 shows the locations of these markets across the four countries as well as the number of monthly observations available for each. Appendix Table A.1 presents a breakdown of the number of markets by country as well as markets across regions of Malawi over the sample period. The price data preview is presented in Figure 2, which shows the national median prices and the timing of the export bans in the respective countries. Over the study period, we find that price levels across all four countries have shown signs of seasonal variation within each year as well as fluctuations across the years. Price levels spiked during the 2007–2008 global food price crisis. Following that, from around 2010 onwards, Mozambique and Tanzania had higher price levels, relative to Malawi and Zambia. The figure also shows the periods during which export bans were in place by each country. During the 2008 food price crisis, when countries were forced to respond to sharp food price inflation, both Malawi and neighboring Zambia and Tanzania imposed export bans. Since 2012, export restrictions have been more active only in Malawi and Zambia. Tanzania’s use of export bans was relaxed until recent years. Mozambique has not imposed any ban during the entire study period.

While the comparison of national average prices may be informative, the empirical analysis adopted to study the impacts of export bans on domestic and relative prices uses market-specific prices in Malawi and pairwise comparison of markets within Malawi and markets in the neighboring countries. We identify the closest and the farthest pairs of markets based on distance and travel time. The imputation of distance and travel time is based on road network data from the HERE API.³ For our analysis, we locate, for each of the 74 markets in MW, the closest markets in country B (where B is MW, TZ, MOZ, or ZM). MW-MW refers to a market pair where both markets are within Malawi, and MW-TZ, for example, indicates that one of the markets is in Malawi, and the other is across the border in Tanzania.⁴ Figure 3 presents the median price dispersion of 327 market pairs, some of which are within Malawi and others across the border in TZ, ZM, and MOZ. The median price dispersion among market pairs within Malawi remains relatively flat across

³ The calculation of the travel time between every pair of markets within Malawi and its neighbors is implemented using the Stata package *georoute* which relies on map data from HERE (<https://developer.here.com/>) (Weber and Péclat 2017).

⁴ The nearest market pairs are identified in the following manner. First, for each of the 74 markets in MW, we identify all possible market pairs (by pairing it with the remaining 73 markets in MW and 79 markets across the border in TZ, ZM, or MOZ) and then impute the travel distance (and travel time) on the existing road network. Second, for market pairs in country B, that is, MW-country B, we identify the nearest market as the one with the decile of travel distance. Using this technique, we identified a total of 327 market pairs and the table below provides a summary of the travel distance. We present results using the lowest decile of travel distance, but the result is similar when we use the lowest quartile of travel distance or even travel time. The number of market pairs varies from 26 pairs in the case of MW-MOZ to 112 pairs for MW-ZM. Within Malawi, the number of market pairs is 128.

Travel distance (km) between market pairs	Mean	Standard deviation	Minimum	Maximum	Number of pairs
MW-MW	95.1	56.4	24.9	301.0	128
MW-MOZ	451.0	112.5	134.6	646.8	26
MW-TZ	725.9	156.4	281.8	940.7	61
MW-ZM	375.6	126.6	96.7	659.7	112
Total	337.1	254.9	24.9	940.7	327
Observations	327				

Source: Authors’ calculations based on distance and travel time between locations of markets.

the sample period, with or without export bans in place. On the other hand, the median price dispersion between markets across the border appears to be responsive to export bans. This lends validity to the key assumption that underpins our empirical strategy: export bans do not affect within-country price dispersions. We formally test this assumption later in our regression analysis.

An essential dimension of the export ban impact that we examine is the role of production conditions in mediating the impact on prices. To do so, we use national maize harvest data from the Food and Agriculture Organization's (FAO) FAOSTAT. We convert annual maize production into per capita maize output estimated from annual maize production and population data. Figure 4 presents the price dispersion along with the deviation of annual maize production per capita from the long-term average (1960–2017) for each country pair (MW-ZM, MW-TZ, and MW-MOZ). The overall patterns indicate that the relative price of maize is lower in Malawi during periods when the domestic harvest is relatively good.

On the other hand, poor maize harvest periods in Malawi are associated with higher relative prices. For instance, we observe a consistently high, positive relative price dispersion (that is, higher relative prices in Malawi) during 2015–2016 when Malawi's maize production dropped significantly below the long-term average maize harvest per capita. On the other hand, when Malawi's maize harvest is more favorable, for example, in 2010–2012, we see that the relative price dispersion tends to fall, that is, relative prices in Malawi fall. These patterns of relationships between harvest realizations and the relative price dispersion appear to hold across all the three country pairs shown in Figure 4. In the regression analysis, we examine in detail the role of harvest in mediating the effect of export bans on price dispersions as well as domestic price levels.

Figure 1: Market locations and observations by country

Source: Prepared by the authors based on data from individual markets, their locations, and administrative and national boundaries shapefiles from different sources.

Figure 2: National median maize price in Malawi and its neighbors (2006–2017)
(during periods with and without export bans)

Source: Authors' calculations based on price data from markets in each country and official exchange rates. *Note:* MOZ = Mozambique; MW = Malawi; TZ = Tanzania; ZM = Zambia. The prices are converted from local currency units to US\$ per kg using the official exchange rate for each country.

Figure 3: Median price dispersion between market pairs within Malawi and across the border

Source: Authors' calculations based on price data from individual markets within countries; distance and travel time based on locations of markets. The median price dispersion (Δp) is defined as a percentage of prices prevailing in the market in Malawi, that is, dispersion is defined as $\left(\frac{P_{MW,i,t} - P_{non-MW,j,t}}{P_{MW,j,t}} \right) \times 100$.

Figure 4: Trends in relative maize prices and maize harvest
(deviation of maize harvest per capita from the long-term average, 1960–2017)

Source: Authors' calculations based on monthly price data from individual markets within countries; per capita production is estimated from population statistics and annual maize harvest quantity from FAOSTAT.

To analyze the welfare implications of the export bans, we link the estimated price effects with household production and consumption pattern extracted from the Malawi Integrated Household Surveys (IHS), rounds 3 and 4. These surveys collect detailed information on nationally representative sample of rural and urban households: 12,271 (in 2010/11) and 12,447 (in 2016/17). The household samples are representative at the district level and collect comprehensive information on livelihoods, including production, sales, and consumption of various crops.

Table 2 presents the descriptive statistics on maize production, sale, and consumption of households. Virtually all households consume maize, which makes up as much as 38 percent of the total food consumption. Share of maize consumption in total food consumption tends to be much higher in rural areas where the staple crop forms a much larger part of the household diet. For example, in the rural Central and South regions, 98 percent and 96 percent of households, respectively, consumed maize in 2016/17, and maize accounted, respectively, for 43 percent and 41 percent of food consumption. Maize makes up a relatively smaller share (35 percent) of food consumption in the North region. The national share of maize consumption in total food consumption has increased from 30 percent in 2010/11 to 38 percent in 2016/17.

A large fraction of the households are also producers of maize. In 2016/17, for example, about 72 percent of Malawians produced maize, and more than 80 percent of Malawians residing in rural areas grew maize. These shares are as a proportion of all households, not just farm households. Of course, almost all farm households grow maize, and nearly all households consume maize. In rural areas, 82 percent of households grow maize, compared to 30 percent of urban residents. Across regions, the North has a lower share of maize-producing households (74 percent), compared to the South (81 percent) and Central (85 percent) regions. A similar pattern of production is observed in 2010/11.

Table 2: Maize production, sale, and consumption patterns in rural/urban areas and by region

	Sample N	% HH producing maize	% HH selling maize	% HH consuming maize	Share of maize consumption in total food expenditure (%)
2016/17					
<i>Urban-Rural</i>					
Urban	2,272	29.2	5.0	97.2	24.5
Rural	10,175	81.8	12.2	96.4	41.2
<i>Region:</i>					
North	2,491	63.3	12.0	90.1	32.0
Central	4,220	75.2	16.9	98.2	39.5
South	5,736	70.1	4.7	96.3	37.8
Malawi	12,447	71.7	10.8	96.6	38.0
2010/11					
<i>Urban-Rural</i>					
Urban	2,233	33.0	3.4	97.6	16.5
Rural	10,038	87.2	14.2	97.0	31.1
<i>Region:</i>					
North	2,302	79.2	14.8	94.0	27.5
Central	4,217	83.9	17.3	97.6	27.7
South	5,752	74.1	7.6	97.4	30.1
Malawi	12,271	78.8	12.5	97.1	28.8

Source: Authors' calculations based on IHS3 and IHS4 data. *Note:* HH = households.

While most farm households produce maize, the share of households engaged in maize sales is minimal, indicating that many of the maize producers are subsistence farmers, producing mainly for their consumption. Even if 72 percent of households grew maize in 2016/17, only 11 percent of households sold maize. Across regions, a larger share of households in the rural Central region (19 percent) engages in maize sales, compared to the South region (5 percent). To make matters worse, farm households typically sell their maize immediately after harvest, when prices are generally low. Maize harvest usually occurs during March–June, mostly in April, when half of the farmers reported starting harvest (Figure 5, panel a). Soon after, newly harvested maize enters the market in May, and farmers complete most maize sales by August/September. In general, the households selling later are also those that undertake maize harvest later in the season (Figure 5, panel b). Limited abilities of farmers to hold maize stocks due to the constraints in storage capacity, high post-harvest losses, lack of access to finance, and other factors contribute to early disposal of maize harvest. Only a few households wait until December–February when prices are generally

high (Figure 5, panel c). These patterns highlight the potential implications for variation in the seasonality of price impacts due to export bans.

Figure 5: Timing of maize harvest and sales, and variation in prices received by farmers (2016/17)

Source: Authors' calculation based on farmers' sales data in IHS4, and similar findings (not shown for brevity) were observed in IHS3.

5. Results: Impacts of Export Bans on Prices

5.1. Association of domestic prices with export bans

We start with a simple comparison of the degree of association between domestic maize prices and changes in Malawi's maize trade policies. We regress the log of monthly maize prices on an indicator for periods in which Malawi had an export ban (equation 1). This simple examination of the association between Malawi's export bans and domestic prices appears to indicate that prices are higher by 20.7 percent during periods of an export ban (column 1, Table 3). A comparison of the domestic price levels in Malawi during periods of export ban and prices observed when no ban is in place, without accounting for harvest differences and trade regimes in neighboring countries, seems to incorrectly imply that prices are higher as a result of the export ban. However, after we control for harvest conditions in Malawi and trade regimes in the neighboring

countries, this association weakens to only 1.8 percent higher prices during a period of export ban (column 3, Table 3). Besides, the association is not statistically significant.

We further examine the relationship between export bans and harvest levels. Observing the trends in harvest levels and the timing of export bans as well as anecdotal evidence from discussions with local experts suggest that, in general, these bans tend to be imposed when the harvest levels are expected to be below average. The analysis presented in Table 3 indicates that once we fully account for harvest conditions, the association of export bans with price is quite different. To identify the difference in the association of prices and harvest during a period with an export ban against a period with no export ban, we include an interaction term between maize harvest and an indicator of the export ban in the above regression specification. Table 4 presents the results of estimating the regression specifications from equations 4 and 5.

Table 3: Association between export bans and domestic prices
(logarithm of price in kwacha/kg)

	(1)	(2)	(3)
Malawi's export ban	*** 0.207 (0.01)	*** 0.046 (0.07)	0.018 (0.02)
Malawi's maize harvest		*** -0.006 (0.00)	*** -0.005 (0.00)
Tanzania's export ban			*** -0.219 (0.02)
Zambia's export ban			*** 0.021 (0.00)
Control for market-year fixed effects	Yes	Yes	Yes
Observations	10,087	10,087	10,087

Note: Column (1) presents the regression results from estimating equation (1), Column (2) from equation (2), and Column (3) from equation (3). Standard errors are clustered by region pairs. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Maize harvest is the national maize production per capita in each year.

The results in Table 4 suggest that export bans are associated with lower domestic prices after we account for harvest levels. Table 4 (column 1) presents the difference in (logarithm of) price responses to a 1 kg per capita increase in harvest during periods of export ban minus the responsiveness of prices to similar harvest increases in periods with no export ban. The coefficient on the interaction term in the first row suggests that a 10 kg per capita increase in harvest, for example, is associated with a 6 percent decrease in prices during periods with an export ban, compared to the response of prices for a comparable increase in harvest during periods without an export ban. The relationship between harvest and domestic prices is different when there is an export ban in place and when it is not (column 2 of Table 4). Specifically, with an export ban in place, domestic prices tend to decrease with an increase in harvest.

On the other hand, with no export ban, prices tend to increase even when harvest levels are high. When Malawi's markets are open to global markets, price levels are likely to be driven by the global market and

net harvests elsewhere. Therefore, the price increase associated with higher harvest during periods of no export bans could be due to factors outside Malawi.

Table 4: Interaction between maize harvest and export bans
(*logarithm of price in kwacha/kg*)

	(1)	(2)
Difference in the association of harvest per capita and prices in a period with and without an export ban (<i>Malawi's harvest</i> $\times$ <i>Malawi's export ban</i>)	-0.006 ^{***} (0.00)	
Harvest's relation with prices in periods with and without an export ban		
No export ban		0.003 ^{***} (0.00)
Export ban		-0.005 ^{***} (0.00)
Malawi's export ban	1.409 ^{***} (0.09)	1.998 ^{***} (0.10)
Malawi's harvest	0.003 ^{***} (0.00)	
Tanzania's export ban	-0.216 ^{***} (0.02)	-0.230 ^{***} (0.02)
Zambia's export ban	0.005 (0.004)	0.018 ^{***} (0.004)
Observations	10,087	10,087

Note: Column (1) presents the regression results from estimating equation (4) and column (2) from equation (5). Market-year fixed effects are included in all regressions. Standard errors are clustered by region pairs. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Subsequently, we examine whether the relationship between prices and export ban interaction with harvest levels varies across the agricultural seasons in Malawi using the regression specification in equation 6. We present the coefficients of interest from this regression in Figure 6. Overall, we find that export bans are also associated with reduced seasonal differences in prices for a given increase in harvest. During periods with no export ban, an increase in harvest initially decreases prices immediately after harvest, but prices start to increase after the season and more sharply during the lean period (January–March). For example, in the absence of an export ban, a 10 kg per capita increase in harvest is associated with a 16 percent decrease in price during the harvest period, but the price increases slowly and reaches an increase of 8 percent during the lean season. Whereas, when export bans are in place, an increase in harvest is generally associated with lower prices throughout the year, even if the magnitude of price decrease is lower (Figure 6).

Figure 6: Association of prices and harvest with and without an export ban, across seasons of a year

Note: The figure presents the coefficient on the interaction of quarterly seasonal dummies with the dummy for export bans and harvest levels from estimating the regression in equation (6). The bars show the point estimates, and the error bars show the 95% confidence intervals based on standard errors clustered by region pairs.

5.2 Difference-in-difference estimates of the effect of export bans on relative prices

We estimate the association of Malawi's export bans with the cross-border price dispersion by comparing the relative change in the price gap between MW and non-MW market pairs versus the price gap between MW-MW market pairs when an export ban is imposed, relative to a period with no export ban. Figure 7 presents the results of the initial regression model to measure the association of Malawi's export ban with relative price across the border (price dispersion). Models 1, 2 and 3 refer to the regression specifications described in equations 7.1, 7.2 and 7.3, respectively.

Results from regression Model 1 show that export bans are associated with a higher relative price in Malawi of nearly 11 percent (compared to prices prevailing in the neighboring countries). Results remain similar when we account for the annual harvest output in Malawi and the neighboring countries (Model 3). In Model 3, we also include an additional term to test the assumption that export bans do not affect the within-Malawi price dispersions. The coefficient measuring the impact of MW ban on relative prices within MW (i.e., α_2 , the coefficient on the interaction term $(1 - nonMW_{ij}) \times ExpBan_t^{MW}$) is statistically insignificant and cannot be distinguished from zero. This confirms our key identification assumption that Malawi's export bans do not affect price dispersion within Malawi.

Figure 7: Association of export bans and price dispersion between Malawi's markets relative to markets in neighboring countries
(coefficients and 95% confidence interval)

Note: The dependent variable is price dispersion (that is, prices prevailing in Malawi minus prices across the border, as a percentage of prices in Malawi). Model 1 presents the regression results from estimating equation 7.1, Model 2 from equation 7.2, and Model 3 from equation 7.3. The standard errors are clustered at the region-pair level. Controls include the distance between the market pairs. The sample consists of monthly price dispersion observations for 327 market pairs from January 2006 to December 2017.

We then extend the base model by including a triple interaction between Malawi's harvest, export bans, and an indicator for a cross-border market pair (equation 9). We present these results in Table 5. Column 1 shows the estimates from the main regression specification. Column 2 presents a fully-saturated variant of the same specification which includes estimates for both periods with and without export ban: *Malawi's harvest* $\times$ *non-MW pair* $\times$ *No Malawi export ban* and *Malawi's harvest* $\times$ *non-MW pair* $\times$ *Malawi export ban*. The results indicate that there is a decrease in price dispersion for a given increase in harvest when export bans are in place. For example, a 10 kg per capita increase in harvest is associated with a 0.68 percentage point (pp) decrease in price dispersion (that is, decrease relative price in Malawi) between a market in Malawi and a market across the border when there is an export ban, compared to a period with no export ban (column 1, Table 5). These results appear to be consistent with the findings seen in Table 3 that suggested that export bans decrease domestic price. The results indicate that export bans are associated with a larger decrease in relative price for a given increase in harvest, compared to periods without an export ban. In other words, export bans are associated with lower relative prices in periods of good harvest (column 2, Table 5).

The impact of the trade restrictions is also likely to vary with the seasonality in the maize crop calendar in Malawi. To examine this variation, we interact our primary variable of interest with indicators for each quarter of the year and present the resulting estimates in Figure 8. We find that, during the harvest season, the response of relative price (that is, price dispersion) to an increase in harvest levels is similar for periods with and without export ban: a 10 kg per capita increase in harvest is associated with about 2.5 pp decrease in price dispersion (as a percentage of prices in Malawi). However, the responsiveness of relative prices to changes in harvest under export bans versus no export bans is quite different in the lean season. Better harvest leads to a smaller decrease in relative prices (0.9 pp decline in price dispersion for a 10 kg per capita increase in harvest) in periods without an export ban, compared to a period with a ban (1.8 pp decrease in price dispersion for a similar increase in harvest). This could be the result of tight domestic supply in the lean season when the export is allowed. When export bans are in place, traders or other intermediaries are less likely to stock maize in anticipation of higher prices and this could be one of the mechanisms through which export bans reduce prices during lean seasons.

Table 5: Export bans and harvest effect on relative price difference

	(1) Price dispersion (%)	(2) Price dispersion (%)
Differences in the association of prices and harvest between periods with and without an export ban (<i>Malawi's harvest</i> × <i>non-MW pair</i> × <i>Malawi's export ban</i>)	−0.068* (0.04)	
Association between export ban and prices, without accounting for harvest (<i>non-MW pair</i> × <i>Malawi's export ban</i>)	10.46*** (1.21)	
Harvest's relation with relative price-dispersion with and without export ban: (<i>Malawi's harvest</i> × <i>non-MW pair</i> × <i>Malawi's export</i>)		
No export ban		−0.057 (0.04)
Export ban		−0.118* (0.06)
Malawi's export ban		5.864*** (1.99)
Tanzania's export ban	−7.544** (2.79)	−7.515** (2.79)
Zambia's export ban	−5.639*** (1.64)	−5.564*** (1.68)
Malawi's harvest	−0.053 (0.04)	

	(1) Price dispersion (%)	(2) Price dispersion (%)
Tanzania's harvest	0.104*** (0.03)	0.105*** (0.03)
Mozambique's harvest	-0.386*** (0.12)	-0.384*** (0.12)
Zambia's harvest	-0.030 (0.07)	-0.031 (0.07)
Observations	46,402	46,402

Note: The regression results are based on the specification in equation 9. Standard errors are clustered by region pairs. Both regressions include country pair-by-year fixed effects. Controls include harvest quantity in neighboring countries and distance between market pairs. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Figure 8: Comparison of price responsiveness to harvest ‘with’ and ‘without’ export bans

Note: Figure presents the coefficients on the interaction of quarterly season dummies with the indicator for non-Malawi market pair, harvest levels and dummies for periods with and without an export ban in Malawi from estimating the regression specification in equation 10. The bars show the point estimates, and the error bars show the 95% confidence intervals based on standard errors clustered by region pairs.

5.3 Welfare implications of the price effects of export bans

We examine the welfare implications of the export bans by estimating the NBR for households, that is, the value of net gain/loss (as a percentage of total household expenditure) due to changes in maize price

following export bans.⁵ The NBR depends on the contribution of maize to household income (production ratio, PR) and its share in total household expenditure (consumption ratio, CR) as well as the magnitude of change in maize price. Based on IHS4, Table 6 summarizes PR, CR, and NBR as well as the share of households that are net-buyers, net-sellers, and self-sufficient. Maize consumption represents 23 percent of total consumption, while maize production accounts for about 10 percent of the income. About 65 percent of the households are net buyers of maize, that is, their maize consumption is higher than production (in value terms), while about 12 percent are net-sellers. About 24 percent of the households are self-sufficient, that is, they produce maize only for their own consumption without any maize sales or purchases in the market.⁶ There is some heterogeneity by residence (urban/rural), region, poverty status, and consumption quintile. For example, rural residents and the poor have high PR and CR, and a larger share of them are self-sufficient, compared to urban residents and the non-poor households.

Lower maize prices typically lead to welfare losses for farm households that have a surplus harvest and rely heavily on maize sales for their incomes. Whereas, those farmers who do not have enough maize harvest (and non-farm urban residents) and purchase maize for consumption would benefit from lower maize prices. As shown in Table 6, the majority of households, both in urban and rural areas, are net-buyers. Therefore, in the short run, a lower maize price due to export bans is likely to benefit these households. The ban is likely to hurt farmers that are net-sellers, but these farmers make up only 12 percent of Malawi's households. The magnitude of the short-term gains, however, is very low. The gains make up a relatively higher share of rural households' consumption (0.86 percent) than urban residents' consumption (0.59 percent).⁷ The gains are also larger in the South (0.97 percent) and North (0.72 percent) regions than the Central region (0.66 percent).

Poor households have a much larger maize consumption share relative to non-poor households, and they tend to be mostly net-buyers of maize. Therefore, a reduction in maize prices results in an average welfare gain of 0.94 percent for the non-poor and 1.14 percent for the poor households. The welfare implications of a decrease in maize prices also vary across the consumption distribution with those in the lowest two quintiles exhibiting a more substantial increase in welfare gains relative to households at the higher end of the distribution. This holds in both urban and rural areas. Within urban areas, households that are in the lowest quintiles gain about 0.7–0.9 percent of their consumption expenditure for a 6 percent decrease in maize prices. In comparison, the effect on the wealthiest households is around 0.3 percent of their consumption. We observe a similar pattern across different consumption quintiles within rural households.

Households that are net-sellers of maize would see a reduction in farm profits due to a decline in maize prices, while households that are net-buyers would gain from consuming cheaper maize. For a 6 percent decrease in maize price, net-sellers would see a welfare loss of 0.88 percent of their consumption, while households that are net-buyers gain nearly 1.1 percent of their consumption (Table 6, Panel B). These changes in their consumption are, however, a small fraction of their total consumption. As a result, these

⁵ Household expenditure is used as a proxy for income.

⁶ The results are similar in 2010/11 (IHS3) and included in Appendix Tables A.3 – A.5.

⁷ This does not necessarily mean that the amount of gain is higher for rural residents but that the gain is a larger share of their initially low consumption.

changes could affect poverty status only for those who are just above or below the poverty line. Simulation of changes in poverty as a result of gains/losses from the export ban shows that the intervention has a limited effect on both moderate poverty and ultra-poverty rates. The change in moderate and ultra-poverty rates is quite small (close to 0.6 percentage point) (see Table A.2 in Appendix).

These findings by no means suggest that the long-term effects of export bans would be positive even for the net-buyers of maize. Large farmers who produce for market likely adjust their production decision in the long term. They could, for example, switch to crops that are less regulated and invest less in fertilizer and improved seeds of maize. These production decisions could reduce the overall maize production in Malawi and could be counterproductive in terms of ensuring food security or domestic food price stabilization. Deaton's framework used to estimate welfare gains/losses is static and does not capture the dynamic decisions that farmers engage in over a longer timeframe.

Table 6: Maize production and consumption ratios and change in NBR from lower price during an export ban

Panel A: Characteristics across various groups of HHs								
Group	PR	CR	NBR (as % of consumption)		Net- buyers	Net- sellers	Self- sufficient HHs	
	(as % of HH expenditure)		(for 1% decrease in prices)	(for a 6% decrease in prices)	(% of households)			
Residence								
Urban	2.82	12.85	0.10	0.59	80.4	5.6	14.0	
Rural	11.19	25.82	0.15	0.86	60.9	13.1	26.0	
Region								
North	7.66	19.85	0.12	0.72	62.2	10.5	27.3	
Central	12.82	24.08	0.11	0.66	63.2	17.0	19.8	
South	6.91	23.35	0.16	0.97	66.4	6.7	26.8	
Poverty status								
Non-poor	8.64	17.93	0.09	0.55	68.6	14.6	16.7	
Poor	10.78	30.06	0.19	1.14	59.7	7.9	32.4	
Urban by Consumption Quintile								
Lowest	5.22	20.12	0.15	0.88	77.0	4.2	18.8	
2	2.92	15.33	0.12	0.73	77.6	5.2	17.2	
3	2.08	12.28	0.10	0.60	82.3	5.0	12.7	
4	2.16	10.33	0.08	0.48	84.3	3.8	11.9	
Highest	1.70	6.12	0.04	0.26	81.0	9.7	9.3	
Rural by Consumption Quintile								
Lowest	11.90	27.90	0.16	0.94	57.0	10.4	32.6	
2	11.06	30.42	0.19	1.14	59.5	8.9	31.6	
3	11.12	28.25	0.17	1.01	60.2	10.5	29.3	
4	11.33	24.51	0.13	0.78	64.5	14.4	21.1	
Highest	10.56	18.02	0.07	0.44	63.4	21.1	15.5	
Malawi	9.60	23.35	0.14	0.81	64.6	11.6	23.7	
Panel B: NBR among net-sellers and net-buyers								
Net-buyers of maize					Net-sellers of maize			
	PR	CR	NBR (1% price decrease)	NBR (6% price decrease)	PR	CR	NBR (1% price decrease)	NBR (6% price decrease)
Residence								
Urban	0.01	0.13	0.12	0.70	0.22	0.10	−0.12	−0.73
Rural	0.07	0.28	0.20	1.21	0.33	0.18	−0.15	−0.88
Region								
North	0.07	0.26	0.19	1.14	0.29	0.16	−0.13	−0.74
Central	0.09	0.29	0.20	1.17	0.35	0.19	−0.17	−0.98
South	0.06	0.27	0.21	1.25	0.28	0.16	−0.12	−0.69
Malawi	0.06	0.24	0.18	1.09	0.32	0.17	−0.15	−0.88

Source: Authors' calculations based on IHS4 data. NBR is estimated based on equation 11. Self-sufficient households would neither gain nor loss due to change in maize prices.

6. Conclusion and policy recommendations

The analysis in this study suggests that export bans are associated with lower domestic prices in Malawi as well as lower relative prices and reduced seasonality in prices after accounting for harvest levels. A 10 kg per capita increase in harvest, for example, is associated with a 6 percent decrease in domestic maize prices during a period of an export ban, compared to the response of prices for a comparable increase in harvest during a period without an export ban. Similarly, a 10 kg per capita increase in harvest is associated with 0.68 pp decrease in price dispersion (that is, decrease relative price in Malawi) between a market in Malawi and a market across the border when there is an export ban, compared to a period with no export ban. Export bans are also associated with lower seasonality in prices.

A static welfare analysis shows that, because the majority of Malawians are net-buyers of maize, lower maize prices associated with the export bans could lead to a small welfare gain in the short-term, especially for the net-buyers. In the short run, welfare gains from low maize prices are estimated to be equivalent to 0.8 percent of household consumption. The gains also accrue mostly to the poor and net-buyers. Even though net-buyers enjoyed benefits equivalent to 1.1 percent of their consumption, the net-seller farmers experienced a welfare loss of 0.9 percent of their consumption. The poverty reduction impact of an export ban is also limited. In addition, these short-term gains and losses do not account for dynamic investment decisions by farmers.

These gains might not materialize in the long-run when bans remain imposed over an extended period, and accordingly, producers adjust their production decisions. The short-term gains could dissipate when surplus farmers, dissatisfied with market outcomes, reduce their effort to produce maize for the market. Therefore, the first and minimum policy actions that could help attenuate the adverse impacts of export bans on net producers is to make the policy actions predictable. Export bans depress prices further during periods of good harvest. Policymakers should make export ban imposition and lifting decisions more transparent and responsive to harvest conditions. Clearer rules surrounding restrictions on maize exports could reduce some of the uncertainties that presently starve the agriculture sector of investment. This would encourage investment by farmers to boost food production and productivity.

A second key policy action that could support surplus farmers as well as protect consumers without compromising long-term investment in agriculture is enhancing the bargaining power of smallholder farmers. Strengthening the position of small farmers relative to traders could raise farm incomes and reduce rural poverty. This could partly be achieved by improving farmers' access to production, price, and market information, all of which enable farmers to get the best price for their crop and reduce the risk of exploitation by traders. Associations and cooperatives of producers could be strengthened to increase the bargaining power of smallholders.

A third, rather long-term policy intervention, is increased investment in accessible rural infrastructure such as transport, storage, and processing facilities. Such investment would support farmers and lower production and marketing costs—by enabling them to take advantage of seasonal variations in prices. One of the reasons why farmers currently sell the entirety of their crop immediately after the harvest when food is plentiful, and prices are at their lowest is a lack of warehouses where crops can be stored without incurring significant post-harvest losses. Warehouse-receipt schemes that allow farmers to store their surplus and

borrow against it to finance consumption and investment would help to smooth some of the seasonal volatility in prices.

Finally, a greater coordination of food security efforts by governments in Eastern and Southern Africa is essential to ensure harvest gains in some countries support deficits in others. The analysis presented in this study suggests that relative maize prices in the region vary depending on production conditions in each country. For example, when a surplus harvest is realized in Malawi, prices tend to be lower there compared to, say, neighboring Tanzania. Coordinated food security measures, including information sharing and establishing trade corridors into frequently surplus areas, could support countries to identify potential production shortfalls/surpluses and facilitate better trading opportunities across surplus and deficit areas.

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Appendix

Table A.1: Number of markets by country over time as well as by region within Malawi

Year	Mozambique	Tanzania	Zambia	Malawi (total)	Northern Malawi	Central Malawi	Southern Malawi
2006	9	20	35	74	14	34	26
2007	9	20	35	74	14	34	26
2008	9	20	35	74	14	34	26
2009	23	20	35	74	14	34	26
2010	23	20	35	74	14	34	26
2011	23	20	35	74	14	34	26
2012	23	20	35	74	14	34	26
2013	23	20	35	74	14	34	26
2014	23	20	35	74	14	34	26
2015	23	20	35	70	14	33	23
2016	22	20	35	67	14	30	23
2017	22	20	35	57	13	25	19

Source: Authors' calculation based on data from various sources.

**Table A.2: Impact of export bans on poverty prevalence
(based on a 6% decrease in maize prices)**

	Initial poverty rate		Change in poverty associated with lower maize prices after the bans	
	Moderate poverty	Ultra-poverty	Moderate poverty	Ultra-poverty
Urban	17.7 [0.8]	4.1 [0.4]	-0.27 [0.11]	-0.19 [0.09]
Rural	59.5 [0.5]	23.8 [0.4]	-0.62 [0.09]	-0.74 [0.09]
<i>Rural by Region:</i>				
North	59.9 [1.1]	23.2 [1.0]	-0.38 [0.16]	-0.73 [0.19]
Central	53.6 [0.8]	18.9 [0.6]	-0.58 [0.15]	-0.7 [0.15]
South	65.2 [0.7]	28.8 [0.6]	-0.7 [0.13]	-0.78 [0.15]
Malawi	51.5 [0.5]	20.1 [0.4]	-0.55 [0.07]	-0.64 [0.08]

Source: Authors' calculations based on IHS4 data. Note: Standard error of means in brackets.

Table A.3: Summary of maize welfare measures and net position of households (Based on IHS3)

PR	CR	NBR	Net- buyers	Net- sellers	Self- sufficient HHs
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	(as % of HH expenditure)		(for 1% decrease in prices)	(for a 6% decrease in prices)		(% of households)	
IHS3 (2010–2011)							
<i>Residence</i>							
Urban	2.09	8.65	0.07	0.39	82.4	8.5	9.2
Rural	9.30	20.34	0.11	0.65	63.9	19.1	17.0
<i>Region</i>							
North	9.67	18.45	0.09	0.52	68.9	17.5	13.6
Central	10.06	17.45	0.07	0.44	63.0	26.2	10.8
South	6.13	19.45	0.13	0.79	69.5	9.8	20.7
<i>Poverty status</i>							
Non-poor	6.36	12.39	0.06	0.36	68.4	20.5	11.0
Poor	10.51	26.42	0.16	0.94	64.6	13.4	22.0
Total	8.17	18.51	0.10	0.61	66.8	17.4	15.8

Table A.4: Variation in welfare measures across household wealth categories (consumption quintiles) in urban and rural areas (Based on IHS3)

		NBR				Net-buyers	Net-sellers	Self-sufficient
Consumption Quintile		PR	CR	(1% price decrease)	(6% price decrease)			
Urban	Lowest	4.65	15.87	0.11	0.66	78.1	10.3	11.6
	2	1.79	10.32	0.09	0.50	88.9	4.5	6.6
	3	1.37	8.12	0.07	0.40	84.4	4.8	10.8
	4	1.64	6.07	0.04	0.26	79.1	11.3	9.6
	Highest	1.01	2.85	0.02	0.11	81.0	11.5	7.4
Rural	Lowest	12.33	28.35	0.16	0.95	60.8	15.2	24.1
	2	9.96	24.59	0.15	0.86	64.2	12.8	23.0
	3	8.79	20.96	0.12	0.72	70.0	15.1	14.9
	4	8.43	16.25	0.08	0.46	68.0	18.1	13.9
	Highest	6.98	11.54	0.05	0.27	65.9	24.8	9.3

Table A.5: Variation in welfare measures between net-buyers and net-sellers of maize across regions (Based on IHS3)

	<u>Net maize buying HHs</u>				<u>Net maize selling HHs</u>			
	PR	CR	NBR (1% price decrease)	NBR (6% price decrease)	PR	CR	NBR (1% price decrease)	NBR (6% price decrease)
Urban	0.01	0.09	0.08	0.48	0.12	0.05	−0.07	−0.40
Rural	0.07	0.23	0.16	0.97	0.22	0.12	−0.11	−0.63
<i>Region:</i>								
North	0.08	0.23	0.15	0.89	0.22	0.11	−0.11	−0.64
Central	0.07	0.22	0.15	0.86	0.24	0.12	−0.12	−0.69
South	0.06	0.24	0.18	1.09	0.19	0.11	−0.09	−0.51
Total	0.06	0.20	0.15	0.88	0.21	0.11	−0.10	−0.62