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Who Uses and Who Benefits From Warehouse Receipt Systems?

An examination of contract level transactions on the Agricultural Commodity Exchange for Africa, 2011–2018

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ABBREVIATIONS

ACE	Agricultural Commodity Exchange for Africa
AHCX	Auction Holdings Commodity Exchange
COMEX	Commodity Exchange
DFID	United Kingdom, Department for International Development
ECX	Ethiopian Commodity Exchange
EACWSE	Ethiopian Agricultural Commodities Warehousing Service Enterprise
ESC	Electronic Silo Certificates
GCX	Ghana Commodity Exchange
GGC	Ghana Grains Council
GIZ	German Agency for International Cooperation
JSE	Johannesburg Stock Exchange
MT	Metric Ton
SAFEX	South African Futures Exchange
USAID	United States Agency for International Development
WR	Warehouse Receipt
WRS	Warehouse Receipt System
ZAMACE	Zambian Commodity Exchange
ZIMACE	Zimbabwe Commodity Exchange

ABSTRACT

This paper examines who uses and who benefits from warehouse receipt systems using unique transaction level data from the Agricultural Commodity Exchange for Africa (ACE) based in Malawi. Between 2011 and 2018, the ACE warehouse receipt system was used 710 times, with most receipts issued for maize, pigeon peas and soybeans. Large traders took out both the largest number of warehouse receipts and deposited the largest volumes, followed by medium and small traders, farmers associations/groups, and then farmers.

An inverse relationship exists between the duration of storage, the cost of financing and the returns that ACE warehouse receipt depositors make. Storing maize and soybeans for less than 180 days generally resulted in a depositor making a profit, while storing pigeon peas for less than 270 days, also generally resulted in profits to storers. However, 73 percent of warehouse receipts issued for pigeon peas made losses compared to 48 percent for maize and 53 percent for soybeans. Wide variations in profits to storers were linked to the collapse of pigeon pea exports and a fourfold decline in maize prices in 2016/17.

This paper develops alternative storage rules with the aid of seasonal price patterns and analysis of depositors' behavior. These rules suggest possible combinations of deposit and sale months that can be used to guide depositors within year storage decisions. The wider implications of the ACE experience for the development of warehouse receipt systems elsewhere in Africa are also discussed.

Keywords: Agricultural markets, warehouse receipt system, ACE, Malawi, Africa

1. INTRODUCTION

In theory, warehouse receipt financing permits farmers, traders, processors and exporters in developing countries to use the commodity stored as collateral to secure a loan, while waiting to sell at a later date at higher prices. Warehouse receipt (WR) systems have therefore been promoted by a range of bilateral and multilateral agencies to prevent smallholder farmers from selling their surplus at harvest when prices are generally at their lowest. However, in practice, warehouse receipt financing generally has not been embraced by smallholders in developing countries (Miranda et al. 2019). Instead, throughout most of Africa south of the Sahara, warehouse receipts are used almost exclusively by large traders, processors, and exporters (Miranda et al. 2019).

A warehouse receipt system (WRS) may be defined as "a platform that enables farmers, traders, processors, and exporters to obtain finance secured by agricultural commodities deposited in a warehouse" (FRMA 2020).[1] The underlying warehouse receipts (WRs) may be either negotiable or non-negotiable, which means that ownership of the receipt can be transferred giving the prevailing holder of the receipt claim to the commodities in their warehouse (Coulter and Onumah 2002).

This paper examines who uses and who benefits from WRS using unique transaction level data between 2011 and 2018 provided by the Agricultural Commodity Exchange for Africa (ACE). The next section describes the historical context including the evolution of ACE's WRS since 2011, while section 3 outlines the data and methods used. Section 4 contains our main results, focusing on who uses and who benefits from the ACE WRS. Section 5 summarizes the analysis and draws conclusions for the future development of WRS in Malawi and elsewhere.

2. CONTEXT

While the origins of commodity trading and inventory based trade financing go back to Ancient Mesopotamia, the origins of modern warehouse receipts lie in the development of commodity markets in North America in the mid-19th century followed by Latin America (Coulter and Onumah 2002; Williams 1986; UNCTAD 2009). Commodity Exchange (Comex) and WRS in other regions, particularly, China, Eastern Europe and the former Soviet Union, and India followed much later after the liberalization of their planned economies.

Commodity trading in Africa dates back to the Portuguese in the 16th century (Eltis 1994; Hopkins 1973). However, Africa did not have any WRS worthy of the name until the early 1990s. In 1994, following the fall of the apartheid regime in South Africa, the ANC Government liberalized the trade in grains by abolishing commodity boards and encouraging the private sector to develop alternative structured trade mechanisms. Reforms included upgrading the market information service and the establishment of future and options contracts on the South African Futures Exchange (SAFEX), as well as the development of a system of electronic silo certificates (ESC). Silo certificates were the foundation for a WRS as farmers could trade or use them to raise collateral financing from commercial banks (UNCTAD 2009). In 2004, the two leading silo operators in South Africa, who accounted for 60 percent of grain handled in the country, commissioned a software company to develop a system of electronic silo certificates. When a farmer, trader or another market participant deposits grain in one of approximately160 approved silos, the warehouse operator creates a receipt that is validated and stored on a Johannesburg-based server. The holder can then access the system and transfer the receipt to other parties as title to the underlying goods or use it as security for a loan.

[1] As Coulter and Shepherd (1995) note, WRS are linked to two older forms of agricultural lending in which credit was advanced against physical stocks: inventory credit and warrantage. Inventory credit, which involves obtaining credit against stocks often held in bonded warehouses, was first used in ancient Rome and is still used extensively in Latin America and a few Asian countries. Warrantage is the French term for a similar system used in 19th century Europe and in contemporary French-speaking Africa.

Holders of warehouse receipts or their brokers can use the system for physical delivery of contracts on SAFEX, which was established in the same year as the ESC. This e-system also provides an online registry of warehouse receipts as well as various types of price and stock information to government agencies and other market participants (UNCTAD 2009). In the 2019–2020 season, the volume of grain traded on SAFEX, a subsidiary of the Johannesburg Stock Exchange, was around 3 million tons with most trades backed by an ESC. However, it is important to recognise that a single ESC may be retendered several times during a season.

Ethiopia is regarded as one of the pioneers of WRS in Africa. Its government enacted a proclamation to establish a pilot WR financing scheme in 2003, although because of financial concerns by commercial banks, poor grading standards and other implementation issues, the scheme never issued more than a few WRs (Pauw 2017). When the Ethiopian Commodity Exchange (ECX) was established in 2008, the government transferred responsibility for WR from the Ministry of Industry and Trade to ECX, which helped to allay the fears of the commercial banks. To reduce defaults, all trades of the ECX are expected to be backed by WR. In 2015, ECX established, with high-level government backing, the Ethiopian Agricultural Commodities Warehousing Service Enterprise (EACWSE) to provide an 'innovative warehouse management service to customers and stakeholders through the application of best practices and available technologies'. This also appears to have been unsuccessful, with dissatisfaction expressed by traders and other market actors on the quality of EACWSE's services. Expansion into the lucrative coffee sector failed due to issues of quality and traceability (Pauw 2017). So, in mid-2017, the EACWSE was merged back into ECX. Since then, trade of WR has been minimal.

Around the same time as ECX was established in Ethiopia, several other Comex were started in southern Africa. These include ZAMACE in Zambia, which has experienced something of a stop start history, and ZIMACE in Zimbabwe. Of the two exchanges, only ZAMACE still exists, although, trading on its main platform was suspended between April 2012 and mid-2018 (Jayne et al. 2014). WRS were offered on the exchange from its establishment in late 2007 until the passage of the Agricultural Credits Act in 2010, which made it illegal for ZAMACE to offer WRS until a statutory instrument was offered in late 2014. ZAMACE then developed an electronic system for WRS – Electronic Silo Certificates (ESC), using the same software package as used by the Johannesburg Stock Exchange (JSE) for its grain futures market, which was launched in late 2015. Nevertheless, the quantities traded on both the exchange and deposit using WR remain low. IAPRI (2019) states that just 4,000 MT of maize were traded on ZAMACE in 2018. While at least 8 private sector warehouse operators with more than 300,000 MT of storage have been certified by ZAMACE, use of their electronic silo receipts system remains negligible (IAPRI 2019). In February 2020, ZAMACE's silo receipts became tradeable on an agricultural commodity platform launched jointly by ZAMACE and the Lusaka Securities Exchange.

Following two unsuccessful pilot WRS during the 1990s (Coulter and Onumah 2002), the Ghana Grains Council (GGC), with support from USAID, established its own WRS in 2015 (AfDB 2017). As of January 2017, the GGC had certified 12 commercial warehouses, with a combined storage capacity of 54,600 MT, and issued WR for 46,942 MT of maize, of which 12,555 MT were financed for approximately US$1.2 million (Miranda et al. 2019). The majority of these WR are reported to have been issued by the certified warehouse operators to themselves to enable them to use their own grain as collateral to secure loans. Three banks and one other financial institution currently advance loans based on GGC WRs. A parallel scheme for smaller approved community warehouses is in operation. Although licensed by the GGC, it does not have the authority to issue WRs. Launched in 2016, the Ghana Commodity Exchange (GCX) entered into a strategic alliance with the GGC to manage the exchange's WRS and to deliver a national WRS that can support the emerging exchange (AfDB 2017).

Around the same time, the G-Soko structured trade and financing platform in Eastern Africa was established by the East African Grains Council in partnership with Food Trade Eastern and Southern Africa and Virtual City, a mobile software and solutions firm. The G-Soko platform is a harmonized trading system that integrates village aggregation centers, certification of warehouses, warehouse receipt financing and commodity exchanges (the East African Commodity Exchange). To date, G-Soko has certified about 70 warehouses with a capacity of over 180,000 MT and traded a total of over 70,000 MT of maize (EAGC 2020; AfDB 2017). The set-up costs of G-Soko were largely funded by the UK Department for International Development through their Food Trade Eastern and Southern Africa program, which ended in 2018. The final evaluation report for the program noted that G-Soko has underperformed despite complementary grants to other organizations working with the platform. This underperformance was partly explained by maize export bans in Tanzania and other countries (including Malawi and Zambia) that limited the use of the platform for cross-border trade, along with extensive government interventions in the cereals sectors (ITAD 2019). Lack of transparency and trust in the system was also noted. With the closure of the Food Trade Eastern and Southern Africa project in late 2018, it is unclear for how much longer the G-Soko platform will continue to operate. In Tanzania, an alternative government backed but thinly traded WRS operated by the Warehouse Licensing Board could take over some of its functions.

Table 1 provides an overview of the WRS currently operating in Africa.

Table 1. Volume and turnover of warehouse receipt systems in Africa

Country	Scheme	Established	Volume (MT) (latest year)	Commodity Exchange/ Operator
Ethiopia	Warehouse Receipt Finance Initiative	2009	minimal	ECX (IFC backed)
Ghana	GGC Warehouse Receipt System	2008	47,000 (2016)	Ghana Grains Council
Kenya, Tanzania, Uganda	G-Soko	2014	1,200 (2017)	East African Grains Council
Malawi	ACE Warehouse Receipt System	2011	28,000	ACE
Malawi	AHCX Warehouse Receipt System	2014	—	AHCX
South Africa	Electronic Silo Certificates System	2004	3.0 million (2019/20)	SAFEX/JSE
Tanzania	Warehouse Licensing Scheme	2005	—	Warehouse Licensing Board
Zambia	Electronic Silo Certificates System	2014	neglible	ZAMACE

Source: Author's compilation from African Development Bank (2017), Miranda et al. (2019), IAPRI (2019); ACE (/www.aceafrica.org/), AHCX (www.ahcxmalawi.com/), ECX (www.exc.com.et), G-Soko (http:g-soko.com/), SAFEX (www.jse.co.za/redirects/safex) accessed March 30, 2020.

Note: GGC = Ghana Grains Council; ACE = Agricultural Commodity Exchange for Africa; AHCX Auction Holdings Commodity Exchange; ECX = Ethiopian Commodity Exchange; SAFEX = South African Futures Exchange; JSE = Johannesburg Stock Exchange; — = data not available.

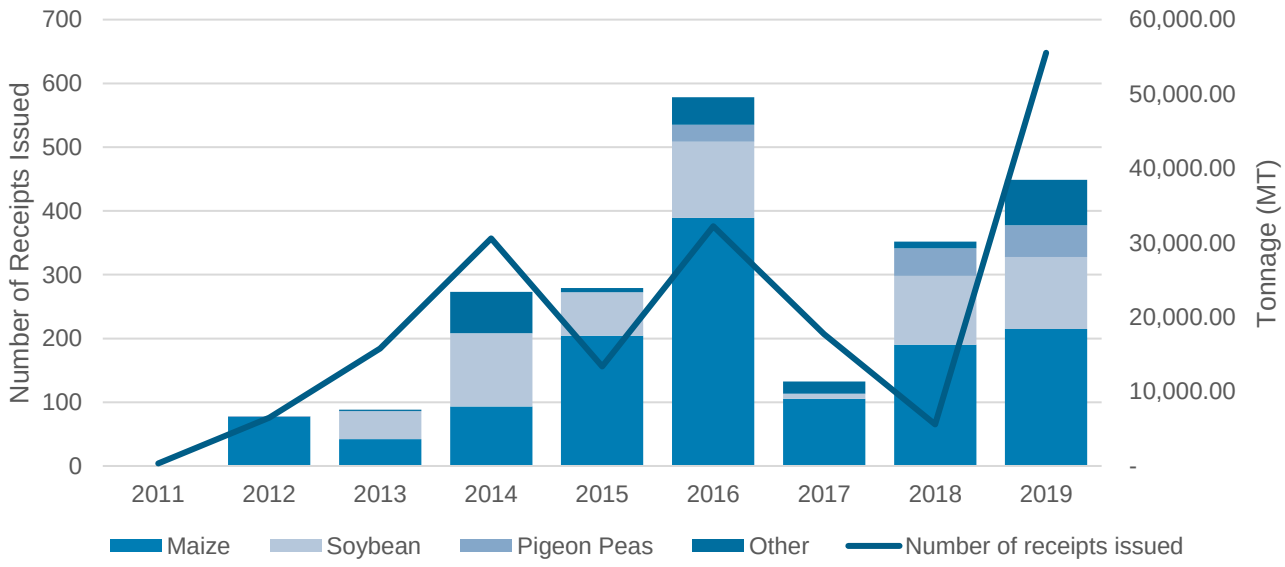
In addition, a further four or five WRS are being established in Africa south of the Sahara. However, all 'require significant work and/or structural adaptation before they can become operationally effective' (AfDB 2017). These include nascent WRS in Cote d'Ivoire, Egypt, Madagascar and Senegal.

2.1. ACE's Evolving Warehouse Receipts System

The Agricultural Commodity Exchange for Africa (ACE), which despite its name currently only operates in Malawi, started issuing WRS as part of a pilot in 2011. Figure 1 shows the evolution of the ACE WRS. Its development proceeded in two distinct phases. First, between 2011 and 2016, the number of WRs issued and the tonnage deposited in ACE certified warehouse grew rapidly. This was driven primarily by deposits of maize (some of it linked to World Food Programme procurement for its humanitarian programs) and pigeon peas (one of Malawi's emerging export crops). A collapse of pigeon peas exports and prices in 2016 and 2017 combined with a four-fold decline in maize prices in 2017 caused commercial banks to halt their credit line to ACE for WRS financing in mid-2017.[2] This led to a second phase of ACE WRS in 2017 and 2018, in which WRs combined with collateral managers were used primarily as a way to guarantee contracts to exporters and processors.[3]

From late 2018 onwards, commodity markets have recovered due to an increase in smallholder trade facilitation, especially maize and soybeans . The number of WRs issued by ACE grew fivefold in 2019 although volumes deposited in ACE certified warehouses are still around half of their peak of 2016. This increase in trade may be linked with the passage of the Warehouse Receipt Act in late 2017, the implementation of Commodity Exchange Directive in April 2019, and the licensing of ACE as a commodity exchange in April 2020.

Figure 1. Evolution of warehouse receipts on ACE, 2011–2018



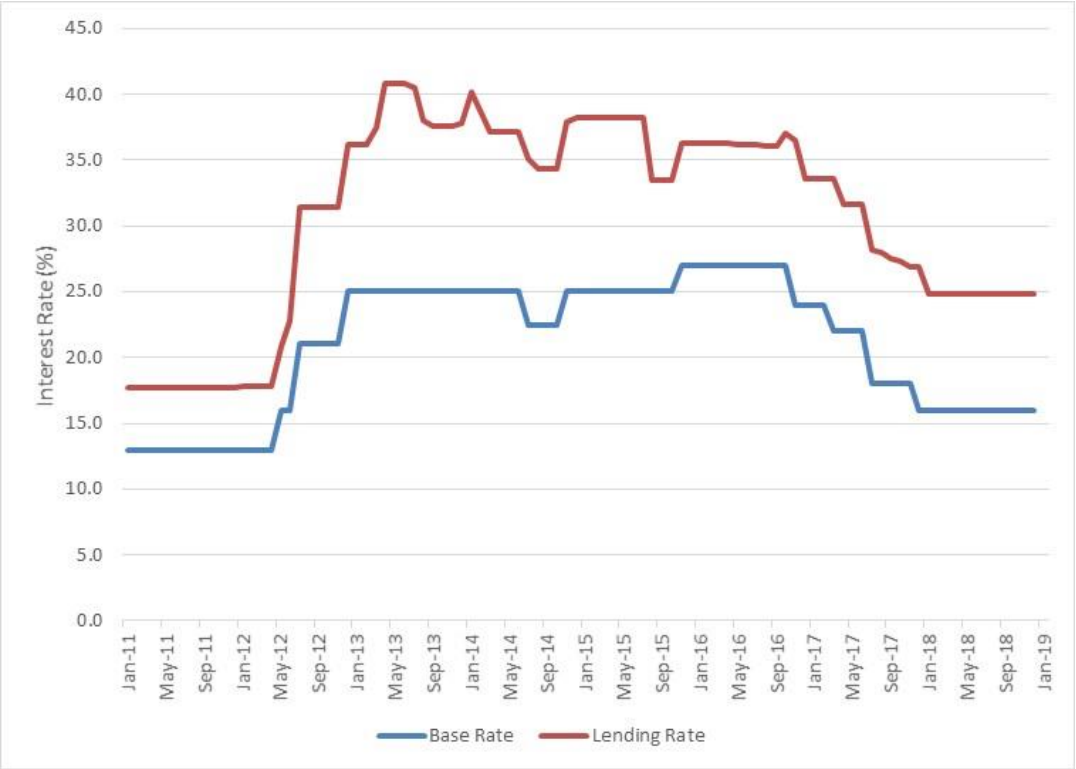
Source: Constructed by authors based on ACE data (2011–2018).

2 The collapse in pigeon pea exports and prices was linked to the imposition of a ban on pigeon peas imports by India, the major importer of Malawian pigeon peas in August 2017, following an exceptionally good Indian harvest in 2016 (Me-Nsope and Nankhuni 2018). The four-fold decline in Malawian maize prices in 2017 was driven by a combination of cross-border imports and massive distribution of humanitarian food aid in response to food shortages in late 2016/early 2017, followed by an exceptional good maize harvest in the second quarter of 2017 (Baulch et al. 2018a).

3 Collateral managers in Malawi offer two main services: (i) stock monitoring; and (ii) full collateral management. Stock monitoring involves physical monitoring of the stocks and reporting to the financial institution on 'as it is said to be' basis. Full collateral management involves 24-hour monitoring of a warehouse, physical verification of the quantity, quality and type of the stock. In addition, it involves reporting to the financial institution of the 'verified stock' and custody of warehouse keys by the collateral management company. The charges for stock monitoring ranges from US$2,000 to US$2,500 per warehouse per month, while charges for full collateral management range from US$3,000 to US$4,500 per warehouse per month. The cost of collateral management is usually added to the cost of the loan by the financial institution, although the risk of default is, in practice, borne by the financial institution (Baulch et al. 2018b).

The high cost of financing is a further key factor that has adversely affected the development of Malawi's WRS. Figure 2 shows how the base rate and lending rate have varied since 2011. Commercial bank lending rates peaking at around 40 percent per annum. Since the lending rate shown in this figure are the minimum rates at which the Reserve Bank of Malawi reports that commercial banks will give loans, many holders of WR backed financing (along with other types of high risk agricultural lending) paid interest rates in excess of 45 percent per annum between 2014 and mid-2016. Subsequently, the policy and lending rates declined quickly reaching an all-time low towards the end of 2019. Figure 2 also shows that the 'intermediation margin' between the base rate and lending rates in Malawi was widest when the base rate—the rate at which the Reserve Bank will make loans as a 'lender of the last resort' –was highest. Overall, the intermediation margin averaged between 9 and 10 percent per annum between July 2012 and early 2020, peaking at 15.5 percent in early 2013.

Figure 2. Reserve Bank of Malawi base rate and commercial bank's lending rates



Source: Reserve Bank of Malawi, https://www.rbm.mw/Statistics/BankRates/, accessed January 10, 2020.

3. DATA AND METHODS

We analyze transaction level data from ACE's WRS from its establishment in 2011 to the 2018 agricultural year. Over this eight-year period, the ACE WRS issued 710 receipts for 9 commodities: beans, cow peas, groundnuts, maize, pigeon peas, popcorn, rice, soybeans and sunflower (Table 2). Maize, soybeans and pigeon peas were the commodities for which most WRs were issued, the most financing was released, and the highest volumes were deposited. These commodities will therefore be the focus of our subsequent analysis. 53 percent of all WRs issued by ACE were linked to financing, while the remainder were pure storage contracts.

Maize was the only commodity for which WRs were issued by ACE in every year between 2011 and 2018, with WRs for soybeans issued in every year since 2014 (Annex 1). Pigeon pea WRs were not issued until 2013 and have not been used since 2017 for reasons that will be explained later.

The main incentive to use WR for most depositors is to allow them to obtain collateral financing for commodities in store, which allows them to defer sales obtain higher prices when the commodities that are eventually sold. Collateral financing can take several forms and is facilitated by the availability of haircut finance from commercial banks and other financial institutions, with the size of the haircut (often 70 or 80 percent) linked to the perceived risk in storing the commodity. Of course, the higher prices and revenues obtained from deferred sales are not assured and must be offset against the storage, financing and other costs incurred.

Table 2. Number of warehouse receipts issued by commodity (2011–2018)

Commodity	Total number of WRs issued	WR with financing	Total volume (MT)
Maize	464	252	8,429.4
Soybeans	136	63	2,246.1
Pigeon peas	84	52	1,139.4
Groundnuts	7	0	32.9
Beans	8	5	87.2
Cow peas	6	3	34.9
Other	4	3	14.7

Source: Author's calculations from ACE data (2011–2018).

Note: WR = warehouse receipt; MT = metric ton; 16 WR issued for repayments of soybeans in 2017 under the ACE Chithumba model (which involves in kind repayments at harvest time for inputs) have been excluded from this analysis. Other include rice, sunflower and popcorn.

The percentage profit (loss), or return to storage, for each WR transactions may be calculated as:

$$\frac{Percentage\ Profit\ (Loss) = (Sales\ value\ after\ storage - (Sales\ value\ before\ storage + Costs))}{Sales\ value\ of\ commodity\ before\ storage}$$

Storage costs here comprise physical storage costs, financing, commissions and other lien. Physical storage costs may include bagging, cleaning, sorting, and weighing on arrival of the commodity at a warehouse, daily, weekly or monthly storage charges, and fees for discharging. Financing costs include the bank interest and arrangement fees, which are also referred to as processing fees. The costs of collateral management are typically also included in financing costs as commercial banks typically require a collateral manager to be employed at the time a WR loan is taken-out (Baulch et al. 2018b). Commissions are the money that ACE makes for finding a market for a client therefore for trade facilitation. Other lien comprise of other costs incurred such as transportation costs, broker commission and seed costs.

4. RESULTS

Table 3 shows the types of depositors that used the ACE WRS between 2011 and 2018. Large traders (including one processor) took out both the largest number of receipts and deposited the largest volumes, particularly for maize. In terms of volumes deposited, this was followed by medium traders, small traders, farmers associations/groups (including formally constituted cooperatives), and then farmers. Larger traders tended to store, on average, for the longest duration, followed by medium and small traders. However, farmers ─most of whom are medium to large scale farmers in the Malawian context ─took out the third largest number of WR contracts and stored for longer periods than farmers associations.

Table 3. Warehouse receipts by type of depositor

Depositor Type	Number of WR	Maize	Pigeon peas	Soybeans	Mean Storage Duration (days)	Total Volume (MT)
Large Trader/Processor	194	135	20	28	300	8,048.3
Medium Trader	128	83	20	22	255	1,435.1
Small Trader	189	126	23	36	222	1,315.0
Farmer Associations/Groups	63	30	11	16	142	597.4
Farmers	136	90	10	35	199	588.8

Source: Author's calculations from ACE data (2011–2018).

Note: WR = warehouse receipt; MT = metric ton.

Table 4 presents the mean and median volumes deposited in metric tons for each commodity according to the frequency of deposits. Just over half of WRs (376 out of 710) were issued to multiple depositors, while the remaining 334 were made by depositors who only used WRs once during the eight-year period. Apart from soybeans, firms/organizations who made multiple deposits over the years tended, on average, to make larger volume deposits than those who only made single deposits. For multiple depositors, average volumes stored were 23.8 MT for maize, and 18.3 MT for pigeon peas. Among one-time depositors, soybeans were deposited in the largest average volume of 29.2 MT followed by maize and soybeans, with average volumes of 12.5 MT and 8.4 MT, respectively. The differences between the mean and median volumes stored shows of the large variation in volumes deposited per WR.

Table 4. Volumes (MT) stored by frequency of deposit

	Multiple Depositor		One-off Depositor	
Commodity	**Mean**	**Median**	**Mean**	**Median**
Maize	23.8	12.2	12.5	5.1
Soybeans	6.8	4.6	29.2	1.5
Pigeon peas	18.3	5.2	8.4	4.0

Source: Authors' calculations from ACE data (2011–2018).

Note: MT = metric ton.

Table 5 and Figure 3 show the distribution of profit/loss percentages for maize, pigeon peas, and soybeans taking into account storage, financing, and other costs. While the mean profits to storage of maize using ACE WR are positive, those for pigeon peas and soybeans are negative. Furthermore, the medians suggest that the majority of WR holders for pigeon peas and soybeans made losses. Furthermore, as can be seen from the minimum and maximum, the range of profits is highly variable ranging from profits of 189 percent to losses of 148 percent in the case of pigeon peas. This is a function of both the duration of storage and the high cost of financing in Malawi.[4]

[4] Between 2011 and 2018, the base lending rate in Malawi varied between 16 and 39 percent per annum (World Bank 2019). Furthermore, the intermediation margin between borrowing and lending rates is high, meaning that holders of WR who took haircut financing paid between 25 and 42 percent per annum in interest for these loans.

Table 5. Distribution of profits/losses to warehouse receipts

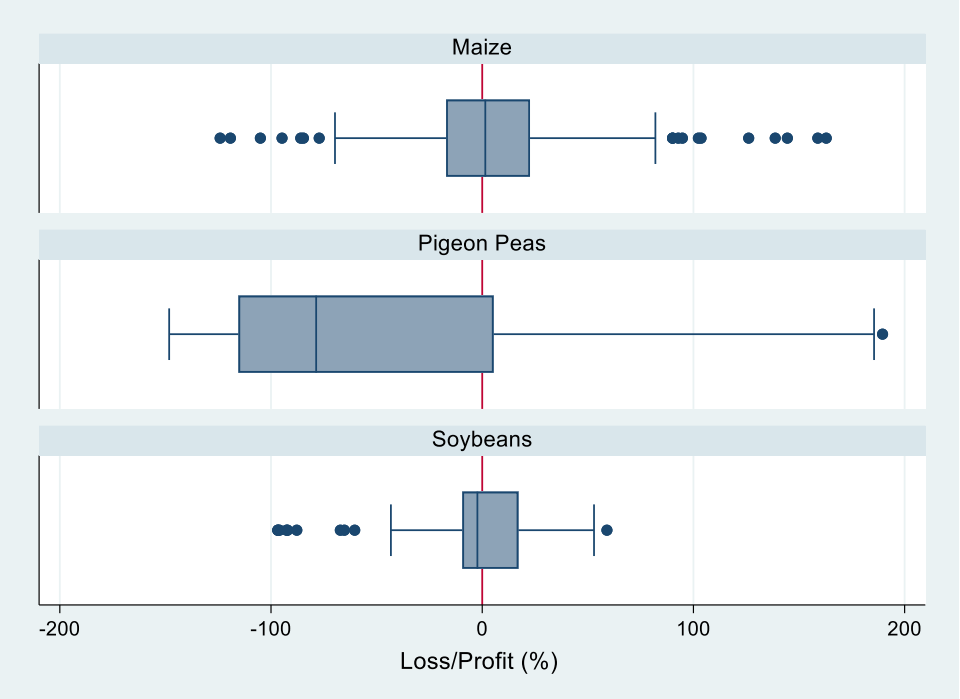
	Profits/Loss				
Commodity	Mean	Median	Minimum	Maximum	Number of WR
Maize	4.2%	1.5%	-124.1%	162.9%	464
Pigeon peas	-43.9%	-78.6%	-148.2%	189.5%	84
Soybeans	0.0%	-2.3%	-96.8%	59.0%	137

Source: Authors' calculations from ACE data (2011–2018), weighted by amount stored per WR.

Note: WR = warehouse receipt.

Figure 3 presents a boxplot of the percentage profits and losses made by WR depositors regardless of whether they took haircut financing. The box plot shows how the profits and losses are distributed, with the red vertical line at zero showing the breakeven point.

Figure 3. Distribution of profit/loss to storage by commodity



Note: Authors' construction from ACE data (2011–2018).

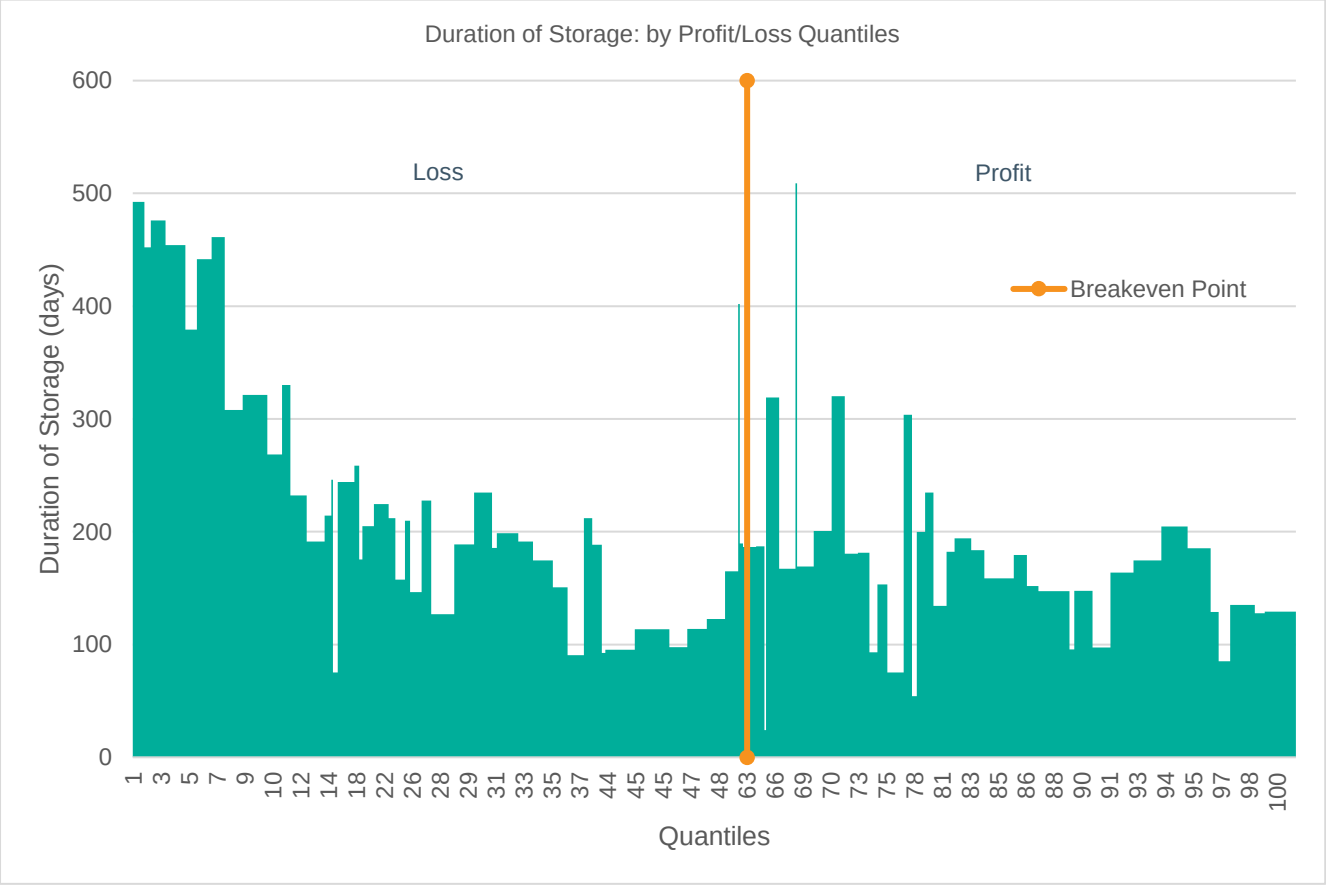
As shown in the first panel, for maize the profits and losses are evenly shared—with 52 percent of depositors making profits and the remainder making losses. This can be seen by the median line in the box falling just to the right of the red breakeven line.[5] Both ends of the distribution contain outliers, with seven WR making profits of over 100 percent while three WR made losses of more than 100 percent. For pigeon peas in the second panel, 73 percent of all warehouse receipts issued resulted in losses. However, most of the top 25 percent of depositors appear to have done well with seven WR making profits in excess of 100 percent. On the other hand, 30 WRs for pigeon peas made losses in excess of 100 percent. The bottom panel shows that soybeans profits and losses are less dispersed than those for maize and pigeon peas. Nonetheless, 53 percent of soybean WRs made losses with 9 of these incurring losses of more than 50 percent.

[5] Boxplots consist of a box and two tails. The box shows the range of the middle 50 percent of a variable's distribution. The horizontal line inside the box shows the median. The tails show 1.5 times the width of the box (the interquartile range) with extreme data points (outliers) shown as dots to their left and right.

Figure 4 illustrates the relationship between how long a commodity is stored and the profit/loss made. To construct this figure, the 710 warehouse receipts issued by ACE were grouped into 100 equal groups (quantiles) depending on the profit/loss percentage each WR made. The 1st quantile shows the WRs which made the largest losses, while the 100th quantile represents the WRs which earned the highest percentage profits. The vertical red line at 63rd quantiles shows the breakeven point, which divides WRs which made losses from those which made profits. Of the 710 warehouse receipts that were issued by ACE between 2011 and 2018, 339 (48 percent) yielded a profit.

The general downward trend in Figure 4 tells us that those depositors who made profits (or smaller percentage losses) generally stored their commodities for shorter durations. WR which earned profits had an average storage duration of 168 days, while those which made losses had an average duration of 224 days. Storage of maize and soybeans were generally only profitable if the WRs were held for less than 180, while pigeon pea WRs were profitable when held for less than 90 days or between 181 and 270 days. Further details of the returns to storage by commodity using 90-day storage intervals, and a year by year breakdown of the returns to storage using are provided in the Annex.

Figure 4. Average duration of storage by profit/loss quantiles



Source: Authors' calculations from ACE WR data (2011–2018).

Returns to WRs naturally depend on whether or not WR financing was taken at the time of deposit, as well as the duration of storage. Table 6 shows the mean and median profits/losses from ACE WR by commodity with and without financing. Of the 385 WRs issued with financing, only soybeans made profits on average. Mean and median profits for WRs for soybeans were 6.5 and 11.5 percent, compared to losses of 7.4 and 6.2 percent for maize. Pigeon peas showed the highest losses

at 81.5 and 115.8 percent and had the longest mean duration of storage (361 days). Almost 64 percent of soybeans WRs with financing made profits, compared to 54.4 percent for maize and just 21.2 percent for pigeon peas.

A total of 299 WR were taken without financing. When financing was not taken, WRs for maize and soybeans earned profits on average with maize earning higher mean and median profits than for soybeans. 49 percent of maize WRs without financing earned profits, compared to 37.5 percent for pigeon peas and 32.9 percent for soybeans.

Table 6. Profits/losses to warehouse receipts with and without financing

Commodity	Number of WR	Profit/Loss		% of WR earning profits
		Mean	Median	
With Financing				
Maize	270	-7.4%	-6.2%	54.4%
Pigeon peas	52	-81.5%	-115.8%	21.2%
Soybeans	63	6.5%	11.5%	63.5%
Without Financing				
Maize	194	14.2%	5.6%	49.0%
Pigeon peas	32	-7.8%	-0.8%	37.5%
Soybeans	73	0.1%	0.0%	32.9%

Source: Authors' calculations from ACE data (2011–2018), weighted by amount stored per WR.

Note: WR = warehouse receipt.

4.1. Storage Rules

The preceding analysis suggests that many WR depositors store for much longer periods than seem advisable given the storage costs, including financing, incurred. Given that depositors are interested in making profits, we have therefore developed some hypothetical storage rules using information on the most common months of deposit and sale of WR, along with our own market knowledge. These storage rules attempt to mimic the typical profits/losses that would accrue to storing in certain months following the main harvest and selling in later months towards the end of the market season. We also analyze a hypothetical storage rule for farmers groups/associations, in which they sell half their surplus production soon after harvest (to meet their immediate cash needs) and deposit the other half using a WR without financing to sell later when prices are higher. It should be noted from the outset that these storage rules do not guarantee a profit due to the inherent volatility and thinness of agricultural markets in Malawi. Furthermore, if all storers were to adopt these rules, the rules would become self-defeating.

Table 7. Storage rules

Storage Rules	With WR Financing				Without WR Financing			
	Number of WRs	Profit/Loss		% of WRs earning profits	Number of WRs	Profit/Loss		% of WRs earning profits
		Mean	Median			Mean	Median	
Maize								
June to September	9	-23%	-44%	11%	2	-49%	-64%	0%
June to November	2	9%	2%	100%	2	-3%	-3%	0%
July to December	18	3%	6%	44%	5	-19%	-27%	0%
July to January	17	-17%	-11%	59%	2	-49%	-39%	0%
July to March	5	-1%	14%	80%	6	-7%	-16%	17%
August to December	15	24%	13%	67%	3	14%	12%	67%
August to January	52	20%	23%	96%	6	53%	-21%	50%
August to March	4	7%	7%	75%	9	7%	-31%	22%
Soybeans								
May to September	11	13%	14%	73%	0	0%	0%	0%
May to October	8	28.20%	26.90%	87.5%	0	0%	0%	0%
June to September	12	22.30%	20.90%	100%	0	0%	0%	0%
June to October	4	41.00%	48.90%	100%	0	0%	0%	0%
July to August	0	0%	0%	0%	22	2.40%	-2.80%	18.20%
Pigeon Peas								
July to November	9	-123.60%	-124.50%	0%	0	0%	0%	0%
August to November	9	-114.20%	-115.10%	0%	0	0%	0%	0%
August to December	9	-117.30%	-116.10%	0%	0	0%	0%	0%

Source: Authors' calculations from ACE data (2011–2018), weighted by amount stored per WR.

Note: WR = warehouse receipt.

Table 7 shows that most WR depositors store maize in June, July or August and then sell their WRs in September, December, January, or March. The August–January storage rule had the most WRs issued, with these 52 receipts yielding the depositor an average profit of 20 percent after the cost of storage are taken into account. 96 percent of depositors who followed this storage rule earned profits from their WR. In contrast those who stored maize in July generally made losses. Somewhat surprisingly, a market driven storage rule of storing when maize prices are lowest in June and selling in February at the peak of the lean season, yielded no corresponding WR. This may be due to the fact that maize in Malawi is mostly sundried, and large traders are often reluctant to purchase maize until its moisture content is below 12.5 percent.

Storers of soybeans tend to deposit between May and July but also tend to store for shorter periods than maize depositors. Table 7 shows that most soybean depositors who took financing earned profits, with the highest profits earned by those who stored between June and October. However, a large number of WRs were also taken without financing for the July–August period and of these only

18 percent made profits. The four main processors of soybeans in Malawi are known to have a regular demand for soybeans but only use WRs to supplement their own storage capacity in the immediate post-harvest season (Baulch et al. 2018b).

Pigeon peas, which are mostly produced in southern Malawi, have a different seasonality from maize and soybeans. They are typically harvested in the winter months and deposited in July and August for sale in November or December. As shown in Table 7, all WRs for pigeon peas took financing and resulted in substantial losses to the depositors. This is linked to the collapse of the pigeon pea market in 2016 and 2017 following an exceptionally good Indian harvest in 2016, and the imposition of import quotas by India in August 2017. These events effectively locked Malawi out of its main export market for the crop and led to a dramatic decline in pigeon peas prices (from MWK650/kg in May 2016 to MWK265/kg in May 2017, and less than MWK110/kg after August 2017). It is possible that the sharpness of this price drop led many depositors to hold on to their pigeon pea stocks in the hope that prices would rise again. However, as pigeon pea prices did not recover until 2019, all of these WR made substantial losses. Pigeon pea depositors in 2016/17 stored for an average of 353 days with more than half of depositors storing their produce for more than 451 days.

Finally, we consider a hypothetical storage rule in which the 21 farmers' associations/groups who took out WR financing, instead sold half their surplus production soon after harvest (to meet their immediate cash needs) and deposited the other half using a WR without financing to sell later when prices are higher. The rationale behind this storage rule is to reduce the storage and financing costs associated with WRs while allowing the association/group to benefit from intra-annual price rises. As there were limited numbers of WRs with financing issued to farmers' associations/groups, it is inadvisable to apply this hypothetical storage rule to each commodity. However, the hypothetical storage rule applied to maize, pigeon peas, and soybeans together involved an average storage duration of 197 days and generated mean and median profits of 12 and 22 percent respectively, with 81 percent of WR earning profits (Table 8). By contrast, mean and median returns for the same 21 contracts with WR financing, were -4 and -7 percent respectively, with 57 percent of WR with financing earning profits.

Table 8. Hypothetical 50:50 storage rule for farmer's associations/groups

Scenario	Number of WRs	Profit/Loss		% of WRs earning profits
		Mean	Median	
Hypothetical storage rule	21	12%	22%	81%
With warehouse receipt financing	21	-4%	-7%	57%

Source: Author's calculations from ACE data (2011–2018).

Note: WR = warehouse receipt.

5. SUMMARY AND POLICY IMPLICATIONS

This paper examines who uses and who benefits from WRS using unique transaction level data between 2011 and 2018 provided by ACE.

Between 2011 and 2018, the ACE warehouse receipt system was used 710 times, with most receipts issued for deposits of maize, pigeon peas and soybeans. An inverse relationship exists between the duration of storage, the cost of financing and the returns for ACE warehouse receipt depositors. Storing maize and soybeans for less than 180 days generally resulted in a depositor making a profit, while storing pigeon peas for less than 270 days generally resulted in profits. However,

because of their longer duration of storage 73 percent of WR issued for pigeon peas made losses compared to 48 percent for maize and 53 percent for soybeans. This was linked to the collapse of pigeon pea exports and a fourfold decline in maize prices in 2016/17.

Collateral financing was only taken by just over half of ACE's WR depositors. Of the 53 percent of WR issued with financing, only storers of soybeans made profits on average. In contrast, for WR issued without financing both maize and soybeans made profits on average. This is a direct consequence of the high cost of financing, which in turn reflects the high level of base interest rates and the intermediation margins charged by commercial banks. Nevertheless, it is known that financial institutions who participated in WR financing in the 2016–2017 period incurred substantial financial losses (Baulch et al. 2018b).

We analyze alternative storage rules with the aid of seasonal price patterns and an analysis of depositors' behavior. These rules suggest possible combinations of deposit and sale months that can be used by depositors to guide within year storage decisions. For cash constrained farmers' associations/groups, a viable storage rule appears to be to sell half of stocks soon after harvest placing the other half in a WR without financing. However, it must be noted that this and other storage rules do not guarantee a profit due to the inherent volatility and thinness of agricultural markets in Malawi.

Our findings indicate four wider implications that should be considered by WRS elsewhere in Africa. First, financing costs can 'make or break' the viability of a WRS. With one of the aims of a WRS being to help facilitate trade financing, financing costs in excess of plausible prices increases lower the appeal to depositors of taking out warehouse receipts. Second, price stability within seasons is critical for companies/farmers' organizations to make informed storage decisions, and for financial institutions to advance finance. Within year price stability allows both depositors and financial institutions to accurately estimate intra-seasonal price changes. This helps depositors to know the optimal duration to store a commodity factoring in the costs that they will incur and helps reduce financial institutions' risks. Third, communications with stakeholders about the advantages and disadvantages of WRS is crucial. WRS providers need to ensure that stakeholders are well informed on the services that they provide and the access to finance their WR gives them. Explaining the benefits as well as the drawbacks of using the WRS for storage as well as financing could help WRS providers reach a broader range of stakeholders, not only farmers' organizations and traders but also small to large farmers. Finally, as the experience of thinly traded WRS elsewhere in Africa south of the Sahara shows, legislation and enabling business environment are crucial to the 'take-off' of WRS. In this regard, Malawi is in a favorable position with the passage of the Warehouse Receipt Act in late 2017 and the implementation of the Commodity Exchange Directive in April 2019. However, Malawi's business enabling environment, while improving according to the World Bank, is still problematic especially in the agricultural sector (World Bank 2019). Confidence, trust, and understanding of the operation of WR and WR financing are also still lacking in Malawi, and the volume of trade is too low to allow the ACE WRS to function as a fully commercial entity.

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ANNEX

Table A 1. Profits/losses volume and number of receipts by year of storage

		With WR Financing			Without WR Financing		
Com-modity	Year of Storage	Profit for De-positor (%)	Total Volume Stored (MT)	Number of WRs	Profit for De-positor (%)	Total Volume Stored (MT)	Number of WRs
Beans							
	2015	17.5	48.8	2	0.0	0.0	0
	2016	22.3	15.1	3	-6.8	17.0	2
	2017	0.0	0.0	0	342.6	6.2	1
Cow peas							
	2016	-58.0	10.7	3	-51.3	8.3	2
	2017	0.0	0.0	0	-7.5	16.0	1
Groundnuts							
	2017	0.0	0.0	0	50.9	94.6	2
	2018	0.0	0.0	0	-14.8	24.5	5
Maize							
	2011	15.5	98.3	3	78.2	4.1	1
	2012	26.0	619.6	57	50.1	12.4	1
	2013	-24.4	1390.5	38	0.0	0.0	0
	2014	-5.4	3346.1	99	33.4	127.4	20
	2015	45.6	205.7	12	61.2	216.8	20
	2016	-24.3	996.3	60	3.8	808.1	100
	2017	-6.1	4.8	1	7.8	526.6	47
	2018	0.0	0.0	0	-0.5	102.1	5
Pigeon peas							
	2013	19.2	54.6	2	59.2	9.3	1
	2014	1.7	32.3	6	13.6	8.8	4
	2015	152.2	21.7	7	28.2	1.0	1
	2016	-105.3	558.2	37	-9.9	452.0	25
	2018	0.0	0.0	0	61.4	1.7	1

		With WR Financing			Without WR Financing		
Com-modity	Year of Storage	Profit for De-positor (%)	Total Volume Stored (MT)	Number of WRs	Profit for De-positor (%)	Total Volume Stored (MT)	Number of WRs
Soybeans							
	2012	-6.7	5.7	1	0.0	0.0	0
	2014	-0.5	12.6	3	0.0	1501.9	2
	2015	20.3	286.1	40	20.7	6.8	2
	2016	-16.4	163.2	20	-3.4	108.2	29
	2017	0.0	0.0	0	3.0	161.4	38
	2018	0.0	0.0	0	-7.3	5.1	2

Source: Author's calculations based on ACE data (2011–2018).

Note: WR = warehouse receipt; MT = metric ton.

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