Do Small Firms Partially Insure Customers from Price Increases? Evidence from Retail Firms in Tanzania

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Abstract

Price variation is a typical feature of markets in low- and middle-income countries. Retail firms that regularly stock food staples and other household commodities face substantial price variation when purchasing in wholesale markets. How much of this input price variation passes through to output prices for rural customers? I use a panel of firm-level wholesale and retail prices from 270 urban and rural retail firms in Tanzania to evaluate passthrough from input price shocks on staple food prices. Rural firms smooth both negative and positive input price shocks more than urban firms. Urban firms passthrough nearly 95% of input price increases, while rural firms passthrough only 55% of input price increases. Price adjustments are asymmetric; rural firms passthrough more cost savings and less cost increases, suggesting that rural customers enjoy partial insurance from negative price shocks. By exploring possible mechanisms, I find evidence that smaller community size among rural firms is associated with lower passthrough on negative price shocks. At the same time, distance to markets and competitive pressure matters as well - rural firms with more competitors and further from urban markets have higher passthrough rates, consistent with a competitive market framework with transaction costs.

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1 Introduction

Food price variation is a significant problem for households in rural areas of low- and middle-income countries. Prices vary seasonally throughout the year across markets and as a result of idiosyncratic cost shocks within markets, contributing to price volatility that affects both producers and consumers of staple foods (Fafchamps, 1992, Barrett, 1996 Boyd and Bellemare, 2020). Prior literature has considered how price uncertainty affects agricultural households as producers of staples foods, noting that many producers sell agricultural output when prices are seasonally low and buy at higher prices later in the year (Stephens and Barrett, 2011; Burke et al., 2019; Cardell and Michelson, 2023). Many rural households that produce food for their own consumption are nonetheless net-buyers of food staples over the course of a year (Barrett, 2010, Bellemare et al., 2022). Seasonal price variation lowers welfare for rural low income consumers who struggle to substitute to foods with the same nutritional quality (Green et al., 2013). Yet, price variation along the food retail value chain is relatively understudied.

Many rural households purchase food staples and other essential commodities from retail businesses located in their community. Small and microenterprises are run by agricultural households and operate with limited access to capital and storage capacity and high rates of entry and exit (McKenzie and Paffhausen, 2019). Seasonal price variation generates price uncertainty that leads to frequent wholesale price shocks for small firms. How much input price variation passes through to output prices for rural customers? Does it vary based on whether a firm operates in rural area or an urban area? And what mechanisms explain differences in pricing behavior? If markets were perfectly competitive, classical economic theory predicts that firms would perfectly passthrough input price increases and decreases. In practice, passthrough rates are often asymmetric and depend on whether input prices increase or decrease, as demonstrated by empirical work on US and European markets (Borenstein et al., 1997; Peltzman, 2000; Bonnet and Villas-Boas, 2016; Benzarti et al., 2020).

I examine retail passthrough rates of wholesale price shocks among rural and urban firms in Tanzania to understand how passthrough affects local food affordability. I depart from earlier studies that rely on consumer data by instead focusing on self-reported input and output prices of small firms that sell staple foods in rural and urban areas. I use a panel of input and output prices for 105 urban and 166 rural retail firms to evaluate passthrough from input price shocks on staple foods sold in urban and rural areas. Analysis focuses on retail firms that sell relatively undifferentiated food commodities - rice, beans, sugar, maize flour, and maize grain - which constitute the primary food staples in many Tanzanian diets. These small retailers purchase goods and re-sell them without adding value beyond transporting them to rural locations. My analysis proceeds in three steps. First, I establish asymmetric passthrough patterns pooling urban and rural firms. Second, I examine heterogeneity by urban and rural firms. Third, I explore mechanisms by examining how distance to wholesale markets, community population size, and the number of competitors explain differences in passthrough rates among rural firms. I also compare common pricing strategies of rural and urban firms to understand how firms' pricing behavior relates to passthrough decisions. Finally, I examine mark-ups to assess whether rural firms charge a premium to compensate for price smoothing behavior.

I first document that retail output prices are sensitive to changes in input prices and that firms pass on cost savings to a greater extent than higher costs. Across urban and rural firms, a one percent increase in input prices is associated with a 0.62% increase in output prices and a one percent decrease in input prices is associated with a 0.84% decrease in output prices. In unpacking heterogeneity among rural and urban firms, I find that rural firms have lower passthrough rates than urban firms following input price increases and marginally higher passthrough rates following price increases. This pattern suggests that rural firms smooth price increases more than urban firms which is akin to providing partial insurance for price risk. Rural firms passthrough 53-55% of input price increases and 81-86% of input price decreases while urban firms passthrough nearly 87-95% of price increases, and 74-80% of price decreases.

The difference in passthrough for price increases is economically meaningful. If both urban and rural firms experience a 10% input price increase, the average urban firm would increase output prices by 8.7-9.5%, while the average rural firm would only increase prices by 5.3-5.5%. In Tanzania, the daily value of consumption of staple grains is $1 per day.[1] A back-of-the-envelope calculation of these price differences shows that a rural individual could afford 1.35 more days of staple foods following a price shock that lasts one month with this rate incomplete passthrough. If rural firms help smooth price risk, do they charge a premium for this service? The average mark-up on staple foods for rural firms is 4-6 percentage points higher than urban firms, but once controlling for distance to input markets, the difference drops to 1-2 pp and is not different from zero, highlighting that rural firms do not have higher average markups beyond that which is explained by transportation costs.

[1] World Bank Food Prices for Nutrition. https://databank.worldbank.org/source/food-prices-for-nutrition

What explains differences between urban and rural firms pricing behavior? Market conditions for urban and rural firms differ for a number of reasons. I define three market-level mechanisms to understand how passthrough rates vary with different features of rural communities. These market mechanisms include distance to the nearest city, village population size, and number of competitors. Distance reflects additional transaction costs incurred by transporting goods to rural areas, population size captures features of small communities, such as having more social ties, and the number of competitors reflects differences based on competitive pressure. These variables are constructed as z-scores and are included in the same regression so that the magnitudes of the point estimates are directly comparable.

Firms in smaller communities have 12-13% lower passthrough rates for staple foods than firms in larger rural communities following input price increases. Firms with higher travel distance to urban centers passthrough roughly 10% more input price increases, suggesting that they compensate for higher transportation costs by passing through a higher share of cost shocks. Competitive pressure pushes firms toward more complete passthrough. For firms with more competitors, input price increases are marginally associated with higher passthrough rates; firms passthrough 8-12% of input price increases.

Higher passthrough due to travel costs and competition is consistent with economic frameworks of competition and transaction costs. The robust and consistent result about the relationship between passthrough and community size is less grounded in standard economic theory. It does, however, relate to the literature about the importance of social ties in market transactions and community risk-sharing. Smaller community size is associated with more pro-social behaviors since agents are more connected via social ties (Allcott et al., 2007). Tighter social ties in rural communities can act as a type of informal insurance where community members help each other when someone in their kinship network experiences a financial shock (Townsend, 1994; De Weerdt and Dercon, 2006; Kinnan and Townsend, 2012; Breza et al., 2019; Kinnan et al., 2021). Given that many village risk-sharing arrangements concern the exchange of gifts, money, labor, and other types of support, it is reasonable to expect rural firms would participate in informal insurance regimes by bearing more staple price risk by not fully passing on input price increases. Small firm behavior often deviates from the standard concept of individual firms competing as independent entities in markets; firms appear collusive to lower exit rates (Banerjee et al., 2022), coordinate to rent machines to one another (Bassi et al., 2022), and their asset endowments affect their bargaining power (Hardy et al., 2022).

This paper contributes to literature on how competitive structure in food and goods markets affects the distribution of prices, passthrough, and consumer welfare (Weyl and Fabinger, 2013; Dillon and Dambro, 2017; Bergquist and Dinerstein, 2020; Casaburi and Reed, 2022; Genakos and Pagliero, 2022). Results about differences between urban and rural markets are consistent with Atkin and Donaldson (2015) who show that mark-ups are lower than expected in rural markets compared to urban markets because demand is more elastic as prices rise. Higher transaction costs in rural areas are also associated with worse road quality and higher information frictions which raise the cost of learning about new market information, including changes in prices (Minten and Kyle, 1999; Allen, 2014; Aggarwal et al., 2018). This paper adds to the literature by using firm data to test different mechanisms to understand how elasticities differ within rural areas and between urban and rural markets.

This paper also connects the literature on diet affordability in low and middle income countries with a literature on asymmetric price passthrough in the US and Europe. Asymmetric passthrough rates in rural areas of Tanzania go in the opposite direction of estimates from high income countries which show that passthrough rates are often *higher* or update more quickly, and are therefore are less favorable to consumers, following input price increases (Borenstein et al., 1997; Peltzman, 2000; Benzarti et al., 2020). In Tanzania, seasonal price variation increases diet costs by 6% and decreases consumption of more nutritious foods, as households substitute away from nutritious vegetables in favor of high-calorie staples (Bai et al., 2020). At their peak, maize and rice prices are two to three times higher than in international markets and are associated with lower total caloric intake of all foods among poor households in rural and urban areas (Kaminski et al., 2016, Gilbert et al., 2017).

Primary results rely on self-reported input and output prices. However, results are generally corroborated when using instrumental variables to predict price shocks using wholesale prices from markets around Tanzania. Main results are also robust to constraining the sample to input prices with at least one exact match to ensure that there is a common support in the distribution of input price shocks. I also provide descriptive evidence about differences in pricing strategies - such as setting discounts and providing credit. Rural firms are more likely to provide credit for their customers, but urban firms are more likely to offer price discounts. Taken together, these price strategies do not explain a large portion of urban-rural passthrough differences. In additional analysis, I show that rural firms have lower passthrough rates than urban firms on non-staple commodities (e.g. soda, water, and medicine) but that prices do exhibit the same asymmetry as food staples.

The paper is structured as follows: First, I describe how different features of markets (demand, transaction costs, competition) could affect pricing behavior among rural and urban firms. Second, I characterize the data used in the analysis and describe price variation in Tanzanian staple food markets. Next, I share the empirical approach, identification assumptions and results. Finally, I describe robustness checks that are included in the appendix and provide an conclusion.

2 Passthrough in Urban and Rural Markets

The structure for urban and rural markets differs based on a variety of factors that could affect passthrough and pricing behavior. Three types of factors are explored: 1.) Features of the customer base and demand, 2.) Transaction costs and information frictions, and 3.) Number of competitors.

2.1 Features of the Customer Base and Demand

A firm's customer base has different aggregate demand and demand elasticities depending on whether it is located in an urban or a rural market. By virtue of being located in populous areas, urban firms have a larger pool of potential customers compared to rural firms that operate in small and medium sized rural towns. Urban firms rely on a steady stream of urban-based customers that are less likely to engage in farming and more likely to have regular incomes, leading to overall more consistent demand. By contrast, rural firms have smaller customer bases whose cash income is irregular. Many rural customers engage in agricultural production, which leads to seasonal changes in demand for foodstuffs purchased from retailers (Barrett, 1996). With relatively low and unstable income compared to urban customers, it is reasonable to expect rural customers to have higher price elasticity of demand and to be more sensitive to price changes compared to urban customers.[2]

Another important element of the customer base is the extent to which buyers and sellers engage in anonymous transactions or build relationships with customers. Smaller community size

[2] Using panel data from Tanzania, Rudolf (2019) finds an own-price elasticity of demand for maize to be more elastic in urban areas compared to rural areas (with estimated elasticities of -.475 and -.167, respectively), arguing that urban households have greater ability to substitute to different foods if maize prices increase. Ecker and Qaim (2011) use data from Malawi and find own-price elasticities for maize that are relatively lower in urban compared to rural areas (-.722 and -.877, respectively) and rural areas have higher elasticities for 14 out of 23 foods tested. This aligns with studies that use meta-analysis research designs to compare own-price elasticities across countries which generally find that own-price elasticities for foodstuffs are higher in lower income settings (Green et al., 2013; Muhammad et al., 2015; Muhammad et al., 2017). Rudolf also finds higher elasticities for the rural poor compared to urban poor as does Boysen (2016), using Uganda data. Therefore, relatively higher own-price elasticity of demand for staples in rural areas is a reasonable assumption.

is associated with more pro-social behaviors since agents are more connected via social ties (Allcott et al., 2007). Given the smaller customer base from a small population, rural firms are more likely to be familiar with their customers and may face community pressure to keep prices low. In the rural firms survey, 82% of rural firms said most of their customers come from their village and 29% of rural firms indicated that they did not transact with any unknown customer over the previous week. Of course, urban firms also build relationships with their customers. But by virtue of living in cities, they have a higher probability of transacting with unfamiliar customers compared to firms in rural markets. In other settings, tighter social ties in rural communities can act as a type of informal insurance where community members help each other when someone in their kinship network experiences a financial shock (Breza et al., 2019; Kinnan et al., 2021; De Weerdt and Dercon, 2006).

Rural firm owners may not think of themselves as vehicles for partial insurance that defend their customers from staple price increases. Instead, it may be that social obligations encourage firms to limit price increases for their customers. In this context, it may be the profit-maximizing strategy for small firms because they build long-run relationships with repeat customers, a strategy that shares features with relational contracts which are common in low and middle income settings (see Macchiavello, 2022 for a review).

2.2 Transaction Costs and Information Frictions

In addition to being more familiar with customers with higher elasticities of demand, rural firms are located in remote locations. As a consequence, they pay additional transaction costs associated with sourcing inputs from cities and transporting them to rural areas to sell. To compensate for higher transaction costs, the unconditional average mark-up on staple foods for rural firms is 19% compared to 15% for urban firms. As road quality worsens further from urban areas, travel costs per distance travelled to source inputs increases for rural firms. After controlling for distance to urban centers and sourcing locations, the difference in markups shrinks to 1-2 percentage points. Despite longer distances and worse road quality, rural firms have lower markups than expected given their higher transaction costs (Minten and Kyle, 1999; Atkin and Donaldson, 2015). Higher transportation costs are also associated with higher information frictions which raise the cost of learning about new market information (Allen, 2014). As a result, rural customers would be slower to update price expectations following a price shock.

2.3 Number of Competitors

Despite higher and more stable aggregate demand, urban firms operate in markets with more competitors, defined as the number of firms in a market that sell the same types of goods (dry-goods stores and cereals/grains sellers). Urban firms in staple food sectors in this sample have an average of 5.4 competitors, while rural firms that sell staple foods have 3.7 competitors. As a share of other firms, staple foods sellers make up 33% of all firms in urban markets and 18.4% of firms in rural markets. The higher number of competitors generates pressure on urban firms to deliver competitive prices. But, having many firms that sell similar products in the same location also facilitates information sharing if firms tacitly or explicitly agree to update prices collectively.

If markets were perfectly competitive, classical economic theory predicts that firms would perfectly passthrough input price changes to output prices. In the simplest model, input price increases and decreases are expected to symmetrically passthrough to output prices and is evidence of a more competitive market structure. As a result, passthrough rates are often used to evaluate market power of firms (Sumner, 1981; Genesove and Mullin, 1998). However, without additional assumptions about the curvature of a demand curve to establish local elasticities, passthrough rates alone are not sufficient to identify the competitive structure of markets (Bulow and Pfleiderer, 1983). Recent work by Genakos and Pagliero (2022) shows that passthrough increase with the number of competitors in isolate gasoline markets in Greece. The extent of market power among traders in crop markets is of particular interest for policymakers since selling agricultural production is a primary source of income for rural households. In maize markets in Kenya, Bergquist and Dinerstein (2020) show experimental evidence that maize traders passthrough rates are closer to a collusive model than a model of Cournot competition. By constrast, Casaburi and Reed (2022) show trader markets are highly competitive when purchasing cacao from growers in Sierra Leone.

In lieu of attempting to identify the competitive structure of markets to characterize market power, I compare whether variation in the number of competitors is associated with different passthrough behavior by rural firms and if those differences are consistent with a competitive market framework. If the number of competitors drives pricing behavior, passthrough rates should be sensitive to the number of firms operating in the same sector. Under a standard perfect competition framework, more competitors should be associated with higher passthrough rates as it decreases the ability of firms to uphold collusive agreements.

3 Data Sources and Variable Construction

3.1 Data

This study uses data collected from urban and rural firms who sold five common staple foods in Singida and Dodoma regions in central Tanzania in 2019-2020.[3] Rural firms' customer base are largely comprised of agricultural households that purchase foodstuffs and other household goods from local retailers. Rural firms travel to purchase business inputs in wholesale markets located in larger towns or urban centers.[4] Four rounds of survey data from 166 rural firms and three rounds of survey data from 105 urban firms were collected from 2019-2020.

3.1.1 Urban and Rural Firms

Markets are defined as either an entire rural village or a neighborhood in an urban center. There are 17 urban markets spread among 3 urban centers - 10 in Dodoma City, 4 in Singida City, and 3 in Manyoni Town. Dodoma has a population of 410,000 people and is the principal trading center for the region as well as the political capital of Tanzania. Singida City is the capital of Singida region and has a population around 150,000. Manyoni Town is a medium-sized trading center with 25,000 people. Urban centers were identified after establishing Singida and Dodoma as target regions. Figure 1 shows these regions in Tanzania and the locations of urban markets (dark blue dots) and rural markets (light blue dots).[5]

Rural markets comprise relatively large rural villages (*vijiji* in Tanzania administrative classification) with populations between 3,000 and 10,000. Twenty five rural markets were randomly selected among the universe of villages with more than 3,000 people located between Dodoma City, Singida City, and Manyoni Town after stratifying on population, distance the nearest urban area, and region. In each rural community, all firms were invited to participate in an on-going project to provide a digital phonebook to rural consumers in Tanzania Dillon et al., 2020. Similarly, urban firms in each city were approached to participate in the project. About 82% of rural firms and 75% of urban firms decided to participate.

[3]Data includes the time period when the COVID-19 pandemic began but were collected before infection rates increased in Tanzania.

[4]Most households in this region grow maize and beans for consumption. At some points in the year, they may have more on hand then other points of the year. Dynamic consumer demand is not modeled but seasonal shifts would be absorbed by time fixed effects.

[5]The southern half of Singida region was not included because it contains only communities with small populations and overlaps with a large national park.

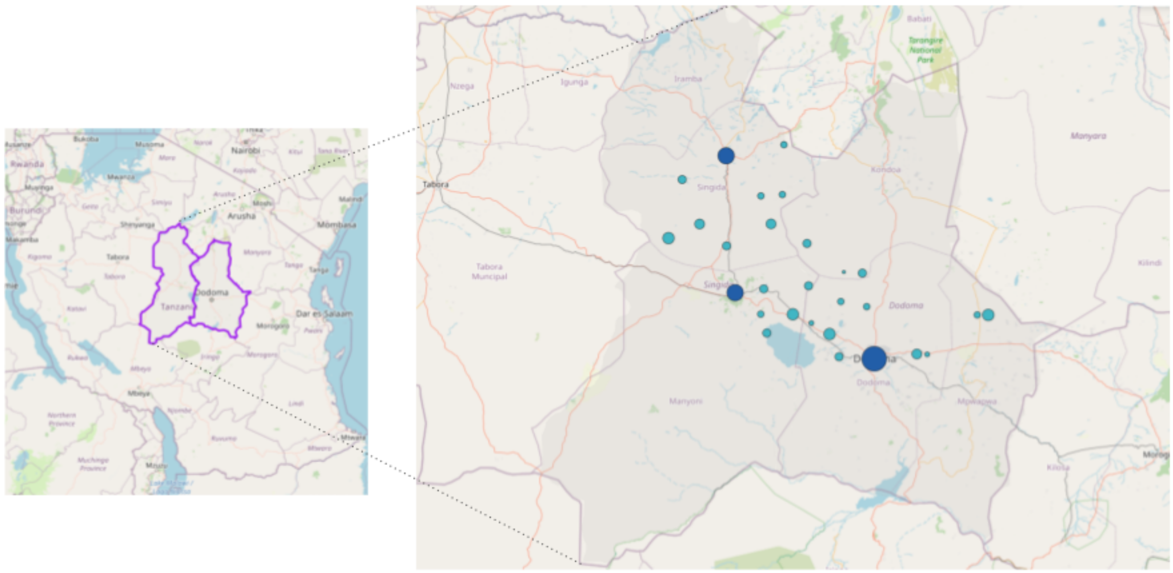

Figure 1: Location of surveyed urban markets (dark blue) and rural markets (light blue) in Tanzania

Table 1 displays summary statistics for urban and rural retail firms in the sample who sell staple foods. Urban and rural firms vary significantly in every dimension - urban firms are on average older, firm owners are older, they are almost eight times more likely to have hired any workers in the previous week. But, the modal urban firm has zero paid workers (43% hired any worker the previous week compared to 7% of rural firms). Rural firm owners are more likely to be women - 29% of rural retailers are women-owned compared to 18% of urban firms. Rural firms operate in villages with an average population of 4,690 people. The largest rural village in the sample has 10,000 people and the smallest has 3,200.

Urban firms sell to a mix of urban customers, rural customers that travel to buy for their households, and rural firms that travel to cities to purchase inputs to re-sell in their village. About 80% of rural retailers purchase inputs for inventory from urban areas and the remaining 20% re-stock inventories from other rural sellers. The average rural firm is located 62 kilometers from the nearest urban center - either Dodoma, Singida, or Manyoni. Rural markets have an average of 13 retail firms, of which 72% are staple food sellers. Urban markets have an average of 24 retailers, of which 44% sell staple foods.

Two measures provide information about the number of other sellers that firms compete with in their market. First, the self-reported measure of number of competitors is 9 for rural firms and 10 for urban firms. Second, the research team counted the number of competitors based on their assessment of which firms sell the same goods. For the census count measure, rural firms have an

Table 1: Urban and Rural Retail Firm Characteristics

Variable	(1) Rural Mean/SD	(2) Urban Mean/SD
Woman-Owned Firm	0.289	0.175
	(0.455)	(0.382)
Age of firm	5.907	7.782
	(6.075)	(10.615)
Owner age	37.717	40.949
	(11.129)	(10.158)
Years of education	6.886	8.137
	(2.722)	(3.610)
Any workers (0/1)	0.072	0.429
	(0.260)	(0.497)
Number of workers	0.145	0.714
	(0.596)	(1.199)
Village/city population	4690.916	289759.615
	(1251.053)	(163645.336)
Distance to urban center	61.976	0.000
	(30.738)	(0.000)
Number of retailers in market	13.277	23.924
	(5.969)	(13.856)
Number of competitors, self reported	9.024	9.712
	(4.726)	(5.095)
Number of competitors, census count	3.675	5.362
	(1.888)	(3.190)

Notes: Means reported for 166 rural firms and 105 urban firms. All means are significantly different at least 5% size except for the number of self-reported sales competitors which was not statistically different.

average of 3.7 competitors in their sector while urban firms have an average of 5.4 competitors.[6] The census count were defined to be mutually exclusive; if a firm sold both staple grains and fruits and vegetables, they would be categorized according to the product with the highest sales. In the self-reported measure, firms were asked "How many sellers in this market sell the same goods as you?" It provides a count based on a more flexible definition of other sellers and provides a measure of perceived competition by firm owners. Analysis in the remainder of the paper used census counts for competitors rather than self-reported measures.

[6]Census counts include firms that declined to participate in the larger project. In those cases, enumerators recorded firm sector information.

3.1.2 Firm Price Data

Firms were asked the most recent input and output price during each survey round. The sample of staple food items includes rice, beans, maize grain, maize flour, and sugar.[7] Retail firms were included in the sample if they reported these as commonly sold items in their stores. Food price units were converted to Tanzanian shillings per kilogram. These staple foods are included in the sample because they are relatively homogeneous, non-branded commodities that are sold by weight.[8] To anticipate possible changes in quality, firms were also asked if the quality of goods changed. Firms only reported any quality change for 2-8% of items each round, suggesting that changes in quality differentiation was not a major factor during the survey period.

Table 9 in the appendix shows descriptive statistics of input and output prices for staples foods. Average mark-ups in shillings range from 124 TSH for maize flour to 352 TSH for beans among urban firms and 109 TSH for maize grain to 403 TSH for sugar among rural firms. Rural firms charge higher mark-ups as a percentage of the input price for all goods except maize grain. Average percent mark-ups for rural firms range from 20% for maize flour and beans to 22% for maize grain. Average mark-ups for urban firms range from 6% for sugar to 19% for beans. Medians are included to highlight that the monetary denomination builds in some price stickiness. Most prices will change by 100 shillings at a time, sometimes 50 shillings, but rarely less than that, which is about \$0.02 to \$0.04 USD.

3.1.3 Wholesale Market Prices

The World Food Programme's Vulnerability Analysis and Monitoring (VAM) dashboard provides monthly price data for wholesale markets located throughout Tanzania for a selected set of food staples - maize grain, beans, rice, sugar, and wheat flour. Figure 5 in the appendix plots the average price in 6 markets in Tanzania for the 2019-2020 period that overlaps with the rural and urban firm data to illustrate that price shocks were relatively similar across markets. Prices for Dodoma are highlighted in red and the other markets are the 5 closest regional markets with monthly price series data. Wholesale prices from other regional markets are used as instrumental variables described in the next section. They also illustrate the extent of seasonal price variation that is common in

[7] The difference between maize grain and maize flour is that flour is processed and sold in bags with set quantities. Maize grain, on the other hand, is unprocessed and sold by the kilogram. Maize flour is the primary dietary staple. Most rural communities have maize mills where agricultural households take maize grain to grind into flour.

[8] In practice, there are different varieties of food crops, especially for rice and beans. To control for this during surveys, firms were asked prices for specific varieties that are most common in rural areas.

some commodity markets in this setting.

Table 2: WFP Prices for Staples from 2019-2020

	Mean Tsh/kg	sd	Coefficient of Variation (CV)	CV - Lowest Month	CV - Highest Month
Beans	1787.89	287.29	0.16	0.09	0.19
Maize	620.60	151.35	0.24	0.12	0.32
Rice	1666.19	207.19	0.12	0.08	0.19
Sugar	2625.91	257.66	0.10	0.06	0.16
Wheat flour	1381.68	187.51	0.14	0.09	0.21

One of the main drivers of input price variation faced by individual firms is seasonal price shifts of food staples throughout the country. Table 2 provides information about the extent of price variation for key staple foods from wholesale markets throughout Tanzania. It reports averages, standard deviations, and coefficients of variation for key food staples in wholesale markets. Coefficient of variation is a measure of price dispersion computed by dividing the standard deviation of a distribution by the mean, thus providing a measure of relative dispersion that is mean-invariant. The coefficient of variation varies from 0.10 for sugar to 0.24 for maize annually in urban markets in Tanzania. Under a normal distribution, it implies that about 68% of maize prices are between 24% below the mean and 24% above the mean and 95% of prices are within 48% below and above the mean (2 standard deviations). This pattern is similar in the survey data - the coefficient of variation for output prices for rice is 0.12, beans is 0.14, maize is 0.34, and sugar is 0.11. Within-month seasonal variation is more variable - ranging from 0.09 to 0.19 for rice in the lowest and highest month, 0.12 to 0.32 for maize, and 0.06 and 0.16 for sugar - due to the agricultural harvest cycles and seasonality in household income. This indicates that price dispersion changes quite a bit month-to-month - some months have tighter price distributions while others exhibit higher within-month variation.

The wholesale price data provide evidence that firms that source these food staples likely face different input prices month-to-month which would require them to update their output prices frequently. Figure 2 supports this using firm-level micro data. The figure is split into three panels according to the firms' input price change - no change, decrease, and increase. The bars within each panel report the share of output prices that remained the same, increased, or decreased. Of all input prices that decreased (middle panel), 68% of corresponding output prices also decreased. Of all input prices that increased (right panel), 77% of output prices also increased. However, some firms went against the grain - decreasing or increasing output prices in the opposite direction of the input price. It shows that firms frequently update prices and make decisions about how much to passthrough their input price shocks to their output prices.

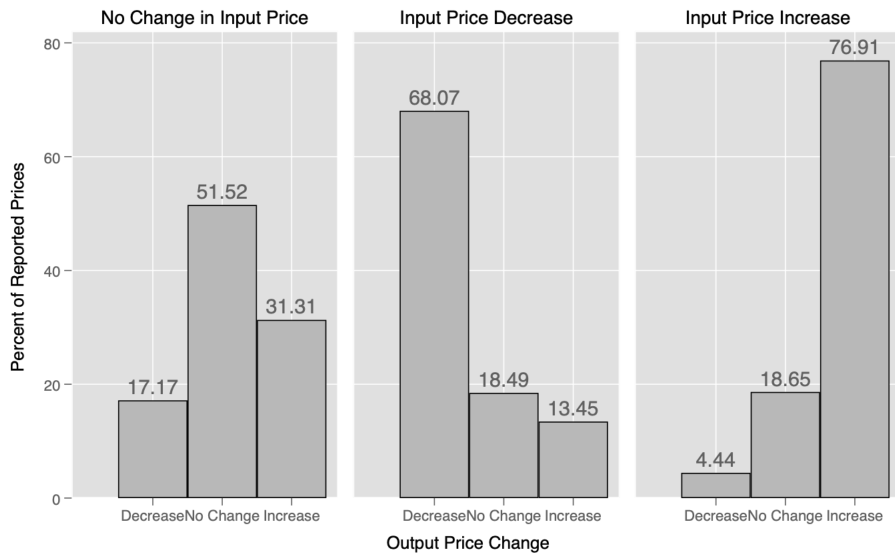

Figure 2: Share of reported output prices that increased, decreased, or remained the same by input price change

4 Empirical Approach

All firms in the sample are retail firms whose primary business activity is purchasing goods and reselling them at a mark-up. Firms' input prices are the wholesale price paid by the firm and the output price is the the marked-up price that firms charge their customers. Equation estimates passthrough rates as an elasticity using multi-way fixed effects with variation in 'treatment' timing, where the 'treatment' variable is a firm-level input price shock.

$$\begin{aligned} \Delta lnP^{output}_{ifmt} &= \alpha + \beta_1 \mathbb{1}\{Increase_{ifmt}\} \times \Delta lnP^{input}_{ifmt} \\ &+ \beta_2 \mathbb{1}\{Decrease_{ifmt}\} \times \Delta lnP^{input}_{ifmt} \\ &+ \gamma_i + \lambda_t + \mathbf{X}_{ifmt}\Phi + \epsilon_{ifmt} \end{aligned} \tag{1}$$

The primary outcome variable is the first difference of the logged output price of item i, for firm f, in market m, at time t. The 'treatment' variables for input price changes are defined as an indicator function set to one if the firm's input price for item i increased or decreased compared to previous survey round multiplied by the first difference of the logged input price. The coefficients of interest are β_1 and β_2 and are interpreted as elasticities that capture passthrough asymmetry depending on whether the firm experienced an input price increase or decrease.

Initial regressions include survey-round fixed effects, λ_t, to control for time invariant unobservables during each survey time period and would capture seasonal shifts in demand that are common across markets. First differencing the price variable is equivalent to de-meaning using dummy-variable fixed effects. Including item fixed effects, γ_i, in addition to first differences is like adding item-specific linear time trends to control for for item-specific changes over time. The term $\mathbf{X}_{ift}\Phi$ represents a vector of controls and includes a treatment dummy from the original experiment and a variable for market size at baseline. Standard errors are robust and clustered at the market level, permitting arbitrary within-market correlation. Results tables consistently report three versions of this specification with progressively more fixed effects - the first model includes time and item fixed effects, the second model adds market fixed effects, and the third model adds firm fixed effects. Market fixed effects will absorb fixed features of villages or markets that would co-determine price-setting tendencies of firms - such as distance to market, condition of village roads, and the time invariant component of demand. Firm fixed effects absorb time invariant firm-level preferences or ability.

4.1 Constructing Price Shocks

Two types of price shocks are used to characterize firms' passthrough rates. First, I construct firm-level input price shocks using self-reported input prices. Second, I use wholesale market prices from different whole markets as an instrument for input price shocks.

Firm Price Shocks: Firm price shocks are defined for each firm-item-time period as the difference between the input price in the current period minus the input price in the previous period as follows:

$$\begin{aligned} \Delta lnP^{output}_{ifmt} &= lnP^{output}_{ifmt} - lnP^{output}_{ifmt-1} \\ \Delta lnP^{input}_{ifmt} &= lnP^{input}_{ifmt} - lnP^{input}_{ifmt-1} \end{aligned} \tag{2}$$

If interpreted as a causal effect, the identifying assumption for firm price shocks requires strict exogeneity by assuming that conditional on common time-invariant unobservables at item, survey round, market, and firm levels, no other unobserved heterogeneity is correlated with the error term. Strict exogeneity assumes that shocks are temporary and decay rapidly across periods so that output prices in one period are uncorrelated with output prices in prior periods. Figure 2 above shows that most rural and urban firms update their output prices and experience changes in input prices each period, suggesting that cross-time correlation in prices is low.[9]

One threat to identification comes from the fact that firms endogenously select into the prices they pay for inputs. The prior section showed that price shocks occur across many markets at the same time, but there is still substantial variation within time periods. Firm-level price search decisions likely contribute to input price variation. Time-invariant firm preferences or strategies for making input purchases are absorbed by the firm fixed effects so that specifications that include firm fixed effects absorb static search and pricing preferences of owners. The strict exogeneity assumption is violated if firms change their search intensity over time by changing search costs to obtain inputs. To test the role of variation in search costs, I construct a search index from the rural firm survey that captures input search intensity. The search intensity index is constructed using three variables that capture search intensity: the number of suppliers that a firm communicated with, the number purchased from, and the number of different locations travelled during each survey round. It is a proxy for time-varying input search costs.

As a check on the feasibility of this assumption, Table 10 in the appendix reports results from regressions of the search index on the logged input price and the first difference of the logged input price with different sets of fixed effects - starting with survey round and item fixed effects in columns 1 and 4, and then adding market firm fixed effects in subsequent columns. Columns 1-2 report results after regressing logged input prices on the search index and show that firm search intensity is negatively correlated with input prices when controlling for item and market fixed effects. In other words, firms that search more tend to have lower input prices. However, after adding firm fixed effects, the relationship goes to zero, suggesting that firms have relatively time-invariant search strategies that do not change over time. Columns 4-6 uses the change in the input price as the dependent variable and shows that there is no relationship between search costs and input price changes over time.

Three models are estimated show how the inclusion of different fixed effects change results when

[9]This differs from settings where a treatment or invention is implemented at different time periods and assumed to persist in subsequent periods, as is common in other literatures that contemplate how to measure treatment effects using differences-in-differences or two-way fixed effects.

the dependant variable is defined using firm-level price shocks. The first model has item and time fixed effects. The second model adds market fixed effects to control for time invariant unobservables that are common within markets and would capture time invariant differences in local market institutions, market access, and remoteness. The third model adds firm fixed effects. However, because strict exogeneity is a strong assumption for causal interpretation, I'll refer to results as associations. Preferred results use firm price shocks rather than instrumented price shocks because they better reflect firm-level price variation and measure revealed passthrough rates averaged over firms.

Instruments using Wholesale Price Shocks: An alternative way to construct price shocks utilizes monthly wholesale price data from the World Food Programme as instrumental variables for individual firm shocks, similar to Hausman (1996) and Nevo (2001). Since individual firm price shocks are subject to endogenous decisions by each firm, changes in wholesale prices in other markets can be used as instruments by assuming that changes in wholesale prices in other wholesale markets Tanzania only affect firms' output prices *via* their input prices. In practice, firms may update their output prices if they perceive national or regional demand shocks that would lead them to raise or lower prices. All equations include item and time fixed effects to control for these demand shifters over time and at the item-level.

Starting with a list of prices for staples goods from ten regional wholesale markets around Tanzania (excluding the two regional wholesale markets in the study area), I use LASSO procedure to select wholesale market prices that predict firm level input price changes following Belloni et al. (2012). This procedure selects five wholesale markets out of ten candidate markets as instruments in the first stage shown in equation 3 below, where $\mathbf{\Delta lnP}$ denote a vector of wholesale price changes for items i, from wholesale markets w, at month t. The predicted values for $\Delta l\hat{n}P_{ifmt}^{input}$ are then used in the second stage equation 1.

$$\begin{aligned} \Delta l\hat{n}P_{ifmt}^{input} &= \alpha + \beta_1 \mathbb{1}\{Increase_{iwt}\} \times \mathbf{\Delta lnP}_{iwt} \\ &+ \beta_2 \mathbb{1}\{Decrease_{iwt}\} \times \mathbf{\Delta lnP}_{iwt} \\ &+ \gamma_i + \lambda_t + \mathbf{X}_{ifmt}\Phi + \epsilon_{ifmt} \end{aligned} \tag{3}$$

5 Asymmetric Passthrough Results

5.1 Pooling Urban and Rural Firms

Results in Table 3 pool rural and urban firms. Variables *increase* and *decrease* are abbreviations for the terms $\mathbb{1}\{Increase_{ifmt}\} \times \Delta lnP^{input}_{ifmt}$ and $\mathbb{1}\{Decrease_{ifmt}\} \times \Delta lnP^{input}_{ifmt}$ from the empirical specification in equation 1. The passthrough elasticity for price increases ranges from 0.62-0.63 using firm price shocks with different progressions of fixed effects in columns 1-3. A ten percent increase in the input price is associated with a 6.2% increase in the output price. When using the instrumented price shocks, passthrough elasticities are between 0.60-0.70, shown in columns 4-6.

For input price decreases, passthrough elasticities are between 0.82-0.84 when modeling firm price shocks, and increase to 1.26-1.39 when using instruments. The large difference between IV and firm shocks is due to by the fact that the IV instruments are constructed using prices from large wholesale markets in other parts of Tanzania, which have lower price dispersion compared to true reported prices of rural and urban firms. When these instruments are used to predict input prices, the result is prices that are smaller in magnitude compared to the true price changes reported by firms. For decreases, 70% of predicted prices are smaller in magnitude than true prices. For increases, only 30% of predicted prices are smaller in magnitude. This difference means that the magnitude of IV passthrough rates for decreases are larger because the difference between the input and output prices is larger. Therefore, firm price shocks are a better reflection of the true passthrough rates and IV price shocks provide supporting evidence and help distinguish between national shocks captured in wholesale markets and individual firm's idiosyncratic shocks.

Table 3: Passthrough Rates - Pooling Rural and Urban Firms

	Dep Var: D.Ln Output Price					
	Firm Price Shocks			**IV Price Shocks**		
	(1)	(2)	(3)	(4)	(5)	(6)
Increase	0.633***	0.617***	0.623***	0.546***	0.549***	0.650***
	(0.074)	(0.075)	(0.085)	(0.099)	(0.096)	(0.144)
Decrease	0.823***	0.837***	0.839***	1.311***	1.313***	1.212***
	(0.060)	(0.066)	(0.048)	(0.131)	(0.155)	(0.119)
P-value Diff	0.1201	0.0897	0.0485	0.0000	0.0005	0.0006
Time FE	X	X	X	X	X	X
Item FE	X	X	X	X	X	X
Market FE		X			X	
Firm FE			X			X
Observations	926	926	926	926	926	926
R-Squared	0.739	0.749	0.804	0.592	0.607	0.683

Standard errors in parenthesis, clustered at market level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Passthrough rates for input price decreases are consistently higher than input price increases indicating that firms pass through cost savings more then cost increases. T-tests for equality of the coefficients on increases and decreases are rejected for at least the 10% level for all specifications except in column 1. This differs from from the canonical paper on price passthrough asymmetry by Peltzman (2000), who found that passthrough is higher for price increases than decreases among US grocery stores. In a simple competitive markets framework, higher passthrough rates are a signal of market competition - where perfect competition with no frictions or market failures would see 100% passthrough for both increases and decreases. We would expect staple foods to exhibit relatively high passthrough rates because they are commodities with little product differentiation and relatively inelastic demand compared to other goods and services. Passthrough rates alone are not sufficient to draw conclusions about market structure because a product's own-price elasticity of demand could also explain variation in passthrough. Consumers in these markets may not be willing to bear price increases and/or substitutes are readily available so that goods are relatively elastic, which tempers firms' ability to fully pass through price changes.

5.2 Urban and Rural Firm Heterogeneity

To examine rural and urban firm heterogeneity, I use the following empirical specification:

$$
\begin{aligned}
\Delta P^{output}_{ifmt} = \alpha &+ \beta_1 \mathbb{1}\{Increase_{ifmt}\} \times \Delta ln P^{input}_{ifmt} \\
&+ \beta_2 \mathbb{1}\{Increase_{ifmt}\} \times \Delta ln P^{input}_{ifmt} \times Rural_f \\
&+ \beta_3 \mathbb{1}\{Decrease_{ifmt}\} \times \Delta ln P^{input}_{ifmt} \\
&+ \beta_4 \mathbb{1}\{Decrease_{ifmt}\} \times \Delta ln P^{input}_{ifmt} \times Rural_f \\
&+ \delta Rural_f + \gamma_i + \lambda_t + \mathbf{X}_{ifmt}\Phi + \epsilon_{ifmt}
\end{aligned}
$$

It is similar to the primary equation in section 1, with the addition that input price shocks are interacted with an indicator term $Rural_f$ equaling one if a firm is located in a rural market. The coefficients, β_1 and β_3 on *Increase* and *Decrease* in table 4 are the passthrough rates for input price changes in urban areas. The coefficients β_2 and β_4 on the interaction terms reflect the difference between rural and urban firms' passthrough rates. P-values for tests $\beta_1 = \beta_2$ and $\beta_3 = \beta_4$ establish whether rural differential passthrough rate is statistically different from urban

Table 4: Passthrough Rates - Rural and Urban Firms

	Dep Var: D.Ln Output Price					
	Firm Price Shocks			**IV Price Shocks**		
	(1)	(2)	(3)	(4)	(5)	(6)
Increase	0.903***	0.867***	0.947***	0.728**	0.596**	0.915**
	(0.145)	(0.157)	(0.210)	(0.288)	(0.258)	(0.375)
Rural x Increase	-0.351**	-0.324**	-0.413*	-0.372	-0.185	-0.437
	(0.144)	(0.156)	(0.216)	(0.317)	(0.268)	(0.403)
Decrease	0.736***	0.750***	0.795***	1.621***	1.673***	1.489***
	(0.070)	(0.099)	(0.075)	(0.203)	(0.256)	(0.148)
Rural x Decrease	0.119*	0.113	0.024	-0.408*	-0.483**	-0.397**
	(0.060)	(0.087)	(0.067)	(0.202)	(0.234)	(0.147)
Rural	0.053**			-0.010		
	(0.020)			(0.024)		
P-value $\beta_1 = \beta_2$	0.0001	0.0005	0.0027	0.0757	0.1414	0.0877
P-value $\beta_3 = \beta_4$	0.0000	0.0012	0.0000	0.0000	0.0001	0.0000
Time FE	X	X	X	X	X	X
Item FE	X	X	X	X	X	X
Market FE		X			X	
Firm FE			X			X
Observations	926	926	926	926	926	926
R-Squared	0.746	0.754	0.810	0.610	0.624	0.699

Standard errors in parenthesis, clustered at market level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

passthrough rates. In all cases, they are rejected at the 10% level except for column 5.

In Table 4 columns 1-3 report passthrough rate heterogeneity using self-reported input price changes. Urban firms have positive passthrough rates ranging from 0.87-0.95% for input price increases and 0.75-0.80% for decreases. Rural firms' price decreases are 0.02-0.12 percentage points higher for price decreases, but are only marginally significant in the first specification without market or firm fixed effects. However, for cost increases, rural firms passthrough rates are 0.32-0.41 percentage points *smaller* than urban firms. It suggests that rural firms do not increase prices as much as urban firms when facing an input price increase. And they are slightly more likely to passthrough more savings from decreases, although results are not as consistent.

Columns 4-6 report results using instrumented price shocks. Similar to the pooled results in table 3, passthrough rates for price decreases are considerably higher in magnitude compared self-reported prices. Again, this suggests that instrumented prices do not predict underlying price differentiation experience by firms in these markets. Despite this, the pattern for price increases between urban and rural firms are consistent with self-reported prices - rural firms have lower passthrough rates compared to urban firms. However, coefficients reverse for price decreases. Rural firms appear to passthrough *less* savings compared to urban firms. This inconsistency is likely driven by the fact that wholesale prices used as instruments predict price increases better than price decreases because some firms are able to search for lower prices.

This result can be explained by several factors - demand elasticities, competition, and customer relationships. The next section unpacks the relative contribution of each of these mechanisms within rural areas.

6 Mechanisms

What explains differences in passthrough rates among rural firms? Is there evidence that differences in market structure or community characteristics are relevant factors? How do firm price strategies correlate with passthrough? This section compares market-level mechanisms and firm pricing strategies to understand why rural firms have different passthrough behavior.

The econometric specification is adjusted as follows:

$$\begin{aligned}
\Delta P^{output}_{ifmt} =& \alpha + \beta_1 \mathbb{1}\{Increase_{ifmt}\} \times \Delta ln P^{input}_{ifmt} \\
&+ \beta_2 \mathbb{1}\{Decrease_{ifmt}\} \times \Delta ln P^{input}_{ifmt} \\
&+ \sum_{1}^{j} (\beta_j \mathbb{1}\{Increase_{ifmt}\} \times \Delta ln P^{input}_{ifmt} \times \mathbf{Mechanism}_m) \\
&+ \sum_{1}^{k} (\beta_k \mathbb{1}\{Decrease_{ifmt}\} \times \Delta ln P^{input}_{ifmt} \times \mathbf{Mechanism}_m) \\
&+ \gamma_i + \lambda_t + \mathbf{X}_{ifmt}\Phi + \epsilon_{ifmt}
\end{aligned}$$

These mechanisms compare which features of rural communities and of the competitive environment explain differences in passthrough rates. All variables are continuous and standardized to z-scores so that the magnitudes of the point estimates are comparable. The coefficients nested in β_j and β_k represent the output price elasticity given a one standard deviation increase in the mechanism variable and a one percent increase or decrease in logged input prices.

6.1 Market Mechanisms for Rural Firms

Lower passthrough rates are consistent with a regime of higher demand elasticities in rural areas - meaning that rural customers are less tolerant of price increases and/or have more substitutes available. This pattern is also consistent with higher competitive pressure in urban areas because passthrough is close to 100%. Rural firms may also be constrained from raising prices due to social norms and community risk sharing. Rural firms also face higher transportation costs per mile travelled because road conditions are worse outside of urban centers.

Three market-level mechanisms are used to establish the relative importance of different pressures faced by firm operators in rural areas: density of competitors, distance to markets, and population size. Mechanisms are time-invariant and defined at the market (e.g. community) level. *Density of competitors* is the number of other firms selling the same good weighted by the village population. It uses census counts of competitors rather than self-reported measures. The number of competitors is weighted by market size because larger markets are likely to serve larger populations with more demand and have more competitors. The weighted number of competitors therefore reflects cases where firms have relatively more competitive pressure for a given market size. *Distance to market* is the distance to the nearest urban center. *Inverse population* is the inverse of the population size of the community where the firm operates. It is oriented as the inverse population so that coefficients point in the same direction to interpret effects in more remote, smaller, and more competitive markets. This analysis focuses on rural areas and excludes urban areas because it is difficult to define the catchment area of the population served or the market boundaries that define the competitive space.

Table 5 reports results for market mechanisms using self reported firm shocks and IV shocks. The coefficients on *Increase x Distance* show that a one percent increase in input price and a one standard deviation increase in distance to urban center is associated with about a 0.10-0.11% increase in the output price for the staple foods using firm price shocks and a 0.11-0.26% increase using instrumented prices. In other words, passthrough increases with distance to the urban market. This is intuitive because more remote firms must compensate for additional distance traveled to obtain goods. For price decreases, distance elasticities are near zero or marginally positive, suggesting that more remote firms do not adjust markups differently than less remote firms when input prices decrease.

If the number of competitors drives pricing behavior, passthrough rates should be sensitive to the number of firms operating in the same sector. There is weak evidence that firms' passthrough rates respond to competition. Columns 1 and 2 show that more competitors are associated with 0.12-0.13% increase in passthrough. Results in columns 3-5 are positive but near zero and negative in column 6 but imprecisely measured. For price decreases, elasticities are near zero across all specifications except in column 6 which estimates a 0.15% passthrough rate for a one percent decrease in prices and a one standard deviation increase in the number of competitors. It provides

Table 5: Passthrough Rates - Market Mechanisms for Rural Firms

	Dep Var: D.Ln Output Price					
	Firm Price Shocks			IV Price Shocks		
	(1)	(2)	(3)	(4)	(5)	(6)
Increase	0.591***	0.587***	0.584***	0.482***	0.564***	0.620***
	(0.047)	(0.048)	(0.057)	(0.096)	(0.103)	(0.149)
Decrease	0.871***	0.875***	0.827***	1.280***	1.234***	1.116***
	(0.041)	(0.040)	(0.036)	(0.132)	(0.116)	(0.107)
Increase x Distance	0.097***	0.108***	0.103***	0.108**	0.171**	0.259*
	(0.022)	(0.025)	(0.032)	(0.041)	(0.071)	(0.131)
Increase x Inverse Population	-0.125***	-0.124***	-0.118***	-0.179***	-0.259**	-0.360**
	(0.037)	(0.039)	(0.039)	(0.063)	(0.101)	(0.163)
Increase x Competitors	0.130***	0.119***	0.080	0.079	0.015	-0.111
	(0.034)	(0.035)	(0.052)	(0.056)	(0.066)	(0.137)
Decrease x Distance	0.019	0.025	0.043	0.136	0.150*	0.057
	(0.039)	(0.037)	(0.033)	(0.089)	(0.081)	(0.050)
Decrease x Inverse Population	0.075	0.063	0.019	-0.098	-0.085	-0.025
	(0.048)	(0.045)	(0.040)	(0.124)	(0.111)	(0.108)
Decrease x Competitors	-0.034	-0.035	-0.004	0.045	0.054	0.148**
	(0.037)	(0.035)	(0.035)	(0.092)	(0.085)	(0.053)
Time FE	X	X	X	X	X	X
Item FE	X	X	X	X	X	X
Market FE		X			X	
Firm FE			X			X
Observations	777	777	777	777	777	777
R-Squared	0.739	0.745	0.797	0.545	0.550	0.661

Standard errors in parenthesis, clustered at market level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

weak, but suggestive evidence that the number of competitors is associated with higher passthrough rates - which is consistent with a simple classical economic framework where more competition causes firms to passthrough all price changes.

For population, smaller communities are associated with *lower* passthrough elasticities of price increases - ranging from about a 0.12% decrease in the self-reported firm shocks to between 0.18-0.36% decrease in the IV specifications. For price decreases, population elasticities are imprecisely measured. Following price increases, firms in small communities do not raise prices as much as firms in larger communities. Focusing on self-reported firm price shocks in columns 1-3, we see that distance and population offset one another. Firms in remote areas with higher transpiration costs and small populations would have similar prices to less remote firms and larger community size.

Village population size is also a proxy for the aggregate demand faced by firms. In these villages, most customers are agricultural households with limited income who engage in subsistence production. It is not necessarily the case that smaller communities are wealthier or poorer than larger communities in rural areas. After controlling for remoteness and competition, we would not expect population size to explain price differences if we assume that poverty rates are similar throughout rural communities. Earlier when comparing urban and rural firms, I suggested that demand elasticities could explain differences because rural households have less income and cannot bear price increases. Examining passthrough differences *within* rural areas shows that smaller populations are associated with lower passthrough rates for price increases. One explanation is that firms in smaller communities are more likely to have stronger social ties with their customers and engage in risk sharing to keep prices affordable. This is consistent with literature showing that strong social ties are associated with risk-sharing behavior in rural villages.

Lower passthrough rates are also classically associated with more market power. We may expect rural firms to have more market power because high search and transportation costs preclude their customers from searching for better prices and fewer firms make it easier to collude. As a result, rural customers have fewer options and firms could price like monopolists. However, the standard result for market power characterizes firms with lower passthrough rates for price increases *and* decreases. Across specifications, we see rural firms passthrough a large share of decreases - meaning customers often benefit from price savings. But, price increases exhibit an asymmetry - firms appear to absorb some price shocks for their customers. Any price setting that deviates from marginal cost pricing indicates that firms hold some market power, but in this case, firms' pricing behavior appears to favor customers.

6.2 Pricing Strategies for Rural and Urban Firms

Why do firms in small communities have lower passthrough rates? Two features may drive firm pricing decisions: aggregate demand and social ties with customers. First, firms in small communities have smaller aggregate demand due to having fewer households as customers. When firms face a price shock, they main refrain from charging higher prices because they understand that it could suppress total demand. In smaller communities, individual firms may be more exposed to any demand adjustment that occurs due to prices changing. This is related to higher demand elasticities - customers cannot bear price changes and adjust purchasing behavior in ways that may hamper firm revenues. Firms anticipate the potential for demand suppression and refrain from raising prices as much as their would in larger communities where there are more customers to smooth purchasing patterns.

Second, firms are more likely to know and have long-standing relationships with their customers as neighbors, family, and friends. Firms in smaller communities are more likely to provide insurance benefits to their customers due to the prevalence of social insurance and risk sharing. One way that firms provide social insurance is through the provision of informal sales credit. Sales credit is a common component of relational contracting relationships in supply chains throughout LMICs.[10] Firms rely on repeat relationships with their customers and offer credit as a way to build a reliable customer base.

Table 6 reports means and standard deviations for four binary variables that characterize firm pricing and stocking: whether a firm offers credit to some customers, frequent customer or bulk purchase discounts, and whether the firm stocked-out of any item in the prior week. The table is split between small and medium population rural firms defined as those firms operating in communities that are below or above the median population size. Urban firms rely more on price discounts for customers - they are 8-10 pp more likely to offer discounts to frequent customers and 14-19 pp more likely to offer bulk discounts. Firms that use pricing discretion might have higher passthrough rates because their base price is set to ensure a particular margin, but they may decide to offer a discount to some customers on the spot.[11]

Table 6: Pricing and Stocking for Rural and Urban Firms

Variable	(1) Rural Small Population Mean/SD	(2) Rural Medium Population Mean/SD	(3) Urban Mean/SD
Offers Credit	0.68	0.70	0.57
	(0.47)	(0.46)	(0.50)
Frequent Discount	0.69	0.73	0.89
	(0.47)	(0.44)	(0.31)
Bulk Discount	0.73	0.78	0.92
	(0.44)	(0.41)	(0.27)
Stock-out last month	0.66	0.64	0.50
	(0.47)	(0.48)	(0.50)
Restock times last month	2.93	3.36	.
	(2.24)	(2.93)	(.)

Notes: All differences in means between urban and rural are significantly different at the 99% level. Differences between small rural and medium rural are not statistically different.

While the majority of firms in both urban and rural areas offer credit to some customers, rural firms are 11-13 pp more likely to offer credit than urban firms. Offering credit is an important source of building relationships with customers. Since firms in small communities are more likely

[10]See Macchiavello (2022) for a review. Rudder and Dillon (2020) characterize other features of relational contracting in this setting.

[11]This discretion would not be captured in the pricing data because we elicit the base price.

to be familiar with their customer base, they are also more likely to have repeat transactions and offer credit when someone cannot afford to pay.

Fifty percent of urban firms and 64-66% of rural firms report stocking out of at least one item the prior week. This means that a customer sought a specific good that they normally stock but that the firm did not have it on hand.[12] While imperfect, it provides a measure of inventory turnover - firms are more likely to run out of goods when there is high turnover. Rural firms are more likely to face longer periods with stock-outs because it takes a few days to re-supply their stocks. Rural firms restock an average of 3 times per month (data are not available for urban firms). We might expect firms to increase prices if they are low on inventory before restocking. I cannot explicitly model this type of pricing behavior because price elicitation did not ask how much stock remains or plans for future restocking.

For suggestive evidence about whether pricing strategies have explanatory power in describing passthrough behavior, I combine the pricing strategies into an index to improve power. Since price strategies are determined at the same time as price shocks, they capture the correlation between price strategies and passthrough. The index reflects different firms types. If a firm uses credit and discounts to differentiate prices they are a type of firm that uses more pricing discretion than other firms that do not use pricing strategies.

Table 7: Passthrough Rates and Pricing Strategies for Rural and Urban Firms

	Dep Var: D.m Output Price					
	Rural Firms			**Urban Firms**		
	(1)	(2)	(3)	(4)	(5)	(6)
Decrease	0.908***	0.910***	0.836***	0.602***	0.617***	0.692***
	(0.046)	(0.046)	(0.042)	(0.090)	(0.117)	(0.125)
Decrease x Price Strategy Index	0.023	0.016	0.049	0.103	0.124	0.223
	(0.067)	(0.066)	(0.065)	(0.097)	(0.120)	(0.284)
Increase	0.532***	0.524***	0.543***	0.950***	0.932***	0.981***
	(0.047)	(0.049)	(0.060)	(0.167)	(0.200)	(0.239)
Increase x Price Strategy Index	-0.065	-0.057	-0.121*	0.081	0.064	-0.095
	(0.048)	(0.049)	(0.070)	(0.137)	(0.122)	(0.156)
Time FE	X	X	X	X	X	X
Item FE	X	X	X	X	X	X
Market FE		X			X	
Firm FE			X			X
Observations	777	777	777	149	149	149
R-Squared	0.728	0.733	0.789	0.807	0.814	0.865

Standard errors in parenthesis, clustered at market level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

[12] Some firms are general stores that sell many products. The question referred to stock-outs of any good, but 64% of stocked-out goods were staple foods.

Table 7 reports results after splitting the sample into rural and urban firms. Rural firms with higher score in the price strategy index have marginally lower passthrough rates following a price shock. Firms that exercise high price discretion passthrough less shocks than those with lower pricing discretion. However, the relationship is only marginally significant in the specification that uses firm fixed effects. The coefficients for rural firms on *Increase* are similar to those estimated without adding a pricing strategy index, suggesting that price discretion has a marginal relationship with passthrough. For urban firms, the price strategy index does not have a strong relationship with passthrough rates. For input price decreases, estimates for both rural and urban firms are positive but too noisy to have confidence that pricing strategies are correlated with passthrough following positive price shocks.

7 Mark-ups and Price Premiums

The preceding analysis shows that rural firms have lower passthrough rates than urban firms following input price increases and relatively similar passthrough rates following input price decreases. Within rural communities, I show evidence that community size and remoteness have the largest and most robust relationship with passthrough rates - smaller communities passthrough less price increases and more remote communities passthrough more price increases. When considering price increases, firm behavior reflects a classic model of competition where firms passthrough a large share of input price decreases. However, rural firms, especially in small communities appear to shield their customers from negative price shocks.

To answer the question about whether this behavior among rural firms constitutes a form of partial insurance, this section analyzes differences in markups. If rural firms charge higher markups, it could be interpreted as a type of premium to cover negative price shocks. The unconditional average markup percent for rural firms in small communities is 19%, 17.8% in medium-sized rural communities, and 14.7% in urban areas, and all differences are statistically significant. We expect rural firms to have higher price levels to compensate for additional transaction costs incurred from moving goods from urban to rural areas. However, we do not necessarily expect markups to be higher in rural areas because urban firms also have transportation costs from transacting in their upstream supply chain. The unconditional average likely masks variation in search and transportation costs that would correlate with higher markups for rural firms, such as search costs and road quality.

Table 8: Markups for Rural and Urban Firms

	Dep Var: Markup Percent			
	(1)	(2)	(3)	(4)
Rural	0.052***		0.015	
	(0.017)		(0.020)	
Rural-Medium		0.045**		0.013
		(0.018)		(0.019)
Rural-Small		0.059***		0.022
		(0.017)		(0.021)
P-value Diff Low-Medium		0.0519		0.3036
Time FE	X	X	X	X
Item FE	X	X	X	X
Controls			X	X
Observations	1136	1136	1136	1136
R-Squared	0.107	0.110	0.132	0.133

Standard errors in parenthesis, clustered at market level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Columns 1 and 2 report markups for rural markets with item and time fixed effects. Columns 3 and 4 reports residual markups for rural markets after adding controls for distance to urban center, location where inputs are purchased, market size, and a treatment dummy.

To control for some of variation in markups, Table 8 reports regressions that characterize firm markups. Point estimates in columns 1 and 2 reflect the residual markup for rural firms with item and time fixed effects. Columns 3 and 4 report residual markups after controlling for distance to urban markets, location where inputs are purchased, market size, and a treatment dummy. The difference in markups range from 4.5-6 percentage points. However, once controlling for other factors, the difference shrinks to 1.3-2.2 pp and is not measured with precision. Taken together, it does not provide robust evidence that rural firms charge higher markups to compensate for price smoothing behavior.

8 Robustness Checks

To understand how sensitive estimates are to different specifications, I conduct two robustness checks. First, I use a matching algorithm to match input prices for rural and urban firms to control for systematic variation in input price changes that could bias estimates for heterogeneous effects. Second, I run analysis for a set of non-staple products and self-reported input and output prices to learn whether pricing behavior extends to other types of goods.

8.1 Matching on Input Price Changes

One potential threat to interpreting differences in passthrough for urban and rural firms would occur if each type of firm has systematically lower or higher input price differences. If urban firms' cost shocks are larger in magnitude than rural firms', it could simply be that they have more room to make upward and downward adjustments, so that their average input price difference is systematically higher. In principal, the elasticity estimation and item fixed effects help control for this. But, to further restrict the influence of outliers that may drive differences, I use a matching algorithm to generate exact matches on input price differences and drop any observation that is not matched across rural and urban firm samples. Table 11 presents results for check for sub-sample with at least 1 nearest neighbor match. This drops 15% of observations. In specifications with firm price shocks, the direction of changes are the same as the main findings: Rural firms have lower passthrough rates for price increases and slightly higher passthrough for price decreases. Using instrumented price shocks, the direction on *Rural x Increase* is the same, but *Rural x Decrease* are larger in magnitude and negative, likely due to instruments failing to predict price decreases as well as price increases.

8.2 Non-Staple Goods

To understand whether pricing patterns are similar across a range of goods, Table 12 in the appendix report results using prices of other non-staple goods. The sample includes non-perishable goods such as water, soda, beer, and medicines from small-scale pharmacies. It also includes perishable vegetables such as tomatoes, potatoes, bananas, and onions. These prices were collected from other firms in the same surveys as the staple goods highlighted in the primary analysis. I exclude them from primary analysis because they have less consistent demand compared to staples, have variable shelf-life in the case of vegetables, and have more measurement error. Columns 1-3 report asymmetric passthrough rates for input price increases and decreases pooling urban and rural firms. Columns 4-6 report heterogeneous effects by firm location in rural and urban areas. Pooled passthrough rates for non-staple goods are smaller in magnitude compared to staple goods. Heterogeneous passthrough rates follow a similar pattern - rural firms do not passthrough increases or decreases to the same extent as urban firms. Unlike staple goods, rural firms have lower passthrough on positive and negative price shocks; they do not pass through price savings to the same extent as staple goods.

9 Conclusion

Understanding how rural firms respond to input price shocks matters for rural consumers that rely on retailers as a source of staple foods. In a simple economics framework, we expect firms operating in a competitive market to passthrough nearly all input price shocks. I document that urban firms passthrough rates approach this conception of perfect competition - passthrough rates range between 74-80% for input price decrease to 90-95% for input price increases, meaning prices rise faster than they fall. For rural firms the opposite is true - prices fall faster than they rise. Rural firms passthrough 80-85% of price decreases and only 50-55% of increases. That implies that if the price of a key staple rises by 10%, an urban firm might raise its price by 9.5% while the rural firm would only raise it by 5.5%.

What features of rural markets motivate firms to smooth prices and provide partial insurance to their customers? Although lower passthrough rates are also consistent with having market power, the asymmetry suggests that rural customers benefit more than urban customers when prices change. If harmful market power was the primary driver, both increases and decreases would be smaller. Rural firms likely also face more elastic demand for staples compared to urban firms. In response, they refrain from passing on price increases because it would dampen demand.

While rural customers on average may have higher demand elasticities than urban customers, I show evidence that community size and thus the likelihood that firm owners have strong social ties with their customers affects passthrough. Firms in smaller communities passthrough even less price increases, even after controlling for remoteness and the number of competitors. However, firms in remote communities increase prices following a negative price. I also find some evidence that having more competitors is associated with higher passthrough rates, consistent with concepts of perfect competition. Rural firms are also more likely to offer credit to their customers, but urban firms are more likely to offer price discounts. However, these pricing strategies do not explain the large differences between urban and rural firms.

It shows that for staples, rural firms passthrough more cost savings and less cost increases, suggesting that rural firms bear some price risk by smoothing output prices despite experiencing higher input prices. Output price smoothing helps households bear seasonal price variation and improves households' ability to afford nutritional diets. After controlling for transportation distances, I do not find robust evidence that rural firms charge higher markups to compensate for this price smoothing service. Point estimates on residual markups are around 1-2 percentage points higher than for urban firms, but are underpowered to reject differences. If markups are 1-2 pp higher, that would deteriorate the savings of rural customers to 3.5-4.5% for a 10% increase.

Month-to-month changes in staple food prices is common in this setting. In addition, information frictions and search costs raise price uncertainty for retail firms when they purchase goods for re-sale. As a result, input prices go up and down throughout the year. Output price smoothing helps households bear seasonal price variation and improves households' ability to afford nutritional diets.

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Appendix

A Input and Output Prices Descriptive Statistics

Table 9: Price Characteristics by Firm Type for Staples

	Urban Firms			Rural Firms		
	Mean	sd	Median	Mean	sd	Median
Rice						
Input Price, 1 kg	1646	185	1650	1658	213	1700
Output Price, 1 kg	1883	184	1900	1934	228	2000
Tsh Mark-up	241	98	250	277	120	250
Percent Mark-up	0.15	0.07	0.14	0.17	0.08	0.15
Input price increase	261	162	250	226	117	200
Input price decrease	-281	192	-250	-361	209	-350
Beans						
Input Price, 1 kg	1845	260	1800	1874	236	1800
Output Price, 1 kg	2185	505	2000	2237	248	2200
Tsh Mark-up	352	305	250	365	168	300
Percent Mark-up	0.19	0.11	0.15	0.20	0.11	0.18
Input price increase	300	159	300	277	206	200
Input price decrease	-164	48	-200	-265	171	-200
Maize Grain						
Input Price, 1 kg	577	212	578	598	212	560
Output Price, 1 kg	706	248	620	692	201	675
Tsh Mark-up	129	109	100	109	86	100
Percent Mark-up	0.27	0.29	0.20	0.22	0.20	0.15
Input price increase	219	124	250	279	94	300
Input price decrease	-396	176	-430	-338	229	-430
Sugar						
Input Price, 1 kg	2345	189	2240	2334	125	2320
Output Price, 1 kg	2486	268	2400	2733	298	2800
Tsh Mark-up	142	144	60	403	253	400
Percent Mark-up	0.06	0.06	0.03	0.17	0.10	0.17
Input price increase	198	167	140	127	94	120
Input price decrease	-45	50	-45	-94	87	-80
Maize Flour						
Input Price, 1 kg	1144	188	1080	1259	220	1320
Output Price, 1 kg	1262	191	1320	1498	242	1500
Tsh Mark-up	124	117	80	245	120	240
Percent Mark-up	0.12	0.12	0.07	0.20	0.12	0.20
Input price increase	334	121	340	213	136	190
Input price decrease	-313	116	-340	-399	192	-460

B Evaluating Strict Exogeneity Assumption

Table 10: Regressing input prices on input search intensity

	Dep Var: Ln Input Price			**Dep Var: Δ Ln Input Price**		
	(1)	(2)	(3)	(4)	(5)	(6)
Search Index	-0.053***	-0.053***	-0.005	-0.002	0.000	-0.013
	(0.007)	(0.006)	(0.008)	(0.008)	(0.008)	(0.021)
Time FE	X	X	X	X	X	X
Item FE	X	X	X	X	X	X
Market FE		X			X	
Firm FE			X			X
Obs	1801	1801	1801	1087	1087	1087
Adj R-Squared	0.8099	0.8140	0.8465	0.3002	0.2938	0.2900

Standard errors in parenthesis, clustered at market level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Columns 1-2 show that firm search costs are related to the input price that they receive. Column 3 shows that in controlling for firm fixed effects, the relationship goes to zero, suggesting that firms have relatively fixed search strategies that do not change over time. Columns 4-6 show that there is no strong relationship between search costs and input price changes over time. The search index components include the number of suppliers that a firm communicated with, purchased from, and the number of different locations.

C Robustness Check: Matching on Input Price Changes

Table 11: Dropping observations without overlap

	Dep Var: D.Ln Output Price					
	Firm Price Shocks			IV Price Shocks		
	(1)	(2)	(3)	(4)	(5)	(6)
Increase	1.002***	0.994***	1.028**	0.519*	0.530*	0.703*
	(0.296)	(0.336)	(0.406)	(0.276)	(0.287)	(0.399)
Rural x Increase	-0.313	-0.311	-0.356	-0.210	-0.163	-0.267
	(0.270)	(0.313)	(0.408)	(0.306)	(0.300)	(0.433)
Decrease	0.671***	0.675***	0.713***	1.738***	1.685***	1.535***
	(0.088)	(0.130)	(0.095)	(0.250)	(0.295)	(0.188)
Rural x Decrease	0.160**	0.161	0.088	-0.692***	-0.666**	-0.586***
	(0.075)	(0.119)	(0.102)	(0.242)	(0.273)	(0.183)
Rural	0.054*			-0.025		
	(0.031)			(0.025)		
Time FE	X	X	X	X	X	X
Item FE	X	X	X	X	X	X
Market FE		X			X	
Firm FE			X			X
Observations	787	787	787	787	787	787
R-Squared	0.720	0.728	0.798	0.570	0.585	0.675

Standard errors in parenthesis, clustered at market level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. This table reports a robustness check on main results for rural and urban firm heterogeneity. It using nearest neighbor matching to identify a subsample where all input price changes are matched to at least one neighbor. Point estimates are the same direction but have different magnitudes.

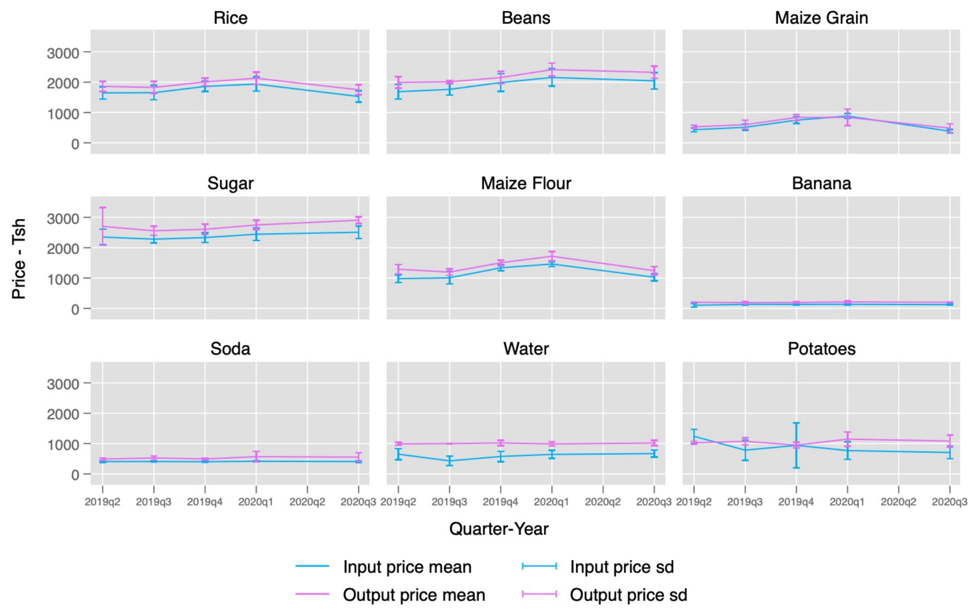
D Passthrough of Non-Staple Goods

Table 12: Passthrough Rates for Rural and Urban Firms - Non-Staple goods

	Dep Var: D.Ln Output Price					
	Non-Staple Goods			**Non-Staple Goods**		
	(1)	(2)	(3)	(4)	(5)	(6)
Increase	0.299**	0.301*	0.334*	0.648***	0.643***	0.736***
	(0.143)	(0.153)	(0.197)	(0.138)	(0.150)	(0.185)
Rural x Increase				-0.522***	-0.518***	-0.602***
				(0.152)	(0.168)	(0.206)
Decrease	0.295**	0.294**	0.275*	0.805***	0.811***	0.813***
	(0.113)	(0.122)	(0.154)	(0.099)	(0.111)	(0.127)
Rural x Decrease				-0.729***	-0.733***	-0.737***
				(0.110)	(0.121)	(0.146)
Rural				0.001		
				(0.044)		
P-value Diff	0.9829	0.9690	0.8093			
P-value Diff Increase				0.0002	0.0006	0.0011
P-value Diff Decrease				0.0000	0.0000	0.0000
Round FE	X	X	X	X	X	X
Item FE	X	X	X	X	X	X
Market FE		X			X	
Firm FE			X			X
Observations	640	640	640	640	640	640
R-Squared	0.301	0.326	0.438	0.436	0.455	0.555

Standard errors in parenthesis, clustered at market level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. This table replicates the main results of staple goods using a variety of non-staple foods. Columns 1-3 report asymmetric passthrough rates for input price increases and decreases pooling urban and rural firms. Columns 4-6 report heterogeneous effects by firm location in rural and urban areas. Pooled passthrough rates for nonstaple goods are smaller in magnitude compared to staple goods. Heterogeneous passthrough rates follow a similar pattern - rural firms do not passthrough increases or decreases to the same extent as urban firms.

E Additional Tables and Figures



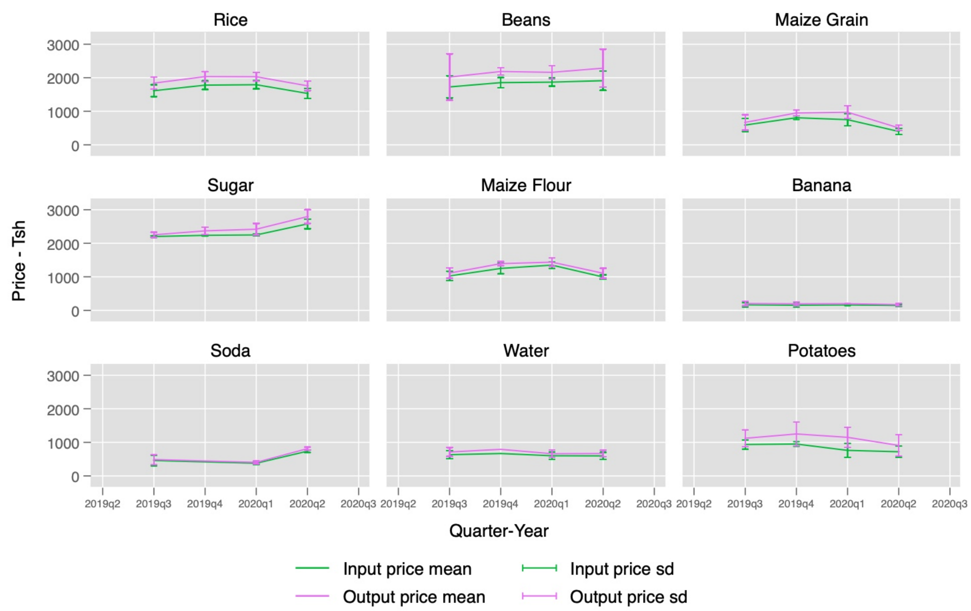


Figure 3: Input and output price means and standard deviations in rural (top) and urban markets (bottom)

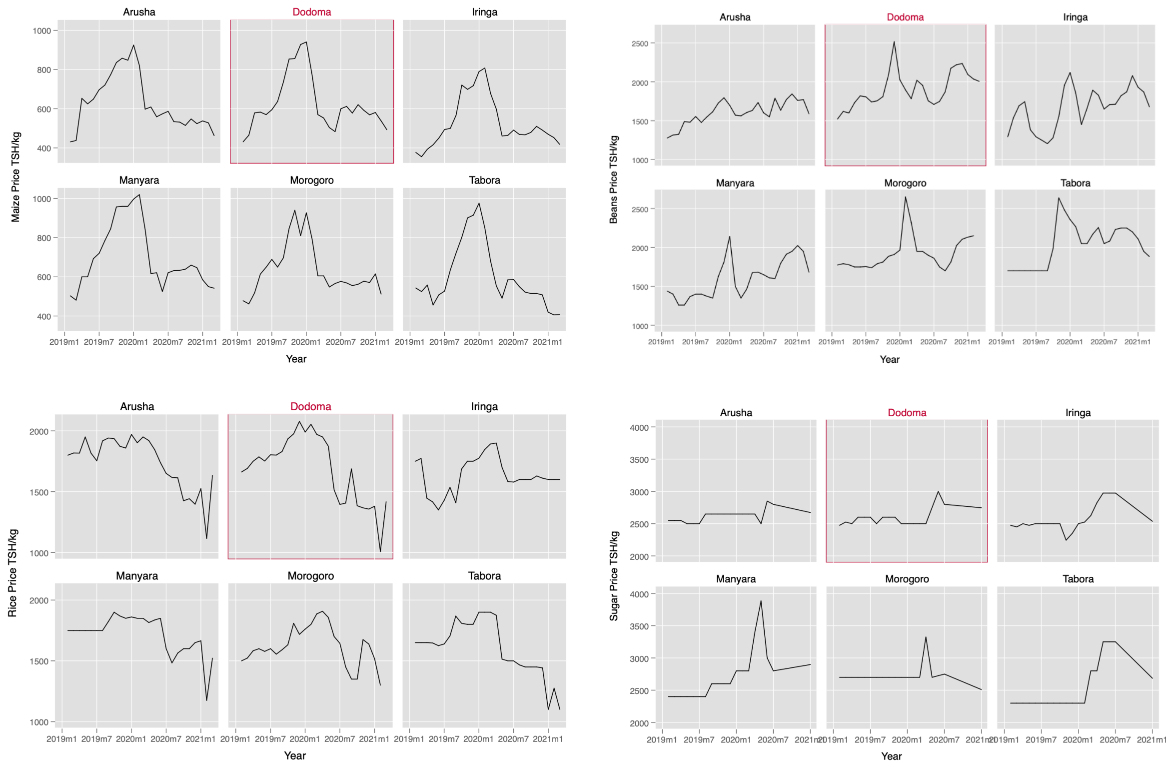


Figure 4: World Food Programme prices for Maize (top left), Beans (top right), Rice (bottom left), and Sugar (bottom right) in 6 markets from 2019-2020

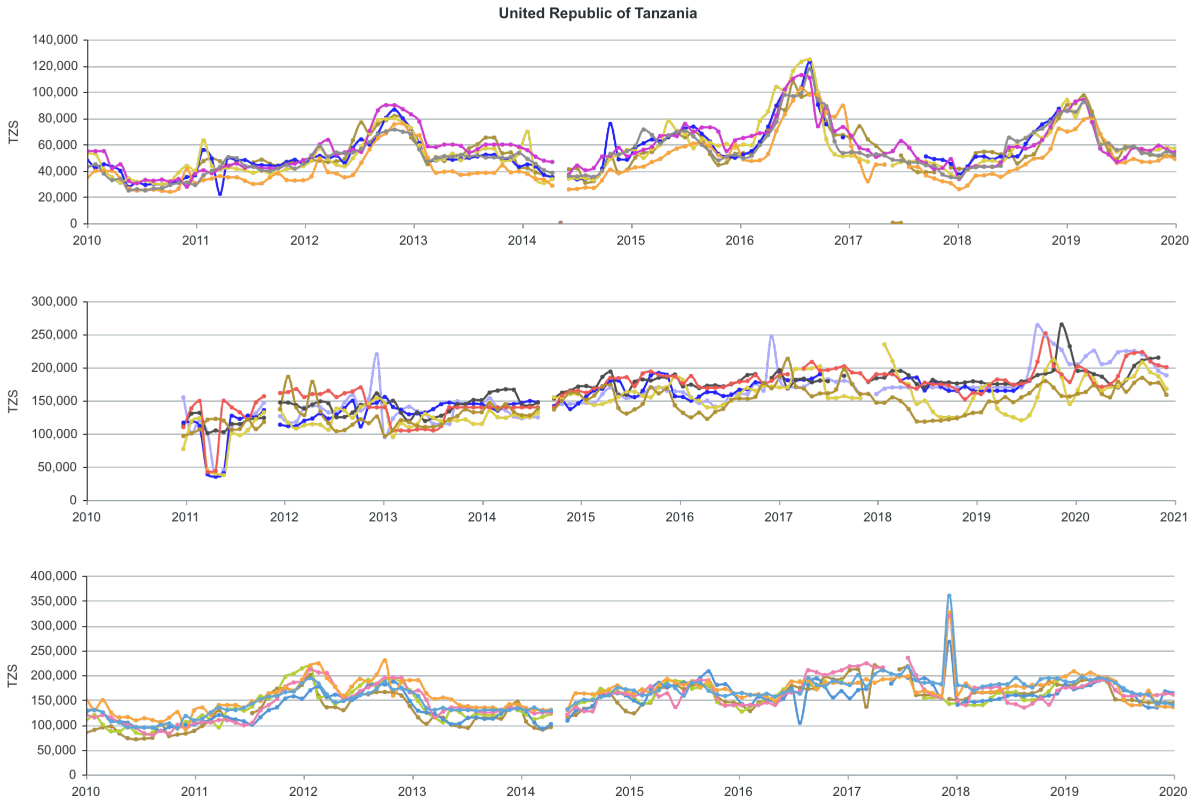


Figure 5: Long-run trends in World Food Programme prices for Maize (top), Beans (middle), and Rice (bottom) in 6 markets from 2010-2020