The Role of Rural Firms in Smoothing Price Variation: A Case Study of Urban and Rural Firms in Tanzania

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Abstract

Commodity price variation is a typical feature of markets in developing countries. Rural firms that source commodities as inputs to their business face substantial price variation when purchasing goods in urban markets. How much of this input variation passes through to prices for rural customers? Rural households rely on local businesses to purchase household food staples and other essential commodities. Yet, relatively little economic literature examines retail passthrough rates of these essential food staples to clarify how it affects local food security. I use a panel of input and output prices for 230 urban firms and 240 rural firms to evaluate pass-through from idiosyncratic input price shocks on key commodities sold through urban-to-rural supply chains. I find that rural firms smooth both negative and positive input price shocks more than urban firms. To examine possible mechanisms, I find suggestive evidence that smaller community size is associated with lower output prices, suggesting that social ties may play a role. At the same time, competitive pressure matters as well - rural firms who face new entrants and have higher absolute number of competitors have higher passthrough rates, consistent with a competitive market framework.

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1 Introduction

Commodity price variation is a typical feature of markets in developing countries. Rural firms that source commodities as inputs to their business face substantial price variation when purchasing goods in urban markets. Many rural households purchase household food staples and other essential commodities from rural businesses. Seasonal price increases for staple foods have been shown to lower welfare for consumers who struggle to substitute to foods with the same nutritional quality (Green et al., 2013; Bai et al., 2020). Yet, relatively little economic literature examines retail passthrough rates of these food staples to clarify how passthrough rates affect local food security. How much of this 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? I use a panel of input and output prices for 387 urban retail firms and 507 rural retail firms to evaluate passthrough from input price changes on key staple foods sold in urban and rural areas. Panel fixed effects are used to isolate the effect of input price shocks and to compare urban and rural firm pricing behavior.

Retail firms purchase goods paying input prices, and re-sell them at a mark-up without adding value beyond transport charging output prices. I first document that retail output prices are sensitive to changes in input prices and that passthrough rate elasticities are larger for input price decreases than input price increases. Across urban and rural firms, a one percent increase in input price is associated with a 0.30-0.62% increase in output prices and a one percent decrease in input prices is associated with a 0.33-0.85% decrease in output prices, depending on the types of goods included in the sample. In general, passthrough rates are larger for staple food commodities than other commodities that are more perishable or have more quality differentiation, such as vegetables and medicine. I then show that rural firms have lower passthrough rates than urban firms following a negative input price shock, providing evidence that rural firms smooth input prices increases more than urban firms. For staple foods, when rural firms experience input price decreases, they have higher slightly passthrough rates compared to urban firms, meaning that they pass through more cost savings. But, once other differentiated commodities are added to the sample, rural firms' passthrough rates on input price decreases are lower than urban firms, meaning they do not pass on cost savings.

Drawing conclusions about structural differences between urban and rural firms based on passthrough rates is difficult because different passthrough rates may simply reflect different demand elasticities - where lower passthrough rates reflect more elastic demand that deters firms from marking up output prices too much because consumer demand falls quickly. In that case, results are consistent with Atkin and Donaldson (2015) who show that mark-ups are lower in rural markets compared to urban markets because demand is more elastic as prices rise. This paper adds to the literature by testing different mechanisms across a wide range of food staples, perishable foods, and differentiated products to understand how elasticities differ within rural areas and between urban and rural markets.

Market conditions for urban and rural firms differ for a number of reasons. I discuss how demand, community pressure and social ties, information frictions, transaction costs, and competitive structure could relate to different passthrough behavior for rural and urban firms. I use proxy variables for transaction costs and social ties as 'community mechanisms' to understand how passthrough rates vary with different features of rural communities. These community mechanisms include two variables that capture remoteness - distance and bus fare to the nearest city. The last community mechanism is community population size, which captures features of small communities, such as social ties. I also construct two 'competition mechanisms' to evaluate the extent to which rural firms respond to 1.) increases in entrants and 2.) the total number of firms that operate in their subsector.

Community Size and Social Ties: Larger community size is associated with fewer pro-social behaviors since agents are less connected via social ties (Alcott 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 (Breza et al., 2019; Kinnan et al., 2021). Although many village risk-sharing arrangements concern the exchange of gifts, money, labor, and other types of support, it is reasonable to expect rural firms to participate in informal insurance by providing credit, price discounts, or bearing more staple price risk by not fully passing on input price increases. 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 customers in smaller communities have relatively more bargaining power than customers in larger communities, which contributes to lower tolerance for price increases.

Using community size as a proxy for social ties, I find that firms in smaller communities have 15-22% lower passthrough rates for staple foods than firms in larger communities when their input prices increase. Evidence following an input price decrease is weaker but move in the opposite direction - firms in smaller communities have 4-7% higher passthrough to output prices when input prices go down, meaning they pass through cost savings. On the other hand, lower passthrough rates may also indicate that firms have more market power in small communities. If market power was the primary explanation, both price increases and decreases would have lower passthrough rates, indicated that monopolistic firms do not change output prices. I only find lower passthrough rates for price increases, suggesting that firms in smaller communities smooth output prices after negative price shocks more than positive price shocks.

Transaction costs and information frictions: Rural firms tend to be located in remote locations and pay additional transaction costs to source inputs from cities. To compensate for higher transaction costs, the average mark-up on staple foods for rural firms is 19% compared to 15% for urban firms. Higher transaction costs are also associated with higher information frictions which raise the cost of learning about new market information, including changes in prices (Allen, 2014; Aggarwal et al., 2018). As a result, rural customers likely have prior beliefs about prices of key food staples and information frictions could cause rural firms to smooth price variation because rural customers would be slower to learn about and accept price changes. I do not find evidence that information frictions slow output price passthrough. I find that more remote firms have higher passthrough rates for price increases and price decreases than firms closer to urban centers. If information frictions slowed price updating, we would see less passthrough of both price increases and decreases.

Competitors: If markets were perfectly competitive, economic theory predicts that firms would perfectly passthrough input price changes to output prices so that elasticities would approach one. I compare whether variation in the number of competitors and change in number of competitors is associated with different passthrough rates among 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 increases or decreases in 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 by increasing the likelihood that a firm will lower a price to the competitive level. At the other end of the spectrum, in a collusive arrangement, passthrough rates would be lower since it is easier to tacitly or explicitly coordinate prices if few firms are present in a market.

I find that new firm entry and total number of other competitors are associated with higher passthrough rates both types of input price shocks, showing that competitive pressure also matters. I also find suggestive evidence that for staple foods, firms do not passthrough cost savings that result from input price decreases even in the presence of higher competitive pressure. Compared to urban firms, rural firms output price passthrough elasticities are estimated to be between 0.02-0.10% higher given a one percent decrease in input prices. Within the rural firm sample, higher competitive pressure is associated with 0.07-0.11% lower passthrough. On net, competitive pressure makes rural firms have similar passthrough elasticities as urban firms, suggesting that variation in competition is an important determinant for staple prices.

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. With relatively low and unstable income compared to urban customers, it is reasonable to expect rural customers have higher price elasticity of demand and are more sensitive to price changes compared to urban customers.[1]

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

[1]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. Yet, 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 (Muhammad et al., 2011; Muhammed et al. 2017; Green et al., 2013). Rudolf also finds higher elasticities for the rural poor compared to urban poor as does Boysen (2015), using Uganda data. Therefore, relatively higher own-price elasticity of demand for staples in rural areas is a reasonable assumption.

associated with fewer pro-social behaviors since agents are less connected via social ties (Alcott 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, 82.3% of rural firms said most of their customers come from their village and 28.9% 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. 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).

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 average mark-up on staple foods for rural firms is 19% compared to 15% for urban firms. Higher transaction costs are also associated with higher information frictions which raise the cost of learning about new market information, including changes in prices (Allen, 2014; Aggarwal et al., 2018). As a result, rural customers likely have prior beliefs about prices of key food staples and information frictions would cause them to be slower to update price expectations once prices change.

All of these features of the customer base mean that rural firms are less likely to passthrough price changes and thus are more likely to smooth input price fluctuations. For example, if an urban firm faces an input price increase and updates their output price, they know that their customers are relatively well-informed, there are more potential customers, and customers can tolerate price fluctuations leading to overall less elastic demand. And urban firms have a larger pool of customers who are less able to exert community pressure to keep prices low. On the other hand, if a rural firm pays a higher price for inputs and updates their output price, their customers may be slower to update expectations to accept higher output prices, can exert community pressure to keep prices low, and are more price sensitive since price changes have greater consequences for their household budgets.

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, cereals/grains sellers, vegetable sellers, etc.). Urban firms in staple food sectors in this sample have an average of 6.8 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. This 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 among firms and can resolve price uncertainty if firms tacitly or explicitly agree to update prices collectively.

If markets were perfectly competitive, 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 competitive market structure. As a result, passthrough rates are often used to evaluate market power of firms (Sumner 1981). In practice, passthrough rates in some markets may differ based on whether input prices increase or decrease (Peltzman, 2000; Bonnet and Villas-Boas, 2016). However, without additional assumptions about the curvature of a demand curve, passthrough rates alone are not sufficient to identify the competitive structure of markets (Bulow and Pfleiderer, 1983).

In lieu of identifying the competitive structure of markets (e.g. perfect competition, monopolistic market structure, or collusion), I compare whether variation in the number of competitors is associated with different passthrough behavior by urban and 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 increase or decreases in 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 by increasing the likelihood that a firm will lower a price to the competitive level. At the other end of the spectrum, in a collusive arrangement, passthrough rates would be lower since it is easier to tacitly or explicitly coordinate prices if few firms are present in a market.

3 Context and Data Sources

3.1 Data

This study uses data collected from urban and rural firms in Singida and Dodoma regions in central Tanzania. Rural firms' customer base is largely comprised of agricultural households that purchase foodstuffs and other household goods from local retailers. Often, rural firms travel to purchase business inputs - either in larger towns or urban centers, linking rural consumers in an urban-to-rural supply chain that supplies goods and services that households do not grow or manufacture for themselves. Four rounds of survey data from 240 rural firms and three rounds of survey data from 230 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 (fourth largest city in Tanzania) and is the principal trading center for the region as well as the political capital for 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).[2]

Rural markets comprise relatively large rural villages (*vijiji* in Tanzania administrative classification) with populations between 3,000 and 10,000. 25 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 market, 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 (Rudder, 2020; 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. The urban firm census only includes retail firms. The original sample of rural firms includes both retail and service firms. To ensure that the samples

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

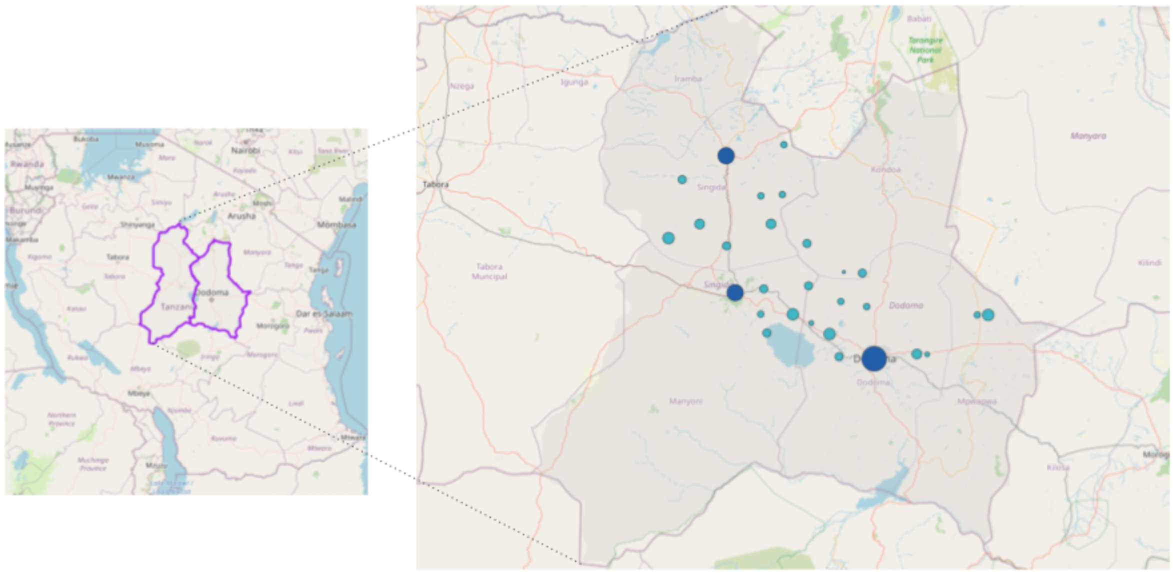


Figure 1: Location of surveyed urban markets (dark blue) and rural markets (light blue) in Tanzania

are comparable, I only use price data from retail firms in rural areas.

Table 1 displays summary statistics for urban and rural retail firms. Urban and rural firms vary significantly in every dimension - urban firms are on average older, firm owners are older, they are almost three times more likely to have hired any workers in the previous week, and hired three times as many workers. But, the modal urban firm has zero paid workers (45% hired any worker the previous week compared to 16% of rural firms). Rural retail firm owners are more likely to be women - 31% of rural retailers are women-owned compared to 23% of urban firms.

Rural firms operate in villages with an average population of 4,850 people. The largest rural village in the sample has 10,000 people and the smallest has 3,200. The average urban center population is about 250,000. This is heavily weighted to the size of Dodoma City, which has the largest population. The catchment area for urban firms likely does not include the entire population since many people in urban areas shop primarily in neighborhood shops. Urban firms also act as wholesalers for rural firms around the region. They sell to a mix of urban customers, rural consumers that travel to buy for their households, and rural firms that travel to cities to purchase inputs. Both urban and rural firms prices could include bulk discounts, frequent customer discounts, or other prices changes. But, these activities are common in all markets. To the extent that firms have pricing policies, firm fixed effects will absorb those policies as long as they are time-invariant. The average rural firm is located 64 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.

Table 1: Urban and Rural Retail Firm Characteristics

	N	(1) Rural Mean/SD	N	(2) Urban Mean/SD
Firm Characteristics:				
Woman-Owned Firm	230	0.313	192	0.229
		(0.465)		(0.421)
Age of firm	230	5.233	187	6.834
		(5.560)		(8.096)
Owner age	230	36.396	188	38.500
		(11.099)		(9.868)
Years of education	230	7.900	191	9.073
		(3.630)		(3.898)
Any workers (0/1)	230	0.157	240	0.446
		(0.364)		(0.498)
Number of workers	230	0.243	240	0.783
		(0.682)		(1.265)
Market Characteristics:				
Village/city population	230	4851.030	238	245252.101
		(1352.536)		(168370.007)
Distance to urban center	230	63.886	240	0.000
		(31.217)		(0.000)
Number of retailers in market	230	13.430	240	27.183
		(5.542)		(15.508)
Share selling staple foods	230	0.722	240	0.438
		(0.449)		(0.497)
Firm Competitors:				
Number of competitors, self reported	230	7.687	239	9.226
		(4.880)		(5.072)
Number of competitors, census count	230	3.161	240	4.083
		(1.907)		(2.749)
Net increase in competitors (0/1)	230	0.365	240	0.546
		(0.483)		(0.499)
Net decrease in competitors (0/1)	230	0.204	240	0.129
		(0.404)		(0.336)
No change in number of competitors (0/1)	230	0.430	240	0.325
		(0.496)		(0.469)

Notes: All means are significantly different at least 5% size

Urban markets have an average of 27 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 7.7 for rural firms compared to 9.2 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 average of 3.2 competitors in their sector while urban firms have an average of 4.1 competitors. The census count is an underestimate because sectors were defined to mutually exclusive - that is if a firm sold both staple grains and fruits and vegetables, they would be categorized according to the product with the highest sales. And only participating firms were counted, so it only represents 75-82% of firms. But, in the self-reported measure, firms were asked "How many sellers in this market sell the same goods as you?" Thus, they provide a count based on a more flexible definition of other sellers that operate roughly in the same sector and provide a measure of perceived competition. The self-reported measure is used in regressions.

Firms were also asked how many new firms began operating in their market over the previous year that sold the same goods. Responses illustrate differences between urban and rural market dynamics. Thirty-seven percent of rural firms experienced an increase in the number of competitors, 20% had a decrease, and 43% had no net change in the number of competitors. By contrast, 56% of urban firms had an increase in the number of competitors, 13% had a decrease, and 33% had no change in the number of competitors. Overall, more new firms enter urban markets and fewer exited.

3.1.2 Price Data

If firms sold staple foods - rice, beans, maize grain, maize flour, or sugar - they were asked the most recent input and output price during each survey round. Units were converted to Tanzanian shillings per kilogram of the good. 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 quality differentiation was not a major factor during the survey period. One limitation is that not every firm provided both input and output prices. Further, firms had to have purchased inputs within the past three months. This eliminated very few firms that sell staple goods. Later, other homogeneous products are introduced to improve power - water, soda, bananas, potatoes, tomato, potato, onion, and three types of medicine (paracetamol, amoxicillan, and diclopar). These were chosen based on having at least 20 prices in both urban rural markets.

Table 2: Price Characteristics by Firm Type for Staples

	Mean	sd	Median	n	P-Val Diff Urban-Rural
Urban Firms:					
Input Price, 1 kg	1596.34	622.02	1700	395	
Output Price, 1 kg	1793.56	690.22	2000	395	
Tsh Mark-up	201.91	196.44	200	388	
Percent Mark-up	0.15	0.16	0.11	388	
Input price diff, if increased	240.80	158.37	250	93	
Input price diff, if decreased	-276.80	162.77	-250	65	
Rural Firms:					
Input Price, 1 kg	1825.06	459.43	1800	1301	0.0000
Output Price, 1 kg	2148.39	546.77	2000	1301	0.0000
Tsh Mark-up	327.09	192.73	300	1292	0.0000
Percent Mark-up	0.19	0.11	0.17	1292	0.0000
Input price diff, if increased	222.04	177.64	200	471	0.3442
Input price diff, if decreased	-283.10	203.03	-240	293	0.8151

Comparing a relatively narrow set of goods reduces the role of product differentiation. Since these goods are ubiquitous and frequently purchased by rural households, they have well-understood demand curves, and consumers are more likely to well-formed beliefs about price.

Table 2 shows other features of input and output prices for staples goods. As expected, input prices are on average higher for rural firms compared to rural firms (1825 Tsh compared to about 1600 Tsh) and output prices follow suit (2150 Tsh compared to about 1800). The mark-up in shillings is about 330 Tsh for rural firms about 200 Tsh for urban firms. Rural firms also charge slightly higher mark-ups as a percentage of the input price - 19% compared to 15% for urban firms. The higher mark-up makes sense given that rural firms incur additional transportation costs to bring goods from urban to rural areas. 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.

The last column of Table 2 displays p-values for t-tests of each price characteristic for urban and rural firms. Input price, output price, mark-up in shillings, and mark-up percent are all rejected with precision for urban and rural firms. But, importantly for first stage regressions, the price change itself is not significantly different for urban and rural firms. If an urban firm experiences an idiosyncratic price increase, they pay an average of 240 shillings more, which is not statistically different from the rural firm average of 220 shillings. And when urban firms experience an input price decrease, they pay an average of 275 shillings less and rural firms pay an average of 280 shillings less. It provides evidence that variation in passthrough rates is not explained by difference in the magnitude of the input price change for urban firms.

3.2 Staple Food Price Variation in Tanzania

The World Food Programme's Vulnerability Analysis and Monitoring (VAM) dashboard provides information about the extent of price variation for key staple foods throughout Tanzania. They report monthly price data for markets located throughout Tanzania for a selected set of food staples - maize grain, beans, rice, sugar, and wheat flour. Figure 4 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. Prices for Dodoma are highlighted in red and the other markets are the 5 closest regional markets with monthly price series data.

Table 3: 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

Table 3 reports averages, standard deviations, and coefficient of variation for key food staples in 6 markets. Coefficient of variation is a measure of price dispersion that controls for the magnitude of the mean. 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 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 firms 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-year 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.

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. I estimate the following econometric specification using multi-way fixed effects with variation in 'treatment' timing, where the 'treatment' variable is a firm-level input price shock:

Main Specification:

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

Where:

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

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 a 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 and market size. Standard errors are robust and clustered at the market level, permitting arbitrary within-market correlation.

4.1 Defining Item Samples

I define three sub-samples of retail items based on how much product differentiation is likely to lead to quality differences:

1. **Staple Foods:** The sample of staple food items includes rice, beans, maize grain, maize flour, and sugar. Rural retail firms reported these items as the most commonly sold items in their stores. Compared to the other items, these food staples have the least quality differentiation and are relatively homogeneous in terms of being non-branded commodities that are sold by weight in unmarked bags.[3]

2. **Commodities:** The second sample includes other food and non-food commodities that have more quality differences than staple foods but nonetheless are relatively similar. The commodities subsample includes all of the food staples, plus bananas, tomato, potato, onion, soda, water, and three of the most common pharmaceutical medicines sold in rural pharmacies. These food items are more perishable and have more observable quality differences.

3. **All Items:** The third sample includes the first two plus differentiated products. It includes 44 items total, including bike tubes and tires, shoes, cloth, ready-made clothing, cement, construction nails, etc. Differentiated products have more variation in quality and different demand curves compared to food staples.

The three different sub-samples were created to provide information about whether mark-up strategies for staple foods differ from other products. Each sub-sample increases the sample size and increases the presence of product differentiation to show whether mark-ups are robust to different types of items or if they are only consistent within the staple foods category. Three models are estimated for each item sub-sample. 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 and removes the item fixed effects. In

[3]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.

surveys, firms were asked prices on the same items during each survey round such that item fixed effects are absorbed by the firm fixed effects.

4.2 Identification Under Strict Exogeneity

The identification assumption 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. In practice, this is a strong assumption because firms endogenously select into the prices they pay for inputs. Fixed firm preferences for input prices are absorbed by the firm fixed effects so that the third econometric specification approaches this standard and approximates the causal effect of input price shocks on passthrough rates. This assumption is violated if firms change their search intensity over time, incurring different search costs to obtain inputs. For example, if a firm searched the first period in three locations to find business inputs that meet their price, quantity, or quality requirements and in the second period the firm only searched one location or talked to one vendor, then their time-varying search costs would vary and would violate strict exogeneity. To test the role of variation in search costs, I use a variable from the rural firm survey that intends to capture input search intensity. The 'Search Index' variable includes the number of suppliers that a firm communicated with, purchased from, and the number of different locations travelled during each survey round. It is a proxy for time-varying input search costs.

Table 7 in the appendix shares results from regressions of the search index on the logged input price and the first difference of the logged input price using the item sub-samples and fixed effects specifications. The first two columns of each sub-sample in the regression with logged input price as the outcome variable (colums 1-2, 4-5, and 7-8) are all negative and different from zero. Firms that search more tend to have lower input prices. However, after controlling for firm fixed effects, the effect size decreases to a precise zero, providing evidence that firm search costs are relatively stable over time. The second panel regresses the first difference of the logged input price on the search intensity and estimates precise zeros for all specifications. It suggests that firms have stable, relatively time-invariant preferences for input prices and do not update their input search behavior to seek better prices.

5 Results 1: Passthrough by Urban and Rural Firms

This section presents results for passthrough rates in two tables. First, results from regressions that pool urban and rural firms establish that firms update output prices when their input price changes. Second, results from regressions that examine rural and urban firm heterogeneity show that rural firms do not update output prices as much as urban firms. The next section explores possible mechanisms to explain differences in output price updating.

Each table includes results for each item sub-sample - Staple foods, differentiated commodities, all items. Each sub-sample has three regressions - 1. item and time fixed effects, 2. item, time, and market fixed effects, and 3., time and firm fixed effects. Preferred specifications are those with firm fixed effects. Variables *increase* and *decrease* are abbreviations for the terms $\mathbb{1}\{Increase_{ifmt}\} \times \Delta lnP_{ifmt}^{input}$ and $\mathbb{1}\{Decrease_{ifmt}\} \times \Delta lnP_{ifmt}^{input}$ from the empirical specification described in section 4.

5.1 Passthrough - Pooling Urban and Rural Firms

The first results shared in Table 4 pool rural and urban firms and shows the first stage result that firms update output prices when input prices change. For the staple foods sub-sample in Columns 1-3, the passthrough rate elasticity is about 0.62 in the preferred specification, but is stable with different sets of fixed effects. That is, a one percent increase in the input price is associated with a 0.62% increase in the output price. Passthrough rates decrease to between 0.26-0.30% when the sample size increases to include differentiated commodities in columns 4-6. When the sample size increases to include all products, passthrough rates are slightly higher - falling between 0.33-0.35%.

For input price decreases, passthrough rates are between 0.82-0.85% for staples, 0.33% for differentiated commodities, and 0.63-0.66% for all items. In all models passthrough rates for input price decreases are higher than input price increases showing that firms pass through cost savings more then cost raises. Passthrough rates are higher for staples compared to the larger samples that include more perishable and differentiated goods. High 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. But, passthrough rates alone are not sufficient to draw conclusions about market structure because the price elasticity of demand could also explain variation in passthrough. It is reasonable to expect staple foods to have higher passthrough rates since they have more firms competing to sell them and there is little product differentiation. But, it could also be that differentiated products have relatively more elastic demand, so that price increases cause demand to decrease at a faster rate.

Table 4: Passthrough Rates - Pooling Rural and Urban Firms

	Dep Var: D.Ln Output Price								
	Staples			**Commodities**			**All Items**		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Increase	0.634***	0.615***	0.616***	0.264*	0.257*	0.299*	0.327**	0.325**	0.351**
	(0.073)	(0.076)	(0.076)	(0.131)	(0.137)	(0.152)	(0.146)	(0.153)	(0.159)
Decrease	0.823***	0.839***	0.854***	0.329***	0.334***	0.331**	0.649***	0.631***	0.658***
	(0.060)	(0.063)	(0.036)	(0.105)	(0.113)	(0.130)	(0.096)	(0.105)	(0.150)
Round FE	X	X	X	X	X	X	X	X	X
Item FE	X	X		X	X		X	X	
Market FE		X			X			X	
Firm FE			X			X			X
Obs	926	926	926	1381	1381	1381	1648	1624	1624
Adj R-Squared	0.7364	0.7355	0.7571	0.2542	0.2517	0.2372	0.6038	0.6055	0.5796

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

5.2 Passthrough - Urban and Rural Firm Heterogeneity

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

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

It is similar to equation in section 4, 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_2 on the terms that are abbreviated to *Increase* and *Decrease* in tables are the passthrough rates for input price changes in urban areas while the coefficients, β_3 and β_4, on the interaction terms reflect the difference of rural firms' output prices compared to urban firms.

Across all models in Table 5, urban firms have positive passthrough rates - ranging from 0.74-0.96% for both price increases and decreases for all sub-samples. Similar to Table 4, input price

Table 5: Passthrough Rates - Rural and Urban Firms - Mechanisms

	Dep Var: D.Ln Output Price								
	Staples			**Commodities**			**All Items**		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Increase	0.895***	0.870***	0.952***	0.652***	0.620***	0.681**	0.742***	0.744***	0.781***
	(0.144)	(0.164)	(0.214)	(0.187)	(0.220)	(0.275)	(0.095)	(0.096)	(0.138)
Decrease	0.743***	0.756***	0.803***	0.781***	0.813***	0.949***	0.884***	0.868***	0.963***
	(0.071)	(0.088)	(0.053)	(0.084)	(0.092)	(0.183)	(0.047)	(0.057)	(0.024)
Rural × Increase	-0.339**	-0.332*	-0.420*	-0.487**	-0.459*	-0.505*	-0.577***	-0.582***	-0.599***
	(0.142)	(0.164)	(0.221)	(0.204)	(0.236)	(0.291)	(0.124)	(0.129)	(0.163)
Rural × Decrease	0.109*	0.107	0.028	-0.563***	-0.590***	-0.733***	-0.640***	-0.622***	-0.738***
	(0.059)	(0.074)	(0.051)	(0.105)	(0.115)	(0.203)	(0.086)	(0.095)	(0.087)
Rural	0.040**			-0.007			-0.024		
	(0.017)			(0.024)			(0.022)		
Round FE	X	X	X	X	X	X	X	X	X
Item FE	X	X		X	X		X	X	
Market FE		X			X			X	
Firm FE			X			X			X
Obs	926	926	926	1381	1381	1381	1648	1624	1645
Adj R-Squared	0.7419	0.7402	0.7650	0.3372	0.3346	0.3551	0.7075	0.7045	0.7092

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

increases have higher passthrough rates for staples in columns 1-3 compared to samples with more differentiated products in columns 4-9. But, passthrough rates for price decreases are higher for differentiated products compared to staple foods - approximately 0.80% for staple foods for the preferred model with firm fixed effects up to 0.96% for samples with differentiated commodities and all items using the preferred specification in columns 3, 6 and 9.

The coefficients on $Rural \times Increase$ are all negative, indicating that passthrough rates are lower for rural firms compared to urban firms. For staple foods sample, a 1% increase in input prices, urban firms' output price increases 0.95% - near to what would be predicted by perfect competition, while rural firms only increase output prices by 0.53%, resulting in 55% lower passthrough rates compared to urban firms. When the sample expands to include differentiated products, rural firm passthrough rate shrinks to be 23-29% lower compared to urban firms. Consistent with Atkin and Donaldson (2015), the lower passthrough rates are consistent with a regime of higher demand elasticities in rural areas - meaning that rural customers are less able to tolerate price increases. This pattern is also consistent with having more competitive pressure in the market structure in urban areas.

Turning to price decreases, a different pattern emerges. For staple foods, rural firms exhibit positive but imprecisely estimated passthrough elasticities, providing weak evidence that rural firms passthrough positive price shocks to a greater degree compared to urban firms. Yet, once the sample increases in columns 4-9, coefficient signs reverse and are consistent with the previous pattern where firms do not passthrough cost savings as much as urban firms. In the preferred specifications in columns 6 and 9, coefficients are negative 0.73-0.74 for price decreases, resulting in passthrough rate elasticities which is 23% lower than urban firms. Overall, it shows that output prices for rural firms exhibit more rigidity compared to urban firms.

6 Results 2: Possible Mechanisms

What explains differences in passthrough rates for rural firms? Is there evidence that differences in market structure are relevant factors? Do community level factors explain differences in prices? The following equation is estimated to understand which mechanisms explain differences in passthrough by rural firms.

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

Three community level mechanisms and two competition mechanisms are included to compare whether features of rural communities or features of the competitive environment explain differences in passthrough rates. All variables are continuous and standardized to z-scores so that they are comparable. The coefficients nested in β_1 and β_2 represent the percent change in the first difference of the logged output price given a one standard deviation increase in the mechanism variable following a one percent increase or decrease in logged input prices. For example, a one percent increase in input price and a one standard deviation increase in distance to urban center is associated with about a 0.12% increase in the output price for the staple foods sample. In other words, passthrough increases with distance.

The three community mechanisms are distance to urban center, bus fare to urban center, and rural population size. The community mechanisms are time-invariant and defined at the market (e.g. community) level and interacted with input price shock variable otherwise they would be absorbed by market and firm fixed effects. They provide information about the role of information frictions and transaction costs and strength of social ties or community pressure in smoothing input price passthrough. In theory, communities that are more isolated with longer travel times to a city would have higher information frictions and transaction costs (Allen, 2014; Aggarwal et al., 2018). And communities with smaller populations are more likely to have stronger social ties (Alcott et al., 2007). The mechanisms distance to urban center and bus fare would capture information frictions and transaction costs and community population size would capture social ties. Bus fare differs from distance because it captures other features of rural communities that make accessing a city more difficult - like road quality.

The two competition mechanisms are the change in the number of competitors and the absolute number of competitors are defined for each firm within each market. The change in number of competitors captures firms pricing response after a new entrant joins their market. It is defined as a percent change in the number of competitors to reflect the fact that increasing competitors from 1 to 2 is more meaningful than an increase in number of competitors from 10 to 11. The absolute number of competitors captures the general competitive pressure associated with have a larger number of rivals. The number of competitors is weighted by market size because larger markets are likely to serve larger populations with more demand. The weighted number of competitors therefore reflects cases where firms have relatively more competitive pressure for a given market size.

Table 6 reports results for these regressions. Distance to urban center is associated with higher passthrough rates for both increases and decreases, but only price increases consistently meet rejection criteria across all samples and specifications. It means that more remote firms passthrough price changes to a greater degree than firms closer to urban centers. Similarly, busfare is weakly related to higher passthrough rates, although few estimates are statistically different from zero. I previously theorized that information frictions could potentially smooth price variation because rural customers would be slower to anticipate and accept price changes. If this were the case, we would see less passthrough of both price increases and decreases. Higher observed passthrough rates shows that firms require additional compensation for higher transportation costs.

Interactions with population size provide clearer evidence that smaller communities are associated with lower passthrough rates. Community population size is defined as the inverse so that coefficients are oriented in the same direction as the distance and bus fare variables. For input price increase, passthrough rates decrease as the population gets smaller. A one standard deviation increase in population size is related to a 0.09-0.12% decrease in logged output price for the staple foods sub-sample. As the sample size increases to includes differentiated products in columns 4-9, point estimates remain negative at slightly smaller, but are not different from zero. Following price increases, small communities do not raise prices as much as firms in larger communities. Evidence following an input price decreases are positive but near zero for all models. This is consistent with literature showing that strong social ties are associated with risk-sharing behavior that includes pricing behavior of rural firms.

Despite some evidence that community pressure or social ties are associated with lower output prices, coefficients on firm entry and total number of other competitors shows that competitive pressure also matters. A one standard deviation increase new entrants is associated with a 0.04-0.06% increase in output prices across all sub-samples, but are only precisely estimated for the staples sub-sample. A one standard deviation increase in the total number of competitors is positive in most specifications, but are near zero and imprecise for the staples sub-sample. Taken together, it shows the input price increases are generally associated with higher passthrough rates that is consistent with having more competitive pressure.

Patterns for input price decreases are more mixed. For the staples sub-sample, point estimates are negative for both change in entrants and the number of competitors. This is a counter-intuitive result because in perfect competition framework, higher competitive pressure would in theory increase passthrough rates for price increases as well as price decreases. The fact that price increases goes in the expected direction, while price decreases are negative suggests that firms in rural areas may retain some of the cost savings if they incur a positive input cost shock. However, once the sample size expands in columns 4-9, point estimates for price decreases are all positive, ranging from 0.03-0.07 for change in competitors, and 0.12-0.18 for number of competitors, suggesting that rural firms do not consistently retain cost savings for more perishable and differentiated goods.

To understand more about the net effect of output price changes regardless of whether the input price increased or decreased, Table 10 in the appendix shares results for symmetric passthrough. Across the differentiated commodities and full items sample, the number of competitors is consistently associated with higher passthrough rates. Point estimates are also positive for the change in competitors, but are less precise. But, for the staples sample alone, point estimates are negative but imprecise. It suggests that output prices for food staples are more rigid compared to other item groups and firms only smooth price variation for a subset of food staples.

Table 6: Passthrough Rates - Mechanisms for Rural Firms

	Dep Var: D.Ln Output Price								
	Staples			**Commodities**			**All Items**		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Increase	0.573***	0.572***	0.563***	0.396***	0.399***	0.400***	0.384***	0.388***	0.388***
	(0.061)	(0.063)	(0.065)	(0.060)	(0.062)	(0.066)	(0.060)	(0.063)	(0.062)
Decrease	0.880***	0.878***	0.864***	0.286***	0.286***	0.285***	0.306***	0.305***	0.301***
	(0.037)	(0.038)	(0.038)	(0.055)	(0.057)	(0.054)	(0.053)	(0.054)	(0.051)
Community Mechanisms									
Increase × Distance	0.117***	0.115***	0.113**	0.106*	0.107*	0.084	0.086*	0.079	0.058
	(0.036)	(0.035)	(0.042)	(0.055)	(0.059)	(0.079)	(0.048)	(0.055)	(0.075)
Decrease × Distance	0.003	0.007	0.011	0.129*	0.128*	0.145*	0.134**	0.136**	0.142*
	(0.033)	(0.033)	(0.036)	(0.065)	(0.068)	(0.082)	(0.062)	(0.066)	(0.081)
Increase × Busfare	0.050	0.061	0.043	0.036	0.033	0.038	0.020	0.020	0.032
	(0.035)	(0.036)	(0.043)	(0.039)	(0.043)	(0.065)	(0.037)	(0.045)	(0.070)
Decrease × Busfare	0.058*	0.048	0.020	0.016	0.015	0.003	0.007	0.009	0.003
	(0.033)	(0.031)	(0.034)	(0.056)	(0.057)	(0.074)	(0.050)	(0.052)	(0.065)
Increase × Inverse Population	-0.094**	-0.087**	-0.123**	-0.085	-0.092	-0.084	-0.060	-0.054	-0.052
	(0.042)	(0.041)	(0.045)	(0.072)	(0.076)	(0.095)	(0.053)	(0.060)	(0.082)
Decrease × Inverse Population	0.032	0.035	0.062	0.022	0.029	0.026	0.030	0.028	0.039
	(0.040)	(0.041)	(0.042)	(0.034)	(0.038)	(0.048)	(0.035)	(0.039)	(0.053)
Competition Mechanisms									
Increase × Change in Competitors	0.038**	0.036**	0.060**	0.049	0.049	0.046	0.056	0.053	0.049
	(0.015)	(0.015)	(0.028)	(0.054)	(0.058)	(0.099)	(0.056)	(0.061)	(0.096)
Decrease × Change in Competitors	-0.074**	-0.071**	-0.110***	0.054	0.051	0.034	0.066	0.065	0.042
	(0.026)	(0.028)	(0.035)	(0.055)	(0.056)	(0.064)	(0.055)	(0.055)	(0.063)
Increase × Number of Competitors	-0.003	0.000	0.055	0.125**	0.132**	0.137**	0.160***	0.166***	0.176***
	(0.047)	(0.048)	(0.064)	(0.056)	(0.057)	(0.061)	(0.055)	(0.058)	(0.060)
Decrease × Number of Competitors	-0.055	-0.060	-0.096*	0.146**	0.141**	0.179**	0.134*	0.123	0.156*
	(0.037)	(0.039)	(0.048)	(0.065)	(0.067)	(0.077)	(0.078)	(0.081)	(0.086)
Round FE	X	X	X	X	X	X	X	X	X
Item FE	X	X		X	X		X	X	
Market FE		X			X			X	
Firm FE			X			X			X
Obs	744	744	744	1074	1074	1074	1168	1168	1171
Adj R-Squared	0.7552	0.7538	0.7540	0.3275	0.3197	0.2571	0.2902	0.2842	0.2321

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

7 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 re-combine input price increases and decreases to one variable to understand whether symmetric passthrough rates are consistent with findings from asymmetric specifications presented in the main results.

7.1 Matching on Input Price Changes

One threat to interpreting differences in passthrough for urban and rural firms is whether each type of firm has systematically lower or higher input price differences. If urban firms cost shocks are larger than rural firms, it could simply be that they have more room to make upward and downward adjustments, especially if urban firms experience more large jumps than rural firms. 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 used 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 8 presents results for check for sub-samples with at least 1 nearest neighbor match, and for 3 nearest neighbor matches. For all samples, this drops several hundred observations that have no matches. In all specifications, the direction of changes are the same as the main findings: Rural firms have lower passthrough rates for price increases. Rural firms also have lower passthrough rates for price decreases for most specifications except for the 1 nearest neighbor match for staple foods, which is consistent with main results and provides further evidence that staple foods costs savings are passed through to a greater degree in rural areas.

7.2 Symmetric Passthrough

For symmetric passthrough, Tables 9, 10, and 11 replicate specifications from the main results section where price shocks are split. Elasticities in Table 9 are the average elasticity for both input price increases and decreases and point estimates are in-between estimates from asymmetric regressions in Table 4. Table 10 shows results for heterogeneous effect by urban and rural firms and shows that for all specifications average passthrough rates are lower for rural firms. Finally, when community and competition mechanisms are evaluated with symmetric input price shocks, we see that distance and bus fare to urban centers are related to higher passthrough rates. But, the importance of community size are close to zero- masking the heterogeneity in the main results that resulted from separating increases and decreases. And the number of competitors is again associated with higher average passthrough rates, but point estimates are negative but close to zero for staples. Again, it appears that pricing strategies for staple foods are different than those for more differentiated commodities.

8 Conclusion

References

Allcott, H., Karlan, D., Möbius, M. M., Rosenblat, T. S., and Szeidl, A. (2007). Community size and network closure. *American Economic Review*, 97(2):80–85.

Ambrus, B. A., Mobius, M., and Szeidl, A. (2014). Consumption Risk-Sharing in Social Networks †. 104(1):149–182.

Attanasio, B. O., Barr, A., and Cardenas, J. C. (2012). Risk Pooling, Risk Preferences, and Social Networks. 4(2):134–167.

Bai, Y., Naumova, E. N., and Masters, W. A. (2020). Seasonality of diet costs reveals food system performance in east africa. *Science Advances*, 6(49):eabc2162.

Bergquist, L. F. and Dinerstein, M. (2020). Competition and Entry in Agricultural Markets: Experimental Evidence from Kenya†. *American Economic Review*, 110(12):3705–3747.

Bonnet, C., Trachtman, C., Van Dop, M., and Villas-Boas, S. B. (2018). Food markets' structural empirical analysis: a review of methods and topics. *European Review of Agricultural Economics*, 47(December 2019):819–847.

Bonnet, C. and Villas-Boas, S. B. (2016). An analysis of asymmetric consumer price responses and asymmetric cost pass-through in the French coffee market. *European Review of Agricultural Economics*, 43(5):781–804.

Boysen, O. (2016). Food demand characteristics in uganda: Estimation and policy relevance. *South African Journal of Economics*, 84(2):260–293.

Breza, E., Chandrasekhar, A., Golub, B., and Parvathaneni, A. (2019). Networks in economic development. *Oxford Review of Economic Policy*, 35(4):678–721.

Busso, M. and Galiani, S. (2019). The causal effect of competition on prices and quality: Evidence from a field experiment. *American Economic Journal: Applied Economics*, 11(1):33–56.

Casaburi, L. and Reed, T. (2021). Using individual-level randomized treatment to learn about market structure . (March).

Chesnes, M. (2016). Asymmetric pass- Through in U.S. gasoline prices. *Energy Journal*, 37(1):153–180.

Cunha, J. M., De Giorgi, G., and Jayachandran, S. (2019). The Price Effects of Cash Versus In-Kind Transfers. *Review of Economic Studies*, 86(1):240–281.

Dalheimer, B., Herwartz, H., and Lange, A. (2021). The threat of oil market turmoils to food price stability in Sub-Saharan Africa. *Energy Economics*, 93:105029.

Di Falco, S. and Giorgi, G. D. (2019). Farmers to Entrepreneurs.

Dillon, B. M. and Barrett, C. B. (2016). Global Oil Prices and Local Food Prices: Evidence from East Africa. *American Journal of Agricultural Economics*, 98(1):154–171.

Ecker, O. and Qaim, M. (2011). Analyzing Nutritional Impacts of Policies: An Empirical Study for Malawi. *World Development*, 39(3):412–428.

Frey, G. and Manera, M. (2007). Econometric models of asymmetric price transmission. *Journal of Economic Surveys*, 21(2):349–415.

Grabrucker, K. and Grimm, M. (2020). Is There a Rainbow after the Rain? How Do Agricultural Shocks Affect Non-Farm Enterprises? Evidence from Thailand. *American Journal of Agricultural Economics*, 00(00):1–25.

Green, R., Cornelsen, L., Dangour, A. D., Honorary, R. T., Shankar, B., Mazzocchi, M., and Smith, R. D. (2013). The effect of rising food prices on food consumption:systematic review with meta-regression. *BMJ (Online)*, 347(7915):1–9.

Harwood, J., Heifner, R., Coble, K., Perry, J., and Somwaru, A. (1999). Measuring price and yield risk. *Managing risk in farming: concepts, research, and analysis. Agricultural Economics Report No. 774*.

Honoré, B. E., Kaufmann, D., and Lein, S. (2012). Asymmetries in Price-Setting Behavior: New Microeconometric Evidence from Switzerland. *Journal of Money, Credit and Banking*, 44(SUPPL. 2):211–236.

Kinnan, C., Samphantharak, K., Townsend, R., and Cossio, D. A. V. (2021). Insurance and Propagation in Village Networks. *NBER Working Paper*, 53(9):1689–1699.

Lewis, M. (2008). Price dispersion and competition with differentiated sellers. *Journal of Industrial Economics*, 56(3):654–678.

Luco, F. (2019). Who benefits from information disclosure? The case of retail gasoline. *American Economic Journal: Microeconomics*, 11(2):277–305.

Mbebe, e. A., Otieno, D. J., Nyikal, R., and Odendo, M. (2019). Invited paper presented at the 6th African Conference of Agricultural Economists ,. *Invited paper presented at the 6th African Conference of Agricultural Economists*, pages 1–23.

Menzio, G. (2021). Optimal Product Design: Implications for Competition and Growth Under Declining Search Frictions.

Meyer, J. and von Cramon-Taubadel, S. (2004). Asymmetric price transmission: A survey. *Journal of Agricultural Economics*, 55(3):581–611.

Muhammad, A., D'Souza, A., Meade, B., Micha, R., and Mozaffarian, D. (2017). The Influence of Income and Prices on Global Dietary Patterns by Country, Age, and Gender. *Amber Waves:The Economics of Food, Farming, Natural Resources, and Rural America*, 2017(10).

Muhammad, A., Seale, J. L., Meade, B., and Regmi, A. (2015). International evidence on food consumption patterns: An update using 2005 international comparison program data. *International Food Consumption Patterns and Global Drivers of Agricultural Production*, pages 1–104.

Müller, G. and Ray, S. (2007). Asymmetric price adjustment: Evidence from weekly product-level scanner price data. *Managerial and Decision Economics*, 28(7):723–736.

Nieber, K. (2017). The Impact of Coffee on Health. *Planta Medica*, 83(16):1256–1263.

Peltzman, S. (2000). Prices rise faster than they fall. *Journal of Political Economy*, 108(3):466–502.

Reardon, T., Echeverria, R., Berdegue, J., Minten, B., Liverpool-Tasie, S., Tschirley, D., and Zilberman, D. (2019). Rapid transformation of food systems in developing regions: Highlighting the role of agricultural research & innovations. *Agricultural Systems*, 172(June):47–59.

Rudolf, R. (2019). The impact of maize price shocks on household food security: Panel evidence from Tanzania. *Food Policy*, 85(April):40–54.

Appendix

A Evaluating Strict Exogeneity Assumption

Table 7: Regressing input prices on input search intensity

	Dep Var: Ln Input Price								
	Staples			Commodities			All Items		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Search Index	-0.054***	-0.053***	-0.008	-0.046***	-0.044***	-0.019	-0.033***	-0.032**	0.011
	(0.007)	(0.006)	(0.011)	(0.012)	(0.014)	(0.024)	(0.011)	(0.012)	(0.024)
Round FE	X	X	X	X	X	X	X	X	X
Item FE	X	X		X	X		X	X	
Market FE		X			X			X	
Firm FE			X			X			X
Obs	1801	1801	1801	2499	2499	2499	4115	4115	4115
Adj R-Squared	0.8094	0.8140	0.4108	0.9532	0.9533	0.8000	0.9502	0.9502	0.6924
	Dep Var: D.Ln Input Price								
	Staples			**Commodities**			**All Items**		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Search Index	-0.002	0.000	-0.014	0.001	0.004	-0.015	0.022	0.022	0.025
	(0.008)	(0.008)	(0.020)	(0.015)	(0.018)	(0.029)	(0.021)	(0.021)	(0.033)
Round FE	X	X	X	X	X	X	X	X	X
Item FE	X	X		X	X		X	X	
Market FE		X			X			X	
Firm FE			X			X			X
Obs	1087	1087	1087	1468	1468	1468	2303	2303	2303
Adj R-Squared	0.3008	0.2938	0.2522	0.0948	0.0911	0.0833	0.0677	0.0644	0.0363

Standard errors in parenthesis, clustered at market level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The top panel outcome variable is the log input price regressed on a search intensity index with different sets of fixed effects. The search index components include the number of suppliers that a firm communicated with, purchased from, and the number of different locations. The bottom panel outcome variable is the first difference of the logged input price regressed on the search index with different sets of fixed effects.

B Robustness Check: Matching on Input Price Changes

Table 8: Dropping observations without overlap

	Panel A: At least 1 nearest neighbor exact matching on input price change								
	Staples			**Commodities**			**All Items**		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Increase	0.998***	0.986***	1.017**	0.650***	0.616***	0.672**	0.728***	0.736***	0.784***
	(0.282)	(0.319)	(0.389)	(0.185)	(0.222)	(0.297)	(0.102)	(0.102)	(0.147)
Rural	0.046			0.004			-0.017		
	(0.028)			(0.024)			(0.023)		
Rural × Increase	-0.301	-0.306	-0.370	-0.473**	-0.439*	-0.458	-0.549***	-0.560***	-0.572***
	(0.255)	(0.297)	(0.391)	(0.210)	(0.245)	(0.320)	(0.138)	(0.140)	(0.182)
Decrease	0.677***	0.685***	0.732***	0.786***	0.815***	0.975***	0.881***	0.858***	0.957***
	(0.087)	(0.110)	(0.070)	(0.111)	(0.117)	(0.202)	(0.052)	(0.066)	(0.027)
Rural × Decrease	0.150**	0.149	0.100	-0.583***	-0.612***	-0.777***	-0.642***	-0.614***	-0.727***
	(0.074)	(0.097)	(0.078)	(0.151)	(0.161)	(0.240)	(0.109)	(0.121)	(0.123)
Obs	788	788	788	1228	1228	1228	1523	1502	1520
Adj R-Squared	0.7169	0.7112	0.7413	0.3042	0.3015	0.3109	0.7085	0.7048	0.7061

	Panel B: At least 3 nearest neighbors exact matching on input price change								
	Staples			**Commodities**			**All Items**		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Increase	1.045***	1.014**	1.089*	0.745***	0.724**	0.750	0.746***	0.741***	0.826***
	(0.377)	(0.434)	(0.569)	(0.215)	(0.296)	(0.494)	(0.136)	(0.134)	(0.179)
Rural	0.037			0.037*			0.004		
	(0.030)			(0.021)			(0.019)		
Rural × Increase	-0.269	-0.250	-0.429	-0.483**	-0.468	-0.556	-0.516***	-0.513***	-0.631***
	(0.333)	(0.401)	(0.572)	(0.238)	(0.310)	(0.511)	(0.155)	(0.155)	(0.206)
Decrease	0.646***	0.650***	0.597***	0.932***	0.960***	0.979**	0.924***	0.912***	1.002***
	(0.122)	(0.154)	(0.182)	(0.151)	(0.187)	(0.398)	(0.047)	(0.063)	(0.020)
Rural × Decrease	-0.054	-0.068	0.083	-0.618***	-0.633***	-0.606	-0.589***	-0.580***	-0.646***
	(0.112)	(0.148)	(0.194)	(0.173)	(0.205)	(0.408)	(0.088)	(0.101)	(0.090)
Obs	528	528	528	921	921	921	1278	1258	1275
Adj R-Squared	0.6724	0.6638	0.6635	0.3126	0.3189	0.2396	0.7408	0.7352	0.7315
Round FE	X	X	X	X	X	X	X	X	X
Item FE	X	X		X	X		X	X	
Market FE		X			X			X	
Firm FE			X			X			X

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

C Symmetric Passthrough

Table 9: Symmetric Passthrough Rates - Pooling Rural and Urban Firms - by Item Sub-samples

	Dep Var: D.Ln Output Price								
	Staples			**Commodities**			**All Items**		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
D.Ln Input Price	0.740***	0.740***	0.753***	0.294***	0.293***	0.315***	0.508***	0.494***	0.529***
	(0.032)	(0.033)	(0.043)	(0.082)	(0.084)	(0.095)	(0.095)	(0.097)	(0.125)
Round FE	X	X	X	X	X	X	X	X	X
Item FE	X	X		X	X		X	X	
Market FE		X			X			X	
Firm FE			X			X			X
Obs	926	926	926	1381	1381	1381	1648	1624	1624
Adj R-Squared	0.7336	0.7314	0.7511	0.2537	0.2509	0.2376	0.5871	0.5913	0.5625

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

Table 10: Symmetric Passthrough Rates - Heterogeneity by Rural and Urban Firms - by Item Sub-samples

	Dep Var: D.Ln Output Price								
	Staples			**Commodities**			**All Items**		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
D.Ln Input Price	0.781***	0.784***	0.853***	0.711***	0.709***	0.803***	0.834***	0.823***	0.898***
	(0.052)	(0.056)	(0.078)	(0.125)	(0.130)	(0.105)	(0.055)	(0.060)	(0.051)
Rural	-0.005			-0.001			-0.017		
	(0.011)			(0.016)			(0.013)		
Rural × D.Ln Input Price	-0.061	-0.066	-0.153*	-0.519***	-0.516***	-0.604***	-0.630***	-0.619***	-0.692***
	(0.060)	(0.063)	(0.082)	(0.134)	(0.140)	(0.117)	(0.077)	(0.084)	(0.074)
Round FE	X	X	X	X	X	X	X	X	X
Item FE	X	X		X	X		X	X	
Market FE		X			X			X	
Firm FE			X			X			X
Obs	927	927	927	1383	1383	1383	1651	1627	1648
Adj R-Squared	0.7162	0.7140	0.7624	0.3349	0.3313	0.3585	0.7011	0.6983	0.7030

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

Table 11: Symmetric Passthrough Rates - Rural Market Mechanisms - by Item Sub-samples

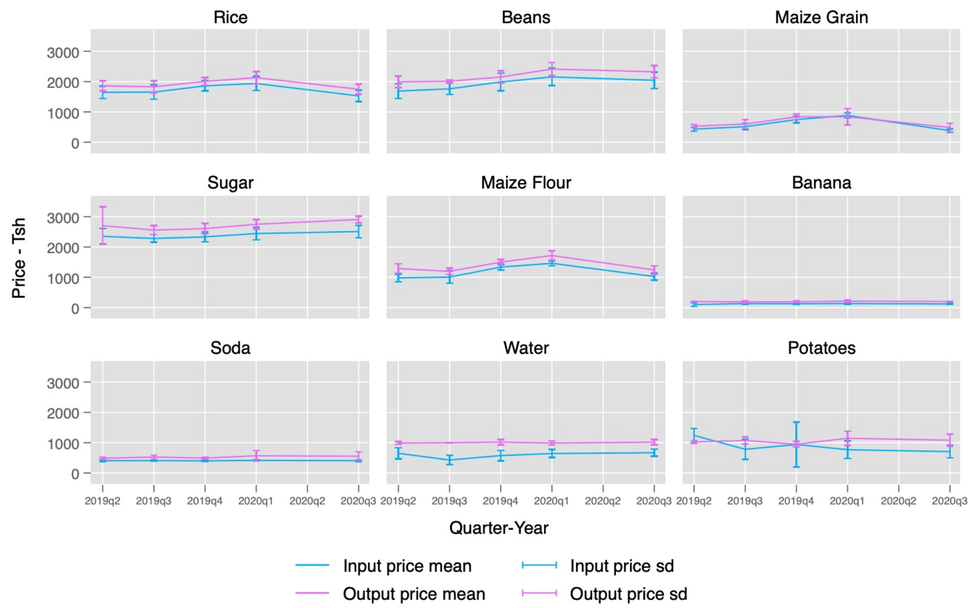
	Dep Var: D.Ln Output Price								
	Staples			**Commodities**			**All Items**		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
ΔlnP^{input}	0.737***	0.735***	0.734***	0.335***	0.336***	0.336***	0.337***	0.337***	0.334***
	(0.034)	(0.035)	(0.038)	(0.028)	(0.028)	(0.031)	(0.033)	(0.034)	(0.035)
$\Delta lnP^{input}\times$ Distance	0.057**	0.059**	0.065**	0.103***	0.104***	0.095***	0.104***	0.105***	0.092**
	(0.024)	(0.024)	(0.024)	(0.033)	(0.033)	(0.034)	(0.033)	(0.033)	(0.034)
$\Delta lnP^{input}\times$ Busfare	0.061***	0.057***	0.036	0.043	0.042	0.044	0.027	0.027	0.034
	(0.020)	(0.019)	(0.025)	(0.033)	(0.033)	(0.035)	(0.029)	(0.031)	(0.031)
$\Delta lnP^{input}\times$ Inv. Population	-0.013	-0.008	-0.011	0.000	0.000	0.011	0.010	0.009	0.022
	(0.026)	(0.026)	(0.035)	(0.022)	(0.023)	(0.026)	(0.024)	(0.025)	(0.029)
$\Delta lnP^{input}\times$ Change in Comp.	-0.009	-0.011	-0.022	0.050	0.049	0.039	0.060	0.059	0.046
	(0.014)	(0.015)	(0.020)	(0.040)	(0.042)	(0.052)	(0.040)	(0.042)	(0.050)
$\Delta lnP^{input}\times$ Number Comp.	-0.036	-0.040	-0.033	0.115***	0.114***	0.126***	0.124***	0.121***	0.136***
	(0.027)	(0.028)	(0.039)	(0.035)	(0.036)	(0.039)	(0.038)	(0.039)	(0.041)
Round FE	X	X	X	X	X	X	X	X	X
Item FE	X	X		X	X		X	X	
Market FE		X			X			X	
Firm FE			X			X			X
Obs	744	744	744	1075	1075	1075	1169	1169	1172
Adj R-Squared	0.7425	0.7417	0.7404	0.3266	0.3177	0.2524	0.2911	0.2856	0.2310

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

D Additional Tables and Figures

Table 12: Price Characteristics by Firm Type for All Commodities

	Mean	sd	Median	n	P-Val Diff Urban-Rural
Urban Firms:					
Input Price, 1 kg	1228.74	792.69	1300	559	
Output Price, 1 kg	1387.33	882.26	1400	559	
Tsh Mark-up	162.44	188.98	100	549	
Percent Mark-up	0.17	0.25	0.12	549	
Input price diff, if increased	198.80	163.68	150	133	
Input price diff, if decreased	-221.28	171.08	-197.5	98	
Rural Firms:					
Input Price, 1 kg	1378.13	809.84	1600	1840	0.0001
Output Price, 1 kg	1658.67	918.70	2000	1840	0.0000
Tsh Mark-up	282.98	205.00	260	1831	0.0000
Percent Mark-up	0.43	0.61	0.21	1831	0.0000
Input price diff, if increased	187.85	175.45	150	619	0.5088
Input price diff, if decreased	-222.45	212.81	-150	421	0.9595



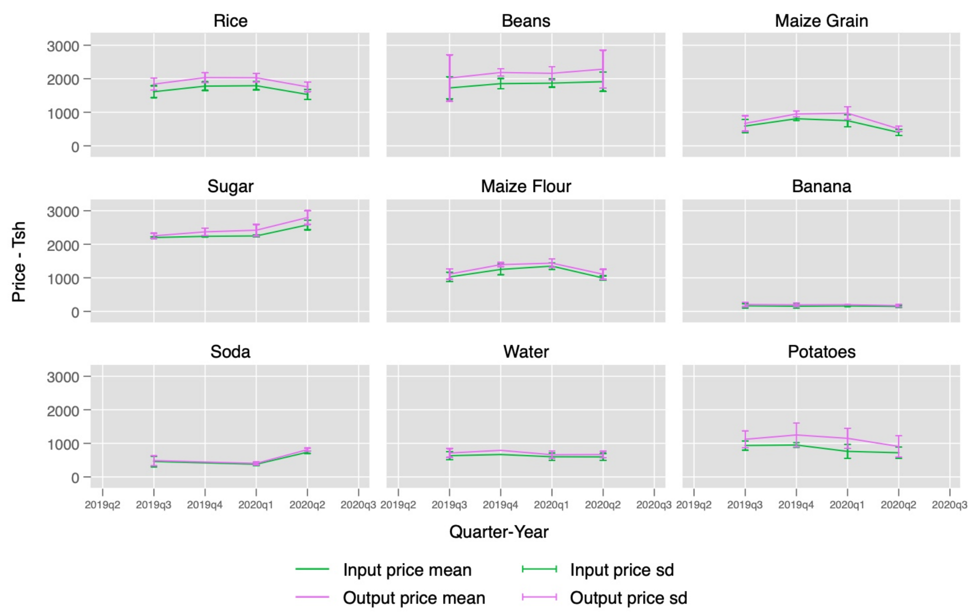


Figure 2: Input and output price means and standard deviations in rural and urban markets

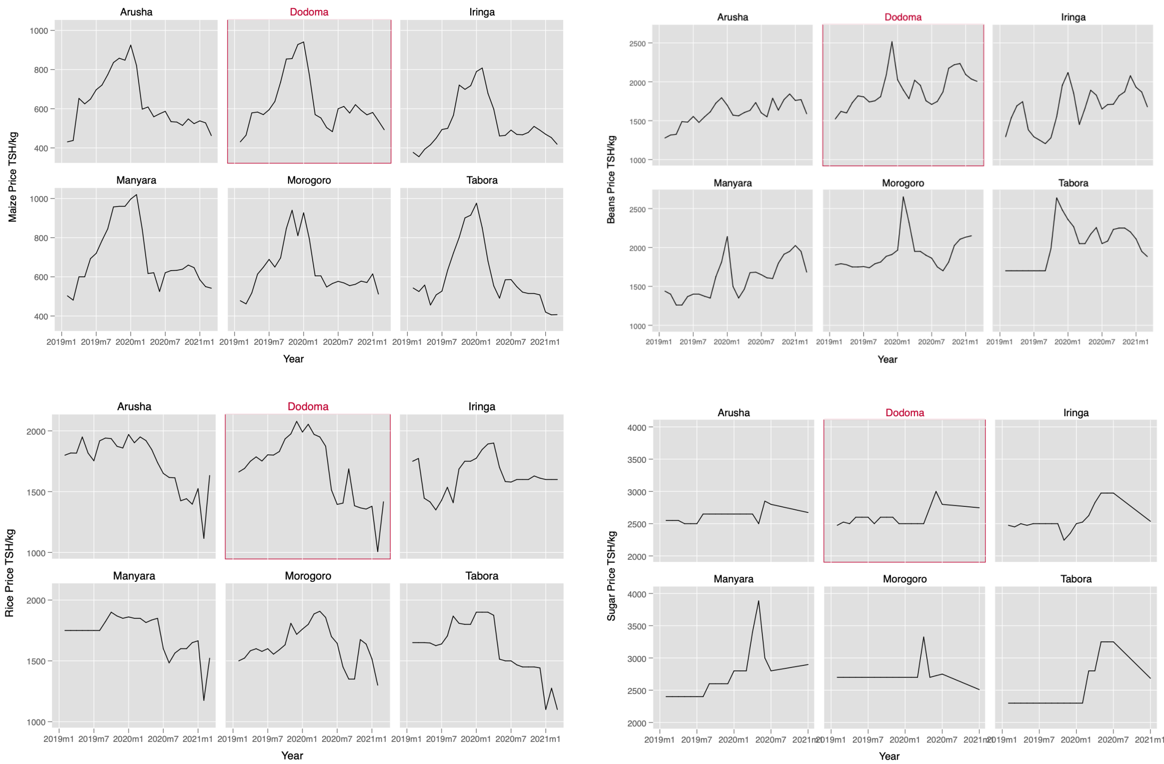


Figure 3: World Food Programme prices for staple foods in 6 markets from 2019-2020

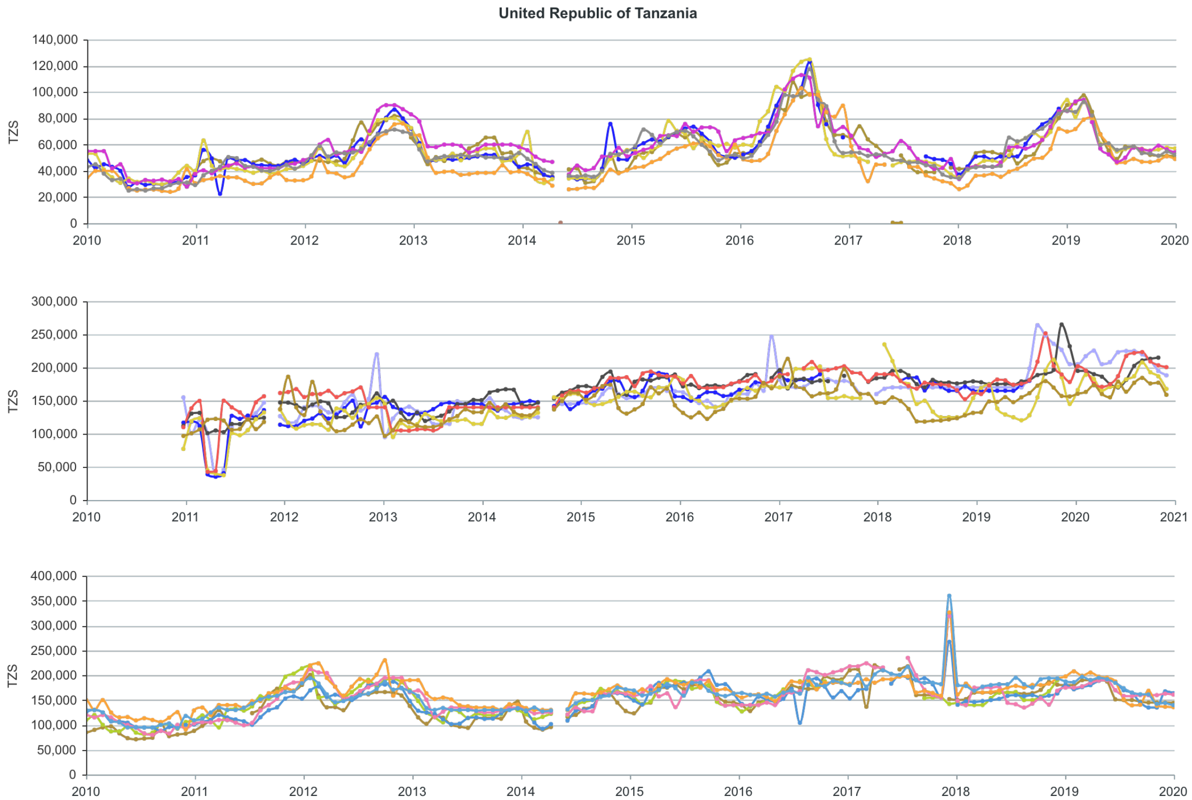


Figure 4: Long-run trends in World Food Programme prices for staple foods in 6 markets from 2010-2020