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Fading choice: transport costs and variety in consumer goods

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Abstract

We examine the spatial variation in variety of manufactured consumer goods to study how choice fades across space. We use data on 132 consumer goods and over 800 brands available from a purpose-designed survey of fixed shops and periodic market stalls in towns and villages in Ethiopia. We find that local consumer choice fades, with fewer varieties in remoter villages. On average, these villages have approximately half the number of available items compared to their nearest market town. A fall in travel time of a half-hour is associated with 4 extra goods and 9 brands. Variety also increases with inequality and market size. Furthermore, we estimate a model of heterogeneous consumers with a preference for variety and monopolistically competitive traders to disentangle the role of transport costs from the taste for variety, and to assess the consequences for prices. Our model estimates suggest that local consumer prices contain a markup of 8% above source town prices and transport costs. We demonstrate the significant costs to consumers from both low variety and high trade costs. Ignoring such costs means that poverty is underestimated in remote places. In turn, when infrastructure investments raise variety, the likely fall in poverty will be underestimated too.

1 | INTRODUCTION

Transport costs reduce consumer welfare not only through higher prices but also through reduced variety: choice fades with distance. To study how remoteness reduces the variety of consumer goods available, we examine the choice of varieties in manufactured consumer goods in domestic markets in Ethiopia, using a purposive survey of goods in shops and sold by itinerant traders.

Why might remoteness affect product variety? First, in remote areas, previous research (Jacoby and Minten 2009; Jacoby 2000; Minten and Kyle 1999; Minten *et al.* 2013; Stifel and

Minten 2008; Dercon *et al.* 2009; Khandker *et al.* 2009) has shown that productivity is relatively low and poverty is more intense. In the case of Ethiopia, for instance, the costs imposed on farm households due to remoteness alone lower incentives to use potentially profitable inputs; Minten *et al.* (2013) show that incentives for fertilizer use decline quickly over space because output to input price ratios drop by half for every kilometre. Dercon *et al.* (2009) report that access to all-weather roads reduces the incidence of poverty by 7 percentage points. Thus if the demand for variety has a positive income elasticity,[1] then remoteness will also be associated with a reduction in the demand for variety. Second, high travel costs imply that goods will be more costly in rural areas. With any fixed cost of taking particular varieties to market, this will give rise to a reduction in the set of varieties. And third, in remote areas, the market size may be too small to support much competition. Therefore shopkeepers and traders might be able to restrict the set of varieties in order to focus on products with high margins.

There is a large literature in international trade examining the effects of fixed costs, incomes and market size on varieties traded. Hummels and Klenow (2005), for example, find that larger and wealthier countries trade more, and that 60% of the difference in aggregate trade flows comes from differences in the number of goods traded.[2] Smaller countries will have less variety in consumption as a result of fixed costs, both in production and in international trade. This literature suggests that there is a strong response of variety to changes in trade barriers or country size (Broda and Weinstein 2006; Eaton *et al.* 2011; Chaney 2008). Hersh and Voth (2009) use historical data and argue that overseas trade in 'new' goods like sugar and tea raised living standards well before the traditional rise in welfare ascribed to rising real wages post-1800.

Relatively little is known, however, about variety in domestic trade. Conventional price indices compare only the prices of goods common to locations, and ignore differences in variety across them. The sparse literature includes Handbury and Weinstein (2015), which examines detailed barcode data (allowing the precise matching of varieties) on purchases of food by households in US cities to argue that accounting for heterogeneity in variety across space reduces the variance in food price levels. Handbury (2019) finds systematic variation in the living costs faced by consumers in different income classes, and demonstrates that these differences are driven by cross-city variation in product variety rather than prices. The rise of e-commerce has offered an opportunity to examine the effects of falling trade costs on variety. For example, Fan *et al.* (2018) and Couture *et al.* (2021) examine the role of reducing trade and transport costs via the expansion of e-commerce in China. Fan *et al.* (2018) document the fall in domestic trade costs using data from the e-retailer Alibaba, while Couture *et al.* (2021) provide evidence that e-commerce leads to a significant reduction in cost of living via lower prices and increased product variety. Finally, differences in prices of goods traded within developing countries have attracted far more attention than variety; one of the few related studies is Atkin and Donaldson (2015), which uses spatial price differences from official consumer price surveys in Nigeria and Ethiopia as a proxy for domestic trade costs within developing countries.[3] Given the thin literature on varieties traded within a country, our contribution is the focus on the spatial variation in product variety in domestic trade. Indeed, as far as we are aware, this is one of the few papers to examine the spatial variation in variety in a developing country,[4] the consequences for prices, and the role of local demand and transport costs in explaining it.[5]

To examine this, we conducted a purposive survey of 100 market towns, and an average of three villages connected to each of them, for a sample of 295 villages, across the four main regions of Ethiopia. In each of these towns and villages, we conducted a census of shops and market stalls to list the goods and associated brands available there. Towns and the villages connected to them were chosen in a way that ensured that the market town could be defined as the final 'source' of goods to the destination village—an issue that we discuss in detail in Section 3. The aim was to ensure that the availability of goods in the market town serves as the set of all goods potentially available in the village, thus allowing a calculation of both the price markup between town and village, and the fall in variety relative to the town.

Variety is defined in two ways: first, in terms of the types of consumer goods available, such as batteries or jeans; second, in terms of the specific brands of each of these goods. The first type of disaggregation describes the standard notion of variety in consumption, akin to disaggregated harmonized system (HS) codes in international trade. The branded goods describe variety too, but are also important to identify prices accurately. We focus on manufactured consumer goods; this covers goods ranging from processed foods, drinks, garments, footwear and cosmetics to kitchenware, hardware and small electronics. Within these groups, there are specific items such as pasta, beers, soaps, tableware, linens, notebooks and batteries, and we can further disaggregate many of these goods by specific brands, for a total of 132 goods and over 800 brands. We describe this in more detail in Section 3.

We estimate that a fall of half an hour in travel time (a proxy for transport costs) is associated with an increase of about 4 goods and 9 brands, *ceteris paribus*. This is in the context of an average number of items in a village at 45 items, relative to 97 in the market town, while the average number of brands is 73 relative to 206 in town. A 10% increase in market size is associated with an increase of 1 item and 3 brands, similar to a 10% fall in the share of poor households, while a one standard deviation increase in inequality (mean-preserving spread) allows an increase of 2 items and 4 brands, *ceteris paribus*. We find that local consumer prices contain a markup of 8% above source town prices, inclusive of transport costs to destination.

The remainder of the paper is structured as follows. In Section 2, we describe the context and present a theoretical framework. This is followed in Section 3 by the design of a purposive survey and a summary of the data. In Section 4, we present our empirical results on the relationship between the variety of items in a village and that in the nearest town. We estimate how variety fades with travel time, and how it increases with market size and local income inequality. Section 5 presents our estimates of the tastes for variety and consequent price markups. Section 6 concludes.

2 | THE CONTEXT AND THEORETICAL FRAMEWORK

Ethiopia offers a useful setting for examining the role of transport costs and other wedges in the functioning of markets. It is landlocked, which affects external trade, while internal trade costs are strongly affected by its particular physical geography. It has a mean elevation of over 1000 metres, and the bulk of the population lives on the high plateau, a terrain bisected by mountains. The terrain has also meant that Ethiopia has one of the lowest road densities in the world. While this potential bottleneck to market development has been recognized, and has resulted in substantial investment in new roads over the last decade,[6] it is still the case that vast swathes of rural Ethiopia are dependent on travel to market on mountain tracks using mules or on foot. Road density in Ethiopia has risen from 0.46 km per 1000 persons to 0.57 km per 1000 persons, which compares very poorly with the average in Sub-Saharan Africa of 3.9 km per 1000 persons (see Ethiopian Roads Authority 2011; Shiferaw *et al.* 2015). The enormous expansion of the road network has seen a fall in the average distance from an all-weather road, from 21 km in 1997 to 10 km by 2011, but this does not reflect the variation in terrain, and the consequent time to travel even short distances. With a low urbanization rate of 17% (compared to a Sub-Saharan average of 33%), both physical and human geography in Ethiopia mean that remoteness from markets is fundamental to describing market access. The relative remoteness of villages and small market sizes also have implications for market structure. Our survey indicates that villages have just one fixed village shop on average; they are also served by itinerant traders who set up market stalls on dates fixed by village and district authorities, ensuring that there is no clash of market days across villages, or between town and village. The fixed shop usually carries foodstuffs, drink, and small durables such as batteries, while traders carry clothing, footwear and household goods in the main.[7]

2.1 | Theoretical framework

In this subsection, we outline a model of how consumers are affected by transport costs, not only through changes in prices, but also through changes in the set of goods that they can buy. We allow for inequality in incomes to examine the relationship between income inequality, travel time (our proxy for transport costs) and product variety, thus offering a framework to judge how quantitatively important these effects are in this setting. The framework that we describe below offers a potential lens to view this relationship and set ideas in a simple fashion, but equally, other standard trade frameworks deliver similar results. However, a useful by-product is that it delivers a clear price markup equation to estimate the relationship between prices in village and those in town.

We investigate how consumers are affected by transport costs, not only through changes in prices, but also through changes in the set of goods that they can buy, that is, the variety available. We also aim to understand the impact of income heterogeneity and market size on prices and variety. The model allows for consumers with a taste for variety and heterogeneous incomes, served by monopolistically competitive traders. As described in detail below, we use a standard approach to modelling preferences with a taste for variety (Dixit and Stiglitz 1977) but also allow that beyond a certain level of consumption, only new goods raise utility—however, with lower marginal utility attached to each new good. This variant on the standard framework allows us to capture the role of within-village income inequality on variety, which has intuitive appeal—there may well be incentives for traders to move expensive varieties even to relatively poor settings as long as there is some demand for such varieties. The standard Dixit–Stiglitz framework implies that there will be less product variety as income decreases, but does not speak to the role of inequality.

The model describes a spatial equilibrium where households are in fixed locations (but can travel to buy goods elsewhere), which captures a key feature of the Ethiopian context where migration remains low.[8] In this setting, traders carry goods from town to village and face both fixed and variable costs—costs that are particularly salient, as we discovered upon interviewing them. Variable costs include the transport costs of goods, while there are two kinds of fixed costs incurred by traders in our context. First, there are a number of transaction costs that increase with distance. These include: transport costs for the trader to go back and forth from the market town (apart from the cost per unit of transporting goods); the costs of sustenance, which increase with distance or days away; and related maintenance costs, including accommodation. Second, there are fixed costs by product group such as inventory and storage costs, licence fees, stall fees in villages, and other local taxes.[9] These local taxes do not work on a per item basis (and neither do licence fees), but village officials often segregate traders selling similar items in periodic markets, so that stalls selling clothes are in a different area to stalls selling shoes and stalls selling electronics, so that both licence and stall fees operate to restrict the variety of items carried by a single trader.

Table 1 offers a summary of why traders specialize in items: 38% of traders quote licences required as the reason for not trading other items, and 33% quote lack of capital, while 20% claim that the lack of demand in more remote areas dissuades them from carrying more items. Note that licences are usually by item category rather than specific to items; nevertheless, we observe that traders specialize in items, or a small subset of items within a larger item category such as clothing, suggesting that other fixed costs likely bite.

2.2 | Preferences

We adapt the standard approach to preferences, allowing for a taste for variety as in Dixit and Stiglitz (1977), by grafting on two key features of the Murphy *et al.* (1989) specification. As noted

TABLE 1 Why do traders not trade in more items?

Reasons for not trading in extra items	%
Licence regulations	38
Capital constraints	33
Low demand	20
Transport costs	5
Other miscellaneous	4

Notes: Data are from traders interviewed in 150 villages. They were asked how many items they carry and why they do not carry any other items, even within the same category, such as processed foods or clothing.

above, this is to allow that in addition to the income effect on variety captured in the standard framework, we also capture the effect of inequality within villages. First, beyond a certain level $\bar{c}$, the consumer can raise his utility only by consuming new goods rather than consuming more of the same goods. Second, marginal utility declines not only as consumption of the same good increases (as in the Dixit–Stiglitz specification) but also as more goods are consumed. Intuitively, this captures the notion that all consumers like variety, but past a level of consumption, look for a new variety. In addition, both rich and poor consume the same set of varieties, with the poor consuming lower quantities of the varieties. As explained above, the standard Dixit–Stiglitz framework implies that there will be less product variety as income decreases, but does not speak to the role of inequality, hence this variant on the usual model:

$$u = \sum_{i=1}^{n} v_i \min(c_i^{\theta}, \bar{c}), \quad 0 < \theta < 1, \tag{1}$$

where c_i denotes consumption of good i, n is the number of available goods, treated as given, and $1 - \theta$ is a measure of the consumer's taste for variety, while the parameters v_i satisfy

$$v_i > v_{i+1} > 0, \quad i = 1, 2, \ldots .$$

Marginal utility for good i is given by

$$\frac{\partial u}{\partial c_i} = \begin{cases} \theta v_i c_i^{\theta-1} & \text{if } 0 < c_i \leq \bar{c}, \\ 0 & \text{if } c_i > \bar{c}. \end{cases} \tag{2}$$

If n goods are available in the location, then utility maximization gives

$$c_i = \min\left\{ \left(\frac{\theta v_i}{\lambda p_i} \right)^{1/(1-\theta)}, \bar{c} \right\}, \quad i = 1, 2, \ldots, n, \tag{3}$$

where λ denotes the Lagrange multiplier of the standard budget constraint. An immediate implication of equation (3) is that the price elasticity of consumer demand decreases with the taste for variety: the more the consumer cares about variety, the more inelastic is demand, and hence the greater the monopoly power of the trader. We refer further to equation (3) below to obtain the equilibrium price, but before we do so, we turn to the traders' optimization problem.

2.3 | Traders

We consider transport and trade to J villages ($j = 1, \ldots, J$), each connected by its own road to a market town where all n goods are available at a given price. The travel time between village j and

the town is s_j. To fix ideas, we begin with the case of homogeneous consumers. Each village j has m consumers whose income y_j is derived from selling a crop. This income is fixed at y^* at $s = 0$, and declines with the travel time from the market town, with γ reflecting iceberg transportation costs:

$$y_j = \frac{y^*}{\gamma s_j}. \tag{4}$$

This is a simplification of more general reasons for falling incomes with remoteness, which turn on lower productivity, higher input costs and lower incentives for higher return inputs such as fertilizers, as suggested by the empirical literature alluded to in the Introduction.

Each trader deals in a single good i that she buys in the market town at a given price $\overline{p}_i$ and transports to a subset of the villages where the good is sold at the price p^*_{ij}. Goods are modelled symmetrically (so we ignore the index i in obtaining the price below), and the cost of transporting a quantity q over travel time s is $(\alpha + \beta q)s$. Hence the trader's profits on sales at village j are given by

$$\pi_j = [p^*_j - (\overline{p} + \beta s_j)](m \times c) - \alpha s_j. \tag{5}$$

Traders are engaged in monopolistic competition. Hence each trader sets a profit-maximizing price taking into account the demand curve. From equations (3) and (5), this gives (for locations that are served)

$$p^*_j = \frac{\overline{p} + \beta s_j}{\theta}. \tag{6}$$

Each trader thus charges a markup over marginal costs $\overline{p} + \beta s_j$, and this markup[10] is increasing in the taste for variety $1 - \theta$.[11] The condition for a trader to enter is implied by the equilibrium condition above: a trader will enter as long as the price obtained in the village (left-hand side of equation (6)) is larger than or equal to the right-hand side of equation (6), that is, the markup over marginal costs that together are a function of distance and the taste for variety. While this condition explains why an additional trader enters, it does not tell us what the total number of traders will be in the village, which will depend on the size of the market in addition to tastes and transport costs. This is obtained in the next subsection, where we derive this for the case allowing consumers to have different incomes.[12]

Note that the parameters v affect consumption levels but not prices. Since new goods have lower marginal utility, c_i decreases with i. If the consumer's income is sufficiently low (i.e. $c_1 < \overline{c}$), then

$$\overline{c} > c_1 > c_2 > \cdots > c_n, \tag{7}$$

while at higher income levels, consumption of the first k goods ($n > k \geq 1$) will be at the bound[13]

$$c_i = \overline{c},\ i = 1, \ldots, k, \quad \overline{c} > c_{k+1} > \cdots > c_n. \tag{8}$$

As income rises, k will successively take the values $1, 2, \ldots$, increasing variety.

2.4 | Income inequality

We now relax the assumption that consumers at a given location are identical. Instead, there now are m_{jH} rich consumers with income y^*_{jH} in the village, and m_{jL} poor consumers with income

y^*_{jL}.[14] We assume that y^*_{jL} is sufficiently low for inequalities (7) to hold, and y^*_{jH} sufficiently high for conditions (8) to hold.[15]

The number of goods available, n_j, is determined by the zero profit condition for the last good:

$$[p^*_j - (\overline{p} + \beta s_j)](m_{jL}c_{n_jL} + m_{jH}c_{n_jH}) = \alpha s_j$$

or

$$m_{jL}c_{n_jL} + m_{jH}c_{n_jH} = \frac{\alpha s_j}{\overline{p} + \beta s_j}\ \frac{\theta}{1-\theta},$$

or, using the two budget constraints,

$$m_{jL}\ \frac{y^*_{jL}}{\gamma s_j}\ \frac{v^*_{n_j}}{v^*_1 + \cdots + v^*_{n_j}} + m_{jH}\left(\frac{y^*_{jH}}{\gamma s_j} - p^*_j k\overline{c}\right)\frac{v^*_{n_j}}{v^*_{k_j+1} + \cdots + v^*_{n_j}} = \frac{\alpha s_j}{1-\theta}, \tag{9}$$

where

$$v^*_i = v_i^{1/(1-\theta)}.$$

The equilibrium condition in equation (9) determines the number of goods available, n_j. The left-hand side (LHS) of this equation measures the value of total consumption for the last good, n_j, in the village.[16] Note that LHS is decreasing in n_j. Hence any change that increases LHS must be offset by an increase in n_j. It follows that n_j increases as fixed costs α and travel times s_j fall. It also follows that n_j is increasing in size of the two groups (m_{jL} and m_{jH}) and in their incomes (y^*_{jH} and y^*_{jL}). Variety is also increasing in market size, measured by total village income $m_{jL}y^*_{jL} + m_{jH}y^*_{jH}$.

Less obviously, variety increases with income inequality: a mean-preserving spread in the distribution of income increases n_j. Intuitively, this is because the poor spend an increase in income on all goods, the rich only on those goods for which their consumption has not yet reached the level $\overline{c}$. A mean-preserving spread will therefore raise total demand for the marginal good, and this induces an increase in variety.

More precisely, the effect of a mean-preserving spread (an increase in y^*_{jH} offset by a reduction in y^*_{jL} so as to keep total income $m_{jL}y^*_{jL} + m_{jH}y^*_{jH}$ and hence mean income constant) is given by the partial derivative

$$\Delta LHS = \frac{m_{jH}}{\gamma s_j}\ \frac{v^*_{n_j}}{v^*_{k_j+1} + \cdots + v^*_{n_j}}\ \Delta y_{jH} + \frac{m_{jL}}{\gamma s_j}\ \frac{v^*_{n_j}}{v^*_{1_j+1} + \cdots + v^*_{n_j}}\ \Delta y_{jL}.$$

Since $m_{jH}\ \Delta y_{jH} + m_{jL}\ \Delta y_{jL} = 0$, we have

$$\Delta LHS = \frac{m_{jH}}{\gamma s_j}\left[\frac{v^*_{n_j}}{v^*_{k_j+1} + \cdots + v^*_{n_j}} - \frac{v^*_{n_j}}{v^*_1 + \cdots + v^*_{n_j}}\right]\Delta y_{jH} > 0,$$

where n_j is kept constant. This increase of LHS calls for an offsetting increase in n_j. Hence an increase in inequality unambiguously improves variety n_j. This is an important implication of the model.

It should be noted that in this framework, both the rich and the poor consume the same set of varieties, with the poor consuming lower quantities of the varieties. As in Li (2021), the gains in welfare from increased variety occur not because of heterogeneity in tastes in this setting, but

from being able to counteract diminishing returns to consuming increasing quantities of the same variety.

The model delivers a number of results. First, the profit-maximizing price for goods in each location includes a markup over their price in origin town, over the costs of travel (see equation (6)). Second, as income rises, variety increases too (see conditions (8)). Third, variety increases as both fixed and variable costs of travel fall, and it also increases with market size (see equation (9), which delivers these results). Finally, and less obviously, variety also increases as income inequality rises.[17] The gains in welfare from increased variety occur not because of heterogeneity in tastes in this model, but because an increase in variety offsets the diminishing marginal utility of increased consumption of a given variety (Li 2021). These results give us the basis for our main econometric specification for describing variety available in a village, relative to the source market town, as well as the specification that delivers our estimates of the price markups in moving goods from town to village.

3 | SURVEY DESIGN

We conducted a census of shops and periodic market stalls served by itinerant traders to obtain information on variety of goods in small towns and villages.[18]

Before delving into our discussion regarding how variety differs across space, it is crucial to delineate the three distinct levels of product categorization that we use: item-group, item and brand. Item-group represents a broad classification, such as beverages or household products, and is used simply for description at the aggregate level. For the main analysis, however, variety is defined in two ways: first, in terms of the items, followed by the specific brand of item. 'Items' differentiate between specific types of goods such as soft drinks or AAA batteries, a disaggregation that describes the standard notion of variety in consumption, akin to disaggregated HS codes in international trade. To clarify further, batteries might be part of a larger item-group broadly called household electricals that includes light bulbs, while AA batteries and AAA batteries are treated as separate items. At the most granular level, 'brands' identify specific brand names within these categories, which is essential for price comparisons akin to barcodes. Thus within the item-group and item pair of 'beverage' and 'soft drinks', the brand might be, say, Coca Cola. Similarly, in the 'household items' and 'AAA batteries' pair, the brand might be Duracell.

Our study focuses on manufactured consumer goods, covering item-groups such as processed foods, beverages, apparel, footwear and cosmetics to kitchenware, hardware and small electronics, totalling 132 items and over 800 brands. A sample of the item-groups, items and brands included in the study is provided in Appendix Table A1.

In order to be precise about the variation across space, it was also necessary to match goods at destination with their origin or source. This concern required careful survey design.[19] We did this by identifying villages connected to the rest of the country exclusively via a single market town. This was to ensure that all goods arriving into the village must then transit though the particular town, so that the full set of goods available in the village is also available in the town. Clearly, these goods need not be produced in this town, but it will have available all potential goods that might be supplied to the village. In brief, we can then treat the town as the 'source' for the destination village. Thus the variety of goods in the market town serves as the set of all potential goods available in the village, with the caveat that some goods might transit the town but are not necessarily sold there. For instance, smaller units of some brands, or items of slightly different quality, might be aimed at different tastes in the village relative to town.

Notably, the geography of Ethiopia makes this design both feasible and representative. Table 2 examines our sampling frame. About 73% of villages within districts are connected to just one market town directly, thus the sampled villages are not unusually situated given the hilly terrain.

TABLE 2 The sampling frame for villages by connections to town.

Number of villages	Mean	SD	Max
In district	10.1	6.7	42
Directly connected to one town	7.4	5.7	30
Directly connected to more than one town	2.6	3.2	17
% connected to only one town	73	28.7	100

Notes: These summary statistics are based on the sampling frame used to list all the market towns and villages linked by a single road or track.

In order to ensure the sampling structure described above, we interviewed district officials and questioned them on the list of villages within districts, and picked a subset of the villages that had only one road or connection (say, a mountain track) to the nearest market town, and no access to any other town except via the said town. Each market town is linked to the village by a single road or track, with no other point of natural entry or exit. We also sampled an average of three villages linked to the same market town.

By sampling about three villages, in the same district, *connected to the same market town*, we focus on the variation in variety and prices within the catchment of the particular town. In the empirical analysis that follows, we thus control for market town fixed effects, and base our estimates of the relationship between variety available at the village level and transport time and local demand entirely on the variation between villages, connected to a specific market town. Figure 1 provides an illustrative map, for *two* of the four sampled regions. Market towns are indicated in shades of blue, denoting differences in travel time to the farthest of the three villages on average to which they are connected, while the black dots denote the villages. We note that the Ethiopian terrain ensures that this strategy produces a set of villages that are not unrepresentative of the country. We thus have a purposive survey of 100 towns, each connected to an average of three villages, for a sample of 295 villages, across the four main regions of Ethiopia.

As explained briefly earlier, towns have fixed shops, but also host market days where itinerant traders sell goods. The goods in shops might also be carried to villages and sold in fixed shops there; furthermore, itinerant sellers also travel to the village in turn, so the sources of goods in the village include shops (supplied via the town) and itinerant sellers who travel from the town to set up periodic market stalls. The main part of the survey involved the survey of shops in the nearest local market town of a full list of potential consumer goods across different categories of consumer goods, from processed foods, household goods and toiletries to clothing and shoes. The next stage involved the collection of data on consumer goods available in the village. Depending on the village, there are small local shops but also periodic (often fortnightly) markets where itinerant sellers bring consumer goods to the village.[20] These market days are on fixed calendar days, which are decided by local and district officials to ensure that there is no clash of dates across villages, as well as the local town. Almost all villages have no more than a single fixed retailer, but the variety of goods offered across villages varies considerably. The items sold in fixed shops are largely durable consumer goods such as batteries, plastics (mugs and buckets), toiletries and notebooks. These fixed retail shops are complemented by periodic markets, where sellers (usually specialized in the type of item) bring clothing, shoes and other consumer goods not provided by the village shop, to be sold in a space or stall allocated to them by village authorities. Since the date for these markets is fixed by custom[21] and rotated across villages, it was also relatively simple for the logistics of the survey; enumerators were able to attend the market on the specific day of the week, and combine this with a visit to the fixed retail shop. Periodic markets have a larger variety in consumer goods, and include clothing for men, women and children, footwear (including plastic footwear), kitchen items such as crockery, and hardware. We surveyed both kinds of outlet on the variety (including brands where clearly branded) of goods and their prices,

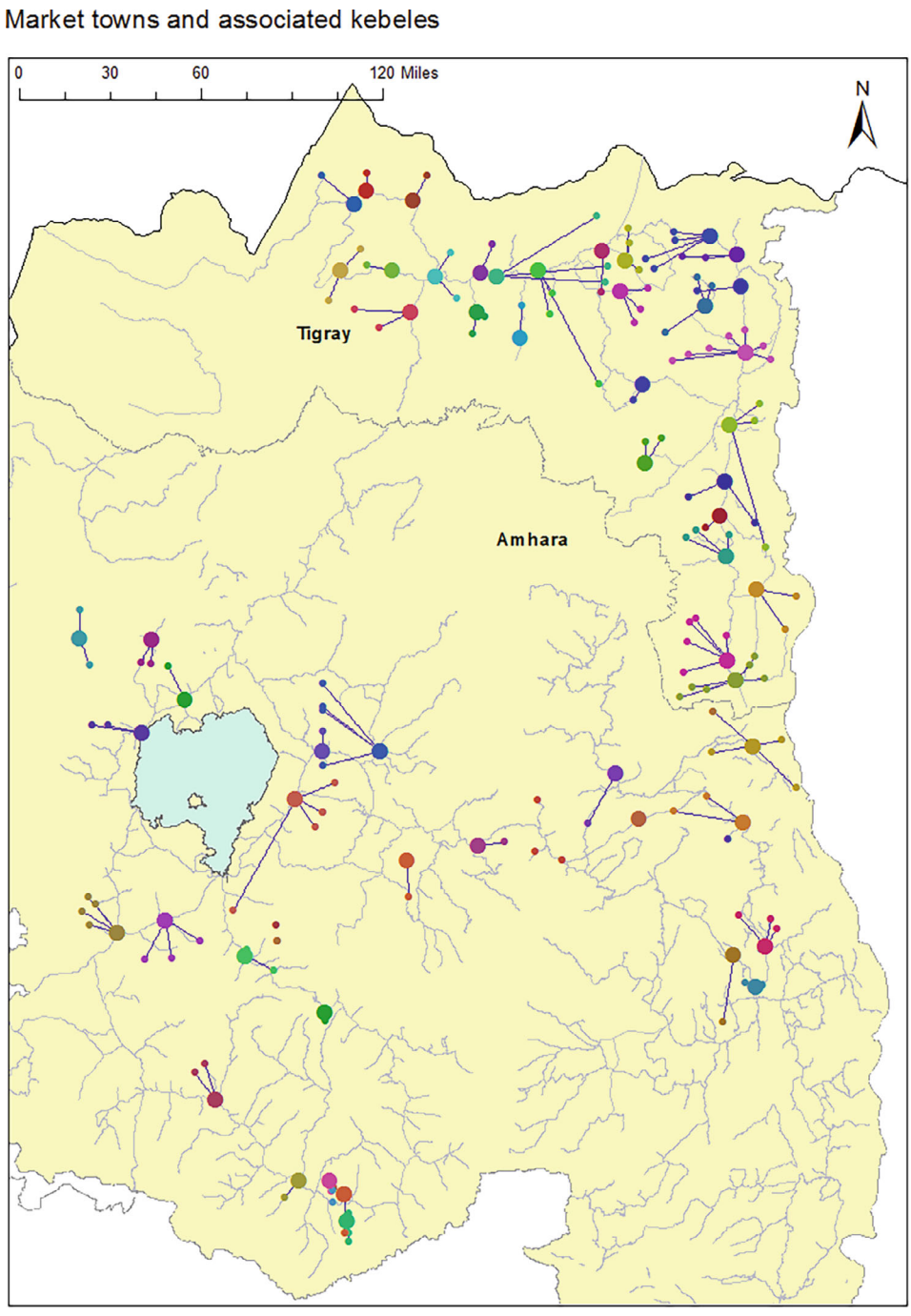

FIGURE 1 Map of sampled villages and associated market towns for two regions. *Notes*: The map represents locations of market towns and the associated villages by distance in two of the four surveyed regions, the Amhara and Tigray regions in Ethiopia.

TABLE 3a Frequency of stockouts.

Availability of items	Frequency (%)
Always/mostly available	93
Sometimes available	6
Rarely available	1

Notes: Shopkeepers and traders in villages were asked about stockouts in items available in town. The numbers reflect the fraction of answers in each category above.

TABLE 3b Item-groups where items are sometimes or rarely available (7% of all items).

Item-group	Examples of key items	Share (%)
Processed foods	Edible oil, sugar	29
Beverages	Beer, sodas	9
Fabric	Shawls, cloth	6
Ready made clothing	Adult male clothing	19
Footwear	Adult male footwear	11
Household and kitchen	Cooking pots, plates, bulbs	14
Educational materials	Exercise books	4
Miscellaneous	Hardware, cosmetics	8

Notes: The answers above come from the interviews with shopkeepers and traders. Edible oil and sugar are rationed by the government. The numbers reflect the fractions of answers in each category above.

with additional questions on whether items from the list of goods available in the local market town were usually available even if they were not on sale on the day we visited. This was to ensure that stockouts did not get noted as a lack of availability in general—but as noted in Tables 3a and 3b, the share of stockouts is small. Some 6% of brand-specific items were recorded as available only sometimes, while only in 1% of cases were items recorded as rarely available.

A key issue in the design of the survey as explained above was to ensure that we were able to compare (local) source and destination variety and prices. We do not ascribe a causal relationship between travel time and the variety of goods; it is possible that better roads are more likely to be placed in villages that are also wealthier and more likely to attract a wider range of goods. However, our focus on the variation between the three villages within the same market town catchment, while not eliminating this issue, does serve to minimize it. This is, in part, because while targeting of roads between towns in districts is important, there is little evidence of targeting to particular villages within a town's catchment.[22] Note also that travel time captures the variation in terrain in the main: villages equidistant from their market town might vary widely in travel time, for a village might be far higher up the mountain compared to its neighbour, even if equally remote in terms of connection to the market town. Our main estimates thus rely on travel time rather than distance, with market town fixed effects. We also note that the descriptions of variety and estimated price markups do not hinge on a causal interpretation.

We interviewed key village officials about village characteristics, amenities and endowments. In addition, in each village, six households were interviewed: three chosen from the lower and three from the upper end of the wealth distribution, again with local consultation. The households were interviewed on their basic characteristics and incomes (both from agriculture and outside agriculture, if relevant), their source for consumer goods, and whether they experienced shortages in availability locally. The household survey was of necessity rather light, and we do not

TABLE 4 Household characteristics by income group.

	Poor	Rich
% saying yes to whether		
Difficulty obtaining consumer goods in last year	55	83
Would produce more for market if travel easier	57	86
Would travel more frequently if travel easier	66	87
Main reasons to travel to town (%)		
Buy inputs and sell produce	10	10
Buy consumer goods	15	15
Both	75	75
Main items reported unavailable locally (item-groups) (%)		
Clothing and linens	48	44
Processed foods	30	34
Leather goods, footwear (plastic)	12	14
Household goods, kitchenware	8	8
Household characteristics		
Mean household size	5.7	7.9
Annual median income (birr)	5500	40,000
Male household head %	80	94
Number of households	906	908

Notes: The data here come from the survey of six households in each village, chosen so that three were deemed to be representative of poor households in the villages, and the other three were deemed relatively rich. This was in consultation with village-level officials.

have detailed data on consumption behaviour; it was designed simply to complement the data on variety obtained from the local shop or local trader.

We obtained data on the infrastructure and amenities, population, population density and aggregate crop production, and most importantly detailed data on transport infrastructure, travel times and quality of roads in each village, as well as distance. The data were collected both from district (*woreda*) officials and local village (*kebele*) representatives. The main data on travel time were obtained by asking the officials and the six local households to report how long it took for them to travel to town by the most common form of transport. We also use data on location and information from Google Maps to calculate the distance between town and village, which, however, neglects any aspect of the terrain. The variation in distance between villages in the catchment of the same town is far lower than the travel times reported by respondents, which take the type of terrain into account.

We present two sets of descriptive statistics as background to the data from shops and itinerant markets. Table 4 describes households' perceptions of the effects of transport costs on variety in consumer goods. We show this separately for households in the bottom and top of the village income distribution. The households were identified by village officials, and it is useful to note that their incomes and assets tally with the description.[23] Poor and rich households differ sharply in their perceptions of the constraints posed by travel costs and distance. Just over half the poor but over 80% of rich households faced constraints in the set of manufactured goods available locally. Similar percentages said that they would produce more for market and would travel more frequently if travel were easier. However, both groups were equally inclined to say that the rationale for travelling to town was to both sell produce and buy goods—even if the transactions of the rich are likely to be larger than those of the poor, as the first set of answers suggests.

TABLE 5a Summary of village characteristics.

Variable	Mean	SD
Items available in village	45.00	22.00
Items available in nearest town	97.00	20.30
Brands of items available in village	73.3	39.92
Brands of items available in town	206.64	74.26
Distance to town in km	22.94	12.43
Travel time in minutes by most common transport	117.24	93.37
Whether tarmac/stone road	0.69	—
Village population	6852.5	3274.7
Share of poor households	0.13	0.21
Reliable electricity	0.26	—
Reliable cell phone	0.40	—

Notes: We do not report standard deviations for binary variables.

What are the items that do not make the last mile into the village, according to the households? There is consensus across households on the items missing locally; this is reassuring because it describes the specific lack of choice in particular item categories that is consistent with the survey data. Clearly, both rich and poor households face a lack of variety in similar item categories even if the rich are expected to spend more within them. The main sets of goods with items unavailable locally are clothing and linens, followed by processed foods. We collected data on 132 different goods and over 800 brands of goods, across all locations. Table 5a describes the main characteristics of the villages and the variety of items in them relative to the nearest market town.

We begin with the extensive margin of variety available: on average, villages have about half the items available in town, at 45 items on average relative to 97 in town; within these items, a third of all brands are available in town, at 73 brands on average in the village relative to 206 in town. The average distance to town is about 22 km while the average time to travel to town by the most common form of transport is about an hour and 45 minutes. We collected data on population size and the number of households in the village, which allows a measure of local market size. The average village population is 6800, or 1000 households. The villages host about 65 households per square kilometre, which is higher than the Ethiopian average since our sample does not include pastoralist areas, but is about average for East Africa.

We also use a proxy measure of whether the village is relatively poor compared to other villages in the sample by checking whether the village is covered by the Productive Safety Net Program (PSNP). This programme is targeted at the poorer villages within poor districts.[24] If the village was part of the PSNP, then we checked village records to discover how many households in the village receive such support. Some 42% of the sampled villages are in the government's safety net; furthermore, in half of these villages, over a third of households are covered by the programme. The share of households in each village who are in the PSNP is thus used as proxy for capturing the level of poverty in a village, which in turn allows us to compare relative poverty (or incomes) across villages. We also collected data on household incomes in the six households in each village; we use these data to construct a measure of the income spread within the village. Finally, in terms of amenities in the village, most villages have a health centre and a primary school, but access to pharmacies and secondary schools is low. About a quarter of the sample has reliable electricity (which means a reliable supply for 3 days a week or more), and 40% report a reliable mobile telephone connection in the same vein.[25]

TABLE 5b Summary of road characteristics and means of transport from villages to market town.

Variable	Number	Share (%)
Types of roads		
Asphalt (concrete)	37	12.54
Made of stones	169	57.29
Dirt road	89	30.17
Means of transport		
Bus (vehicles)	143	48.47
Carts	18	6.10
Mules (animals)	11	3.73
Foot (walking)	123	41.70

Notes: Number indicates how many villages are connected to their market town by the specific type of road or means of transport listed in each row.

Table 5b summarizes the challenges posed by the transport infrastructure: only 12% of villages are connected by an asphalt road to town, while over half have a stone track, and about a third have only a dirt track. In summary, 70% of sampled villages are connected to their market towns by a road made of tarmac or stone (labelled an 'all-weather or good road'), while the remainder are served by a dirt track or worse. For just under half the villages, the most common means of transport is by bus; for 41% it is by foot, with the remainder by mule.

4 | EMPIRICAL RESULTS: VARIETY

We wish to investigate to what extent the key factors—travel time (a proxy for transportation costs), market size and inequality—affect the distribution of variety across space, using the framework described in Section 2. We begin with a description of how the key variable, the extent of variety available in villages and their nearest market town, varies by travel time to town. We measure the extent of variety in manufactured consumer goods available using a simple count of all items and brands available locally in village markets and their source town. Figure 2(a) presents a picture of the fall in variety of items across space, both by travel time and distance to the nearest connected market town. Note that while variety falls steadily with travel time, the variation in variety across distance is non-monotonic, with variety falling sharply over short distances, then rising sharply between 11 km and 33 km, and finally falling again. This is due to the fact that often villages that are only a short measured distance away are accessible only on foot with relatively high travel times, while those in the middle distance have better access on all-weather roads, so that the effect of better road connections trumps distance; while finally, at higher distances, distance and travel time move together to lower variety. The point here is that distance is a poor measure of transport costs and travel time, since it *does not* take into account the effects of terrain and means of transport. This is also reflected in Figure 2(b), which presents a similar graph of (log) household income against distance and travel time. Again, incomes and travel times are negatively related, while the variation by distance is non-linear again.

The empirical specification is to allow us to understand the relative contribution of the key factors to the extent of variation in the availability of manufactured consumer goods. We model the probability that a village j with vector of characteristics X_j (which includes travel time to the nearest market town, local market size, income distribution—captured as a mean-preserving spread—and village-level amenities) has available exactly Y_j items, relative to its nearest market

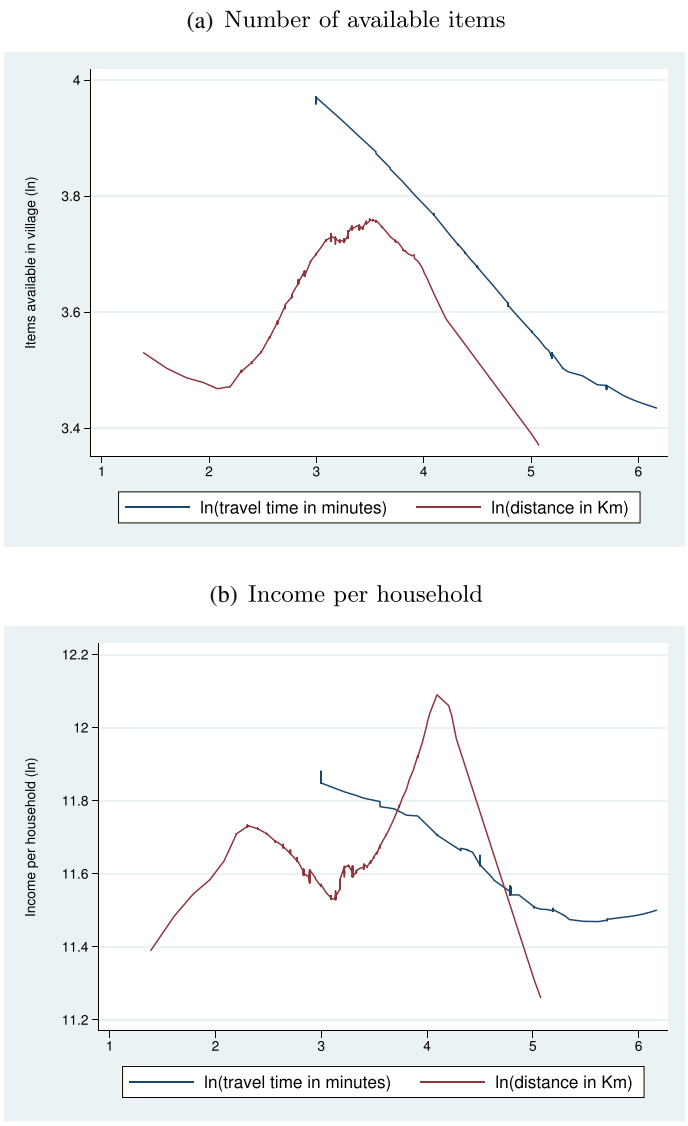

FIGURE 2 Variation of available items and household income by travel time and distance. *Notes*: The figure shows a LOWESS plot of the total count of items available (ln) in each village, and the income per household (ln) relative to the time taken to travel (minutes) and distance (km) to the nearest market town.

town, with Y_m items. We use a count data specification, with a Poisson model to do so, with Y_m treated as the exposure variable, constrained to coefficient 1:

$$\begin{aligned}\ln(Y_j) = {} & \beta_0 + \beta_1 \ln(\textit{travel time}) + \beta_2 \ln(\textit{village population}) \\ & + \beta_3 \ln(\textit{income per household}) + \beta_4(\textit{local inequality}) \\ & + \beta_5(\textit{local share of poor}) + \beta_6[(\textit{local share of poor}) * (\textit{local inequality})] \\ & + \textit{market town fixed effects} + \ln(Y_m) + \varepsilon_j.\end{aligned}$$

The main specification[26] includes the time to travel to town using the most common form of transport,[27] and a measure of market size, proxied by the population of the village. We also add measures of local amenities, with access to electricity and mobile telephony. We use both a count of items available and a count of brands as dependent variables. We construct a simple measure of local inequality, based on a mean-preserving spread. As explained earlier, in addition to the census of items in shops and periodic or itinerant markets, we also surveyed six households in

TABLE 6 Poisson estimates of all items and brands available in villages.

	Total number of items available		Total number of brands available	
	(1)	(2)	(3)	(4)
ln(Travel time to town in minutes)	−0.109	−0.084	−0.155	−0.120
	(0.03)***	(0.03)***	(0.03)***	(0.03)***
ln(Income per household)	0.044	0.041	0.066	0.056
	(0.03)	(0.03)	(0.04)*	(0.04)
ln(Population of village)	0.175	0.142	0.188	0.155
	(0.05)***	(0.05)***	(0.05)***	(0.05)***
Share of poor households	−0.368	−0.328	−0.514	−0.478
	(0.20)*	(0.19)*	(0.23)**	(0.22)**
Income spread	0.227	0.207	0.223	0.192
	(0.07)***	(0.07)***	(0.08)***	(0.08)**
Income spread ∗ Share of poor	0.189	0.127	0.293	0.260
	(0.20)	(0.20)	(0.25)	(0.24)
Reliable electricity		0.136		0.142
		(0.05)***		(0.06)**
Reliable mobile phone		0.025		0.077
		(0.05)		(0.05)
Number of observations	284	284	284	284
Pseudo R-squared	0.39	0.40	0.51	0.52

Notes: Robust standard errors clustered at kebele level are given in parentheses. Market size is measured as ln(Population) in the village. The share of poor households is measured as the share of households in the village who participate in the PSNP that is targeted at poor villages, while income spread measures the difference in incomes between the richest and poorest households in the sample, with the mean standardized to zero, a mean-preserving spread.
*, **, *** indicate $p < 0.1$, $p < 0.05$, $p < 0.01$, respectively.

each village, where three households were drawn from the bottom of the distribution, and the remainder from the top, as identified privately by local village officials. The households were interviewed about their income from both agriculture and other sources, along with their own subjective assessment of their income, within the three categories rich, comfortable and poor. The measure of incomes is noisy, given the light nature of the questionnaire and the usual difficulties of obtaining reliable estimates in one short interview. Instead of relying on any single measure, we use an average of all these measures, as a standardized variate, to proxy the distribution of income within villages. We use the bottom 20% and the top 20% of households, to capture the range of incomes or the mean-preserving spread, with the mean being standardized at zero.[28] However, the distribution of incomes thus measured captures only variation within a village, and the proportions of poor and rich are likely to differ across villages. To anchor this income distribution, we use the share of households that receive support from the government's PSNP, thus controlling for the relative poverty of the village.

Table 6 presents the first set of estimates, using the 'Total number of items available' in columns (1) and (2), and then 'Total number of brands available' (across all item categories) in columns (3) and (4), as the dependent variable. Columns (2) and (4) compare the estimates where the specification is augmented by key village-level amenities, electricity and mobile telephone access. Variety is significantly affected by travel times: for an average village, a fall of 30 minutes in travel time is associated with an increase of about 3.75 items and 9 brands, *ceteris paribus*.[29] Market size matters too: we measure market size using the village population, and a 10% increase

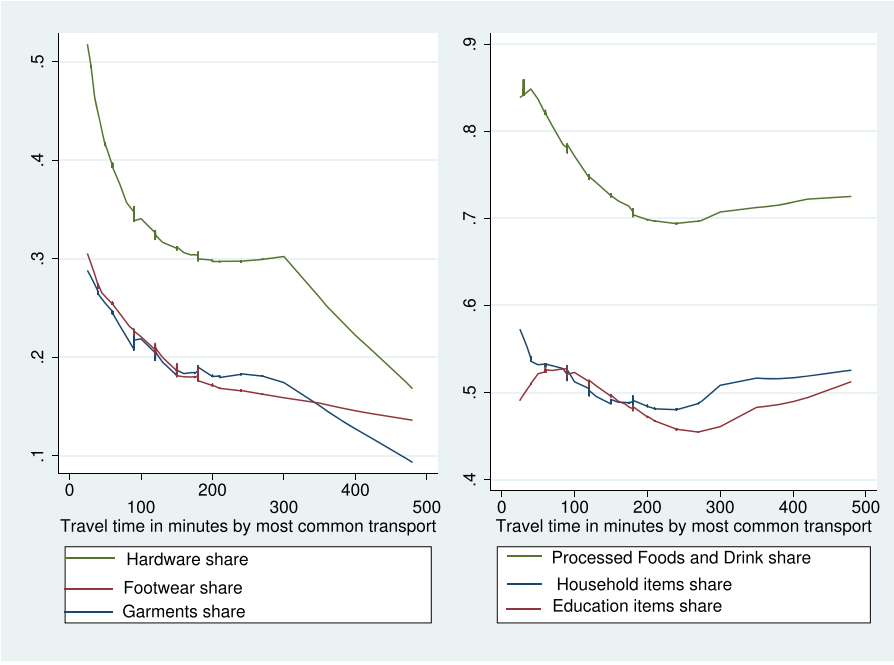

FIGURE 3 Variety across space by item-groups. *Notes*: The figure displays LOWESS graphs of shares of a subset of items available in the village relative to the associated market town, disaggregated by item-groups to examine heterogeneity in the fall in variety by travel time. Heavier, bulkier items such as processed food and drink and hardware display a sharper fall in variety by travel time. Clothing and footwear also see sharp drops in variety across space.

in this measure is associated with 1 item more on average, and an extra 3 brands, similar to a fall in the share of poor households by 10%. Household incomes are positively (if insignificantly) associated with variety. An increase in inequality (mean-preserving spread) of one standard deviation is associated with an increase of 2.5 items and 4 brands, *ceteris paribus*. Obtaining access to reliable electricity is associated with an increase of 6 items and 11 brands, on average. It is useful to examine the impact on the coefficients of the key variables when controlling for amenities, and it is reassuring that those effects remain similar in size and significance.

Figure 3 demonstrates the heterogeneity in the relationship between variety and travel time across goods, illustrated by six item-groups.[30] Heavier, bulkier goods are more likely not to make the last mile: processed foods (which include bottled drinks here), clothing and footwear exhibit sharp declines within 30 minutes of travel time from the nearest market town. Clothing and Footwear also seem to be categories where items are likely to be far less available in villages, with even less distant villages offering only 30% of the variety available in town. The results in Table 6 hide this heterogeneity, and disaggregating this relationship by item-groups suggests much larger effects of remoteness for some groups compared to others.

5 | EMPIRICAL RESULTS: PRICES AND MARKUPS

We now turn to examining the difference in prices between town and village. The data that we gathered were meant to capture the extensive margin, that is, whether or not a good is available in a market. Since the focus was on matching items and brands, rather than unit prices, the data have limitations in terms of their use for analysing the impact of distance on prices. First, given our focus on variety, we include a large number of generic brands—for instance, as long as a pair

of jeans branded as 'Made in China' is available, and sold as different from another pair of jeans, it is treated as a different 'brand', within the category of 'Jeans'. Second, even when the brands are clearly defined (for instance, as a particular brand of flour), the unit of measurement used at point of sale could vary across areas, making comparison between origin and destination difficult in terms of prices.

We dealt with these difficulties by carrying out a separate survey of prices alone in about half the sample (115 villages and 43 market towns) for specific item–brand pairs obtained from the main survey, to control for any measurement error in the first survey on variety. We interviewed owners of fixed outlets in both village and town, as well as itinerant sellers once again, concentrating on prices and unit of measurement of clearly branded goods listed in the first survey. This is also a more restricted set of items that does not include clothing or footwear. The difficulty for these two important groups of items is that matched item or brand prices are hard to obtain since brands of these goods are often generic, and identical quality is difficult to establish. We do have data on whether items such as jeans or trainers are available in a village, but we cannot be certain that a particular brand of jeans labelled 'China' is identical in both village and town, and hence cannot be sure that we are comparing prices of the exact item. We now have 1562 observations but a smaller set of 15 items and 39 brands across them, now precisely matched in brands and units of measurement. These items are: soft drinks, beer, bottled water, pasta, edible oil, laundry soap, bath soap, hair oil (liquid), shaving blades, cigarettes, matches, pens, batteries, and electric bulbs of two wattages.

Finally, we also offer a separate comparison of the estimated markup across major towns in Ethiopia, with secondary data from the government's National Price Surveys collected by the Central Statistical Authority for establishing the CPI,[31] which survey the 118 larger market towns and urban centres across Ethiopia. We focus on a narrow set of branded goods as in Atkin and Donaldson (2015), where source and destination prices can be determined clearly. The 9 items included are bottled water, beer, flour, cigarettes, hair oil (liquid and paste), toilet paper, paint, and water storage tankers for domestic use.

We label these two different data sources the price survey and the national survey, for ease of reference. We use these surveys to estimate two different measures of the price markups in villages relative to town using the framework described in Subsection II. The first estimate is from our price survey conducted in small market towns and associated villages. The second estimate comes from the national data on prices described above, and describes markups between towns connected by tarmac roads across the country.

The zero profit-maximization conditions yield a markup equation for prices as in equation (6). The empirical counterpart to the equation is

$$p_j^* = \alpha_j + \alpha_1 \overline{p} + \alpha_2 s_j + \varepsilon_j. \tag{10}$$

This includes item–brand fixed effects α_j. The estimate of markup, $1/\theta$, is obtained as $\widehat{\alpha_1}$, while $\widehat{\alpha_2}$ gives us the marginal effect of an increase of an hour in travel time multiplied by the markup $1/\theta$.

Furthermore, indexing these parameters by k for each item-group also allows us to estimate the parameter θ_k, the group-specific price markup. Before we turn to doing so, we describe the global markup, obtained from the estimate of equation (10).

We report the regression of prices paid in the village on prices paid in town and travel time in Table 7, using the price survey and the national survey as explained above. The regression examines the variation of prices across space for the different sets of matched pairs of villages and market towns. Our price survey gives us an estimate of markup of 8%, where the markup is defined as $1/\theta$.[32] The associated estimate of the marginal costs of travel, $\widehat{\beta}$, is 0.13.

The final estimates are obtained using the national data on prices in the main source town and 118 market towns, in the National Price Surveys. We use data on prices of a set of 8 items and 13 brands collected monthly since 2010, where the 13 products are chosen such that we can

TABLE 7 Prices in source town versus destination town or village.

	Price survey (1)	National survey (2)
Source town price ($1/\theta$)	1.083	1.170
	(0.02)***	(0.01)***
Travel time in hours	0.147	0.280
	(0.02)***	(0.16)*
Number of observations	1562	29,240
R-squared	0.996	0.948

Notes: Robust standard errors clustered at kebele level are given in parentheses. Column (1) uses prices on branded items from a survey on prices alone in 115 villages and 43 market towns as a consistency check. Column (2) uses data (on 11 brands whose source town is established) from the National Price Survey conducted by the Central Statistical Authority in 118 market towns from 2010–14. We use these years since the road quality (and thus travel time) between source town and market town can be assumed to be unchanged. Note that this last set of prices reflects national differences rather than within-district variation in as in column (1). Both columns include brand fixed effects. Column (2) also includes time fixed effects.
*, **, *** indicate $p < 0.1$, $p < 0.05$, $p < 0.01$, respectively.

map the source and destination prices accurately. We obtain the travel time in hours between the source and destination towns, using data on location and information from Google Maps to calculate the distance between towns (as in Atkin and Donaldson 2015). Column (2) of Table 7 provides the estimate of the taste for variety using these data, to obtain an estimated markup of 16.9%, while the estimate of the marginal travel costs using these data is 0.28, nearly twice that in our survey above. Note that this estimate is based on an even smaller set of item–brands than before, mostly processed food and drink, with travel across major highways rather than between small town and village. We speculate that the higher marginal costs of travel are likely due to the higher costs of freight carriers across highways (Coar *et al.* 2021) while our data use a mix of small private vehicles, foot and donkeys.

6 | CONCLUSION

While the new economic geography has led to a large number of empirical studies on the effect of international trade on variety, there is comparatively little empirical work on the effect of domestic trade on the number of varieties available to consumers, and only for developed countries. This is likely to be a much more important issue in developing countries, where transport costs are very much higher. This is one of the few papers that addresses the loss in variety available in remote places, and the consequences for prices: consumer choice fades away with distance in developing countries.

We examine how consumers are affected by the costs of transport, not only through changes in prices, but also through changes in the set of available goods. We do so using data collected in a purpose-designed survey of shops and itinerant markets in villages and their associated source market towns in Ethiopia. We examine the variation in variety of about 132 different consumer goods and 800 brands across space. We find that variety declines sharply as travel time increases. Specifically, a 30 minute increase in travel time to town is associated with a fall of 4 items and 9 brands, where the average number of items is 45 relative to 97 in town, and the average number of brands in the village is 73, relative to 206 in town. Variety is also strongly affected by the size of the local market and the distribution of income. In addition, we use data on a subset of precisely matched items and brands to estimate a price markup of 8% across source and destination.

What do these results tell us? They demonstrate that there are likely to be significant costs to consumers from both low variety in manufactures and the intra-trade costs (markups and

transport costs) that matter in affecting this margin. These costs will increase with rising incomes unless domestic trade costs fall as well. It should also be emphasized that the items lost are usually part of a basic set of necessary consumption items, in this low-income setting, comprising basic clothing, footwear, hygiene, kitchenware and housewares, and even educational items. These costs are universally ignored in welfare calculations relative to the price effects for which poverty and other measures are meticulously adjusted. However, ignoring the costs of fading variety has clear implications for welfare measurement: poverty is underestimated since people in remote places have little to choose—but equally, when changes such as infrastructure investments raise variety, rates of decline in poverty will be underestimated too.

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ENDNOTES

[1] Li (2021) examines the Engel curve for variety in India, with positive estimates of the elasticity of variety in food consumption.

[2] Broda and Weinstein (2006) estimate welfare gains from variety growth in imports alone as 2.8% of GDP.

[3] Atkin and Donaldson (2015) also note that variety in consumer goods falls across space using the information from the CPI surveys in Ethiopia, by presenting a graph of the fall across space. Their focus is on estimating domestic trade costs across large towns in Ethiopia, while we examine both variety and trade costs between market towns and remote villages.

[4] In a parallel piece by one of the authors, Krishnan and Zhang (2020) study the causal effect of transport costs on variety in the household consumption basket, using household survey data on a set of remote villages in north-western Ethiopia. They find that a 1% increase in travel time decreases variety by 7%, establishing that variety consumed is sharply affected by remoteness, as here. In that study, variety is measured by broad categories of 24 manufactured goods consumed by the household. The difference here, apart from the detailed data on variety, is the ability to compare availability in town with that in the village, in addition to the prices in town and village.

[5] Hilberry and Hummels (2008) show that the spatial frictions on intermediate inputs strongly affect the extensive margin of trade within the USA.

[6] The Ethiopian Government embarked on a major programme of investment in roads with a 10-year Road Sector Development Programme, 1997–2007. The first phase of the programme (1997–2002) focused on the rehabilitation of the main road network, and since then, there has been work on an investment programme for new roads. See Ethiopian Roads Authority (2015).

[7] Apart from the census of goods, information on the retailers and traders was beyond the scope of the survey. Thus we do not know how many traders attend periodic markets, for instance.

[8] Farmers in Ethiopia have only user rights to land, which they must relinquish if they migrate to town. Settlement patterns across Ethiopia have remained unchanged for decades, and migration rates are among the lowest in Sub-Saharan Africa (Bundervoet 2018), both of which are consistent with the low urbanization rates as well.

[9] The existence of fixed lump sum fees per trader is attributed to a combination of land regulation and tax policy. Rozelle *et al.* (2003) describe similar difficulties facing itinerant traders in rural China: 'Local officials clearly understand how difficult it is to collect taxes from itinerant peddlers. As a consequence, officials spend little time trying to collect value-added taxes, relying instead on simple taxation methods such as collecting stall fees or negotiating lump sum fee payments.'

[10] Note that for $\theta \to 1$, the markup vanishes; if consumers have no taste for variety, then marginal cost pricing is, of course, optimal.

[11] Benassy (1996) points out that this formulation locks the taste for variety to the elasticity of demand, and suggests an alternative formulation that would separate the two parameters. While this is theoretically appealing, it is clear that the taste for variety parameter thus separated affects only unobservable variables, namely welfare and the number of optimal varieties (see Benassy 1996, §6), and hence is unidentifiable in a fundamental sense.

[12] However, in the simpler case of homogeneous consumers, it can be shown easily that the condition for the equilibrium number of traders is $n_j = (1-\theta)my_j/\gamma s_j$, where $(1-\theta)$ denotes the taste for variety, m denotes the number of consumers in each village, y_j denotes their incomes, and s_j denotes the fixed costs of moving goods across the distance from

village j to the market town. Traders will continue to enter until this condition is satisfied, with incomes, market size and taste being the key determinants along with the fixed transport costs.

[13] We ignore the extreme case $k = n$. In that case, part of the consumer's income would be useless; spending it would not add to utility.

[14] We assume throughout that $y_L^* < y_H^*$.

[15] If inequalities (7) hold for both groups, then the rich would consume more of each good in proportion to their income, i.e. $c_{iH} = c_{iL}(y_H^*/y_L^*)$, and in this case, inequality would not matter: the number of goods available would be determined by total market size (as in the Dixit–Stiglitz model), irrespective of the distribution of income.

[16] Since n_j is integer, equation (9) will not hold as an equality. Instead, in equilibrium we have $LHS \geq RHS$ (where RHS denotes the right-hand side of equation (9)), and $LHS < RHS$ if n_j is replaced by $n_j + 1$. Hence the last trader may make a profit, but there is no incentive for a new trader to enter the market with a new good.

[17] Kichko and Picard (2020) discuss general conditions for demand functions that deliver this result.

[18] One reason why the literature on variety in domestic consumption is sparse is that standard household surveys do not collect these data for manufactures. In particular, standard household consumption surveys collect detailed data on food consumption but not non-food consumption; non-food is invariably reported in aggregate categories (clothing and education, for instance) that do not allow any delineation of variety in consumption, or the prices of different types or varieties of consumer goods.

[19] This is also a key issue for Atkin and Donaldson (2015), who thus concentrate on a small list of goods that they can match from their CPI surveys. For Ethiopia, this restricts their sample to 13 goods.

[20] In a series of articles, Skinner (1964) describes the role of periodic markets in rural areas where itinerant traders bring goods to villages. This is a similar setting, and as Rozelle *et al.* (2003) find in China, fixed stores coexist with periodic markets.

[21] Rozelle *et al.* (2003) describe similar periodic markets in China.

[22] The Ethiopian Road Authority uses five main criteria during the preliminary selection of new road projects, which unsurprisingly target potentially more productive and populated regions: (i) roads providing access to areas with economic development potential (20%); (ii) roads leading to areas with surplus food and cash crop production (20%); (iii) roads that link existing major roads (20%); (iv) roads providing access to large and isolated population centres (30%); (v) roads that bring balanced development among the regions in the country, and that provide access to emerging regions (10%). However, the targeting is effectively in two stages: the first at the regional level, and the second within regions at the district level—vitiating concerns about targeting at the level of the village. Shiferaw *et al.* (2015, p. 11) discuss these criteria and argue that while they suggest a degree of targeting to the district, this is not borne out in the data. They conclude that: 'Regressing our road infrastructure variables on district-level (or woreda) control variables, we find that most of the variation in road accessibility is captured by the year dummies and the region fixed effects.' Our data also support this when we examine the relationship between the type of village road—whether a surfaced road (tarmac or stone) or a dirt track—and village-level variables. Consistent with the description above, in over half of the sample, controlling for the district fixed effect completely explains the type of road in the village, while for the remainder, there is no correlation between type of road and observable village characteristics.

[23] We obtained data on total monthly expenditures, and agricultural and off-farm incomes and values of livestock. Uniformly, for poor households these values are at most a third of those of the rich households within villages. Note that the distribution of income across villages varies substantially.

[24] Some 40% of the country's 710 districts (*woredas*) are covered by the PSNP, and the programme supports about 8 million people, or 10% of the population (International Food Policy Research Institute 2016).

[25] This may seem at odds with the reliability of the electricity connection; mobile telephones are often deposited with a shopkeeper in town to be charged, or with the local shop if they have better access to electricity, since households have poor access in general.

[26] The number of items/brands available in the nearest market town is treated as the exposure variable, since the counts of availability are better understood in relative terms as a fraction of the availability in town.

[27] An alternative is to use the distance between village and town, together with controls for quality of road, by season. The results do not differ if these are included instead.

[28] We could also use estimates of village-level incomes as estimated by village officials. These were far noisier (even if correlated with the estimates obtained from the households), hence our reliance on the measures based on the survey of the households.

[29] We calculate the marginal effects for this non-linear model using the margins command in Stata.

[30] The item-groups displayed here are: Clothing (for men, women and children, which includes jeans, shirts and skirts, but also fabric); Footwear (for men, women and children, in plastic or other materials); Hardware (includes items such as nails and locks); Detergents (which covers all household cleaning products); Cosmetics and hygiene (includes items such as shampoos, soaps and toothpaste); Household items (includes plastic buckets, ceramics and kitchenware as well as batteries); Processed foods (includes tinned foods, oils and and pasta) and Beverages (includes bottled drinks and beers); Educational Items (includes notebooks and pens).

[31] These are also used by Atkin and Donaldson (2015).

[32] We also estimated the markup using distance rather than travel time, and obtained a similar estimate of markup. The estimate of marginal effect on travel, $\widehat{\beta}$, is smaller and noisier.

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APPENDIX

TABLE A1 Partial list of items and brands by item-group, for illustration.

Item-group	Item	Brand	Quantity/unit
Processed foods	Sugar	Fincha	1 kg
Processed foods	Sugar	Metehara	1 kg
Processed foods	Salt	Enat Iodized	1 kg
Processed foods	Salt	Ermon	1 kg
Processed foods	Biscuits	Amare	1 packet
Processed foods	Biscuits	Banana	1 packet
Processed foods	Pasta	Vera	500 g
Processed foods	Pasta	Prima	500 g
Beverages	Soft drinks (sodas)	Pepsi	330 ml
Beverages	Soft drinks (sodas)	Sprite	330 ml
Beverages	Processed juices	Joly Juice	1 litre
Beverages	Processed juices	Prigat Juice	500 ml
Cigarettes	Cigarettes	Rothmans	1 packet
Cigarettes	Cigarettes	Nyala	1 packet
Fabric	Polyester	Manchini	1 m
Fabric	Polyester	Hawassa	1 m
Clothing—male adults	Jeans	Fashion Jeans	1 piece
Clothing—male adults	Jeans	Lucky (China)	1 piece
Footwear—adult women	Leather shoes	Kangaroo	1 pair
Footwear—adult women	Leather shoes	Dursen	1 pair
Footwear—adult women	Leather shoes	Linstar	1 pair
Household items—kitchen	Washing container	Modern Plastic	1 piece
Household items—kitchen	Washing container	Tiger Plastic	1 piece
Household items—kitchen	Coffee/tea cups	Queen	1 piece
Household items—kitchen	Coffee/tea cups	Oasis	1 piece
Household items—kitchen	Thermos	Giant	1 piece
Household items—kitchen	Thermos	Ever Nice	1 piece
Other household items	Batteries	Abyssinia	1 pair
Other household items	Batteries	Durata	1 pair
Other household items	Matches	Kangaroo	1 packet

TABLE A1 (Continued)

Item-group	Item	Brand	Quantity/unit
Other household items	Matches	Scissors	1 packet
Other household items	Flashlight	Tiger	1 piece
Other household items	Flashlight	Super Bright	1 piece
Detergent	Powder	Zahara	300 g
Detergent	Powder	Crown	200 g
Cosmetics and hygiene	Toothpaste	Colgate	1 piece
Cosmetics and hygiene	Toothpaste	Signal	1 piece
Hardware	Nails	Dashen	1 kg
Hardware	Locks	Kaihong	1 piece

Notes: These item-groups are chosen to illustrate the types of items and brands included in our survey.