

Transactions costs and the role of bargaining and information: evidence from Peru

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Abstract

This paper looks at the role of transaction costs in the marketing decision patterns of potato producers in the the Peruvian Andes. Besides access to road infrastructure, a number of other transactions related attributes are found to influence farmers' market decision. In particular, access to price information is found to be equivalent to a 23 percent reduction in transportation costs. In addition, more than half of the variation observed in prices received in some markets can be attributed to bargaining. These results offer an empirical example of the importance of transaction costs besides transport in marketing decisions and market integration. As such, they suggest that policies aiming to reduce transaction costs should address not only road and infrastructure but also create mechanisms that improve bargaining and enhance information flows.

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1 Introduction

Unlike the zero transaction costs assumption in neoclassical economic theory, transaction costs economics (TCE) posits that agents making decisions on different types of actions do so in a costly way (Williamson [11]). For example, farmers deciding where to sell a particular crop will base their decision not only on the price they expect to receive in each market but also on additional costs related to transacting in these markets.

These transaction costs can be divided in two broader categories: variable and fixed. Variable transaction costs change according to how much a household sells (or buys). For example, the cost related to transporting a product to a market will depend on the quantity but also the time it takes to reach the market.

On the other hand, fixed transaction costs are independent of the quantities sold or bought. They can be further distinguished between information, bargaining and monitoring. Information costs occur before the exchange takes place and include aspects such as searching for attributes that could facilitate the transaction, finding prices, and searching for potential buyers. In addition, bargaining or negotiation costs take place during the exchange and can include the cost of time to reach an agreement, contractual and payment arrangements. The extent of which a person will be able to minimize these costs will be a factor of individual characteristics (education, skills, gender), product attributes like quality or the relationship between the agents participating in the transaction. Finally, monitoring can ensure that the conditions of an exchange are met (for example enforcing the payment schedule agreed or that the quality of the product is the correct one).

Based on the above, the main insight from TCE is that an agent engaging in a transaction will choose the strategy which will maximize overall benefits (Coase [2]). As such, this paper looks at the marketing decision patterns of net sellers of potatoes in the Peruvian Andes. Using transaction-specific data, the paper explains how differential transaction costs influence the selection of markets where the producers choose to sell. In particular, our findings show that besides price differentials and access to good road infrastructure, access to information about markets and prices, relationships with buyers and the farmers' bargaining abilities, also affect market choices. In addition, we find that bargaining explains a large percentage of the variation in prices received in the markets. These results offer an empirical example of the importance of transaction costs in marketing decisions and market integration. They suggest that policies aiming at reducing transaction costs should address not only road and infrastructure but also create mechanisms to enhance information flows. Furthermore, as the results indicate that different aspects of bargaining can affect transaction outcomes via both market participation and prices received, increasing bargaining power should also be a key issue for policy makers.

While the body of theoretical literature on transaction costs is extensive, the empirical literature on transaction costs has been lagging. As transaction costs are often unobserved, the empirical challenge has been to develop methodologies

to measure them indirectly. Most data sets usually lack explicit information on variables relevant to these types of costs. With the exception of transaction costs attributes like distances to markets and transportation costs, aspects like market information or search and bargaining procedures are rarely included in most surveys. Therefore, much of the empirical work on transaction costs has focused on testing their existence but not on their actual measurement or their effect on behavior.

Nonetheless, there are a number of studies that try to empirically address these limitations. Cogan [3] estimates a model of labor supply for married women with fixed transaction costs associated with entry into the labor market. Estimates of these fixed transaction costs confirm his hypothesis that they are relevant. Earlier studies, on the contrary, had found large own-wage elasticities for married women. Cogan's results suggest that such large values may be due to ignoring the existence of fixed costs of labor market entry. Goetz [5] proposes a way of empirically estimating the supply response of coarse grains producers using data from rural household in Senegal. Recognizing that the decision of participation in the market is endogenous, Goetz first estimates a probit model to assess the probability of market participation and then uses the results to correct the estimation of the response of two distinct variables: quantity sold and quantity bought. He finds that the availability of better information about the market raises the probability of market participation. Hobbs [6] looks at the factors affecting the choice between different types of cattle marketing and concludes that various transaction costs in addition to farm characteristics affect the choice of marketing channel.

More recently, Key, Sadoulet and de Janvry [7] develop a theory of household behavior under the presence of both fixed and variable transaction costs. Applying their model to Mexican data of corn producers, they estimate a censored regression with unobserved threshold and confirm the importance of both variable and fixed transaction costs. Finally, Renkow and Hallstrom [9] develop a conceptual framework for quantifying fixed transaction cost of semisubsistence farm-households in Kenya and find that on average, these costs are equivalent to a 15 percent ad-valorem tax.

The paper proceeds as follows: section 2 discusses the decision process that farm-households face in allocating their marketed surplus to a market. Insights from the transactions specific survey are presented in section 3 while the results and subsequent analysis are in section 4. Section 5 concludes.

2 Decision timeline

In order to conceptualize the problem, consider an economy that produces an agricultural product. A farm-household's production decision process in this economy can be divided in three phases. Initially, during the planting season, farm-household i chooses the optimal allocation of resources to determine the total quantity to be produced. Following a typical farm-household setting, this decision will be based on the expected price of the product, available resources

such as labor, land and other incomes.

The second decision phase, at the harvest season, entails household i 's realization of the effective total quantity produced Q_i and an assessment of how to allocate it given available information (such as current product prices, market conditions). In particular, Q_i can be consumed or sold.¹ Denoting the quantity consumed c_i the marketed surplus for household i , q_i is given by:

$$q_i = Q_i - c_i \quad (1)$$

The final decision for the farm-household is where to sell the marketed surplus. Focusing on farm-households that are net-sellers (that is $q_i > 0$), and assuming that there exist J available markets where farm-household i can sell q_i , the farm-household's decision will be based on a number of factors. First, for farm-household i , selling in market j will be associated with variable transaction costs TC_{ij}^v . These costs are a function of the distance (d_{ij}) and time (m_{ij}) to reach market j , as well as other individual-specific characteristics that are associated with variable transaction costs (z_{ij}^v).² Variable transaction costs are thus given by:

$$TC_{ij}^v = TC^v(d_{ij}, m_{ij}, z_{ij}^v) \quad (2)$$

In addition, the farm-household will consider the expected price to be received at each candidate market j . In particular, the expected price $E[p_{ij}]$ to be received at market j is decomposed in:

$$E[p_{ij}] = E[\bar{p}_j + B(q_i, z_{ij}^b)] \quad (3)$$

where \bar{p}_j is a market specific exogenous expected price; and $B(q_i, z_{ij}^b)$ is a potential price markup that farmer i expects to receive in market j . This markup depends on the quantity sold (q_i) as well as other bargaining related attributes such as bargaining ability, experience or product quality (z_{ij}^b). Notice that for the same farmer i these may differ across markets.

The expected price received and the variable transaction costs can be used to comprise the expected revenues R_{ij} associated with market j :

$$R_{ij} = q_i * (E[p_{ij}] - TC_{ij}^v) \quad (4)$$

Selling to market j is also associated with fixed costs $TC^f(z_{ij}^f)$. Such costs are related to searching for the best market and buyer or obtaining information about prices. In addition, they are invariant to the specific quantity sold and may also be market specific. For example, knowledge of market specific attributes such as prices and relevant infrastructure (that could potentially affect the probability of finding a buyer) can influence the decision of a farm-household as to where to sell. Individual specific characteristics such as experience, education,

¹Of course, other options that could be incorporated in this decision are the possibility for storage or payment in kind. However, these do not add much to our analysis at this point so we omit them for simplicity.

²For example, owning a truck versus an animal affects both the quantity able to transport and the time to reach all the markets.

gender and age could also enhance the ability to collect and analyze relevant information and thus can affect market choices. Finally, contractual agreements between a farmer and a specific buyer or information about types of contractual agreements available at different markets may also affect market choice.

Based on the above, farm-household i will sell q_i in the market that yields the highest net profits (Π_{ij}). Specifically, farm-household i will choose to sell in market j such that:

$$j : \arg \max \{ \Pi_{ij} = R_{ij} - TC^f(z_{ij}^f) \} \quad (5)$$

or in reduced form:

$$j : \arg \max \{ \Pi_{ij} = q_i * (E[\bar{p}_j] + B(q_i, z_{ij}^b)) - TC^v(d_{ij}, m_{ij}, z_{ij}^v) - TC^f(z_{ij}^f) \} \quad (6)$$

As such, observing farm-household's i selling in market j implies that:

$$\Pi_{ij} > \Pi_{ik} \quad \forall j \neq k \quad (7)$$

Two questions can be tested empirically using this framework: (i) whether the farm-household's market choice is influenced by both variable (distance, time) and fixed (information, search) transaction costs (Eq. (6)); and (ii) how does bargaining affect the seller's prices received (Eq. (3)).

3 Transaction costs insights from rural Peru

3.1 Markets, transactions and location

The data used in this paper, collected in early 2001, comes from a survey of 229 small-scale farm-households in the province of Tayacaja in Peru (Figure 1). The main objective of the survey, designed and implemented by the Grupo de Análisis para el Desarrollo (GRADE), was to study transaction costs. These farm-households are part of about 1500 households in the region dedicated mainly to potato production.³

A number of different locations exist where they can sell potatoes: the farmgate, two local markets (Pazos and Pichus) and two distant ones (Huancayo and Lima).⁴ The two local markets open twice a week while the two distant ones are open every day. Farmers can also arrange directly with buyers to come at the farmgate to purchase their potatoes. Potential buyers also travel around these communities in search of potatoes, which allows informed farmers to sell at the farmgate. All markets are open markets with minimal infrastructure. However, the distant markets are larger and thus attract more sellers and buyers. The average quantities sold in these markets is also higher. As such, the fact that

³For an extensive description of the region see Escobal [1].

⁴There are a number of other small markets where farmers could potentially transact, but are not included them in the analysis due to too few observations and their relative significance.

not everyone sells in those markets can be partly attributed to transaction costs, as discussed next.

The transactions typically occur as follows: a seller is approached by a buyer (even though the opposite can also occur). The buyer proceeds to evaluate the condition and quality of the potatoes and then the two parties negotiate a unit price. If there is an agreement, they weight the desired quantity and conclude the transaction.⁵

Farm-households in the survey are distinguished based on their access to road infrastructure: about two thirds of the households have good road access, while the rest reside in a region with limited road network (North-East region in Figure 1). This latter group of farmers is also significantly farther away from the available markets (Table 1), and as seen below have fewer assets, produce less and are overall poorer than the farmers that have access to good roads.

3.2 Market destination

Table 2 presents the average quantities sold per transaction in the different markets. In general, the average quantity sold in distant markets is significantly higher than the quantities sold locally or at the farmgate. In addition, the sales quantity per transaction is strongly correlated by the road access. Farm-households with good road access sell on average 3 times more per transaction than those with bad road access. As mentioned above, road access (and in effect the distance and time to reach a specific market) can play an important role in the market choice and as such, good road access enables farm-households to sell in distant markets more easily.

In fact, sales in distant markets represent more than two thirds of total sales for farm-households with good road access, as opposed to only 25 percent for farm-households with bad road access (Figure 2). For farm-households with bad road access, almost 70 percent of the marketed surplus is sold in local markets, suggesting the importance of access to good roads in choosing markets.

The survey also included a question about why the farm-household chose the market where they sold. These perceptions signal not only what the farmers may value the most in terms of market choice, but indirectly the level of information they may have. The main reasons that farmers considered for making the market choice were: the expectation for higher prices, availability of more buyers and a higher trust level in the potential buyers in that market (Table 3). These results indicate that the expected price is not the only consideration for farmers in deciding where to sell. Instead, transaction related aspects like the availability of buyers (that could signal lower transaction costs in terms of the higher probability to find a buyer), or the trust-worthiness for buyers in specific markets (reflecting information asymmetries) are also aspects that the farmers take into consideration to decide where to sell.

⁵In most cases, each party uses his own weighting scale out of concern that the other agent may tamper the machine.

3.3 Transaction specific data

Perhaps the most interesting aspect of the survey is the availability of transaction costs related information. In particular, the survey contains data on 1204 potato sales transactions in the five markets described above. As discussed earlier, one way to classify transaction costs is between transportation, information, bargaining and monitoring. First, transportation costs are expected to be higher the furthest a market is. Indeed, per kilo transportation costs are higher for transactions that take place in the more distant markets (Table 4). Specifically, the transportation costs for farm-households that sold in local markets was on average three cents per kilo, as opposed to eleven cents for those that sold in the two distant markets.

Prior to deciding where to sell, farm-households form expectations about the prices in each market. This will require time to collect information from different sources and knowledge about markets and seasonal idiosyncrasies that could affect prices. Interestingly, with the exception of the farmgate, the market that farmers chose to sell is the one that they are more likely to know the prices (Table 5). For example, among farmers that sold in Pazos, a local market, almost two thirds of the farmers knew the price in Pazos as opposed to only 24 percent for Huancayo. Similarly, 85 percent of those farmers that sold in Lima knew the price there, the highest among all other markets for these farmers. This strongly indicates the importance of information in deciding where to sell.

In addition, farmers that sell in distant markets seem to be more informed overall in terms of information about prices in different markets. (Table 5). By contrast, farmers that sell in local markets have information mainly about the prices of the market where they sell. One explanation is that, as discussed above (Table 1), most of the farmers that sell in local markets are farmers with bad road access to the distant markets. For them accessing these markets is too costly and therefore collecting information about them may not be as important. Consistent with the above is the fact that compared with households that sold in other markets, more farm-households that sold in distant markets reported that the price received was the one expected (Table 3). Still, very few farm households reported receiving a higher price than expected, while a third of the farm households reported receiving on average a lower price, suggesting the importance of information in forming expectations and thus influencing the market choice decision.

Another aspect of information costs is that related to search costs for finding market specific information or potential buyers. One would expect that this type of information to be more difficult or costly to collect for distant markets, as a person will generally know more about the place he resides. Interestingly, almost two thirds of the farm-households that sold in distant markets found the buyer prior to the transaction, compared with only a third of the farm-households that sold in local markets (Table 6). Still, finding a buyer is costly: half of the farmers that sold outside the farmgate needed on average more than two hours to sell their product, a third needed between one to two hours while the rest did not find a buyer in the same day, implying that the transaction costs for

finding buyers are important.

The ability to affect the price received will depend on a number of factors: the farmer's negotiating skills, the product's attributes (such as quality), or the relationship with the other party. The survey reveals a number of interesting insights. For example, farmers that sell in distant markets are wealthier, more educated and have more farming experience compared with those that sell in local markets (Table 6), implying that they may be better equipped to negotiate. In addition, most of the farmers negotiate the sales transaction themselves. Still, while the negotiation may be more effective in this way, it also comes at the cost of additional time spend negotiating.

The quantity sold can also offer a bargaining advantage for a seller by lowering the search costs for the buyer. The quantity can also constrain a farmer from selling to a particular markets as it may not be profitable to sell there below a minimum quantity (in order to recover transportation or fixed costs). More than 80 percent of the farmers that sell in distant markets sell improved potato varieties, as opposed to 65 percent of those who sell at the farmgate and 50 percent of those who sell in local markets suggesting that potato quality may be more of a desirable attribute for buyers from distant markets rather than local ones (Table 6).⁶

Still, and reflecting higher fixed transaction costs, a third of all farmers had problems with agreeing on the quality of the product.⁷ Even though some farmers reported that they managed to resolve these types of problems, the majority did not. As such, farmers may not only incur the time costs associated with the negotiation but also settle for a lower price if there is uncertainty about the availability of other buyers.

Finally, even after the transaction takes place, the farmer may still incur additional costs. For example, the farmer may enter an agreement to get paid in the future and as such, he can incur costs related to enforcing the sales agreement. Interestingly, for farmers that sold in distant markets, it took more than four days to get paid, compared to only two for those that sold in local markets (Table 6). This could be one explanation as to why 40 percent of the farmers that sold in distant markets signed a contractual agreement with the buyer.

⁶In fact, field observations revealed that native potato varieties have higher consumption incidences among local communities than the improved varieties.

⁷This entails the verification and subsequent agreement between the two parties that the potatoes are of a specific quality and variety (for example between good and bad condition, or between native or improved variety). While the variety is usually easier to verify, agreeing on the quality can be more challenging.

4 Understanding market choices and the role of transaction costs

4.1 Market choice

The empirical patterns in the previous section suggest that both fixed and variable transaction costs related variables such as transportation, information, bargaining and monitoring could be linked to farmers' market choice. Based on Eq. (6) from section 2, household i will choose market j to sell, as long as the net profits are the highest than any other market. The probability that individual i will choose market j is therefore:

$$\text{Prob}_{ij} = \frac{\exp(\beta^0 x_{ij} + a_j^0 y_i)}{\prod_{k=i} \exp(\beta^0 x_{ik} + a_k^0 y_i)} \quad (8)$$

where x_{ij} is a vector of characteristics for market j as perceived by farmer i ; y_i is a vector of individual characteristics for farmer i ; a_j and β are coefficients to be estimated.⁸

Table 8 reports the results for a reduced form conditional logit of market selection (Eq. (8)).⁹ The results indicate a number of interesting patterns. First, holding other variables constant, farmers are less likely to sell in any of the markets compared with selling at the farmgate. It is interesting to note that for the distant markets the effect is stronger. In other words, if these dummies can be interpreted as capturing the role of location (and therefore of variable transaction costs), they suggest that the further away a farmer is from a market, the more likely it is that he will choose to sell at the farmgate instead of that particular market.

In terms of variable costs, and as expected, the longer it takes to reach a specific market, the less likely it is to choose to sell in that market, reflecting the higher variable costs associated with reaching more distant markets. In addition, access to good roads makes it less likely for farmers to sell in local markets, compared to selling at the farmgate. This implies that buyers may be more willing to come at the farmgate if roads are better. Conversely, since transaction costs are lower for farmers with good road access they are more likely to sell in distant markets compared to selling at the farmgate.

A number of fixed transaction costs related variables also affect the market choice decision. For example, indigenous farmers are less likely to sell in distant markets and more likely to sell in local markets (as opposed to selling at the farmgate). This could be suggesting that fixed costs such as language barriers

⁸While β shows the effect of an attribute specific parameter (such as distance to a market), a_j captures the market specific impact of individual characteristics (such as the role of education) on the market choice.

⁹We report relative risk ratios. Thus, for a market specific attribute (such as distance to market j), a coefficient greater (less) than 1 implies that a unit increase (decrease) for that attribute will increase (decrease) the likelihood of choosing the corresponding market.

may be constraining the ability of indigenous farmers to integrate in some markets. It could also indicate that indigenous farmers face discrimination in some markets so that their overall participation is limited. Furthermore, experience (reflecting the ability to negotiate), makes farmers more likely to interact with all of the markets compared with selling at the farmgate. Finally, the higher the quantity the farmer has available to sell sold the higher the likelihood of selling in a particular market, especially in distant markets¹⁰.

Knowing the prices in different markets can allow a farmer to make a more informed decision about where to sell. We thus expect a positive effect of this knowledge on the probability to sell in a specific market. Nonetheless, as collecting such information is likely to be endogenous to the market selection, for the estimation, we proxy this by the share of farmers in a farmer's village that knew prices in a specific market. Indeed, we find that a higher level of information about prices in a specific market increases the likelihood of selling in that market, corroborating the story that information is indeed crucial for market selection.

In summary, while variable transaction costs are key elements for the market decision for potato farmers, a number of fixed transaction costs relating to bargaining and information are also important determinants for market choice. We now try to further explore these results in order to understand the relative importance of these effects.

4.2 Prices received and bargaining

According to Eq. (3), the expected price received at a given market will depend on the actual market price observed and any additional markup that the farmer could obtain. Therefore, the ability to bargain with buyers will be a crucial factor in the determination of this market price. We thus expect prices received both within and across specific markets to vary significantly. Table 9 presents the prices received per kilo of potatoes by market and road access. Indeed, there is a more than thirty percent variation in the prices received, and the pattern remains even after decomposing the prices by market access.¹¹ One additional interesting point worth indicating is that the farmgate offers the lowest prices while the more distant market the highest. Still, these prices do not account for transportation costs so that comparisons across markets are not appropriate per se (the next section addresses this issue). These findings seem to corroborate the hypothesis that while there is a significant variation in prices received within a specific market, it is not entirely explained by market location or market

¹⁰Since the decision of how much to sell is likely to be simultaneously taken with the decision of where to sell, we instrument the quantity sold (q_i) using a number of production and household characteristics (Table 7). The identifying instruments were the number of kids and elder in the household.

¹¹The prices reported in the survey are prices received at the market destination and at the time of the sale. Hence, to make them comparable within each market, these prices are deflated and expressed in constant prices of December 2000.

access.¹²

To empirically explore the source of this price variation, we estimate a model of the price received at market j , as a function of farmer attributes that represent different aspects of bargaining ability. Since the choice of selling in a particular market j is not random, as the farmer chooses to sell in the market j that leads to the highest expected net profits, we estimate a price equation correcting for market selection bias using the results from Eq. (8) above. Therefore, for each market j , we estimate an equation of the form:

$$p_{ij} = p(B(q_i, z_{ij}^b), \mathfrak{A}_{ij}) \quad \forall j \quad (9)$$

where \mathfrak{A}_{ij} is a market selection correction term derived from equation (8).

The results show that a number of bargaining related attributes significantly affect the price received at the market (Table 10). For example, the quantity sold seems to positively affect the price received, reflecting the fact that the buyer could be willing to pay more if he can buy everything from the same seller (and thus minimizing his transaction costs of finding other sellers).

Given the above and the fact that we are more interested in assessing the relative importance, rather than the magnitude, of bargaining on the price received, we decompose the price variation and evaluate the relative importance of different bargaining aspects. In particular, we classify the explanatory variables between those that relate to the exogenously given market prices and those that reflect bargaining (such as ability, product attributes or relationship with buyers). We keep the variation observed due to the market selection term separate. Therefore, for each market j , we decompose the total explained variance of the estimated price received in each market (i.e. $Var(\hat{p}_{ij}) = Var(\mathfrak{A}_{ij}) + Var(\mathfrak{b}w)$) in M components (4 in our case):

$$Var\left(\sum_{m=1}^M (\mathfrak{b}w)_m\right) = \sum_{m=1}^M Var(\mathfrak{b}w)_m + \sum_{m=1}^M \sum_{\substack{k=1 \\ k \neq m}}^M Cov((\mathfrak{b}w)_m (\mathfrak{b}w)_k) \quad (10)$$

where \mathfrak{b} and w are the parameter estimates and explanatory variables from Eq. (9). Each component m represents a subset of w that captures a particular aspect of the price determination process. For example $m = 1$ could reflect those variables that affect bargaining via individual skills while $m = 2$ the attributes of the product (such as quality).

The decomposition reveals that while for distant markets and the farmgate the role of bargaining is important, it is not true for local markets (Table 11). In particular, for the distant markets, more than 70 percent of the price variation can be attributed to variation in aspects related to bargaining. For Huancayo, one of the distant markets, individual ability, the types of relationships with buyers and product-specific traits are all important in explaining the price variation. Interestingly, for Lima which is the biggest market but also the furthest

¹²We also compared the price variation based on quantities sold and whether the sale was near the harvest season or not and still found high variation in the prices.

away, more than half the price variation is due to bargaining ability. By contrast, the price variation in local markets is mainly explained by non-bargaining aspects like the time of the sale. One explanation is that local markets have overall fewer buyers and as such sellers may face monopsonistic pricing which may leave little room for bargaining. By contrast, in the bigger distant markets where there are more potential buyers, bargaining will be a crucial mechanism for receiving higher prices, especially due to the high level of asymmetric information about both prices and buyers.

4.3 Revisiting the market choice: a semi-structural approach

The analysis so far has established that transaction costs are indeed present and significantly affect farmers' behavior. While the last exercise explored the role of bargaining, the exercise presented below compares the relative importance between information and expected prices. In particular, we want to assess whether, in addition to expected prices, information (and to that extent fixed transaction costs) is a key determinant for market choice. Unlike the reduced form analysis above, in this case we want to compare the relative importance between the two.

To implement the above, we use the regressions on prices received to predict (expected) prices for each farmer and market. In addition, as these prices are not comparable across markets, we discount them by subtracting the unit costs related to transporting potatoes in the particular market. This entails estimating a transportation costs model, based on Eq. (2) and predicting the transportation costs for all markets associated with each farmer (Table 12).¹³ For each farmer and market, we then calculate market prices net of transportation costs ($\mathbf{p}_{ij} - \mathcal{P}C_{ij}^v$), which are now comparable across markets (Table 13). As expected, these net prices are more similar across the different markets than the prices received at the market (Table 9). Interestingly, even after discounting for transportation costs, the price variation in prices is still high (about 50 percent).

With the net prices calculated, we can re-estimate a semi-structural market selection model of Eq. (6):

$$\text{Prob}_{ij} = f(q_i, \mathbf{p}_{ij} - \mathcal{P}C_{ij}^v, z_{ij}^f) \quad (11)$$

As expected, higher (net) prices significantly increase the likelihood of selling in a market (Table 14). In addition, information about market prices (capturing the impact of fixed transaction costs) also positively related to selling in a market. In order to further explore these results, we convert the coefficient for this market price information in net price equivalent, by dividing it with the net price coefficient. The new normalized parameter is 0.85 and can be interpreted it as follows: access to market price information is equivalent to 0.85 of a unit increase

¹³We also correct for market selection.

in net prices. In other words, providing market price information to farmers would have the same effect on market participation as reducing transportation costs by 1.17 soles per kilo ($1/0.85$). Given that the average transportation cost is 5 soles per kilo, it implies that access to information is equivalent to a 23 percent reduction in average transportation costs. As such, these results seem to suggest a large effect of access to information through the reduction of information asymmetries.

To further explore these results, we simulate the effect on the conditional probability for market selection from reducing transportation costs to zero or having complete information about prices. Using these simulated predicted probabilities as weights, we can calculate a counterfactual distribution of sales between farmgate, local and distant markets (a la Figure 2). This allows us to simulate the sales distribution of the marketed surplus under no variable transaction costs or full market prices information. The results presented graphically in Figures 3 and 4 suggest that eliminating these costs would improve overall market participation by allowing farm households to integrate with all the available markets. For example, among farmers with bad road access, eliminating all transportation costs would increase their sales at the farmgate more than 400 percent, while access to full information about prices would increase them even more. Interestingly, among farm households with good road access, eliminating these transaction costs increases their interaction with local markets. We view this as indicating that as markets become more homogeneous, the comparative advantages of accessing one over the other decline and as such we should not expect to see systematic differences in terms of who accesses them.

5 Conclusions

While transaction costs are difficult to measure, understanding the impact they have on behavior is crucial as it can inform policy design. This paper shows how different types of transaction costs influence decisions and outcomes for farm-households in rural Peru. We find that in addition to variable costs such as the distance to reach a market or access to good roads, transaction costs attributes like information about prices, relationships with potential buyers or bargaining abilities are also important determinants of market selection. Furthermore, bargaining explains a large share of the market specific price variation observed in the data, complimenting its role in the transaction process. Estimations of on market selections allows us to find that eliminating information asymmetries about market prices is equivalent to a reduction of 23 percent in transportation costs. Finally, simulations on the effect of reducing different types of transaction costs imply that farmers responsive to both changes in their access to information as well as transportation costs.

In terms of policy, these findings suggest that if the goal is to reduce transaction costs, policy makers should address both variable and fixed costs by creating mechanisms that not only improve physical infrastructure, but also introduce tools that enhance information flows and market integration. In the

case of farmers in Tayacaja, while ameliorating the existing road infrastructure is crucial, the results suggest that policies aiming to increase the availability of information and facilitate bargaining are perhaps more important. In fact, given the available policy tools, it may be more effective (both in cost and effectiveness) to implement policies that improve information linkages as opposed to infrastructure enhancements such as road construction. For example, setting up local committees for collecting and disseminating market related information such as prices could be a cheap and easy mechanism to mitigate information gaps and allow farmers make informed choices. In addition, the creation of cooperative-like schemes that can allow farmers market large quantities could be a feasible option to lower the fixed transaction costs associated with reaching distant markets and could also increase farmers' bargaining ability via the larger quantities offered. Finally, improving language abilities among these farmers (in particular Spanish), could also increase the participation rates of indigenous farmers in the distant markets where indigenous dialects may be less used and reduce any existing discrimination based on language differentials.

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A Tables and Figures

Table 1: Sample structure, transactions and location

	Good road access	Bad road access	All
Number of farm-households	138	91	229
Sales transactions:			
Total number	671	533	1204
At the farmgate	291	43	334
In local markets	175	436	611
In distant markets	205	54	259
Average number per household:	5.5	6.7*	6.0
Average distance to (km):			
Pazos (local)	22	80*	47
Pichus (local)	29	25*	27
Huancayo (distant)	84	120*	100
Lima (distant)	392	469	426
Average time to (minutes):			
Pazos (local)	38	194*	101
Pichus (local)	30	88*	54
Huancayo (distant)	89	245*	148
Lima (distant)	220	374*	270

* significantly different from those with good road access at the 90% level or more.

Table 2: Quantities sold per transaction (by market and road access, in kilos)

	Good road access	Bad road access	All
Farmgate	5285	1787*	4555
Local markets:	3683	2375*	2750
Pazos	3683	3088*	3433
Pichus	n.a.	1914	1914
Distant markets:	10452	8128 ¹	10236
Huancayo	8948	8128 ¹	8821
Lima	15481	n.a.	15481
All	7108	2831*	5215

* significantly different from those with good road access at the 90% level or more.

¹ Small sample.

Table 3: Perceptions by market and by road access

	Good Road access			Bad Road access		
	Farmgate	Local	Distant	Farmgate	Local	Distant
The farmer prefers to sell in this market because of (%):						
Higher prices	23	44	38	4	55	89
More buyers	30	26	33	0	30	0
More trust in buyers	27	20	25	4	5	11
Only option available	20	9	3	86	2	0
Other reasons	0	1	0	6	8	0
The price received was [...] compared to the expected price (%):						
Higher	5	8	3	0	0	0
Lower	30	26	25	53	19	3
Same	65	66	72	47	81	97

* significantly different from the group to its left at the 90% level or more.

** significantly different from the distant market at the 90% level or more.

Table 4: Transportation costs by market and road access (in soles)

	Good road access		Bad road access		All	
	Total	Per kilo	Total	Per kilo	Total	Per kilo
Local markets:	204*	0.06*	58*	0.02*	100*	0.03*
Pazos	215	0.06	99	0.04	153	0.05
Pichus	n.a.	n.a.	27	0.02	27	0.02
Distant markets:	1121	0.12	309	0.04	1025	0.11
Huancayo	857	0.11	309 ¹	0.04 ¹	772	0.10
Lima	2003	0.15	n.a.	n.a.	2003	0.15
All	550	0.07	77	0.02	341	0.05

* significantly different from distant markets at the 90% level or more.

¹ Small sample.

Table 5: The role of information: knowing prices

	Among farmers who sold in:				
	Farmgate	Local		Distant	
		Pazos	Pichus	Huancayo	Lima
% of farmers who knew prices in:					
Farmgate	24	13	1	21	10
Pazos	60	60	8	64	32
Pichus	9	9	40	6	7
Huancayo	50	24	1	84	51
Lima	14	4	0	15	85
Obs	257	329	184	258	68

Table 6: Transaction cost related variables by market destination

	Farmgate	Local	Distant
Information and search (ex ante)			
Found a buyer and fixed price before the sale (%)	37**	35	63*
Knew buyer (%)	64**	81*	88*
Buyer lives in same area (%)	35**	11*	0*
Time to sell in market (%)			
less than an hour	n.a.	12	16*
between 1-2 hours	n.a.	37	29*
more than 2 hours	n.a.	43	43
not in the same day	n.a.	8	11*
Bargaining and negotiation			
Number of negotiation rounds before agreeing on price	1.3**	1.5*	1.9*
Farmer bargained himself (%)	58**	79*	63*
Number of available buyers if sold at farmgate	2.7	n.a.	n.a.
Had problems agreeing on quality (%)	42**	29*	36*
Managed to agree on quality (%)	40**	18*	50*
Buyer paid with cash (%)	60**	65*	37*
Land owned (hectares)	4.8**	4.7	6.6*
Farm experience (years)	17**	19*	19
Improved variety (%)	65**	52*	82*
hh head age (years)	47**	50*	49
hh head education (years)	5.3**	5.3	5.7*
hh head gender (%)	95	91*	94*
hh head indigenous (%)	57	64*	57*
Monitoring and enforcement (ex post)			
Time to get paid (days)	3.0**	2.1*	4.5*
Number that farmer had to ask for payment (%)	1.5**	1.6*	2.0*
Confidence in buyer (1:worst, 10 best)	4.4**	4.6*	5.0*
Signed an agreement (%)	21**	28*	41*

* significantly different from the group to its left at the 90% level or more.

** significantly different from the distant market at the 90% level or more.

Table 7: Quantity sold (OLS estimation)

Production characteristics	
Access to good road (yes=1)	4,744***
Farming experience (years)	-26
Indigenous (yes=1)	-622
Improved variety (yes=1)	1,500***
Date (at harvest=1)	939***
Number of adults	858***
Land owned (hectares)	1,267***
Household characteristics	
Number of children	351*
Number of elder	1,134***
Constant	-9,437***
Observations	1096
R-squared	0.42
Dependent variable: quantity sold (in kilos)	
Significance of underlying parameters: * at 10%; ** at 5%; *** at 1%	

Table 8: Market choice: conditional logit

		Market choice
	Markets	
Pazos (Local market)		0.72
Pichus (Local market)		0.82
Huancayo (Distant market)		0.08***
Lima (Distant market)		0.01**
	Quantity sold (predicted)	
Quantity * Pazos	q_i	1.0002***
Quantity * Pichus	q_i	1.0001
Quantity * Huancayo	q_i	1.0005***
Quantity * Lima	q_i	1.0007***
Quantity * Access to good road * Pazos	$q_i * z_{ij}^p$	0.9997***
Quantity * Access to good road * Pichus	$q_i * z_{ij}^p$	0.9999
Quantity * Access to good road * Huancayo	$q_i * z_{ij}^p$	0.9995***
Quantity * Access to good road * Lima	$q_i * z_{ij}^p$	0.9995**
	Proportional Transaction Costs	
Distance to market (in km)	d_{ij}	1.007
Distance to market squared	d_{ij}	0.99997
Time to market (in minutes)	m_{ij}	0.99367***
Time to market squared	m_{ij}	1.000007
Access to good road * Pazos	z_{ij}^p	0.17***
Access to good road * Pichus	z_{ij}^p	0.01***
Access to good road * Huancayo	z_{ij}^p	2.43
Access to good road * Lima	z_{ij}^p	18.79
	Bargaining and negotiation	
Indigenous * Pazos	z_{ij}^b	1.15
Indigenous * Pichus	z_{ij}^b	1.60**
Indigenous * Huancayo	z_{ij}^b	0.84
Indigenous * Lima	z_{ij}^b	0.53**
Improved variety * Pazos	z_{ij}^b	1.75**
Improved variety * Pichus	z_{ij}^b	0.61**
Improved variety * Huancayo	z_{ij}^b	1.63**
Improved variety * Lima	z_{ij}^b	2.58**
Experience * Pazos	z_{ij}^b	1.07***
Experience * Pichus	z_{ij}^b	1.07**
Experience * Huancayo	z_{ij}^b	1.05***
Experience * Lima	z_{ij}^b	1.08***
	Information	
Farmers in village know the market price (%)	z_{ij}^f	3.09***
	Date of sale	
Big harvest season * Pazos		1.42**
Big harvest season * Pichus		1.64**
Big harvest season * Huancayo		1.40**
Big harvest season * Lima		1.40
Observations		5480
Omitted market is farmgate.		
Relative risk ratios reported		
Significance of underlying parameters: * at 10%; ** at 5%; *** at 1%		

Table 9: Prices received by market and road access (in soles/kilo)

	Good road access	Bad road access	All
Farmgate	0.20 (0.05)	0.17 (0.03)*	0.19 (0.05)
Local markets:	0.26 (0.07)	0.24 (0.08)*	0.25 (0.08)
Pazos	0.26 (0.07)	0.26 (0.02)	0.26 (0.05)
Pichus	n.a.	0.22 (0.02)	0.22 (0.02)
Distant markets:	0.34 (0.09)	0.35 (0.05) ¹	0.34 (0.08)
Huancayo	0.32 (0.08)	0.35 (0.05) ¹	0.32 (0.08)
Lima	0.41 (0.07)	n.a.	0.41 (0.07)
All	0.28 (0.09)	0.25 (0.08)*	0.26 (0.09)

* significantly different from the group to its left at the 90% level or more.

Standard deviation in parenthesis.

¹ Small sample.

Table 10: Explaining prices received (by market)

		Farmgate	Local		Distant	
			Pazos	Pichus	Huancayo	Lima
Quantity sold (in kg.)	q_i	-3.2	-0.2	12.1	60.9*	-39.3
Hh head farm exper. (years)	z_{ij}^b	0.1	-9.2	-12.5	-10.1	-13.2
Hh head farm exper. squared	z_{ij}^b	-0.2	0.2	0.5	0.4	0.2
Improved variety (yes=1)	z_{ij}^b	10.7	-21.2	-92.3**	-174.2	-51.1
Knew buyer (yes=1)	z_{ij}^b	39.3	8.7	0.4	-172.1	-97.1
Harvest season (yes=1)		-17.1	-112.7***	-274.4***	-83.7	6.9
Selectivity	$\hat{\lambda}_{ij}$	-175.7***	-70.9	95.4**	47.1	66.4
Constant		-1399***	-1133***	-1478***	-1367	-358.7
Observations		257	329	184	258	68
R-squared		0.12	0.08	0.58	0.18	0.11
F-test		4.94***	2.18**	25.84***	9.01***	2.24*

Dependent variable: log of price received

Coefficients reported are multiplied by 1000

Significance of underlying parameters: * at 10%; ** at 5%; *** at 1%

Table 11: Variation of price received by component

	Farmgate	Local		Distant	
		Pazos	Pichus	Huancayo	Lima
Market (time of sales) ¹	0.02	0.92	0.91	0.18	-0.01
Bargaining (ability) ²	0.38	0.02	0.00	0.38	0.52
Bargain (product attributes) ³	0.00	0.03	0.06	0.42	0.17
Selectivity	0.61	0.03	0.04	0.02	0.31

¹ Harvest season² Hh head farm experience, knew buyer³ Improved variety, quantity sold

Table 12: Transportation costs (estimations by market)

		Local		Distant	
		Pazos	Pichus	Huancayo	Lima
Access to good road (yes=1)	z_{ij}^p	4.14	-20.68**	1.78	0.03
Distance to market (km)	d_{ij}	-0.024	0.033**	0.015	-0.02
Distance to market squared	d_{ij}^2	-0.0016**	0.0058***	0.0005**	-0.0005
Time to market(in minutes)	m_{ij}	0.06***	-0.007	0.004	0.007
Time to market squared	m_{ij}^2	-0.00014***	-0.0003***	-0.0001	-0.0006
Big harvest season (yes=1)		-1.12	1.44	2.13**	0.03
Selectivity	$\hat{\lambda}_{ij}$	-5.48**	8.55**	-0.25	-1.01**
Constant		-4.93	-23.34***	-6.91	3.73
Observations		329	184	258	68
R-squared		0.20	0.35	0.06	0.41
Dependent variable: log of transportation costs paid					
Significance of underlying parameters: * at 10%; ** at 5%; *** at 1%					

Table 13: Prices received net of transportation costs by market and road access (in soles/kilo)

	Good road access	Bad road access	All
Farmgate	0.20 (0.05)	0.17 (0.03)*	0.19 (0.05)
Local markets:	0.20 (0.10)	0.22 (0.08)* \diamond	0.21 (0.09) \diamond
Pazos	0.19 (0.10)	0.23 (0.03)*	0.21 (0.07)
Pichus	n.a.	0.21 (0.03)	0.21 (0.03)
Distant markets:	0.22 (0.19) \diamond	0.31 (0.05)* \diamond	0.23 (0.13) \diamond
Huancayo	0.21 (0.15)	0.31 (0.05)*	0.23 (0.14)
Lima	0.26 (0.28)	n.a.	0.26 (0.28)
All	0.21 (0.14)	0.22 (0.08)*	0.22 (0.12)

* significantly different from the group to its left at the 90% level or more.

\diamond significantly different from local and farmgate at the 90% level or more.

\diamond significantly different from farmgate at the 90% level or more.

Standard deviation in parenthesis.

Table 14: Revisiting market choice: semi-structural conditional logit

	Markets	Market choice
Pazos (Local market)		0.995
Pichus (Local market)		1.208
Huancayo (Distant market)		0.302***
Lima (Distant market)		0.031***
	Quantity sold (predicted)	
Quantity * Pazos	q_i	0.9998***
Quantity * Pichus	q_i	0.9997***
Quantity * Huancayo	q_i	1.0001***
Quantity * Lima	q_i	1.0002***
	Effective price	
Predicted net price received (soles)	$\hat{E}[p_{ij}] - \hat{TC}_{ij}^p$	7.23***
	Information	
Farmers in village know the market price (%)	z_{ij}^f	5.58***
	Date of sale	
Harvest season * Pazos		1.87***
Harvest season * Pichus		2.41***
Harvest season * Huancayo		1.95***
Harvest season * Lima		1.66*
Observations		5480
Omitted market is farmgate		
Relative risk ratios reported		
Significance of underlying parameters: * at 10%; ** at 5%; *** at 1%		

Figure 1: Survey map

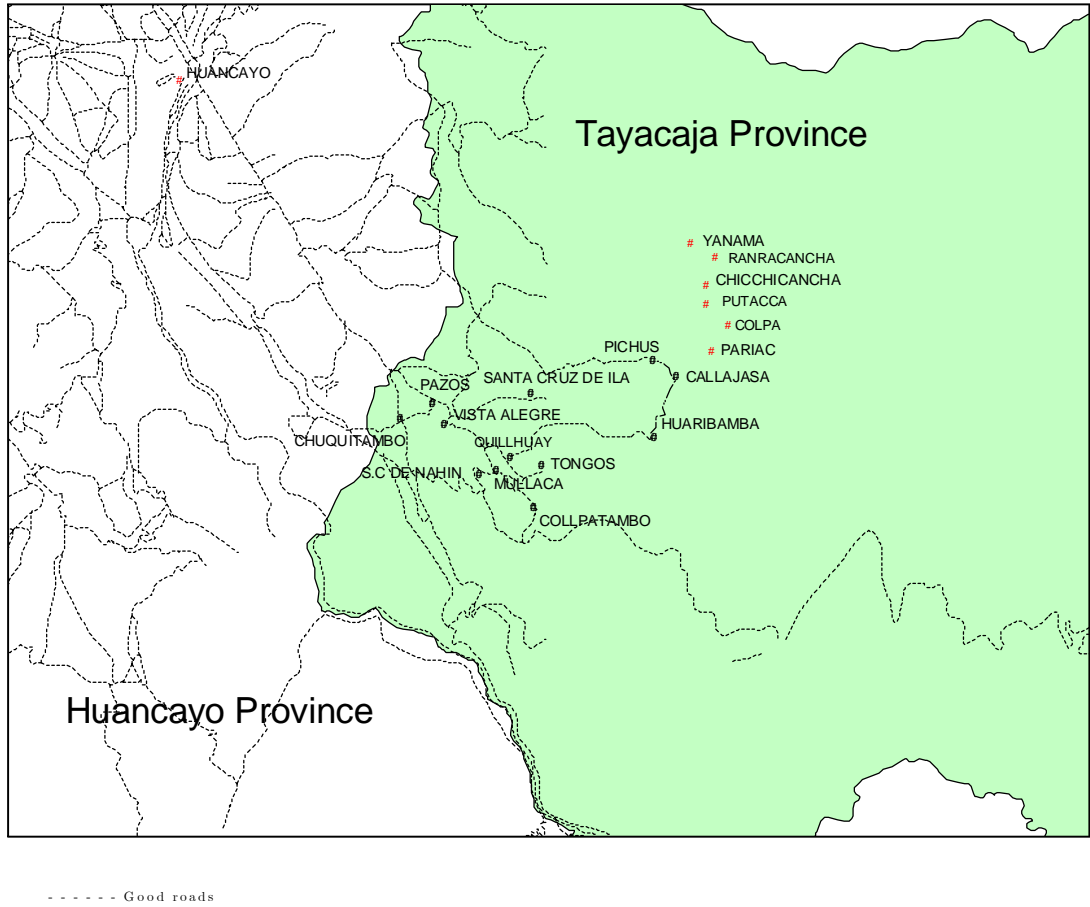


Figure 2: Distribution of total quantities sold, by market destination and road access

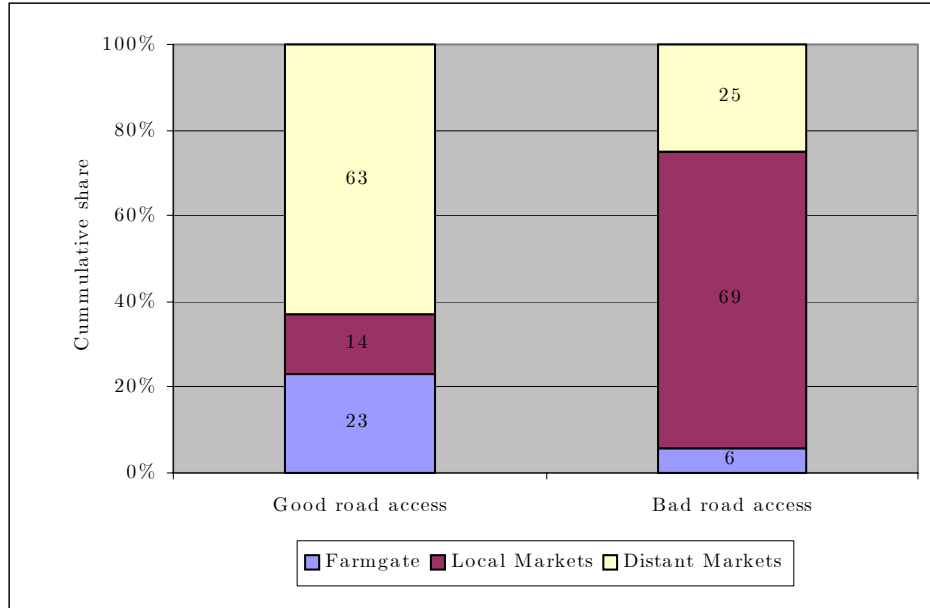


Figure 3: Simulated distribution of total quantities sold due to changes of transportation costs and price information (Bad road access)

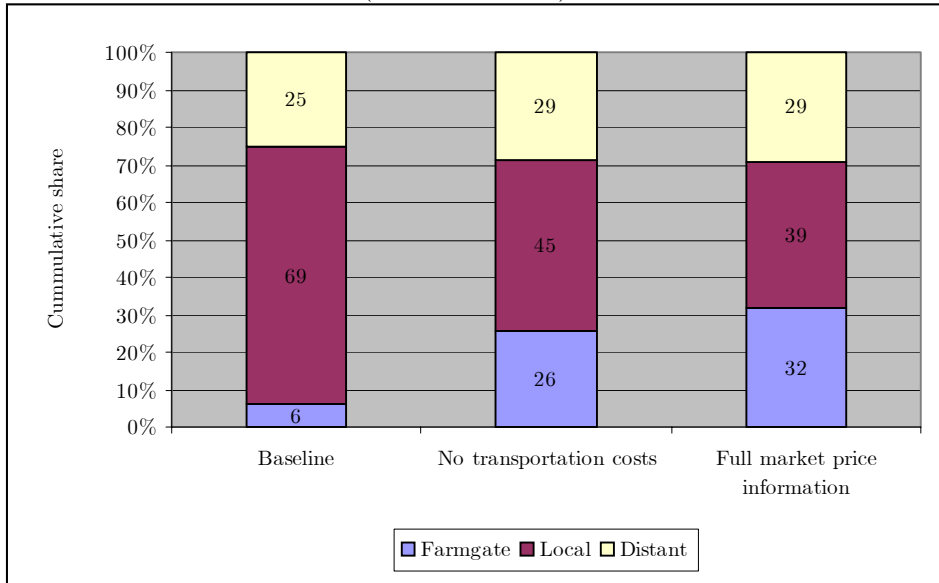


Figure 4: Simulated distribution of total quantities sold due to changes of transportation costs and price information (Good road access)

