Incomplete, Slow, and Asymmetric Price Transmission in Ten Product Markets of Bolivia

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Abstract

With food prices on the rise, understanding the transmission of price shocks, both internationally and domestically, is central for trade policy analysis. This paper examines spatial market integration and its determinants for ten key food products in Bolivia, across the four most important cities, and with the world, over the period 1991–2008. Within Bolivia, markets for onions, chicken, sugar, and to a lower extent for potatoes, cooking oil, wheat flour, and rice are integrated. However, only chicken, sugar, cooking

oil, and rice are integrated with world markets, with incomplete and slow transmission. The perennial result of asymmetric price adjustment to foreign shocks also holds for Bolivia: domestic prices respond faster when the world price increases than when it decreases. This points to a perennial recommendation: the importance of stimulating competitive practices to avoid welfare redistribution due to imperfect competition. Infrastructure improvements will also contribute to accessible food prices for the poor.

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1. Introduction

Recent sharp rises in food prices have affected the welfare of the poor and raised important policy questions. Food price inflation has become a key concern for policy makers, and in particular, for those acting in developing countries where food expenditure accounts for a large portion of total expenditure of poor households.

Understanding the patterns of food price variations is thus essential. In a competitive setting, in which producers and consumers are free to transact domestically and internationally, and in the absence of transportation costs, food prices measured in domestic currency will be determined by world supply and demand conditions as well as by the price of foreign currency measured in units of domestic currency (and the same holds for any other tradable good). Departures from competitive settings or sufficiently high transportation costs that would make the arbitrage arising from spatial price differences unprofitable would make prices be determined by domestic market conditions, and allow space for government interventions to affect food prices.

From a conceptual point of view, the analysis of price transmission has captured attention in the literature given the crucial role that price signals have in resource allocation efficiency. Understanding how much and how fast price signals are transmitted in a particular context, as well as understanding what factors delay or impede transmission is also a key input for policy-makers attempting to understand how costly and effective policy interventions will be.

The literature on price transmission and spatial market integration abounds (see Table 1 for a summary), although the empirical analysis of its determinants has been generally neglected, with some exceptions being the works of Ravallion (1986), Goodwin and Schroeder (1991), Goletti, Raisuddin and Farid (1995) and Ismet et al. (1998), Goodwin and Piggott (2001), Rashid (2004), Van Campenhout (2007), and Varela, Aldaz-Carroll and Iacovone (2012).

This paper contributes to the literature by providing evidence on international and domestic price transmission in ten product markets across four

cities of a small and relatively open economy like Bolivia. We measure the size and the speed of the price transmission, both internationally and within Bolivia, and test for upward and downward symmetry in that speed. We also shed light on the determinants of geographical price differences and price transmission. We focus on ten key products for the median Bolivian household: bananas, beef, cooking oil, chicken, milk, onions, potatoes, rice, sugar and wheat flour, and on the main four cities that accumulate more than half of the population: Cochabamba, El Alto, La Paz and Santa Cruz.² The main results of the paper are that domestic and foreign goods are imperfect substitutes, as transmission from world to domestic prices is imperfect and slow. Marked asymmetries in transmission patterns also point to departures from perfectly competitive settings. Finally, we identify a clear association between regional production levels and prices for non-industrial products, which point to the importance of transportation costs as determinant of price differences and a possible barrier to market integration.

The remaining of this paper is structured as follows. Section 2 presents the data and the methodology used. In section 3 we present the main results of the spatial integration analysis, both within Bolivian cities, and between world and domestic markets, and explores whether transmission from world to domestic prices is symmetric with respect to increases and decreases of world prices. Section 4 provides an informal discussion of possible determinants of geographical price differences. Section 5 provides some concluding remarks.

2. Data & Methodology

Domestic price data for the ten products analyzed here were obtained from the National Statistics Office of Bolivia (INE) for the period 1991m1 - 2008m9.³ World price series for the corresponding products were obtained

² El Alto and La Paz are virtually the same market, as they are contiguous.

³ For Bananas, we use price series No. 11016 from INE, for Beef, 112010, for Chicken, 112059, for Onions, 114039, for Potatoes, 115017, for Rice 111050, for Cooking Oil,

from the World Bank Commodity Price Database, and the Boliviano/Dollar exchange rate from the IMF IFS dataset.

The choice of the ten products is based on their importance either in consumption or production structures of the economy. Bananas, for example, are the fruit that carries the largest weight in the CPI, and is among the top export products in the country, as well as sugar and cooking oil. Beef accounts for 5.24% of the CPI basket and together with wheat related products displays the largest contribution to the CPI. Chicken and related products account for 1.9% of the CPI basket (another of the top ten contributors to the index), as well as potatoes, and rice. We also included in the analysis milk and onions, although there is no international price, since the products are important for the consumption bundle of the poor. Finally, we include wheat flour where international trade is substantial and Bolivia is a net importer.

Table 2 provides some descriptive statistics on the monthly growth rates of these price series, and shows that for all products that are traded in world markets with the exception of bananas, growth rates of domestic prices are roughly similar to the growth rates of world prices expressed in Bolivianos. Domestic price changes tend to be less volatile than world price changes, which is reasonable given that the former include marketing and distribution margins that are less prone to volatility and that within domestic prices and also as expected, less processed products exhibited larger price volatility than more processed products.

To assess the extent of spatial integration, either between domestic and world prices, or between the prices in two given Bolivian cities we analyze how the price series under consideration co-move. First, we report correlation coefficients of the price levels and their changes. Second, we follow Engle and Granger (1987), and use a 2-step procedure. The first step consists of estimating a long-run static relation between every possible pair of price series p_{it} and p_{jt} , corresponding to regions i and j respectively, as in equation (1):

113019, for Sugar, 117015, for Wheat Flour, 111098, and for Milk, 113518.

$$p_{i,t} = \beta_0 + \beta_1 t + \beta_2 p_{j,t} + u_t \quad (1)$$

A pair of regions i and j are *integrated* forming one market, if prices in region i and j are integrated of order 1 (I(1)) and share a stochastic trend, which implies that there exists a linear combination of p_i and p_j that renders u in equation (1) stationary.⁴ Operationally, testing for spatial integration implies estimating equation (1) testing for a unit root in the estimated residuals, $\hat{u}$, and rejecting the null. In table 5, of section 3 we report the results of these t tests for integration. In the second stage, we look at the dynamics, estimating the following relation:⁵

$$\Delta p_{i,t} = \alpha_0 + \sum_{n=1}^{12} \beta_n \Delta p_{i,t-n} + \sum_{n=1}^{12} \gamma_n \Delta p_{j,t-n} + \delta \hat{u}_{t-1} + \varepsilon_t \quad (2)$$

The lag length is chosen using the Akaike information criterion, and the price series are purged from their seasonal components in the estimation.⁶ From equation (2) we obtain information on short and long run dynamics.

1. Short Run: short run responses of prices in region i to prices in region j (or to world prices, or exchange rate changes if that is what is being estimated).⁷

⁴ We control for a deterministic trend in the long run relation.

⁵ The unit root tests are augmented Dickey Fuller, with the choice of lags being determined by the Akaike Information Criterion. Because the test is performed on the residuals from equation (1) that are estimated with error, the critical values are non-standard. We used the critical values tabulated by Engle and Yoo (1987). For brevity sake, these results, as well as the estimates of β_2 , which represents the pass-through coefficient from region j to region i are only summarized here. The full set of results is available from the author upon request.

⁶ We tested and rejected stochastic seasonality in the price series, using the methodology of Reilly and Kempaka (2007). However, deterministic seasonal patterns were found in the series. In the analysis that follows, we used seasonally-adjusted series. Although in most cases the seasonal components explained a low portion of the price variations, for specific unprocessed products such as potatoes, seasonal factors accounted for more than 30% of price variations.

⁷ We could also obtain information on whether one regional price series Granger-causes another regional price series, by testing the joint significance of the twelve γ coefficients. If they are jointly significantly different from zero, that implies that

2. Long Run: whether the regions are integrated (an additional test to that discussed above), and a measure of integration. If i and j are integrated, then prices share a long run stochastic trend. In the short run, misalignments from the equilibrium may exist, and they are captured in $\hat{u}$. If $\delta < 0$, these are corrected period after period. If no correction process exists (either because $\delta = 0$ or $\delta > 0$), then there is no long run relationship between the two price series. Therefore, the negative sign and the significance of this coefficient constitute another test of market integration. Its size is a measure of integration and indicates how much of the disequilibrium is corrected every period. The more efficiently markets work, the faster information flows, and therefore, the faster these short run disequilibria will be corrected.

We choose the Engle-Granger approach to more sophisticated techniques such as those of Johansen (1988) or Stock and Watson (1993). Our decision is based on three elements. First, the Engle-Granger approach is intuitively appealing and consists essentially, of a careful examination of relative prices. Second, Johansen and Stock and Watson's techniques have proven to outperform Engle-Granger in large samples. These techniques rely on asymptotic properties (their estimators are obtained through maximum likelihood techniques), which fail to hold in small samples like the ones we are using in this study. Third, Johansen's techniques are superior to Engle-Granger when the cointegration analysis is multivariate. Our analysis is bivariate. Stock and Watson generalized the estimators of cointegrating vectors for series that are integrated of higher order, while our price series are all integrated of order one. Despite all the aforementioned, and for the purposes of checking robustness of results, we use Johansen techniques to check the consistency of the results. Consistency is found, and for brevity's sake, we do not report Johansen's results.

Next, we tackle the following question: Do Bolivian prices react to world

lagged prices in j are relevant to explain (and therefore predict) prices in i . That analysis is out of the scope of this paper.

price shocks symmetrically when these imply price increases and when these imply price decreases?

To test for asymmetric price transmission we considered the long run equilibrium relationships between each regional price series and world price series. When domestic prices were above the long run relationship, returning to the equilibrium implies a price adjustment downwards (and the residuals from the long run relation equation are positive). When domestic prices are below the long run relationship, returning to the equilibrium implies a price adjustment upwards (and the residuals from the long run relation equation are negative).

We estimated the long run relation as in equation (3), and extracted the residual $\hat{u}$. We identified the periods in which domestic prices were above (residual being positive) and those in which domestic prices were below the long run relationship (residuals being negative), and split the error correction term into a “positive” ($\hat{u}_{(+)}$) and a “negative” one ($\hat{u}_{(-)}$).

Then, we estimated (4) incorporating the residuals from equation (3), positive and negative, and allowing for two different speeds of adjustment, δ_{up} - which shows the speed of the adjustment of prices upwards, and δ_{down} - which shows the speed of adjustment downwards.

$$p_{i,t} = \beta_0 + \beta_1 t + \beta_2 p_{world,t} + u_t$$

$$\Delta p_{i,t} = \alpha_0 + \sum_{n=1}^{12} \beta_n \Delta p_{i,t-n} + \sum_{n=1}^{12} \gamma_n \Delta p_{j,t-n} + \delta_{up} \hat{u}_{(-)t-1} + \delta_{down} \hat{u}_{(+)t-1} + \varepsilon_t.$$

If δ_{up} is significantly different from δ_{down} , then we conclude that transmission is asymmetric.

We tested for asymmetry in price adjustment to world price shocks among those products that showed substantial co-movement with world prices: chicken, sugar, rice and cooking oil. We first used data for the period 1991m1 – 2007m12, and then replicated the analysis using data for 1991m1 – 2008m9.

3. Results

3a. Spatial Integration Analysis

Here we report and discuss the results of measuring, first, the extent to which the Bolivian markets of Cochabamba, El Alto, La Paz and Santa Cruz are spatially integrated, and second, for those products that are traded internationally, whether these are integrated with world markets.

The first stage in the analysis of co-movement consisted in looking at price correlations, in levels and in first differences.⁸

Tables (3) and (4) show the correlation coefficients of price levels across all four cities. Regional price levels are highly correlated, and these are also highly correlated with world price levels. When we look at price changes, within Bolivia correlations are still significant. However, domestic price changes are not correlated with world price changes, which should be seen as preliminary evidence of absence or weak integration, or slow transmission from world to domestic prices.

The second stage in the analysis consisted in testing for cointegration, and estimating an error correction model for each pair of regional markets, as well as for each regional market and world markets.⁹ We focus on three dimensions of the results: a) whether a pair of regions were integrated (i.e.: if price signals were transmitted from one region to the other), b) the extent of the transmission, and c) the speed of the transmission.

⁸ The reader should be cautious to interpret these correlation coefficients, as the series used here incorporate seasonal components. In the subsequent error correction models we estimate, all price series are seasonally adjusted.

⁹ For all error correction models we tested for serial correlation of the residuals using Breusch-Godfrey test and for homoscedasticity using the Breusch Pagan test. We cannot reject the null of serially uncorrelated residuals, at 5% significance, for the models estimated for Bananas, Beef, Chicken, Milk, Onions, Rice, and Wheat Flour. For the cases of Potatoes, Soya Oil and Sugar, we cannot reject only at a stricter threshold of 1% significance. Homoscedasticity cannot be rejected for the cases of Bananas, Potatoes, Sugar, and Chicken, but is rejected for the rest. For this reason we used the robust transformation in all models.

Integration: Yes or No? Within Bolivia we found strong evidence of market integration for onions, chicken and sugar, and to a lower extent, for potatoes, cooking oil, wheat flour and rice. Price signals are efficiently transmitted for these products. All regional prices share a common stochastic trend and exhibit a stable relationship. For bananas, we found mixed evidence of integration (the cluster of regions where there was some evidence of integration was El Alto/La Paz and Cochabamba). For beef, only El Alto and La Paz seem to be integrated, and we found no evidence of integration for milk markets.¹⁰

Only the chicken, sugar, and to a lower extent, rice and cooking oil markets are integrated with world markets.¹¹ Table (5) shows the results from the cointegration tests, for each pair of regional markets, and for each product. The markets of wheat flour, and beef seem to be isolated from world markets, or at least with very weak linkages. The lack of integration of beef markets with world markets is not surprising given substantial quality differentials that may exist between the internationally traded and the domestically consumed versions of the product. For the case of wheat flour, the co-movement is tested against the US wheat price. Even if wheat flour is imported in Bolivia, the movements in wheat flour prices are not necessarily going to strongly co-move with world wheat prices, as the latter is an indicator of only one (although key) component of the former product (in this case, this could be seen as a test of ‘vertical’ integration of markets, along the production chain). Results for the market for bananas were much less conclusive about integration. This latter result is surprising given that banana is an important export product in Bolivia, and may point to imperfect substitution between domestically consumed bananas, and exportable ones.

¹⁰ For the case of milk, the price series behave as if there was no market determination of the price, but a price setter. That behavior hinders the price transmission analysis, and most probably, explains the strange results found.

¹¹ For the case of cooking oil, the results are ambiguous: one integration test suggests that domestic markets are not integrated with world markets, but another test suggests that domestic markets follow world prices closely.

How much, how fast? In addition to exploring if markets were spatially integrated or not, we explored the extent of the integration, by looking at how much prices are transmitted from one region to the other (or by how much world prices affect domestic prices, where the two markets are integrated). This is captured in the pass-through coefficient. In addition, we also explored how long it takes for a region to adjust to a price change in another region (or in the world). This is captured in the speed of adjustment coefficient.¹²

Within Bolivia and for products whose markets exhibit integration, the pass-through is generally close to one. An increase in the price in one region of 1% leads to an increase in the price of the other region by 1% in the long run, implying full transmission. However, the pass-through coefficient varied by product and by city. We found that full transmission was the rule for the relationship between the contiguous markets of El Alto and La Paz. However, we found for the markets of onion and chicken, that the pass-through was significantly lower for distant regions (e.g.: between La Paz-Santa Cruz around 0.6, and for La Paz-El Alto around 1), suggesting that transportation costs may be limiting the scope for full transmission.

For most products in which we found spatial integration, the price adjustment after a shock in another region takes between 5 to 10 periods. This means a speed of adjustment coefficient of 10–20% per period. The exception was the adjustment between El Alto and La Paz, which was generally faster.

For those products whose markets were integrated with the world, the adjustment to world shocks was incomplete and slow. Full adjustment to a world price shock may take up to 2 years, and it is incomplete: an increase in world prices of 10% leads to an increase in domestic prices in the range of 1 to 4%, depending on the product: 0.3-0.4 for sugar, 0.25 for chicken, 0.11-0.14 for

¹² For brevity's sake, we summarize the results, but do not report here all pass-through and speed of adjustment's coefficients. These coefficients are available from the author upon request.

rice. This is because domestic and foreign products are imperfect substitutes, and constitutes a common finding in the literature. (See, for example, Warr, 2008.) The speed at which Bolivian regional prices adjust to world price shocks is also product specific and generally slow. In the chicken market adjustment is the fastest. Full adjustment takes only about 3-4 months in Santa Cruz. In most other products, however, it may take up to 2 years the price adjustment to be processed domestically after a foreign price shock.

3b. Rockets & Feathers: Asymmetric Transmission

Although symmetric transmission is expected in a competitive setting, it is rarely found when tested, but the tests are often omitted in price transmission analysis. Bolivia is no exception to asymmetric transmission.¹³

Domestic prices respond significantly faster when the adjustment implies an increase in prices than when the adjustment involves a price reduction. This implies an asymmetric transmission from world to domestic prices, and hints that some market inefficiencies associated with lack of competition in a segment of the market may exist in Bolivia. Interestingly, this evidence becomes blurry when we incorporate in the analysis the first nine months of 2008. Although the point estimates still suggest asymmetry, statistical significance often vanishes. This is because 2008 exhibits very atypical price behavior both of domestic and world markets.

Prices adjust upwards faster than they do downwards. This evidences asymmetry in the transmission from world to domestic prices and suggests some degree of market power in the markets for chicken, sugar, cooking oil and rice in Bolivia. The evidence is stronger when we exclude the extreme price movements of 2008. This result of asymmetric transmission is quite common in the literature (see Peltzman (2000)), and it has important welfare and policy implications. It implies a transfer of welfare from consumers to producers; it

¹³ See Meyer and von Cramon-Taubadel (2004) for a review of the literature on the subject.

often points to market failure and may warrant government interventions.¹⁴

Tables (6), (7), (8) and (9) present the estimates of the speed of adjustment to world shocks, separated for adjustments that imply an increase in the domestic price (upward adjustment), and those that imply a decrease in the domestic price (downward adjustment), for chicken markets, sugar markets, rice markets and cooking oil markets respectively when we use consider the period 1991m1 – 2007m12, along with statistical significance, and the confidence interval in which these adjustment parameters fall.

Figures (1), (2), (3) and (4) help to visualize these results, by showing how much of a world price shock is corrected every period when it implies a domestic price increase (green line), how much when it implies a domestic price decrease (red line), and how much on average (blue line), for chicken, sugar, rice and cooking oil markets respectively. The pattern in all figures is that the line that shows the adjustment upwards is systematically above that one showing the downward adjustment. In other words, it takes longer for firms to adjust their prices downwards, following a world price decrease, than it takes them to adjust their prices upwards, following a world price increase. This is likely to imply some degree of market power in the markets for chicken, sugar, cooking oil and rice in Bolivia. With the exception of the rice market of Cochabamba (where the difference is not significant), we systematically find that the adjustment upwards is faster than the adjustment downwards. In addition, the speed of adjustment upwards is always significant at 10% ($p\text{-value} < 0.1$), whereas the speed of adjustment downwards is insignificant.¹⁵

Once we incorporate 2008 in the analysis, the results are distorted. Though the

¹⁴ Although systematic, these results are weak, and should be interpreted with caution, as they are “blurry”, from the point of view of statistical significance. Also, if there are adjustment costs associated with pricing decisions, and these are asymmetric, asymmetric price transmission may not reflect imperfect competition, or imply any transfer of welfare. It is however difficult to find convincing arguments for these asymmetric adjustment costs.

¹⁵ Note that the adjustments in Cochabamba to world prices of chicken and rice are not significant. The same happens for El Alto’s adjustment to world prices of soya oil. We include them in the figures, anyway, for illustrative purposes.

results point in the same direction, the evidence becomes blurry from a statistical significance point of view (see tables (10), (11), (12) and (13)). The number of extreme episodes drives the distortion in 2008.

4. Determinants of Price Differences and Spatial Integration

Here we attempt to understand the patterns behind systematic price differences across cities, and of spatial market integration. Strictly, spatial integration implies only a stable price co-movement. Price differences, no matter their size, are consistent with spatially integrated markets as long as these price differences are explained by marketing margins (distribution and transport costs).

Price Differences There are significant price differences across cities. For a given product, the geographical distribution of price differences is explained by the geographical distribution of production.

We calculated average price differences among the four cities considered and found systematic patterns. Prices in El Alto are lower than in La Paz for all products, and they strongly co-move (for the case of milk, the price difference is of about one tenth of a percentage point, for beef and chicken, the differences are not statistically significant). Strong co-movement is consistent with the contiguity of these markets (only 13 kilometers away from each other) and the good road infrastructure that links them (Table 15). The price difference is likely related the fact that households are poorer in El Alto relative to La Paz, and may consume products of a lower quality.

Prices are lower in surplus areas (net producers), and higher in deficit areas (net consumers). This finding is robust across products (although price differences are not significant for cooking oil and wheat flour), and is consistent with integration: price differences are explained, to some extent, by transportation and distribution costs. Transport costs increase the final price that

consumers pay in net consumer departments.¹⁶

Transportation costs as a driver of price differences matters more for less processed products (e.g.: bananas, onions, potatoes) than for more processed ones (e.g.: wheat flour, cooking oil), as they explain a smaller share of the price variations of the latter group.

These findings can be visualized in figures (5), (6), (7), (8), (9), (10), (11), (12), and (13). For each product, the map on the left hand side (LHS) shows the geographical distribution of output of the commodity divided by the population. Each color corresponds to a given amount of output per capita in kilograms, being produced in the department, as indicated in the legend next to the map. The intensity of the color increases with the amount of output per capita produced in that department. The map on the right hand side (RHS) shows the distribution of price differences (in percentage points) with respect to the price in La Paz, which has been normalized to one. The legend shows the correspondence of the price difference with the color in the map. Darker colors are consistent with prices higher than in La Paz, and the converse is also true.¹⁷

Take for example the map on the RHS of figure (5). The price of rice is about 15% lower in the net producer area of Santa Cruz than it is in the net consumer area of La Paz, and about 9% lower in Cochabamba than in La Paz. Santa Cruz accounts for 75% of Bolivian rice output (output of rice per capita is 115 kilograms), while only 5.2 and 6% of national output is produced in Cochabamba (11 kilograms per capita) and La Paz (7.7 kilograms per capita) respectively. Population differences between Cochabamba and La Paz (see table (14)), together with the fact that Cochabamba is about 400km closer to Santa Cruz than La Paz (see table (15)) explain that rice is cheaper in

¹⁶ Because we do not have data on consumption, we can only approximate whether a region is a surplus or deficit area by calculating the ratio of output to population, and taking the average as a benchmark.

¹⁷ Data on output are available for all Bolivian departments. Data on prices are only available for La Paz/El Alto, Cochabamba and Santa Cruz, therefore, all other regions are in grey in the RHS maps, indicating no data are available.

Cochabamba than in La Paz.

Santa Cruz also accounts for the largest share of production of soybeans and sunflower (98% and 100% respectively), the main inputs in production of cooking oil. Figure (6) shows that in Santa Cruz, soybean output per capita reaches 502 kilograms. Despite this strong concentration of output in one department, cooking oil price differences across departments are not significant from a statistical and economical point of view (less than one per cent). With respect to La Paz, in Santa Cruz consumers pay about 0.6% more for cooking oil, and in Cochabamba only 0.1% more. As a processed product, the portion of the final price that is explained by transport costs may be relatively low. In addition to this, there is upward pressure in the price of cooking oil in Santa Cruz as an important portion of exports is canalized through that department.

Similar to the cooking oil case, price differences in wheat flour across cities are not significant. Although half of wheat output is concentrated in Santa Cruz, where output per capita is about 32.5 kilograms per annum (13% is produced in Cochabamba - output per capita is about 10.5 kilograms), it is still likely that all cities are net consumers, as Bolivia relies substantially on imported wheat and wheat flour (mainly from Argentina and from the US). This, together with nature of the product, with a low portion of the final price being explained by transport costs, may explain these low price differences.

Figure (8) shows that output of sugar cane is concentrated in Santa Cruz - about 1781 kg/per capita. In turn, the price of refined sugar there is 7.3% lower than in La Paz (see RHS map).¹⁸

Figure (9) shows output and price differences for potatoes. The lowest price is found in Cochabamba, where output per capita is the highest (among the three regions considered in this analysis). The converse happens in Santa Cruz where output per capita is the lowest, and the price is the highest.

¹⁸ The 13.4%-higher price in Cochabamba relative to La Paz is explained by the packaging being different. The price information collected by the INE for Cochabamba is that of sugar bags of one-pound weight, whereas for La Paz and Santa Cruz, they collect information on sugar bags of 5 kilos.

Figure (10) shows the distribution of output of onions, and their price differences distribution. Onions are mainly produced in Cochabamba - 8.5 kilograms per person (about 43.3% of Bolivian output), where their price is the lowest (45% less than in La Paz). Onions are also cheaper in Santa Cruz than in La Paz (16.7%), this could be explained by the proximity of Santa Cruz to the main producing regions in the country (Chuquisaca, Tarija and Cochabamba).

In the chicken market, the price differences are also related to the departments being net producers or net consumers. Figure (11) shows that output is mainly concentrated in Cochabamba and Santa Cruz where consumers pay about 4.8 and 7.6% less for chicken than in La Paz, respectively. Figure 12 shows the same pattern for beef markets. People in Santa Cruz, one of the main producing departments, pay about 15% less for beef than people in La Paz. In Cochabamba prices are lower than in La Paz by about 6%.

Figure 13 reveals an analogous story for bananas, being 39% cheaper in Cochabamba than in La Paz, where three quarters of national output is generated - about 82 kilos per capita, and 6.7% cheaper in Santa Cruz (that accounts for 12.6% of output).

Spatial Integration We shift the focus from price differences, to market integration determinants, and try to understand whether there is a pattern in regional markets that are isolated from other Bolivian markets. In Section 3 we identified integrated and non-integrated markets. Here we try to understand whether there are systematic patterns behind market integration.

Table (5) shows that for most of the products being considered, regional markets are widely spatially integrated. This is the case for rice, cooking oil, sugar, potato and onion markets. For wheat flour and bananas, regional markets show to be weakly integrated, and for beef and milk the markets do not show patterns of integration.¹⁹ Tables (14) and (15) show indicators of infrastructure and development by department and distance between regional markets as well

¹⁹ In the case of milk, as mentioned above, the series suggest that the market does not determine prices. There seem to be a dominant firm that sets prices. This pricing behavior distorts the analysis and so we do not consider milk in the analysis of determinants.

as an indicator of quality of roads - measured as the percentage of the road paved from the capital of region 'i' to the capital of region 'j'.²⁰ A road that is paved in most of its length links the four markets under consideration. In addition to this, there are no significant differences in terms of infrastructure. The deeper penetration of cellular phones in Santa Cruz relative to La Paz and Cochabamba is noticeable. In terms of GDP per capita, differences are not significant, and in terms of road quality and density, the departments with poorer indicators are those with larger areas, and lower population densities.

Transport cost and not distance between a pair of cities is what isolates one from the other. This is suggestive of markets working with relative efficiency, and gives some scope for public policy to improve transport infrastructure. There are not other visible patterns that explain market integration. In general, distance between markets does not seem to be an insulating factor. Rice is produced mainly in Santa Cruz and it travels 473 kilometers to reach the market of Cochabamba, and 848 kilometers to reach that of La Paz. That distance between production and the consumption shows in the price difference between producing and consuming regions. This applies for most of the products considered: transport costs are, generally, not binding constraints.

However, the effect of distance on integration seems be product-specific. There are products for which a given distance implies higher transport costs than for other products. In the case of beef, distance is more important due to the fact that it has to be refrigerated during transportation. Unlike most of the other products, beef is mostly transported by air from Santa Cruz to La Paz. Higher transportation costs for beef may be inhibiting trade of low-quality cuts

²⁰ In Table (14), road density is measured as the kilometers of roads divided by the area in sq kilometers of the department. Road quality is the percentage of total roads that are paved. Telephone and cell phone lines are the number every 100 inhabitants. GDP PC is GDP expressed in dollars. Surface is measured in squared kilometers and population density is population/surface. The LHS portion of table (15) shows the distance in kilometers from the capital of one department to the capital of another. C is Cochabamba, SC is Santa Cruz, EA is El Alto and LP is La Paz. The RHS portion of that table shows the portion of the road that links each of the capitals that is paved.

between distant regions, which may explain why markets for beef (with bone) in Santa Cruz are weakly integrated with Cochabamba's markets, but they are not integrated with La Paz. While El Alto and La Paz's markets are strongly integrated (see the beef section of Table 5).

As expected, integration of domestic markets with world markets is linked to the existence of substantial international trade in the market. Prices of the internationally traded products show co-movement with world prices. We found that for cooking oil, sugar, rice and chicken, markets are to some extent integrated with world markets. For cooking oil and sugar, exports are significant. Rice consumed in Bolivia is mainly imported. International trade in the chicken market is less marked, but still there are some exports of that product. The puzzle remains for bananas, whose market is significantly exposed to international trade, and still we found mixed evidence of integration with world markets, probably, due to quality differences between exportable and domestically consumed version.

5. Conclusions

Over the last years food prices have increased dramatically as a response to increased demand from fast growing economies with large populations. These shocks have raised concerns among policy makers in developing countries, and trade economists, who have been trying to understand how price shocks are transmitted spatially, both domestically and internationally, and what are the factors behind that transmission.

This paper focused on one developing, small, and relatively open economy: Bolivia, and examined spatial market integration across the four most important cities in the country: La Paz, El Alto, Cochabamba and Santa Cruz, and between each of this cities and the world, for ten key food products for the median Bolivian household: bananas, beef, cooking oil, chicken, milk, onions, potatoes, rice, sugar and wheat flour.

We found that within Bolivia, markets for onions, chicken, sugar and to a

lower extent for potatoes, cooking oil, wheat flour and rice are integrated spatially. We found mixed evidence for bananas, and no evidence for the markets of beef or milk, where domestic (within the city) market conditions matter the most. Where integration exists, transmission is generally complete or almost complete, and the adjustment to price shocks somewhere else in the country is fast: a shock to the price in one region takes, on average, between 5-10 months to be fully absorbed in another region.

We found that only the markets for chicken, sugar, cooking oil and rice are integrated with world markets, with price transmission being incomplete and slow. After an increase in world rice prices of, say, 10%, domestic prices increase on average by 1.1-1.4%, for chicken, the same world price shock raises domestic prices by 2.5%, and for sugar, by 3-4%, and this incomplete adjustment takes long to be processed. Domestic and foreign goods seem to be imperfect substitutes.

Transmission of world price shocks into domestic retail prices is asymmetric, with domestic prices responding up to three times faster to increases than to decreases. This is likely to be a welfare redistributing phenomenon and is typically associated with market power.

Finally, important geographical price differences were documented. These are almost always explained by the geographical distribution of output, with prices being lower in regions that produce the good, as it would be expected. Evidence suggests that when it comes to market integration, it is transport costs, and not pure geographical distances that matter.

From a policy perspective, these results suggest that, first, for products in which Bolivian cities show market integration, targeted government interventions in one city may have a relatively fast effect on prices in other cities. For those products in which markets are integrated with the world, these interventions may be costly and short-lived. Second, infrastructure investment could help to integrate markets further, and to decrease price differences across cities substantially. Whether the costs of those infrastructure investments are compensated by the aforementioned benefits has not been explored here, how-

ever. Last but not least, the perennial result of asymmetric transmission of price shocks calls for a perennial policy recommendation: the stimulation of competition will help reduce food prices, and prevent perverse welfare redistributions.

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Table 1: Summary of the Literature

Authors	Date	Location	Product	Method of Analysis	Dets of integration?	Dets of price volat?	Journal
Ravallion, M.	1986	Bangladesh	Rice	Error Correction Model - Instrumental Variables	No	No	American Journal of Agricultural Economics
Goodwin, B.K., T.C.Schroeder	1991	USA	Cattle	Cointegration Analysis	Yes - Regression Analysis	No	American Journal of Agricultural Economics
Alexander, C., J. Wyeth	1994	Indonesia	Rice	Error Correction Model, Cointegration, Causality Tests	No	No	Journal of Development Studies
Goletti, F., R.Ahmed, N.Farid	1995	Bangladesh	Rice	Correlation Coeff, Cointegration, dynamic multipliers	Yes - Regression Analysis	No	The Developing Economies
Baulch, B.	1997a	Philippines	Rice	Parity Bound Model	No	No	American Journal of Agricultural Economics
Ismet, M., A.P.Barkley, R.V.Llewelyn	1998	Indonesia	Rice	Multivariate cointegration (Johansen, Juselius)	Yes - Regression Analysis	No	Agricultural Economics
Badiane, O., G.E.Shively	1998	Ghana	Maize	Cointegration, ARCH models	Yes - Simulation	Yes - ARCH	Journal of Development Economics
Baffes, J., M.I. Ajwad	2001	World (Selected Regions)	Cotton	Error Correction Model, Cointegration.	No	No	Applied Economics
Goodwin, B.K., N. E. Piggot	2001	North Carolina, US	Soybeans	Threshold autorregressive cointegration models, impulse resonse functions	No	No	American Journal of Agricultural Economics
Rapsomanikis, G., D.Hallam, P.Conforti	2003	Ethiopia, Rwanda, Uganda; Egypt	Coffee; Wheat	Multivariate cointegration (Johansen, Juselius), Causality Test Asymmetric Adj. Tests	No	No	Book chapter, in: Commodity Mkt Review FAO, 2003-2004
Abdulai, A.	2003	Ghana	Maize	Threshold autorregressive and cointegration	No	No	Book Chapter.
Rashid, S.	2004	Uganda	Maize	Multivariate cointegration (Johansen, Juselius)	Not formally	No	Journal of African Economies
Van Campenhout, B.	2007	Tanzania	Maize	Threshold autorregressive (with a trend for the threshold)	No	No	Food Policy
Fossati, S., F.Lorenzo, C.M.Rodriguez	2007	Uruguay	Sorghum, maize, wheat, beef	Multivariate cointegration (Johansen, Juselius)	No	No	Journal of Applied Economics

Table 2: Descriptive Statistics on Monthly Proportional Price Changes

Product	Region	Mean	Std Dev	Coef V	Kurtosis
Rice	C	0.007	0.04	5.36	30.05
	EA	0.007	0.03	4.12	10.83
	SC	0.008	0.04	5.35	13.97
	LP	0.007	0.03	4.05	15.90
	W in B	0.007	0.06	8.77	12.44
Beef	C	0.006	0.02	4.19	13.38
	EA	0.005	0.02	3.82	14.38
	SC	0.005	0.02	2.98	9.07
	LP	0.006	0.02	3.34	13.12
	W in B	0.005	0.04	7.68	4.39
C Oil	C	0.007	0.02	2.75	16.21
	EA	0.007	0.02	2.44	16.80
	SC	0.007	0.02	2.82	18.80
	LP	0.007	0.02	2.52	13.60
	W in B	0.008	0.05	6.33	5.60
Wheat F	C	0.008	0.03	3.23	17.78
	EA	0.010	0.06	5.76	159.35
	SC	0.007	0.04	5.22	10.03
	LP	0.011	0.06	5.23	138.43
	W in B	0.008	0.06	7.40	4.50
Bananas	C	0.009	0.07	7.85	12.43
	EA	0.005	0.05	10.94	5.16
	SC	0.009	0.06	7.34	28.91
	LP	0.003	0.06	20.45	5.24
	W in B	0.005	0.19	40.18	3.73
Sugar	C	0.004	0.03	7.29	9.02
	EA	0.004	0.03	7.77	7.20
	SC	0.005	0.03	7.46	6.95
	LP	0.004	0.03	7.39	6.94
	W in B	0.005	0.07	13.39	3.17
Chicken	C	0.005	0.07	14.08	4.08
	EA	0.003	0.06	22.31	5.75
	SC	0.004	0.10	24.93	3.58
	LP	0.005	0.07	14.39	5.70
	W in B	0.006	0.02	3.43	3.77
Milk	C	0.005	0.02	3.73	25.37
	EA	0.005	0.02	4.00	51.02
	SC	0.006	0.02	3.81	20.28
	LP	0.006	0.02	4.01	48.40
Potato	C	0.008	0.11	13.63	2.97
	EA	0.005	0.09	18.82	3.42
	SC	0.008	0.09	11.89	3.36
	LP	0.006	0.08	14.67	3.47
Onion	C	0.007	0.18	26.70	5.79
	EA	0.004	0.15	34.72	16.75
	SC	0.006	0.13	22.65	4.54
	LP	0.004	0.14	31.88	21.17
NER		0.003	0.00	1.36	5.01

Source: Own elaboration, based in price data from INE, and World Bank. Notes: C is Cochabamba, EA is El Alto, SC is Santa Cruz, LP is La Paz W in B is World in Bolivianos, NER is the nominal exchange rate.

Table 3: Correlation Coefficients for Price Levels

Rice	C	EA	SC	LP	C Oil	C	EA	SC	LP
C					C				
EA	0.985				EA	0.997			
SC	0.974	0.979			SC	0.998	0.996		
LP	0.983	0.990	0.978		LP	0.998	0.998	0.997	
W in B	0.739	0.761	0.728	0.713	W in B	0.830	0.850	0.834	0.835
W Flour	C	EA	SC	LP	Sugar	C	EA	SC	LP
C					C				
EA	0.991				EA	0.978			
SC	0.968	0.968			SC	0.977	0.995		
LP	0.987	0.995	0.968		LP	0.980	0.998	0.996	
W in B	0.860	0.858	0.851	0.865	W in B	0.799	0.823	0.813	0.825
Chicken	C	EA	SC	LP	Beef	C	EA	SC	LP
C					C				
EA	0.970				EA	0.980			
SC	0.913	0.910			SC	0.987	0.984		
LP	0.969	0.994	0.904		LP	0.981	0.999	0.984	
W in B	0.844	0.865	0.758	0.865	W in B	0.670	0.603	0.625	0.613
Bananas	C	EA	SC	LP	Milk	C	EA	SC	LP
C					C				
EA	0.842				EA	0.988			
SC	0.865	0.868			SC	0.987	0.976		
LP	0.871	0.958	0.891		LP	0.988	1.000	0.977	
W in B	0.796	0.598	0.693	0.628	-				
Potato	C	EA	SC	LP	Onion	C	EA	SC	LP
C					C				
EA	0.983				EA	0.850			
SC	0.962	0.940			SC	0.917	0.798		
LP	0.988	0.989	0.962		LP	0.853	0.970	0.842	

Notes: C is Cochabamba, EA is El Alto, SC is La Paz, W in B is world prices expressed in bolivianos .

Table 4: Correlation Coefficients for Price Changes

Rice	C	EA	SC	LP	C Oil	C	EA	SC	LP
C					C				
EA	0.694				EA	0.684			
SC	0.682	0.628			SC	0.723	0.611		
LP	0.685	0.713	0.631		LP	0.666	0.759	0.673	
W in B	0.113	0.122	0.043	0.011	W in B	-	-	-	-
W Flour	C	EA	SC	LP	Sugar	C	EA	SC	LP
C					C				
EA	0.581				EA	0.718			
SC	0.401	0.409			SC	0.677	0.801		
LP	0.535	0.754	0.392		LP	0.738	0.924	0.782	
W in B	0.028	0.085	0.273	0.114	W in B	-	-	-	-
Chicken	C	EA	SC	LP	Beef	C	EA	SC	LP
C					C				
EA	0.807				EA	0.418			
SC	0.611	0.554			SC	0.562	0.407		
LP	0.807	0.927	0.527		LP	0.407	0.910	0.370	
W in B	0.013	0.000	0.065	0.008	W in B	-	-	-	-
Bananas	C	EA	SC	LP	Milk	C	EA	SC	LP
C					C				
EA	0.098				EA	0.436			
SC	0.099	0.067			SC	0.381	0.318		
LP	0.079	0.503	0.258		LP	0.418	0.963	0.320	
W in B	0.113	0.006	0.018	0.041	-				
Potato	C	EA	SC	LP	Onion	C	EA	SC	LP
C					C				
EA	0.890				EA	0.606			
SC	0.803	0.781			SC	0.813	0.522		
LP	0.897	0.949	0.808		LP	0.616	0.889	0.547	

Notes: C is Cochabamba, EA is El Alto, SC is La Paz, W in B is world prices expressed in bolivianos .

Table 5: Spatial Integration - Cointegration Results

Rice	C	EA	SC	LP	C Oil	C	EA	SC	LP
C					C				
EA	***				EA	*			
SC	*	**			SC	***	**		
LP	***	**	***		LP	***	***	***	
World	*	**	***	**	World				
W Flour	C	EA	SC	LP	Sugar*	C	EA	SC	LP
C					C				
EA					EA	*			
SC	***				SC	**	***		
LP	**	***			LP		***	***	
World					World	***	***	***	***
Chicken	C	EA	SC	LP	Beef	C	EA	SC	LP
C					C				
EA	***				EA				
SC	***	***			SC	*			
LP	***	***	***		LP		***		
World	**	***	**	**	World				
Bananas	C	EA	SC	LP	Milk	C	EA	SC	LP
C					C				
EA	**				EA				
SC		*			SC	***			
LP	**	***			LP				
World		*			World				
Potato	C	EA	SC	LP	Onion	C	EA	SC	LP
C					C				
EA	***				EA	***			
SC	***	***			SC	***	***		
LP	***	***	***		LP	***	***	***	

Notes: *** indicates significance of the link at 1%,
 * indicates significance at 10%. + Sugar price reported in Cochabamba is for a product with different packaging than in EA, SC and LP.

** indicates sign if

Table 6: Asymmetric Adjustment in Chicken Markets

Chicken	1991-2007	Speed	T-stat	P-Value	Conf Interval	
Cochabamba	Downward Adj	-0.027	-0.310	0.757	-0.200	0.146
	Upward Adj	-0.129	-1.290	0.197	-0.325	0.067
El Alto	Downward Adj	-0.065	-0.730	0.464	-0.240	0.110
	Upward Adj	-0.186	-1.900	0.060	-0.379	0.008
Santa Cruz	Downward Adj	-0.290	-2.830	0.005	-0.492	-0.088
	Upward Adj	-0.366	-3.260	0.001	-0.588	-0.144
La Paz	Downward Adj	-0.154	-1.780	0.077	-0.324	0.017
	Upward Adj	-0.208	-2.260	0.025	-0.390	-0.026

Notes: Speed is the speed of adjustment to world price shocks. Coefficient must be negative for the divergence to be corrected.

Table 7: Asymmetric Adjustment in Sugar Markets

Sugar	1991-2007	Speed	T-stat	P-Value	Conf Interval	
Cochabamba	Downward Adj	-0.033	-0.850	0.395	-0.110	0.044
	Upward Adj	-0.077	-1.970	0.051	-0.154	0.000
El Alto	Downward Adj	-0.009	-0.260	0.794	-0.075	0.057
	Upward Adj	-0.057	-1.860	0.065	-0.117	0.004
Santa Cruz	Downward Adj	-0.018	-0.620	0.539	-0.074	0.039
	Upward Adj	-0.060	-2.080	0.039	-0.118	-0.003
La Paz	Downward Adj	-0.030	-0.890	0.376	-0.097	0.037
	Upward Adj	-0.060	-2.000	0.047	-0.118	-0.001

Notes: Speed is the speed of adjustment to world price shocks. Coefficient must be negative for the divergence to be corrected.

Table 8: Asymmetric Adjustment in Rice Markets

Rice	1991-2007	Speed	T-stat	P-Value	Conf Interval	
Cochabamba	Downward Adj	-0.025	-0.840	0.402	-0.084	0.034
	Upward Adj	-0.033	-0.990	0.322	-0.097	0.032
El Alto	Downward Adj	-0.025	-0.960	0.339	-0.077	0.027
	Upward Adj	-0.084	-2.910	0.004	-0.140	-0.027
Santa Cruz	Downward Adj	-0.047	-1.360	0.177	-0.115	0.021
	Upward Adj	-0.081	-2.200	0.029	-0.153	-0.008
La Paz	Downward Adj	-0.012	-0.520	0.607	-0.058	0.034
	Upward Adj	-0.059	-1.890	0.061	-0.121	0.003

Notes: Speed is the speed of adjustment to world price shocks. Coefficient must be negative for the divergence to be corrected.

Table 9: Asymmetric Adjustment in Cooking Oil Markets

Oil	1991-2007	Speed	T-stat	P-Value	Conf Interval	
Cochabamba	Downward Adj	-0.014	-0.610	0.541	-0.061	0.032
	Upward Adj	-0.056	-2.290	0.023	-0.104	-0.008
El Alto	Downward Adj	-0.026	-1.050	0.296	-0.074	0.023

	Upward Adj	-0.048	-2.270	0.024	-0.090	-0.006
Santa Cruz	Downward Adj	-0.020	-0.840	0.402	-0.068	0.027
	Upward Adj	-0.051	-2.160	0.032	-0.098	-0.004
La Paz	Downward Adj	-0.017	-0.710	0.478	-0.064	0.030
	Upward Adj	-0.043	-1.850	0.066	-0.088	0.003

Notes: Speed is the speed of adjustment to world price shocks. Coefficient must be negative for the divergence to be corrected.

Table 10: Asymmetric Adjustment in Chicken Markets including 2008

Chicken	1991-2008	Speed	T-stat	P-Value	Conf Interval	
Cochabamba	Downward Adj	0.029	0.380	0.704	-0.120	0.178
	Upward Adj	-0.114	-1.230	0.219	-0.297	0.069
El Alto	Downward Adj	-0.126	-1.490	0.138	-0.294	0.041
	Upward Adj	-0.134	-1.300	0.194	-0.337	0.069
Santa Cruz	Downward Adj	-0.126	-1.520	0.130	-0.291	0.038
	Upward Adj	-0.303	-2.810	0.005	-0.515	-0.091
La Paz	Downward Adj	-0.108	-1.380	0.168	-0.263	0.046
	Upward Adj	-0.158	-1.710	0.088	-0.341	0.024

Notes: Speed is the speed of adjustment to world price shocks. Coefficient must be negative for the divergence to be corrected.

Table 11: Asymmetric Adjustment in Sugar Markets including 2008

Sugar	1991-2008	Speed	T-stat	P-Value	Conf Interval	
Cochabamba	Downward Adj	-0.028	-0.740	0.458	-0.101	0.046
	Upward Adj	-0.080	-2.100	0.037	-0.156	-0.005
El Alto	Downward Adj	-0.008	-0.230	0.818	-0.073	0.058
	Upward Adj	-0.058	-1.920	0.057	-0.117	0.002
Santa Cruz	Downward Adj	-0.021	-0.750	0.454	-0.077	0.035
	Upward Adj	-0.058	-2.070	0.040	-0.114	-0.003
La Paz	Downward Adj	-0.028	-0.810	0.422	-0.095	0.040
	Upward Adj	-0.058	-2.000	0.047	-0.116	-0.001

Notes: Speed is the speed of adjustment to world price shocks. Coefficient must be negative for the divergence to be corrected.

Table 12: Asymmetric Adjustment in Rice Markets including 2008

Rice	1991-2008	Speed	T-stat	P-Value	Conf Interval	
Cochabamba	Downward Adj	-0.037	-1.200	0.231	-0.099	0.024
	Upward Adj	-0.009	-0.320	0.750	-0.068	0.049
El Alto	Downward Adj	-0.028	-1.080	0.280	-0.080	0.023
	Upward Adj	-0.076	-2.730	0.007	-0.130	-0.021
Santa Cruz	Downward Adj	-0.077	-2.370	0.019	-0.142	-0.013
	Upward Adj	-0.045	-1.510	0.133	-0.103	0.014
La Paz	Downward Adj	-0.031	-1.120	0.265	-0.087	0.024
	Upward Adj	-0.043	-1.460	0.147	-0.100	0.015

Notes: Speed is the speed of adjustment to world price shocks. Coefficient must be negative for the divergence to be corrected.

Table 13: Asymmetric Adjustment in Cooking Oil Markets

Oil	1991-2008	Speed	T-stat	P-Value	Conf	
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		Interval				
Cochabamba	Downward Adj	-0.037	-1.590	0.113	-0.084	0.009
	Upward Adj	-0.031	-1.130	0.262	-0.087	0.024
El Alto	Downward Adj	0.012	0.440	0.660	-0.043	0.067
	Upward Adj	-0.050	-2.030	0.044	-0.099	-0.001
Santa Cruz	Downward Adj	-0.044	-1.770	0.078	-0.092	0.005
	Upward Adj	-0.025	-0.910	0.366	-0.080	0.030
La Paz	Downward Adj	-0.021	-0.960	0.340	-0.065	0.023
	Upward Adj	-0.035	-1.440	0.152	-0.084	0.013

Notes: Speed is the speed of adjustment to world price shocks. Coefficient must be negative for the divergence to be corrected.

Table 14: Indicators of Infrastructure and Development by Department

	Road Dens	Road Qual	Tel Lines	Cel Phones	GDP PC	Pop	Surface	Density
Cochabamba	0.023	0.514	10.59	19.83	1,012	1,282,958	55,631	23
Santa Cruz	0.011	0.357	8.11	28.73	1,251	1,696,930	370,621	5
La Paz	0.020	0.243	8.81	22.07	924	2,125,626	133,985	16

Source: Administracion Boliviana de Carreteras

Note: Road density is measured as the kilometers of roads/area in sq kilometers of the department. Telephone and cell phone lines are the number every 100 inhabitants. Road quality is the % of total roads that are paved.

population density is population/surface

GDP PC is GDP exp

Table 15: Distance in km and percentage of paved route from i to j

	C	SC	LP		C	SC	LP
C				C			
SC	473			SC	98%		
LP	375	848		LP	100%	99%	
EA	362	362	13	EA	100%	99%	100%

Source: Administracion Boliviana de Carreteras and INE

Figure 1: Asymmetric Adjustment to World's Chicken Price Shocks*

*Note to Figures 1- 4: Periods are measured in months. The y-axis shows the percentage of the adjustment processed.

Figure 2: Asymmetric Adjustment to World's Sugar Price Shocks

Figure 3: Asymmetric Adjustment to World's Soya Oil Price Shocks

Figure 4: Asymmetric Adjustment to World's Rice Price Shocks

Figure 5: Distribution of Rice Output (Left) and Rice Price Differences (Right)

Figure 6: Distribution of Soybean Output (Left) and Cooking Oil Price Differences (Right)

Figure 7: Distribution of Wheat Output (Left) and Wheat Flour Price Differences (Right)

Figure 8: Distribution of Sugar Cane Output (Left) and Sugar Price Differences (Right)

Figure 9: Distribution of Potato Output (Left) and Potato Price Differences (Right)

Figure 10: Distribution of Onion Output (Left) and Onion Price Differences (Right)

Figure 11: Distribution of Chicken Output (Left) and Chicken Price Differences (Right)

Figure 12: Distribution of Beef Output (Left) and Beef Price Differences (Right)

Figure 13: Distribution of Bananas Output (Left) and Banana Price Differences (Right)