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Effects of food prices on poverty: The case of Paraguay, a food exporter and a non-fully urbanized country

Efectos de los precios de los alimentos en la pobreza: el caso de Paraguay, un país exportador de alimentos y no completamente urbanizado

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Abstract

Agriculture in Paraguay plays a key role in economic development and economic growth. Fluctuations in commodity prices have been added to the inherent sector's volatility linked to climate conditions. Since a vast share of households in developing countries like Paraguay are both consumers and producers of food the welfare effects of commodity prices fluctuations are not obvious: higher prices hurt consumption but benefit production. In this paper we simulate the welfare effects of a potential hike in food prices. We use the traditional agricultural model, households' survey data and monthly price data for 127 food items. Our main results

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suggest that the expenditure effect is negative and regressive for all households, but larger in rural than urban areas. The income effect is positive and progressive in rural areas and negligible in urban ones. Therefore, we find that the potential overall impact of a potential increase in food prices in Paraguay has a very flat U-shaped curve effect. We conclude with a policy response simulation in order to help those affected by the initial increase in food prices.

Keywords: Food prices, distribution, poverty, policy response, Paraguay.

Resumen: La agricultura en Paraguay juega un papel clave en el desarrollo y el crecimiento económico. Las fluctuaciones en los precios de las materias primas se han sumado a la volatilidad inherente del sector vinculada a las condiciones climáticas. Dado que una gran parte de los hogares en países en desarrollo, como Paraguay, son consumidores y productores de alimentos, los efectos de las fluctuaciones de los precios de los productos básicos en el bienestar no son obvios: mayores precios perjudican el consumo, pero benefician la producción. En el presente artículo, simulamos el efecto sobre el bienestar de una posible subida de los precios de los alimentos. Usamos el modelo agrícola tradicional, datos de encuestas de hogares y datos de precios mensuales para 127 alimentos. Los resultados sugieren que el efecto sobre el consumo es negativo y regresivo para todos los hogares, pero mayor en las zonas rurales que en las urbanas. El efecto sobre la producción es positivo y progresivo en las zonas rurales e insignificante en las urbanas. El impacto general tiene un efecto de curva en forma de U muy plana. Concluimos con una simulación de respuesta política para ayudar a los afectados.

Palabras clave: precios de los alimentos, distribución, pobreza, respuesta política, Paraguay.

Classification/clasificación JEL: D31, I38, Q12

1. Introduction

Historically, the agricultural sector in Paraguay has played a key role in economic development and contributed significantly to economic growth (World Bank, 1995). Approximately 65 percent of households in rural areas rely on some sort of agriculture-related income (e.g., working on their own land or as employees in agriculture-related activities). Even in urban areas this share is about 17 percent. During the first decade of the 2000s, Paraguay's extreme poverty has been stubbornly stable at around 18 percent, despite the sizable growth in

average individuals' incomes and high rates of economic growth. Part of the explanation for this stylized fact is related to the increase in food prices. Between 2005 and 2007, basic food basket prices outpaced the overall inflation rate becoming more expensive and despite the real income of the poorest quintile was growing it was not enough to compensate for the price increase. This phenomenon reveals how fluctuations in food prices can affect household welfare through different channels in countries where a large share of households is both consumers and producers of basic food. Moreover, those effects on welfare are far from being obvious (***i.e.,*** higher prices harm households on the consumption side while they can benefit them on the production side through higher incomes).

Since developing economies, and fundamentally those dependent on agriculture, are permanently exposed to food price fluctuations the objective of this paper is to simulate the welfare effects of a potential hike in food prices in Paraguay. Following the traditional agricultural model, originally proposed by Singh ***et al.*** (1986), we simulate three different effects of higher prices on households' welfare: (i) the ***expenditure effect***, as consumers face more expensive prices; (ii) the ***income effect***, as profits for farm holders or wages for employees in agricultural activities increase; and (iii) a ***government policy response***, simulated as an increase in the amount of the cash transfer to current beneficiaries of the existing social program Tekoporã[1]. We simulate an increase in food prices similar to the one observed between September 2010 and August 2011, when annual food inflation was 17 percent while overall inflation was around 9 percent (5.4 percent if we exclude food items). We combine three sources of information. First, as baseline data, we use the 2011-2012 Income and Expenditure Survey (***Encuesta de ingresos y gastos y condiciones de vida*** – EIG-CV henceforth) to characterize households in terms of incomes and expenditures (***i.e.,*** consumption patterns). Second, we simulate on the EIG-CV a food price hike using monthly price data collected in Greater Asunci´on by the Central Bank of Paraguay. Here we consider heterogeneous price movements across 9 sub-categories of food items. Third, we simulate on

1 The ideal way to quantify the distributional impact of higher food prices in 2007-2008 on household's welfare would be to compare micro-data of household's expenditure/income just before and after 2007-2008. Unfortunately, this is not possible in the context of Paraguay since the two latest household expenditure surveys were carried out in the years 1997-1998 and 2011-2012, respectively. It is also important to remark, that this is a common feature for many developing countries. For instance, most Latin American countries monitor their poverty and inequality figures on an annual basis but using income household surveys. In addition, expenditure-based surveys are more expensive than income-based surveys (Deaton and Grosh, 1998), and they are generally gathered once every ten or fifteen years in order to know in detail about consumption patterns and its evolution.

EIG-CV the potential effect of a policy response by using the 2015 Permanent Household Survey (***Encuesta permanente de hogares*** –EPH henceforth)[2].

Our main results suggest that the ***expenditure effect*** is negative and, as expected, regressive for all households, but larger in rural than urban areas. The ***income effect***, largely dominated by greater profits of those self-employed, is positive and progressive in rural areas while negligibly in urban areas[3]. Therefore, we find that the overall impact of an unexpected increase in food prices in Paraguay has a very flat U-shaped curve effect (***i.e.***, those households at the extremes of the welfare distribution are less affected), similar to what Ferreira ***et al.*** (2013) found for Brazil, with an increase in extreme and moderate poverty. ***Government policy response*** produces an ambiguous effect on vulnerable households. For instance, quadrupling the amount of existing monthly cash transfer would compensate the loss due to higher food prices but not everywhere. There would be fewer households in extreme poverty in rural areas while an extra effort would be necessary to help those in urban ones. On the contrary, the moderate poverty rate would be two points less than the pre-shock level after the transfer's relief.

We believe our contribution is twofold. First, we contribute by providing evidence on the effects of a hypothetical price increase disentangling the impacts on consumers and producers, as well as in rural and urban areas. We focus on a country that has not been studied yet and where the agricultural sector plays a major role in the national economy. Second, we contribute by estimating a sub-component of the ***income effect*** (***i.e.,*** the ***profit effect***) that was not considered in the existing literature (at least for Latin American countries). This contribution is relevant since the ***profit effect*** explains a substantial part of the final results. With this contribution, we provide additional evidence to a relatively scarce but growing literature. Existing studies support that the distributional effects of staple prices differ depending on the share of net-consumers and producers along with the income distribution. Deaton (1989) analyzed the distributional effects of price changes on households' real income in Thailand,

2 We combine both surveys since the EIG-CV 2011-2012 does not report specific information on potential social programs beneficiaries.

3 In this paper, regressive and progressive terms are used in the same way as in Ferreira *et al.* (2013). The effect of an unexpected food price hike on households' welfare is estimated through a measure of the compensating variation (CV) associated with a price change. The CV is the revenue that the central planner needs to give to households in order to compensate them for the price change so as to restore their original utility level. In this context, regressive (progressive) means that poor households need to be compensated more (less) than rich ones to restore their original level of utility.

considering their role as both consumers and producers. Benjamin and Deaton (1993) and Ravallion and van de Walle (1991), provided a similar analysis for price changes in Ivory Cost and Indonesia, respectively. Ravallion (1990) incorporated labor market responses to changes in food prices in rural Bangladesh into the estimation of welfare effects. Ivanic and Martin (2008), made arguably one of the first attempts to do a cross-country analysis. Using households survey data for ten low-income countries they found an overall poverty-increasing impact of higher food prices because, in their sample, poor individuals are majorly net-consumers of food (both in urban and rural areas)[4]. Similarly, Robles and Torero (2010) analyzed four Latin American countries finding that a hike in food prices affects those food-importer countries and poor households in urban and semi-urban areas. Finally, there are two interesting case studies of a single country in Latin America. Ferreira ***et al.*** (2013) studied the impact of food prices on welfare in Brazil in 2008, considering the ***income effect*** of prices (only) on wages. Attanasio ***et al.*** (2013) estimated the effects of food prices in Mexico accounting for substitution effects on the demand side (but did not include ***income effects*** on the producer side)[5].

The paper is structured as follows. Section 2 introduces several stylized facts of the Paraguayan economy. Section 3 presents data on household surveys and prices used in the empirical analysis. Given that prices are regularly observed only in urban areas, Section 4 discusses whether these prices are indeed a good approximation of prices faced in rural areas. Section 5 describes the analytical framework to assess the effect of a price increase on households' welfare and provides a brief literature review. Section 6 presents the simulation and main results. Section 7 analyzes the potential effects of different policy responses. Finally, concluding remarks are presented in Section 8.

2. Context

Paraguay is a small country with approximately 8 million inhabitants, located in South America. Its economy mostly depends on agriculture which in turn makes it more volatile (World Bank, 2014b). Growth in agriculture has explained over 80 percent of the variation of

4 Hoyos and Medvedev (2011) show similar findings using a representative sample of 63-93 percent of the developing world's population.

5 Related research of country-specific studies can be found in Porto (2010) and Moncarz *et al.* (2017) for the case of Argentina.

real GDP growth since the early 90s. In the period 2003/13, real per capita GDP grew by 33 percent but experienced a major dip during the 2009 drought and global financial crisis when it fell by 5.2 percent with respect to the previous year. Yet, the record growth of 11.2 percent in 2010, driven by a 50 percent growth in agriculture, more than compensated that major dip. In 2014, the agriculture sector represented 25 percent of total GDP and 40 percent of national exports (World Bank, 2014a and b). The country is a net exporter of agricultural and livestock products, and a net importer of foodstuffs such as prepared foods, beverages, etc. (Table 1).

Since 2005, the prices of many food items have risen considerably (Figure 1). In the middle of 2008, the international food price index was 80 percent higher than in 2005. Then, it dropped massively by the end of the year. A second and equally sizable hike was observed in early 2011. "[P]rice increases of this magnitude for basic foodstuffs, over a relatively short period, led to widespread concern about possible impacts on hunger and deprivation" (Ferreira ***et al.***, 2013). In this sense, higher food prices negatively affect the purchasing power of households, bringing them closer to situations of greater income vulnerability and poverty[6]. However, if household income is linked to activities associated with food sales at higher prices, they may experience an increase in their purchasing power, moving away from situations of greater vulnerability. Since agriculture is one of those activities that are highly dependent on food prices, households whose income is associated with this sector could benefit from higher prices in the form of higher benefits for farm holders or higher salaries for employees.

Given that the Paraguayan economy mostly depends on agriculture, the effects on the income side are relevant in rural areas. In countries such as Paraguay, which are large producers and exporters of foodstuff, a price hike leads to both a loss for net buyers of food items (mostly, urban households) and to a gain for net sellers (mostly, rural households)[7]. Overall, how higher food prices affect incomes and poverty in an agriculture-dependent country is not obvious. In this context, inquiring on these effects for Paraguay is very relevant. Most of all since two-thirds of the extreme poor people live in rural areas.

6 Given this negative effects of food prices hikes and in this context, many countries adopted different instruments to help vulnerable families. Those instruments included exports restrictions (Argentina, Bolivia, and Ecuador), price restrictions in domestic markets (Argentina, Bolivia, Honduras, Mexico, and Panama), and compensations to households purchasing power loses with higher cash transfers (most countries in Latin America). For country examples see Table 1 in World Bank (2008).

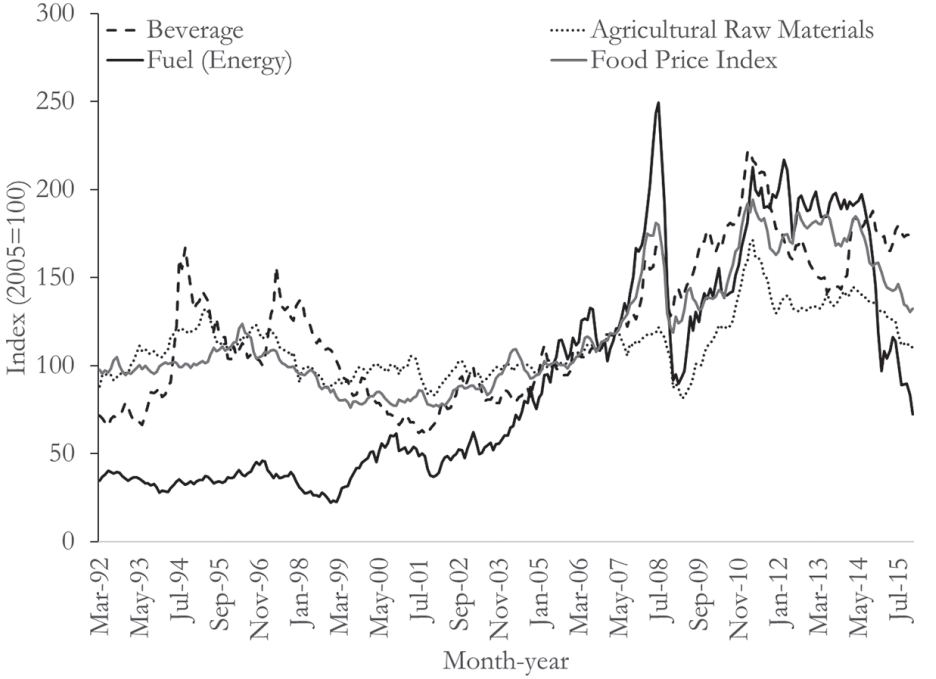
7 "While the welfare of these households [net food buyers] will tend to decline with the price increases, those aggregate income gains must accrue to someone, and where the gainers are in the initial income distribution is likely to matter for the overall poverty and distributional consequences of the price shock" (Ferreira *et al.*, 2013).

Table 1
Exports and Imports by sub-category for Paraguay, year 2012

	Value (USD)		Share of total (%)	
Category	**Export**	**Imports**	**Export**	**Imports**
Animal Products	825	60	15.8	0.5
Vegetable Products	2,709	139	52.0	1.2
Animal and Vegetable Bi-Products	183	24	3.5	0.2
Foodstuffs	507	716	9.7	6.4
Mineral Products	45	1,400	0.9	12.5
Chemical Products	122	1,499	2.3	13.4
Plastics and Rubbers	96	567	1.8	5.1
Animal Hides	125	46	2.4	0.4
Wood Products	98	17	1.9	0.1
Paper Goods	15	274	0.3	2.4
Textiles	155	418	3.0	3.7
Footwear and Headwear	33	121	0.6	1.1
Stone And Glass	11	134	0.2	1.2
Precious Metals	115	6	2.2	0.1
Metals	66	582	1.3	5.2
Machines	71	3,321	1.4	29.7
Transportation	7	1,203	0.1	10.7
Instruments	4	146	0.1	1.3
Weapons	0	12	0.0	0.1
Miscellaneous	19	509	0.4	4.5
Arts and Antiques	0	1	0.0	0.0
Total	5,207	11,198	100.0	100.0

Source: Simoes & Hidalgo (2011); Hausmann *et al.* (2011).

Figure 1: Monthly evolution of commodity prices, 1992-2015 (2005=100, in terms of U.S. dollars)

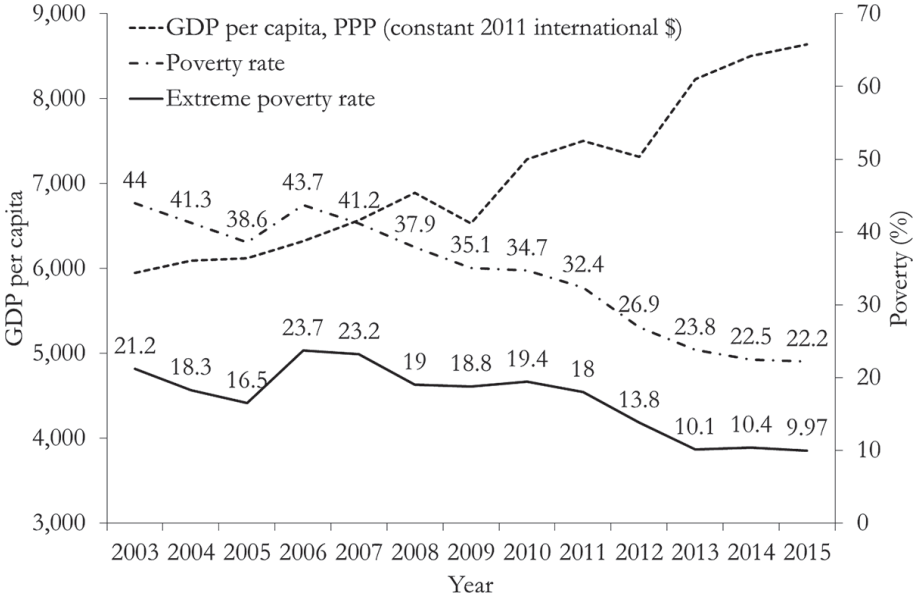


Source: International Monetary Fund.

As prices fluctuated, between 2003 and 2013 Paraguay performed substantially well in terms of poverty reduction, showing sizable reductions in moderate and extreme poverty. This was the result of a period with significant economic growth combined with a reduction in inequality. A significant share of these improvements in welfare were only experienced after 2011. Before 2011, extreme poverty remained stable despite ***per capita*** GDP increased by 22 percent. Between 2011 and 2013 extreme poverty almost halved (Figure 2). A key factor behind the evolution of poverty rates in this decade was related to changes in food prices (World Bank, 2015). While both growth and inequality reduction (redistribution) were contributing to a significant increase in the income of the poor during the period 2003-2011, food prices were rising at a higher rate than the general price index, mitigating to a significant

extent the reduction in extreme poverty[8]. In contrast, these three forces (growth, inequality reduction and changes in food prices) worked in the same direction since 2011 (Figure 3). The sizable income growth among the less well-off and especially in rural areas was a strong factor behind the recent improvement in poverty reduction. In both periods, higher labor incomes derived from higher earnings (and higher number of earners) have been the driving force of this reduction. Since 2013, non-labor incomes such as public transfers started to play a significant role (World Bank, 2015).

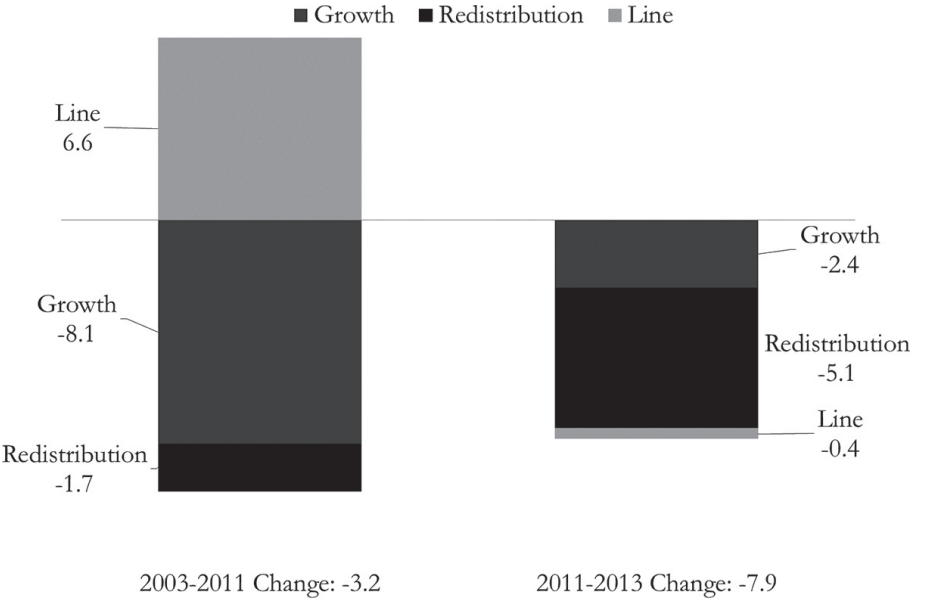
Figure 2: GDP and poverty rates evolution



Source: DGEEC, WDI and own calculations.

8 Refer to Shorrocks (2013), for more details on the methodology used to decompose and analyze changes in poverty.

Figure 3: Decomposition of changes in extreme poverty



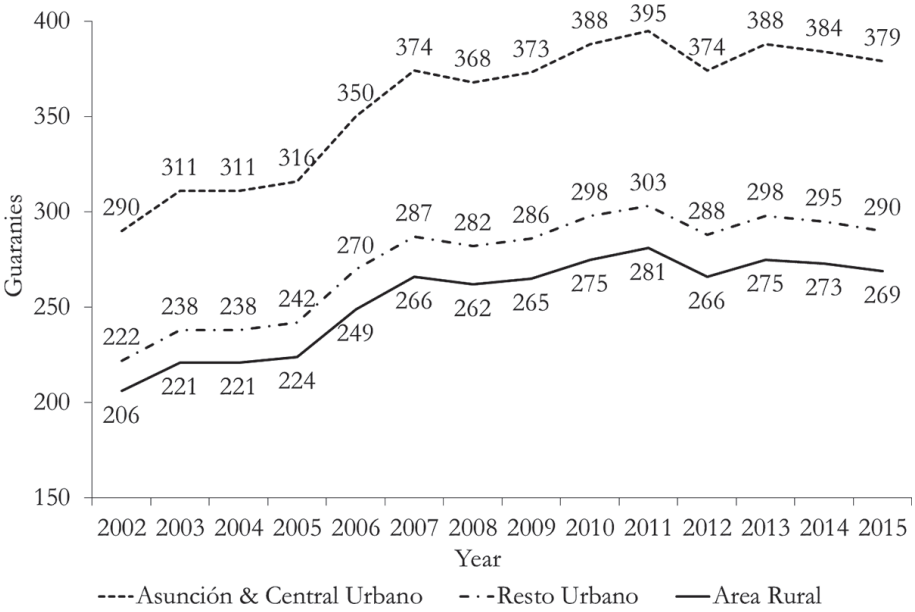
Source: DGEEC and own calculations.
Notes: Shapley decomposition is estimated, see Shorrocks (2013) for a detailed explanation on the methodology. Each bar presents the contribution of growth, income redistribution and change in food prices (line) to the change in poverty during 2003/11 and 201113, respectively. Bars below (above) the horizontal line indicate a positive (negative) contribution of each factor to poverty reduction.

To complete this context of poverty reduction, it should be noted that extreme poverty lines (also called 'food poverty lines') are updated annually using the food consumer price index for the Metropolitan Area of Asuncion. This index is provided by the Central Bank of Paraguay (BCP)[9]. Figure 4 presents the evolution of the real value of the extreme poverty lines adjusted by the general consumer price index. Food prices have grown at a faster rate than general prices, as reflected by the ascending value of the food lines. Food prices, relative to overall prices, were relatively stable until 2005 but soared in 2005-2007, in line with the evolution of world prices of many staple food commodities. Since 2007 the growth in food

9 Extreme poverty lines were constructed on the basis of the 1997-1998 expenditure survey (*Encuesta integrada de hogares* EIH 1997-1998). The construction of the lines is based on the population's consumption patterns and a minimum caloric requirement. Three lines are used: Metropolitan Area of Asuncion, Rest of Urban area and Rural Areas. Ideally, each line should be inflated according to the observed price movements in its areas. Unfortunately, price information is only collected in the metropolitan area of Asuncion and thus the three lines are updated using the same price data.

prices slowed down relative to other prices. By 2013, the extreme poverty line remained slightly higher than five years earlier.

Figure 4: Evolution of extreme poverty lines



Source: DGEEC and own calculations.
Notes: All values in this figure are expressed in thousands of Guaranies and in real values of October 2015.

3. Data

In this paper, we use three sources of information. The 2011-2012 EIC-CV that contains detailed information on household expenditure on food and non-food items as well as detailed income data, including an agricultural module. This survey was carried out by the National Statistical Office from Paraguay (DGEEC for its acronym in Spanish) during a whole year from August 2011 to July 2012 and collected information for 5,417 households from both urban and rural areas. Its design allows doing robust estimations for urban and rural

areas, and also for the departments of Asuncion, San Pedro, Caaguazu, Itapua, Alto Parana, Central and rest of departments (this includes all the remaining areas)[10].

Secondly, we use comprehensive monthly price data at item level for the period 2007-2015. This data feeds the Consumer Price Index (CPI) published by the Central Bank of Paraguay[11]. The general CPI includes 450 items, 359 goods, and 91 services. Of these, 127 are used in the food CPI. Item weights for both general CPI and food CPI allow us grouping individual items into sub-groups, such as Oils and Butters, Cereals and related products, Meat, Fresh and canned vegetables, among others[12].

Finally, we exploited the 2015 EPH. This survey is also carried out by DGEEC and generally used to estimate official poverty and inequality figures. It contains detailed information on income including labor, and various sources of non-labor income such as rents, interest or dividends, remittances (both internal and external), pensions, among others. In addition, unlike the EIG-CV, the EPH contains information related to existing social programs like ***Tekoporã*** (a conditional cash transfer program to families with school-aged children) and ***Adultos mayores*** (non- contributory pension plan which contemplates a monthly monetary transfer equivalent to one-quarter of the current minimum wage). We use this survey to simulate alternative policy responses that are presented and discussed in Section 7.

4. Do rural prices move similarly to those in Asuncion?

The Paraguayan CPI is disaggregated into several sub-components such as food, clothes, public services, health, and transport costs[13]. Prices are only collected in the metropolitan area of Asuncion. Thus, it is not possible to monitor price changes neither in the rural/urban spectrum nor at the departmental level, as it is possible in various other countries in the region (such as Brazil).

10 With the only exception of the departments of Alto Paraguay and Boquer´on, whose population represent less than 2% of total country's population.

11 The Consumer Price data uses December 2007 as its base year and the item weight information comes from the 2005-2006 Household Budget Survey (*Encuesta de presupuestos familiares*).

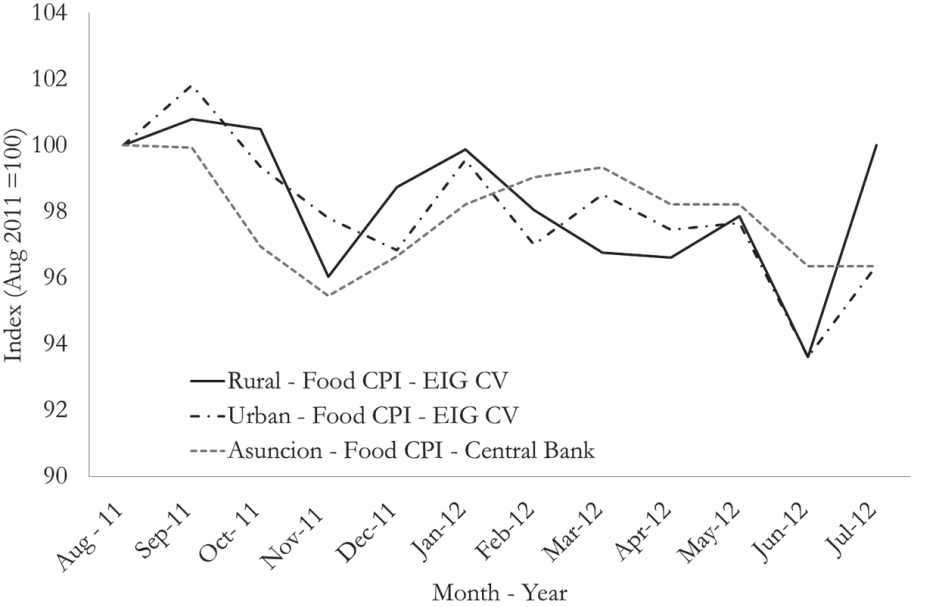
12 See Table A1 in the Annex for a description of the nine food groups.

13 Available at www.bcp.gov.py.

The CPI is used to annually update the value of national (extreme and moderate) poverty lines. For this purpose, both the food price index and the general price index are used. The assumption is that while price levels might differ across regions or areas of the country, price changes (inflation) are relatively similar across the country. This is a reasonable assumption in cases where transport costs are relatively low and distribution systems are highly developed, though less true in developing countries (Deaton, 1997). Having access to unit values (even if imperfect substitutes for prices) for different areas and over a whole year, allows us to test (at least to some extent) whether the assumption is a reasonable one. Before moving into the analysis, a few caveats are in place. First, unit values are different from prices. Unit values are the implicit prices reported by households when asked about the quantity (***i.e.***, in kilos, or grams) and total expenditure on goods. These values are affected by the quality (***i.e.***, a kilo of prime rib costs more than a kilo of ground beef) and by the shop place (***i.e.***, small shop or large supermarket), which could vary across the country. There are also measurement errors, especially when some information (on quantity or expenditure) is missing for a given good. Second, the survey was not ex-ante designed to provide accurate price estimates for sub-periods (months, trimesters, etc.) but for the whole year, therefore the representativeness by rural/urban areas for these sub-periods is not assured. Nonetheless, the distribution of interviews across months by urban/rural as well as by socioeconomic status is relatively smooth across time.

Based on the item weights used by the BCP for the CPI's construction and unit values from EIG-CV, we generated monthly price indexes, for both urban and rural areas. A preliminary analysis suggests that (a) urban and rural price indexes move quite closely across the year; and (b) that both are close to the food price index reported by the Central Bank. The implication is that the assumption used to update the poverty lines is, at least for the period under analysis, not at odds with the information coming out from unit prices gathered at the household level. For our purpose, the remaining implication (c) is that it would not be inappropriate for the analysis that follows to use the CPI-BCP information to produce simulations using the EIG-CV (Figure 5).

Figure 5: Evolution of urban, rural and CB indexes



Source: BCP and own calculations using EIG-CV 2011/12.
Notes: The Central Bank's Index refers to the official CPI used in Paraguay; while the other two alternatives are two indexes that try to mimic the official one based on the EIG-CV 2011/2012.

5. Analytical Framework

The idea that we explore in this paper is the following. Households consume a set of goods at a given set of prices. On the one hand, a price increase makes households poorer since with the same income they can buy fewer goods (***expenditure effect***)[14]. On the other hand, households could benefit from higher income if they work (***e.g.,*** farm-holders that produce and sell their own production or as wage employees) in those activities affected by the increase in prices (***income effect***).

The general analytical framework to explore the idea is the traditional agricultural model proposed by Singh ***et al.*** (1986), continued among others by Deaton (1989). In this paper, we closely follow the adaptation by Brambilla and Porto (2009). The unit of analysis is the

14 Technically, the *expenditure effect* consists of two effects: pure substitution effect (change in relative prices) and income effect (with the same amount of income households can buy less). For a comprehensive discussion on this refer to Mas-Colell *et al.* (1995).

household, indexed by h. In equilibrium, household expenditures (including savings) e^h are financed with household incomes (including transfers).

$$e^h\left(p,u^h,x^h\right)=\sum_j w_j+\sum_i \pi_i^h\left(p,\varnothing\right)+T^h+x_0^h \tag{1}$$

In (1), goods (household members) are indexed by i (j). On the left-hand side, the expenditure function $e(.)$ of household h is defined as the minimum expenditure that guarantees a given level of utility u^h. It depends on a vector of prices of consumption goods p, on the level of utility u^h, and other household characteristics x^h (*i.e.*, household composition). Income comprises the sum of the wages of all working members j (w_j) and the sum of the profits (Π_i) made in different economic activities i. Profits include the net income from agricultural production or farm enterprises as a function of prices, technology, and some key household characteristics (summarized by φ). T^h measures transfers (public or private), savings, and another unmeasured factor returns. Finally, x^h represents an exogenous income. It is evident that household welfare depends on equilibrium variables such as prices and wages (that affect household choices) and also on household endowments[15]. It follows that changes in commodity prices affect welfare directly via consumption and production decisions and that these impacts depend on household choices and endowments.

Let's consider now the impact of changes in the price of commodity i, which can be obtained by differentiating equation (1) –while keeping utility constant and adjusting T^h. It follows that

$$cv^h \cong \sum_i \left(b_i-s_i\right)\frac{dp_i}{p_i}+\sum_i\sum_j \varepsilon w_i^j \theta^j \frac{dp_i}{p_i} \tag{2}$$

where $CV \approx -\frac{dx0}{e}$ is a measure of the compensating variation, as a share of initial expenditures[16]. In equation (2), b_i is the share of total household income from the production of good i, and s_i is the budget share spent in good i. εw_i^j is the elasticity of the wage earned by household

15 As it is remarked in Brambilla and Porto (2009), equation (1) assumes the principle of "separability" between consumption and production decisions.

16 The standard compensating variation, as defined in Hicks (1939) and Mas-Colell *et al.* (1995), refers to the revenue that a planner needs to compensate households for the price change.

member j with respect to the price $p_i \cdot \theta_j$ is the share of the wage income of member j in total household income[17]. The right-hand side of (2) reveals impacts on both household expenditure and income. In a first-order approximation, the first term reflects that there is a direct impact on profits if households produce the good i, which depends on the share of total household income attributed to this good, b_i. The first term also measures, through budget shares s_i, how prices affect the consumption side. It is clear that households that are net-consumers $(b_i < s_i)$ are worse off if prices go up whereas net-producers $(b_i > s_i)$ are better off. The opposite is true for price reductions. The second term represents a first-order approximation of how price changes affect wages. Against a price change, labor demand for different types of labor (an also labor supply) can change, thus affecting equilibrium wages. This response is captured by the elasticity εw_i^j . These impacts on labor income depend also on the share of total household income contributed by wages of different household members θ^j18.

As argued by Brambilla and Porto (2009) and Lederman and Porto (2016), many issues associated with the first order impacts need to be highlighted. First, the role of imperfect pass-through of international to domestic prices and therefore to households[19]. Second, the existence of spillover effects both on the production and on the expenditure side[20]. Third, while the net-consumer/net-producer approach is very intuitive, it rests in a strong assumption: the first-order approximation. Relaxing this assumption or analyzing large price changes, require the consideration of responses in demand and supply (second-order effects)[21]. As we previously mentioned, consumers always lose from a price increase. But if they can adjust, the

17 It is also possible to include an additional term that involves a change in transfers, dT^h, allowing for a potential policy response. Note that the compensating variation is measured at the household level. As can be appreciated in Table A1 in the Annex, we measure s_i at the commodity level using the 9 consumption categories and then we aggregate it at the household level. The parameters associated with the *income effect* (*i.e.,* wages and benefits) are measured at the individual level and then aggregated at the household level. The *income effect* cannot be measured at the commodity level since the survey does not provide information on the commodity market where the income is earned. The only differentiation that can be obtained is between income related to agriculture and non-agriculture sectors. As can be appreciated in Section 6.1, the parameter εw_i^j is used at the individual level to estimate the *income effect*.

18 Clearly, if countries differ in technologies, endowments, or labor regulations, the response of equilibrium wages to prices may be heterogeneous across different economies (Brambilla and Porto, 2009).

19 For a detailed discussion, see Feenstra (1989), Rogoff (1996), Goldberg and Knetter (1997), Burstein *et al.* (2003) and Nicita (2009).

20 For example, the expansion of a sector affects up/downstream activities, or an increase in income due to the expansion of a sector raises the demand for output and thus the derived demand for inputs in other sectors.

21 As pointed out by Brambilla and Porto (2009), the net position of the household is endogenous when households respond to price changes. For small price changes, the first-order approximation can be accurate, and the "endogeneity" of the household is a second order concern. However, for larger price changes the approximation error grows larger.

losses can be ameliorated by reducing purchases of the more expensive goods[22]. The addition of second-order effects alters equation (2) as follows:

$$cv^h \cong \sum_i \left(b_i - s_i\right)\frac{dp_i}{p_i} + \sum_i \sum_j \varepsilon w_i^j \theta^j \frac{dp_i}{p_i} + S\left(\Delta p\right) \qquad (3)$$

where the last term $S(\Delta p)$ corrects for substitution behavior, as a function of the full vector of price changes[23]. The literature has tried to quantify consumption responses through the estimation of a system of demand elasticities (own- and cross-price elasticities)[24]. Friedman and Levinsohn (2002) –while did not include wages or income responses in their model– found that allowing for substitution effects in consumption makes a big difference and the estimated losses can be cut by a half. Nonetheless, the distributional consequences are shown to be rather stable across the whole income distribution. In a recent study, Tiberti and Tiberti (2018) indicate that the second-order effects reduce the negative effects due to the first-order consumption effects, with significant differences across quintiles. On average, the second-order effects represent up to roughly 40 percent of total first-order effects.

As discussed by Ferreira *et al.* (2013), and to the best of our knowledge, there is still no evidence that has fully captured all terms of equation (3). This paper is not the exception. Unfortunately, due to the lack of data to estimate substitution in consumption against a price change we are not able to include second-order effects. In any case, not including substitution effects lead us to estimate an upper bound for the effect on poverty and inequality of price changes.

6. Simulation and Main Results

6.1. Simulation

Between September 2010 and August 2011, prices of food items in Paraguay rose 17 percent, whereas overall inflation was around 9 percent (5.4 percent if we do not include food items)[25].

22 Similar arguments can be made for producers, which always lose from a price decline. In this case, adjustments can mitigate the losses by shifting resources to more productive activities.

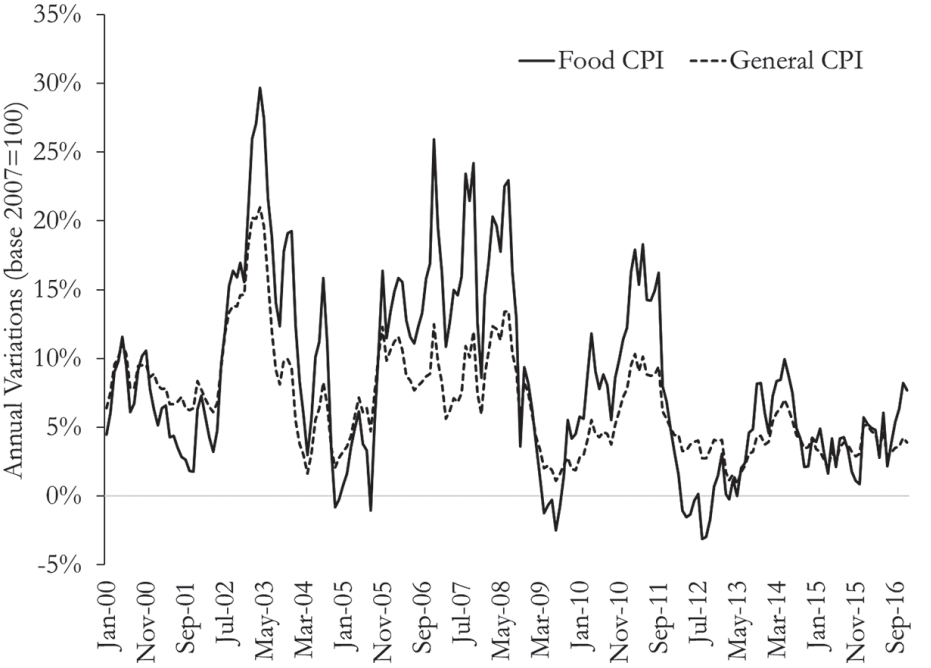
23 See Ferreira *et al.* (2013) for an interesting discussion on this.

24 The leading framework to estimate demand systems is Deaton and Muellbauer (1980) and further developments based on it.

25 Central Bank of Paraguay.

About 40 percent of the total population lives in rural areas, where a sizeable part of incomes is related to agriculture. Therefore, the potential impact of food price changes on poverty and inequality might be significant. To shed light on this, we simulate an increase in prices similar to the previously mentioned one (Figure 6). In the simulation, we consider to some extent the heterogeneity of price changes observed across foodstuffs. The EIG-CV data allow us to observe 127 food items prices, which we grouped into nine food groups, following the classification used in the construction of the Consumer Price Index[26].

Figure 6: Annual variations in the food and general price index



Source: Central Bank of Paraguay.
Notes: The food share presented in this figure corresponds to the moving average of each centile. Urban and rural centiles are constructed using the population living in each area respectively. Naturally, national centiles consider the population of the whole country.

26 Specifically, the simulated inflation for each subgroup of goods j is $Inf_j = (Inf_j - InfNonFood)$, whereas *InfNonFood* refers to overall inflation without including food items.On the poverty lines, the baseline extreme line is inflated by 11.8 percent while we do not makeany adjustments on the moderate poverty line. See Table A1 in the Annex for a detailed description of the ninefood groups and parameters included in the simulation.

We calculate the first-order effect of this price change as described by equation (2). Regarding the first term of equation (2), available information on household expenditures and incomes (provided by the EIG-CV) allows us to compute both consumption and production shares. Specifically, in our view, the calculation of production shares represents an important contribution of this paper, considering that some relevant studies do not calculate it due to a lack of information[27]. Moreover, Paraguay has the greatest share of rural the population in Latin America and, as a consequence, own production is a key determinant of household's welfare. As we will appreciate later, omitting this component of the ***income effect*** does not have negligible effects on the final results. Regarding the wage-price elasticity (εw_i^j) for the second term of the right-hand side of equation (2) we initially assume a value of 0.2, based on Ravallion (1990)[28]. Given that this election is, to some extent, arbitrary we explore other alternatives for sensitivity analysis (as, for example, in Ferreira ***et al.*** (2013)). Specifically, we consider the following cases: i) no response ($\varepsilon w_i^j = 0$), ii) long-run response ($\varepsilon w_i^j = 0.5$) and iii) full transmission ($\varepsilon w_i^j = 1.0$)[29]. Finally, we assume that (consumed and produced) quantities of each item are the same before and after the price change. Then, we compute the resulting household level values of expenditure and incomes and analyze the welfare variation across the income distribution. As mentioned, this implies an upper bound effect, given that households may substitute either in consumption or in production.

6.2. Main Results

We begin by presenting the results on the ***expenditure effect***. Considering that prices of food items increased relatively more than the general level, this effect is majorly explained by the share of expenditure that households spend on food. Naturally, as expected, this share varies across centiles of income ***per capita***, and between urban and rural areas with an average of 37 percent and 47 percent, respectively (Figure 7). This is a standard textbook result and is well known as the Engel curve. Our result suggests that the ***expenditure effect*** is negative

27 For example, Ferreira *et al.* (2013) were not able to compute production shares due to some restrictions in Brazilian data.

28 Since nominal wages are usually sticky, it could be expected that agricultural wages do not respond (or respond weakly) to food price rises. Therefore, we consider a situation where there is either no response on wages which implies a $\varepsilon w_i^j = 0$, or a weak response assuming an elasticity parameter of $\varepsilon w_i^j = 0.2$ which could be considered a good approximation of a rather short-run behavioral reaction.

29 Boyce and Ravallion (1991), Porto (2005), Porto (2006), and Nicita (2009) provide alternative estimations of wage-price elasticity.

and obviously regressive everywhere, but larger in rural than urban areas (Figure 8). When comparing extreme poverty rates after the simulated price hike, and considering only the ***expenditure effect***, we can appreciate an increase in the number of people not able to afford the basic food basket[30]. This increase in extreme poverty is greater in rural areas (Table 2). Specifically, extreme poverty increases three points in urban areas and more than six points in rural ones. Something similar occurs with moderate poverty that rises approximately half a point in urban areas but more than a point and half in rural areas. Inequality rises slightly.

On the other hand, the food price hike leads to higher incomes for small farm holders and those employed in agriculture. The ***income effect*** that we address in this paper includes not only the effect of prices on wages, as in Ferreira ***et al.*** (2013), but also greater returns for agriculture entrepreneurs and self-employed. We identified agro- and non-agro-related household income, and estimated the ***income effect*** only on those working in agro-related activities[31]. As with the ***expenditure effect***, differences across areas are substantial; the probability of having an agricultural-related income is 17 percent in urban areas whereas 65 percent in rural ones[32]. Table 2 presents the overall ***income effect***, differentiating between ***income-wage effect*** and ***income-profit effect***. Both effects lead to a reduction in poverty but while the ***income-wage effect*** is quite small, the ***income-profit effect*** significantly contributes to poverty reduction. In addition, the ***income-profit effect*** is greater in rural areas. Two results are important to be highlighted. First, the fact that the ***income-wage effect*** is negligible reveals that the agro-industrial sector is still something not very well developed in Paraguay. Therefore, improvements in this sector will then help to boost household income and contribute to poverty reduction. Second, not including the ***income-profits effect***, as in Ferreira ***et al.*** (2013), leads to an important omission in total household income. This component may also be more important in Paraguay as compared to other countries in Latin America, given its employment distribution[33].

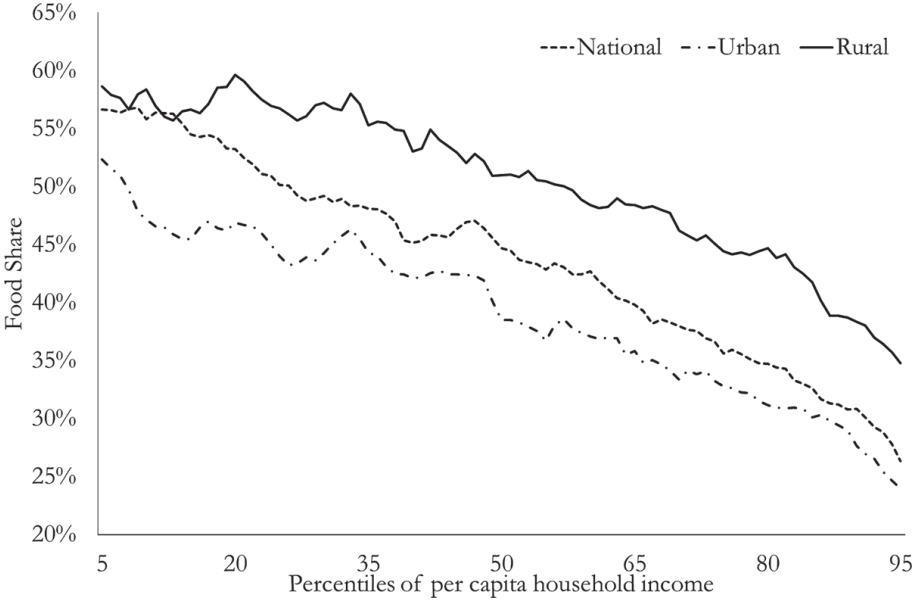
30 For extreme and total poverty calculations we use official poverty lines published by DGEEC.

31 The identification of agro-related activities follows the official definition that is available within the household survey. Note that the *income effect* is naturally zero for those in other sectors. Unfortunately, due to data restrictions, we cannot do a granular analysis within the different agro-related activities, so we assume that the increase in prices in the whole sector corresponds to the average increase in food prices.

32 A probabilistic model (*probit*) is estimated here. The dependent variable is binary equaling 1 if the household has some income from agriculture and 0 otherwise. The independent variable is the monthly *per capita* income. The model is estimated for both rural and urban areas, and the corresponding probability is predicted.

33 See Table A2 in the Annex.

Figure 7: Food share on total expenditure by area

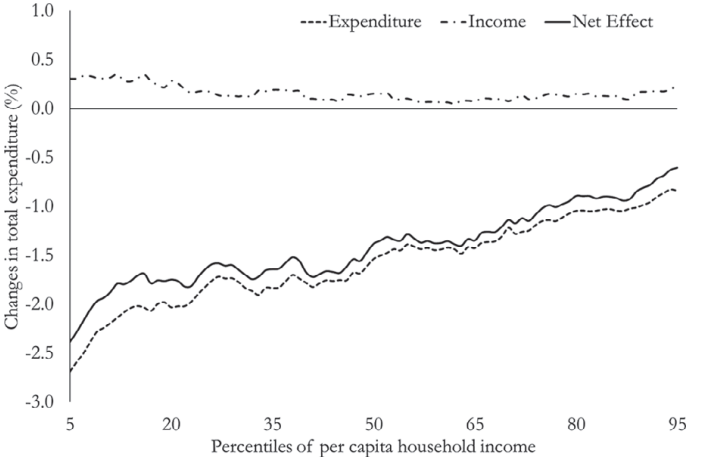


Source: Own calculations based on EIG CV 2011/12.
Notes: The food share presented in this figure corresponds to the moving average of each centile. Urban and rural centiles are constructed using the population living in each area respectively. Naturally, national centiles consider the population of the whole country.

Figure 8: Expenditure, Income and net effect (price elasticity = 0.2)

Panel A. All country

Panel B. Urban areas



Panel C. Rural areas

Source: Own calculations based on EIG CV 2011/12.
Notes: Each effect in these figures was estimated as the moving average of each centile.

Table 2
Extreme and moderate poverty, and inequality (price elasticity = 0.2)

	Baseline	*Expenditure*	*Income*			
			All	*Income (wages)*	*Income (profits)*	*Net (expenditure + income)*
National	[1]	*[2]*	*[3]*	*[4]*	*[5]*	*[6]*
Extreme	13.37	17.79	15.62	16.21	15.65	17.14
	(0.46)	(0.52)	(0.49)	(0.50)	(0.49)	(0.51)
Moderate	25.78	26.81	24.97	25.78	24.97	26.27
	(0.59)	(0.60)	(0.59)	(0.59)	(0.59)	(0.60)
Inequality	0.527	0.533	0.527	0.527	0.527	0.533
Urban						
Extreme	5.91	8.69	7.73	7.80	7.73	8.65
	(0.40)	(0.48)	(0.46)	(0.46)	(0.46)	(0.48)
Moderate	15.03	15.75	14.98	15.03	14.98	15.71
	(0.61)	(0.62)	(0.61)	(0.61)	(0.61)	(0.62)
Inequality	0.489	0.494	0.490	0.489	0.490	0.494
Rural						
Extreme	24.23	31.03	27.11	28.45	27.18	29.49
	(0.97)	(1.04)	(1.00)	(1.02)	(1.00)	(1.03)
Moderate	41.43	42.92	39.51	41.43	39.51	41.64
	(1.11)	(1.12)	(1.10)	(1.11)	(1.10)	(1.11)
Inequality	0.523	0.534	0.526	0.523	0.526	0.537

Source: Own estimations based on EIG CV 2011/12.
Notes: Standard errors in parentheses. Extreme and moderate refer to the headcount ratio using the extreme and moderate poverty line respectively. Inequality refers to the Gini coefficient. In this table we consider a price elasticity of 0.2 and full pass-through of profits linked to self-employed earnings. In each column we report the following concepts: [1] baseline estimation (before the shock); [2] estimates after shock where we include only the expenditure effect; [3] add to [1] the income effect; [4] add to [1] the wage effect; [5] add to [1] the profits effect; [6] add to [1] the expenditure and income effect.

As Figure 8 suggests, the income effect is positive and progressive in rural areas and negligible in urban areas. As we increase the wage-price elasticity (εw_i^j), the income effect becomes greater. But wages do not play a substantial role as can be observed in Table 3, which presents a summary of additional estimations with alternative values for εw_i^j. Overall, at the national level, we find that the potential impact on the welfare of an unexpected increase in food prices in Paraguay is a very flat U-shaped curve (Figure 8)[34,35]. Using the same logic as Higgins and Lustig (2013), Table 4 presents a mobility matrix at the national level and by area. It shows in a dis-aggregated way, the initial composition of socioeconomic classes before and after the price shock (including both the ***expenditure*** and ***income effect***). For instance, 30 percent of individuals that were under moderate poverty before the shock, fell into extreme poverty after the price variation.

34 In this Figure, we can also observe that the choice of the poverty measure and of the poverty line is not trivial as stated by Ravallion and van de Walle (1991).

35 If we repeat the same exercise that we do in Figure 3 we could see, indeed, that at the national level, the three components (i.e., growth, redistribution, and line), go against poverty reduction. Nevertheless, the growth effect goes in favor of poverty reduction when narrowing the analysis to rural areas, although it is overweighted by redistribution and line effects.

Table 3
Summary of simulations: elasticity and pass-through of profits alternatives

		Net effect - Wage Elasticity alternatives			
	Baseline	0	0.2	0.5	1
	[1]	*[2]*	*[3]*	*[4]*	*[5]*
		Full profit pass-through			
National					
Extreme	13.37	17.16	17.14	17.12	17.02
	(0.46)	(0.51)	(0.51)	(0.51)	(0.51)
Moderate	25.78	26.27	26.27	26.26	26.20
	(0.59)	(0.60)	(0.60)	(0.60)	(0.60)
Inequality	0.527	0.533	0.533	0.533	0.533
Urban					
Extreme	5.91	8.69	8.65	8.65	8.64
	(0.40)	(0.48)	(0.48)	(0.48)	(0.48)
Moderate	15.03	15.71	15.71	15.71	15.71
	(0.61)	(0.62)	(0.62)	(0.62)	(0.62)
Inequality	0.489	0.494	0.494	0.494	0.494
Rural					
Extreme	24.23	29.49	29.49	29.45	29.23
	(0.97)	(1.03)	(1.03)	(1.03)	(1.02)
Moderate	41.43	41.64	41.64	41.61	41.47
	(1.11)	(1.11)	(1.11)	(1.11)	(1.11)
Inequality	0.523	0.537	0.537	0.537	0.537
		No profit pass-through			
National					
Extreme	13.37	17.79	17.76	17.73	17.68
	(0.46)	(0.52)	(0.52)	(0.52)	(0.52)
Moderate	25.78	26.81	26.81	26.80	26.74
	(0.59)	(0.60)	(0.60)	(0.60)	(0.60)
Inequality	0.527	0.533	0.533	0.533	0.533
Urban					
Extreme	5.91	8.69	8.69	8.65	8.64
	(0.40)	(0.48)	(0.48)	(0.48)	(0.48)
Moderate	15.03	15.75	15.75	15.75	15.75
	(0.61)	(0.62)	(0.62)	(0.62)	(0.62)
Inequality	0.489	0.494	0.494	0.494	0.494
Rural					
Extreme	24.23	31.03	30.96	30.95	30.83
	(0.97)	(1.04)	(1.04)	(1.04)	(1.04)
Moderate	41.43	42.92	42.92	42.89	42.74
	(1.11)	(1.12)	(1.12)	(1.12)	(1.11)
Inequality	0.523	0.534	0.534	0.534	0.534

Source: Own calculations based on EIG CV 2011/12.
Notes: Standard errors in parentheses. Inequality refers to the Gini coefficient. In each column we report the following concepts: [1] baseline estimation (before the shock); [2] estimates after shock where we consider a wage elasticity of 0 in [2], 0.2 in [3], 0.5 in [4] and 1 in [5], respectively.

Table 4
Mobility Matrix before and after the shock (simulation)

National		Net - Post Shock (expenditure + income)				
		Extreme Poor	Moderate Poor	Vulnerable	Noon Poor	Total
Pre Shock	Extreme Poor	100%	0%	0%	0%	13.37%
	Moderate Poor	30.32%	67.49%	2.19%	0%	12.41%
	Vulnerable	0%	2.00%	97.55%	0.45%	38.04%
	Non Poor	0%	0%	1.76%	98.24%	36.17%

Urban		Net - Post Shock (expenditure + income)				
		Extreme Poor	Moderate Poor	Vulnerable	Noon Poor	Total
Pre Shock	Extreme Poor	100.00%	0%	0%	0%	5.91%
	Moderate Poor	30.00%	70.00%	0%	0%	9.12%
	Vulnerable	0%	1.87%	98.00%	0%	36.20%
	Non Poor	0%	0%	1.76%	98.24%	48.77%

Rural		Net - Post Shock (expenditure + income)				
		Extreme Poor	Moderate Poor	Vulnerable	Noon Poor	Total
Pre Shock	Extreme Poor	100.00%	0%	0%	0%	24.23%
	Moderate Poor	30.57%	65.55%	3.88%	0%	17.20%
	Vulnerable	0%	2.16%	96.98%	0.86%	40.73%
	Non Poor	0%	0%	1.76%	98.24%	17.84%

Source: Own calculations based on EIG CV 2011/12.
Notes: This table should be read from left to right. For instance, for those individuals that were in an extreme poverty status in the pre-shock situation, after the shock (simulation) some of them ended up in the same situation (extreme poverty), while others move to moderate, vulnerable, or non-poor status. Values in this table are based on a simulation that considers a price elasticity of and full pass-through of profits linked to self-employed earnings.

7. Policy Responses: simulating in-cash-transfers interventions

As was shown in the previous section, a shock on food prices increases poverty rates. To mitigate this perverse effect, governments can use their social protection systems[36]. Tekoporã is the most important social program in Paraguay, devoted to improving life's quality of the most deprived. This program warrants food access, health, and education to less well-off families. Also, it strengthens social networks to eradicate the inter-generational transmission of poverty. Its design is pretty similar to many other conditional cash transfer programs that were implemented in the region. It is mainly focused on families in extreme poverty and

36 World Bank (Food Price Watch) identifies that policy responses can be addressed via five different fronts: i) the producer side, ii) the consumer side, iii) or both; in addition to iv) foreign trade terms intended to protect national markets, and v) risk management future type of contracts. This paper will focus uniquely on the consumer side.

vulnerability, which have children and adolescents between 0-18 years old, disabled persons, and pregnant women[37].

Tekoporã has been gaining relevance and coverage since 2005 and its beneficiaries have increased steadily. In 2005, 4,324 families in poverty and vulnerability conditions were covered by the program. Actually, the program covers all departments in Paraguay with 131,159 families[38]. Each household receives a lump sum transfer of Gs. 90,000 and a flexible transfer depending on the number of children (of Gs. 40,000 for each child). For instance, a household with four children receives a total amount of Gs. 250,000[39].

The existence of Tekoporã, allows us to simulate a policy response from the government side to help those most affected by the price shock[40]. To assess this issue, a major methodological obstacle needs to be removed. In particular, the main source of information used in this paper (EIG-CV 2011-2012) does not report a specific question about whether the individuals receive or not the program. So, an approximation to a hypothetical distribution of Tekoporã's beneficiaries needs to be estimated. For this purpose, we take advantage of the EPH 2015 where a specific question about the reception (or not) of Tekoporã is reported. We followed several steps outlined below.

First, we identify the current number of households receiving Tekoporã in EPH 2015. Second, we propose a probabilistic model to identify those simulated beneficiaries in EIG-CV 2011-2012 but based on EPH 2015. Specifically, we run a probability model (see Table A3 in the Annex) using as a dependent variable whether the household receives the program or not. As regressors, we include a set of household head characteristics and a set of variables

37 Specifically, the conditionality are households that have been identified and classified in a situation of poverty and vulnerability, and that have among their members: boys and girls from 0 to 14 years old and/or - adolescents from 15 to 18 years old; pregnant women; people with disabilities; indigenous communities. See https://www.mds.gov.py/index.php/programas/tekopora for more details. The best approximation to the distribution of the served population can be obtained from the EPH and is presented in Figure A.1 in the Annex. For a survey of conditional cash transfer programs in the Latin American region refer to Stampini and Tornarolli (2012).

38 Some studies on the evaluation of Tekoporã indicate positive impacts on *per capita* income and consumption, poverty reduction, school attendance, investment in agricultural production, access to credit, savings, and social participation. Less success is found in reducing child labor or increasing child immunizations, and access to credit, (Veras *et al.*, 2008, 2010). The program had no significant effects on labor supply (Núñez-Guerrero, 2019).

39 The maximum number of children allowed to claim for the benefit is four. The program also grants Gs. 40,000 for a pregnant woman (up to one pregnant woman), Gs. 150,000 for disability (up to two disabled persons) and 225,000 for an indigenous family.

40 A review conducted by the World Bank (2008) shows that a large number of Latin American countries tended to focus their policies on the consumer side, aiming to increase the real income of poor households: school feeding programs and conditional cash transfer programs, like Tekoporã, are among the most popular.

that captures the household structure and dwelling features[41]. Thus, through this model we obtain the estimated probability of being Tekoporã beneficiary in EPH 2015[42]. Third, using the previous model coefficients we compute the estimated probability in the EIG-CV 2011-2012, and we obtain a simulated distribution of hypothetical beneficiaries[43,44]. We set the number of beneficiaries in the EIG-CV 2011-12 to be the same amount as those in EPH 2015.

Afterward, using the current Tekoporã's scheme and the ***mimic*** of beneficiaries in the EIG-CV 2011-2012, we simulate governmental assistance through an additional transfer to Tekoporã's beneficiaries. This additional amount is calculated as a share of the actual (monthly) transfer that beneficiary's receipt. Regarding this, we proposed two scenarios (not exhaustive, logically). One in which each household receives an extra monthly transfer. Another in which each household receives four extra transfers. So, following the previous example, a household with four children receives (in our simulation) a monthly compensation of Gs. 250,000 and Gs. 1,000,000 in each scenario[45].

The last two columns in Table 5 present the simulations (we keep the first two columns as in Table 2 for reference). The first of them generates a small decline in (extreme and moderate) poverty rates. Also, inequality is reduced after the price shock (column 3 versus 2). This reduction is almost imperceptible in urban areas while much greater in rural areas (moderate poverty is even lower than before the shock)[46]. The second scenario generates

41 The variables related to household head characteristics are age and marital status; those related to the household structure are the number of members, number of siblings and two-parent home. Finally, dwelling features include geographic area, geographic department, *per capita* household income, poverty status, number of rooms, walls materials, electricity provision, network water provision, piped gas provision, the existence of drain, the existence of telephone and existence of bathroom.

42 It is worth to be remarked that our model fits relatively well, with an R-squared of 0.40.

43 The comparison between the distribution (by deciles of *per capita* household income) of Tekopoã beneficiaries, both obtained through EPH 2015 and simulated with EIG-CV 2011-2012 is shown in the Annex (Figure A.1).

44 Simply, what we do is what the literature recognizes as a survey-to-survey imputation.

45 Note that we are simulating an increase in the cash transfer given that the government can easily carry it out through the current scheme. Nevertheless, increasing cash assistance is not free of potential problems. For a general discussion about cash transfers versus in cash transfers see Conconi and Marchionni (2008). Recent research has shown that government aid can also affect market competition and therefore affect prices. Filmer *et al.* (2018) show that in Philippines a cash transfer program -targeted to poor households show that a 9 percent increase in village income- significantly raised the prices of perishable protein-rich foods while leaving other food prices unaffected. The price changes are largest in areas with the highest program saturation. Cunha *et al.* (2019) show that in-kind transfers, as compared to cash transfers, increase competition at the local level, especially in more isolated areas, and then local stores react by reducing their prices. In addition, Hastings and Washington (2010) show that stores increase their prices during the first days of the month because many with beneficiaries of Food Stamps or cash welfare assistance currency do their purchases during this period.

46 In this setting, the government should make 13 "monthly" payments per year instead of the 12 (one per month) that performs under regular conditions. Based on official information, *Situaci´on Financiera (SITUFIN)* – Ministry of Economic Affairs, the budget spent in Tekoporã represents 0.8 percent of total government expenses in 2014. The cost of the less generous transfer simulated in this paper is approximately 10 percent of Tekoporã's spending, that is to say, 0.1 percent of total spending.

more pronounced declines, logically, as the transfer is four times bigger. At the national level, extreme poverty is reduced by three points reaching almost pre-shock values. Even moderate poverty is two points less than before the shock. Again, much of the action is coming from rural areas while almost nothing happens in urban ones. In urban areas the transfer does not compensate enough those households that were affected by the price shock, ending with extreme poverty higher than the baseline scenario[47,48].

Table 5
Policy response simulations

			Policy Response	
	Baseline	*Net (expenditure + income)*	**100%**	**400%**
National				
Extreme	13.37	17.14	16.32	14.31
	(0.46)	(0.51)	(0.50)	(0.48)
Moderate	25.78	26.27	25.73	23.06
	(0.59)	(0.60)	(0.59)	(0.57)
Inequality	0.527	0.533	0.530	0.520
Urban				
Extreme	5.91	8.65	8.55	8.15
	(0.40)	(0.48)	(0.48)	(0.47)
Moderate	15.03	15.71	15.63	15.11
	(0.61)	(0.62)	(0.62)	(0.61)
Inequality	0.489	0.494	0.493	0.491
Rural				
Extreme	24.23	29.49	27.62	23.28
	(0.97)	(1.03)	(1.01)	(0.95)
Moderate	41.43	41.64	40.42	34.63
	(1.11)	(1.11)	(1.11)	(1.07)
Inequality	0.523	0.537	0.528	0.505

Source: Own calculations based on EIG CV 2011/12.
Notes: Standard errors in parentheses. Inequality refers to the Gini coefficient. In this table we consider a price elasticity of 0.2 and full pass-through of profits linked to self-employed jobs. The policy response refers to either one or four extra monthly payments of Tekoporã.

47 To reach the baseline extreme poverty rate at the national level, the government should make more than 16 payments, or an alternative that combines a different transfer amount for those living in urban and rural areas respectively. As it can be appreciated in the last column of Table 5, the most generous transfer shifts poverty rates back to baseline levels in rural areas but is not enough in urban ones. Therefore, introducing differential amounts *e.g.*, larger in urban areas while keeping constant in rural ones, could be an alternative to restore national figures to the baseline levels.

48 Standard errors of these results are somehow large and thus, most of the differences in our poverty measures are not statistically different. Still, we believe that this does not invalidate the exercise.

8. Conclusions

In this paper we contribute by providing evidence of the potential effects on welfare of a price increase, disentangling between those that affect consumption and those that affect production. The paper also differentiates the effects between rural and urban areas. We focus on Paraguay where the agricultural sector plays a key role and where the availability of data is far from being the ideal one, which imposes challenges to the analysis.

Concretely, we simulate a food price hike of approximately 17 percent, similar to the one experienced in Paraguay between September 2010 and August 2011. Using micro-level data, we estimate the impact of this hike on households' welfare. We use the Income and Expenditure (EIG-CV 2011-2012) and the Permanent Household (EPH 2015) surveys. In addition, we use detailed monthly price data collected in Greater Asunci´on gathered by the Central Bank of Paraguay. The analytical framework is based on the compensating variation, assuming that households are entitled to their pre-shock level of utility. We consider three different effects: the ***expenditure effect***, as consumers face more expensive prices; the ***income effects***, derived either as greater wages for employees in agricultural activities or as greater profits for those self-employed; and the ***government policy response***, simulated as an increase in the cash transfer to beneficiaries of the existing social program Tekoporã. Here, we contribute by estimating a sub-component of the ***income effect*** (***i.e.***, the ***profit effect***) that was not considered in the existing literature (at least for Latin American countries). This contribution is relevant since the ***profit effect*** explains a substantial part of the final results, given the economic structure of Paraguay. One caveat of our results is that we were not able to estimate behavioral responses after the shock (***i.e.***, second-order effects). Given this, we think that our results could be understood as upper bound estimates, where households have no room to adjust consumption or production decisions.

Our results show that the effects of higher food prices on poverty and inequality could be non-trivial, particularly for those in rural areas. Specifically, we find that the potential overall impact of an unexpected increase in food prices in Paraguay could be represented by a very flat U-shaped curve effect. This means that if we were to sort the population from the poorest to the richest, those households located in the extremes of the distribution will be less affected (though the differences throughout the distribution are not large). Yet, governments such as

Paraguay, that have in place a relatively extensive social assistance system could take measures to react quickly to such shocks, protecting the most vulnerable. The paper simulates such policy response, with varying generosity degrees on the transfer.

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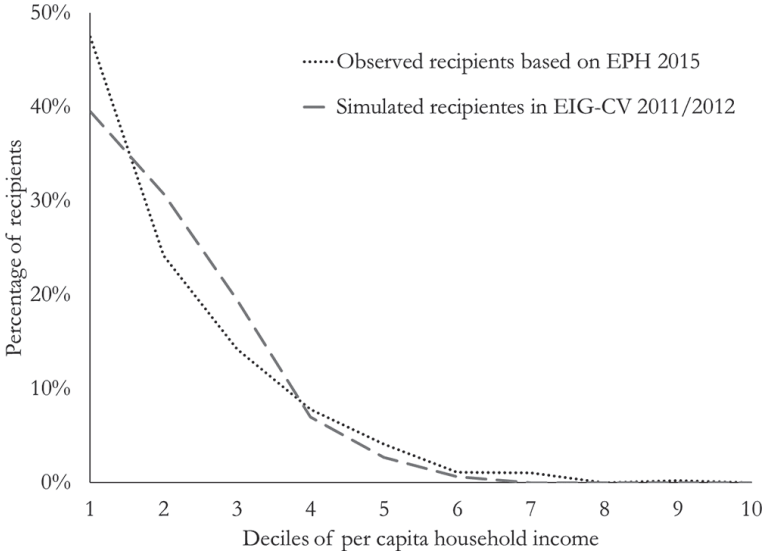
Annex

Figure A1: Tekoporã recipient's simulation



Source: Own calculations based on EIG CV 2011/12 and EPH 2015.
Notes: The simulation in the EIG-CV 2011/2012 is the result of imposing the coefficients estimated in a probability model on the eligibility to receive the program based on the EPH 2015.

Table A1
Simulation components

Quintiles	Consumption (9 categories) [1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	Benefits	Wages
	Urban										
1	4.0	5.5	4.1	1.2	2.6	1.8	0.5	1.0	1.0	2.5	1.1
2	2.8	5.0	3.5	0.8	2.0	1.2	0.4	0.7	1.2	1.2	0.7
3	2.1	4.2	3.2	0.6	1.8	1.1	0.3	0.6	1.2	0.8	0.5
4	1.8	3.7	2.8	0.5	1.4	0.8	0.3	0.5	1.1	0.8	0.2
5	1.1	2.7	1.9	0.3	1.1	0.6	0.2	0.4	1.0	1.5	0.6
	Rural										
1	4.2	7.8	5.4	2.1	7.7	2.0	0.5	1.3	0.5	33.2	2.3
2	3.5	7.0	5.8	1.8	5.6	2.1	0.5	1.2	0.8	28.6	5.0
3	3.4	6.2	4.5	1.5	3.9	1.7	0.5	1.0	0.9	21.6	5.1
4	2.9	5.6	4.2	0.9	2.8	1.3	0.4	0.8	1.0	13.3	5.6
5	2.0	4.4	3.0	0.6	2.1	0.9	0.3	0.6	1.0	16.9	5.0
Change in price	3.2%	12.1%	4.3%	9.8%	33.4%	18.1%	5.7%	7.4%	-4.7%		

Source: Own calculations based on EIG CV 2011/12 and BCP.
Notes: Quintiles of household income *per capita*. Categories of expenditure correspond to: [1] Cereals and related products; [2] Meat; [3] Dairy products and eggs; [4] Oils and butters; [5] Fresh and canned vegetables; [6] Sugar, sweeteners, candy, and ice cream; [7] Spices and semi-prepared meals; [8] Yerba, coffee, tea and chocolate; [9] Soft drinks.

Table A2
Employment distribution in Paraguay, year 2012

	Employee		Self Employed	
Quintil	Agro	Other	Agro	Other
I	0.7%	2.6%	6.4%	3.8%
II	0.6%	7.7%	4.6%	5.0%
III	0.5%	11.6%	2.4%	5.7%
IV	0.4%	14.3%	1.5%	6.8%
V	0.5%	16.8%	1.1%	7.0%
Total	2.7%	53.1%	15.9%	28.3%

Source: Own calculations based on EIG CV 2011/12.
Notes: Each cell is the ratio of the numbers of workers for a given category, sector and quintile, over the total number of workers in the country. Quintiles were calculated based on the *per capita* income distribution.

Table A3
Probit model of the probability to be an eligible household

Explanatory Variables	
Household Head Characteristics	
Age	-0.005**
	(0.002)
Marital Status (=1 if married)	0.137**
	(0.068)
Household Structure	
Total number of members	-0.088***
	(0.033)
Total number of children [0;18]	0.282***
	(0.040)
Household with both parents	0.106
	(0.080)
Dwelling Characteristics	
Type of dwelling (=1 if house)	0.855
	(0.563)
Rooms (=1 if less than 2)	0.166**
	(0.069)
Bedroom (=1 if bedroom =1)	-0.262***
	(0.080)
Walls (=1 if brick made)	-0.365***
	(0.065)

Water	0.191***
	(0.062)
Electricity	0.492*
	(0.282)
Telephone	-0.340
	(0.257)
Bath	1.202**
	(0.481)
Gas	-0.564***
	(0.090)
Owner	0.174**
	(0.081)
Sewage	-0.374***
	(0.073)
Other vars	
Area (=1 if urban)	-0.309***
	(0.072)
San Pedro	0.165
	(0.233)
Caaguazú	-0.263
	(0.231)
Itapúa	-0.599**
	(0.249)
Alto Paraná	-0.731***
	(0.247)
Central	-0.823***
	(0.298)
Rest	-0.188
	(0.220)
Per capita income	-0.000***
	(0.000)
Moderate poor	0.124
	(0.086)
Non poor	0.094
	(0.101)

Source: Own calculations based on EPH 2015.
Notes: Regression based on 8,229 households, with an adjusted-R2 of 0.40. Standard errors in parentheses.