DECLARATION FOR THE PhD THESIS

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January 31st, 2011

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UNIVERSITA' COMMERCIALE LUIGI BOCCONI
PhD IN INTERNATIONAL LAW AND ECONOMICS

Issues of Trade and Poverty In Bolivia

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To my father,

who taught me the importance of

humility, sacrifice and determination.

And still does...

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PAPER 2

THE POVERTY AND DISTRIBUTIONAL IMPACT OF HIGH FOOD PRICES: THE CASE OF BOLIVIA

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Introduction

This thesis consists of three self-contained papers devoted to the analysis of the main socio-economic shocks occurred in Bolivia in the present decade and their impact on poverty and welfare.

Firstly, a comprehensive analysis of poverty and pro-poor growth in Bolivia between 2001 and 2007 is provided. The general poverty picture is then further investigated by looking at the main economic events affecting households as well as the state. In particular, the second essay investigates the poverty and distributional impact of high food price (2005-2008), a very relevant topic given the importance of the agricultural sector in Bolivia, especially among poor households

The other significant economic shock analyzed, likely to affect also in the long term Bolivian economy and its population' s welfare, is the hydrocarbon sector. Bolivia nationalized its hydrocarbon sector in 2005 and the change in the fiscal regime associated with it, together with a very favourable context of high price, determines an extraordinary inflow of resources in the country. The third paper thus investigates whether the increase in fiscal resources from the natural gas, transferred to the municipalities and earmarked for health and education spending, does actually translate into better education and health outcomes.

The focus on Bolivia is motivated by the extraordinary socio-economic challenges that Bolivia is facing in the present decade and their potential repercussion on its poor and unequal society.

Bolivia is one of the poorest countries in the world. In 2006, 60 percent of the population live below the poverty line. With a Gini index of 60.1 it is the seventh most unequal country of the world. Compared to average Latin American figures, life expectancy at birth is low - 65 years in Bolivia versus 73 years in the Latin American

region; infant mortality is high - 55 per 1,000 live births versus a regional average of 22. Although Bolivia is one of the poorest countries in the world, there has been scant attention paid to Bolivian poverty within the research network. However, Bolivia is experiencing extraordinary political, economic and social changes such as the election of the first indigenous president in Bolivian history, Evo Morales, and his proclaimed commitment to eradicate poverty and redistribute resources; the process towards indigenous emancipation; the internal regional tensions between the wealthy regions of the east, which call for more autonomy from the central state, and the poor regions in the highland; the surge in agricultural prices, the nationalisation of Bolivia's hydrocarbon reserves and the boom in natural gas price and fiscal revenues. These events are likely to impact the socio-economic equilibrium of the country and providing a preliminary assessment of the changes is the main aim of this thesis.

The empirical work has been conducted using household and municipal level data. The first paper uses seven rounds of the National Household Survey (National Surveys, sponsored by MECOVI program, have been conducted in1999, 2000, 2001, 2002, 2005, 2006 and 2007). Given the inaccuracy of the consumption aggregates provided within the surveys, original and consistent estimates of consumption are computed by the author, aggregating data on the consumption of 64 food items, 40 non-food items, different items on education and housing expenditure.

The second paper employs the 2005 National Household Survey. Information on 64 food products consumed, 88 agricultural products produced and 33 processing food items are used to define the net production or consumption positions of Bolivian households.

The third paper employs an original combined panel dataset spanning the 327 Bolivian municipalities over eight years, from 2001 to 2008. The dataset gathers information on aggregate measures of wellbeing (enrolment and completion rates, gender gap in primary and secondary school completion rate, proportion of children immunized against measles and proportion of births attended by skilled personnel) and per capita municipal fiscal transfers derived from natural gas, comprising data on royalties and IDH, the Direct Tax on Hydrocarbon, introduced in 2005.

Each paper has its own literature review, data section and empirical strategy. The contributions of this thesis are presented separately for each paper, together with a brief description of the methodology and results obtained.

The first paper analyzes consumption poverty and pro-poor growth in Bolivia. The poverty literature on Bolivia is very scarce and dated. Furthermore, previous studies focus on income as welfare indicator and neglect consumption. Therefore, no previous study investigates what happened to households' consumption decisions or what the poverty story would be using consumption rather than income, despite the fact that consumption is considered a better indicator of welfare in developing countries' context. The paper aims at filling this gap in the literature and it presents a very different story on the recent Bolivian poverty trend. Using seven Bolivian household surveys conducted between 1999 and 2007, consistent and accurate estimates of consumption are computed and used to create poverty profiles. Challenging the previous income-based poverty trend, this study shows that Bolivia experienced a very large poverty reduction from 2002 onwards, halving poverty headcount during the 2002-2007 period. Moreover, the present study investigates whether there have been any specific socio-economic pattern in the large welfare change experienced in Bolivia during the present decade and the paper tries to assess which groups have benefited the most, whether the welfare growth has been pro-poor and how the indigenous population, over-represented among the poorest segments of the society, has fared.

The second paper provides an assessment of the poverty and distributional impact of soaring food prices in Bolivia between 2005 and 2008. When trying to determine the social welfare effects of a price increase, information about the specific net production and consumption position of the household is needed. Price increase might affect households in different ways: If a household is net seller an increase in price might results in larger profits from its sales; if a household is engaged in subsistence farming, it will not take advantage of the potential higher profits but, on the other hand, he will not be directly affected by the price increase occurring at the market because he is, simply, not involved in the market. Finally, a non farmer

household will be directly affected by the price increase but his income might be highly correlated to the agricultural ones so that, although not directly benefiting from the price increase, positive externality may raise. The overall welfare impact is an empirical matter. Using the 2005 Bolivian household survey, 'Encuesta de Hogares 2005', a methodology based on Deaton (1989) is implemented to conduct a series of simulations of the welfare and poverty impact. By calculating the net benefit ratio, using a definition of food that aggregates eight of the main components of the peculiar Bolivian consumption and production patterns, the paper identifies where and how the main losses and benefits are distributed across household groups.

The results show that, on average, the welfare impact is significantly negative and poverty rises by 2.87 percentage points. However, high heterogeneity emerges across locations and expenditure quintiles. The poorest experiences the least adverse welfare impact. Largest losses pass through the price increase of rice, wheat and sugar while the poorest also considerably benefit from the price increase of potato and maize.

The third paper looks at the impact of fiscal revenues from natural gas on municipalities' wellbeing. Between 2005 and 2008 Bolivian municipalities received an extraordinary large amount of fiscal resources, earmarked for investments health and education. The paper investigates whether this increase does actually translate into better education and health outcomes.

In order to do that a combined panel dataset spanning over eight years of data between 2001 and 2008 is constructed with 327 Bolivian municipalities being the units of observation. The model regresses aggregate municipal education and health MDG indicators (enrolment rate, completion rate, gender gap in primary and secondary school completion rate, proportion of children immunized against measles and proportion of births attended by skilled personnel) as a function of municipal per capita fiscal transfer from natural gas. The results suggest that no significant impact seems to occur at the municipal level and suggestive evidence on the potential "curse" effects of the rents from gas are discussed.

PAPER 1

Consumption Poverty and Pro-Poor Growth in Bolivia (1999-2007)

1.1 Introduction

Bolivia is one of the poorest countries in Latin America and has one of the highest levels of inequality. The United Nations Development Program (UNDP) ranked Bolivia 111th (out of 179 countries) on its Human Development Index.[1] Bolivia exhibits a high level of inequality with a Gini index of 60.1 and by Latin American standards, life expectancy at birth is low - 65 years in Bolivia compared with and 73 years in the Latin American region; infant mortality is high - 55 per 1,000 live births versus a regional average of 22.

Although Bolivia is one of the poorest countries in the world, there has been scant attention paid to Bolivian poverty within the research network. Existing literature indicates that the declining poverty trend in the 1990s reversed during the first years of the present decade although the more recent developments have not been analysed yet. However, the extraordinary political, economic and social changes experienced in Bolivia over the last years (such as Morales' election, his proclaimed commitment to eradicate poverty and redistribute resources, the nationalisation of Bolivia's hydrocarbon reserves and the boom in natural gas price and fiscal revenues, the internal ethnic and regional tensions, etc.) and the availability of recent and good quality household data are a strong incentive to research on poverty and related issues. The only available data on the trends in poverty during the present decade are the official statistical poverty calculations computed by the INE (National Statistics Office) and UDAPE (Economic Policy Analysis Unit). They use income as indicator of wellbeing and they show that there has been a significant negative shock in 1999 with poverty headcount increasing by 5 percentage points. In 2000, an even larger poverty change occurred that led the headcount poverty measure to decrease by more than 6 percentage points. From 2001 onwards, poverty exhibited quite stable patterns with a modest decreasing trend from 2002. Unfortunately, there is no alternative literature on the very recent trends in poverty. However, being able to compare these results with alternative sources and methodologies is extremely

[1] UNDP, Human Development Report 2008.

important in order to validate them. This is even truer considering that the literature on poverty analysis in developing countries has shown the shortcomings using income as an indicator of welfare. In fact, there is a wide agreement on expenditure being a better indicator of welfare than income (Deaton, 1997).

No previous study investigates what happened to households' consumption decisions or what the poverty story would be using consumption rather than income. Previous studies focus on income as a welfare indicator or wellbeing and neglect consumption. The aim of the present work is to fill this gap in the literature and to present a very different story on the recent Bolivian poverty trend. Using seven Bolivian household surveys conducted between 1999 and 2007, consistent and accurate estimates of consumption are computed and used to create poverty profiles. Challenging the previous income-based poverty trend, this study shows that Bolivia experienced a very large poverty reduction from 2002 onwards, halving poverty headcount during the 2002-2007 period. Moreover, the present study investigates whether there have been any specific socio-economic pattern in the large welfare change experienced in Bolivia during the present decade. Many social, political and economic shocks occurred in the present decade that affected welfare changes across regions and social groups and the paper tries to assess which groups have benefited the most, whether the welfare growth has been pro-poor and how the indigenous population, over-represented among the poorest segments of the society, has fared.

The paper is organized as follows. Sections 2 and 3 review the literature on poverty in Bolivia and examine theoretical arguments in favour of consumption as a better measure of welfare in developing countries. Section 4 defines the concept and the computation of consumption data employed for the present study. Section 5 presents summary statistics on the consumption. Section 6 focuses on the trend in durable goods which are not included in the definition of consumption applied in this paper, but provide interesting insights on households' investment behaviours. Section 7 constructs consumption figures and presents consumption-based poverty profiles, while Section 8 compares the consumption-based poverty profile with the income-

based one. Section 9 tests the robustness of the results by comparing the survey-based consumption data with National Accounts data. Section 10 tests the sensitivity of the poverty lines using poverty dominance analysis. Section 11 analyses correlations of poverty – containing data description, estimation results and tests of welfare change over time, the differences between indigenous and non-indigenous population and to what extent Bolivia experienced pro-poor growth. Section 12 sums up the main results of the study.

1.2 Literature Review on Poverty in Bolivia

Although Bolivia is one of the poorest countries in the world, there has been scant attention paid to Bolivian poverty within the research network. Partly, this is due to scarce data availability and comparability. Nationally representative household surveys with income and expenditure information are only available from 1997 onwards[2]. Prior to 1997, there have been income surveys for departmental capitals going back to 1989, and some spotty survey information from urban areas; therefore, rural and Peri-urban areas where almost half of the population live, were excluded from these surveys. In addition, there are three national censuses (1976, 1992, and 2001) and four nationally representative Demographic and Health Surveys (DHS in 1989, 1994, 1998 and 2003), but none of which contains income information. These surveys present serious limitations in terms of comparability - changes over time in the questionnaires make comparison of even basic socio-economic variables like income and education difficult; moreover, surveys before 1999 did not capture household expenditures.

[2] The 1997 survey is also not comparable to later surveys so that consistent national time series data is only available from 1999.

However, since 1999, the World Bank, through the MECOVI program[3], has supported the National Statistics Office (INE) with the development of nationally representative annual household surveys that have significantly improved the comparability of data for poverty monitoring and analysis[4]. Despite that, specific and comprehensive studies on the dynamics of poverty are simply missing; most of the poverty figures available, at least to the author's knowledge, are derived from studies whose focus is on growth analysis[5]. Furthermore, even the few existing works on Bolivia poverty only cover the period up to the late 1990s.

As a result of the lack of available data and different methodological solutions employed to overcome the data limitations, there have been considerable disagreements about the historical trends in poverty in Bolivia[6]. Nevertheless, most of the studies agree on the following three stylized facts: first, in the late 1990s, poverty is much higher in rural than urban areas; second, there was some decline in poverty in capital cities since 1989 with an upturn in poverty again after 1997; third, non-income measures of poverty have declined more sharply than those measured by income throughout the 1990s, particularly in urban areas. Thiele (2001) provides a comprehensive review of the early literature covering studies up to the late 90s.

Another comprehensive study on poverty was carried by World Bank (World Bank, 2005b). The report collects data and studies on poverty, based on different monetary and non-monetary welfare indicators. In general terms, the report shows that monetary poverty measures improved during the growth episode in the 1990s which led to a decline in income-measured poverty from 52% in 1993 to 46% in 1999, while

[3] MECOVI is a Spanish acronym for: "Mejoramiento de las Encuestas de Hogares y la Medición de Condiciones de Vida" -Improving Household Surveys and Measurement of Living Conditions.

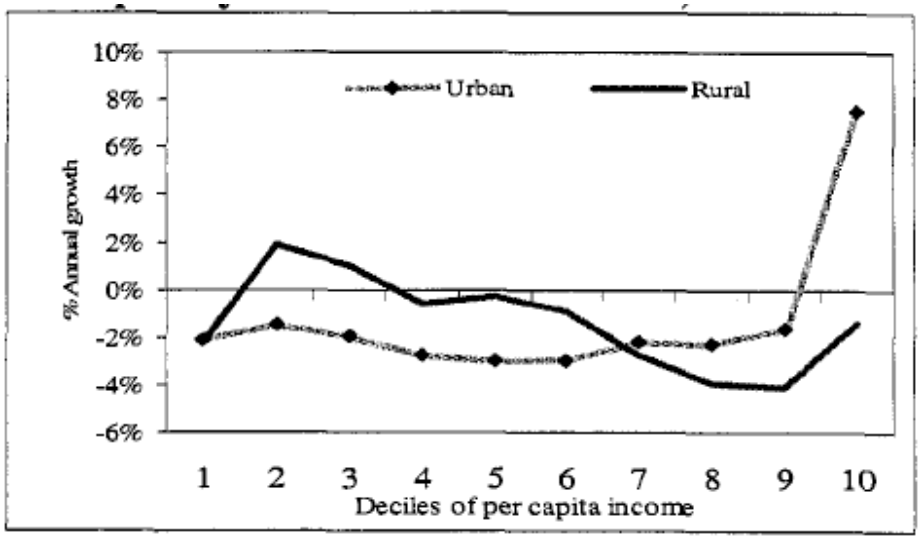
[4] The first MECOVI Survey of Living Conditions with national coverage was carried out in November/December 1999. Three more surveys were conducted annually from 2000 to 2002 and three more from 2005 to 2007 for a nationally representative sample of households. They were also carried out in November/December, to ensure comparability. In 2003, INE introduced a new sample design and a new questionnaire for the MECOVI survey program with a view to overcoming the shortcomings of previous MECOVI surveys. The 5th MECOVI survey was dubbed the Continuous Household Survey (CHS) (Encuesta de Hogares, ECH). The CHS differs from the other MECOVI surveys in terms of design, questionnaire and coverage.

[5] Mainly studies that analyse the impact of macro variables (economic growth, employment, price shocks) on poverty. See later this paragraph for review of the relevant literature.

[6] See Thiele (2001) and Klasen *et al.* (2004).

the fraction of the population in extreme poverty decreased from 24% to 21%. The earlier improvement in poverty has reversed since 1999. By 2002 poverty levels in the capital cities went back to the level of the early 1990s. Rural poverty, particularly extreme rural poverty, showed an upward trend between 1999 and 2002. Official poverty rates that rely on household expenditures for rural areas showed a slight increase in total rural poverty, and a two percentage-points decline in extreme rural poverty. The negative impacts on household incomes have been uneven. Figure 1 shows the change experienced by households between 1999 and 2002 disaggregated by income deciles and area. Real income per capita fell by two-percentage points per year for urban households throughout all the income distribution (except for the richest deciles). For rural households, it improved slightly for the poorer half of households and shows a decline of 2-3 percent per year for the upper deciles.

Figure 1.1: Change in household income per capita by income decile and area, 1999-2002



Source: World Bank (2005b)

A complementary approach to income (expenditure) poverty measure is to compute the number or percentage of individuals with unsatisfied basic needs (UBN). The Unsatisfied Basic Needs Index takes into account living conditions, access to basic

social services, such as health, education, etc. The national index shows a declining trend of poverty between 1992 and 2001, although huge discrepancies exist between rural and urban areas. In some rural areas in 2001, 91% of the population continued to suffer from unsatisfied basic needs.

The World Bank report (2005b) also describes results of a study on the determinants of Bolivians' subjective perceptions of wellbeing. The study finds that subjective poverty perceptions in Bolivia are consistent with income metrics and lead to similar conclusions on who the poor are and the main determinants of poverty. Employment, education, access to assets and basic services, ethnicity and location are core determinants of both income poverty and self-rated poverty. Bolivians tend to have a greater likelihood of falling into income poverty or to consider themselves poor if they are young, have low level of education, are unemployed or underemployed, have an indigenous heritage, live in rural areas, lack access to basic services.

Table 1.1: Poverty according to Unsatisfied Basic Needs (% of individuals)

	1992			**2001**		
	National	**Urban**	**Rural**	**National**	**Urban**	**Rural**
Overall Index	**70.9**	**53.1**	**95.3**	**58.6**	**39**	**90.8**
Housing Materials	48.2	22.5	83.6	39.6	15.6	75.7
Housing Crowding	80	76.3	85.1	70.8	68.9	76.3
Sanitary Services	75.9	60	97.6	58	44.3	78.9
Energy Services	51.8	21.2	93.8	43.7	14.1	91.2
Education	69.1	53.9	90.1	52.5	36.5	70.9
Healthcare	53.6	44.2	66.6	37.9	31	54.5

Source: World Bank 2005b

An interesting contribution to the literature on poverty in Bolivia is Klasen *et al.* (2004). The paper investigates the extent to which Bolivia has been able to achieve pro-poor growth and the results are very much in line with the poverty dynamics

described by the World Bank report. The paper uses consumption in rural areas and income in capital cities and towns as the welfare measure as incomes in rural areas are implausibly low (about 25% lower than consumption with many households reported extremely low incomes).[7] It finds that there is a big difference in poverty levels between capital cities, towns, and rural areas, with the latter at a much higher level. It also finds that poverty measured by the headcount or the poverty gap measure declines considerably between 1989 and 1999 and then increases again between 1999 and 2002. The authors also employ an alternative methodology, generating an asset index, as a proxy for income, using DHS (Demographic and Health Surveys) for 1994 and 1998, and that largely confirms the findings above for the time period 1994 to 1998, but with some slightly different nuances.

Barja *et al.* (2004) provides some interesting figures on poverty. Although the paper's main objective is to evaluate the short-term impacts on poverty of pro-poor expenditure and total social expenditure during the 1999-2002, it also provides the only consumption-based poverty profile.[8] The paper uses data on consumption based on 1999 household survey[9] and adopts poverty lines computed by UDAPSO (1995)[10] to compute poverty indicators. The adjusted headcount ratio at the national

[7] For the purposes of this study, the authors employ two alternative methodologies to generate national poverty data and poverty profiles for the time prior to 1997. The first uses information from the DHS (Demographic and Health Surveys) to generate an asset index for 1994 and 1998 as a proxy for income following proposals from Sahn and Stiefel (2003) and Pritchett and Filmer (2001). The second combines information from the urban household surveys with the DHS to generate income and poverty information for the entire country from 1989 to 2002. The poverty lines used here are based a regionally differentiated basket of goods that allows sufficient caloric consumption which has been updated using local price data on these goods. The extreme poverty line is derived by just allowing for enough caloric consumption while the moderate poverty line also makes allowance for non-food items.

[8] To my knowledge, this consumption-based poverty profile is the only one available in the literature on Bolivian poverty.

[9] Definition of consumption used: in the filtering process, all expenditures that are not frequent like legal fees, home repairs and improvements, taxes, expenditures on social ceremonies (e.g. marriages, births, etc.) are dropped. Furthermore, all purchases of financial assets, as well as amortization of debt and interest payments are also excluded from aggregate consumption. Two other items not included are gifts and transfers, given their inclusion in the household that acts as a recipient. Finally, some special items like health expenditures (e.g. hospital and medicines) are also excluded.

[10] As a reference the urban poverty line is 328.1 bolivianos per capita monthly (54.4 US$), the rural poverty line is 233.6 bolivianos per capita monthly (40.1 US$) and the national poverty line is 293.1 bolivianos per capita monthly (50.4 US$).

level indicates that 41.4% of Bolivian households were poor in 1999.This indicator changes dramatically when comparing urban (23.7%) with rural areas (71.5%).

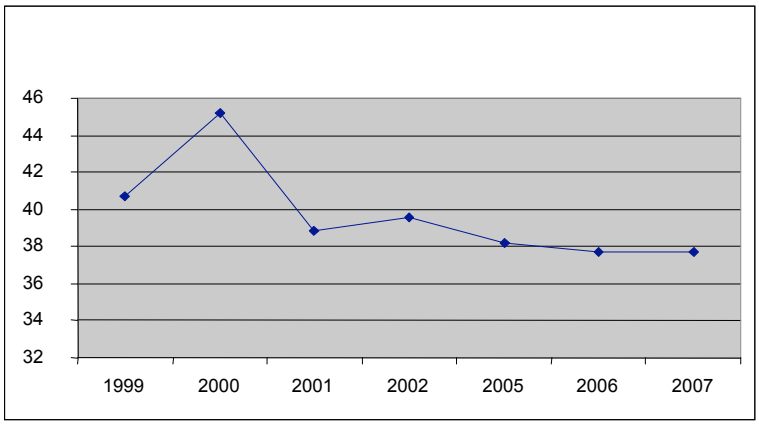
The adjusted poverty gap at the national level indicates that the poor households have a mean shortfall of 39.8% of the poverty line value and require on average an additional per capita consumption of 116.5 bolivianos per month to overcome their poverty condition. This indicator also shows large differences when comparing the depth of poverty between urban (24.6%) with rural areas (48.4%). The adjusted intensity or severity of poverty at the national level indicates an average of 37.8% degree of inequality among poor households. The severity of poverty is greater in rural areas than urban areas, reflecting less inequality between poor people in urban areas and more in rural areas.

Jemio and Choque (2006) analyse pro-poor economic growth in Bolivia and find that despite the fact that Bolivia experienced a relatively long period of economic growth during the 1990s, growth was relatively modest in those sectors where the poor are employed (agriculture, micro and small enterprises). Those sectors where the bulk of employment is concentrated presented the lowest growth rates, labour productivity and real incomes and therefore income-based poverty measures did not improve. Agricultural workers (39.3% of the total employment at the national level) presented 81.7% of poverty incidence in terms of income levels. Urban activities employing most of the urban labour force, (manufacturing, construction, commerce and other services), also were affected by high poverty levels.

From the literature it emerges that the declining poverty trend in the 1990s reverses during the first years of the present decade. There is no study to analyse what happened after that. However, the extraordinary political, economic and social changes have happened in Bolivia in the last years and the availability of recent household data provide strong incentives to conduct research on poverty and related issues. The only information available on the trends in poverty during the present decade is the official statistical poverty calculations computed by the INE (National Statistics Office) and UDAPE (Economic Policy Analysis Unit).

The data are based on household surveys from 1999 to 2007. However, the definition and measurement of poverty have not been very consistent throughout the years: from 1999 to 2002 poverty is computed using income for urban households and expenditure for rural households. From 2005 onwards, the indicator used for the entire population is income. However, INE and UDAPE also provide estimates of the headcount poverty measures based on the income definition for the whole period considered, see Figure 2.

Figure1.2: Official headcount poverty measures (income definition), percentage



Source: UDAPE, INE

In line with the literature presented above, the results exhibit a significant negative shock in 1999 with an increase in the poverty headcount of five-percentage points. In 2000, an even larger poverty change occurred that led the headcount poverty measure to decrease by more than six-percentage points. From 2001 onwards, poverty exhibits quite stable patterns with a modest decreasing trend from 2002. Unfortunately, there is no alternative literature on the very recent trends in poverty. However, being able to compare these results with alternative sources and methodologies is extremely important in order to validate them. This is even truer given that the literature on poverty analysis in developing countries has widely shown the shortfalls of using income as an indicator of welfare. In fact, there is a wide agreement on expenditure being a better indicator of welfare than income (Deaton, 1997).

1.3. Income versus Consumption

Researchers have intensively debated on the strengths and weaknesses of different welfare indicators with a quite clear consensus on favouring consumption over income. First of all, families and individuals derive material well-being from the actual consumption of goods and services rather than from the receipt of income *per se* [11]. Deaton and Zaidi (2002) argue that consumption better reflects long-term income as it is not closely tied to short-term fluctuations in income and is smoother and less variable than income.

As a result, if life-cycle models hold a person's consumption at any age is proportional to his or her lifetime resources so that measuring consumption is not only useful in its own right but also provides an indicator of lifetime welfare. However, as Deaton and Grosh[12] claim, "the evidence for this hypothesis is controversial to say the least; for many people, the promise of resources in the future may do little to pay the bills today". If lifetime is too long a reference period, "there is evidence that people can smooth their incomes within a particular year and perhaps over a series of years, so that consumption reflect at least living standards throughout the year and perhaps even over a series of years"[13]. While conceptual arguments generally favour consumption over income as a measure of well-being, practical matters related to the nature of the available data are equally relevant. Both income and consumption are usually based on data from national household surveys that collect information on the socio-economic condition of a sample of households. Collecting data on expenditure is usually very time consuming. Households are asked to report the total expenditure on goods and services which results in gathering information on hundreds of items. However, the concept of expenditure is usually clear while income, especially computation of income from self-employment, is not always so. Income is more straightforwardly collected, at least in developed countries or in those situations

[11] Johnson (2004:2).
[12] Deaton and Grosh (1999**:** 4).
[13] Deaton and Grosh (1999:4).

where there are only few and stable sources of income. Calculating income from self-employment appears to be quite difficult. This is particularly true for agriculture and small businesses where it is difficult to separate business transactions from those of consumption.

Furthermore, income is more likely to be affected by seasonal patterns, especially in agriculture resulting either underestimation or overestimation of real income. Multiple seasonal visits to the respondents would be necessary to account for seasonal variability, a rare praxis given the costs involved. If consumption is smoothed over the seasons, then it appears to better reflect (or approximate) the real living standard. Moreover, income is likely to be a more sensitive issue for respondents than consumption. People may be reluctant to share information about their income and assets. In developing countries' context this is even more pronounced given that, as suggested in Deaton and Grosh (1996), most of the surveys are conducted of necessity in semi-public places, where respondents might be even more reluctant to share information about their wealth in front of relatives or others. There is some evidence that failure to respond is positively correlated to socio-economic status: well-off people are less likely to participate in the survey or to respond.[14] This might bias the results in a way that underestimates income inequality among the population.

[14] See Deaton (2005) and Groves and Couper (1998) as cited in Deaton (2005).

1.4. How to Measure Consumption

Measuring consumption is quite a difficult task[15]. Consumption includes several components: all the individual expenditure on goods and services, a value for consumption that does not go through the market (home production, transfer in kind, etc.) and a value for durable goods possessed. For the latter some sort of consumption flow needs to be imputed.

There is an important distinction to make between consumption and expenditure – the former includes the value of service flows from durable items and assets (such as home, vehicles, washing machine, computers, etc.) whereas the latter includes current expenses on the purchase of these items. Theoretically, consumption is preferable to expenditure as it better reflects material resources, although in practice estimating the value of service flows involves crucial assumptions (such as definition of durable good, depreciation rate of different items, etc.).[16] The methods adopted to construct consumption measures significantly vary among countries and over time. Most of the choices involved with the measurement of consumption are usually driven by data availability or by comparability over time within a country. There exist, however, good practice techniques and guidelines which one could look at when trying to construct an accurate measure of consumption.[17]

Total household consumption expenditure should comprise: food consumption, non food consumption, education expenditure and housing expenditure. In revising the method adopted by the Bolivian National Institute of Statistics (INE), it emerged, however, that the computation of the total consumption expenditure was not clear and consistent[18]. However, from 2005 onwards INE includes in the consumption aggregate only the current expenditure thus excluding the value of service flows of

[15] For literature on how to estimate consumption from expenditure surveys see Kay, Keen and Morris (1984) and Johnson (2004).
[16] The definition of consumption used in the present work excluded the durables.
[17] See Deaton and Zaidi (1999) and ILO (2003).
[18] In the period of 1999-2002, total expenditure includes a not clearly defined imputation of having some assets inside the house such as beds, TV, microwave oven, etc. Information on the method used to impute such values (which items are included, how the service flows are computed, etc.) are not available.

durables. Moreover, in computing current expenditure, durable goods and expenditures made in house repair and construction that are above a certain threshold (equal to 2005 US$ 100, or approximately Bs. 800 in local currency) are excluded because they are regarded as investment rather than consumption.

As a result, a lack of consistency in the definition and construction of consumption aggregates provided by the INE is apparent and that simply prevents one from comparing those figures over time. Aware of that, the only feasible option for conducting sound research using consumption data is devoting intense effort to create original, consistent, accurate consumption estimates. This task, although very time consuming, represents a notable and original contribution of the present study to the literature on Bolivia[19].

To estimate consumption figures the following components have been aggregated:

Food consumption inside the household (food purchases, self-produced food, food from other sources-such as gifts, transfers in kind) [20]

- Food consumed outside the household (breakfast, drinks, lunch/dinner, snacks,..)
- Non-food consumption (aggregate of about 40 categories related to current housing costs, domestic fuel and power, tobacco products, clothing and footwear, medical care and health expenses, transport, recreation, personal care, miscellaneous goods and services[21])
- Education expenditure (tuition fees, transport, books and copies, uniform, etc.)
- Housing expenditure (actual rent or rental equivalence value, expenses- gas, water, electricity, telephone- house repair-decoration[22]).

[19] Appendix 2 describes in detail the steps taken to construct the consumption data employed in the present work.

[20] Data on the consumption of 64 food items were added up to get the household total food expenditure.

[21] With respect to the non-food components in the questionnaire (and to the official consumption estimate) the present work does not include the expenses in financial and capital services - such as mortgages, payment instalments - to avoid double counting of those expenses already reported elsewhere.

[22] Monthly expenditure in house repair-decoration above 100US$ were considered as investment rather than consumption and were not then included in the computation. The benchmark of 100US$

The computation has been done at the (per capita) household level. When the expenditure was reported at the individual level, the household aggregate has been computed and the per capita mean has then been obtained dividing the household figure by the household size. As respondents are allowed for some modules to answer either in US dollars or Bolivianos (LCU), all the values in US dollars have been converted into real Bolivianos. The exchange rates used are the ones of the month during which the survey was conducted (usually November-December)[23]. The length of the recall period varies throughout the modules and the items considered[24]. All the figures have been converted to get monthly figures. With regard to missing values, the imputation has been done only when the respondent reports to consume a good but doesn't then report the amount actually spent. In those cases, the amount spent is imputed using the rural/urban mean (rural and urban means exhibit very large gaps) but there still remains some missing data[25].

The definition of consumption used in the present work excluded the durables. However, a separate exercise to compute the stock of durables and the current expenditure in durable goods have been done to provide a insight into the household's investment patterns over the time considered. Further discussion on the computation and analysis of durable goods is provided in section six.

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was indicated by the INE and deflated by inflation rate, taken from WDI. As respondents are allowed to answer either in Dollars or Bolivianos, the value has been converted into real Bolivianos. The exchange rates used are from INE and I use the monthly rate reported for the month during which the survey was conducted (usually November-December).

[23] Data on exchange rates are taken from INE.

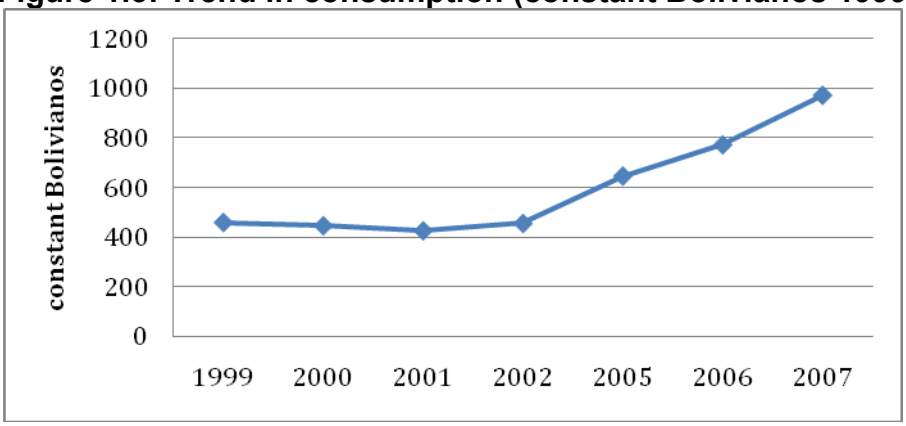
[24] Monthly recall period for the modules "food inside the home" and "food away from home". Depending on the variables, the education module includes monthly and annual recall periods; the non food module uses monthly, three months and annual recall periods; the housing module uses monthly and annual recall periods.

[25] Distinguishing between those missing values who are missing by definition and those who should have an imputed value is almost impossible. Mostly, respondents are asked just to report the expenditure of an item. The missing value might then be either a "zero" value (no consumption of it) or a true missing value (cannot answer, doesn't remember how much he spends, etc.). Just in few cases, the respondent is asked to specify both whether he consumes the item and the amount of money. I proceed with imputation only in those cases. See annex for details.

1.5. Descriptive Statistics of Consumption

Figure 3 reports the average consumption estimates in real terms, obtained by deflating the nominal averages computed from the surveys by the general CPI. A modest decline in consumption occurs during the first three years considered. Thereafter, an extraordinary increase in consumption clearly emerges. Consumption more than doubled during the period considered, with an average annual growth rate of 10 per cent.

Figure 1.3: Trend in consumption (constant Bolivianos 1999-2007)



Source: Author's own calculation based on surveys

The decomposition of the aggregates into the consumption components reported in Table 2 provides interesting insights. All the sub-categories exhibit a trend similar to the general estimates: the average figures slightly decline over the first years and they then increase from 2002 onwards. Over the period considered the figures almost double for non-food consumption, education and housing expenditure. For food consumption (both at home and away from home) the increase is even higher.

Table 3 reports the budget shares of each component. It shows a quite stable picture. Non-food expenditure accounts for about 20% of total consumption. Education consumption slightly declines over the period, with a budget share of 5-6% with the lowest share in 2007. Housing consumption accounts for 22-25% and remains quite stable over time. Food consumption is the most important component

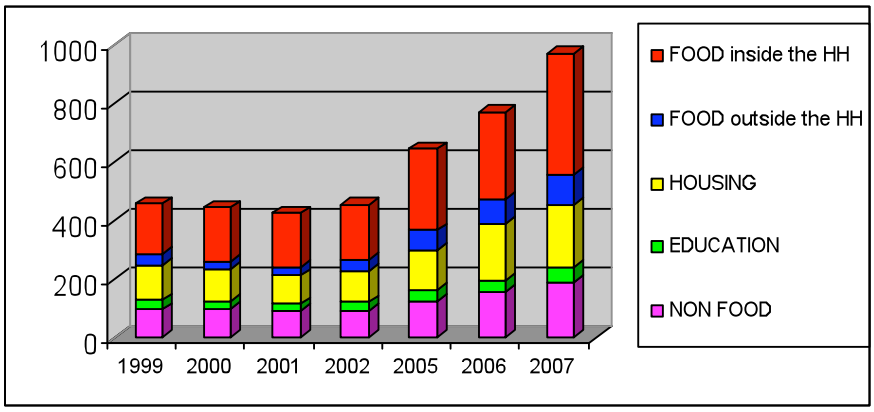
of households' total consumption and the only sub-category that reveals an increasing share over time passing from about 46% (both food at home and away from home) to 53%.

Table 1.2: Decomposition of total expenditure estimates (average constant Bolivianos using general CPI) 1999-2007

Variable	1999	2000	2001	2002	2005	2006	2007
NON FOOD	95.39	97.22	90.21	92.55	124.42	155.43	187.38
EDUCATION	32.80	29.52	25.29	29.13	38.96	42.80	52.06
HOUSING	118.33	107.36	96.10	105.33	138.01	191.49	213.94
FOOD outside the HH	39.87	28.46	31.40	41.27	65.31	83.36	103.84
FOOD inside the HH	172.05	183.11	182.91	186.38	278.70	298.34	412.93
TOTAL CONSUMPTION	458.44	445.66	425.03	454.66	645.40	770.76	970.14

Source: Author's own calculation based on surveys

Figure 1.4: Trend in consumption 1999-2007 (constant Bolivianos)



Source: Author's own calculation based on surveys

This exercise might provide us some hints to better understand households expenditure trend: food expenditure accounts for most of the increase in total expenditure. Some of the food expenditure increase, however, could be biased by the "unusual situation" described in Mukherjee and Chatterjee (1974). The sharp increase in food prices experienced in those years might have affected households'

perception of prices, resulting in an upward bias in the reporting of prices and expenditure[26].

Table 1.3: Decomposition of total expenditure estimates

	1999	2000	2001	2002	2005	2006	2007
NON FOOD	20.81	21.82	21.22	20.36	19.28	20.17	19.31
EDUCATION	7.16	6.62	5.95	6.41	6.04	5.55	5.37
HOUSING	25.81	24.09	22.61	23.17	21.38	24.85	22.05
FOOD away from home	8.70	6.39	7.39	9.08	10.12	10.82	10.70
FOOD at home	37.53	41.09	43.03	40.99	43.18	38.71	42.56
TOTAL CONSUMPTION	100	100	100	100	100	100	100

Source: Author's own calculation based on surveys

1.6. Descriptive Statistics on Durable Expenditure

The Bolivian household surveys contain a module on durable goods. In this section, households are asked about the amount and value of the durable goods they have. Households report whether they own any durable good (such as TV, radio, PC, bicycle, motorbike, car, kitchen, fridge, washing machine, wardrobe, etc.), how many, how long ago they were bought, how much they spent when they bought them and how much they think they could now sell them for. The latter is a good proxy of the present value of the good and it is therefore used to compute the aggregate value of durables owned by the household.

The total stock of durables is computed, summing up the imputed values per each item and, to find out the household's "investment" decision year by year, the current

[26] If this theory holds, then non-food consumption should be upward biased as well, due to the high increase in oil prices. Not a significant increase, though, seems to occur there.

(last year) expenditure in durables (or the imputed value when the purchase cost was not reported) is also calculated.[27]

Table 4 and Figures 5-6 describe the present values of durables. The first row reports the per capita value of all the durables owned by the household from 1999 to 2007. The total figures are decomposed to highlight the present value of goods purchased during the previous 12 months, which represents the current expenditure in durables. The figures on durables' levels are converted in real terms and growth rates calculated to describe the overall trend.

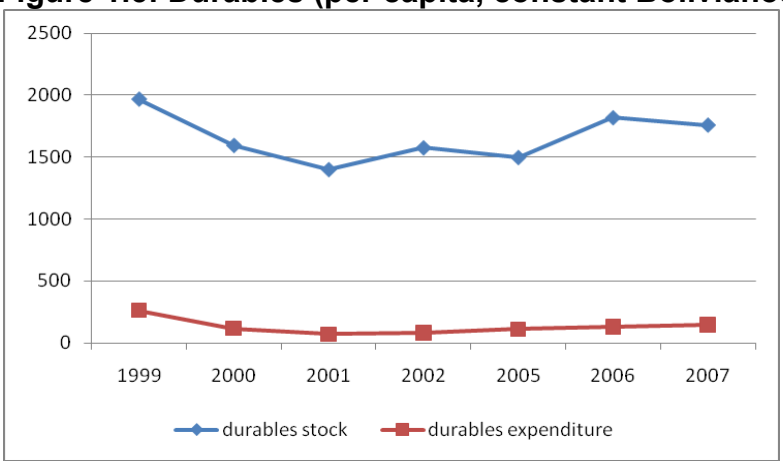
Table 1.4: Durables stock and expenditure

DURABLE GOODS real	1999	2000	2001	2002	2005	2006	2007
Durables stock	1967.06	1595.53	1401.61	1576.33	1498.84	1817.71	1759.08
Durables expenditure	262.60	117.81	71.09	82.32	110.96	128.97	147.28
Stock growth rate		-18.89	-12.15	12.47	-4.92	21.27	-3.23
Expenditure growth rate		-55.14	-39.66	15.79	34.79	16.23	14.20

Source: Author's own calculation based on surveys

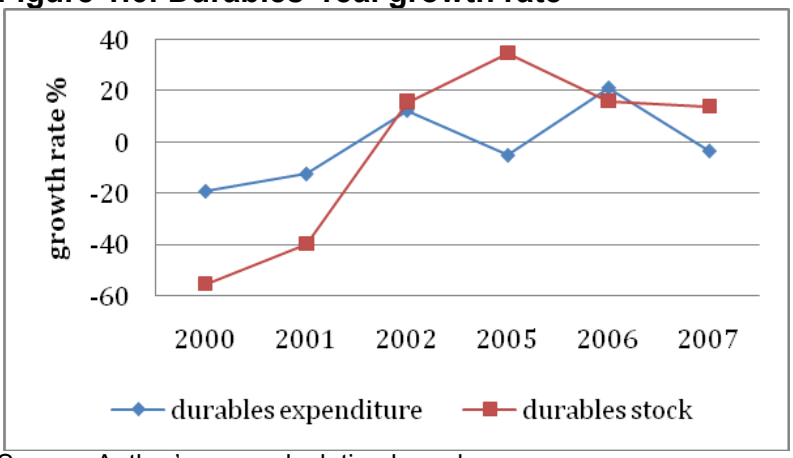
[27] The details on the construction of the variables used in the present paragraph are reported in Appendix 2.

Figure 1.5: Durables (per capita, constant Bolivianos)



Source: Author's own calculation based on surveys

Figure 1.6: Durables' real growth rate



Source: Author's own calculation based on surveys

A clear pattern in durables (both stock and expenditure) emerges during the period considered. A substantial reduction in durables occurs from 1999 to 2001 with expenditure dropping respectively by 55% in 2000 and 40% in 2001. From 2002 onwards durables growth rates are positive, with the only exception being a small negative rate for the durable stock in 2005. Particularly, current expenditure in durables grow significantly during the period 2002-2007, with an average 20% annual growth rate. Durable stocks also exhibit, on average, a positive but smaller trend during the period 2002-2007, with an average growth rate of six-percentage points. It is interesting to analyze how durable expenditure shifts over time with respect to

consumption expenditure. Does durable expenditure, seen as a proxy of investment, follow the general trend of consumption expenditure? What's the "investment" behaviour of households facing increasing or decreasing consumption levels?

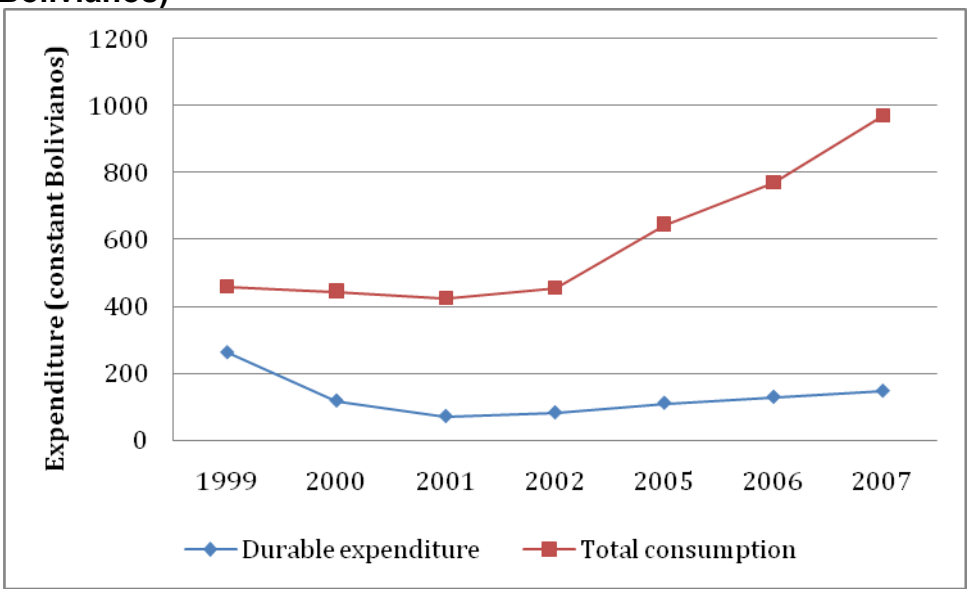
Table 5 and Figures 7-8 show that the trends in durable expenditure is very similar to the consumption one. The initial decline is followed by a constant positive growth from 2002 onwards. The two variables' growth rates exhibit an interesting pattern: the initial reduction in durables is much larger than the consumption one. Thereafter, durables' growth rates closely follow the consumption ones, with durables experiencing relatively smaller growth rates than consumption.

Table 1.5:Trends in durable expenditure and total consumption (real terms)

	1999	2000	2001	2002	2005	2006	2007
Durable expenditure	262.60	117.81	71.09	82.32	110.96	128.97	147.28
Total consumption	458.44	445.66	425.03	454.66	645.40	770.76	970.14
Durable expend growth rate		-55.14	-39.66	15.79	34.79	16.23	14.20
Total consumption growth rate		-2.79	-4.63	6.97	41.95	19.42	25.87

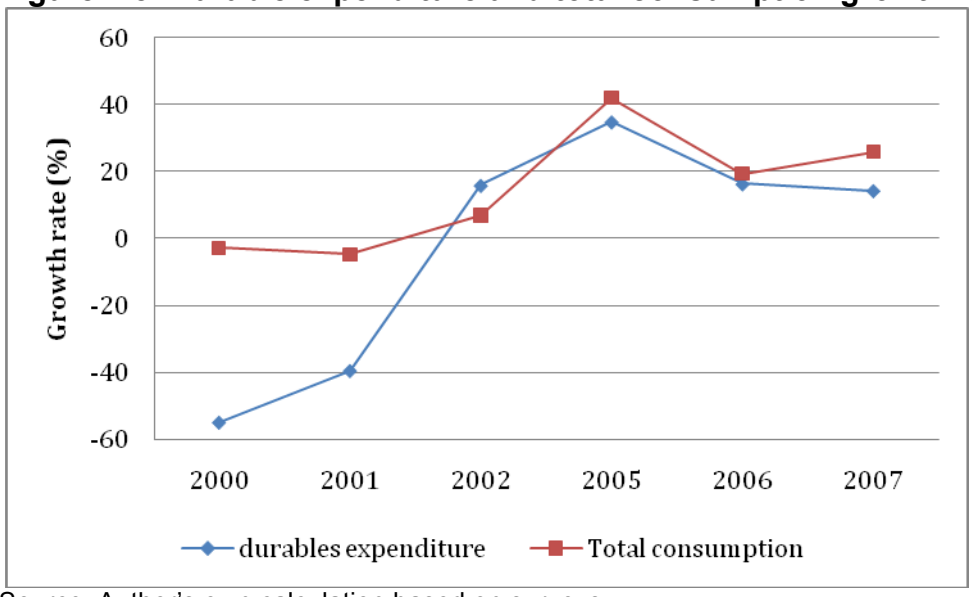
Source: own calculation based on surveys

Figure 1.7: Trends in durable and total consumption 1999-2007 (constant Bolivianos)



Source: Author's own calculation based on surveys

Figure 1.8: Durable expenditure and total consumption growth rate



Source: Author's own calculation based on surveys

1.7 Summary Statistics on Poverty

The concept of poverty is deeply embedded in the poverty literature as well as the conceptual and practical difficulties to measure it. In the context of measuring, consumption-based is more favourable than income-based (Deaton 2002). There much less agreement, however, on the definition of poverty and poverty lines. The definition and construction of a poverty line is a crucial step in a poverty measurement and many approaches have been adopted by the literature[28]. Poverty lines are used as the poverty thresholds to classify those households and individuals whose disposable consumption expenditures fall short as the poor.

In this work, the extreme poverty lines calculated by the Bolivian Statistical Institute are used as reported in Table 6. These poverty lines are based on the cost of basic

[28] See World Bank (2005) for methods and guidelines.

needs (CBN) method and are adjusted for differences in the cost of living across regions and between rural and urban areas[29].

Table 1.6:Poverty lines 1999-2007 (spatial adjusted lines based on CBN methods)

	Oct. 99	Dec. 2000	Oct-Nov. 2001	Nov-Dec. 2002	Nov-Dec 2005	Nov-Dec 2006	Nov-Dec 2007
RURAL	134.74	131.61	131.53	133.03	160.47	167.58	205.23
Sucre	169.39	169.45	168.29	169.48	194.17	211.22	261.00
La Paz	180.16	180.74	182.04	181.84	205.04	214.32	239.50
Cochabamba	177.31	177.37	176.16	177.40	194.17	211.22	261.00
Oruro	163.83	164.35	165.54	165.35	205.04	214.32	239.50
Potosí	150.68	151.16	152.25	152.08	205.04	214.32	239.50
Tarija	180.20	177.37	176.16	177.40	194.17	211.22	261.00
Santa Cruz	180.17	179.79	174.35	174.69	197.53	214.45	276.00
Trinidad	180.17	179.79	174.35	174.69	197.53	214.45	276.00
El Alto	164.12	163.13	164.81	165.20	181.83	190.20	225.20
Pando	180.17	179.79	174.35	174.70	197.53	214.45	276.00

Source: INE

Based on the lines described above, some poverty measures are computed to provide a profile of poverty in Bolivia. The three measures, defined by Foster, Greer and Thorbecke (1984), are the headcount ratio (or incidence of poverty), defined as the fraction of the population below the poverty line; the poverty gap index, to be

[29] Consumption baskets made up of basic food items that reflect the actual consumption patterns of low-income families are used to define poverty lines separately for rural and urban areas. The monetary value of the basic food basket is interchangeably called the food poverty line, extreme poverty line, or the indigent line. Addition of non-food consumption items yields the poverty line. Poverty lines were established separately for rural and urban areas, and for each Department. They were calculated from a priced basket of basic goods and services, obtained from the Household Budget Survey of 1990 (urban) and EVI-FIS survey of 1997 (rural). Auto-consumption and transfers in kind are valued by the price estimates of such products by respondents on the basis of market reference prices, in estimating the total household consumption. The poverty measures obtained using extreme poverty lines by INE are fairly close to the one obtained using the standard “dollar-a-day” expenditure-based measures of poverty. This is an important characteristic as it allows comparisons between the present study and other studies which use the dollar-a-day measure.

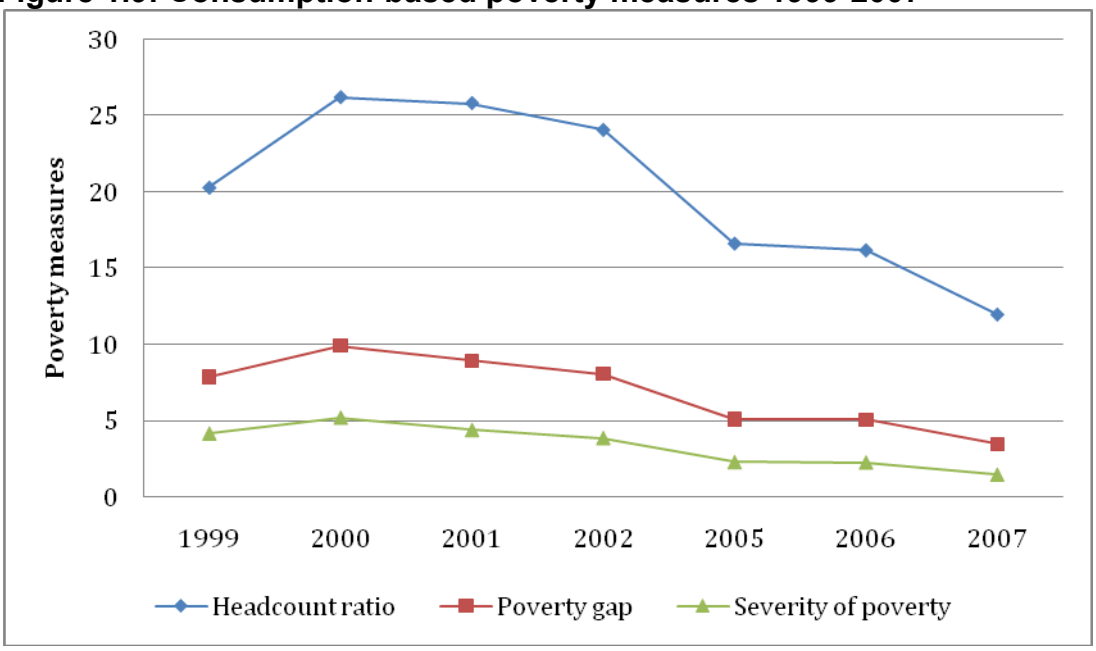
interpreted as a per capita measure of the total shortfall of individual welfare levels below the poverty line; and, the squared poverty gap (or index of severity of poverty) that takes into account not just the proportion of the poor households and the average income of the poor population, but the variance of income among the poor[30].

Table 1.7: Poverty measures, Bolivia 1999-2007 (%)

	1999	2000	2001	2002	2005	2006	2007
Headcount ratio	20.30	26.23	25.85	24.09	16.64	16.20	11.99
Poverty gap	7.91	9.95	8.98	8.10	5.11	5.08	3.49
Severity of poverty	4.17	5.20	4.40	3.88	2.31	2.28	1.48

Source: Author's own calculation based on surveys

Figure 1.9: Consumption-based poverty measures 1999-2007



Source: Author's own calculation based on surveys

The poverty measures exhibits interesting results: poverty increases significantly in 1999-2000 and starts decreasing thereafter. The poverty reduction is small during 2000-2002 but it accelerates thereafter. Surprisingly, the poverty reduction showed in

[30] The set of poverty measure is defined by $P_\alpha = (1/N) \sum [(z-x_i)/z]^\alpha$, where N is total population, z is poverty line, x_i is income of poor household i, and the summation is limited to poor households.

the consumption-based measures is so large that poverty headcount halves in 5 years time, passing from 24% in 2002 to 12% in 2007. The measures of depth and severity of poverty follow similar trends. An initial worsening of the measures from 1999 to 2000 is followed by a significant improvement that further intensifies from 2002. In 2007, both depth and severity of poverty exhibit the lowest score ever, thus denoting a clear improvement of those measures over time.

1.8. Comparison between Income and Consumption Poverty Measures

Within the literature on alternative measures of poverty there is considerable disagreement regarding whether using different welfare indicator affects trends in poverty. Many have argued that while the level of poverty varies significantly with different measures, the trends are generally quite similar.[31] In contrast, others provide evidence that some of these alternative measures follow distinct patterns.[32] Earlier work looking specifically at consumption-based measures of poverty suggests that changes in these measures differ from income-based poverty trends, but some recent work concludes otherwise.[33]

The trend of poverty in Bolivia is highly sensitive to the indicator of welfare in use. In fact, consumption and income tell quite a different story about poverty levels and speed of poverty reduction. The overall trend is vaguely similar: a strong increase in poverty between 1999 and 2000 and poverty decrease thereafter. However, the extraordinary large poverty reduction that emerges from the consumption-based measures is striking and there is no similar pattern in the income-based figures. Income-based poverty exhibits a significant decline in 2000 (a reduction of almost 14

[31] See Hoynes, Page and Stevens (2006), Lang (2007), Triest (1998), Short *et al.* (1999), and Dalaker (2005) for poverty comparison on US data; Zaidi and de Vos (2001) on EU.

[32] Meyer and Sullivan (2009).

[33] Cutler and Katz (1991) find that consumption poverty rose more than income poverty during the 1970s. Slesnick (2001) concludes that consumption poverty fell considerably more than income poverty from 1980 through 1995. Johnson (2004) also finds differences between consumption and income based poverty trends, while Bavier (2008) concludes they are similar.

percentage points) and remains quite stable thereafter or with modest yearly changes. If the entire period is considered, poverty headcount declines by 7-percentage points; although the decline is noticeable it is not comparable with the 40% reduction obtained using the consumption-based data.

Figure 10 suggests that, for the initial period considered, consumption simply responds smoothly to income shocks. The negative shock experienced by the Bolivian households between 1999 and 2000, that generates a large poverty increase, has been promptly absorbed from an income point of view while the consumption response is more gradual and cautious. However, this interpretation - consumption responding smoothly to income shocks- does not hold when one looks at the second part of the period considered. While income poverty is generally stable and no significant shock occurs from the income point of view, consumption poverty decreases very intensively with peaks of 26-30 percent reduction in 2005 and 2007. Income does not seem to play a role at all in consumption behaviours. Despite no significant improvement in their income, households spend more and the overall number of households below the poverty line decline.

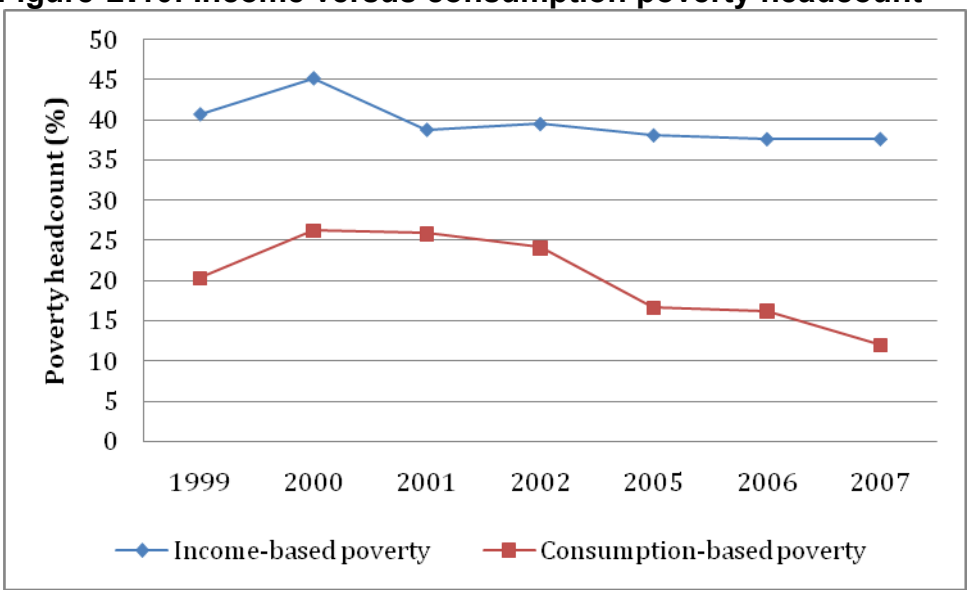
Table 1.8: Income versus Consumption based poverty headcount

Poverty headcount	1999	2000	2001	2002	2005	2006	2007
Income-based poverty	40.74	45.16	38.84	39.54	38.16	37.68	37.70
Consumption-based poverty	20.30	26.23	25.85	24.09	16.64	16.20	11.99

Source: Author's own calculation based on surveys

The other poverty measures considered poverty depth and severity, exhibit similar trends. While income-based levels are generally higher than the consumption ones, an overall improvement of the poverty measures occurs. Consumption-based reduction rates are also much larger than the income ones. The poverty gap more than halved in the period considered while income-based figures exhibit a reduction of 26%. The severity of poverty declines by more than 60% according to the consumption story and by 36% if income is used.

Figure 1.10: Income versus consumption poverty headcount



Source: Author's own calculation based on surveys

Table 1.9: Change in income and consumption-based poverty headcount

Change in poverty	1999-2000	2001-2000	2002-2001	2005-2002	2006-2005	2007-2006
Income poverty	10.84	-13.99	1.82	-3.49	-1.27	0.07
Consumption poverty	29.23	-1.45	-6.83	-30.91	-2.64	-26.03

Source: Author's own calculation based on surveys

Table 1.10:Income versus Consumption-based Poverty Gap and Squared poverty gap

	1999	2000	2001	2002	2005	2006	2007
Poverty gap							
Income	22.22	26.32	20.06	20.57	20.30	18.15	16.26
Consumption	7.91	9.95	8.98	8.10	5.11	5.08	3.49
Squared poverty gap							
Income	15.86	19.53	13.89	14.37	14.08	11.87	10.39
Consumption	4.17	5.20	4.40	3.88	2.31	2.28	1.48

Source: Author's own calculation based on surveys

1.9. Robustness Check: Survey-Based versus National Accounts Consumption Data

In order to gain confidence on the consumption figures obtained, this section compares the data based on national sample surveys with household consumption expenditure collected from the National Accounts (NAS).

Table 11 reports data from national accounts and compares national accounts' expenditure per capita with nominal expenditure per capita estimated from the national surveys. The figures of the national accounts are from the WDI and, specifically, the aggregate annual household final consumption expenditure in current local currency is used. In order to compare it to the mean per capita monthly expenditure levels from the surveys (which are in nominal terms), the annual final consumption expenditure is divided by the World Bank population estimates per each year. The surveys and NAS growth rate are also computed. The WDI defines the annual household final consumption expenditure (formerly private consumption) "as the market value of all goods and services, including durable products (such as cars, washing machines, and home computers), purchased by households. It excludes purchases of dwellings but includes imputed rent for owner-occupied dwellings. It also includes payments and fees to governments to obtain permits and licenses. Here, household consumption expenditure includes the expenditures of non-profit institutions serving households, even when reported separately by the country. Data are in current local currency. [34]

On average, the ratio of consumption surveys to NAS estimates is 1.17 with a range that goes from 1.05 in 2001 to 1.27 in 1999. Regarding the growth rates, with the exception of the figures for 2000-2001[35], a similar and positive consumption trend emerges. Consistently, NAS and surveys date reveal large and constant growth rates in consumption from 2002 onwards.

[34] WDI database (16-4-2009) Insert link and then Accessed on 'date'.

[35] Survey-based growth rates are negative but the trend is positive whereas in the NAS the figures are positive but the trend is decreasing.

Table 1.11: Per capita monthly household expenditure consumption from national accounts and surveys (Bolivianos)

BOLIVIA	1999	2000	2001	2002	2005	2006	2007
Survey-based expenditure	479.53	445.66	418.35	443.43	553.37	633.73	733.79
NAS-based expenditure	378.47	397.35	397.60	402.58	460.71	504.56	616.77
Ratio survey/NAS expenditure	1.27	1.12	1.05	1.10	1.20	1.26	1.19

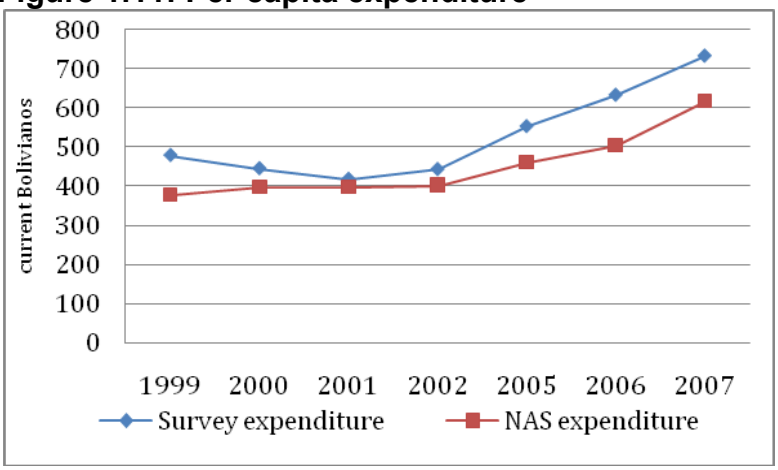
Source: WDI and author's own calculation from surveys

Table 1.12: NA and surveys expenditure growth rate (1999-2007)

Growth rate (%)	1999-2000	2000-2001	2001-2002	2002-2005	2005-2006	2006-2007
Survey expend. growth rate	-7.06	-6.13	5.99	24.79	14.52	15.79
NAS expend. growth rate	4.99	0.06	1.25	14.44	9.52	22.24

Source: WDI and author's own calculation from surveys

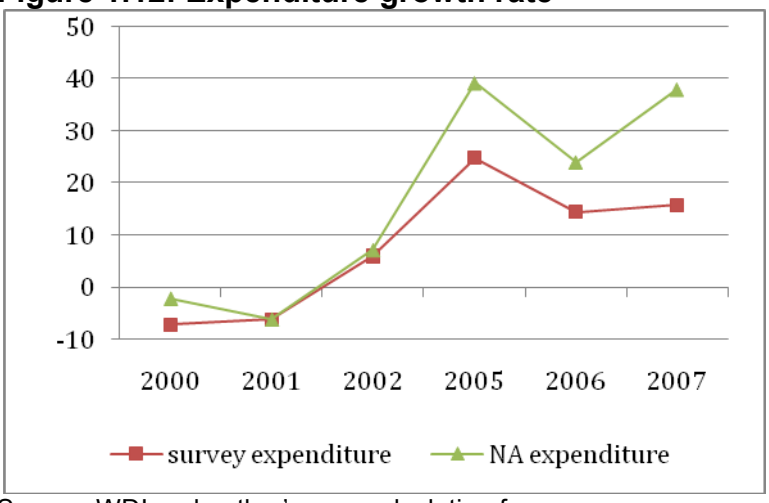
Figure 1.11: Per capita expenditure



Source: WDI and author's own calculation from surveys

NAS and surveys' consumption levels and growth rates do not perfectly match but some of the discrepancy might be due to the different nature of data and aggregation methods employed. Moreover, the graphs above show an extremely similar trend of consumption. Both sources reveal the extraordinary large increase in households' consumption from 2002 onwards. This exercise boosts confidence on the consumption data obtained from the surveys employed.

Figure 1.12: Expenditure growth rate



Source: WDI and author's own calculation from surveys

1.10. Robustness Check: Poverty Dominance Analysis

Having checked the robustness of the surveys data with the alternative source, the next step is to check the sensitivity of the results obtained to the poverty lines adopted. The peculiar poverty estimations obtained could, in fact, be driven by the poverty lines used which are constructed using the cost of basic needs method and are disaggregated at regional level. Poverty dominance analysis is particularly useful at this point as it allows abstracting from any specific poverty line and from any specific poverty measure without having to calculate each possible poverty measure for each possible poverty line. In order to assess the robustness of the poverty trend to the specific poverty lines, cumulative distribution functions (c.d.f.) are created by plotting the log of per capita expenditures on the horizontal axis and the cumulative probabilities on the vertical axis. Hence, the c.d.f. can be used to estimate the value of the headcount ratio, and by varying the poverty line, one can examine how the headcount ratio varies. In order to do that, the chosen indicator of welfare, i.e. per capita expenditure, has to be adjusted for spatial and temporal cost-of-living differences. To the extent that the poverty lines adopted are comparable in utility

terms (as in our case), then the ratio of the poverty line for region A to that of region B is an appropriate cost of living index. The computed cost of living indexes for the 7 years considered are reported in Table 15.

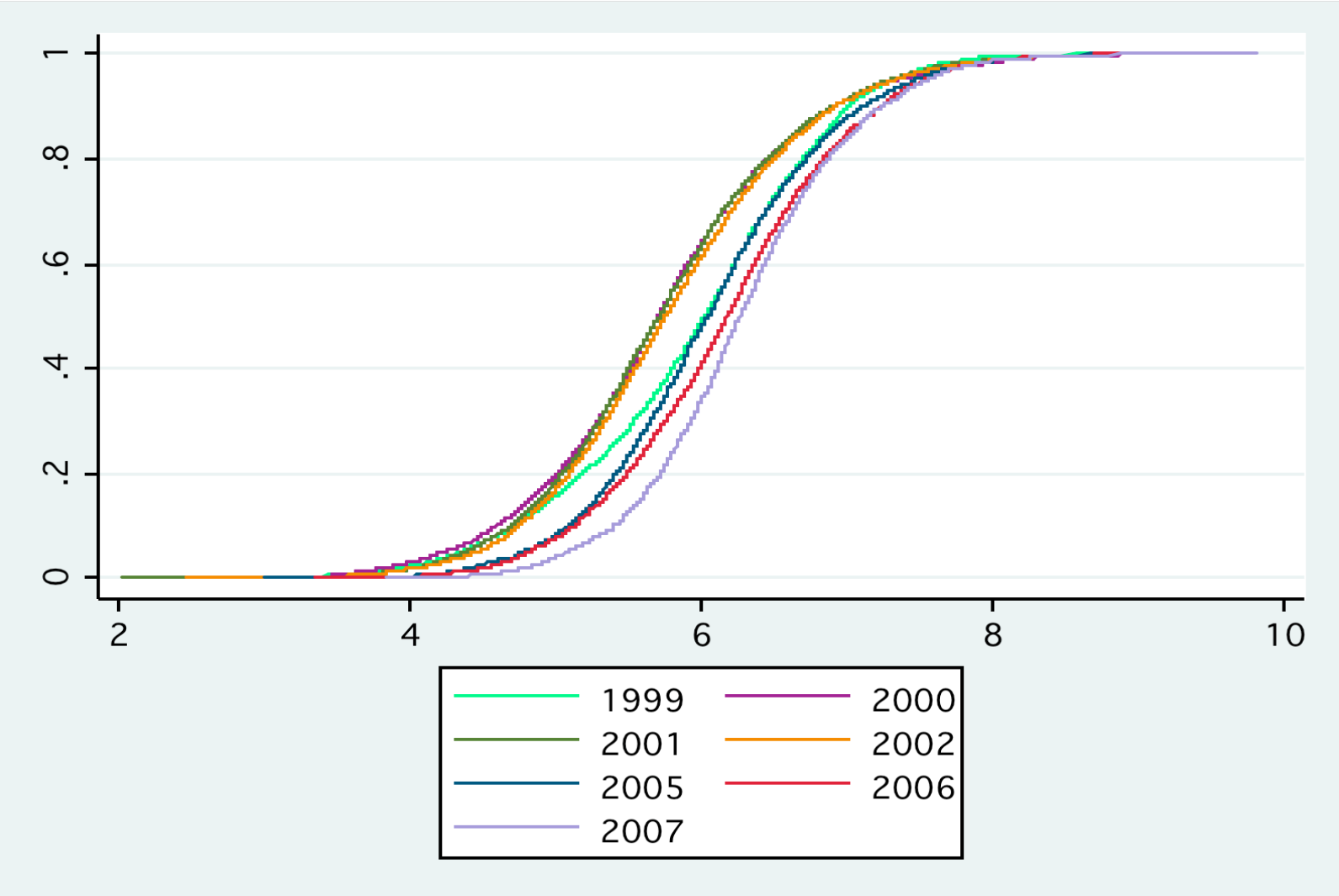
Figure 13 shows the national distribution of the log of per capita expenditure for the seven survey years. It exhibits a positive shift in the whole distribution between 2000 and 2007, the c.d.f. for each of 2001-2007 is always below the c.d.f. for the previous year, indicating that consumption expenditure increased for all percentiles in 2001-2007. The c.d.f. for 1999 exhibits a different pattern with respect to the subsequent ones. This is consistent with the poverty analysis presented above: a large expenditure reduction (and poverty increase) between 1999 and 2000 and a significant expenditure increase thereafter. The exercise confirmed that any poverty line employed would provide the same poverty trend obtained before. The same analysis using real per capita income has been conducted and the results are shown in Figure 14 - with the usual exception of 1999's c.d.f., from 2000 onwards income c.d.fs showing a positive shift. The c.d.f. for 2007 exhibits however a small negative shift mainly in the middle/upper part of the distribution.

Table 1.13: Cost of living index (la Paz=1)

	1999	2000	2001	2002	2005	2006	2007
Rural	0.75	0.73	0.72	0.73	0.78	0.78	0.86
Sucre	0.94	0.94	0.92	0.93	0.95	0.99	1.09
La Paz	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Cochabamba	0.98	0.98	0.97	0.98	0.95	0.99	1.09
Oruro	0.91	0.91	0.91	0.91	1.00	1.00	1.00
Potosí	0.84	0.84	0.84	0.84	1.00	1.00	1.00
Tarija	1.00	0.98	0.97	0.98	0.95	0.99	1.09
Santa Cruz	1.00	0.99	0.96	0.96	0.96	1.00	1.15
Trinidad	1.00	0.99	0.96	0.96	0.96	1.00	1.15
El Alto	0.91	0.90	0.91	0.91	0.89	0.89	0.94
Pando	1.00	0.99	0.96	0.96	0.96	1.00	1.15

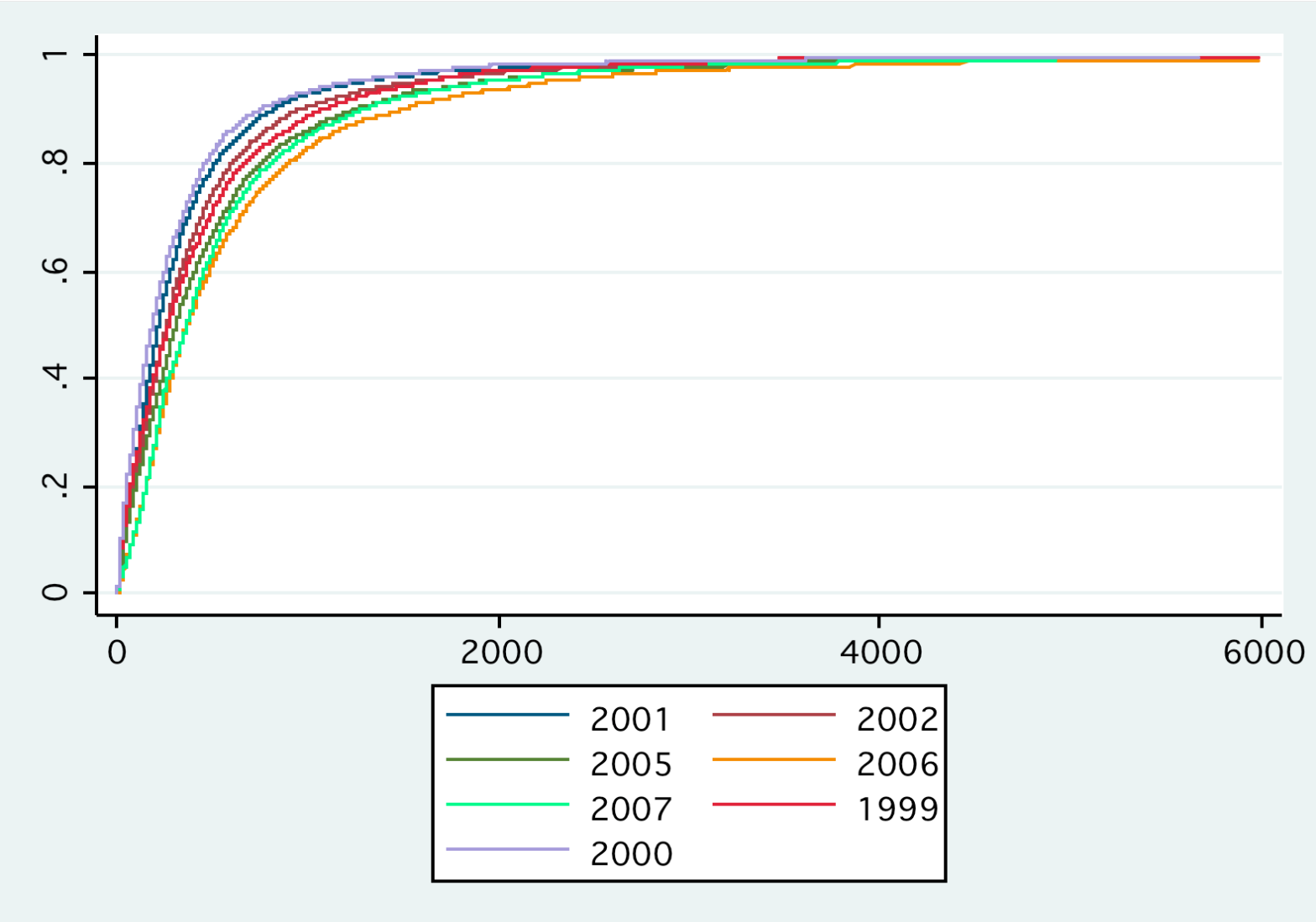
Source: INE

Figure 1.13: Log of real per capita expenditure cumulative distribution



Source: Author's own calculation based on surveys

Figure 1.14: Real per capita income cumulative distribution



Source: Author's own calculation based on surveys

1.11. Correlates of Poverty

The consumption aggregates previously obtained and validated by robustness checks are used in the present section to ascertain the demographic and socio-economic characteristics likely to be correlated with households' welfare status. The simple regression equation, typically applied to poverty analysis, is:

$$\ln\left(\frac{y_i}{z_i}\right) = \alpha + \alpha_1 x_1 + \alpha_2 x_2 + \ldots \alpha_n x_n$$

where z_i is the SCOL index, y_i is per capita consumption and x_n are the explanatory variables. Note that $\left(\frac{y}{z}\right)$ is in log form to allow for the log normality of the variable.

The first specification pools data from 1999 to 2007 to provide a general picture on the significant variables associated with welfare and their magnitude. Other specifications will be used to check for welfare change over time and for differences in correlates of welfare between indigenous and non-indigenous population.

1.11.1 Data Description

The set of explanatory variables hypothesized to be correlated with poverty is selected based on the literature on correlates of poverty, variables consistently defined and constructed across surveys' rounds and variables likely to be exogenous. The analysis is conducted at the household level, mainly looking at variables related to the head of the household and his/her spouse, considered being a good proxy of the entire household.

Only the working population is considered given the difficulties of dealing with many sub-categories of non-working population (retired, unemployed, temporary inactive, permanent inactive). Summary statistics of the selected variables are reported in Annex 2.

INDEPENDENT VARIABLES

The first variable included is a dummy that takes the value 1 if the household lives in a rural area (URBRUR) and 0 otherwise. The demographic data is the household size and its quadratic term (MHOGAR and MHOGAR2). The quadratic term is introduced to allow for non-linearities in the relationship between household size and living standards. Based on the literature, a negative relationship between total household size and total consumption per capita is expected. A dummy variable for the gender of the head of the household is also included (F_HEAD). Human capital is assumed to contribute positively to higher living standards. Three variables related to education are adopted: first, a dummy variable for whether the head of the household can read and write (LITER); second, a variable that measures the years of schooling of the head of the household (EDUC) and its quadratic term (EDUC2); third, the years of schooling of the head's spouse (EDUC_SPOUSE). Two variables on the occupation of the head of the household are included. In particular, three broad sectors of employment are distinguished: agriculture, including livestock and fisheries; industry, mining, and construction; and commerce, transport, communication, and other services. Three corresponding dummy variables are constructed to define in which sector the head of the household is engaged. Agricultural sector is selected as a reference group and the coefficients for the industry (EMPLEO2) and service (EMPLEO3) dummies are then to be interpreted with respect to the agricultural base. A dummy variable for whether the spouse of the head of the household works is also included (EMPLEO_SPOUSE).

As a proxy for income diversification a dummy variable is introduced that controls whether the head of the household has or doesn't have a secondary occupation (EMPLEO_SEC). The purpose is to examine the hypothesis that multiple income sources contribute to lower risks and higher welfare for the household. A dummy variable that takes on the value 1 when the head of the household defines himself/herself as belonging to one indigenous group (quechua, aymara, guarani', chiquitano, moieno, other) and 0 otherwise (INDIG) is included. The location effect is captured with the inclusion of regional dummies for the nine Bolivian departments:

Chuquisaca (base group), La Paz, Cochabamba, Oruro, Potosì, Tarija, Santa Cruz, Beni and Pando.

DEPENDENT VARIABLE

The chosen indicator of household welfare, i.e., per capita expenditure, has to be adjusted for spatial cost-of-living (SCOL) differences since prices in any given year vary substantially across areas and regions. In theory, the SCOL index is simply the ratio of the cost of attaining a reference level of utility in, say, region *k* to the cost of attaining the same in the reference region *r*. To the extent that spatial poverty lines are comparable in utility terms (i.e. they imply the same standard of living), then the ratio of the poverty line for region *k* to that for the reference region *r* is an appropriate SCOL index. For this purpose, the official regional poverty lines are used to approximate SCOL differences between rural and urban areas and between regions. (La Paz is chosen as reference region). Comparison of household welfare over time also requires the chosen welfare indicator, consumption expenditure, to be adjusted for nominal price movements during the period considered.

However, as the official poverty lines used are already adjusted for province-specific CPI changes, it is straightforward to achieve real consumption estimates by simply deflating the consumption expenditures using year-specific SCOL indices. As common in the literature, the dependent variable is defined in natural logarithm form.

1.11.2 The Pooled Model Estimation Results

The results from the pooled model are reported in Table 14. The estimation gives very significant results with a good measure of fit and all the variables have the expected signs.[36] *Ceteris paribus*, households living in a rural area have a 17.3% lower real consumption than those living in urban areas. The size of the household

[36] Note that as the dependent variable is in natural logarithm form, the estimated regression coefficients measure the percentage change in consumption per capita from a unit change in the continuous independent variables. When the explanatory variable is a dummy, the percentage change in the dependent variable from a unit change in the dummy is approximately eβˆ –1.

has a significant negative impact on welfare. An additional person in the household is predicted to have a negative, but decreasing, impact on consumption per capita.[37] When the head of the household is a female, *ceteris paribus*, the household has 8% higher welfare than male-headed households. This is quite an interesting result as female-headed households are generally considered to be more likely to be poor than male-headed households. Empirical evidence on this score, however, is mixed. (Kabeer, 2003; Medeiros and Costa, 2008; Fuwa, 2000; Marcoux, 1998 and Quisumbing, Haddad and Peña, 2001). A possible explanation could be related with female-headed households being more likely to receive remittances from partners based elsewhere. In order to test this hypothesis, a separate specification is run controlling for the impact of remittances on household's welfare. The coefficient on households, regardless of the gender of the head, receiving remittances was positive but not significant. The interaction term of female-headed households and the remittances dummy was negative, as expected, but not significant. The coefficient on female-headed households (not receiving remittances) remains positive and significant. The hypothesis that controlling for remittances female households would have a lower welfare than male ones failed and different dynamics seems to be at stake.

The coefficient on literacy predicts a large and significant impact: on average, when the head of the household can read and write, household per capita consumption is predicted to be 37% higher than in illiterate headed households. The coefficients on years of schooling of the head of the household and its quadratic term suggest an increasing effect of education on welfare, after the first three years[38].

[37] The coefficients on household size and its quadratic term suggest that welfare starts increasing when the household has 10 members. However, given that only less than 1% of the sample has size of 10 or more, this effect can be ignored.

[38] The negative coefficient on education suggests a negative return to education for the first 3 years. However, this result is driven by the presence of the variable dummy on literacy that is likely to capture the positive return of schooling during the first year. As expected, if the dummy on literacy is dropped the coefficient on education becomes positive for any year of schooling.

Table 1.14: Pooled cross section model on correlates of welfare

VARIABLES	Log per capita consumption
Urbrur	-0.190***
	(0.0106)
Mhogar	-0.323***
	(0.00568)
mhogar2	0.0164***
	(0.000520)
F_head	0.0794***
	(0.0116)
Liter	0.319***
	(0.0166)
Educ	-0.0269***
	(0.00350)
educ2	0.00395***
	(0.000183)
educ_spouse	0.0156***
	(0.00103)
empleo2	0.217***
	(0.0122)
empleo3	0.300***
	(0.0121)
empleo_spouse	0.0173**
	(0.00848)
empleo_sec	0.0444***
	(0.0104)
Indigo	-0.117***
	(0.00876)
Lapaz	0.0814***
	(0.0154)
Cochabamba	0.227***
	(0.0160)
Oruro	0.0485***
	(0.0184)
Potosi	-0.0177
	(0.0174)
Tarija	0.362***
	(0.0186)
Santacruz	0.378***
	(0.0161)
Beni	0.351***
	(0.0195)
Pando	0.676***
	(0.0263)
Constant	6.406***
	(0.0299)
Observations	27936
R-squared	0.519

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

For instance, *ceteris paribus*, an increase from 7 to 8 years of education increases welfare by 2.84%. When the years of schooling are 10, an additional year results in a 5.21% increase in welfare. An increase from 12 to 13 years of schooling results in an increase in welfare by 6.79%. Looking at the education of the spouse of the household, it emerges that an additional year of schooling of the spouse of the household results in a positive small (1.6%) increase in welfare.

The estimates on the two dummy variables on employment measure the proportionate difference in welfare relative to households whose head is engaged in agriculture. The coefficients reveal that households working in the agriculture sector are the worse off. Households working in the industry sector and services have respectively 24% and 35% higher welfare than those engaged in agriculture. The coefficient on the dummy variable that controls whether or not the head of the household is engaged in a secondary occupation confirms the hypothesis that income diversification is likely to improve welfare. Other things equal, households whose head is engaged in a secondary occupation are predicted to have a 4.5% higher welfare. *Ceteris paribus*, the welfare of a household whose head belongs to an indigenous group is predicted to be 11% lower than that of a non-indigenous households. The regional dummies reveal very large welfare differences across departments. With Chuquisaca as a base group, other things equal, living in La Paz, Cochabamba and Oruro results respectively in an 8, 25 and 5% higher welfare. In Potosì, welfare is on average 1.7% lower than Chuquisaca whereas living in Tarija, Santa Cruz, Beni and Pando results on average in a very large welfare improvement (44%, 46%, 42% and 96%)[39]. The value of the F-test for the joint significance of the regional dummy coefficients indicates that regional dummies are jointly significant.

[39] Caution is called for when interpreting coefficients on small departments such as Beni and Pando as the number of observations is generally much smaller than for the remaining departments.

1.11.3 Testing for Welfare Change Over Time

It is interesting to look at the variation over time. Table 15 presents the parameter estimates and standard errors for the cross-sectional model with dummy variables for each year considered, 1999 being the reference year.

The fit of the model is good, with an adjusted R-squared of 0.54, and all the coefficients are highly significant. The model allows discerning the change in welfare over time other things being equal. As expected, the coefficients on the dummy variables show that, on average and *ceteris paribus*, welfare decreased from 1999 to 2002 (-19% in 2000, -13% in 2001 and 2002) and it improved significantly from 2002 onwards, respectively by 9% from 2002 to 2005, 6% in 2006 and 22% in 2007, thus confirming the results emerged in the previous sections. At this point, one might want to investigate whether there have been any specific socio-economic patterns in the large welfare change experienced in Bolivia in the present decade.

Many social, political and economic shocks occurred in the present decade that contributed to welfare changes across regions and social groups. Trying to identify the main causal factor is challenging and might result in a simplistic exercise; it is probably more sensible to look at the overall welfare effect and try to find out which groups or regions benefited the most. Which groups have benefited the most? Has the welfare growth been pro-poor? In order to address these questions, the next two sections investigate whether any differences in the correlates of poverty exist between indigenous and non-indigenous population and test the pro-poor growth hypothesis.

Table 1.15: Cross sectional model on correlates of poverty over time

VARIABLES	Log per capita consumption
Urbrur	-0.194***
	(0.0104)
Mhogar	-0.321***
	(0.00558)
mhogar2	0.0164***
	(0.000511)
F_head	0.0648***
	(0.0114)
liter	0.302***
	(0.0163)
educ	-0.0233***
	(0.00344)
educ2	0.00377***
	(0.000180)
educ_spouse	0.0159***
	(0.00101)
empleo2	0.197***
	(0.0120)
empleo3	0.285***
	(0.0119)
Empleo_sec0	0.0511***
	(0.0102)
Empleo_spouse	0.00619
	(0.00830)
Lapaz	0.0642***
	(0.0149)
cochabamba	0.207***
	(0.0155)
oruro	0.0220
	(0.0178)
potosi	-0.0527***
	(0.0169)
tarija	0.402***
	(0.0181)
santacruz	0.406***
	(0.0157)
beni	0.369***
	(0.0191)
Pando	0.710***
	(0.0257)
y2000	-0.179***
	(0.0147)
y2001	-0.125***
	(0.0142)
y2002	-0.126***
	(0.0143)
y2005	0.0891***
	(0.0153)
y2006	0.0639***
	(0.0153)
y2007	0.199***
	(0.0153)
Constant	6.382***
	(0.0311)
Observations	27944
R-squared	0.537

1.11.4 Testing Differences between Indigenous and Non-indigenous Groups

The poverty measures and regression analysis employed earlier show a very high correlation between poverty and ethnicity. In this section, two separated models of correlates of poverty over time are computed. The first model restricts the observations to the non-indigenous population only whereas the second to the indigenous population. In fact, one might expect that model parameters obtained in the pooled data to differ between the two sub-populations. For example, the effects of education and employment on welfare could be different; welfare trend over time could differ as well between indigenous and non-indigenous population.

The Chow test is employed to test whether there are any differences in effects across groups. Using the pooled dataset, a model is employed where the intercept and all slopes can be different across groups by including the indigenous group dummy and all interaction terms. The test for joint significance of the interaction terms only rejects the null hypothesis that the model parameters are the same for indigenous and non-indigenous groups. The coefficients and standard errors of the two sub-groups' models are reported in the Table 16. The coefficients for the two groups have the same sign but slightly different magnitude. Other things equal, the welfare gap between rural and urban households is much larger for the indigenous population than for non-indigenous households (respectively -23% and -15%). The size of the household has a significant negative impact on welfare. An additional person in the household is predicted to have a negative, but decreasing, impact on consumption per capita[40].

Female-headed households have higher welfare than male-headed households for both groups but the coefficient is larger within indigenous households (respectively 7% and 4% higher). Surprisingly, the welfare improving impact of having a literate head of the household is larger on non-indigenous households. While, *ceteris*

[40]The coefficient on household size and its quadratic term suggest that welfare starts increasing when the household has 10 members. However, given that only less than 1% of the sample has size of 10 or more, this effect can be ignored.

paribus, a literate indigenous head of the household has a 30% higher welfare than an illiterate one, for non-indigenous, being literate results in a 38% higher welfare. Interestingly, the coefficients on education reveal that, *ceteris paribus*, the return on schooling is much larger for non-indigenous households. When the years of schooling are 10, an additional year results in 5.6% higher welfare for non-indigenous households but only 4.6% higher for indigenous; when the years are 15, an additional year of schooling results in a 10.4% higher welfare for non-indigenous and only 7.4% for indigenous. The estimates on the two dummy variables on employment reveal that the welfare improving effect of working in the industry sector and services with respect to agriculture is much larger for indigenous than for non-indigenous households. Being employed in the industry sector results in a 13% higher welfare for non-indigenous and 26% higher for indigenous. The effect is even larger for the service sector: working in services results in a 21% higher welfare for non-indigenous and 39% higher for indigenous. The welfare gap between households living in the Media Luna regions (Tarija, Santa Cruz, Beni and Pando) and households living in other parts is significantly large for the indigenous population. *Ceteris paribus* and with Chuquisaca as a reference group, living in Tarija, Santa Cruz, Beni and Pando results respectively in 55%, 56%, 61% and 130% higher welfare when the household belongs to an indigenous group and 39%, 45%, 36% and 88% for non-indigenous households. By comparing the coefficients on the year dummy variables between the two sub-populations, one can infer whether, other things being equal, indigenous households have experienced a stronger welfare improvement than the non-indigenous ones. In fact, the coefficients on the year dummy variables suggest that the two groups experienced quite different patterns of welfare change. Both groups experienced welfare reduction between 1999 and 2002 but the intensity was milder for the indigenous population with respect to the non-indigenous. On the other hand, the welfare improvement that occurred from 2005 onwards was much larger for the indigenous population. *Ceteris paribus*, in 2007 indigenous households had on average 30 percent higher welfare than they had in 1999; non-indigenous households only 8%.

Table 1.16: Correlates of poverty: indigenous versus non indigenous

Log per capita consumption	(1) non indigenous	(2) indigenous
Urbrur	-0.140***	-0.206***
	(0.0163)	(0.0135)
Mhogar	-0.313***	-0.326***
	(0.00824)	(0.00745)
mhogar2	0.0156***	0.0170***
	(0.000736)	(0.000693)
F_head	0.0416**	0.0728***
	(0.0173)	(0.0150)
Liter	0.321***	0.260***
	(0.0283)	(0.0201)
Educ	-0.0390***	-0.0100**
	(0.00518)	(0.00459)
educ2	0.00476***	0.00281***
	(0.000258)	(0.000251)
educ_spouse	0.0119***	0.0153***
	(0.00142)	(0.00145)
empleo2	0.122***	0.229***
	(0.0186)	(0.0156)
empleo3	0.195***	0.330***
	(0.0181)	(0.0157)
empleo_sec0	0.0384**	0.0599***
	(0.0159)	(0.0132)
empleo_spouse	0.0694***	-0.00896
	(0.0123)	(0.0112)
Lapaz	0.180***	0.101***
	(0.0236)	(0.0200)
Cochabamba	0.254***	0.266***
	(0.0253)	(0.0206)
Oruro	0.0617**	0.0870***
	(0.0312)	(0.0230)
Potosi	0.00100	0.0144
	(0.0324)	(0.0217)
Tarija	0.335***	0.448***
	(0.0222)	(0.0346)
Santacruz	0.374***	0.445***
	(0.0209)	(0.0238)
Beni	0.308***	0.478***
	(0.0248)	(0.0297)
Pando	0.636***	0.832***
	(0.0289)	(0.0635)
Y2000	-0.177***	-0.219***
	(0.0229)	(0.0190)
Y2001	-0.173***	-0.112***
	(0.0230)	(0.0179)
Y2002	-0.182***	-0.112***
	(0.0227)	(0.0183)
Y2005	0.00117	0.131***
	(0.0240)	(0.0196)
Y2006	0.00981	0.0810***
	(0.0237)	(0.0200)
Y2007	0.0764***	0.267***
	(0.0236)	(0.0199)
Constant	6.491***	6.308***
	(0.0493)	(0.0401)
Observations	11,074	16,862
R-squared	0.528	0.507

1.12. Testing for Pro-poor Growth: Growth Incidence Curve

The previous section reveals a pro-indigenous welfare growth in the present decade. Can this pattern be identified also as a genuine pro-poor growth? Or, instead, a political commitment in favour of the indigenous population? To test this hypothesis, growth incidence curves are constructed as a measure of "pro-poor" growth. The growth incidence curve gives the rates of growth by quintiles of the distribution of income/consumption. It is therefore possible to see how the poorest segments of the population have fared with respect to the average or to the better off. [41] The growth incidence curve is downward sloping, indicating that incomes of the richer percentiles of the income distribution grow slower than incomes of poorer percentiles. In fact, the mean growth rate over the entire distribution is 0.83% per year. The growth rate in the mean is 0.76% per year. The first three quintiles experienced two-three times more growth than the average.

[41] Let F(y) denote the cumulative distribution function (CDF) of income (or expenditure), giving the proportion of the population with income less than y at date t. Inverting the CDF at the pth quintile gives the income of that quintile:

Yt(p)0 Ft-1(p)= Lt'(p)μt (y't (p) >0)

where L (p) is the Lorenz curve (with slope L't(p)) and μt is the mean; for example, y (0.5) is the median. Comparing two dates, t-1 and t, the growth rate in income of the pth quintile is

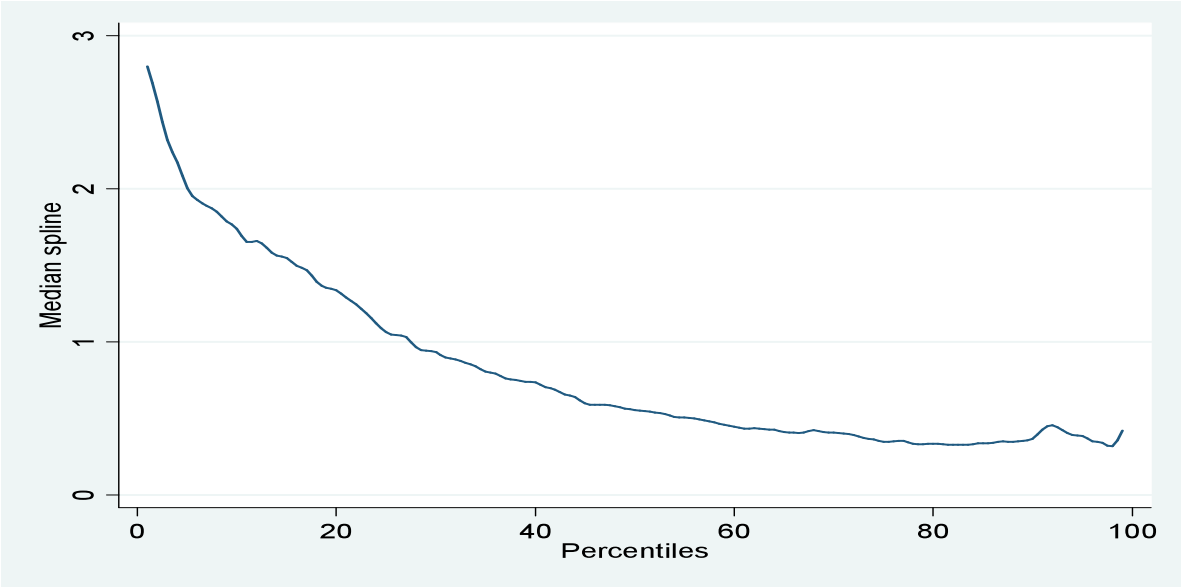
g (p)=[y t (p) / y t-1 (p)] - 1.

Letting p vary from zero to one, g t (p) traces out what we will call the 'growth incidence curve' (GIC). It follows that:

$$g_t(p) = \frac{L_t'(p)}{L_{t-1}'(p)}(\gamma_t + 1) - 1$$

where γt =(μt / μt-1)-1 is the growth rate in μt . If the Lorenz curve does not change then g t (p) = γt for all p. Also g t (p) > γt if and only if y t (p) / μt is increasing over time. If g t (p) is a decreasing (increasing) function for all p then inequality falls (rises) over time.

Figure 1.15: Growth incidence curve for Bolivia, 1999-2007



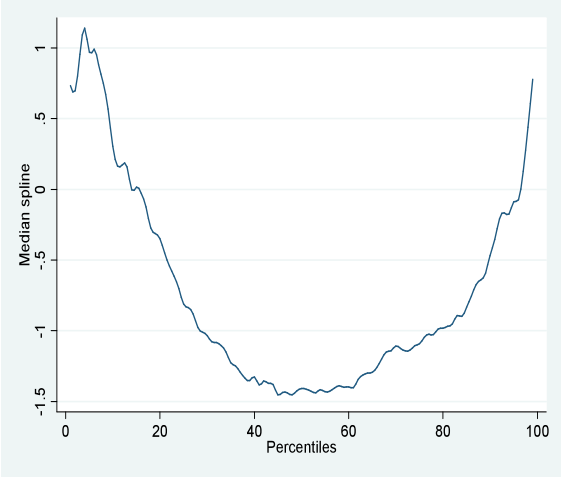
Source: Author's own calculation based on surveys

This calculation is repeated for two sub-periods, 1999-2002 and 2005-2007. The CIGs show pro-poor patterns as above-average growth was recorded for the poorest quintiles. However, the 1999-2002 GIC takes a U shape indicating that percentiles at both the tails of the distribution experienced above-average growth. The 2005-2007 GIC instead is clearly downward sloping, indicating that income of the richer percentiles of the income distribution grow much slower than the poorest.

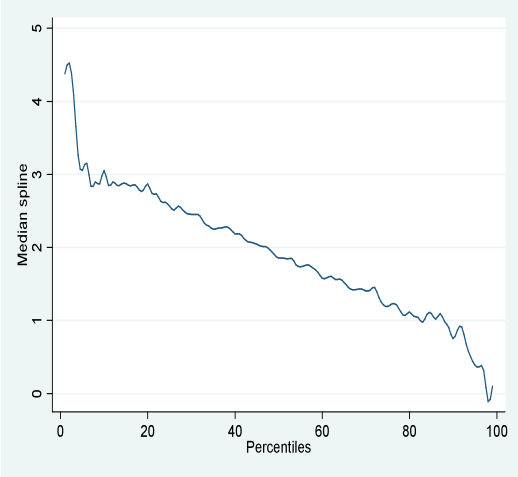
Now the same exercise is repeated for the two ethnic sub-groups. Both curves denote pro-poor growth, with the poorest segments of the population benefiting much more than the richest. However, the growth rates differ significantly between the two groups at any point of the distribution. In fact, for the indigenous population, the mean growth rate over the entire distribution is 1% per year and the growth rate in the mean is 0.96% per year while for the non-indigenous population the mean growth rate over the entire distribution is 0.31% per year and the growth rate in the mean is 0.28% per year. Relative to the sub-groups' respective averages, the poorest percentiles experienced around two times more growth than average, whereas the non-indigenous population relatively benefiting a bit more. In fact the growth rate at

the 30th percentile of the indigenous distribution is 1.72% (versus mean growth rate of 1%) and the growth rate at the 30th percentile of the non-indigenous distribution is 0.67% (versus mean growth rate of 0.31%).

Figure 1.16: GIC 1999-2002

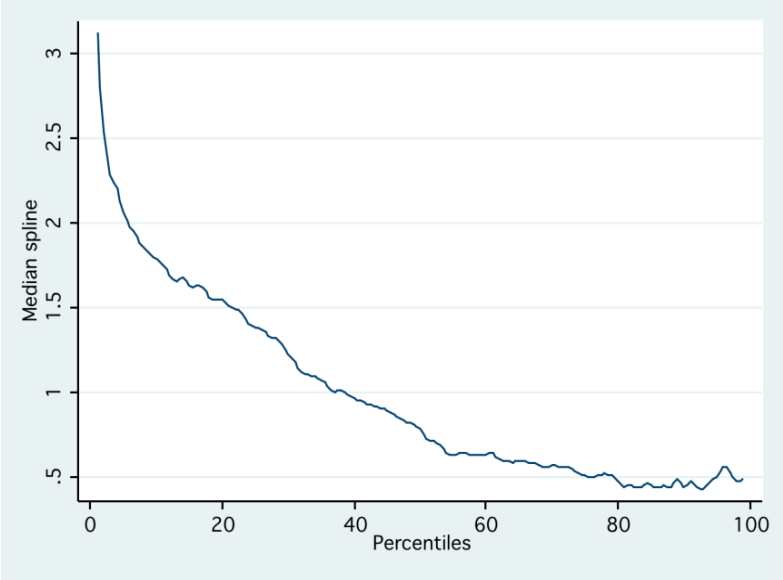


GIC 2005-2007



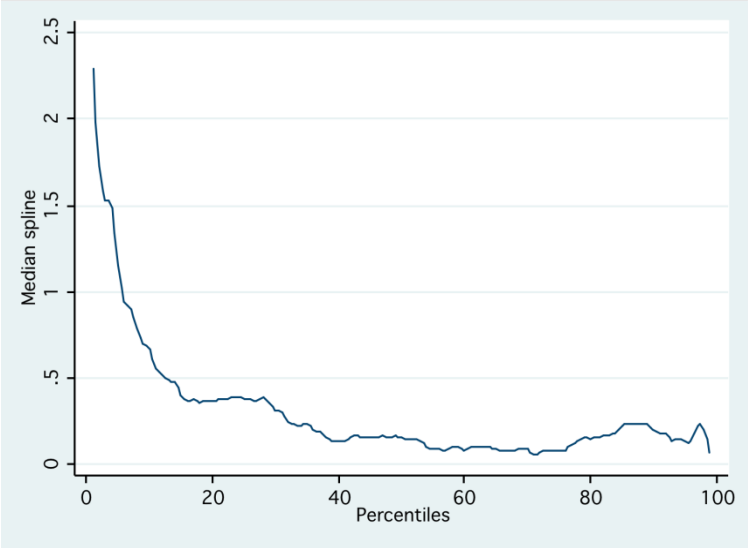
Source: Author's own calculation based on survey

Figure 1.17: Growth incidence curve indigenous population 1999-2007



Source: Author's own calculation based on surveys

Figure 1.18: Growth incidence curve non-indigenous population 1999-2007



Source: Author's own calculation based on surveys

1.13. Conclusion

Filling the gap in the literature on consumption and consumption-based poverty analysis in Bolivia, consistent and accurate estimates of consumption and poverty measures are computed using seven household surveys (1999-2007). This paper provides a recent and previously unexplored story on Bolivian poverty. With respect to the official poverty measures based on income, we find that Bolivia experienced an incredibly large poverty reduction from 2002 onwards, halving poverty headcount during the 2002-2007 period. Robustness checks confirm these results. Furthermore, the welfare improvement has a strong pro-poor component which contributes to reduce the high level of inequality of the country and, particularly, to narrow down the large welfare gap between indigenous and non-indigenous groups.

1.14. References

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Appendix 1.1: Computation of consumption: technicalities

I estimate consumption figures aggregating the following components:

- Food consumption inside the household (food shopping, self-produced food, food from other sources-such as gifts, transfers in kind) [42]
- Food consumed outside the household (breakfast, drinks, lunch/dinner, snacks, etc.)
- Non-food consumption (aggregate of about 40 categories related to current housing costs, domestic fuel and power, tobacco products, clothing and footwear, medical care and health expenses, transport, recreation, personal care, miscellaneous goods and services[43])
- Education expenditure (tuition fees, transport, books and copies, uniform, etc.)
- Housing expenditure (actual rent or rental equivalence value, expenses-gas, water, electricity, telephone, house reparation-decoration[44]).

The computation has been done at the (per capita) household level. When the expenditure was reported at the individual level, the household aggregate had been computed and the per capita mean had then been obtained.

Extreme values (namely, per capita consumption values with standard deviation of the mean above 3) were replaced with mean values: 5 changes in 1999 (housing aggregate), 110 changes in 2000 (non-food and food inside the HH), 75 changes in

[42] Data on the consumption of 64 food items were added up to get the household total food expenditure.

[43] With respect to the non-food components in the questionnaire (and to the official consumption estimate) the expenses in financial and capital services -such mortgages and payment instalments- are not included to avoid double counting of those expenses already reported elsewhere.

[44] Monthly expenditure in house reparation-decoration above 100US$ were considered as investment rather than consumption and were not then included in the computation. The benchmark of 100US$ was indicated by the INE and deflated by inflation rate, taken from WDI. As respondents are allowed to answer either in dollars or Bolivianos, the value has been converted into real Bolivianos. The exchange rates used are from INE and I use the monthly rate reported for the month during which the survey was conducted (usually November-December).

2001 (non-food and food inside the HH), 20 changes in 2002 (mainly food inside the HH), 20 changes in 2005 (mainly food inside the HH), 2 changes in 2006 (1 housing 1 non-food) and 4 changes in 2007 (housing).

Data on the specific consumption components comes from different datasets and they have therefore been merged. In some cases the number of the households did not match and therefore no complete information about the total consumption was available. Those households were dropped (150, 30 and 110 observations respectively in 2001, 2006 and 2007).

MISSING VALUES

Distinguishing between those missing values who are missing by definition and those who should have an imputed value is almost impossible. Mostly, respondents are asked just to report the expenditure of an item. The missing value might then be either a “zero” value (no consumption of it) or a true missing value (cannot answer, doesn’t remember how much he spends, etc.). Just in few cases, the respondent is asked to specify both whether he consumes the item and the amount of money. I proceeded with imputation only in those cases: when the respondent reports to consume it but does not then report the amount actually spent. In those cases, I imputed the amount using the rural/urban mean (rural and urban means exhibit very large gaps). Out of these cases, the missing values remain missing[45].

I list below the modules/years for which I could impute values:

- Education: I imputed the values for each variable if the individual reported to be enrolled in a course (not in 2006 because there were too many missing values; 14000 out of 16000).
- Housing: imputed using rural and urban means

[45] However, having to aggregate them with EGEN command, the missing values are finally treated as zero values.

- Food outside: imputed using rural and urban means (in 2001 no rural/urban variable so just single mean)

DURABLE GOODS

In the section on durable goods, households are asked about the amount and value of the durable goods they have. Households report whether they own any durable good (such as TV, radio, PC, bicycle, motorbike, car, kitchen, fridge, washing machine, wardrobe, etc.), how many of them they own, how long ago they have bought them, how much they have spent for them and how much they think they could now sell them for. The latter is a good proxy of the present value of the good and it is therefore used to compute the aggregate value of durables owned by the household. I computed both the total stock of durables, summing up the imputed values per each item and, as we are interested in the household's "investment" decision year by year, I also calculated the last year expenditure in durables (or the imputed value when the purchase cost was not reported). Respondents are asked: "How long ago did you buy the item?" and I collected information on items bought one year ago or less.[46]

All the values are converted in Bolivianos (households can report the values either in local currency or in US dollars). In dealing with the missing values of the imputed present value of the good, I identify three cases:

- In case of proper missing values (it is impossible to know whether the household owns the item) I leave them missing;
- If the household reports to possess a good, the amount of money he spent for it and that it has been bought during the last year but cannot impute its present value, the missing imputed value is replaced by purchase's cost (it is reasonable to assume a modest depreciation of the good within a year time). This is a rough approximation but this solution is likely to be more sensible than the one used for the third case.

[46] When the purchase occurred during the last 12 months, the interviewers had to report it as bought 1 year ago.

- Whenever the household declares to own the good but does not report the cost nor the imputed value, the good-specific mean of the imputed value is used to replace the missing value.

To distinguish between very new products and less new ones, two different means are used: one of the imputed value of good bought less than one year ago and a second mean of the imputed values of good bought more than one year ago.

Appendix 1.2
Table 1a: Summary statistics of the correlates of welfare

	1999	2000	2001	2002	2005	2006	2007
Log cons	5.89	5.70	5.72	5.76	6.04	6.13	6.26
	0.90	0.92	0.88	0.87	0.80	0.82	0.73
Rural	0.48	0.47	0.53	0.45	0.46	0.35	0.35
	0.01	0.01	0.01	0.01	0.01	0.01	0.01
HH size	4.37	4.35	4.37	4.47	4.24	4.14	4.12
	2.18	2.23	2.29	2.29	2.17	2.14	2.12
Female HH	0.16	0.16	0.17	0.16	0.19	0.20	0.21
	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Literate Pop	0.84	0.85	0.86	0.88	0.89	0.91	0.91
	0.01	0.01	0.00	0.00	0.01	0.00	0.00
years educ	6.91	6.83	6.60	6.98	7.32	8.21	8.08
	5.29	5.08	4.98	4.99	5.13	5.37	5.36
years educ spouse	4.18	4.06	3.72	4.06	4.29	4.88	4.79
	5.11	4.91	4.71	4.80	4.97	5.53	5.51
Agriculture	0.41	0.44	0.48	0.40	0.38	0.29	0.29
	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Industry	0.21	0.21	0.19	0.22	0.23	0.24	0.25
	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Services	0.38	0.35	0.32	0.38	0.39	0.47	0.46
	0.01	0.01	0.01	0.01	0.01	0.01	0.01
working spouse	0.46	0.45	0.48	0.46	0.44	0.43	0.45
	0.01	0.01	0.01	0.01	0.01	0.01	0.01
2nd occupation	0.16	0.13	-	0.15	0.13	0.13	0.13
	0.01	0.01		0.01	0.01	0.01	0.01
Indigenous	0.66	0.58	0.65	0.60	0.60	0.57	0.57
	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Chuquisaca	0.08	0.08	0.07	0.08	0.08	0.08	0.08
	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Lapaz	0.26	0.25	0.26	0.21	0.22	0.22	0.22
	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Cochabamba	0.18	0.16	0.19	0.16	0.15	0.16	0.16
	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Oruro	0.06	0.09	0.07	0.09	0.09	0.09	0.09
	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Potosi	0.10	0.10	0.09	0.11	0.11	0.11	0.11
	0.01	0.00	0.00	0.00	0.01	0.01	0.01
Tarija	0.06	0.08	0.07	0.08	0.08	0.09	0.09
	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Santacruz	0.18	0.16	0.17	0.16	0.16	0.16	0.16
	0.01	0.01	0.01	0.01	0.01	0.01	0.01

	1999	2000	2001	2002	2005	2006	2007
Beni	0.06	0.06	0.06	0.07	0.07	0.07	0.07
	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pando	0.03	0.02	0.02	0.03	0.03	0.03	0.03

Summary statistics (mean values for Log consumption, household size and years of education of head of the household and spouse. Proportions for all the other variables. Standard errors below. Source: own calculation based on surveys)

PAPER 2

The Distributional and Poverty Impact of High Food Prices:

The Case of Bolivia

2.1 Introduction

Much debate has developed recently on the impact of high food prices. The extraordinary price increase experienced from 2005 onwards has affected, to different extent, all food products and all the countries. Assistance and policy interventions are called for to mitigate the adverse effects of the shock and protect the most vulnerable categories[47]. The underlying assumption is that the soaring cost of living makes life even harder for the millions of people already struggling against poverty and hunger. However, such a general assessment on the poverty impact is not appropriate. When trying to determine the social welfare effects of a price increase, information about the specific net production and consumption position of the household (or country) one is looking at is crucial. Bearing in mind that, especially in developing countries, a large share of the poor population is located in rural areas, often engaged in agricultural activities, a price increase might affect it in different ways. If a household is net seller an increase in price might result in larger profits from its sales; if a household is engaged in subsistence farming, it will not take advantage of the potential higher profits but, on the other hand, he will not be directly affected by the price increase occurring at the market because he is, simply, not involved in the market. Finally, a household not engaged in agricultural activities will be directly affected by the price increase but its income might be highly correlated to the agricultural ones so that, although not directly benefiting from the price increase, positive externality may raise. The overall welfare impact is an empirical matter: do benefits offset the losses? And, as our main focus is on the poorest population, how are the poor affected?

Never before have evaluations of the poverty impact of trade policy and shocks been so systematic or so prominent an element of the debate[48]. There is an interesting

[47] See FAO (2006, 2007, 2008a, 2008b, 2008c, World Bank 2008a, 2008b).

[48] This new approach is particularly evident in the new emerging set of international development goals that go beyond the crude focus on aggregate output. Examples are the Millennium Development Goals by the UN as well as the Poverty Reduction Strategy Papers (PRSPs), policy documents

literature and a wide range of techniques currently available for evaluating the poverty impact of economic shock which generally operates at a microeconomic level[49]. In the ideal case, one would collect information about food consumption and production before and after the increase in prices. The time series variation would allow figuring out how consumption patterns and welfare position of each household have changed in the light of the price shock. Given that, at the time of writing, the increase in prices is an on-going process and that household surveys take years before they get released from the national institutes of statistics, a modelling approach to simulate the impact of the shock is the most appropriate methodology[50]. By implementing a simple methodology based on Deaton (1989), the present work provides an assessment of the poverty and distributional impact of soaring food prices in Bolivia.

Using a very recently released Bolivian household survey, "Encuesta de Hogares 2005", a series of simulations of the welfare and poverty impact are conducted. By calculating the net benefit ratio, using a definition of food that aggregates eight of the main components of the peculiar Bolivian consumption and production patterns, it is possible to identify where and how the main losses and benefits are distributed across household groups. A more detailed analysis is also conducted at the commodity level to discern the role of each commodity with respect to the overall welfare and poverty impact. Throughout the work, the analysis was carried out at the most disaggregated level in order to distinguish the impact between urban and rural population, regional location and household position along the expenditure distribution, with a special attention devoted to the poorest population.

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requested by IMF and World Bank to countries seeking access to their resources, which have a specific focus on poverty reduction objectives and other social goals. See Bourguignon and Pereira da Silva (2003).

[49] See Winters (2000; 2002), Winters *et al.* (2004), Cirera *et al.* (2001), Friedman and Levinsohn (2002), Minot and Goletti (2000), Porto (2003; 2005), Hertel and Winters (2006)., Ravallion and van der Walle (1991). A comprehensive synthesis of the techniques is provided by Bourguignon and Pereira da Silva (2003).

[50] At time of writing (summer 2008) the latest survey available was the 2005 household survey. No comparison with later surveys was therefore possible.

The results show that, on average, the welfare impact is significantly negative and poverty rises by 2.87 percentage points. However, high heterogeneity emerges across locations and expenditure quintiles. The poorest experiences the least adverse welfare impact. Largest losses pass through the price increase of rice, wheat and sugar while the poorest also considerably benefit from the price increase of potato and maize.

The present work is organized as follows: section 2 describes the methodological framework; section 3 and 4 present data and summary statistics on food consumption and food production; section 5 discusses the price increase and section 6 measures poverty; in sections 7 the net benefit ratio is computed and in section 8 and 9 the results of the simulation of the welfare and poverty impact of a uniform 10 percent increase (for aggregated and disaggregated food definitions) are provided. Sections 10 and 11 present the results of the simulation of the welfare and poverty impact of the current price increase (for aggregated and disaggregated food definitions). Section 12 concludes.

2.2 Methodology

In this study, the framework used to assess the direct impact of food price changes on Bolivian households is a static partial equilibrium. The methodology implemented is based on the agricultural household models described by Singh, Squire and Strauss (1986) and the insightful theoretical and empirical guidelines contained in the vast literature on welfare analysis by Deaton[51]. Deaton (1989: 186) highlights the importance of the net benefit ratio (NBR) that 'can be thought of as the elasticity of (the money value of) welfare with respect to a price change.' The concept is of paramount importance in the literature on the welfare impact of price changes and it is a fundamental pillar in the present work.

The net benefit ration for a household can be defined as:

[51] See Deaton (1989, 1997), Deaton and Case (1987), Deaton, A. and Zaidi, S. (2002).

$$NBR_h = \frac{p_i(y_{hi} - q_{hi})}{x_h}$$

Where p_i is the price of food *i*, y_{hi} is household h production of good *i*, q_{hi} is the amount of good *i* consumed by that household, and x_h is household per capita expenditure.

The derivation and interpretation of the net benefit ratio, as a measure of the welfare change is provided below.

Consider a household that consumes food and participates in the labour market (either in a farm- producing food- or elsewhere). The impact of a price change can be decomposed into the impact on the household as a consumer of the good and the impact on the household as a producer.

2.2.1 The impact of a price change on the household as a consumer

Household's consumption can be represented as an expenditure function, such as
e (p, u),
defined over p, a vector of prices and u is utility.

A concept often used to calculate the welfare impact of a price change is the compensating variation, defined as the amount of money needed to compensate a consumer for the price change and restore the original utility level.

The compensating variation can be calculated as the difference between the expenditure function before (0) and after (1) the price change.

$$CV = e(p_1, u_0) - e(p_0, u_0) \qquad (1)$$

Using a second-order Taylor-series expansion, (1) can be approximated:

$$CV \approx \frac{1}{1!}\sum_{i=1}^{n}\frac{\partial e(p_0,u_0)}{\partial p_i}\left(p_{1i} - p_{0i} \right) + \frac{1}{2!}\sum_{i=1}^{n}\sum_{j=1}^{n}\frac{\partial^2 e(p_0,u_0)}{\partial p_i \partial p_j}(p_{1i} - p_{0i})\left(p_{1j} - p_{0j}\right) \quad (2)$$

Using Shephard's lemma and replacing ($p_{1i} - p_{0i}$) by Δp_i

$$CV \approx \sum_{i=1}^{n} h_i(p_0,u_0)\Delta p_i + \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n}\frac{\partial h_i(p_0,u_0)}{\partial p_j}\Delta p_i \Delta p_j \quad (3)$$

Where h_i (p_0,u_0) is the Hicksian demand for the good i at the initial level of price p_0
To simplify (3) the partial in the second term is converted into the Hicksian own-price elasticity of demand. Hicksian demand, h_i (p_0,u_0) , is replaced with the Marshallian demand at the original income level, q(p_0,x_0), with x_0 the initial level of income.

The equation then is:

$$CV \approx q_i(p_0,x_0)\Delta p_i + \frac{1}{2}\varepsilon_{ii}^{H}\frac{q_i(p_o,x_0)}{p_{0i}}\Delta p_i \Delta p_i \quad (4)$$

Where q_i is the quantity demanded of good *i* and p_i is price of good *i*. ε^H_{ii} is the own-price Hicksian demand elasticity of good *i*.
When both sides are divided by the original expenditure (x_o) and multiply the top and bottom of the right side by p_{oi} , what you get is:

$$\frac{CV}{x_0} \approx \frac{p_{0i}q_i(p_0,x_o)}{x_0}\frac{\Delta p_i}{p_{0i}} + \frac{1}{2}\varepsilon_{ii}^{H}\frac{p_{0i}q_i(p_0,u_0)}{x_0}\left(\frac{\Delta p_i}{p_{0i}}\right)^2 \quad (5)$$

If the consumption is defined ratio as the value of good i as a proportion of expenditure, and called it CR, by substituting CR in (5), the result is:

$$\frac{CV}{x_0} \approx CR_i\frac{\Delta p_i}{p_{0i}} + \frac{1}{2}\varepsilon_{ii}^{H}CR_i\left(\frac{\Delta p_i}{p_{0i}}\right)^2 \quad (6)$$

2.2.2 The impact of a price change on the household as a producer

Household's production activities can be represented with a profit function, such as π(p, w, z),
defined over p, a vector of output prices, w, a vector of input prices and z, a vector of fixed factors such as land and management skills.

The change in income can be expressed:

$$\Delta x = \pi\,(p_1, w_0, z_0) - \pi\,(p_o, w_0, z_0) \qquad (7)$$

Where Δx is the change in income and the subscripts of *p*, *w*, *z* refer to before (0) and after (1) the price change.
This can be approximated using a second-order Taylor-series expansion:

$$\Delta x \approx \frac{1}{1!}\sum_{i=1}^{n}\frac{\partial\pi(p_0,w_0,z_0)}{\partial p_i}\left(p_{1i}-p_{0i}\right)+\frac{1}{2!}\sum_{i=1}^{n}\sum_{j=1}^{n}\frac{\partial\pi^2(p_0,w_0,z_0)}{\partial p_i\partial p_j}(p_{1i}-p_{0i})\left(p_{1j}-p_{0j}\right) \qquad (8)$$

Using Shephard's lemma and replacing ($p_{1i} - p_{0i}$) by $\Delta\, p_i$

$$x \approx \sum_{i=1}^{n} s_i\left(p_0,w_0,z_0\right)p_i+\frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n}\frac{\partial s_i\left(p_0,w_0,z_0\right)}{\partial p_i}\Delta p_i\Delta p_j \qquad (9)$$

To simplify (9) the partial in the second term is converted into a supply price elasticity (ε^{s}_{ij}):

$$\Delta x \approx s_i\left(p_0,w_0,z_0\right)p_i+\frac{1}{2}\varepsilon^{s}_{ii}\frac{s_i\left(p_o,w_0,z_0\right)}{p_{0i}}\Delta p_i\Delta p_i \qquad (10)$$

Where s_i is the supply of good *i* and p_i is price of good *i*. ε^H_{ii} is the own-price supply elasticity of good *i*.

When both sides are divided by the original expenditure (x_o) and multiply the top and bottom of the right side by p_{oi} , what you get is:

$$\frac{\Delta x}{x_0} \approx \frac{p_{0i} s_i(p_0, w_o z_0)}{x_0} \frac{\Delta p_i}{p_{0i}} + \frac{1}{2} \varepsilon^s_{ii} \frac{p_{0i} s_i(p_0, w_0 z_0)}{x_{0i}} \left(\frac{\Delta p_i}{p_{0i}} \right)^2 \quad (11)$$

As before, the production ratio is defined as the value of production of good i as a proportion of total expenditure (PR), and by substituting PR in (11), the result is:

$$\frac{\Delta x}{x_0} \approx PR_i \frac{\Delta p_i}{p_{0i}} + \frac{1}{2} \varepsilon^s_{ii} PR_i \left(\frac{p_i}{p_{0i}} \right)^2 \quad (12)$$

Combining the effect of the price change on the household as a consumer (6) with the effect of the price change on the household as a producer (12), the result is the following:

$$\frac{\Delta w^2}{x_0} \approx PR_i \frac{\Delta p_i}{p_{0i}} + \frac{1}{2} \varepsilon^s_{ii} PR_i \left(\frac{p_i}{p_{0i}} \right)^2 - CR_i \frac{\Delta p_i}{p_{0i}} - \frac{1}{2} \varepsilon^H_{ii} CR_i \left(\frac{\Delta p_i}{p_{0i}} \right)^2 \quad (13)$$

Where Δ w^2, the difference between the change in income and the compensating variation computed, is the second-order approximation of the net welfare effects of a price change on a household. If elasticities are set equal to zero, assuming no behavioural response of the household, a measure of the direct impact of price change is obtained:

$$\frac{\Delta w^1}{x_0} = (PR_i - CR_i) \frac{\Delta p_i}{p_{0i}} \quad (14)$$

Where Δw^1 is the first-order approximation of the net welfare effect of a price change. The term in brackets of equation (14) is the net benefit ratio (NBR) of good i and can be interpreted as "the elasticity of the cost of living with respect to the price of good i" (Deaton, 1989:4). For net producers of the good, the NBR is positive, negative for net consumers and equal to 0 if the household consumes as much as he produces. In other words, when the price of good i increases net producers will benefit, net consumers will be negatively affected and those with the NBR equal to zero will not be (directly) affected. As stated by Budd (1993: 589) 'the manner in which this ratio varies across the income distribution illuminates how a price change affects income across the income distribution'.

The definition of NBR, as formulated by Deaton (1989), providing a straightforward description of the consumption and production activities of the household, allows to predict the direction and the extent of the price change impact. Nevertheless, it has same limits that worth a mention.

First of all, Deaton's definition assumes market clearing and, accordingly, information about sales and purchases of the household are inferred from the quantity produced and consumed. Assuming that the share of production that is not consumed by the household is entirely sold to the market is highly questionable. When dealing with imperfect markets in rural areas in developing countries, market failures have to be taken into account and market clearing assumption is far from plausible. Likely, on the consumption side, considering total consumption of a good masks important information on its sources: a household may buy all the food it consumes from the market, may only consume what it produces by itself, and so forth. Instead, as the direct impact of a price change occurs through the market, it is fundamental to know how much the household is exposed to it.

An example may be useful at this point. Imagine a farmer producing 100 kg of rice per month and consuming 120 Kg per month. According to Deaton's definition, the household is a net consumer of rice. However, It may be that the household produces high quality rice (maybe for export) earning 10 bolivianos per kilo while, as it is a poor household, for its consumption needs, cheaper rice is bought and it costs

7 bolivianos per kilo. The total amount actually obtained by the selling is then 1000 bolivianos while the consumption expenditure is 840 bolivianos. If the value of sales/purchases of a good as well as quantity is taken into account, the household is not a net consumer anymore. According to a definition of net seller based on value of sales and purchases, if a price increase occurs, the household will actually benefit.

In the light of the considerations above, rather than taking into account production and consumption's quantities, one should be interested in the quantities actually sold and purchased by the household[52].

Secondly, Deaton's formula implies that all households face the same prices for the same product. However, consumers and producers face different prices, prices vary across regions and even within same regions, many varieties of the same product may be available to meet differences in taste or quality[53].

Seasonality, geographic location and choice of quality affect consumer prices while producers obtain different prices depending on their choices (or constraints) in terms of destination market or selling period. In addition, assuming a unique and undifferentiated price prevents to capture the heterogeneity that characterizes production, consumption and marketing choices of each household. Given that the strength of household surveys is actually to account for all this heterogeneity, their analysis should make rich use of it.

In line with relevant literature[54], the definition of NBR adopted in the present work differs from the original one in two aspects:

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[52] The shortcoming of the present approach is that the use of purchases and sales assumes no change in own-consumption. This prevents from capturing households' strategic changes: a price increase may induce households to reduce the amount of own-consumption and sell more to the markets if higher profits emerge. If marketing options are too costly, households may increase production and own-consumption to avoid higher prices for its purchases.

[53] Minot and Goletti (2000) use an extension of Deaton's definition of NBR allowing consumer and producer prices to differ and, furthermore, they use regional prices.

[54] Deaton (1989, 1997), Ivanic and Martin (2008), Aksoy and Dikmelik (2008) calculate the NBR subtracting household purchases to the value of amounts sold; Budd (1993) considers monetary values of sales and value of payments in kind; Minot and Goletti (2000) use production and consumption.

1. Only information on sales and purchases, rather than production and consumption, are taken into consideration to compute the NBR. By doing so, the focus is on the quantities actually involved in market transactions.
2. Monetary values of marketed quantities, as reported by respondents in the household survey, are used instead of matching quantities (from the survey) with undifferentiated price values collected from other sources.

Net sales are obtained by subtracting household purchases to the value of amount sold per each crop yields. The NBR is thus simply the net sales divided by total household expenditure.

Equation (14) can be re-specified as:

$$\frac{\Delta w^1}{x_0} = (SR_i - PR_i)\frac{\Delta p_i}{p_{0i}} \qquad (15)$$

Where SR is the value of amount sold over total expenditure and PR is the value of household purchases over total expenditure.

The net welfare effect due to price change can thus be computed for each product and each household.

By adding the computed compensating measure to the initial household expenditure level one is are able to assess whether and to which extent the price change improves or worsens the welfare condition of the household. Focus of the present work is the distributional effect of the increase in food prices in Bolivia. Detailed analysis is thus conducted to determine the impact at the very disaggregated level, trying to assess how and where benefits and losses are distributed across the country and along the expenditure distribution. Furthermore, by comparing each household's expenditure level pre and post the price shock with respect to an appropriate poverty line, an overall impact on poverty of the increase in prices is provided.

2.2.3 The model: limits

The methodology employed is far from perfect. This section highlights the limits and flaws that one has to be aware of before proceeding with the analysis.

First of all, as stated by Deaton and Case (1987:106), the formula above (15) is 'a good approximation for the net welfare effect when quantities consumed or produced do not change much, or for small price change'. The formula is unlikely to be a good approximation when quantity or price's changes are large which is, unfortunately, our case. Prices experienced a strong acceleration in the last three years and that might have induced households to change their behaviours. Consumption and productive patterns might have changed in response to the change in prices: households may switch consumption from more expensive products to substitutes, less affected by the price shock or they may reduce their purchases and find more convenient to increase own-production; incentives to foster output and productivity may rise.

Therefore, It is important to be aware that the model implemented considers only the first-order impact of food price change on the poor. As it might overestimate the actual impact, the results obtained have to be interpreted as a strictly lower bound measure of it. Although not incorporating behavioural response represents a limit, this, however, doesn't seem to particularly affect the solidness of the model: the present approach is consistent with relevant literature (e.g. Chen and Ravillon, 2004) and seems appropriate considering that (1) behavioural responses have to be very large to change direction of the impact[55] (Ivanic and Martin 2008: 5); (2) demand and supply elasticities for staple food are generally very low, especially in developing countries' context (Tyers and Anderson 1992); (3) demand elasticities are plausibly even lower when the increase in prices is generalized and it affects the entire category of food products.

[55] As they state, 'considering the net trade position of a household, or a country, reversal of the sign of the welfare impact requires that the net trade position be more than reversed when only the direct impacts of the price changes are considered.' (Ivanic and Martin, 2008: 5)

Therefore, It is reasonable to assume that the scope for modifying consumers' and producers' behaviours, in the short time-period considered (2005-2008), is relatively small.

The second feature of the model to point out relates to the labour market. The partial equilibrium analysis completely ignores the impact of a price change on wages. However, there is little doubt that, to a certain extent, an increase in food prices, by stimulating production and demand for agricultural labour, affects wages[56]. Furthermore, besides the direct impact on agricultural wages, higher food demand might indirectly affect non agricultural incomes. In areas where food production is the main economic activity, non farmers' income is likely to heavily depend on the expenditure possibility of farmers[57].

There is a lively debate and little agreement on how responsive wages are to food prices (Ravallion 1990). The spectrum of views is well summarized by, on one hand, Sah and Stiglitz's position (1987), that assume a food price elasticity of the agricultural wage rate close to unity, and, on the opposite side, by de Janvry and Subbarao (1986) assuming fixed, inelastic wage rate. A correct assessment of the impact of food price changes induced by wage responses requires the use of times series data on wage and price movements to estimate elasticities, like by Ravallion (1990)[58]. The estimation of elasticities is beyond the scope of the present work, while it is necessary to bear in mind that a price change might, to some extent, induce changes on the labour market. The model implemented ignores this and might then over-estimate the poverty impact of high food prices[59].

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[56] For more discussion on the critical role of factor markets in determining trade-poverty linkage, see Hertel *et al*. (2000, 2004), Hertel and Reimer (2004), Porto (2005), Harrison *et al*. (2002).

[57] Porto (2005) highlights this potential second-order effect showing that an increase in maize price in Mexico might generate benefits also to non farmers.

[58] See Ravallion (1990) for theoretical approach and empirical results on the welfare effect of price change on agricultural wages in Bangladesh.

[59] Ivanic and Martin (2008) calculate the poverty impact of food price change taking into account the labour market effect. According to their analysis, in Bolivia, the impact of poverty is 10% lower when the effect on wages is incorporated.

2.3 Data

The data were obtained from the household surveys “Encuesta de Hogares 2005”, conducted and made available by the Bolivian National Statistics Institute (INE – “Instituto Nacional de Estatistica de Bolivia”). The purpose of the survey is gathering information about the living conditions of the Bolivian society in order to generate poverty indicators and formulate policies and programs which contribute to the improvement of the household welfare conditions. The survey includes information about the socio demographic characteristics of the household, migration, wealth, education, employment, non-wage incomes, expenditure, housing and loans. The survey was conducted between November and December 2005. The survey’s sample consists of 4077 households, of which 1746 live in rural areas and 2331 in the urban[60]. The main dataset containing information on socio demographic characteristics, migration, incomes, expenditure and housing is accompanied by four more detailed datasets on food consumption, agricultural and processing food production and livestock holding.

The four datasets contain information at a very disaggregated level, collecting information on 64 food products consumed, 88 agricultural products produced and 33 processing food items. For the purpose of the present work the main interest is on the household’s food consumption and production, disaggregated at product level. The next sections describe in detail variables and statistics referred to consumption and production side.

2.3.1 Food consumption

The main dataset provides data on the components of consumption aggregated into four main classes: food items, non-food items, education and housing.

[60] Eight households were excluded from the analysis because of implausible responses on food consumption.

The food consumption class is further decomposed to distinguish food obtained by different sources. Food can (1) be purchased in the market place (either to be consumed inside or outside home), but also (2) be home-produced, (3) be received as a gifts or payment- in-kind for services rendered. While all the above components contribute to the definition of food consumption, for the purpose of this analysis the focus is on "purchased food", calculated on a monthly period[61]. In the survey, households report both quantities and expenditures for most of the food they purchase and with this information the relative budget shares can be computed. Given the high number of food items reported, some decisions have to be made to restrict the definition of food used throughout the analysis. Staple food items with a high relevance in the Bolivian context, in terms of both food consumption and production, were selected. The selected products were aggregated in the following categories: rice, wheat, maize, potatoes, milk, sugar, beef and poultry[62].

2.3.2 Food Production

The agricultural modules of the survey's questionnaire collect information about the production and own-consumption of 88 agricultural products produced, 33 processing food items. Data on livestock activities classify meat products in 6 categories. As mentioned above, the focus of the present analysis is on a set of 8 staple products which are relevant in terms of both households' consumption and production[63]. Data on rice, potatoes, maize and wheat are collected from the agricultural module; data

[61] Respondents were asked about quantity, monetary value and frequency of purchases. Purchases may occur daily, twice a week, once a week, twice a month, monthly, bimonthly, six-monthly or annually. Quantity, monetary value and frequency were converted into monthly equivalents to make them comparable across products and households.

[62] The aggregations computed refers to (1) potatoes: it includes different varieties of potatoes as well as "chuno", a processed product derived from a native variety of potato, the hardy "bitter potato", which is cultivated at altitudes as high as 4 300 m), (2) maize: different varieties and maize flour, (3)wheat: wheat flour and bread (given the high correlation between the two prices).

[63] For this reason some products have been omitted. Although relevant in the Bolivian economy they did not entirely satisfy those criteria. Products, such as soybeans and coffee were excluded because of their export-oriented marketing patterns. Fruits and vegetables because of high seasonality and price volatility.

on milk from the processing food section while beef and poultry are elaborated from the livestock production.

The survey collects information about cultivated area, production and value of production. Furthermore, the respondents are asked to report if part of the total production is sold to the market or own-consumed and if so data on quantity and market values are reported. For the purpose of the present work, only the quantity and value of products directly exposed to the market (and thus exposed to the price increase to be simulated) are of interest. Therefore, information about production actually sold is single out and the ratio of the monetary value of sales over the total household's expenditure consumption computed.

2.4. Summary statistics

2.4.1 Food consumption

The main dataset provides data on the components of consumption aggregated into four main classes: food items, non-food items, education and housing. Table 1 shows summary statistics on consumption and the breakdown into its components with disaggregation by regions, by location and by expenditure quintile. More than half of the total expenditure is devoted to food consumption. The figures differ significantly among urban and rural population with an average proportion of 50 percent in food consumption inside the household in the urban area and 70 percent in the rural one. Urban population devotes 11 percent of its expenditure in food consumption outside the household, while the rural figure is much less (5 percent). In line with the Engel's law, the share of food consumption declines with level of living. Households at the bottom of the expenditure distribution (the first quintile) spend on average 75.6 percent of their total expenditure in food and less than 3 percent in food consumed away from home. On the other hand, the share of food consumption in the richest quintile is about 36 percent (and 15 percent away from home). Therefore, poor

population devotes much less resources to other consumption components, such as education and housing[64]. According to the above food consumption patterns, poor and rural households are likely to be the most affected by an increase in food prices.

Table 2.1: Budget share by household group

Household category	Food Inside HH	Food Outside HH	Education	Housing	No food
BOLIVIA	59.21	8.48	5.64	9.04	17.59
Location					
URBAN	50.63	11.02	7.19	12.13	19.02
RURAL	70.70	5.09	3.58	4.92	15.69
Region					
CHUQUISACA	59.95	7.79	4.62	9.22	18.41
LA PAZ	58.17	9.50	7.24	8.59	16.48
COCHABAMBA	58.91	8.06	7.12	8.97	16.91
ORUR0	59.60	7.63	5.02	8.10	19.62
POTOSI'	64.89	5.46	4.18	7.03	18.41
TARIJA	56.37	10.70	5.16	9.60	18.15
SANTA CRUZ	56.30	9.48	5.26	11.45	17.49
BENI	62.34	8.11	3.89	8.78	16.86
PANDO	61.71	8.06	3.54	8.27	18.40
Expenditure group					
1st(poorest)quintile	75.60	2.98	4.59	5.50	11.30
2nd quintile	70.56	4.98	4.47	7.01	12.96
3rd quintile	62.95	7.28	5.16	8.94	15.65
4th quintile	56.13	9.35	5.65	10.35	18.49
5th quintile	38.68	15.24	7.70	11.96	26.40

Source: Author's calculation from Encuesta de Hogares 2005

The products selected for our analysis were aggregated in the following categories: rice, wheat, maize, potatoes, milk, sugar, beef and poultry. Table 2 shows budget shares for the selected categories with disaggregation by regions, by urban and rural and by expenditure quintiles. Beef and poultry meat exhibit, on average, the highest values. Among the agricultural products, the most important products are wheat, rice, sugar and potatoes. The analysis of the budget share by expenditure consumption

[64] On average, expenditure in education accounts for about 5 percent of the total household expenditure with significant differences between rural (3.58) and urban (7.19) and first and fifth quintile (4.59 and 7.70 percent). Housing consumption is more relevant in urban area while no food consumption (transport, water, electricity bills, rents) on average accounts for 17 percent of total expenditure with important variation among quintiles of expenditure (11.30 percent in the first quintile and 26.40 in the fifth quintile).

quintiles is extremely insightful. The share of rice, sugar and wheat decline fairly steadily, with share of rice falling from 4.24 percent in the first quintile to 1.32 percent in the last quintile, from 4.27 percent to 1.01 percent for sugar and from 4.15 to 2.33 for wheat. Also shares of potatoes and maize fall with higher expenditure levels although for potatoes expenditure elasticity is quite low. On the contrary, meat products and milk exhibit patterns of luxury goods: their budget shares increase significantly in richer households.

Table 2.2: Budget share of selected food products

	Rice	Potatoes	Maize	Wheat	Sugar	Milk	Beef	Poultry
Bolivia	2.79	1.64	0.31	3.86	2.32	0.89	5.67	2.82
Location								
URBAN	2.22	1.71	0.20	4.18	1.69	1.25	6.77	3.51
RURAL	3.57	1.56	0.46	3.44	3.17	0.41	4.22	1.91
Region								
CHUQUISACA	2.49	1.24	0.20	2.67	2.28	0.60	3.69	2.35
LA PAZ	2.59	1.44	0.20	4.28	2.10	0.59	5.95	2.29
COCHABAMBA	2.56	2.36	0.24	3.41	2.29	1.11	5.36	2.87
ORURO	2.71	1.83	0.33	3.91	2.26	0.41	4.21	1.81
POTOSÍ	3.27	1.57	0.37	3.87	2.67	0.35	4.23	1.79
TARIJA	1.53	1.30	0.42	3.76	2.41	0.97	5.19	3.94
SANTA CRUZ	2.91	1.71	0.31	4.30	2.18	1.67	6.59	4.33
BENI	3.93	1.35	0.61	4.40	2.83	1.33	9.85	2.47
PANDO	5.51	1.38	0.57	2.83	2.58	0.82	7.82	4.04
Exp. Quintiles								
1st Quintile	4.24	1.76	0.43	4.15	4.27	0.25	3.10	1.02
2nd	3.85	2.12	0.39	4.74	3.06	0.57	5.81	2.83
3rd	2.93	1.91	0.32	4.66	2.19	0.87	7.17	3.26
4th	2.30	1.61	0.29	3.81	1.80	1.25	7.01	3.90
5th	1.32	0.98	0.17	2.33	1.01	1.29	4.82	2.68
Poverty								
no poor	1.96	1.34	0.26	3.15	1.47	1.16	5.83	3.15
moderate poor	3.25	1.98	0.34	4.66	2.59	0.84	6.71	3.09
extreme poor	4.18	1.92	0.40	4.49	3.99	0.34	3.91	1.67

Source: Author's calculation from Encuesta de Hogares

2.4.2 Agricultural Production

Before proceeding with the analysis and given the importance of understanding the country-specific context, a more detailed analysis is presented on the Bolivian agricultural (and pastoral) sector, paying particular attention to regional productive and marketing patterns[65].

While farming accounts for only 11% the gross domestic product (GDP), about 38% of the working population is engaged in agriculture (including small numbers in livestock holding, forestry, and fishing and coca production).

Historically, land productivity and its unequal distribution have been major problems in the Bolivian economy. According to the 2nd survey "Censo Nacional Agropecuario", 56% of agricultural households are small farmers, with an average farm size of 20 hectares covering only 3.71% of the total land area. On the other hand, 3.86% of households has at least 100 hectares of land, holding 90.94% of the all area. Furthermore it is to note that households having less than 5 hectares of land account for 68.16% of the total agriculture population[66]

The agriculture sector is characterized by a strong dualism where a modern agro-industrial activity in the East stands in contrast to traditional small-scale and subsistence farming in the mountainous West, especially on the cold and windy high plateau ("altiplano")[67]. The domestic traditional agricultural sector has been the main

[65] This section is based on UDAPE (2005) and FAO (2008c).

[66] Apart from the unequal distribution of land, the agriculture sector is affected by issues of different nature: morphological constraints, low land quality with high risk of erosion, frequent climate shocks, weak legal security and protection of property rights and a modest level of investment in infrastructure and capital.

[67] The small farmers of the Andean region, "los campesinos", represent about 500-600 thousand households. In the Andean region, agricultural development is strongly constrained by morphology and adverse climate. Farms are small and overexploited and the main products are potatoes, maize, wheat, quinoa and, in some areas, fruits and vegetables.

Medium and large farms are mainly located in the Department of Santa Cruz where about 50-70 thousand farming units exist. Production is strongly export-oriented and specialized in products for the agri-industry, such as soybeans, wheat, maize, sorghum, cotton, sugar canes and rice. Regional isolation and transport costs challenge the distribution and competitiveness of agricultural products from the region. The region is badly connected to the main domestic cities and to the neighbour

food supplier of the country even if its importance has been increasingly challenged by imports from international markets. The extent and the channels by which agricultural production is marketed strongly differ among regions and products. Generally speaking, in highly insulated areas production is mainly devoted to own-consumption while in accessible areas, close to the main capitals' markets, production is generally market oriented.

The selected products, to be used in the empirical experiment (rice, maize, wheat, potato, sugar) were chosen taking into consideration their importance in both production and consumption in the Bolivian context and table 5.3 reports relative figures on total cultivated area, production, yield and value of production. [68]

Table 2.3: Area, Production and Yield of selected agricultural products, Bolivia 2005

DESCRIPTION	Cultivated area (hectares)	Production (tons)	Yield (tons/hectares)	Value of prod. (Million Bolivianos)*
Rice	197864	526836	2.66	304
Maize	337779	816736	2.42	727
Wheat	110295	119227	1.08	127
Sugar canes	108309	5112222	47.20	372
Potato	134375	761891	5.67	853

Source: INE and FAOSTAT (*)

Given the highly diversified production and marketing characteristics of Bolivian agriculture, a deeper analysis is needed and data form the Encuesta de Hogares are used to provide average production, sales and own-consumption for each product reported in table 5.4[69].

countries. Railroad is the main channel of import-export distribution that connects Santa Cruz to Brazil and Argentina.

[68] See appendix for figures on the total agricultural production. Soybeans, potato, maize are the most important products in the Bolivian economy, followed by sugar canes, cassava and rice. Soybeans were omitted despite the high value of production because it's mainly export-oriented with no relevance in the Bolivian food diet.

[69] See appendix for figures disaggregated at the regional level.

Table 2.4: Average Production, marketing and own-consumption of selected agricultural products

	Producers[1]	Seller[2]	Cultivated area[3]	Production[4]	Sales[4]	Consumption[4]	Ratio sales[5]	Ratio Consumption[6]
Rice	4.39	3.14	2.71	108.76	90.83	7.43	0.62	0.24
Maize	16.87	9.78	16.07	39.66	24.34	5.08	0.54	0.21
Wheat	7.48	3.41	22.85	20.92	15.15	2.69	0.48	0.26
Sugar	0.17	0.073	13.35	5963.76	5601.45	7.24	0.97	0.01
Potato	25.31	14.79	8.11	38.98	23.47	7.35	0.49	0.26

Source: Author's calculation based on Encuesta de Hogares 2005

[1]Proportion of households that are producers [2]Proportion of households that sell to the market

[3] Hectares [4]Quintals [5] Ratio quantity sold over total production

[6]Ratio quantity own-consumed over total production

Cultivated in the Bolivian Andes for thousands of years, the potato is today the country's most important food crop, along with soybeans, with a value of production of 853 million Bolivianos. It is grown across some 135 000 hectares of land by an estimated 25.31 percent of the total households. However, only 15% of the households is engaged in marketing activities of potato as an important fraction of the production is directed to household consumption. Maize is also very relevant, in terms of households engaged (about 17%) and total value of production (727 million Bolivianos). Its production is highly concentrated in the regions of Chuchisaca and Santa Cruz. Rice production is concentrated in the humid regions of Beni, Cochabamba and Pando. The country produces 530.000 tons of rice for a value of 300 million Bolivianos. Less than 5% of the total households are involved in rice growing and a significant part of them sells it to the market.

Wheat production records a value of 127 million Bolivianos and more than 7% of the Bolivian households grows wheat but only half of them sell to the market. Wheat is grown across more than 100.000 hectares of land with an average cultivated land per household of 22.85 hectares. Sugar represents an important component of the industrial agricultural sector in Bolivia. More than 5 million tons of sugar canes are produced for a value of 373 million Bolivianos. The production is highly concentrated in few large farms in Santa Cruz where most of the production is sold to the market.

2.5 Price

International real food prices have experienced a rising trend since 2000 and a dramatic acceleration in 2008. The FAO Food Price Index[70] shows an extraordinary increase in food prices in 2008. The March 2008 index averaged 220, a 57 percent increase from the March 2007 one, when the index of 157 was already up 23 percent from 2006. Rice, wheat, maize and dairy products are the most affected commodities[71]. By the end of March 2008 prices of wheat and rice were about twice their levels of a year earlier, while those of maize were more than one-third higher[72].

In a recent paper, Ivanic and Martin (2008) conducted an analysis on the poverty impact of high food prices on some developing countries, including Bolivia. They calculate the impact on poverty using a national poverty line corresponding to the $1 per day international definition of extreme poverty. To simulate the increase in prices they obtained average annual prices from FAO and calculated rough percentage changes over 2005-2007 period. Following Mundlak and Larson (1992), they assume that "price transmission between world and domestic markets is approximately complete under normal market circumstances and specify a unitary elasticity of price transmission"[73].

However, that assuming full price transmission is not correct. Perfect price transmission requires well-functioning rural markets with low transaction costs, assumptions quite far from feasible in developing countries environments[74]. Furthermore, this is particularly true in the light of the actual price spike's context where Government policies designed to avoid large price shock were implemented

[70] The FAO Food Price Index consists of the average of 6 commodity group price indices weighted with the average export shares of each of the groups for 1998-2000: in total 55 commodity quotations considered by FAO Commodity Specialists as representing the international prices of the food commodities noted are included in the overall index.
[71] FAO Price indices are shown in Table 9a in the appendix.
[72] FAO (2008).
[73] Ivanic and Martin (2008: 15).
[74] The extent to which outside prices are transmitted to local economies can range from perfect to nil. To date, there has been little effort to empirically test for price transmission in rural economies (two exceptions are Larson, 2002; Rozelle, 2002). There is evidence, however, that imperfect price transmission results in isolated markets for factors and goods in some areas (Valdes, 2002).

and the depreciation of the US dollar tent to reduce transmission from world to domestic markets. A brief comparison between world and Bolivian price changes (see table 5) shows the inaccuracy of simply assuming full price transmission. The figures, even if not easily comparable[75], strongly differ and do not show any significant linear correlation.

Table 2.5: Domestic and world price change (2005-2008)

Product	Domestic price change	World price change
Rice	71.70	162.63
Potato*	48.22	-
Maize	51.33	147.34
Wheat	42.75	171.38
Sugar	23.54	27.78
Milk	25.33	98.22
Beef	48.91	17.43
Poultry	66.14	50

Source: Author's calculation on data by INE

* No world price available

Given the difference between world and domestic market prices, the analysis is conducted using prices collected at the more decentralized level available in order to capture not only the international-domestic differences but also the potential variation across locations in Bolivia. In the empirical experiment to follow, the initial level of prices is indirectly provided by the household survey. By using the household's response on monetary values of purchased quantities per each product to calculate the budget share, data on prices are incorporated. These data are much more accurate than any others collected from other sources as they are the prices actually paid by each household, taking into account the household specific location, taste and choice of quality. However, for information about prices in 2008 and price changes from 2005 to 2008, there is no choice but to use data collected from external sources[76]. However, data available at the commodity level are limited.

[75] The world price changes are computed as variation between 2005 and 2008 prices for food categories as obtained from FAOSTAT. Bolivian price changes are computed as variation between February 2005 and February 2008 average price for the selected products. Bolivian data come from the INE website.

[76] Note that at time of writing the 2005 household survey is the most recent available.

Data at the most decentralized level are obtained from the national institute of statistics (INE) which collects time series of most commodity prices at a regional level. Prices are collected at the markets of the four main cities of the country (La Paz, Cochabamba, Santa Cruz, and El Alto) where 60% of the population lives. It is possible therefore to calculate price changes over the period February 2005-February 2008 disaggregated at the regional level and the results are reported in the table below[77].

Before proceeding with the next section, a deeper look at spatial price variation is provided. Data on spatial and temporal price variation reveal a complex picture. Prices vary significantly across the cities, to a degree not easily explained by geographic location or transportation costs, a fact that suggests the existence of local markets and prices.

It is plausible that price variation is more product-specific rather than region-specific. Food production patterns differ across the country and depending on the local availability of each product, price may vary substantially. An evidence of this is the patterns of sugar price: Santa Cruz, capital city of the only region that produces sugar, exhibits the lowest price levels in both 2005 and 2008. Also the price change in this three years time is the lowest.

A significant problem still remains. Even if 60% of the population is likely to actually face the price changes collected, there is a large proportion of population excluded and for which information about price changes are totally unknown. Assessing the degree of price transmission to rural population and to remote regions, distant from the main markets considered, is a difficult task: high transaction costs in product and factor markets may isolate some households from outside markets, limiting or blocking the transmission of shock influences[78]. When transaction costs isolate local economies from outside markets, demand and supply may be linked by endogenous, local prices.

[77] As more recent prices referred to the 2008 are not available, February 2005 prices are used to avoid seasonality price biases.

[78] This is the concept of missing market elucidated by Strauss 1986 and de Janvry *et al.* (1991).

Dynamics of price transmission to rural areas play an important role in determining the magnitude and spatial variation of price shock impact and it is of extreme interest *per se*. However, without available time series on rural prices, our analysis cannot be extended beyond a theoretical discourse. Some assumptions have to be made. From the analysis of the price characteristics in the four main cities emerged a complex picture. If prices do not exhibit any specific geographic pattern, one cannot either assume that the most distant regions, being the most isolated, will face an undifferentiated lower price elasticity. Assuming that household living in the four cities' surrounding areas are exposed to the capital city prices seems a good option but it leaves unsolved the issue with respect to the remaining regions. For sake of simplicity, the empirical analysis to follow will thus assume that population living in different locations than the four cities considered, will experience a price change equal to the average increase occurred in the four cities (the average are those reported in table 6 above). This is a quite rude simplification of the reality but lack of data prevents from more accurate and realistic solutions.

Further analysis of price dynamics in Bolivia is needed but that goes beyond the aim of the present work. This section only provides some interesting highlights on the complexity of price dynamics across the country. This awareness makes the decision of using price data at the most disaggregated level more convincing and appropriate.

Table 2.6: 2005-2008 price changes by product and market, Bolivia (Bolivianos)

PRODUCT	LOCATION	PRICE 2005	PRICE 2008	PRICE CHANGE
Bread (unit)	LA PAZ	0.35	0.4	14.29
	COCHABAMBA	0.25	0.4	60.00
	SANTA CRUZ	0.18	0.25	38.89
	EL ALTO	0.3	0.4	33.33
Rice (pound)	LA PAZ	2.2	3.5	59.09
	COCHABAMBA	2	3.7	85.00
	SANTA CRUZ	1.96	3.51	76.14
	EL ALTO	2.2	3.6	63.64
Maize (pound)	LA PAZ	2.75	3.5	27.27
	COCHABAMBA	2.27	3.63	60.00
	SANTA CRUZ	2.15	3.4	57.89
	EL ALTO	2.5	4	60.00
Wheat flour (pound)	LA PAZ	1.5	2.2	46.67
	COCHABAMBA	1.43	2.72	90.48
	SANTA CRUZ	1.47	2.27	53.85
	EL ALTO	1.5	2.1	40.00
Beef meat (boneless)* (Kg)	LA PAZ	19	28	47.37
	COCHABAMBA	16	25.5	59.38
	SANTA CRUZ	18	27.5	52.78
	EL ALTO	16.5	25.5	54.55
Beef meat (Kg)	LA PAZ	13	18.5	42.31
	COCHABAMBA	12.75	19.5	52.94
	SANTA CRUZ	11.5	16.5	43.48
	EL ALTO	13	18	38.46
Chicken (Kg)	LA PAZ	9	15	66.67
	COCHABAMBA	8.5	15	76.47
	SANTA CRUZ	8.5	12.75	50.00
	EL ALTO	8.75	15	71.43
Milk (1l)	LA PAZ	3.5	4.4	20.00
	COCHABAMBA	3.2	4	25.00
	SANTA CRUZ	3.3	4	21.21
	EL ALTO	3.4	4.4	23.53
Potatoes (Kg)	LA PAZ	1.74	2.52	45.00
	COCHABAMBA	1.64	2.61	59.27
	SANTA CRUZ	1.91	2.87	50.00
	EL ALTO	1.74	2.43	40.00
Sugar (Kg)	LA PAZ	3.39	4.35	28.21
	COCHABAMBA	3.97	4.85	22.22
	SANTA CRUZ	3.20	3.80	18.75
	EL ALTO	3.30	4.13	25.00

Source: Author's calculation on data by INE* INE collects differentiated prices for boneless meat and meat.

2.6 Poverty

When measuring welfare in developing countries' context, 'there is a very strong case in favour of using measures based on consumption not income' (Deaton 2002: 148). Consumption is considered to better reflect lifetime welfare than current income, the latter being more variable and subject to seasonality's bias.

To compute poverty measures, consumption is used as indicator of welfare and regional poverty lines, computed by the INE, based on data from the 2005 Encuesta de Hogares are adopted. The poverty lines consist of two different lines (poverty line and extreme poverty line) adjusted for differences in the cost of living across regions and between urban and urban areas.[79] Their construction is based on the CBN method, as recommended by the World Bank. Furthermore, the poverty measure obtained using extreme poverty lines by INE is fairly close to the one obtained using the standard "dollar-a-day"[80] consumption-based measures of poverty.

Table 2.7: Poverty lines, Bolivia 2005 (Bolivianos)

Geographical location	Poverty line	Extreme poverty line
RURAL	281.5179	160.4652
URBAN:		
CHUQUISACA	367.3217	194.1709
LA PAZ	368.7720	205.0372
LA PAZ (EL ALTO)	299.5632	181.8349
COCHABAMBA	384.4968	194.1709
ORUR0	335.3385	205.0372
POTOSI'	308.4184	205.0372
TARIJA	384.4968	194.1709
SANTA CRUZ	388.8344	197.5279
BENI	388.8344	197.5279
PANDO	388.8344	197.5279

Source: INE

[79] The poverty lines adopted are reported in table 7.

[80] According to this definition, a person is poor if he/she consumes less that 1.08 USD in 1993 Purchasing Power Parity terms. The dollar-a-day poverty line on Bolivia 2002 is taken from the 2007 World Bank World Development Indicators (WDI).

Based on the lines described above, three measures, developed by Foster, Greer and Thorbecke (1984), are computed to provide a profile of poverty in Bolivia: headcount ratio, poverty gap index and squared poverty gap[81].

Table 8 shows the poverty profile for different population sub-groups. The headcount index highlights the fact the rural poverty is more severe than urban one. In fact, the incidence of poverty is three times higher in the urban population. The index reveals a quite unequal geographical picture. Chuquisaca, Potosì and Cochabamba exhibit the highest incidence of poverty with indices well above the national average. Pando and Santa Cruz have the lowest poverty incidence as well as the minimum scores for the other poverty measures. The analysis of the other poverty measures shows significant discrepancies among sub-groups. In particular, the poverty gap scores four times higher in the rural area than in the urban one and the severity is almost six times higher. Chuquisaca and Potosì from all the measures considered have the highest and most severe concentration of poverty. Table 9 shows the difference of indexes between households living in capital cities and in the rest of the department. It is evident that the average values conceal significant poverty disparity: the capital cities exhibit much lower indexes than the rest of the department. However, given the high share of population living in the cities, in absolute terms, cities contain the largest share of poor people.

[81] The set of poverty measures is defined by $P_\alpha = (1/N) \sum [(z-x_i)/z]^\alpha$, where N is total population, z is poverty line, x_i is income of poor household i, and the summation is limited to poor households.

Table 2.8: Poverty measures, Bolivia 2005

	Headcount	Poverty gap	Squared Poverty gap
BOLIVIA	21.14	6.67	3.10
Location			
URBAN	10.76	2.74	1.03
RURAL	35.01	11.91	5.87
Region			
CHUQUISACA	39.09	16.22	8.98
LA PAZ	19.14	5.28	2.18
COCHABAMBA	25.16	7.69	3.40
ORUR0	14.47	3.88	1.76
POTOSI'	35.81	12.92	6.39
TARIJA	16.47	5.06	2.21
SANTA CRUZ	11.83	2.45	0.82
BENI	16.36	5.18	2.44
PANDO	7.63	2.18	1.02

Source: Author's calculation based on Encuesta de Hogares 2005

Table 2.9: Poverty measures, by location Bolivia 2005

	Headcount	Poverty gap	Squared Poverty gap
BOLIVIA	21.14	6.67	3.10
LA PAZ	19.14	5.28	2.18
Capital city	5.14	1.02	0.33
Rest of Department	23.59	6.63	2.76
COCHABAMBA	25.16	7.69	3.40
Capital city	8.62	2.19	0.89
Rest of Department	31.33	9.73	4.33
SANTA CRUZ	11.83	2.45	0.82
Capital city	4.50	1.16	0.53
Rest of Department	15.47	3.08	0.95

Source: Author's calculation based on Encuesta de Hogares 2005

2.7 The net benefit ratio

The figures about food sales, purchases and the computed NBR for the aggregated products considered are given in table 8.1.

The results show that on average the percentage of sales over the total expenditure is 9.7 and the average percentage of food purchases over the total household

expenditure is 20.5[82]. Therefore, on average, the NBR for the Bolivian context is negative (-10.81) and predicts an adverse impact of high food prices on the overall welfare.

Only 13.12% of the household are net sellers and, as expected, the figure significantly differs between rural and urban population. The share of net sellers among the rural population is much higher (26.82 percent) while only 2.87% of the urban population is net sellers. As net sellers constitute just a little more than one-fifth of the households, one can say that the majority of the population, also in rural areas, is net food buyer.

Given that, the next objective is to explore net sellers' position with respect to the poverty line based on the cost-of-basic-needs (CBN) method.

A relevant proportion of poor population is net seller: about one-forth of the extreme poor population and almost one-third of those at the bottom 20 percent of the expenditure distribution. That seems to suggest that although there are more net food buyers than sellers, the latter are, on average, very poor and, therefore, an increase in food prices will be welfare improving for that fraction of the extreme poor population. At the regional level, on average budget share for food consumption are quite similar across countries and they range between 15.71% (Chuquisaca) and 26.87% (Beni). Instead, the picture of food sales (as percent of total expenditure) is much more diversified. Beni, Chuquisaca, Santa Cruz exhibit the highest average values (respectively 26.26%, 16.41% and 12.33%) while Oruro, Pando and Potosì have much lower values (3.01%, 3.13% and 4.9%)[83]. However, only Potosì has an extraordinary high proportion of net sellers (88.74% of the population with NBR

[82] An important comment on the food expenditure ratio is appropriate. According to the Engel's law, poor people generally spend a higher ratio of their expenditure in food than rich people. These figures do not reveal such trend because the focus here is on food purchases and not on total food consumption. Food consumption includes own-consumption, transfer in kind which represent significant components of poor and especially poor rural households' food consumption patterns. If those quantities were taken into account one would get results consistent to the Engel's law.

[83] There is no clear interpretation of the diversified patterns of sales and purchases among and within regions. If the regions recording highest selling production values exhibit the highest purchases ratios, one could infer that they are simply the most exposed (close) to market. However this doesn't seem the case because very different selling patterns correspond to quite similar purchases ones.

higher than zero), followed by Chuquisaca (32.73%). The other regions show much lower proportion (between 4 and 16%). The relative NBR results show also high heterogeneity: apart from Chuquisaca, the only region that on average benefits from an increase in prices, with NBR of 0.7%, the average NBR ratios for all the other regions are negative, with values ranking from -22.48% in Pando to -0.6 in Beni. Therefore, the most negatively affected region is Pando, followed by Oruro (-14.68%), Potosì (-13.38%), Tarija (-13.37%) and La Paz (-13.2%).

Table 2.10: Food sales, purchases and net sales by household group

Household category	Food sales*	Food purchases*	NBR	Net sellers	Net buyers
	(average percentage)			(percent of households)	
BOLIVIA	9.70	20.52	-10.81	13.12	86.88
Location					
URBAN	4.31	21.70	-17.39	2.87	97.13
RURAL	16.91	18.94	-2.02	26.82	73.18
Poverty line					
No poor	6.45	18.48	-12.03	6.63	93.37
Moderate poor	11.57	23.67	-12.10	14.43	85.57
Extreme poor	14.93	21.11	-6.18	26.80	73.20
Region					
CHUQUISACA	16.41	15.71	0.70	32.73	67.27
LA PAZ	6.39	19.60	-13.20	12.27	87.73
COCHABAMBA	11.39	20.43	-9.04	16.09	83.91
ORUR0	3.01	17.691	-14.68	7.11	92.89
POTOSI'	4.94	18.33	-13.38	88.74	11.26
TARIJA	6.40	19.78	-13.37	12.06	87.94
SANTA CRUZ	12.33	24.20	-11.86	10.48	89.52
BENI	26.26	26.87	-0.60	8.18	91.82
PANDO	3.13	25.62	-22.48	4.24	95.76
Expenditure group					
1st(poorest)quintile	16.78	19.42	-2.64	30.85	69.15
2nd quintile	11.12	23.58	-12.45	19.31	80.69
3rd quintile	12.87	23.57	-10.70	11.38	88.62
4th quintile	5.10	22.14	-17.03	6.21	93.79
5th quintile	5.29	14.72	-9.42	3.94	96.06

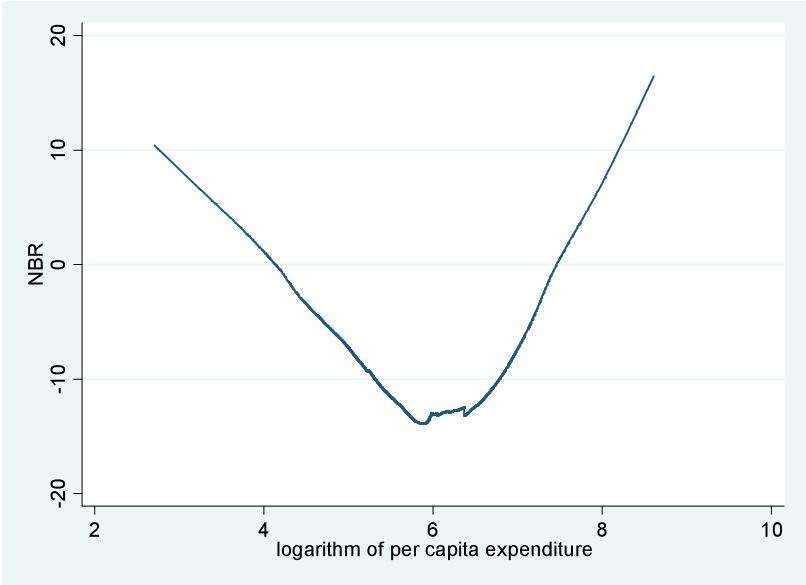
Source: Author's calculation from Encuesta de Hogares 2005

- Percentage over total expenditure

As in Deaton (1997: 194) nonparametric techniques are employed to provide a clear, graphical picture of the relationship between the net benefit ratio and level of living[84]. Figure 1 shows the non parametric regression of the net benefit ratio on the logarithm of per capita expenditure, that is, the conditional expectation of the net benefit ratio given expenditure.

Density functions can be thought of as smoothed histograms (Budd, 1993:589) and they "provides the answer to the question of by how much the people at each level of living would benefit from an increase in the price. Since the net benefit ratio expresses the benefit as a fraction of total household consumption, a flat line would show that all rural households benefit proportionally, so that the change would be neither regressive nor progressive. A positive slope would indicate that that benefits are proportionally larger who those who are better-off, and vice versa for a negative slope" (Deaton 1997: 195-6).

Figure 2.1: Net benefit ratio, Bolivia 2005



Source: Author's calculation from Encuesta de Hogares 2005

[84] Non-parametric techniques are used to obtain graphical representation of densities or the relationship between two variables without having to impose a parametric form either to the density or to the relation between the two variables considered. As in Budd (1993: 589) 'As no structure is imposed on the data, each point of the graph is simply a conditional expectation'.

In fact, the graph shows peculiar patterns: it is the households in the middle of the distribution who are the most affected by a price increase. As one moves from the middle of the distribution towards both tails, the net benefit ratio increases, showing a less adverse impact of price increase on the better-off and those at the bottom of the expenditure distribution[85].

2.8 Welfare Impact of a 10 percent Price Increase (Aggregated Food Definition)

In this section, the direct impact of a homogeneous 10% increase in the prices of the composite food items is considered. By multiplying the NBR for the 10% price change, the first-order approximation of the net welfare effect is obtained (expressed in percentage). By adding the real expenditure change to the old level of expenditure, the new expenditure level can be computed. Furthermore, the new expenditure level is compared to the established poverty line in order to assess the poverty impact. The results are presented in table 11.

A 10% increase in food prices, on average, results in a welfare reduction of 1.08% and the figure is relatively higher in urban than rural area. There is no significant variation among the different regions, apart from the region of Pando which is the most affected (-2.24%) and Chuquisaca which is the only region recording a small but positive impact on real expenditure (0.07%). The second column shows the poverty distribution by household group estimated from the 2005 survey, the third column describes the poverty distribution after the price shock and the variation between the two rates is then summarized in the last column.

[85]Bear in mind that one has to be cautious with the interpretation of the extreme tails of the curve due to width of standard errors and the small number of observations at each end of the income distribution that may bias the picture. The graph is likely to best represent the population in the middle of the distribution. .

Table 2.11: Welfare impact of 10 percent price increase (aggregated food definition)

Household category	Change in real expenditure (%)	Poverty rate Pre-shock	Poverty rate Post-shock	Poverty impact (%)
BOLIVIA	-1.08	21.14	21.56	0.42
Location				0
URBAN	-1.73	10.76	11.58	0.82
RURAL	-0.20	35.01	34.90	-0.11
Region				0
CHUQUISACA	0.07	39.09	38.48	-0.61
LA PAZ	-1.32	19.14	19.82	0.68
COCHABAMBA	-0.90	25.16	24.69	-0.47
ORUR0	-1.46	14.47	15.79	1.32
POTOSI'	-1.33	35.81	35.81	0
TARIJA	-1.33	16.47	17.06	0.59
SANTA CRUZ	-1.18	11.83	12.28	0.45
BENI	-0.06	16.36	18.22	1.86
PANDO	-2.24	7.63	8.47	0.84

Source: Author's calculation from Encuesta de Hogares 2005

The average figure forecasts on average an increase in poverty of 0.42%. The average masks important information about the poverty impact among rural and urban population. Poverty is expected to increase by 0.82% in the urban area whereas rural population experiences a small poverty reduction (-0.11%). Accordingly, in the regions with the highest poverty rates, Chuquisaca, Cochabamba and Potosì, no poverty increase occurs (in Chuquisaca and Cochabamba poverty decreases by 0.61 and 0.47%). The regions that exhibit the most acute poverty increase are Beni (1.86), Oruro (1.32) and Pando (0.84).

2.9 Welfare Impact of a 10 percent Price Increase (Commodity Level)

In this section, the previous analysis is repeated at the commodity level to assess how the poverty impact differs across food products. Before looking at each product in detail, the average results for the all country are briefly discussed. Table 12 shows the average results for each food category considered. Column one and two report

the ratio of sales and purchases with respect to total expenditure, column three the net benefit ratio; column four the percentage of net sellers over the total population and the final column shows the poverty impact of a homogeneous 10% price increase.

The highest average food sales ratio are the ones referred to potatoes, beef and rice (2.68%, 2.25% and 1.83) while the sales of wheat, sugar, milk and poultry on average account for very small fraction of the expenditure. The figures on food purchases show that beef is on average the most important component of the food basket considered with a budget share of 5.67%. Wheat, poultry, rice and sugar are also very significant with shares between 2.32 and 2.862% of the total expenditure level. Potatoes and maize are not very significant component of the household expenditure but this might be due to a high own-consumption component. Potatoes and maize exhibit the highest proportion of net sellers. 14.03% of the Bolivian population is net seller of potatoes, so that would benefit from a price increase, as revealed by the positive relative NBR (1.04). Similar figures refer to maize with 9.91% proportion of net sellers and positive NBR (0.79). According to the average figures, wheat, beef, poultry and sugar have the most negative welfare impact. A 10% price increase results in a small increase in poverty rate for all the products with the exception of potato.

Table 2.12: Welfare impact of 10 percent price increase (commodity level)

	Food sales*	Food purchases*	NBR	Net sellers (%)	Poverty impact (%)
Rice	1.83	2.79	-0.96	2.65	0.05
Potatoes	2.68	1.64	1.04	14.03	-0.22
Maize	1.1	0.31	0.79	9.91	0.03
Wheat	0.24	3.86	-3.62	2.80	0.2
Sugar	0.17	2.32	-2.15	0.07	0.15
Milk	1.15	0.89	0.26	2.62	0
Beef	2.25	5.67	-3.42	5.20	0.13
Poultry	0.26	2.82	-2.55	4.15	0.05

Source: Author's calculation from Encuesta de Hogares 2005

* Percentage of total expenditure

The average figures, however, do not provide a satisfactory and accurate picture. In order to deepen the analysis of the distributional impact of a price increase, one needs to look at figures at a more disaggregated level, differentiating the impact over regions and expenditure quintiles. This is the aim of the next sub-sections.

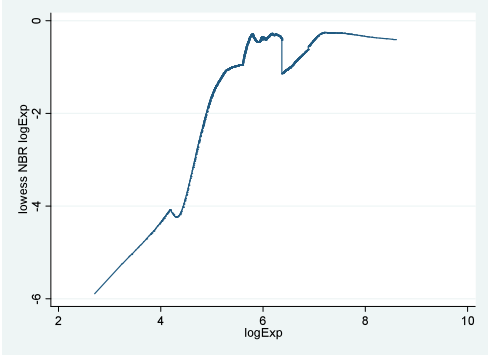
Figure 1 shows the non parametric regressions of the net benefit ratio on the logarithm of per capita expenditure for each commodity[86]. From a first look at the figures, one easily notes the extreme heterogeneity. The underlying structure is upward sloping for rice and sugar, definitely downward sloping for potatoes and maize. The NBR presents a U shape for wheat, beef and poultry while milk reveals an inverted U shape. This heterogeneity immediately suggests that general statement on the distributional impact of a uniform price increase in Bolivia is inappropriate. Each product's ratio presents peculiar features, based on the specific production and consumption patterns Therefore, for each product, a price increase affects households differently, generating benefits for some and losses for others.

As the aim of the present work is to figure out how the poor population is affected by the current price increase, the focus is given to the household at the lower end of the expenditure distribution. Furthermore, the analysis attempts to point out those household categories likely to be suffering the most acute impact.

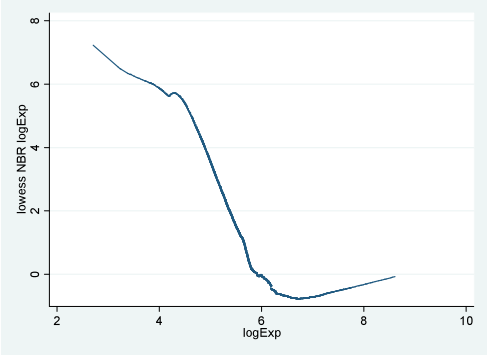
[86] See Appendix for tables on NBR and poverty impact by location and quintile for each product.

Figure 2.2: Net benefit ratio, by commodity

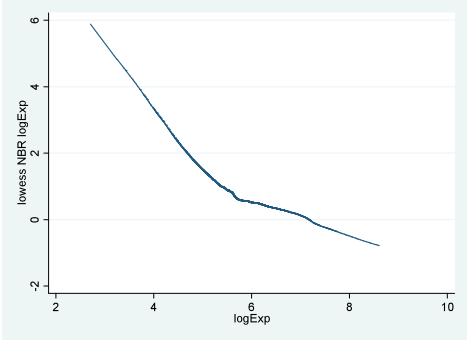
Rice



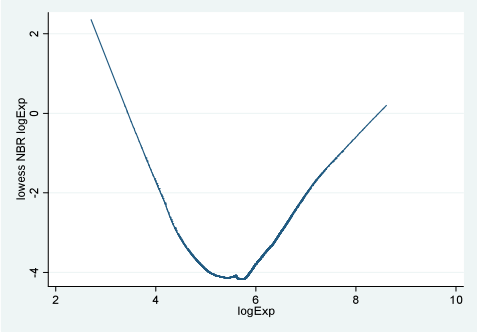
Potatoes



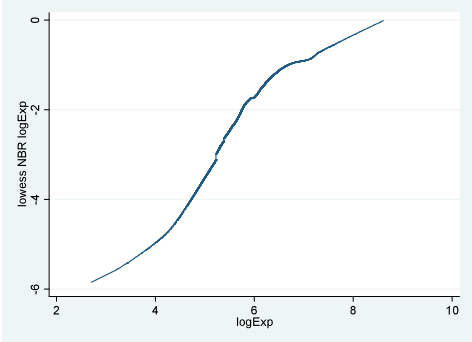
Maize



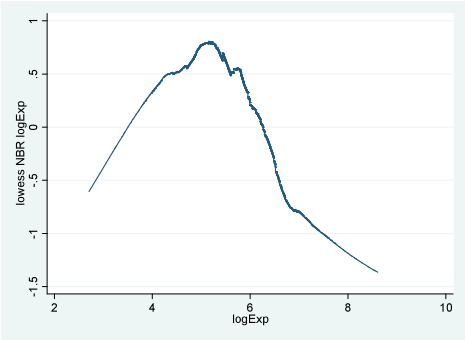
Wheat



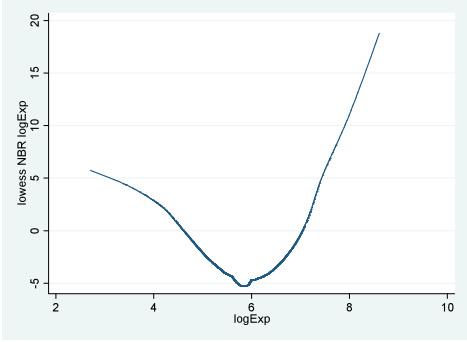
Sugar



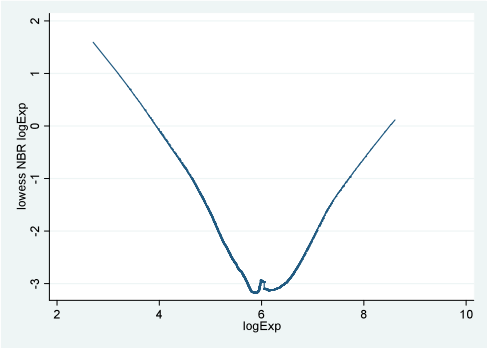
Milk



Beef



Poultry



2.9.1 Rice

Rice is a fundamental component of Bolivian consumption bundle, in particular for the poorest quintile, who consumes almost four times more rice than the richest. Rice production is also extremely important especially in the regions of Beni, where most of the rice is produced. Rice sales' ratio is overall low, with the only exception of Beni. The average budget share is 2.79% with higher figures for Pando (5.51%). The analysis over the expenditure quintiles shows that the third quintile records the highest sales ratio (5.85%) while the poorest quintile of the population devotes on average 4.23% of their total expenditure to rice purchases. The relative NBR ratios reflect those features: an average value of -0.96 for the Bolivian population, negative net sales for all the regions apart from Beni where the NBR exhibits an extraordinary value of 11.43. To illustrate the distributional impact of an increase in rice price nonparametric representation is discussed. The upward sloping curve suggests that those at the bottom of the expenditure distribution are likely to be affected the most. Even when the poor produce rice, very little is sold and large quantities of rice to satisfy household consumption needs are still to be provided by the market. As one moves towards higher expenditure levels, sales increase and purchases diminish (as rice is an inferior good). The NBR, albeit still negative, increases. The overall negative NBR values suggest that an increase in rice's price generate losses for all the categories and those at the bottom of the distribution suffer the most severe impact. The poverty impact is quite modest, though. In Chuquisaca and Santa Cruz, poverty rates register a small reduction (-0.3% and -0.15%) and an increase in La Paz (0.23%), Oruro (0.27) and Beni (0.37%).

2.9.2 Potatoes

Potato is an essential component of the Bolivian food culture. Its consumption is very widespread across the country and along the expenditure distribution, albeit it lightly decreases among the better-off. Given that a significant proportion of Bolivian population is engaged in its cultivation (25.31%) while a smaller part of it sells to the market (14.79%), own-consumption is likely to be very relevant, especially for poorer people. Potato is mostly grown by poor farmers, quite evenly distributed across regions, with the exception of Beni and Pando where production and sales are almost absent. Cochabamba and Chuquisaca reveal the highest sale ratios while patterns on purchases are very similar across country and expenditure quintiles. 14.03 % of the population results being a net seller of potato with extremely high proportion among the first quintile (36.41%). The clear negative slope of the NBR is thus, not surprisingly: the first quintile, with an average NBR of 6.14 will relevantly benefit form an increase in price while urban and better-off population will be negatively affected. Increase in potato price will be, therefore, pro-poor. Poverty will decrease by, on average, 0.22 percentage points[87].

2.9.3 Maize

Maize is cultivated by about 17% of the population but only 10% sells to the market. The NBR is, on average, positive, with higher figures in Chuquisaca and Santa Cruz (4.68% and 1.11%), the main suppliers of maize in the country. As people at the bottom of the distribution are mainly engaged in its production, the NBR exhibits the highest value for the first quintile of the population (2.40%) and it then declines as

[87]As stated recently by FAO (2008c) “Unlike major cereals, potato is not a globally traded commodity. Only a fraction of total production enters foreign trade, and its prices are determined usually by local demand and supply conditions, not the vagaries of international markets. Moreover, being absent in the major commodity exchanges, there is no risk of potato bearing the ill-effects of speculative activity, which cannot be said of cereal commodities. It is, therefore, a highly recommended food security crop that can help low-income consumers ride out any repeat of the current turmoil in world food supply and demand”.

one moves along the expenditure distribution. Therefore, an increase in the price of maize, likely potato, has a pro-poor impact, generating benefits especially for the poorest.
The overall poverty rate due to a 10% increase in the maize price increases but fairly little (0.03%).

2.9.4 Wheat

Wheat represents an important component of Bolivian diet, especially among the poor. Its production is concentrated in the areas of Chuquisaca, Cochabamba and few large producers located in Santa Cruz. However, wheat production is not enough to satisfy Bolivian demand to the extent that imports account for three fourth of the domestic demand. The NBR ratio is thus, highly negative, for both average Bolivian figure and for all the household categories considered. The structure of the NBR along the expenditure distribution seems to suggest that household in the middle of the distribution are the most negatively affected category (average NBR ratios for 2nd and 3rd quintile are respectively 4.49 and 4.54).

2.9.5 Sugar

Sugar represents, together with soybeans, the most advanced agricultural industry of the country. Production is totally concentrated in few very large areas in Santa Cruz. Sugar consumption is, instead, significant and quite widespread across household categories. Rural and poor population exhibits the highest budget shares (3.17% and 4.27%). The NBR is significantly negative for all categories, especially the poorest and rural households. The structure of the NBR exactly reflects these patterns: its upward slope suggests that the poor are intensively affected by an increase in price and the losses decrease moving towards the better-off (who consume less quantity). Nonetheless, only the few big producers gain from an increase in price. Poverty rate rises by 0.15 percentage points.

2.9.6 Milk

Sales of milk represent on average 1.15% of the total household expenditure. The highest values are the ones referred to the 2nd and 3rd quintiles while at the extreme tail of the distribution sales are rather small. Milk purchases reveal patterns of a luxury good: the poor spends only 0.25% of their expenditure on milk while for the better-off the figure is 1.29%. Urban population spends three times more on milk than the rural population. These patterns might be a combination of relevant component of own-consumption among poor and rural population and proper characteristics of a luxury good. Accordingly, the NBR ratio is, on average, positive, (0.25) with negative values for urban population and household at 4th and 5th quintiles of the expenditure distribution. Poverty impact is null.

2.9.7 Beef

Beef farming is an important activity in the Bolivian context where about 17% of the total population is engaged in beef livestock holding. Beni, Santa Cruz and Chuquisaca show the highest sales ratios (8.88%, 3.41% and 3.4%) while budget shares reveal the importance of beef purchases on the household consumption. The average Bolivian household spends 5.67% of their total expenditure in beef. While food consumption is quite similar across regions, significant differences occur along the expenditure distribution. As one could expect, meat is an expensive good and its consumption increases along with the level of living. The 3rd and 4th quintiles exhibit budget shares of about 7% while for the poorest the share is 3%. Given the marketing and consumption patterns for beef livestock, the NBR is rather heterogeneous across categories. The average ratio is definitely negative (-3.42) and it exhibits lower values for household in the middle of the expenditure distribution. As the graph shows, given their high budget shares, population in the middle of the distribution experiences the most negative welfare impact when a price increase occurs. Poverty rate increases on average by 0.13% and only in urban areas (0.22).

2.9.8 Poultry

Poultry exhibits very similar patterns. Its relevance, though, in terms of expenditure share is more modest, due to the lower price level of the livestock. Food sales account for 0.26% of the average household expenditure, with higher values for Chuquisaca (1.59%), Pando (0.47%), Santa Cruz (0.46%) and Beni (0.44%). Purchases are a quite relevant component of the total household consumption (2.82%), especially in Santa Cruz (4.33), Pando (4.04%), and Tarija (3.94%). The Bolivian NBR ratio is, on average, negative (-2.55%) with highest values in Santa Cruz (-3.87), Tarija (-3.83) and Pando (-3.57).

The sales, purchases and NBR along the expenditure distribution are quite similar to the ones noted for beef livestock: sales are higher in the middle of distribution while consumption increases with income level. The poorest quintile spends about 1% of the total expenditure in poultry and its relevance increases, accounting for 3.9% for the 4th quintile and 2.68% for the 5th. The increase in poultry price is thus mostly affecting households in the middle of the distribution, with average reduction of welfare between 3-4 percent. As 10.7% of the household in the first quintile are net sellers and likely to be the least affected by an increase in prices, the poverty impact is quite modest. A significant poverty reduction occurs in Chuquisaca (-0.3%), while increases are recorded in Beni (0.37%), Oruro (0.27%) and La Paz (0.12).

2.10. Welfare Impact of Current Price Increase (Aggregated Food Definition)

National food price indices (INE), referred to 2005 and 2008, collected from the Bolivian institute of statistics, are used to calculate the actual price variation for the aggregated food bundle. From 2005, food price index increases by 46%. The next step is to multiply the NBR for the price variation to figure out the welfare impact for different household groups. The new level of expenditure is computed and compared to the proper poverty line to assess the overall impact on Bolivian poverty rate. The

results are summarized in table 13 that shows the average percentage changes in real expenditure (column 1), the 2005 poverty rate (column 2), 2008 poverty rate (column 3) and the percentage variation between the two rates (last column).

The results are remarkable. The average Bolivian real expenditure decreases by 5% and the poverty rate rises by 2.87%. The losses experienced by the large category of net food buyers more than offset the gains of the net sellers. The disaggregated figures are particularly noteworthy. As expected the urban population is the most affected, with a welfare reduction of 8%. The poverty rate there increases by almost 4 percentage points. However, also the rural population is, on average, negatively impacted: with a small welfare reduction of 0.93 percentage points, the poverty rate is raising to 36.62%, showing an increase of 1.61%.

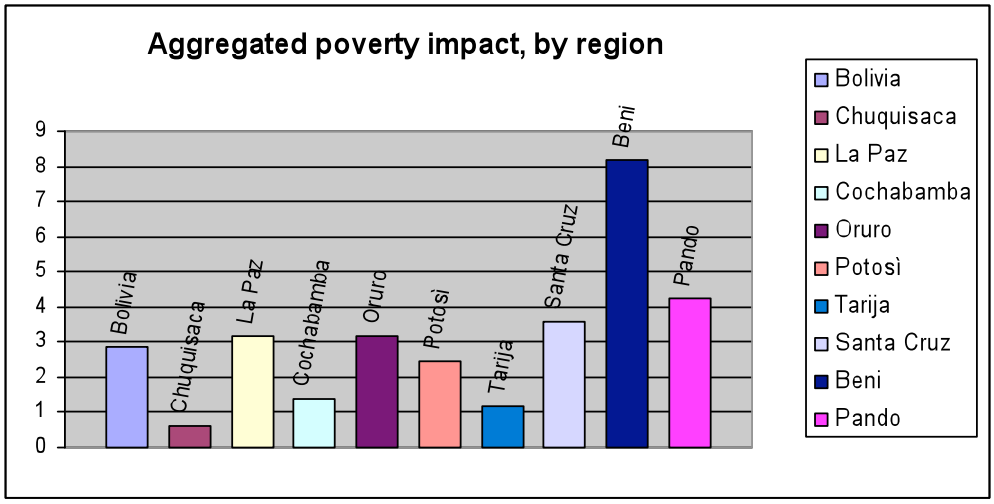
At the regional level, a homogeneous food price increase of 46% generates significant welfare reductions in all the regions but in Chuquisaca (the only one experiencing a small but positive welfare change of 0.32%) and Beni (where the reduction is fairly small, –0.28%). Pando exhibits extraordinary figures: a welfare reduction of 10.4% and in increase in poverty of 4.23%. All the other regions experience welfare reduction ranking between 5.48% (Santa Cruz) and 6.7% (Oruro). Interesting is the case of Beni: despite the small welfare reduction, it experiences the most relevant poverty impact with an 8.18% higher poverty rate than in the 2005.

Table 2.13: Welfare and poverty impact of actual price change for aggregated food definition by household group

Household category	Change in real expenditure (%)	Poverty rate Pre-shock	Poverty rate Post-shock	Poverty impact (%)
BOLIVIA	-5.00	21.14	24.01	2.87
Location				0
URBAN	-8.04	10.76	14.58	3.82
RURAL	-0.93	35.01	36.62	1.61
Region				0
CHUQUISACA	0.324	39.09	39.70	0.61
LA PAZ	-6.10	19.14	22.30	3.16
COCHABAMBA	-4.18	25.16	26.56	1.4
ORUR0	-6.79	14.47	17.63	3.16
POTOSI'	-6.19	35.81	38.29	2.48
TARIJA	-6.18	16.47	17.65	1.18
SANTA CRUZ	-5.48	11.83	15.42	3.59
BENI	-0.28	16.36	24.54	8.18
PANDO	-10.40	7.63	11.86	4.23
Expenditure distribution				
1st quintile	-1.22			
2nd	-5.76			
3rd	-4.95			
4th	-7.88			
5th	-4.36			

Source: Author's calculation from Encuesta de Hogares 2005

Figure 2.3: Poverty impact of current price increase, by region



Source: Author's calculation from Encuesta de Hogares 2005

2.11 Welfare Impact of Current Price Increase (Commodity Definition)

The last simulation is conducted using data on regional price changes per each commodity computed in section 5. The results are shown in tables 14 and 15 that present, the first, the percentage impact of increase price on household real expenditure and, the second, the relative effect on the poverty rate.

On average, the price increase of potatoes, maize and milk generate a welfare improvement (0.49%, 0.4% and 0.02%) while, for all the other products, a welfare reduction prevails. Beef, poultry and wheat exhibit particularly high welfare effect, reducing real expenditure by 1.66, 1.67 and 1.56 percentage points. Increase in prices of rice and sugar results in an average welfare reduction of 0.68% and 0.5%. If the figures are disaggregated between urban and rural population, the impacts are very different, sometimes the direction of the impact is even inverted. On average, urban population is more negatively affected than the rural one by 1 percentage point. In the case of potatoes and milk, while the average Bolivian impact is positive, the impact on urban population is negative. Beef, Poultry and wheat are the products that most contribute to the welfare reduction in the cities while maize is the only product that generates some, small, benefits. Among the rural areas, welfare benefits from the price increase of potatoes (1.88%), maize (0.87%) and milk (0.14%). All the other products negatively affect the welfare condition, especially poultry (-1.12%), sugar (-0.72%), wheat (-1.25%) and beef (-0.55%).

To mention the most relevant figures at the regional level, it is apparent that Chuquisaca is strongly negatively affected the rice price change (-1.48%) while significant welfare improvements results from increase in prices of potatoes and maize (1.54% and 2.37%). La Paz is particularly affected by beef, poultry, wheat and rice (-1.91%, -1.54%, -1.67 and -1.59%). Cochabamba suffers much from increase in beef and poultry prices (-2.34 and -1.97%) but significant benefits come from the increase in potatoes (1.46%). Oruro is negatively impacted for all the range of products considered, with the worst welfare reduction caused by price increases of rice (-1.94%), wheat (-1.65). Potosì is strongly affected by the increase in rice price (-

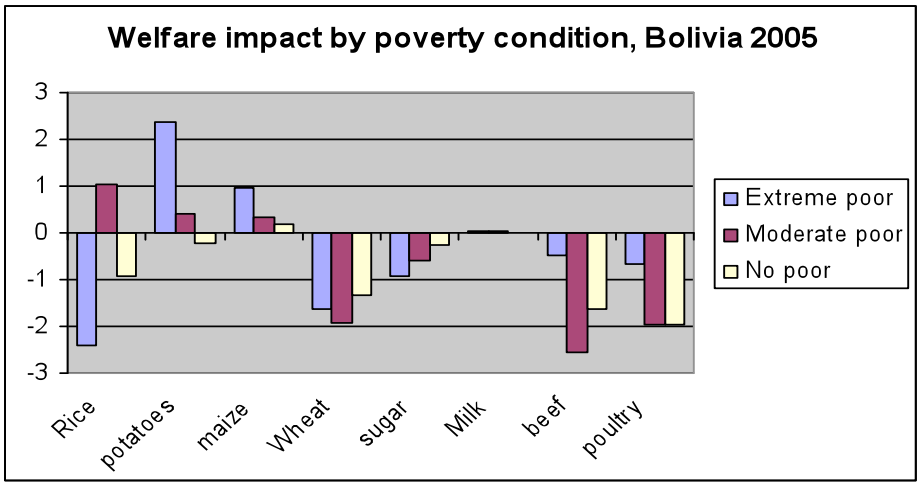
2.34%) but it benefits from potatoes and maize increases. Tarija exhibits high welfare reduction for poultry (-2.53%), beef (-1.82%) and rice (-1.09%). Santa Cruz is not particularly affected by the increase in rice but exhibits negative welfare impact for wheat, higher than the national average. Poultry impact is also higher than the average (-2.34%). Figures about Beni surprise for the extremely relevant welfare improvement due to the increase in rice price (8.19%) while Pando experiences the hardest welfare reduction (-3.43%) caused by rice price increase.

Table 2.14: Welfare impact of current price increases (percentage)

Household category	Rice	potato	maize	wheat	sugar	milk	beef	poultry	Total impact
BOLIVIA	-0.68	0.49	0.4	-1.56	-0.50	0.02	-1.66	-1.67	-5.16
Location									
URBAN	-1.15	-0.53	0.06	-1.79	-0.34	-0.06	-2.49	-2.09	-8.39
RURAL	-0.05	1.88	0.87	-1.25	-0.72	0.14	-0.55	-1.12	-0.8
Region									
CHUQUISACA	-1.48	1.54	2.39	-0.67	-0.53	0.00	-0.14	-0.50	0.61
LA PAZ	-1.59	0.80	-0.03	-1.67	-0.51	0.05	-1.91	-1.54	-6.4
COCHABAMBA	-0.68	1.46	0.46	-1.54	-0.53	0.07	-2.35	-1.97	-5.08
ORUR0	-1.94	-0.22	-0.16	-1.65	-0.53	-0.01	-1.38	-1.18	-7.07
POTOSI’	-2.34	0.55	0.23	-1.52	-0.62	0.03	-1.90	-1.17	-6.74
TARIJA	-1.09	0.32	0.23	-1.47	-0.56	0.06	-1.82	-2.53	-6.86
SANTA CRUZ	-0.14	-0.21	0.56	-1.81	-0.23	0.01	-1.53	-2.34	-5.69
BENI	8.19	-0.64	0.35	-1.87	-0.66	-0.10	-0.47	-1.34	3.46
PANDO	-3.43	-0.66	0.05	-1.21	-0.60	-0.08	-3.21	-2.36	-11.5
Exp. Distribution									
1st quintile	-2.52	2.96	1.24	-1.39	-1.00	0.04	0.22	-0.55	-1
2nd	-1.64	1.07	0.36	-1.92	-0.71	0.07	-1.95	-1.38	-6.1
3rd	2.11	-0.02	0.33	-1.95	-0.51	0.15	-2.76	-2.07	-4.72
4th	-1.39	-0.37	0.21	-1.61	-0.23	-0.04	-2.69	-2.51	-8.63
5th	-0.40	-0.38	0.12	-1.00	-0.23	-0.07	-0.82	-1.58	-4.36
Poverty									
No poor	-0.93	-0.23	0.19	-1.32	-0.26	0.01	-1.64	-1.95	-6.13
Moderate poor	1.03	0.41	0.35	-1.93	-0.61	0.04	-2.56	-1.95	-5.22
Extreme poor	-2.42	2.37	0.98	-1.62	-0.93	0.03	-0.49	-0.65	-2.73

Source: Author’s calculation from Encuesta de Hogares 2005

Figure 2.4: Welfare impact by poverty condition



Source: Author's calculation from Encuesta de Hogares 2005

Given our focus on the distributional impact, specific attention is given at the impact across the expenditure distribution quintiles. From the simulation conducted with the actual price shock, accounting for the regional price variation, the results suggest that the poorest quintile has the least negative welfare impact. The computed total reduction in real expenditure is one percentage point for the first quintile while for all the other quintiles the total reduction ranges between 4.36% (5th quintile) and 8.63% (4th quintile). Looking at the specific commodities' impact, one can note that, compared to the average values, the first quintile's welfare is significantly reduced by the increase in price of rice (-2.52%), wheat (-1.39%) and sugar (-1%). The poorest exhibits particularly positive values from potato (2.96%), maize (1.24%) and beef (0.22), the latter being the only positive figures across the quintiles. The second quintile is also, with respect to the average, negatively affected from rice (-1.64%) while benefiting from potatoes (1.07%). The third is the only quintile that gains significantly from increase in rice price (2.11) but it is negatively affected by the increase in wheat, beef and poultry. The welfare impact for the forth quintile is negative for all the products, with the exception of maize. Particularly high values are recorded for wheat (-1.61%), rice (-1.39%), beef (-2.69%) and poultry (2.51%). With

respect to the average results, the fifth quintile exhibits negative impact by the increase in potatoes' price while all the other values are smaller than the average.

Looking at the poverty impact, table 15 shows that the largest poverty impact passes through rice, wheat, beef and poultry, for which the actual price increase rise poverty by 0.79, 0.76, 0.76 and 0.57 percentage points. Instead, increase in prices of potato and maize cuts poverty by 0.24%. At the urban level poverty rises for all the commodities price increase, with larger impacts due to beef (1.2%), wheat (0.95%), rice (0.78%). At the rural level, poverty is significantly cut by potatoes (-1.14%) and maize (0.68%) while is raised considerably by the price increase of rice (0.81%).

Table 2.15: Poverty impact of current price increases (percentage)

Household category	rice	potatoes	maize	wheat	sugar	milk	beef	poultry
BOLIVIA	0.79	-0.24	-0.24	0.76	0.3	-0.05	0.76	0.57
Location								
URBAN	0.78	0.43	0.09	0.95	0.22	0	1.2	0.6
RURAL	0.81	-1.14	-0.68	0.52	0.41	-0.11	0.18	0.52
Region								
CHUQUISACA	0.3	-0.3	-0.61	0	0	0	0	0.3
LA PAZ	0.91	-0.67	-0.11	1.02	0.57	0	0.68	0.57
COCHABAMBA	1.4	-0.63	-0.32	0.47	0.31	-0.47	0.62	0.31
ORUR0	1.32	0.27	0.27	1.32	0.53	0	0.79	1.06
POTOSI'	0.68	-0.9	-0.45	0.45	0	-0.22	0.45	0.45
TARIJA	0.29	-0.29	-0.29	0.88	0.29	0	-0.29	0.88
SANTA CRUZ	0.15	0.15	-0.45	0.45	0	0	1.04	0.6
BENI	0.74	1.48	0	2.23	0.74	0.37	3.34	0.74
PANDO	1.69	0	0	0	0	0.84	0.84	0
Exp.distribution								
1st quintile	-0.31	-1.71	-0.62	0	0	-0.16	-0.78	0
2nd	4.22	0.13	-0.77	3.96	1.53	-0.13	4.6	2.94

Source: Author's calculation from Encuesta de Hogares 2005

At the regional level, rice price is to raise poverty in Pando (1.69%), Cochabamba, (1.4%) and Oruro (1.32%). Potato price increase particularly rises poverty in Beni (1.48%) but it reduces it in Potosì (-0.9%), La Paz (-0.67%) and Cochabamba (-0.63%). Maize is to reduce poverty, especially in Chuchisaca (-0.61%), Potosì and Santa Cruz (-0.45%) while wheat generates poverty increase in all the regions, with Beni and Oruro exhibiting the highest impacts (2.23% and 1.32%). Sugar raises

poverty mainly in Beni (0.74%), La Paz (0.57%) and Oruro (0.53%). Milk has a diversified effect on poverty: it decreases it in Cochabamba and Potosì while it increases it in Beni and Pando. Beef has a widespread poverty increasing effect, with Beni experiencing the highest poverty change (+3.34%) and Tarija the only poverty reduction (-0.29%). Poultry follows similar patterns with significantly large poverty impact in Oruro and Tarija.

2.12. Conclusions

This work described and analysed the distributional and poverty impact of the extraordinary food price increase experienced by Bolivia between 2005 and 2008. Using a very recently released household survey “Encuesta de Hogares 2005”, update data on food consumption, agricultural production and poverty measures are provided at a very disaggregated level. As little prior research has been conducted using the 2005 Bolivian household survey, this work represents an important contribution to the literature on Bolivia. By calculating the net benefit ratio, using a definition of food that aggregates eight of the main components of the peculiar Bolivian consumption and production patterns, it is possible to identify where and how the main losses and benefits are distributed across household groups. A more detailed analysis is also conducted at the commodity level to discern the role of each commodity with respect to the overall welfare and poverty impact. Throughout the work, the analysis is conducted at the most disaggregated level in order to distinguish the impact between urban and rural population, regional location and household position along the expenditure distribution. This choice results to be appropriate given the extreme heterogeneous results obtained.

The results show that, on average, the increase in food prices is substantially welfare reducing for the Bolivian population. As a result, poverty will increase by 2.87 percentage points. The poor will be the least adversely affected, experiencing a reduction of real expenditure of one percentage point. Largest losses pass through

the price increase in rice, wheat and sugar whereas they also considerably benefit from the price increase of potato and maize. The present work is relevant on different levels:

1) It provides useful guidelines to policy makers and institutions in charge of setting up social protection programmes to protect the most vulnerable to food price shock. Social protection interventions must be carefully designed and the present work can contribute to effectively target the most affected categories.

2) It enriches the academic debate on the links between trade and policy, by providing empirical analysis on the poverty and distributional impact of a price shock in Bolivia. The strength of this work is that minimum aggregation has been imposed on the analysis of the welfare impact. Even when the price shock has little impact on the average figures, large heterogeneity emerges across households groups and regions or commodities. By implementing the simulations with prices collected at the regional level, the welfare impacts obtained are likely to be fairly accurate. Initial analysis of spatial price variation and transmission dynamics are also presented. However, more data and research are needed, especially with respect to price transmission towards rural and remote areas, on which there are no data or prior study available.

The present work has some limitation too. The model employed doesn't readily identify certain dynamic effects of price shock. Soaring food prices in the last three years are likely to have induced behavioural responses. There are many ways in which households might respond to the price change that are not captured here. For example, households may change their consumption choices, switching from more expensive products to substitutes less affected by the price shock or They may reduce their purchases and find more convenient to increase own-production; poor households that cannot further reduce their food expenditure may have to cut other expenses, such as education or health care, with detrimental long-term consequences; Incentives to foster production and productivity may rise; important wage changes may occur in the agricultural sector and multiplier effect may generate higher income for non food producing households; perspectives of higher profits in

food production may provide incentives to big producers to invest and produce, reducing market access and competitiveness of small producers facing economic or credit constraints and further acerbating the level of inequality in the country. All these crucial effects are, unfortunately, neglected here. Therefore, It is important to be aware that the results might overestimate the actual impact and have to be interpreted as a strictly lower bound measure of it. Extending the analysis incorporating behavioural effects, however, is a challenging task for future research.

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Appendix 2.1: Production and Yields, by product

Table 2.1a: Cultivated land, Production, Yield, Bolivia 2005

DESCRIPTION	Cultivated land (Hectares)	Production (Tons)	Yield (kg/Hectares)	Value of prod.* (Million Bolivianos)
CEREALS	857.374			
Rice	197.864	526.836	2.663	304
Barley	92.083	73.996	804	44
Maize	337.779	816.736	2.418	727
Quínua	39.302	25.201	641	80
Sorghum	80.051	245.58	3.068	39
Wheat	110.295	119.227	1.081	127
STIMULATING	25.518			
Coffee	25.518	24.976	979	140
FRUIT	65.583			
Banana	18.893	180.896	9.575	150
Banana tree	41.792	443.369	10.609	-
Vine	4.898	33.313	6.801	-
VEGETABLES	55.219			
Pea	15.859	25.173	1.587	55
Bean	30.292	55.062	1.818	64
Tomatoes	9.068	127.678	14.08	141
INDUSTRIAL	1.159.792			
Cotton	9.5	3.986	420	197
Sugar canes	108.309	5.112.222	47.2	372
Sunflower	89	72.98	820	-
Peanut	11.915	14.227	1.194	-
Soybeans	941.068	1.693.087	1.799	1496
TUBÉR	170.741			
Potatoes	134.375	761.891	5.67	853
Cassava	36.366	370.482	10.188	309
FORAGE	23.303			-
Alfalfa	23.303	167.127	7.172	-

Source: INE and FAOSTAT (*)

Appendix 2.2: Agricultural Production, by Product

Rice

The rice production is concentrated in the humid regions of Beni, Cochabamba and Pando, where 17%, 7.97 and 21% of the population is engaged in rice activities and a significant part of them (15.24, 3.44 and 11.86) sells it to the market. The Department of Beni and Cochabamba exhibit on average, the highest production level (168 and 133 quintals). The department of La Paz is characterized by few big producers with an average farm size of 4.63 hectares and a strong market-oriented nature (95% of the production is sold). Unlikely, in the Department of Beni, where there is the highest proportion of rice producers' households, farms and production and small and mainly directed to own-consumption (only half of the production is sold).

Table 2.2a: Rice production and consumption, Bolivia 2005

	Producers[1]	Seller[2]	Cultivated area[3]	Production (Quintals)	Sales (quintals)	Consum. (quintales)	Ratio sales[4]	Ratio Consum.[5]
BOLIVIA	4.39	3.14	2.71	108.76	90.83	7.43	0.62	0.24
Chuquisaca	1.21	0.91	0.5	24.67	18.42	2.83	0.74	0.17
la paz	0.45	0.23	4.63	90	84.5	5.5	0.95	0.05
Cochabamba	7.97	3.44	2.92	133.91	117.07	9.84	0.69	0.25
Santa Cruz	7.34	6.89	2.66	75.98	52.04	3.51	0.62	0.16
Beni	17.1	15.24	3.17	168.09	153.45	9.97	0.62	0.28
Pando	21.19	11.86	1.36	23.87	10.04	10.39	0.44	0.43

Source: Author's calculation based on Encuesta de Hogares 2005

[1]Proportion of households that are producers [2]Proportion of households that sell to the market [3] Hectares

[4]Ratio quantity sold over total production [5]Ratio quantity own-consumed over total production

Potatoes

Potatoes are a traditional staple food in Bolivia. On average 25% of the households are engaged in its cultivation which is quite widespread all around the country. Production is on average higher in Santa Cruz, Tarija, and Cochabamba and there is a quite constant ratio of quantity sold and own-consumed among the regions.

Table 2.3a: Potato production and consumption, Bolivia 2005

	Producers[1]	Seller[2]	Cultivated area[3]	Production (Quintals)	Sales (quintals)	Consum. (quintales)	Ratio sales[4]	Ratio Consum.[5]
Bolivia	25.31	14.79	8.11	38.98	23.47	7.35	0.49	0.26
Chuquisaca	45.15	30	0.61	39.33	23.52	8.47	0.52	0.3
La Paz	33.75	20.91	8.68	30.85	13.21	5.54	0.36	0.24
Cochabamba	23.75	18.28	5.13	46.89	37.91	5.39	0.67	0.21
Oruro	29.74	6.84	0.61	18.3	6.28	2.78	0.35	0.2
Potosí	44.37	18.69	0.38	28.58	11.11	7	0.4	0.29
Tarija	28.53	21.47	0.66	50.93	33.23	13.86	0.59	0.32
Santa Cruz	3.89	2.99	0.84	94.68	73.94	13.35	0.67	0.24
Beni	0.37	0.37	0.5	15	7.5	7.5	0.5	0.5

Source: Author's calculation from Encuesta de Hogares 2005

[1]Proportion of households that are producers [2]Proportion of households that sell to the market [3] Hectares

[4]Ratio quantity sold over total production [5]Ratio quantity own-consumed over total production

Wheat

On average 7.48% of the households are engaged in wheat production but only half of them sell to the market. Producers are concentrated in Chuquisaca, Cochabamba (where the cultivated area is large – 51.68 and 14.24 Hectares) Potosí and Tarija. In Santa Cruz there are few but big producers that produce large share of the total production and sell all to the market.

Table 2.4a: Wheat production and consumption, Bolivia 2005

	Producers[1]	Seller[2]	Cultivated area[3]	Production (Quintals)	Sales (quintals)	Consum. (quintales)	Ratio sales[4]	Ratio Consum.[5]
Bolivia	7.48	3.41	22.85	20.92	15.15	2.69	0.48	0.26
Chuquisaca	25.15	14.84	51.68	16.81	7.97	4.14	0.45	0.27
la paz	2.61	0.57	0.61	5.65	1.90	1.95	0.34	0.33
cochabamba	10.31	6.09	14.24	10.17	5.94	2.14	0.55	0.26
Oruro	1.84	0.52	1.13	6.50	3.50	0.75	0.48	0.13
Potosí	21.36	5.45	0.22	7.49	2.79	1.56	0.38	0.24
Tarija	7.94	5.29	0.50	10.07	6.67	2.06	0.59	0.25
santa cruz	0.75	0.30	21.50	626.30	626.30	0.00	1.00	0.00

Source: Author's calculation from Encuesta de Hogares 2005

[1]Proportion of households that are producers [2]Proportion of households that sell to the market [3] Hectares

[4]Ratio quantity sold over total production [5]Ratio quantity own-consumed over total production

Maize

On average, about 17% of the sampled households produces maize. The Department of Chuquisaca exhibits the highest figures in terms of proportion of producers and average production. On average, half of the production is sold to the market with Chuquisaca and Santa Cruz being the main suppliers.

Table 2.5a: Maize production and consumption, Bolivia 2005

	Producers[1]	Seller[2]	Cultivated area[3]	Production (Quintals)	Sales (quintals)	Consum. (quintales)	Ratio sales[4]	Ratio Consum.[5]
Bolivia	16.87	9.78	16.07	39.66	24.34	5.08	0.54	0.21
Chuquisaca	46.06	30.00	1.09	59.83	37.75	6.50	0.46	0.27
la paz	3.75	1.82	0.32	12.88	5.72	3.33	0.40	0.29
Cochabamba	21.88	10.94	0.67	21.60	14.07	2.87	0.62	0.19
Potosí	27.03	9.68	0.39	14.83	8.67	2.53	0.48	0.29
Tarija	26.18	14.12	0.83	30.28	13.58	9.36	0.52	0.21
santa cruz	12.57	10.33	1.59	67.63	44.06	4.94	0.62	0.11
Beni	17.84	15.61	143.49	25.89	15.22	4.76	0.61	0.19
Pando	16.95	10.17	1.21	23.63	13.56	2.06	0.56	0.12

Source: Author's calculation from Encuesta de Hogares

[1]Proportion of households that are producers [2]Proportion of households that sell to the market [3] Hectares

[4]Ratio quantity sold over total production [5]Ratio quantity own-consumed over total production

Sugar

Santa Cruz hosts the main important sugar industry. There are few big producers with an average farm size of 13.35 Hectares and with a production of 6000 quintals. Almost the entire production is sold to the market.

Table 2.6a: Sugar production and consumption, Bolivia 2005

	Producers[1]	Seller[2]	Cultivated area[3]	Production (Quintals)	Sales (quintals)	Consum. (quintales)	Ratio sales[4]	Ratio Consum.[5]
Bolivia	0.17	0.073	13.35	5963.768	5601.449	7.246377	0.97	0.01
Chuquisaca	1.05	0.45	13.35	5963.768	5601.449	7.246377	0.97	0.01

Source: Author's calculation from Encuesta de Hogares

[1]Proportion of households that are producers [2]Proportion of households that sell to the market [3] Hectares

[4]Ratio quantity sold over total production [5]Ratio quantity own-consumed over total production

Beef

Beef farming is an important activities throughout the country. On average, the number of livestocks hold by the household is low, reflecting the high subsistence component of farming in Bolivia. Beni and Santa Cruz are the only exceptions with an average number of livestock equal to 30 and 11.64, almost entirely directed to the market.

Table 2.7a: beef livestock holding, Bolivia 2005

Beef	Proportion of holders	n. of livestock sold	value of livestock sold	n.of livestock consumed	value of livestock consumed
Bolivia	17.29	2.52	2844	0.15	0.80
Chuquisaca	28.78	0.78	816.21	0.06	933.33
La paz	20.68	0.57	766.92	0.022	1150
Cochabamba	20.46	0.47	569.39	0.03	2402
Oruro	13.15	0.8	1268	0.04	2000
Potosì	17.5	0.19	212.33	0.013	200
Tarija	22.64	0.71	887.4	0.15	1108
Santa cruz	10.03	11.64	12801	0.61	2305
Beni	7.8	30	32770	1.76	4101
Pando	4.23	3.4	3880	0.4	2900

Source: Author's calculation from Encuesta de Hogares 2005

Poultry

Chuquisaca, Cochabamba Beni and Pando hosts the biggest poultry industry with high value of products sold. A large share of livestock holdings is used for own household consumption.

Table 2.8a: poultry livestock holding, Bolivia 2005

	Proportion of holders	n. of livestock sold	value of livestock sold	n.of livestock consumed	value of livestock consumed
Bolivia	22.6	20.16	310.54	6.54	177.29
Chuquisaca	39.69	47.71	488.16	7.42	123.96
La paz	14.77	0.22	4.47	0.76	54.69
Cochabamba	34.24	1.11	15.49	4.73	144.74
Oruro	17.63	0.21	2.98	0.24	25.00
Potosì	25.68	0.20	3.42	1.25	36.87
Tarija	33.82	2.74	47.39	6.85	145.75
Santa cruz	18.86	84.00	1486.40	10.73	193.50
Beni	14.5	20.89	426.28	33.15	746.18
Pando	21.18	13.84	352.80	21.60	472.00

Source: Author's calculation from Encuesta de Hogares 2005

Table 2.9a: FAO Food Price Index

	Food Price Index [1]	Meat [2]	Dairy [3]	Cereals [4]	Oils and Fats [5]	Sugar [6]
2000	**93**	100	106	87	72	105
2001	**95**	100	117	89	72	111
2002	**94**	96	86	97	91	88
2003	**102**	105	105	101	105	91
2004	**114**	118	130	111	117	92
2005	**117**	121	145	106	109	127
2006	**127**	115	138	124	117	190
2007	**157**	121	247	172	174	129
2007 March	**140**	121	186	151	138	134
April	**142**	119	213	148	150	125
May	**144**	119	222	150	161	121
June	**151**	120	252	159	170	119
July	**156**	120	277	160	175	131
August	**162**	123	287	171	181	126
September	**171**	124	290	195	190	125
October	**175**	122	297	201	202	128
November	**181**	126	302	203	221	130
December	**187**	123	295	224	226	137
2008 January	**197**	126	281	239	250	154
February	**217**	130	278	282	273	173
March	**220**	133	276	284	285	169

Source: FAO 2008

[1] **Food Price Index:** Consists of the average of 6 commodity group price indices mentioned above weighted with the average export shares of each of the groups for 1998-2000: in total 55 commodity quotations considered by FAO Commodity Specialists as representing the international prices of the food commodities noted are included in the overall index.

[2] **Meat Price Index:** Consists of 3 poultry meat product quotations (the average weighted by assumed fixed trade weights), 4 bovine meat product quotations (average weighted by assumed fixed trade weights), 3 pig meat product quotations (average weighted by assumed fixed trade weights), 1 ovine meat product quotation (average weighted by assumed fixed trade weights): the four meat group average prices are weighted by world average export trade shares for 1998-2000.

[3] **Dairy Price Index:** Consists of butter, SMP, WMP, cheese, casein price quotations; the average is weighted by world average export trade shares for 1998-2000.

[4] **Cereals Price Index:** This index is compiled using the grains and rice price indices weighted by their average trade share for 1998-2000. The grains Price Index consists of International Grains Council

(IGC) wheat price index, itself average of 9 different wheat price quotations, and 1 maize export quotation; after expressing the maize price into its index form and converting the base of the IGC index to 1998-2000. The Rice Price Index consists of three components containing average prices of 16 rice quotations: the components are Indica, Japonica and Aromatic rice varieties and the weights for combining the three components are assumed (fixed) trade shares of the three varieties.

[5] **Oils and Fats Price Index:** Consists of an average of 11 different oils (including animal and fish oils) weighted with average export trade shares of each oil product for 1998-2000.

[6] **Sugar Price Index:** Index form of the International Sugar Agreement prices.

Appendix 2.3: Sale ratio, budget share, net benefit ratio and poverty impact of a 10% price increase, by product

Table 2.10a: Rice sale ratio, budget share, net benefit ratio and poverty impact of a 10% price increase, by household groups

Household category	Food sales*	Food purchases*	NBR	Net sellers (%)	Poverty impact (%)
BOLIVIA	1.83	2.79	-0.96	2.65	0.05
Location					
URBAN	0.59	2.22	-1.63	0.86	0.05
RURAL	3.50	3.57	-0.07	5.04	0.06
Region					
CHUQUISACA	0.41	2.49	-2.08	0.91	-0.3
LA PAZ	0.24	2.59	-2.35	0.23	0.23
COCHABAMBA	1.68	2.56	-0.88	3.28	0
ORUR0	0.00	2.71	-2.71	0	0.27
POTOSI'	0.00	3.27	-3.27	0	0
TARIJA	0.00	1.53	-1.53	0	0
SANTA CRUZ	2.76	2.91	-0.15	6.74	-0.15
BENI	15.36	3.93	11.44	11.52	0.37
PANDO	0.73	5.51	-4.78	5.08	0
Expenditure group					
1st(poorest)quintile	0.72	4.24	-3.52	2.95	0
2nd quintile	1.55	3.85	-2.30	4,09	0.26
3rd quintile	5.85	2.93	2.91	3.92	0
4th quintile	0.34	2.30	-1.95	1.84	0
5th quintile	0.75	1.32	-0.57	0.93	0
Poverty					
No poor	0.66	1.96	-1.30	1.76	
Moderate Poor	4.67	3.25	1.42	4.04	
Extreme Poor	0.81	4.18	-3.38	2.90	

Source: Author's calculation from Encuesta de Hogares 2005

* Percentage of total expenditure

Table 2.11a: Potato sale ratio, budget share, net benefit ratio and poverty impact of a 10% price increase, by household groups

Household category	Food sales*	Food purchases*	NBR	Net sellers (%)	Poverty impact (%)
BOLIVIA	2.68	1.64	1.04	14.03	-0.22
Location					0
URBAN	0.60	1.71	-1.11	2.83	0
RURAL	5.47	1.56	3.92	29	-0.51
Region					0
CHUQUISACA	4.44	1.24	3.20	28.79	-0.3
LA PAZ	3.03	1.44	1.59	19.48	0
COCHABAMBA	5.52	2.36	3.17	17.34	-0.78
ORUR0	1.38	1.83	-0.46	7.11	0
POTOSI'	2.72	1.57	1.15	16.89	-0.45
TARIJA	1.97	1.30	0.67	20.59	0
SANTA CRUZ	1.28	1.71	-0.43	2.99	-0.15
BENI	0.01	1.35	-1.34	0.37	0
PANDO	0.00	1.38	-1.38	0	0
Expenditure group					0
1st(poorest) quintile	7.90	1.76	6.14	36.41	-0.31
2nd quintile	4.35	2.12	2.23	20.84	-0.9
3rd quintile	1.86	1.91	-0.05	11.87	0
4th quintile	0.84	1.61	-0.77	5.98	0
5th quintile	0.20	0.98	-0.78	2.49	0
Poverty					
No poor	0.85	1.34	-0.49	5.85	
Moderate Poor	2.84	1.98	0.86	15.46	
Extreme Poor	6.85	1.92	4.93	31.55	

Source: Author's calculation from Encuesta de Hogares 2005

***** Percentage over total expenditure

Table 2.12a: Maize sale ratio, budget share, net benefit ratio and poverty impact of a 10% price increase, by household groups

Household category	Food sales*	Food purchases*	NBR	Net sellers (%)	Poverty impact (%)
BOLIVIA	1.1	0.31	0.79	9.91	0.03
Location					
URBAN	0.32	0.20	0.12	2.66	0
RURAL	2.16	0.46	1.70	19.6	0.06
region					
CHUQUISACA	4.88	0.20	4.68	30.3	-0.3
LA PAZ	0.12	0.20	-0.07	1.8	0.12
COCHABAMBA	1.15	0.24	0.91	11.72	0
ORUR0	0.00	0.33	-0.33	0	0
POTOSI'	0.84	0.37	0.47	9.91	0
TARIJA	0.89	0.42	0.47	14.71	0.29
SANTA CRUZ	1.42	0.31	1.11	10.18	0
BENI	1.29	0.61	0.69	14.87	0
PANDO	0.68	0.57	0.11	9.32	0
Expenditure group					
1st(poorest)quintile	2.85	0.43	2.42	24.96	0
2nd quintile	1.10	0.39	0.72	12.28	0.13
3rd quintile	0.97	0.32	0.65	9.06	0
4th quintile	0.71	0.29	0.42	5.98	0
5th quintile	0.41	0.17	0.23	2.18	0
Poverty					
No poor	0.63	0.26	0.38	4.63	
Moderate Poor	1.03	0.34	0.69	11	
Extreme Poor	2.32	0.40	1.92	21	

Source: Author's calculation from Encuesta de Hogares 2005

***** Percentage over total expenditure

Table 2.13a: Wheat sale ratio, budget share, net benefit ratio and poverty impact of a 10% price increase, by household groups

Household category	Food sales*	Food purchases*	NBR	Net sellers (%)	Poverty impact (%)
BOLIVIA	0.24	3.86	-3.62	2.80	0.2
Location					
URBAN	0.04	4.18	-4.13	0.43	0.26
RURAL	0.50	3.44	-2.94	5.96	0.12
Region					
CHUQUISACA	1.10	2.67	-1.57	13.94	0
LA PAZ	0.01	4.28	-4.28	0.23	0.34
COCHABAMBA	0.41	3.41	-3.00	4.53	0
ORUR0	0.03	3.91	-3.88	0.26	0.79
POTOSI'	0.30	3.87	-3.57	4.5	0
TARIJA	0.31	3.76	-3.45	4.12	0
SANTA CRUZ	0.15	4.30	-4.15	0.3	0
BENI	0.00	4.40	-4.40	0	0.74
PANDO	0.00	2.83	-2.83	0	0
Expenditure group					
1st(poorest)quintile	0.89	4.15	-3.26	11.63	0
2nd quintile	0.25	4.74	-4.49	2.81	1.02
3rd quintile	0.12	4.66	-4.54	1.22	0
4th quintile	0.09	3.81	-3.72	0.69	0
5th quintile	0.03	2.33	-2.29	0.1	0
Poverty					
No poor	0.09	3.15	-3.05	0.54	
Moderate Poor	0.16	4.66	-4.49	1.98	
Extreme Poor	0.70	4.49	-3.79	9.28	

Source: Author's calculation from Encuesta de Hogares 2005

***** Percentage over total expenditure

Table 2.14a: Sugar sale ratio, budget share, net benefit ratio and poverty impact of a 10% price increase, by household groups

Household category	Food sales*	Food purchases*	NBR	Net sellers (%)	Poverty impact (%)
BOLIVIA	0.17	2.32	-2.15	0.07	0.15
location					0
URBAN	0.23	1.69	-1.46	0.09	0.13
RURAL	0.10	3.17	-3.07	0.06	0.18
region					0
CHUQUISACA	0.00	2.28	-2.28	0	0
LA PAZ	0.00	2.10	-2.10	0	0.23
COCHABAMBA	0.00	2.29	-2.29	0	0
ORUR0	0.00	2.26	-2.26	0	0.53
POTOSI'	0.00	2.67	-2.67	0	0
TARIJA	0.00	2.41	-2.41	0	0.29
SANTA CRUZ	1.06	2.18	-1.12	0.3	0
BENI	0.01	2.83	-2.83	0.37	0.37
PANDO	0.01	2.58	-2.57	0	0
Expenditure group					0
1st(poorest)quintile	0.00	4.27	-4.27	0	0
2nd quintile	0.00	3.06	-3.05	0.13	0.77
3rd quintile	0.00	2.19	-2.19	0	0
4th quintile	0.81	1.80	-0.99	0.23	0
5th quintile	0.00	1.01	-1.01	0	0
Poverty					
No poor	0.34	1.47	-1.12	0.1	
Moderate Poor	0.00	2.59	-2.59	0.09	
Extreme Poor	0.00	3.99	-3.99	0	

Source: Author's calculation from Encuesta de Hogares 2005

***** Percentage over total expenditure

Table 2.15a: Milk sale ratio, budget share, net benefit ratio and poverty impact of a 10% price increase, by household groups

Household category	Food sales*	Food purchases*	NBR	Net sellers (%)	Poverty impact (%)
BOLIVIA	1.15	0.89	0.26	2.62	0
location					
URBAN	0.60	1.25	-0.65	0.99	0
RURAL	1.89	0.41	1.47	4.81	0
region					
CHUQUISACA	0.59	0.60	-0.01	2.73	0
LA PAZ	1.19	0.59	0.60	1.91	0
COCHABAMBA	1.87	1.11	0.76	3.28	0
ORUR0	0.22	0.41	-0.18	2.11	0
POTOSI'	0.74	0.35	0.39	1.35	0
TARIJA	1.66	0.97	0.69	4.41	0
SANTA CRUZ	1.80	1.67	0.12	4.04	0
BENI	0.27	1.33	-1.06	1.49	0
PANDO	0.00	0.82	-0.82	0	0
Expenditure group					
1st(poorest)quintile	0.67	0.25	0.43	2.02	0
2nd quintile	1.36	0.57	0.79	4.6	0
3rd quintile	2.46	0.87	1.59	3.79	0
4th quintile	0.77	1.25	-0.48	2.07	0
5th quintile	0.54	1.29	-0.75	0.93	0
Poverty					
No poor	1.26	1.16	0.10	2.15	
Moderate Poor	1.32	0.84	0.48	3.87	
Extreme Poor	0.68	0.34	0.34	2.09	

Source: Author's calculation from Encuesta de Hogares 2005

***** Percentage over total expenditure

Table 2.16a: Beef sale ratio, budget share, net benefit ratio and poverty impact of a 10% price increase, by household groups

Household category	Food sales*	Food purchases*	NBR	Net sellers (%)	Poverty impact (%)
BOLIVIA	2.25	5.67	-3.42	5.20	0.13
Location					
URBAN	1.62	6.77	-5.15	1.07	0.22
RURAL	3.09	4.22	-1.13	10.72	0
Region					
CHUQUISACA	3.40	3.69	-0.29	10.61	-0.3
LA PAZ	1.81	5.95	-4.14	7.09	0.12
COCHABAMBA	0.74	5.36	-4.63	3.13	0.15
ORUR0	1.37	4.21	-2.84	5.26	0.53
POTOSI'	0.33	4.23	-3.90	1.35	-0.22
TARIJA	1.46	5.19	-3.73	7.65	0.29
SANTA CRUZ	3.41	6.59	-3.18	4.04	0
BENI	8.88	9.85	-0.97	4.46	0.74
PANDO	1.25	7.82	-6.57	2.54	0
Expenditure group					
1st(poorest)quintile	3.55	3.10	0.45	9.46	0
2nd quintile	1.77	5.81	-4.03	6.78	0.64
3rd quintile	1.48	7.17	-5.69	5.02	0
4th quintile	1.47	7.01	-5.55	4.03	0
5th quintile	3.13	4.82	-1.69	2.28	0
Poverty					
No poor	2.45	5.83	-3.38	4	
Moderate Poor	1.43	6.71	-5.29	5.15	
Extreme Poor	2.89	3.91	-1.02	8.12	

Source: Author's calculation from Encuesta de Hogares 2005

***** Percentage over total expenditure

Table 2.16a: Poultry sale ratio, budget share, net benefit ratio and poverty impact of a 10% price increase, by household groups

Household category	Food sales*	Food purchases*	NBR	Net sellers (%)	Poverty impact (%)
BOLIVIA	0.26	2.82	-2.55	4.15	0.05
Location					
URBAN	0.31	3.51	-3.19	0.81	0.05
RURAL	0.20	1.91	-1.71	8.6	0.06
Region					
CHUQUISACA	1.59	2.35	-0.76	13.03	-0.3
LA PAZ	0.01	2.29	-2.28	0.56	0.12
COCHABAMBA	0.03	2.87	-2.84	2.66	0
ORUR0	0.01	1.81	-1.80	0.53	0.27
POTOSI'	0.02	1.79	-1.77	1.58	0
TARIJA	0.10	3.94	-3.83	7.06	0
SANTA CRUZ	0.46	4.33	-3.87	5.84	0
BENI	0.44	2.47	-2.04	8.92	0.37
PANDO	0.47	4.04	-3.57	6.78	0
Expenditure group					
1st(poorest)quintile	0.19	1.02	-0.83	10.7	0
2nd quintile	0.72	2.83	-2.11	5.75	0.26
3rd quintile	0.13	3.26	-3.13	3.79	0
4th quintile	0.07	3.90	-3.83	1.96	0
5th quintile	0.23	2.68	-2.44	0.73	0
Poverty					
No poor	0.17	3.15	-2.98	2.05	
Moderate Poor	0.12	3.09	-2.98	4.04	
Extreme Poor	0.69	1.67	-0.98	9.28	

Source: Author's calculation from Encuesta de Hogares 2005

***** Percentage over total expenditure

Figure 2.1a: Map of Bolivia

Source: Perry-Castañeda Library Map Collection, University of Texas-Austin

PAPER 3

The impact of rents from natural gas on Bolivian municipalities' wellbeing

3.1 **Introduction**

The recent boom in oil, gas and mineral prices has brought to the fore issues related to the use of revenues from non-renewable resources for development purposes in developing countries' context. Given the importance of such revenues in many developing countries and their non-renewable character, it is of utmost importance to use these revenues wisely, and in a sustainable manner that will benefit future generations (UNDESA 2007).

Much of the research available on resource-rich countries has an emphasis on macro-economic models and the developmental impact of the use of these resources at the local level remains largely unknown.

The aim of the present paper is to provide a preliminary assessment of the impact of the fiscal revenues from natural gas on Bolivian municipalities' aggregate measures of wellbeing from 2001 to 2008.

Bolivia nationalized its hydrocarbon sector in 2005 and the change in the fiscal regime associated with it, together with a very favourable context of high price, determines an extraordinary inflow of resources in the country. Part of these rents is transferred to the municipalities earmarked for investments in health and education[88].

This paper investigates whether the increase in fiscal resources from the natural gas, transferred to the municipalities and earmarked for health and education spending, does actually translate into better education and health outcomes.

In order to do this a combined panel dataset spanning over eight years of data between 2001 and 2008 is constructed with 327 Bolivian municipalities being the units of observation.

The model regresses aggregate municipal education and health MDG indicators (primary school enrolment and completion rates, gender gap in primary and secondary school completion rate, proportion of children immunized against measles

[88] The assumption is that the increase in resources translates into increased level of spending in education and health sectors. However, the assumption cannot be tested due to lack of data on municipal spending over time.

and proportion of births attended by skilled personnel) as a function of municipal per capita fiscal transfer from natural gas. Two different models are employed to account for region and municipality fixed effects. Different specifications are applied with the dependent variables expressed in levels, shortfall reduction, and variation of levels.

Also, an index for governance at the municipal level is used to test whether municipalities with better governance indicators are the ones who can make better use of the fiscal resources and obtain better welfare outcomes.

The results suggest that no significant improvement in key indicators of wellbeing seems to occur at the municipal level. When investigating whether the level of resources received have a significant impact on the levels and changes of the indicators of wellbeing, a negligible, if any, effect is found. The results also reject the hypothesis that municipalities with better governance are the ones that can produce better welfare outcomes.

Although preliminary, these results suggest that the mere availability of financial resources does not result in significant welfare improvement *per se*. Suggestive evidence reveals that the “curse” effect of fiscal rents from natural gas is likely to be due to inefficient municipal management.

There have been strong data constraints in conducting this research. Information at the municipal level, especially for such recent years, are very limited and even when they exist, having access to them has proved to be hard.

Nevertheless, the paper can contribute to the literature by collecting the scarce information available and attempting a preliminary analysis of the extraordinary economical and welfare shock occurring in Bolivia. Although preliminary, the assessment informs about the potential direction of the future impact and give policy makers tools to re-direct (re-shape) revenue allocation arrangements or spending behaviours in a way to make more effective use of the fiscal rents.

The paper is structures as follow:

The relevant literature on resource curse and poverty impact of decentralization is reviewed in section two; section three looks at the natural gas sector in Bolivia and revises the fiscal regime applied to the hydrocarbon sector, focusing on the main

fiscal resources (IDH, IEDH, royalties); sections four and five describe the data and the empirical strategy and results are discussed in section six; section seven tests for governance; section eight focuses on municipalities located in Tarija and Pando, the two regions receiving above-average transfers from gas; further considerations are reported in section nine and section ten concludes.

3.2 **Literature review**

A body of theoretical and empirical literature suggests that abundance of natural resources often leads to lower growth rates, lower level of human development and more poverty (Sachs and Warner, 1995, 1997, 2001; Bulte *et al.,* 2005; Gylfason, 2001; Leite and Weidmann, 1999; Isham *et al.,* 2005; Kolstad, 2007; Collier and Goderis, 2007; Brunnschweiler and Bulte, 2008; Karl, 1997; Sala-i-Martin and Subramaniam, 2003).

Paradoxically, resources seem to be a curse more than a blessing for the countries that host them. The evidence triggered considerable debate about the causes of the resource curse (Rodriguez and Sachs, 1999; Neumayer, 2004; Stijns, 2005; Robinson *et al.,* 2006; Papyrakis and Gerlagh, 2007; Zhang *et al.,* 2008) and some channels of transmission from abundant natural resources to sluggish economic growth have been indentified: specifically, 'Dutch disease' – the tendency for the real exchange rate to become overly appreciated in response to positive price shocks (Sachs and Warner, 1995; van Wijnbergen, 1984; Matsen and Torvik, 2005; Sarraf and Jiwanji, 2001;), voracious rent-seeking and corruption (Collier and Hoffler, 2002; Collier, 2007; Baland and Francois, 2000; Petermann *et al.,* 2007; Kolstad and Soreide, 2009) and weakened public and private incentives to accumulate human capital (Gylfason, 2001, 2008; Stijns, 2006).

However, some studies suggests that countries can escape the resource curse (Sachs and Warner, 2007) and turn the windfall revenue into a blessing if they have good institutions (Mehlum *et al.,* 2006), are open to international trade (Arezki and

van der Ploeg, 2008), or have well- developed financial systems (van der Ploeg and Poelhekke, 2008).

The available empirical studies employ either cross-country analysis or when they focus on a single country, they tend to have a national approach.

However, in the light of the widespread decentralization process, "government…are devolving political, fiscal and administrative powers to sub-national tiers of government" (World Bank, 1999:107) so that the role, functions and resources of the local governments have expanded. As a result, in the average country sub-national expenditures as a share of GDP have tripled since 1972 (World Bank, 2000) and local governments now provide the majority of public infrastructure (sewage, water, electricity, and roads) in most countries (Shah, 1997: 9).

Furthermore, decentralization advocates have asserted likely developmental and pro-poor outcomes as decentralization brings government closer to the people and it is expected to lead to greater participation at the local level (Blair, 2000; Manor, 1999; Crook and Manor, 1998). Local governments can become more responsive to citizens' needs by "tailoring levels of consumption to the preferences of smaller, more homogeneous groups" (Wallis and Oates, 1988:5).

Therefore, more than ever, the performance of the sub-national entities affects (determines) the economic and social development of the country as a whole.

Only few recent studies go beyond the national framework and analyse the dynamics of resource-rich countries at the sub-national level (Caselli and Micheals, 2009; Aragon and Rud, 2009; Monteiro and Ferraz, 2009; Naritomi et al. 2007; Bobonis, 2008; Vicente, 2008). Most of these studies find strong correlation between revenues from natural resources and mismanagement, corruption and slow socio-economic development, thus suggesting that the resource curse hypothesis holds even when looking at sub-national level.[89]

[89] The only exception is Aregon and Rud (2009). They analyze the impact of a gold mine in Peru on the local population and they find that the expansion of the mine increased real income and welfare of the local population and reduced poverty. However, they rule out that the results are driven by increased public expenditure associated to the mining revenue windfall, showing that the effect seems to be driven by the demand shock and its multiplier effect, associated to the mine's backward linkages.

Caselli and Micheals (2009) look at the impact resource windfalls from oil on Brazilian municipalities. They find that oil abundance causes municipal revenues and reported spending on a range of budgetary items to increase, mainly as a result of royalties. Nevertheless, they are 'unable to detect commensurate improvements in various socio-economic outcomes that would be expected to respond to the recorded spending increases. Furthermore, increases in household income associated with oil-induced government revenues are modest-to-undetectable. (Caselli and Micheals, 2009:30).

Monteiro and Ferraz (2009) study the impact of oil royalties on political patronage and rent-seeking in Brazilian municipalities. They find that municipalities receiving royalties hire more public employees and have a larger probability of facing candidates with charges of malfeasance or misconduct during ballots, which are therefore forbidden to run for election. In these municipalities, elections are characterized by less competition, higher costs and lower candidates' years of schooling.

Naritomi *et al.* (2007) using a within country approach show that Brazilian municipalities with origins tracing back to the sugar-cane colonial cycle display today more inequality in the distribution of land, while municipalities with origins tracing back to the gold cycle display worse governance practices and less access to justice. Moreover, the evidence suggests that the worse institutional quality determined by this colonial heritage is reflected in lower income per capita today (Naritomi *et al.*, 2007:33).

Bobonis (2008) uses variation in the coffee industry across municipalities in Puerto Rico to examine whether changes in the incentives for elite groups to enforce coercive labour and political institutions led to a restricted provision of public schooling. They find that municipalities in coffee producing region allocated more public resources to enforce coercive labour measures and for purposes of political repression, and assigned fewer resources towards the provision of primary schooling.

Interesting studies that use sub-national governments as units of observation are also those from the literature on governance and, in particular, from that strand of research that looks at the impact of decentralization on poverty and welfare.

Although the focus of these studies is pretty different from the one of the present work, a brief review of the relevant literature is presented as this literature might help highlighting strengths and flaws of the local governments in achieving economic and social outcomes that are likely to be valid also in the context of resource-rich countries.

The review of the developing countries literature resulted in little convincing evidence that decentralisation necessarily delivers improvement in quality of public service provision and alleviates poverty (see Crook, 2003; Johnson, 2001; Crook and Sverrisson, 2001; Bossuyt and Gould, 2000; Ahmad and Brosio, 2009). There is even some counter evidence: that decentralisation can work against poverty reduction due, among other factors, to the problem of elite capture and elite cooptation (clientelism), less coordination among policy aims, reduced efficiency, and financial loss due to rent seeking (Crook, 2003; Johnson, 2001; Vedeld, 2003; Weingast, 1995; Treisman, 2000; O'Donnell, 1999; Bardhan and Mookherjee, 2000; Prud'homme, 1995); also, local government officials are often lacking in training and expertise, thus undermining the planning of policy initiatives (Barrilleaux *et al.*, 1992). An additional factor to take into account is municipalities' reliance on locally generated taxes. Reliance on government transfers should be associated with higher levels of spending and debt while reliance on self-generated taxes induces politicians to emphasize responsiveness and efficient policy provision as well as investment in public goods (Hines and Thaler, 1995; Remmer and Wibbels, 2000; Rodden, 2003; Rodden and Wibbels, 2002).

Crook and Sverrisson (2001, 2003) reviewing the evidence conclude that responsiveness to the poor has actually been a rare outcome. This is more likely to happen when the interests of the poor are supported externally by committed governments and/or party (Crook and Sverrisson, 2003) or under certain benign conditions – for example, when extended participation or accountability mechanisms

are adopted (Crook, 2003). Manor (1999, 2000, 2003) stresses that democratic decentralization usually helps to reduce poverty that arises from inequalities between regions or localities. This is so because it tends to provide remote regions that have suffered from under-representation with more voice and resources, more so if the system includes equalization mechanisms which redistribute resources from prosperous to deprived areas. However, decentralization often does less to reduce poverty that arises from inequalities within regions or localities, because local elites may capture most of the power and spoils that decentralization provides. Prejudices against the poor, excluded groups may be stronger at the local level than at higher ones (Manor, 1999: 105-107).

Concluding, decentralization does not *per se* lead to service delivery improvement and poverty alleviation. The effectiveness of the local action in achieving those targets will depends on whether they have incentives to be responsive to public demands, fiscal freedom to respond to those demands, and the capacity to design and implement those plans efficiently.

3.2.1 **Literature review on Bolivia**

For the scope of the present work, reviewing the studies on the Bolivian contexts is particularly interesting as it sheds lights on the decentralization process started in the 90s and on the strengths and weaknesses of municipalities in delivering effective service provision and poverty reduction. As it emerges from the general literature, Bolivia is often reported as an example of successful decentralization: the Government embarked in a committed decentralization process devolving adequate powers and financial resources onto local bodies (Vedeld, 2003); funding procedure was transparent and relations between the central government and local governments institutionalized in laws and procedures that reduced uncertainty (Jutting *et al.*, 2004); resources switched towards more socially relevant projects (Faguet and Sanchez, 2006); civil society has become more involved (Vedeld, 2003; Ebel and Yilmaz, 2002). However, other studies highlight the limits of the

decentralization process, highlighting the inefficiency of local bodies (Inchauste, 2009), a growing level of municipalities' indebtedness and corruption (Singer, 2006).
Faguet and Sanchez (2006) analyse the effect of decentralization on educational outcomes in Bolivia and Colombia. They suggest that decentralization had overall a positive impact, switching resources from infrastructure and industry to primary social services and this is assumed to be in line with citizens' preferences. In Bolivia public investment in education became more responsive to local needs, rising disproportionally in those municipalities with worse education indicators.[90] Further evidence suggests that this was not the simple result of increasing financing *levels*, but due instead to the *quality* of investment that municipalities achieved. According to their analysis, results were mainly driven by the performances of the smallest, poorest, rural municipalities which decentralization managed to empower.
Looking at political and social municipal characteristics, Faguet (2009) investigates the determinants of local governments' responsiveness and accountability in Bolivia. He finds that in those municipalities where 'many diverse economic interests support a variety of political currents, and society is organized into intermediating groups capable of solving the collective action problem, government will have a strong tendency toward responsiveness and accountability to citizens' (Faguet, 2009:60). Specifically he finds that the level of responsiveness relies on the interaction between private firms and civic organizations through the local political system.
Gray Molina (2002) estimates the determinants of poverty reduction across Bolivian municipalities and he finds that that urbanization has been a key determinant of the reduction in the Unsatisfied Basic Need (UBN) index between 1992 and 2001. Secondly, municipal social investments are significantly biased towards infrastructure and little impact is found on specific educational and health outcomes, the latter being mostly determined by national, rather than local policies.

[90] There is no, however, precise checking of the correspondence between increased expenditure and increase in enrolment outcomes.

High turnover of mayors is negatively correlated with poverty reduction while the number of grass-roots organizations participating in budget planning showed no significance.

Pinc (2004) also addresses the question of the extent to which participation at the local level contributed to poverty reduction measured through the UBN index. He finds that urbanization, low altitude, high temperature and strong historical links to the central government are associated with large poverty reduction at the municipal level. Also, municipality pro-poor expenditure is closely linked to the ability of municipal governments to raise their own resources.

He also finds that citizen participation played a limited role and only under certain circumstances. Municipalities with the best outcomes in poverty reduction did register an above average percentage of grass-roots organizations participating in municipal planning meetings. However, on the other hand, many municipalities with high rates of participation revealed weak performance in poverty reduction.

Vedeld (2003) reviews some successful cases of positive impact of decentralization on poverty reduction, mainly Bolivia, Philippines, India, Uganda and Mali. In Vedeld words, “Bolivia is a case that underscores the critical importance of a committed government in furthering relatively successful administrative and financial decentralisation, with measures also to involve civil society” (Vedeld, 2003:189). Local vigilance committees are introduced although in some cases they have no real effect on local decision-making. But in other cases communities have successfully utilised them to uncover corruption and lobby for service providers to reduce. As a result, civil society has become more involved in tracking public expenditure and local governments have become increasingly responsive to public demands (Vedeld, 2003:189).

Singer (2006) shows that the success of Bolivian municipalities in reducing poverty headcount during the 1990s depends on spending in education, capacity of generating local tax base and level of indebtedness. However, he also finds that ‘while spending on education reduces poverty as does increased use of taxation powers instead of relying on transfers, merely increasing the total amount of

revenues available to municipalities does not seem to impact poverty levels either; the total revenue available per resident is never a significant predictor of poverty reductions. Hence it seems that while devolving finances to sub-national governments may be a necessary condition to empower them to fight poverty, the actual content of local government policy is more important than mere act of having a local government with finances' (Singer, 2006:28).

Inchauste (2009) looks at Bolivian municipalities from 2001 to 2005. The author uses fiscal and household survey data to check whether resources transferred to municipalities under the Highly Indebted Poor Countries (HIPC) initiative have had any impact on short-term social indicators, such as illiteracy rate, rate of unattended respiratory diseases, and home access to electricity and water. Results do not provide convincing evidence of efficient local governments' action. Municipalities, particularly the poorer ones, show substantial problems in transforming increased revenue in effective spending: increases in education transfers do not significantly affect the share of children not attending school; changes in spending or transfers in investment do not significantly affect the share of homes with access to water and electricity services. More in general, there is no evidence of a clear improvement of conditions in the poorest municipalities, or for the poorest segments of the population.

3.3 **Background: the natural gas legislative and fiscal regime**

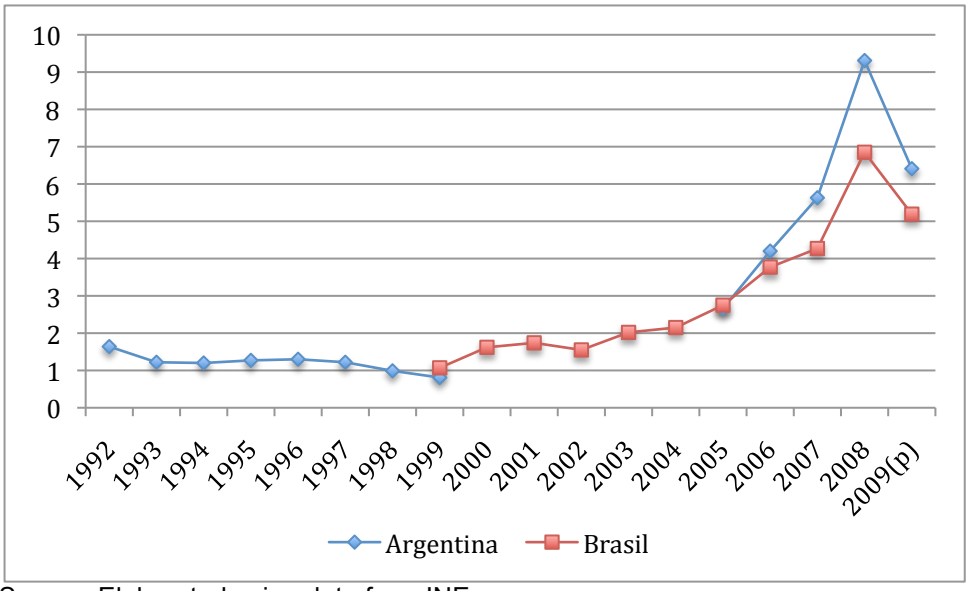
The production of natural gas in Bolivia increased substantially during the last decade. In 2000 the production was 201.39 million cubit feet and this figure more than doubled in the subsequent eight years with a production in 2008 of 542.946 million cubit feet[91].

[91] The figures on 2009 suggest a declining trend in both production and export but caution is called for as the figures are still preliminary ones.

The gas sector accounted for only 10% of the total export in 2000 but the figure has increased thereafter. In 2008 with an export of 3.159 million US$, the gas represents about 45% of total export. In GDP terms, the hydrocarbon sector accounted for 4.8% of the GDP in 2000 and 6.6% in 2008.

Bolivia started natural gas exports to Argentina in 1972 with a 20-year contract and for 27 years, Bolivia's natural gas exports were dependent on Argentina as its sole buyer. The export contract was extended in 1991 for another 8 years but it comprised lower prices and reduced export volumes.[92] The export price of natural gas had been reduced since 1985, following the trend observed in world prices of oil.

Figure 3.1: Natural Gas Price US$ (1995-2009)



Source: Elaborated using data from INE

By 1991, the average export price of gas was US$ 3.02 per thousand c.f., and it then decreases to US$ 1.64 in 1992, reaching in 1999 an average level of US$ 0.81 per thousand c.f.. In the meantime, Bolivia started a 20-year contract with Brazil and, under the contract, the price was based on the cost of a basket of alternative fuels, which was adjusted periodically. That implies an extremely large increase in the gas

[92] The natural gas has no world standard price mechanism; the price is usually negotiated between the trade partners as stipulated in the existing contracts that normally include clauses that index the gas price to the world price of its close substitutes (mainly oil).

export price, from US$1.7 per thousand cubic feet in 2001 to US$2.75 in 2005 and to US$6.85 in 2008.

The development of Bolivia's natural gas policy during the 1990s created profound political controversies within the country due to the widespread perception that the organization of Bolivia's hydrocarbons sector strongly favoured private (mostly foreign) capital, while disadvantaging the state (Kohl and Farthing, 2006). Plans to allow foreign interests to export liquefied natural gas (LNG) via Chile, Bolivia's historic rival (to which Bolivia lost its coastal territory in the 1879–83 War of the Pacific), were similarly viewed as an intolerable affront (Perreault and Valdivia, 2010)

In 2003, a wave of protests, the so-called 'gas war' exploded throughout the country calling for the re-nationalisation of the gas sector. The then President Sanchez de Lozada resigned and in 2004 a referendum was held on hydrocarbons policies.

In May 2005, Congress passed Hydrocarbons Law No 3058. The new legislation compels companies to relinquish the total hydrocarbons production to the Bolivian State, the latter being the owner of all hydrocarbons production at the wellhead. The law introduced a new important fiscal tool, the Direct Tax on Hydrocarbons (IDH), equivalent to 32% of total gross hydrocarbon output measured at the wellhead, which determined new enormous fiscal inflow in the country.[93]

The fiscal regime applied to the gas production is particularly complex and it varied many times in the last decades. There are seven different taxes, both direct and indirect, related to the gas production and tracking all the technical changes in the fiscal regime associated with natural gas is beyond the scope of the present work.

In terms of economic importance, three fiscal mechanisms are of particular interest as together they account for more than two third of the total fiscal resources from gas. In the next paragraphs, a brief description of their main features, economic relevance and their resources' allocation rules is presented.

[93] On May 2006, the newly elected government of President Evo Morales, the first indigenous president elected in Bolivia, declared a decree re-nationalizing the natural gas sector. Spectacularly, military troops were deployed in the natural gas fields, Bolivian flags hoisted upon the corporations' buildings and slogans proclaiming "property of all Bolivians" hang over gas stations. The Supreme Decree 28701 established a 180-day period of transition for foreign oil companies to renegotiate and sign new contracts with the new YPFB as major shareholder.

3.3.1 IEHD

The IEHD (special tax on hydrocarbons and derivatives) was created in 1994 by Law 1606. The IEDH taxes the commercialization of hydrocarbon products within the domestic market, regardless of their origins (national or imports). The IEHD is an indirect tax on hydrocarbon products with a fixed aliquot annually set.
Between 1997 and 2000 the IEDH represented the main source of fiscal revenues but its relative importance decreased afterward so that in 2005 the IEDH is the third most important fiscal revenues after IDH and royalties.[94]

3.3.2 Royalties

Royalties represent the payment for the right to explore and exploit gas resources. As defined in article 52 of the Law 3058, royalties comprises:

1) a regional royalty equivalent to the 11% of the total production paid to the region where the production originates;
2) a compensatory national royalty equivalent to 1% of the total production paid to the department of Beni (2/3) and Pando (1/3);
3) a share of 6% of the total production in favour of the Treasury;

Consequently, the State receives through the royalties 18% of the value of the total production. 1/3 of those resources benefit the Treasury. The remaining part is divided among the four producing regions (Cochabamba, Chuquisaca, Santa Cruz and Tarija) and Beni and Pando.[95]

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[94] The IEDH is distributed between the Treasury (65%), the regions (25%) and the FCD, a compensatory fund created to compensate those regions that receive less royalties than the average. 20% of the amount transferred to the regions is assigned to Universities. In 2007 the amount of revenues from the IEDH received by the Treasury was $US 196.3 millions while the amount transferred to the regions was around $US 105.7 millions.

[95] In 2007, the royalties collected were US$ 419 million of which US$ 138 million went to the Treasury, and US$ 281 million to the six regions, with the producing regions, especially Tarija, getting the largest amount of it.

3.3.3 IDH

Law 3058 (in 2005) introduces the Direct Tax on Hydrocarbons (IDH), equivalent to 32% of total gross hydrocarbon output measured at the wellhead.[96]

The creation of the IDH generated a new and very significant fiscal inflow for the Government and sub-national entities. In 2005 the amount of revenues from IDH was Bs. 2,321 million and it grow to an average of Bs. 5,726 million during 2006 and 2007, turning into the most important source of income from the hydrocarbon sector.

Much debate arose about the rules governing the sharing and use of such copious resources. The idea of the Law 3058 was to address regional disparities between producing and non producing regions, created by the royalty. Resources from the IDH were thus assigned to the non producing regions as well (Oruro, Potosi', La Paz, Beni and Pando).

Article 8 of the DC 28223 (2005) defines the distribution criteria of the IDH:

1) 12.5% of the total value extracted is assigned to hydrocarbon producing regions, distributed according to the regional level of production.

2) 31.25% of the total value extracted is assigned to non producing regions (6.25% each region)[97]

3) 56% is allocated to the Treasury of which: 93% is to be assigned Indigenous people, farmers' communities, municipalities, Universities, Army, police, Fund for National Development, others; 6.9% is intended to be redistributed among regions through a Compensation Fund.[98]

The allocation of the IDH has changed since then several times, and it is still the object of most political bargaining.[99]

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[96] Decreto supremo 28223

[97] Note that he fact that each region received the same percentage determines large disparities in the per capita distribution of IDH resources. The issue will be discussed in section four.

[98] The Compensation Fund assigns resources to those producing regions in case they receive an amount of IDH resources that are less than the amount received by any of the non producing regions.

[99] The legislative framework has been modified by Decreto Supremo 28421 (2005), Law 3322 (2006), DS 29322 (2007), Law 3791 (2007), DS 29400 (Dec 2007) and DS 29432.

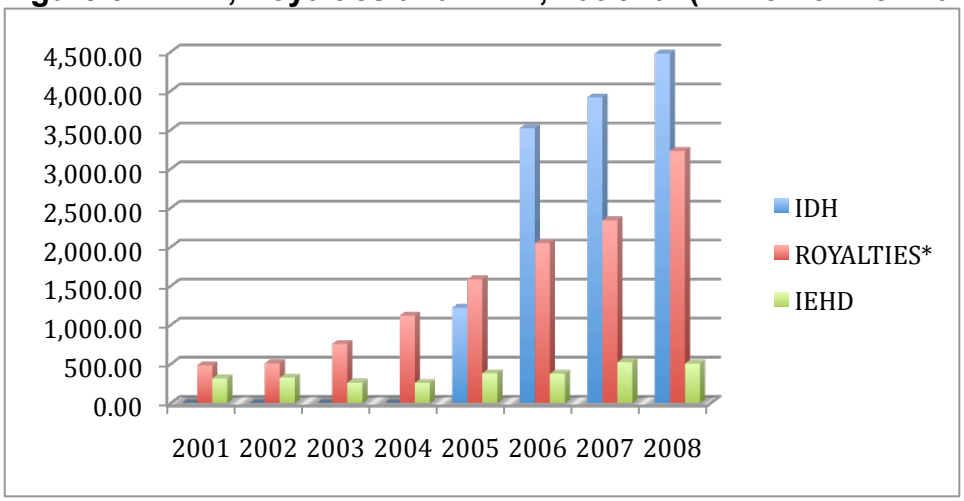
As a result of these modifications, the actual revenue sharing arrangement is characterized by reduced Government discretion in the allocation of its resources; and change in the sharing arrangement among sub-national actors, incorporating municipalities and Universities as direct beneficiaries.[100]

The new fiscal regime, together with a very favourable high oil price, determines an extraordinary large inflow of fiscal revenues in the country. Figures 2 shows the trends of the main fiscal mechanisms at the national level.

It is apparent the increase in resources over time, with total revenues passing from 793 millions of Bolivianos in 2001 (US$ 120 millions) to 8207 Millions of Bolivianos in 2008 (US$ 1140 millions). The large increase is driven by the creation of the IDH in 2005.

[100] Part of the share assigned to the national level (still 56%) is to be redistributed among regions. The other part is to finance specific compensation and social funds as well as the police and the army. Specifically, 9.5% of the Treasury's share of IDH is to finance the Compensation Fund, especially aimed at benefiting the three largest cities of La Paz, Santa Cruz and Cochabamba. Funds are assigned to the Municipality (for health, education, employment creation, and road), 20% to Universities; 5% is assigned to the Indigenous People and Campesino Communities Fund; 30% Pension Fund (Universal Fund for Old Age) this fund pays a pension to people above 60 years of age formerly uncovered (Renta Dignidad).

Figure 3.2: IDH, Royalties and IEDH, national (Million of Bolivianos)



Source: Own calculation based on UDAPE

According to a recent report on the distribution of revenues from Extractive Industries (EI) across levels of government in seven resource-rich countries (Morgandi, 2008), Bolivia is characterized by high level of distribution by derivation and a (moderate) level of re-distribution to non-producing regions (which receive about 20% of the revenues) with a relatively small (37%) take of the Central Government (Morgandi, 2008:7).

The report also highlights that the Bolivian case is also unique in the sense that the re-distribution does not take into account region-specific characteristics, such as population, size and fiscal capacity.

3.4 **Data description**

The present work employs an original combined panel dataset on aggregate measures of wellbeing and fiscal rents from natural gas between 2001 and 2008, at the municipal level.

The units of observations used in the present work are 327 Bolivian municipalities, distributed across nine departments (80 municipalities located in La Paz, 56 in Santa

Cruz, 45 in Cochabamba, 38 in Potosi, 35 in Oruro, 28 in Chuquisaca, 19 in Beni, 15 in Pando and 11 in Tarija).

Given that the aim of this paper is to assess the impact of the rents from gas on welfare changes experienced by the Bolivian municipalities from 2001 to 2008, the analysis requires aggregate measure of wellbeing at the municipal level, which ought to be very recent and comparable over time[101].

The socio-economic data are provided by the Ministry of Education and the Ministry of Health and Sport and consist of education and health indicators. The variables selected are good proxy of the municipal achievements in education and health and their relevance is internationally recognized as they are all indicators used to monitor the MDG progress. Specifically, the variables used are:

1. Net Enrolment rate (ratio of the number of children of official school age who are enrolled in primary school to the total population of children of official school age)[102]
2. Primary completion rate (proportion of pupils starting grade 1 who reach last

[101] Unfortunately, the only comprehensive source of data at the municipal level dates back to the last census, conducted in 2001, and the household surveys carried out since then do not allow disaggregation at the municipal level (and most of them not even at the regional level). Therefore, the few existing studies carried out at the municipal level use census data (UNDP 2004) or a combination of data from the census with household surveys (INE-UDAPE 2003) INE-UDAPE 2003 used the small area estimation method developed by Elbers, Lanjouw, and Lanjouw (2003) to create consumption poverty maps at the level of municipalities combining the census 2001 with the household surveys carried out in 1999, 2000, and 2001 by the INE.

[102] There are reasons to believe that the data on enrolment rate in Bolivia are likely to be over-reported. As the 2003 UN report 'Indicators for Monitoring the Millennium Development Goals' states: School enrolments may be overreported for various reasons. Survey data may not reflect actual rates of attendance or dropout during the school year. Administrators may report exaggerated enrolments, especially if there is a financial incentive to do so. Children who repeat years may mistakenly be included in the net figures. Children's ages may be inaccurately estimated or misstated. Census data may be out of date or unreliable. There may also be insufficient data on school enrolment by sex, but existing measurement problems make it difficult to assess the situation correctly. The indicator attempts to capture the education system's coverage and efficiency, but it does not solve the problem completely. Some children fall outside the official school age because of late or early entry rather than because of grade repetition.' (UN, 2003: 17) On the Bolivian case, evidence suggests that many schools tent to over-report the numbers of students in order to received more funding. Also, many municipalities report enrolment rate higher than 100%. This could due to late or early school entry or inaccuracy of population projection at the municipal level (based on the 2001 Census).

grade of primary)[103]

3. Gender gap in primary completion rate (difference between girls and boys' primary school completion rates)[104]

4. Gender gap in secondary completion rate (difference between girls and boys' secondary school completion rates)

5. Proportion of one year-old children immunised against measles (percentage of children 12-23 months who received at least one dose of measles vaccine)

6. Percentage of births attended by skilled health personnel

Figure three shows the trends of the average aggregate measures of wellbeing of the Bolivian municipalities. Although the average masks important variation across municipalities, it is apparent that Bolivia did not experienced any major improvement in the MDG indicators considered. The gender gap in both primary and secondary school completion rates improved and the proportion of births attended by skilled personnel increased over the period considered but the other indicators (enrolment rate, completion rate and percentage of children immunized against measles) show negative trend, especially in the last years of the period.

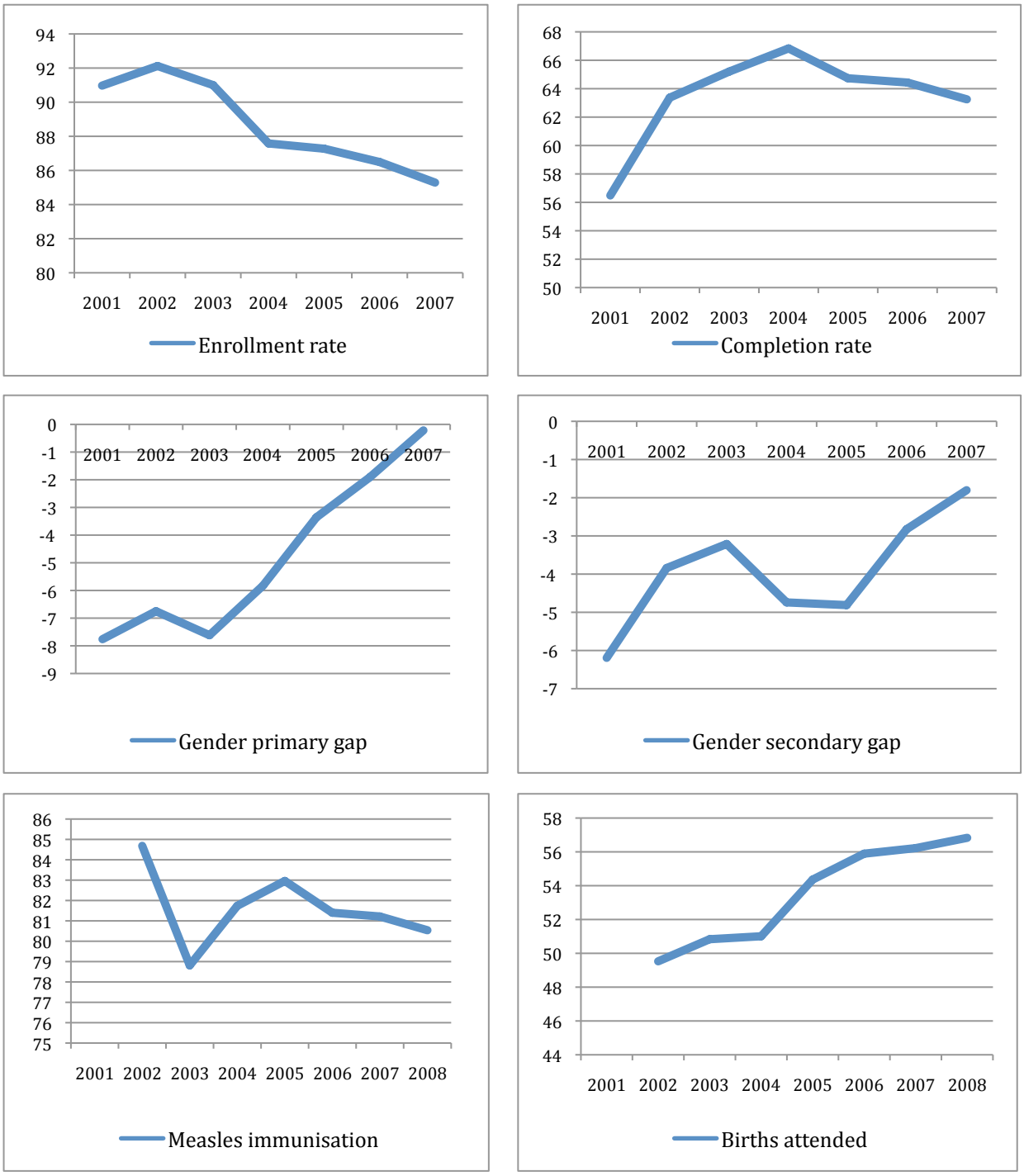
The other set of data needed are the fiscal rents from natural gas transferred to the municipalities from 2001 to 2008.

This set of data is from the Ministry of Treasury that provides figures on the fiscal transfer to the municipalities by composition. For the scope of the present paper, only transfers from hydrocarbons are considered and, specifically, royalties and IDH.

[103] The primary completion rate is calculated through the Gross Intake Rate at the Last Grade of Primary: "Total number of new entrants in the last grade of primary education, regardless of age, expressed as a percentage of the population of the theoretical entrance age to the last grade". Global Education Digest 2004 (page 149) - Comparing Education Statistics Across the World, UNESCO Institute for Statistics.

[104] Gender gap in primary and secondary completion rates are included because these variables are likely to be good proxy for the municipal commitment towards inclusive and equitable policies in education as well as in other social policies.

Figure 3.3: Aggregate measure of wellbeing over time (mean)



Source: Elaborated using data from Ministry of Education and Health

Those two fiscal resources are a good proxy for the actual allocation of rent from the gas sector. In fact, first, they represent the largest fiscal resources and, secondly, they are representative of the actual allocation revenue sharing arrangement between sub-national entities and between producing and non producing regions.

The figures on IDH are of key interest. Introduced in the 2005, the IDH is the only fiscal mechanism that comprises direct transfers to the municipalities (about 25% of the IDH rents). Before the introduction of the IDH, regions rather than municipalities were the only beneficiaries at the sub-national level. However, looking at the IDH only would not be representative of the actual distribution of the gas rents across the national territory and it will prevent from analysis the pre-IDH (and therefore pre-price boom) period. Therefore, the variable GAS also takes into account the amount of royalties received by the municipality's corresponding region. As a proxy for royalties, the variable simply comprises the amount of royalty received by each region from 2001 to 2008 divided by the regional population[105].

Summing up, the variable GAS contains both the per capita amount of royalties received by the region each municipality belongs to (from 2001 to 2008) plus the exact share of IDH transferred to each municipality computed at the per capita level from 2005 to 2008[106] As it is constructed, the variable GAS suffers from an important shortcoming. While the variable comprises the exact level of IDH fiscal transfers, the amount of revenues from royalties received by each municipality is simulated. Royalties are regional income and no direct transfer to municipalities actually occurs. To construct it, an unrealistic scenario is assumed, that is, royalties are directly transferred to the population. This is a very imprecise assumption and is likely to overestimate the amount of transfer received by municipalities in royalty recipient regions. However, totally neglecting royalties would result in a biased and even more unrealistic picture of the revenue allocation arrangement. Also, one can assume that

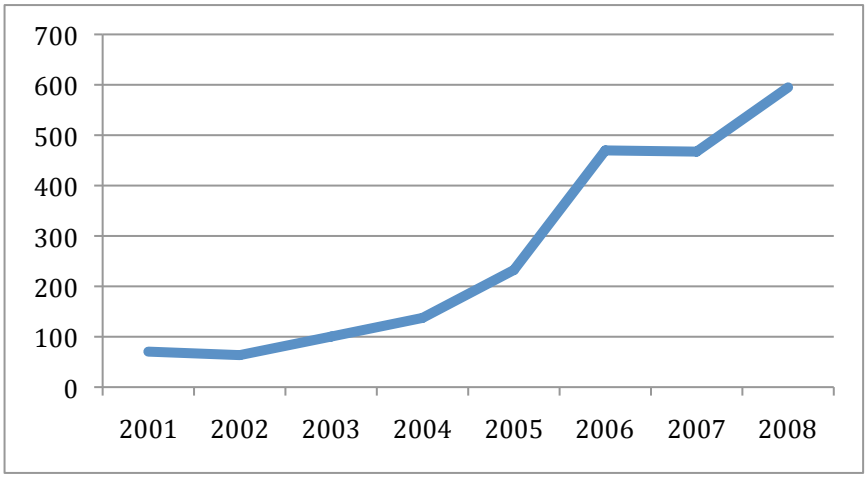
[105] This calculation tells us how much every person would receive if the royalties were transferred directly to the population. This is a rough approximation because royalties are regional revenue, spent by the regional authorities and therefore no direct transfer to municipalities or people actually occurs.

[106] The nominal figures in LCU (Bolivianos) are converted in real terms, by deflating them with the average annual CPI.

municipalities located in royalty-receiving regions are likely to indirectly benefit from those resources. Furthermore, if only IDH data were considered, the analysis' time period would be restricted to only three years panel (from 2005, when the IDH is introduced, to 2008). Therefore, despite the limitations of the GAS variable as it is constructed, the inclusion of the royalties is still preferred.

The graph below shows the enormous increase in the per capita fiscal transfers from gas to the municipalities. The rents have had an increasing trend since 2001. From a mere 70 Bolivianos per capita in 2001 (equivalent to US$10 or US$ 25 in PPP) in 2008 the average figure rises to almost 600 Bolivianos in 2008 (equivalent to US$83 or US$ 250 in PPP)[107]

Figure 3.4: Per capita municipal gas rents over time (mean)



Source: Elaborated using data from Ministry of Treasury

Table 3.1: Per capita municipal gas rents over time (mean and standard deviation)

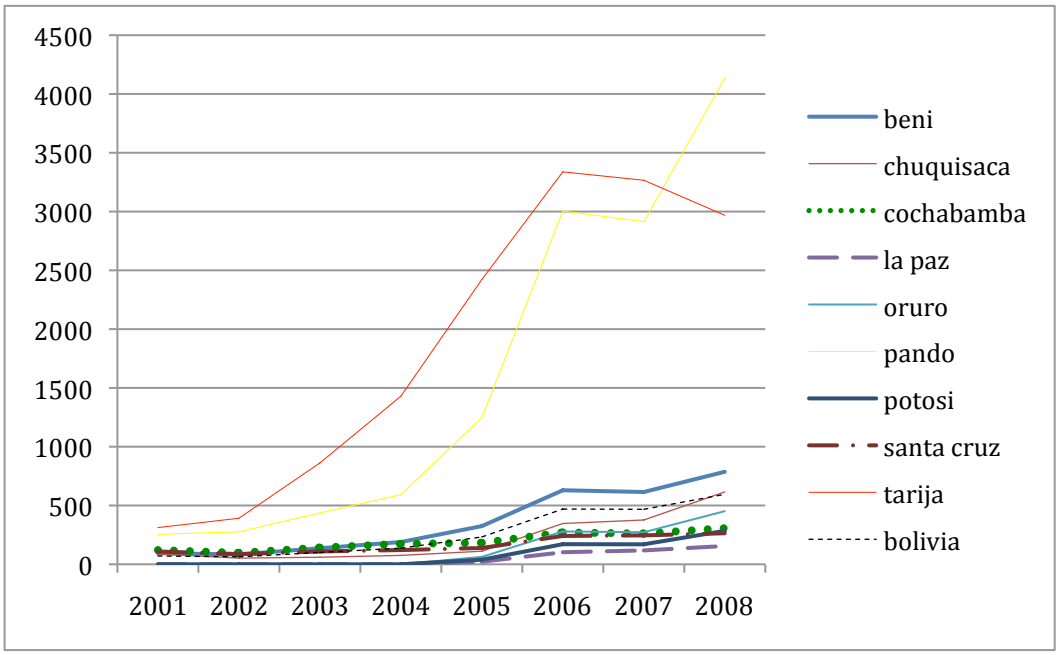
Bolivia	2001	2002	2003	2004	2005	2006	2007	2008
mean	70.47	63.53	100	137.36	232.49	470	467.38	594.9
st. dev.	80.79	88.84	173.11	274.6	480.91	801.4	778.92	939.65

Source: Elaborated using data from Ministry of Treasury

[107] Official exchange rate (LCU per US$, period average) and PPP conversion factors are from WDI dataset. The official exchange rate is 6.61 LCU per US$ in 2001, 8.0 LCU in 2005 and 7.24 LCU per US$ in 2008. The PPP conversion factor for private consumption is 2.47 LCU per international $ in 2001, 2.57 in 2005 and 3.01 in 2008.

However, the average masks very large and interesting differences across municipalities. The graph below shows that when looking at the average municipal figures by the regions they belong to, the picture looks more uneven.[108] Although the rents increase for all the municipalities, the average gas transfer for municipalities belonging to two regions – Tarija and Pando - is tremendously larger than the rest of the municipalities. With Tarija being in absolute term the most important gas producing region, one might be tempted to infer that producing regions are definitely benefitting the most. But the figures on Pando, a non producing region, reject this hypothesis[109].

Figure 3.5: Per capita municipal gas rents over time, by region (mean)



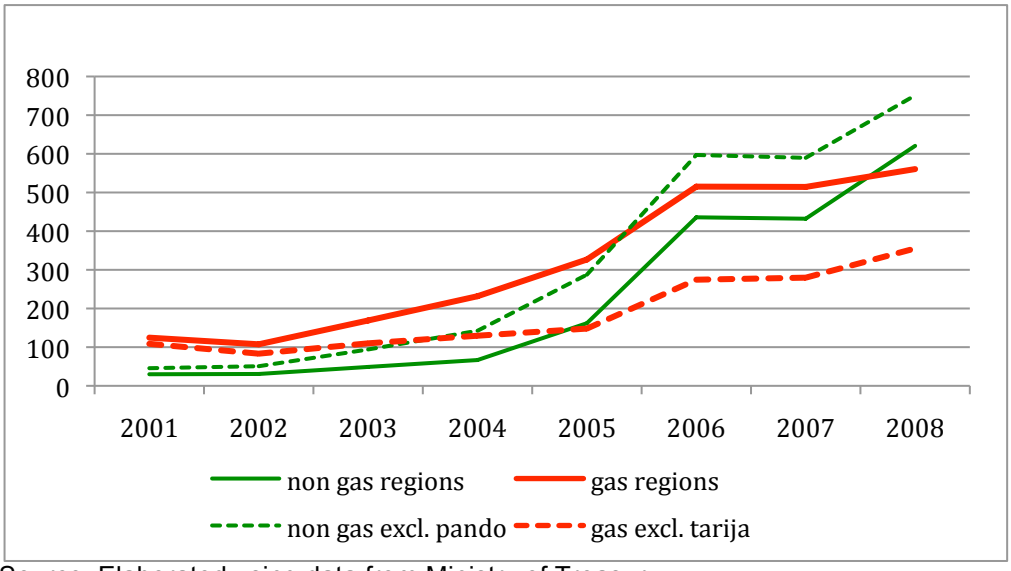
Source: Elaborated using data from Ministry of Treasury

[108] Table A.1 in Appendix 1 reports mean and standard deviation for each region.

[109] The high per capita disparity across regions is partly due to the revenue allocation formula used. While royalties are mainly distributed among producing regions on the basis of their gas production shares, the regional allocation of resources from the IDH is subject a complex formula that also comprises a fix percentage to be transferred to each region. Part of the IDH is to be "equally" distributed among regions, and that determines, therefore, large disparities at the per capita level. This partly explains why low populated municipalities situated in the regions of Tarija and Pando benefit a much larger per capita transfers than the municipalities in the highly populated regions (such as La Paz, Santa Cruz and Cochabamba).

Nevertheless, as a further analysis, the trend in rents decomposed by municipalities in producing and non-producing regions are reported in the graph below. It is evident that producing regions exhibit a higher level of transfers over time but the gap narrows down in the recent years and 2008 figures show an inverted trend. Municipalities located in non producing regions in 2008 benefit rents from gas equal to 620 Bolivianos, around 10% more than municipalities located in producing regions. However, the picture changes completely if the observations on municipalities in Tarija and Pando are dropped (as outliers). The dotted lines show that, excluding those municipalities, it seems that producing regions had a higher share of rents till 2004 but afterwards, the trend is reverted and non producing regions in 2008 receive more than double amount of rents than producing regions.

Figure 3.6: Per capita municipal gas rents, by producing and non producing regions



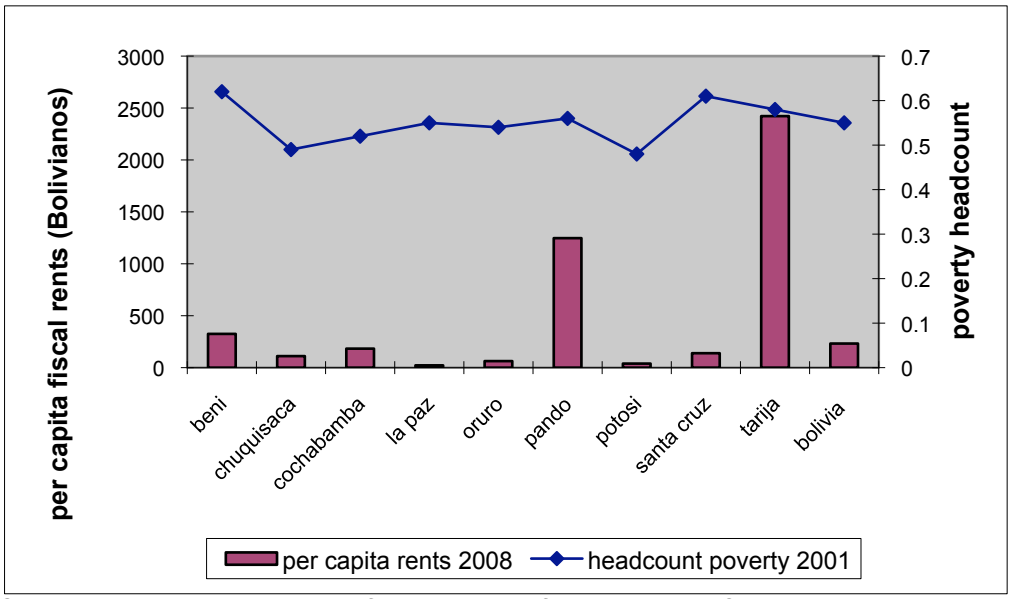
Source: Elaborated using data from Ministry of Treasury

The hypothesis that rents from gas disproportionally benefit producing regions is therefore rejected. Furthermore, it seems that municipalities located in non producing regions (when excluding Pando and Tarija from the analysis) receive an increasingly higher share of the revenues from 2004 onwards.

In order to investigate further the revenue allocation criteria, the distribution of fiscal rents is analyzed on the basis of municipal poverty measures. A sensible revenue allocation arrangement could aim at reducing disparities between municipalities in terms of their welfare or poverty indicators.

In order to test that, the amount of rents received by the municipalities in 2005 is compared to the municipalities aggregate extreme poverty headcount from the last 2001 Census. Also this hypothesis does not hold as no clear correlation emerges between the level of rents and the poverty headcount. The revenue allocation mechanism does not take into consideration the level of poverty across regions.

Figure 3.7: Per capita municipal gas rents and extreme poverty, by region



Source: Elaborated using data from Ministry of Treasury and Census 2001

3.5 Empirical strategy

The estimation method is panel spanning over eight years of data. The data covers 327 municipalities in nine departments. The model regresses indicators of municipal welfare (enrolment rate, completion rate, gender gap in primary and secondary school completion rate, measles immunization and births attended by skilled

personnel) between 2001 and 2008 as a function of the per capita gas rents.
Two different specifications are employed: first, a panel model with fixed effect to account for time invariant, region-specific effects and time dummies to control for time-varying shocks, common across regions (1)
Second, a panel model with fixed effect to account for time invariant, municipal-specific effects and time dummies to control for time-varying shocks, common across municipalities (2)

The basic estimated equation for specification (1) is :

$$W_{it} = \alpha_i + \beta_t + \gamma GAS_{i_{t-1}} + u_{it} \qquad (1)$$

For i= 1,…,9 and t=2001,…,2008.

where W_{it} is the measure of wellbeing in municipality i in time t, $GAS_{i_{t-1}}$ is the constructed variable of gas rents in municipality i in time t-1. The model allows for regional fixed effect, α_i , and year fixed effects, β_t , to control for common shocks that may change over time. u_{it} is the error term, clustered at the municipal level.

The estimated equation for specification (2) is:

$$W_{it} = \delta_i + \varepsilon_t + \xi GAS_{i_{t-1}} + u_{it} \qquad (1)$$

For i= 1,…,327 and t=2001,…,2008.

where W_{it} is the measure of wellbeing in municipality i in time t, $GAS_{i_{t-1}}$ is the constructed variable of gas rents in municipality i in time t-1. The model allows for municipality fixed effect, δ_i, and year fixed effects, ε_t, to control for common shocks that may change over time. u_{it} is the error term, clustered at the municipal level.

The GAS_{it-1} variable is lagged one year. This is because we assume that the impact of the municipal spending on welfare is not immediate, but instead takes one year to materialize.[110] The coefficient ξ will thus indicate the effect of per capita municipal revenues from gas on the particular aggregate municipal welfare the year after.

Different specifications are employed with the dependent variables expressed as: indicators' levels - percentages for enrolment and completion rates, measles immunization and births attended and difference between female and male percentage for primary and secondary gender gaps- (section 6.1); indicators' percentage change from year 1 to year 2 ($\left[(y_{t2} - y_{t1})/y_{t1}\right]*100$) (section 6.2)[111]; welfare indicators' shortfall reduction, that indicate the progress towards a maximum $\left[(y_{t2} - y_{t1})/(100 - y_{t1})\right]*100$ (section 6.3)[112] and, variation of levels $(y_{t2} - y_{t1})$

The fixed effects inclusion is particularly appropriate in this case here as it allows controlling for omitted variables that differ between regions and municipalities but are constant over time. The Hausman test confirms that the fixed effect is preferable to the random effects model by rejecting the null hypothesis of no correlation between the random effects and the error term.

A test to check for joint significance of time fixed effect dummies is applied and confirmed the appropriateness of including time dummies.

The analysis of the revenues allocation arrangements and the descriptive statistics presented in the previous section show that the fiscal rents from gas vary widely

[110] The reasons and limitation of using one year lag is discussed in section 9. As we are specifically interested in what happens in the very recent years, from 2005 onwards, when the gas rents enormously increased, by allowing more "time to build", important information about the gas rents received in the latest years would be lost.

[111] The annual growth rate describes the indicator' s variation over time and it thus gets around the main shortcoming of looking at the indicator's levels, that is that the levels depends on the municipality' starting point.

[112] The shortfall reduction describes a progress towards a maximum and it allows taking into account the fact that municipalities with higher outcomes are likely to have lower percentage variation as the 'last mile' is harder to be achieved.

across municipalities and over time. In order to rule out possible sources of endogeneity, one needs demonstrating that the variable of interest (GAS_{it}) is uncorrelated with u_{it}.

Correlation might exist if the fiscal rents allocation rule is correlated with unobservable characteristics of the municipalities that the model does not allow to control for.[113]

Specifically, it could be the case that the rents are distributing in a way that favours municipalities located in producing regions or that revenues are allocated with a redistributive objective and more resources are thus transferred to poorest areas. If that were the case, the independent variable would result being inconsistent.

However, from the analysis of the revenue allocation arrangement and from the summary statistics presented above, it seems that the amount of rents from gas transferred to municipalities is not correlated with the fact that municipalities are located in gas producing regions. Nor evidence was found about correlation between level of transfers and poverty measures.

However, there might be other unobservable characteristics of the municipalities which are less evident that are correlated the revenues allocation rule. To test this, one can look at the correlation between the level of rents received by the municipality in 2008 and the indicators of wellbeing in 2001, before the fiscal shock occurred[114]. If a correlation is found, that would suggest that there are some unobservable characteristics in the error term that are correlated with the revenue allocation rule; if no correlation is found, that would suggest that the allocation of rents is uncorrelated with those unobservables.

Panel regression is employed to test that, conditional on geographical controls,

[113] Due to lack of data, the model does not allow to control for any time varying municipal effects. This is a serious shortcoming of the analysis and therefore it is impossible to rule out all the possible sources of endogeneity.

[114] Ideally, one would like to test whether the level of transfers in 2008 is correlated with outcomes and changes in outcome before the natural gas started to be produced (or before the fiscal rents started to be distributed). However, data on the indicators of wellbeing is only available from 2001. This is a limitation because in 2001 some regions were receiving royalties. However, compared to the amount of rents distributed from 2005 onwards, the 2001 figures are very small. As the main fiscal shock occurs in 2005, the 2001 figures could be interpreted as reflecting the pre-shock trend.

municipalities significantly differ from each other in terms of measures of wellbeing adopted at the beginning of the period, before the gas shock occurred.
Table 2 shows the results from a panel regression of the following model:

$$W_{i2001} = \beta_i GAS_{i2008} + \alpha X_i + u_{it} \qquad (2)$$

where W_{i2001} are the selected measures of wellbeing in municipality i in 2001 (or 2002 if the 2001 indicator is not available), and GAS_{i2008} is per capita rent from gas in municipality i in year 2008.

Table 3.2: Test for correlation between gas revenues and municipal indicators of wellbeing

VARIABLES	(1) enrol2001	(2) comp2001	(3) genderpri2001	(4) gendersec2001	(5) measles2002	(6) birthat2002
gas2008	0.0171	0.000194	-0.0133	0.00664	0.0150	-0.00194
	(0.0147)	(0.0174)	(0.0101)	(0.00518)	(0.01000)	(0.00819)
Constant	82.27***	58.62***	7.388	-0.174	65.02***	46.55***
	(13.58)	(15.08)	(8.173)	(4.935)	(9.708)	(8.236)
Observations	308	310	310	308	311	311
R-squared	0.163	0.125	0.042	0.221	0.144	0.242

Robust standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1 All the specifications include regional dummies.

The results show that, conditional on regional location, municipalities did not differ among each other in a way that was correlated with their subsequent level of revenues from gas received. Although one cannot prove that the revenue allocation rule is totally random, it is plausible to claim that gas rents are conditionally quasi-randomly assigned.

3.6 Results

3.6.1 Dependent variables expressed in welfare indicators' levels

Table 3 shows the results of the specification (1) that includes region fixed effect, with the dependent variable expressed in levels.

The results below suggest that the rents from gas have a small but positive impact on the welfare indicators considered.

One standard deviation increase in per capita rents results, on average, in a 0.136 standard deviation increase in enrolment rate (the year after); a 0.0936 standard deviation increase in completion rate (the year after); a -0.0820 standard deviation decrease in gender gap in primary school (the year after); a 0.162 standard deviation increase in the proportion of children immunised against measles (the year after); a 0.136 standard deviation increase in the percentage of births attended by skilled health personnel (the year after).[115]

The regional dummies provide a sense of the cross sectional variation of wellbeing. There are quite large and significant differences in the indicators of wellbeing across regions. With Chuquisaca being the base group, one can note that most of the regions have large and significant higher enrolment and completion rates, lower gender gaps in primary school completion rate, and large and lower proportions of births attended by skilled personnel. The regional dummies on gender gap in secondary school completion rate and measles immunization are generally not very significant.

[115] The interpretation is based on fully standardized coefficients (beta). Both dependent and independent variables are standardized to have a mean of 0 and a standard deviation of 1.

Table 3.3: The effect of gas on municipal wellbeing (dependent variables=levels and region fixed effect)

VARIABLES	(1) enrol	(2) comp	(3) genderpri	(4) gendersec	(5) measles	(6) birthat
L.gas	0.00767***	0.00570***	-0.00353*	-0.000827	0.00905***	0.00673***
	(0.00144)	(0.00121)	(0.00207)	(0.000859)	(0.00186)	(0.00247)
_Iyear_2001	0	0	0	0	0	0
	(0)	(0)	(0)	(0)	(0)	(0)
_Iyear_2002	0	2.551*	-7.599***	-2.349**	5.760***	-1.343**
	(0)	(1.341)	(1.393)	(1.170)	(0.864)	(0.597)
_Iyear_2003	-0.759	4.492***	-8.786***	-1.787	0	0
	(0.484)	(1.298)	(1.338)	(1.164)	(0)	(0)
_Iyear_2004	-5.189***	5.369***	-6.524***	-3.334***	2.535***	-0.182
	(1.139)	(0.889)	(1.145)	(1.081)	(0.786)	(0.581)
_Iyear_2005	-5.771***	2.890***	-3.726***	-3.472***	3.454***	2.518***
	(1.179)	(0.794)	(1.178)	(1.052)	(1.011)	(0.861)
_Iyear_2006	-7.152***	2.382***	-1.990*	-1.623	0.769	3.239***
	(1.270)	(0.652)	(1.197)	(0.990)	(1.359)	(1.054)
_Iyear_2007	-10.14***	0	0	0	-1.689	1.655
	(1.469)	(0)	(0)	(0)	(1.350)	(1.277)
_Iyear_2008	0	0	0	0	-2.428*	2.265*
	(0)	(0)	(0)	(0)	(1.411)	(1.301)
beni	10.34**	24.24***	10.32***	1.325	-3.581	-11.96**
	(5.147)	(4.846)	(2.601)	(2.182)	(4.606)	(5.128)
cochabamba	7.477**	14.46***	0.941	-1.820	-0.815	-13.49***
	(3.498)	(4.346)	(2.707)	(2.123)	(3.063)	(3.982)
lapaz	7.883***	29.66***	0.0497	-14.46***	-6.206**	-18.00***
	(2.959)	(3.038)	(2.478)	(2.079)	(2.903)	(3.776)
oruro	-17.91***	11.67**	7.830***	-0.179	-15.98***	-18.51***
	(5.142)	(5.705)	(2.770)	(3.414)	(4.237)	(4.374)
pando	1.157	-6.063	-0.582	-1.992	-3.871	-23.83***
	(7.071)	(6.675)	(4.733)	(2.349)	(5.271)	(5.863)
potosi	0.640	13.21***	-4.225	-3.764	15.63*	-15.23***
	(2.852)	(4.504)	(2.601)	(2.558)	(9.023)	(3.927)
santacruz	17.40***	29.94***	12.19***	8.138***	-3.613	1.551
	(3.126)	(3.504)	(2.463)	(2.127)	(2.909)	(4.704)
tarija	-1.011	10.09*	17.49***	8.319***	-15.92***	-19.04***
	(3.800)	(5.432)	(4.422)	(2.616)	(4.675)	(6.659)
Constant	87.16***	41.93***	-2.515	1.455	80.95***	62.68***
	(2.009)	(2.322)	(2.315)	(1.856)	(2.420)	(2.840)
Observations	1,927	1,929	1,929	1,928	2,235	2,234
R-squared	0.176	0.164	0.119	0.186	0.096	0.114

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 4 shows the results of specification (2) that includes municipality fixed effect, with the dependent variable expressed in levels.

The results below are very similar to the ones obtained in specification (1) suggesting a small positive impact of rents on most of the welfare indicators considered.

Table 3.4: The effect of gas on municipal wellbeing (dependent variables=levels)

VARIABLES	(1) enrol	(2) comp	(3) genderpri	(4) gendersec	(5) measles	(6) birthat
L.gas	0.00684***	0.00553***	-0.00346*	-0.000783	0.00806***	0.00638***
	(0.00143)	(0.00114)	(0.00195)	(0.000860)	(0.00182)	(0.00240)
_Iyear_2001	0	0	0	0	0	0
	(0)	(0)	(0)	(0)	(0)	(0)
_Iyear_2002	0	-1.976**	1.094	-2.358**	6.600***	-1.340**
	(0)	(0.969)	(1.128)	(1.164)	(1.570)	(0.596)
_Iyear_2003	-0.771*	0	0	-1.719	0.833	0
	(0.449)	(0)	(0)	(1.155)	(1.296)	(0)
_Iyear_2004	-4.921***	1.287	2.221*	-3.318***	3.406***	-0.168
	(1.107)	(1.091)	(1.175)	(1.080)	(1.183)	(0.580)
_Iyear_2005	-5.473***	-1.186	5.017***	-3.457***	4.239***	2.820***
	(1.162)	(1.146)	(1.112)	(1.047)	(1.057)	(0.827)
_Iyear_2006	-6.774***	-1.678	6.746***	-1.613	2.128**	3.979***
	(1.251)	(1.160)	(1.418)	(0.986)	(1.076)	(1.005)
_Iyear_2007	-9.561***	-4.020***	8.718***	0	0	2.488**
	(1.467)	(1.281)	(1.331)	(0)	(0)	(1.223)
_Iyear_2008	0	0	0	0	-0.742	3.104**
	(0)	(0)	(0)	(0)	(0.670)	(1.248)
Constant	91.69***	64.70***	-7.574***	-1.182	77.07***	50.17***
	(0.794)	(0.772)	(0.786)	(0.797)	(1.018)	(0.665)
Observations	1,927	1,929	1,929	1,928	2,235	2,234
R-squared	0.081	0.028	0.039	0.009	0.048	0.084
Number of ID	327	327	327	327	327	327

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The results suggest that an additional Bolivianos in the per capita gas rent results in a 0.007 points increase in enrolment rate and a 0.005 points increase in the completion rate (the year after);

Also, an additional Bolivianos in the per capita gas rent results in a 0.008 increase in the proportion of children immunised against measles (the year after) and a 0.006

increase in the percentage of births attended by skilled health personnel (the year after). The coefficients on gender gap (both in primary and secondary schools) have a negative sign suggesting no improvement associated with extra revenue from gas (however, the coefficient on secondary school gender gap is not significant).

In terms of impact of gas rents on measures of wellbeing, it is apparent that although most of the signs are positive, the coefficients are small, showing a very small impact of rents on welfare.

For example, the average municipality population size in 2005 is 30000 and assuming an average completion rate of 64.23%, that means that 30000 additional Bolivianos (3370 2005 $US which in PPP is 8660 $US) result in 0.005 increase in the completion rate; the completion rate is still les than 64.24% Looking at the proportion of children immunised, 30000 additional Bs will result in increase in the proportion of 0.008, passing from 82.72 to 82.73% which means not even one more immunisation)[116]. The impact of the proportion of births attended by skilled personnel is even smaller: 30000 additional Bolivianos will leave the figure as low as 54.026% (average rate 54.02%) the year after, probably meaning not even one more pregnant women giving births assisted by health personnel.

3.6.2 Dependent variables expressed in welfare indicators' percentage change

However, one might also be interested in whether the rents from natural gas have an impact on the speed of welfare change, the indicator's rate of variation over time. To test that, specification (1) with region fixed effect and specification (2) with municipality fixed effect are employed, using the indicators' growth rates between year 1 and year 2 as dependent variables.[117] The specification tests whether the rate of improvement is larger when the level of transfers is higher. The results suggest

[116] According to population projection, children between 12 and 24 months represents 2.7% of the population. In an average municipality of 30000 inhabitants, children between 12 and 24 months will be 818. 0.008% increase in the proportion means that 0.06 more children will be immunised.

[117] The dependent variable is $\left[(y_{t2} - y_{t1}) / y_{t1}\right] * 100$

that the impact of the rents is positive and significant on the enrolment rate growth rate, although very small. However, the coefficient ion the proportion of children immunized against measles and on births attained by skilled personnel is significant but with an opposite sign (very low coefficients though). A larger amount of fiscal rents, ceteris paribus, worsens the indicators of wellbeing. [118]

Table 3.5: The effect of gas on municipal wellbeing (dependent variables=% change) with region fixed effect

VARIABLES	(1) enrol_g	(2) comp_g	(3) genderpri_g	(4) gendersec_g	(5) measles_g	(6) birthat_g
L.gas	3.18e-05***	4.51e-05	0.000677	0.000871	-9.11e-05***	-0.000231***
	(8.73e-06)	(6.41e-05)	(0.000478)	(0.000574)	(2.54e-05)	(7.75e-05)
Constant	-0.0214***	0.0236	-0.0761	-1.454*	-0.0963***	0.0240
	(0.00744)	(0.0260)	(1.088)	(0.836)	(0.0146)	(0.0257)
Observations	1,902	1,882	1,872	1,747	1,898	1,893
R-squared	0.025	0.048	0.002	0.008	0.027	0.065

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3.6: The effect of gas on municipal wellbeing (dependent variables=% change) with municipality fixed effect

VARIABLES	(1) enrol_g	(2) comp_g	(3) genderpri_g	(4) gendersec_g	(5) measles_g	(6) birthat_g
L.gas	2.97e-05***	3.51e-05	0.000724	0.000824	-9.24e-05***	-0.000258***
	(9.20e-06)	(5.70e-05)	(0.000480)	(0.000574)	(2.43e-05)	(9.76e-05)
Constant	-0.0131***	0.0874***	-0.653	0.203	-0.0285**	0.162***
	(0.00425)	(0.0269)	(0.629)	(0.479)	(0.0134)	(0.0427)
Observations	1,902	1,882	1,872	1,747	1,898	1,893
R-squared	0.015	0.027	0.001	0.007	0.014	0.025
Number of ID	326	323	323	312	325	325

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

[118] The year and regional dummies are not reported as not particularly significant.

3.6.3 Dependent variables expressed in welfare indicators' shortfall reduction

However, one must take into account the fact that, when looking at the change in welfare indicators over time, the fact that municipalities start from different indicators' levels is neglected. It is reasonable to expect that municipalities with already high welfare indicators will have lower improvement, regardless of the amount of resources available: further improvements are possible but probably costly.

A different dependent variable is then used to compute the shortfall reduction of the welfare measures. The shortfall reduction measures progress in terms of percentage progress towards a maximum (which is 100% for enrolment rate, completion rate, measles immunization and percentage of births attended and 1 for gender gaps in education). The formula to measure the relative progress, also used to monitor the official MDG progress,[119] is:

$$\left[\left(y_{t2} - y_{t1}\right)/\left(100 - y_{t1}\right)\right] * 100$$

This measure will reflect that the 'last mile' is always harder to achieve in social indicators.

Table 7 shows the results for specification (1) with region fixed effect and table 7 the results for specification (2) with municipality fixed effect.

However, for both specifications all the coefficients are insignificant. The amount received as transfer from gas does not seem to have any relevant impact on the welfare relative progress.[120]

[119] See HDR 2005 technical note 3

[120] Only the coefficient on gender gap in secondary school is significant at 10% but the magnitude is very small. The year and regional dummies are not reported as insignificant.

Table 3.7: The effect of gas on municipal wellbeing (dependent variables=shortfall reduction with region fixed effect)

VARIABLES	(1) enrol_sf	(2) comp_sf	(3) genderpri_sf	(4) gendersec_sf	(5) measles_sf	(6) birthat_sf
L.gas	0.000183	-0.000117	-0.000108	-0.000754*	-0.000607	7.46e-05
	(0.000286)	(0.000104)	(0.000498)	(0.000400)	(0.000386)	(5.41e-05)
Constant	-0.136	0.0601	1.164	0.556	-0.511	-0.0862
	(0.148)	(0.175)	(0.939)	(1.288)	(0.372)	(0.187)
Observations	1,904	1,909	1,909	1,902	1,893	1,900
R-squared	0.013	0.006	0.005	0.010	0.008	0.004

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3.8: The effect of gas on municipal wellbeing (dependent variables=shortfall reduction and with municipality fixed effect)

VARIABLES	(1) enrol_sf	(2) comp_sf	(3) genderpri_sf	(4) gendersec_sf	(5) measles_sf	(6) birthat_sf
L.gas	0.000236	-0.000125	-6.81e-05	-0.000755*	-0.000554	7.73e-05
	(0.000244)	(0.000102)	(0.000494)	(0.000406)	(0.000391)	(5.66e-05)
Constant	-0.106	0.125	0.617	0.427	-0.00784	-0.0407
	(0.143)	(0.144)	(0.674)	(0.679)	(0.230)	(0.0749)
Observations	1,904	1,909	1,909	1,902	1,893	1,900
R-squared	0.008	0.001	0.001	0.006	0.005	0.001
Number of ID	327	327	327	327	327	327

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

3.6.4 Dependent variables expressed in welfare indicators' change in levels

When looking at the change in levels $(y_{t2} - y_{t1})$, the coefficients on enrolment and completion rates are significant and positive in both specification (1) an (2). The coefficients on measles immunisation and birth attended are negative and significant at 10%. The coefficients on gender gaps are insignificant.

Table 3.9: The effect of gas on municipal wellbeing (dependent variables=change in levels and region fixed effect)

VARIABLES	(1) enrol_v	(2) comp_v	(3) genderpri_v	(4) gendersec_v	(5) measles_v	(6) birthat_v
L.gas	0.00264***	0.00288**	-0.000690	0.000294	-0.00295*	-0.00166
	(0.000661)	(0.00124)	(0.00177)	(0.000903)	(0.00171)	(0.00106)
Constant	-1.624***	2.991***	-1.313	0.301	-2.110*	-1.058
	(0.551)	(1.048)	(1.301)	(1.126)	(1.103)	(0.918)
Observations	1,908	1,911	1,911	1,908	1,905	1,903
R-squared	0.022	0.039	0.005	0.006	0.057	0.031

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.10: The effect of gas on municipal wellbeing (dependent variables=change in levels and municipality fixed effect)

VARIABLES	(1) enrol_v	(2) comp_v	(3) genderpri_v	(4) gendersec_v	(5) measles_v	(6) birthat_v
L.gas	0.00241***	0.00275**	-0.000448	0.000336	-0.00293*	-0.00172*
	(0.000683)	(0.00117)	(0.00167)	(0.000911)	(0.00173)	(0.00103)
Constant	-1.288***	1.802*	-1.024	0.624	1.175	1.391**
	(0.363)	(0.973)	(1.186)	(1.173)	(1.075)	(0.567)
Observations	1,908	1,911	1,911	1,908	1,905	1,903
R-squared	0.017	0.037	0.003	0.005	0.037	0.011
Number of ID	327	327	327	327	327	327

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

3.7 Checking for governance

The previous paragraph suggests that the amount of rents from natural gas affects (vaguely) positively the indicators of aggregate wellbeing when they are expressed in levels while it does not seem to impact the change of those measures over time regardless of the way the variation is measured.

However, these are not surprising results and they are in line with much of the previous evidence on the effect of rents from natural resources on welfare. Part of the literature on resource curse shows that good governance can be fundamental factor determining the ability of resource-rich countries to make wise use of natural

resources' rents to the benefit of the population. This section tests the hypothesis that municipalities with better governance are the ones that make an effective use of their resources and experience better welfare improvement. However, the only information on governance available at the municipal level refers to 2005-2007 and no other consistent indicator of governance that covers the entire period considered is available.

The governance index, constructed by the UNDP is an index that goes from 0 to 100 and it comprises five sub-indexes that refer to municipal efficacy, participation, accountability, political stability and corruption.[121] Municipalities are then ranked according to their index scores. A dummy variable called GOVERNANCE is then created that takes the value of one for the 100 municipalities with the higher governance index. Then an interaction term of the governance dummy with the GAS_{it-1} variable is constructed. It is plausible to expect the coefficient on governance and the interaction term to be positive and large: municipalities with better governance can make better use of the gas rents and have a significant positive impact on the indicators of wellbeing. Furthermore, higher levels of rents, when governance is good, are likely to have an even larger positive and significant impact on wellbeing.[122] However, none of the different specifications used gives very significant results. Surprisingly neither the interaction term nor the dummy for good governance seem to have a significant impact on indicators of wellbeing, regardless of the way the dependent variable and the governance dummy are constructed.[123]

[121] The indicator includes a total of 18 variables: share of budget executed, share of tributary revenues, share of own fiscal resources, investment per capita, percentage of voters over the total population entitled, numbers of local organizations over population, number of female members of the local council over total members, number of frozen account's cases, whether the municipality submitted the annual operative plan, whether the municipality notified budgetary expenditure, mayor's turnover, reasons for mayor's turnover, mayor's electoral support, number of party coalitions, number of audit processes, number of trials for administrative, civil o criminal offences, cases of embezzlements of funds.

[122] The model is a panel fixed effect spanning over three years, from 2005 to 2007, the only years the governance index at the municipal level is available for.

[123] The results are reported below for each of the specification used (dependent expressed in levels, percentage change). Other specifications, with the dependent variable expressed in shortfall reduction and change in levels as well as different definitions of the governance dummy have been employed and all of them give results consistent with the ones reported here.

When using the dependent variable in terms of levels, the governance dummy is significant at 5% only for the primary school gender gap. The coefficient is extremely high but, surprisingly, the interaction term is negative. Municipalities with higher levels of rents and good governance have a lower gender gap than municipalities with good governance and low rents.

Table 3.7: Testing for governance (dependent variables in levels)

VARIABLES	(1) enrol	(2) comp	(3) genderpri	(4) gendersec	(5) measles	(6) birthat
L.lgas	-1.302***	-0.835*	2.468**	1.151	-3.735	0.124
	(0.309)	(0.506)	(0.980)	(0.973)	(2.619)	(1.711)
L.GOVdummy	0.179	1.320	26.77**	-0.654	-23.21	1.785
	(3.035)	(5.357)	(10.94)	(7.823)	(35.97)	(7.546)
L.GOVgas	0.0937	-0.0959	-4.452**	0.166	5.708	-0.392
	(0.568)	(1.017)	(1.860)	(1.354)	(8.127)	(1.349)
Constant	91.95***	67.49***	-14.24***	-7.788	98.90***	56.39***
	(1.511)	(2.456)	(4.867)	(4.848)	(11.46)	(8.707)
Observations	654	654	654	654	981	981
R-squared	0.053	0.011	0.036	0.007	0.011	0.000
Number of ID	327	327	327	327	327	327

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.8: Testing for governance (dependent variables in % change)

VARIABLES	(1) enrol_g	(2) comp_g	(3) genderpri_g	(4) gendersec_g	(5) measles_g	(6) birthat_g
L.lgas	-0.00538	-0.0247	0.166	-0.524	-0.0530	-0.0559
	(0.00650)	(0.0243)	(0.833)	(0.447)	(0.0334)	(0.0469)
L.GOVdummy	0.0116	0.106	0.319	-5.067*	-0.0747	-0.329
	(0.0487)	(0.258)	(3.429)	(2.857)	(0.619)	(0.239)
L.GOVgas	-0.000248	-0.0328	-0.0789	1.010*	0.0333	0.0486
	(0.00899)	(0.0545)	(0.665)	(0.588)	(0.120)	(0.0419)
Constant	0.0108	0.173	-1.307	2.106	0.274*	0.394*
	(0.0318)	(0.117)	(4.034)	(2.142)	(0.152)	(0.238)
Observations	652	646	643	618	971	971
R-squared	0.005	0.008	0.000	0.005	0.007	0.003
Number of ID	326	323	323	311	325	325

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

When looking at the percentage change in the wellbeing indicators, governance is significant at 10% only for the secondary school gender gap. The coefficient,

however, is negative: municipalities with good governance experience a negative change. The interaction term, significant at the 10%, show that municipalities with good governance and higher level of rents perform slightly better. The results seem to suggest that the governance is not a particularly significant factor explaining why some municipalities can make better use of their fiscal resources than others.

3.8 The cases of Pando and Tarija

From the summary statistics it emerges that municipalities located in two regions enjoyed a disproportionally large amount of per capita rent. Those regions are Pando and Tarija, the former being a relatively poor area in the lowland and Tarija a proportionally wealthy region in the valley. 65 percent of the national production of natural gas is based in Tarija and this explains the extremely large amount of royalties the region receives. Also, as discussed in section three and four, the revenue allocation arrangement does not specifically take into account region-specific characteristics, such as population and size. Part of the IDH is to be "equally" distributed among regions and that determines, therefore, large disparities at the per capita level. This partly explains why low populated municipalities situated in the regions of Tarija and Pando benefit a much larger per capita transfers than the municipalities in the highly populated regions (such as La Paz, Santa Cruz and Cochabamba).

This section focuses on the impact of the fiscal rents on the municipalities located in these regions as one might expect to see an apparent and probably larger impact of the rents from gas there with respect to the other regions receiving less than the average.

It might be the case that limitations with the data or the model employed in the previous sections prevented from capturing a larger positive impact of the rents from gas. If that is the case, focusing on those municipalities that received an

extraordinary large, above-average amount of transfers, might provides more apparent results.

One might expect that larger transfers will determine a clear and positive impact on the municipal aggregate measures of wellbeing.

Figure 8 and 9 show summary statistics of the indicators of wellbeing for the municipalities in Pando and Tarija. A positive, though timid, trend seems to emerge over time.

Figure 3.8: Trends in wellbeing in Pando

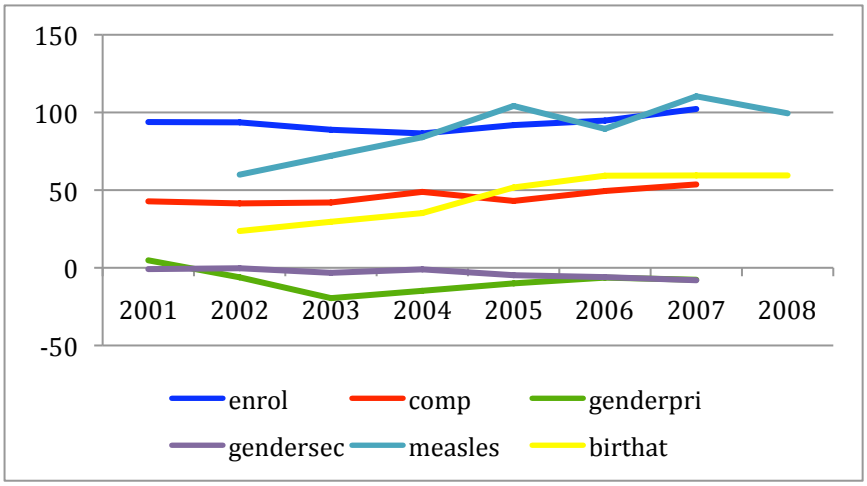


Figure 3.9: Trends in wellbeing in Tarija

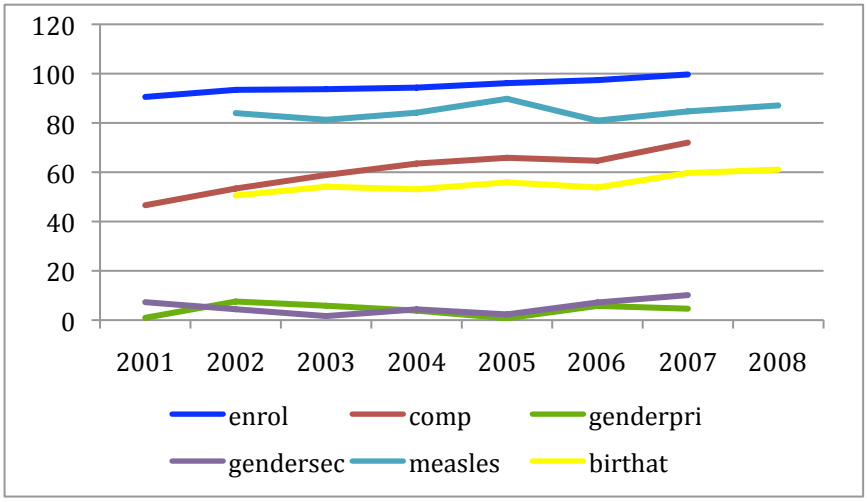


Table 3.9: The effect of gas on municipal wellbeing in Tarija and Pando (levels)

Tarija pando VARIABLES	(1) enrol	(2) comp	(3) genderpri	(4) gendersec	(5) measles	(6) birthat
L.gas	0.00175	0.00606	-0.0190**	0.00401	-0.0203**	-0.0242***
	(0.00518)	(0.00643)	(0.00882)	(0.00310)	(0.00982)	(0.00847)
Constant	90.36***	44.23***	4.489	1.451	74.33***	42.08***
	(1.684)	(3.126)	(2.994)	(1.920)	(3.375)	(4.383)
Observations	154	154	154	154	180	182
R-squared	0.194	0.131	0.081	0.028	0.290	0.361
Number of ID	26	26	26	26	26	26

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 9 reports the results of the empirical model employed in section six, specification (2) with municipality fixed effect where the indicators of wellbeing are regressed on the level of fiscal transfers, using as units of observation the municipalities located in Pando and Tarija.

Significant coefficients are found for gender gap in primary school, proportion of immunisation against measles and proportion of births attended by skilled personnel. However, the sign is negative. More rents are associated with lower indicators.

This result is confirmed by the results obtained in table 10 where the same model is employed for the sub-sample of municipalities in regions other than the ones located in Tarija and Pando. This sub-sample, comprising municipalities receiving average or below-average rents from gas, shows positive and significant coefficients for most of the indicators of wellbeing. Factors, other than the crude amount of fiscal transfers, seem to play a role in determining level and speed of welfare improving in Bolivian municipalities.

Table 3.10: The effect of gas on municipal wellbeing in all municipalities but those in Tarija and Pando (levels)

others	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	enrol	comp	genderpri	gendersec	measles	birthat
L.gas	0.00684***	0.00553***	-0.00346*	-0.000783	0.00806***	0.00638***
	(0.00143)	(0.00114)	(0.00195)	(0.000860)	(0.00182)	(0.00240)
Constant	91.69***	64.70***	-7.574***	-1.182	77.07***	50.17***
	(0.794)	(0.772)	(0.786)	(0.797)	(1.018)	(0.665)
Observations	1,927	1,929	1,929	1,928	2,235	2,234
R-squared	0.081	0.028	0.039	0.009	0.048	0.084
Number of ID	327	327	327	327	327	327

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

3.9 Further comments

The results obtained in the previous paragraph suggest that despite the enormous increase in reported resources earmarked for education and health, when looking at the real outcomes in these areas a very small impact, if any, is found. Furthermore, the results are negligible even when controlling for municipalities' governance.

However, these can hardly be conclusive results and in this section the limitations of the present analysis are discussed.

Unfortunately, the analysis was strongly constrained by data availability.

Firstly, it could be the case that the welfare indicators used, which are unfortunately the only ones available at the municipal level, are not the most appropriate to show where welfare improvement occurred. Having a larger set of indicators on health and education at the municipal level would definitely help to check the robustness of the results.

However, one of the most important municipal initiative, funded by IDH resources, is the In-School Breakfast Program (Desayuno Escolar). This program offers nutritional incentives that are believed to be effectively contributing to higher enrolment and

attendance rates as well as child health. Started in 2005, the program has increased in both coverage and financial importance and in 2007, on average, 20 percent of the IDH resources at the municipal level were devoted to this program.[124] Therefore, it is reasonable to expect that positive impact of such initiative would be reflected exactly on the indicators used in the present analysis, specifically enrolment and completion rate.

Secondly, a limitation of the present work is the very short time period considered. The revenues received by municipalities increased substantially only in 2005. One can expect that benefits will take some time to be apparent in the data.

The empirical model employed includes fiscal rents with one year lag assuming that the local governments are capable to produce benefits within one year time.

However, this assumption is likely to be imprecise because one should allow more time to build and produce evident impacts. This is especially true when the spending involves infrastructure projects, which might take more than one year to be completed or health projects, which might comprise campaign to raise awareness on health issues that might provide apparent effects only on the long term. Other kind of projects, however, might not imply long-term implementation (such as hiring more teachers or delivering cash transfers). Furthermore, the decision to use one year lag only is driven by the short time period of the model employed. As the specific objective of the present paper is in what happens in the very recent years, from 2005 onwards, when the gas rents enormously increased, by allowing more “time to build”, important information about the gas rents received in the latest years would be lost.

Therefore, the one year lag option is preferred while highlighting here that the results might not be very accurate. It could be the case that the real impact of the gas rents will take more years to become apparent[125].

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[124] SIAM (2007).

[125] Table A.2 in Appendix 1 reports the results of the empirical model described in section five using a two years lagged independent variable instead. When the dependent variables are expressed in levels, the coefficients on enrolment and completion rates, measles immunisation and births attended by skilled personnel are significant. Compared to the results using one year lag, the magnitude of the coefficients is slightly larger (around 0.002 points higher). However, when expressing the dependent variables in change rate or shortfall reduction none of the coefficients are significant.

Thirdly, data constraints do not allow a comprehensive analysis of the municipalities' use of gas-related resources. The information available refers to the transfer actually made to municipalities on a year basis but unfortunately no accessible data exist on municipalities' budget execution rate, total revenues and spending.

This information would be particularly informative about the municipalities' ability to allocate resources and effectively implement projects. Also, it would allow discerning which types of spending are proved to be more effective in improving wellbeing.

Evidence on other resource-rich countries suggest that the executed rates for projects budgeted on rents from natural resources are generally very low and that there is a tendency to allocate resources to infrastructure and construction projects (UNDESA, 2007; Gelb, 1986; Robinson and Torvick, 2005)

Also, the literature emphasizes that 'resource dependent economies and resource booms seem to lead to highly dysfunctional state behaviour, particularly large public sectors and unsustainable budgetary policies' (Robinson *et al.*, 2006:448)[126].

Furthermore, reliance on government transfers from natural resources tends to be associated with low tax collection effort with detrimental effect on governments accountability, responsiveness and bureaucratic capability (Moore, 2004; Tsalik, 2003).

In general, issues of transparency and accountability have increasingly come to the fore as one of the main challenges that resource-dependent countries need to face in order to correct the distortions at the heart of the resource curse (de Renzio *et al.,* 2009; Robinson et al. 2006)[127]

Providing systematic evidence of these mechanisms on the Bolivian case is beyond the scope of the present work. However, some of the tendencies highlighted by the

[126] On the linkage between resource curse and expansion of the public sector see Lane and Tornell, 1999; Gelb, 1988; Auty, 2001; Bates and Collier, 1993; Gelb et al. 1991; Eifert et al. 2003; Medas and Zakharova, 2009.

[127] Several initiatives have also been taken to improve transparency in resource-rich countries, such as the Extractive Industries Transparency Initiative (EITI), which focuses on transparency in revenues from extractive industries such as petroleum and minerals, the IMF Guide on Resource Revenue Transparency, the Transparency obligation initiative of the EU, and guidelines by the International Accounting Standard Board.

literature seem to be at stage and suggestive evidence is therefore discussed.

According to IMF (2009), in Bolivia, earmarking, capacity constraints, and tight treasury controls limit the effective use of hydrocarbon resources at the sub-national level. Budget execution and release of funds to sub-national governments is at times complicated by disputes over adequate reporting between the treasury and sub-national governments. Also, budget allocations are often underestimated and communicated late in the budget process, complicating the sub-national budget process. In 2007 and 2008, municipalities on average spent just 60 and 70 percent of the available resources from IDH revenues respectively[128].

A study by SIAM analyses the fiscal and financial characteristics of Bolivian municipalities, providing an overall picture of the revenues and spending patterns of Bolivian municipalities (FAM-Bolivia, 2009). They show that the IDH has an increasing incidence on municipalities' total revenues, accounting for 10 percent of total revenues in 2005 and 37 percent in 2008. The study shows that municipal spending reveals large increase in investment in social sector and infrastructure, especially from 2005 onwards. The social investment category comprises mainly spending in education and health. However, those categories also include spending on construction of schools and heath centres but unfortunately, decomposed figures are not available.[129] However, data from the Ministry of Education reports that the number of schools grew considerably during the period considered, suggesting that school infrastructure, together with spending on the 'desayuno escolar' represents a large share of the investment in education.[130]

The report also shows that the incidence of total transfers from the central Government on total revenues significantly increased in the recent years and it reached its peak in 2008 with transfers representing more than 60 percent of the total municipal resources. However, the high dependency on transfers from the central

[128] Data are from the Ministry of Treasure.

[129] The information would be informative on the potential bias towards infrastructure projects highlighted by the literature.

[130] The number of schools increases by 6% despite enrolment and completion rates showing a stable/declining number of students attending.

government seems to have affected local tax efforts that show an apparent decline.
Also, the municipal operating budget shows an increasing trend during the period considered: on average, operating expenditure doubled between 2003 and 2008. The figure is even more striking for small municipalities, those with population less than 15000 inhabitants, that, between 2001 and 2008, quadrupled their operating spending. These figures seem to suggest that tendency for the state to become over-expanded. Furthermore, national data show that public sector wages grew at much higher rate than the other sectors' ones during the period considered (despite having already an above average wage level).
In terms of transparency and accountability, Bolivia scores are generally quite low. The International Budget Project (IBD) provides an evaluation of budget transparency across countries and in a list 24 resource-rich countries considered, Bolivia scores 16th with a total index of 30, which is much lower than the average (43).[131]

3.10 Conclusion

The present paper provides a preliminary assessment of the impact of the large fiscal transfer from natural gas received by Bolivian municipalities on different measures of wellbeing. Using a combined panel fixed effect spanning from 2001 to 2008 the model employed regressed aggregate MDG indicators of education and health on per capita municipal gas rents.
Despite an increasingly large amount of fiscal resources transferred to municipalities, which are earmarked to investment in education and health, no significant improvement in key indicators of wellbeing seems to occur at the municipal level. When investigating whether the level of resources received have a significant impact

[131] The ''Open budget questionnaire'' collects comparative data on the public availability of budget information and other budgeting practices. The questionnaire contains a total of 122 questions based on generally accepted good practice related to public financial management. Scoring countries on a 0-100 scale, the survey shows that countries that are not resource-dependent fare considerably better than resource-rich ones. Relatively to the average, Bolivia seems to fare particularly low in revenue transparency (33 versus an 48) and budget transparency (29 versus 44) and less bad for budget account (27 versus 36).

on the levels and changes of the indicators of wellbeing, a negligible, if any, effect is found. The results also reject the hypothesis that municipalities with better governance are the ones that can produce better welfare outcomes.

Although preliminary, these results suggest that the mere availability of financial resources does not result in significant welfare improvement *per se*. Suggestive evidence reveals that the "curse" effect of fiscal rents from natural gas is likely to be due to inefficient municipal management. There is a tendency to increase operational spending and focus on infrastructural investment. Qualitative studies also describe how local governments can be unaccountable, inefficient and corrupt.

However, cautious is needed and more research is called for. First, the fiscal shock is very recent and it might be the case that local investment will take more time to be translated into substantial improvement of the indicators considered. Second, data constraints prevented from analysing the specific dynamics behind the observed municipal ineffective action. Hopefully, making data more easily accessible would help proving more robust results.

In fact, the results are quite surprising given the Morales commitment towards social redistribution and pro-poor growth. Many of the social protection initiatives implemented since he is in power are notable (cash transfers to pregnant women, to children in return for regular attendance at school, universal pension scheme) and previous work of the author found that consumption poverty has indeed significantly decreased in the last decade.

Moreover, regardless of the short-medium term impact of the rents from gas, in the long term the challenge stems from the exhaustibility of gas reserves and concerns the issues of fiscal sustainability and intergenerational resource allocation. Gas is exhaustible, and its price and therefore fiscal rents is volatile and uncertain. How are these social programs going to be sustained when the price will decrease? Will future generations be able to enjoy the same amount of public good?

In principle, capital expenditure and the accumulation of physical assets could represent an effective way of preserving national wealth for future generations and ensuring fiscal sustainability. In particular, investment in physical and social

infrastructure is generally seen as beneficial in this regard, as such expenditure can be conducive to diversifying the economy away from hydrocarbons, developing the private non-oil sector and thus also creating a basis for generating tax revenues. As this seems to be the policy strategy adopted by the current Moral administration, more efforts are needed to improve the stock and quality of existing public capital and thus the marginal return on additional investment, especially in education and health.

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Appendix 3

Table 3.A.1: Per capita municipal gas rents over time, by region (mean and st.dev. below)

GAS pc	2001	2002	2003	2004	2005	2006	2007	2008
beni	93.56	83.87	136.27	189.36	324.65	629.62	614.83	786.94
	0.00	0.00	0.00	0.00	12.31	57.58	60.61	108.05
chuquisaca	87.85	52.50	60.01	75.57	111.12	346.92	376.76	615.49
	0.00	0.00	0.00	0.00	1.81	12.60	14.76	28.83
cochabamba	121.16	97.64	142.00	173.85	182.79	271.06	261.49	306.97
	0.00	0.00	0.00	0.00	2.88	19.27	22.83	36.16
la paz	0.00	0.00	0.00	0.00	21.56	102.59	117.89	155.57
	0.00	0.00	0.00	0.00	2.80	13.51	17.47	24.71
oruro	0.00	0.00	0.00	0.00	63.20	279.20	272.52	451.74
	0.00	0.00	0.00	0.00	10.69	48.58	57.87	109.75
pando	254.81	276.01	436.85	591.82	1247.46	3003.89	2914.13	4135.50
	0.00	0.00	0.00	0.00	56.93	301.87	353.17	681.73
potosi	0.00	0.00	0.00	0.00	38.75	170.93	169.90	284.63
	0.00	0.00	0.00	0.00	2.98	14.37	17.10	33.57
santa cruz	108.92	86.93	109.12	121.07	138.57	241.01	245.88	263.89
	0.00	0.00	0.00	0.00	4.72	26.89	30.63	42.52
tarija	311.93	391.63	861.81	1429.45	2421.71	3337.61	3266.30	2968.26
	0.00	0.00	0.00	0.00	5.78	30.75	36.38	72.32

Source: Elaborated using data from Ministry of Treasury.

Table 3.A.2: The effect of gas on municipal wellbeing (dependent variable expressed in levels and GAS lagged two years)

VARIABLES	(1) enrol	(2) comp	(3) genderpri	(4) gendersec	(5) measles	(6) birthat
L2.gas	0.00914***	0.00778***	-0.00365	0.000326	0.00465***	0.00486**
	(0.00226)	(0.00173)	(0.00256)	(0.00146)	(0.00166)	(0.00208)
_Iyear_2001	0	0	0	0	0	0
	(0)	(0)	(0)	(0)	(0)	(0)
_Iyear_2002	0	0	0	0	0	0
	(0)	(0)	(0)	(0)	(0)	(0)
_Iyear_2003	0	0	0	0	0.131	-0.108
	(0)	(0)	(0)	(0)	(1.369)	(0.582)
_Iyear_2004	-3.836***	1.544	2.067*	-1.627	3.043**	0
	(1.096)	(1.082)	(1.154)	(1.008)	(1.259)	(0)
_Iyear_2005	-4.470***	-1.010	4.869***	-1.808*	4.033***	3.062***
	(1.190)	(1.140)	(1.103)	(0.942)	(1.129)	(0.774)
_Iyear_2006	-5.460***	-1.265	6.404***	-0.0497	2.493**	4.634***
	(1.225)	(1.136)	(1.404)	(1.034)	(1.140)	(0.904)
_Iyear_2007	-7.494***	-3.034**	7.902***	1.346	1.864**	4.205***
	(1.375)	(1.202)	(1.230)	(1.122)	(0.762)	(1.009)
_Iyear_2008	0	0	0	0	0	3.656***
	(0)	(0)	(0)	(0)	(0)	(1.179)
Constant	90.72***	64.49***	-7.525***	-2.961***	77.88***	50.28***
	(0.951)	(0.834)	(0.809)	(0.634)	(0.968)	(0.631)
Observations	1,619	1,619	1,619	1,619	1,924	1,923
R-squared	0.065	0.025	0.039	0.011	0.021	0.061
Number of ID	327	327	327	327	327	327

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Conclusions

The first paper, filling the gap in the literature on poverty analysis in Bolivia, provides consistent and accurate estimates of consumption and consumption-based poverty measures. This paper reveals a previously unexplored story on Bolivian poverty: with respect to the official poverty measures based on income, the results suggest that Bolivia experienced an incredibly large poverty reduction from 2002 onwards, halving poverty headcount during the 2002-2007 period. Robustness checks confirm these results. Furthermore, the welfare improvement has a strong pro-poor component which contributes to reduce the high level of inequality of the country and, particularly, to narrow down the large welfare gap between indigenous and non-indigenous groups.

The second paper focuses on the distributional and poverty impact of the 2005-2008 increase in food prices. Using the 2005 Bolivian National Household Survey, the paper investigates whether the gains of food sellers offset the losses of the food buyers. Experiments to assess the distributional and poverty impact are conducted at a disaggregated level, using regional prices. The results suggest that, on average, a large negative welfare effect prevails on the households as a result of the price increase. Urban households experience the most negative effect, with an 8.4 percentage points reduction in welfare versus a 0.8 points reduction for rural households. The decomposition by quintiles shows that poorest quintile has the least negative welfare impact. The computed total reduction in real expenditure is one percentage point for the first quintile while for all the other quintiles the total reduction ranges between 4.36% (5th quintile) and 8.63% (4th quintile). The simulation of the poverty impact shows that, on average, poverty rises by 2.87 percentage points. The

largest poverty impact passes through rice, wheat, beef and poultry, for which the actual price increase rises poverty by 0.79, 0.76, 0.76 and 0.57 percentage points. Instead, increase in prices of potato and maize cuts poverty by 0.24%.

The framework used to assess the direct impact of food price changes on Bolivian households is a static partial equilibrium. It allows identifying the first order impact but neglects certain dynamic effects of price shock and this represents the main limitation of the paper. In fact, soaring food prices between 2005 and 2008 are likely to have induced behavioural responses. For example, households may change their consumption choices, switching from more expensive products to substitutes less affected by the price shock or They may reduce their purchases and find more convenient to increase own-production; poor households that cannot further reduce their food expenditure may have to cut other expenses, such as education or health care, with detrimental long-term consequences; Incentives to foster production and productivity may rise; important wage changes may occur in the agricultural sector and multiplier effect may generate higher income for non food producing households; perspectives of higher profits in food production may provide incentives to big producers to invest and produce, reducing market access and competitiveness of small producers facing economic or credit constraints and further acerbating the level of inequality in the country. All these crucial effects are, unfortunately, neglected in the paper. Therefore, It is important to be aware that the results might overestimate the actual impact and have to be interpreted as a strictly lower bound measure of it.

The third paper provides a preliminary assessment of the impact of the large fiscal transfer from natural gas received by Bolivian municipalities on different measures of wellbeing. Using a combined panel fixed effect spanning from 2001 to 2008 the model employed regressed aggregate MDG indicators of education and health on per capita municipal gas rents. Despite an increasingly large amount of fiscal resources transferred to municipalities, which are earmarked to investment in education and health, no significant improvement in key indicators of wellbeing seems to occur at the municipal level. When investigating whether the level of resources received have a significant impact on the levels and changes of the

indicators of wellbeing, a negligible, if any, effect is found. The results also reject the hypothesis that municipalities with better governance are the ones that can produce better welfare outcomes.

Although preliminary, these results suggest that the mere availability of financial resources does not result in significant welfare improvement *per se*. Suggestive evidence reveals that the "curse" effect of fiscal rents from natural gas is likely to be due to inefficient municipal management and there is a tendency to increase operational spending and focus on infrastructural investment.

However, these can hardly be conclusive results as, unfortunately, the analysis is strongly constrained by data availability. Firstly, it could be the case that the welfare indicators used are not the most appropriate to show where welfare improvement occurred. Having a larger set of indicators on health and education at the municipal level would definitely help to check the robustness of the results.

Secondly, a limitation of the present work is the very short time period considered. The revenues received by municipalities increased substantially only in 2005. One can expect that benefits will take some time to be apparent in the data.

The empirical model employed includes fiscal rents with one year lag assuming that the local governments are capable to produce benefits within one year time. Aware of the imprecision of this assumption, the decision to use one year lag only is driven by the short time period of the model employed. As it is particularly interesting looking at what happens in the very recent years, from 2005 onwards, when the gas rents enormously increased, by allowing more "time to build", important information about the gas rents received in the latest years would then be lost.

Thirdly, data constraints do not allow a comprehensive analysis of the municipalities' use of gas-related resources. The information available refers to the transfer actually made to municipalities on a year basis but unfortunately no accessible data exist on municipalities' budget execution rate, total revenues and spending.

This information would be particularly informative about the municipalities' ability to allocate resources and effectively implement projects. Also, it would allow discerning which types of spending are proved to be more effective in improving wellbeing.