THE INDEPENDENCE BETWEEN PRICE INDICES AND LIVING STANDARDS IN RWANDA

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Abstract

Using data from several seasons in Rwanda, we test the indpendence between Laspeyres local and seasonal price indices and nominal living standards in Rwanda. the results show that the hypothesis of independence cannot generally be rejected in rwanda, although the choice ogf the adult-equivalence scale can be in‡uential in some seasons.

This result has several consequences

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Résumé

1 Introduction

Geographical di¤erences in prices that households face is a typical feature of LDCs, much explained by imperfect markets, high transport and commercialisation costs, information problems.

The independence between prices and real living standards is commonly taken for granted in applied microeconomics, often without mention, let alone statistical test.In welfare analysis, the non independence between prices and living standards may imply to use more sophisticated methods as usual (as in Muller (1998c)). In behavioural models such as consumption demands or output supply, the consideration of the sampling scheme generating decisions and price observations, and the non independence between prices and living standards may imply to revise the usual hypothesis of exogeneity of prices, similarly to what happens when using unit-values instead of prices (Deaton (1988, 1990)).

decrire a …nd les raisons pour lesquelles les p i et les n l s peuvent etre lies. Idem poout les p i et les r l s

The theoretical literature about price indices is extensive[1]. It has been applied to empirical welfare studies (Muellbauer (1974); Glewwe (1990), Grootaert and Kanbur (1996)). Theoretical price indices are ratios of cost functions representing the preferences of households. However in practice, applied price indices are generally Laspeyres or Paasche price indices, much ignoring the responses of households to price movements.

The aim of this article is to test the independence of living standards and Laspeyres price indices. We use data from rwanda in which substantial seasonal and geographical variability of prices justi…es to correct living standards using local price indices.

We present the data in section 2 and the results of the tests of independence in section 3. Finally, section 4 concludes.

2 The Data

Rwanda in 1983 is a small rural country in Central Africa. At this period, it is relatively preserved from extreme economical, political or climatic shocks.

[1] See among others: Fisher and Shell (1972); Pollak (1978); Diewert (1981); Foss, Manser, Young (1982), Baye (1985); Pollak (1989); Diewert (1990), Selvanathan and Rao (1995).

Its population is 5.7 million, nearly half under 15 years of age. Rwanda is one of the poorest country in the world, with per capita GNP of US $ 270 per annum. More than 95 percent of the population live in rural areas (Bureau National du Recensement (1984)) and agriculture is the mainstay of the economy, accounting for 38 percent of GNP and most of the employment.

Data for the estimation is taken from the Rwandan national budget-consumption survey, conducted by the Government of Rwanda and the French Cooperation and Development Ministry, in the rural part of the country from November 1982 to December 1983 (Ministère du Plan (1986a))[2]. 270 households were surveyed about their budget and their consumption. The consumption indicators are of very high quality. Indeed, every household was visited at least once a day, during two weeks for every quarter. Daily and retrospective interviews and food weighting were carried out, and every household had also to register much information in a diary between the quarterly survey rounds. This enabled a thorough cleaning of the data, by more than thirty ex-enumerators after the collection, under our supervision. Sophisticated verification algorithms have been designed using the many redundancies present in the data. Finally, the consumption indicators are based on algorithms reducing measurement errors, from the combination of several information sources.

Agricultural year 1982-83 is a fairly normal year in terms of climatic fluctuations (Bulletin Climatique du Rwanda (1982, 1983, 1984)). The agricultural year can be split up into four climatic seasons and two cultural seasons. The collection of the consumption data was organised in four rounds, corresponding to four quarters (A, B, C, D) of the agricultural year 1982-83, and roughly assimilated to seasons.

The average household size has 5.22 members, including 2.67 children or adolescents (less than 18 years old), and 2.55 adults (18 years old and more). The average land area is very small (1.24 ha). Table 1 shows that for the sample used in estimations, the average agricultural production is worth 57 158 Frw (Rwandan Francs), which is to compare with 51 176 Frw of average consumption (10613 Frw per capita).

Several studies of price surveys in Rwanda show that the geographical and seasonal price variabilities are considerable (Niyonteze and Nsengiyumva (1986), O.S.C.E. (1987), Ministère du Plan (1986b), Muller (1988b)).

[2] The main part of the collection has been designed with the help of INSEE (French national statistical institute).

We have calculated elementary price indicators of the main categories of goods, for every season and every cluster of the sample. The prices of each category of goods are represented by the price of the main product, which enables us to compare prices across seasons and clusters with little quality bias. Muller (1998a) discusses the type and the sample of prices used, the price index and the difficulty of the shadow prices approach. True price indices could be derived from the estimation of a complete demand system (as in Braithwait (1980) and Slesnick (1993)). Because of market imperfections and high own-consumption rates, production and consumption decisions of most agricultural households are likely to be non separable. In that situation, shadow prices (Pollak (1978), Singh, Squire and Strauss (1986)), would be required for the calculus of price indices. Since the high own-consumption ratios that are observed in the sample, these shadow prices are expected to be intermediate between observed consumption prices and observed production prices (de Janvry, Sadoulet, Fafchamps (1991)). At the local geographical and temporal level, consumption prices correspond better to the timing of the observed consumption of households, and market prices have been specifically collected to valorise the observed weighted food for consumption. The average market and consumption prices at the cluster level, are prefered herein for the calculation of price indices.

We approximate the theoretical price index with a Laspeyres price index (I_{it}) specific to each household and each period, in which the basis is the annual national average consumption.

$$I_{it} = \Sigma_j \ \omega^j \frac{p^j_{gt}}{p^j_{..}} \text{ where } \omega^j = \frac{\Sigma_i \Sigma_t p^j_{it} q^j_{it}}{\Sigma_j \Sigma_i \Sigma_t p^j_{it} q^j_{it}} \quad (1)$$

where p^j_{it} (resp. p^j_{gt}) is the price of good j for household j (resp. in cluster g where is observed household i) at date t, q^j_{it} is the consumed quantity of good j by household i at date t in cluster g.

The annual national prices are calculated as follows:

$$p^j_{..} = \frac{\Sigma_i \Sigma_t p^j_{it} q^j_{it} POND_{it}}{\Sigma_i \Sigma_t q^j_{it} POND_{it}} \quad (2)$$

where $POND_{it}$ is the sampling weight of household i at date t, corrected for missing values. We therefore consider simultaneously geographical and seasonal price variability, although without modelling temporal and spatial autocorrelations of prices.

The living standard indicator for household i at period t is

$$y_{it} = \frac{c_{it}}{es_i \; I_{it}} = \frac{w_{it}}{I_{it}} \tag{3}$$

where c_{it} is the value of the consumption of household i at period t ; w_{it} is the standard of living of household i at date t; es_i is the equivalence scale of household i and I_{it} is the price index (or "p.i.") associated with household i and period t. We denote $w_{it} = c_{it}/es_i$, the living standard indicator non corrected for price variability (nominal living standard, or "n.l.s.").

The equivalence scale is de…ned by:

where nmk is the number of members in class k and ak is the adult-equivalent coe¢cient for a member of class k. Four classes have been de…ned: male adults (k=1), female adults (k=2), children over 10 years old (k=3), children between 0 and 10 years old (k=4). es0 corresponds to the per capita consumption (ak = 1 for all members); es1 is de…ned by: a1 = a2 = 1, a3 = 1/3, a4 = 1/4; es2 is de…ned by: a1 = 1, a2 = 0.7, a3 = 0.2, a4 = 0.15. We do not consider the change of household composition across the seasons because of the lack of reliable data.

To account for geographical and seasonal price variations, we correct the individual welfare indicators by the individual price indices (see for instance Muellbauer (1973)). We calculate elementary price indices of the main categories of product for every season and every cluster. The prices of each category of product are represented by the price of the main product, which ensures the comparability of prices across seasons and regions with little quality bias. Again, the estimation of a cost function for every household may introduce some variability coming from the inaccuracy of the estimates, which is probably not wise when studying the transient component of poverty. We therefore prefer to approximate the structural individual price index by a price index (Iit) speci…c to each household and each period.

Because of market imperfections and high autoconsumption rates, production and consumption decisions of most agricultural households are likely to be non separable. For this reason, shadow prices corresponding to the separating budget constraint would be more appropriate in the calculus of price indices. However, these shadow prices are unobserved and their estimation from a complete agricultural household model may lead to very noisy estimates, in contradiction with our robustness approach.

3 Tests of independence

Table 1 provides the mean and standard deviation of real and nominal per capita consumption, real production and consumption, price index, for every quarter and at the yearly level. While the mean price index and the mean nominal per capita consumption do not seem to move parrallely across the quarters, their standrd deviartions are large enough to indicate that most of their variability comes from di¤erences across quarters. This suggests to examine the link between p.i. and n.l.s. at the household level.

Table 2 shows the correlation coe¢cients between price indices and nominal living standards (i.e. value of household consumption divided by adult-equivalent scale), and the correlation coe¢cients between the same variables in logarithms, at several periods and for several equivalence scales. Most of the correlation coe¢cients are not signi…cant. However, it may be that the relation between p.i. and n.l.s is not linear, which implies to test directly their independence and not only their linear correlation.

Table 3 shows the results of tests of independence between nominal living standards and price indices, based on deciles of these variables. Of course, deciles of variables in levels and in logarithms are identical.

$\hat{A}^2$, ° (di¤erence between conditional probabilities of like and unlike order) and Kendall's $¿_b$ test statistics have been calculated, as well as the Cramer's V association measure. Goodman and Kruskal (1954, 1959, 1963, 1972) discuss measures of association for cross classi…cation.

De…nition 1 Let be P, the number of concordances of the two classi…cation variables, and Q, the number of discordances, then

° = (P-Q)/(P+Q);

$¿_b$ = (P-Q)/((n^2 - $n_{i:}$)(n^2 - $n_{:j}$))$^{\frac{1}{2}}$

and Cramer's V = ($\hat{A}^2$/(n.Min(I-1,J-1)))$^{\frac{1}{2}}$.

The results of the $\hat{A}^2$ test show that there is almost always independence between price indices and nominal living standards (except once in period C). The ° and the $¿_b$ tests indicate that the only period when independence is rejected is quarter A (and not with the equivalence scale es0).

A few di¤erences occur between the results on the one side of the correlation coe¢cients and $\hat{A}^2$ tests, and on the other side of the ° and the $¿_b$ tests. Such upshot is due to the di¤erent proximity measures associated with the various tests. Moreover, the measure of association V is between 0.17 and 0.23, implying that the non rejection of the independence hypothesis may well be attributed to the small sample size.

However, on the whole, price and nominal living standards are close to a situation of independence, even if quarters A and B are sometimes associated with a signi...cant dependence between price indices and nominal living standards with scales es1, es2, es3).

Scales es1 and es2 are more often related to signi...cative dependence (in quarter A or C for some tests), which invite analysts to try several di¤erent scales when the dependence matters for the problem under study.

ajouter tests d independence avec real living standards to show that dividing by the peice index can create a pb

4 Conclusion

Using data from several seasons in rural Rwanda in 1983, we test and cannot reject the hypothesis of indpendence of Laspeyres local and seasonal price indices and nominal living standards.

This implies ...rstly that prices can be safely considered as exogenous in living standards models and in consumption demand equations since our notion of living standard is based on observations of quarterly consumption AV Secondly, that theorems of welfare analysis based on this assumption of independence can be applied (see Muller (1998d)); thirdly this justi...es the separated study of distributional functional forms for price indices or nominal living standards distributions.

1 parage sur resultats avec real livingf atnadrds

Table 1: Mean and standard deviation of the main variables

	Annual	A	B	C	D
Real Consumption	51176:15 (24985:80)	13521:52 (9527:40)	13232:20 (8192:52)	13452:85 (8249:68)	10969:57 (6092:44)
Real P roduction	57158:02 (24985:80)	13240:50 (12178:27)	15548:30 (16610:28)	15416:63 (18171:03)	12952:59 (10662:06)
Real Per Capira Consumption	10613:27 (5428:08)	2750:173 (1701:169)	2702:944 (1620:898)	2850:082 (1968:637)	2310:075 (1511:553)
Price Index	1:0487 (0:0634)	1:1087 (0:1294)	0:9534 (0:1015)	1:0476 (0:1316)	1:0847 (0:0978)
Nominal Per Capita Consumption	10905:18 (5355:731)	2995:399 (1826:006)	2539:347 (1475:742)	2902:023 (1834:125)	2468:417 (1524:948)

Standard deviations in parentheses.

Table 2: Correlation coe¢cients between nominal living standards and price indices

Quarter	es0	es1	es2	es3
A	¡ 0:0448	¡ 0:0606	¡ 0:0506	¡ 0:0478
	(0:48)	(0:33)	(0:42)	(0:45)
B	¡ 0:0442	¡ 0:0774	¡ 0:0903	¡ 0:1051
	(0:48)	(0:22)	(0:15)	(0:0933)
C	¡ 0:1103	¡ 0:1448	¡ 0:1566	¡ 0:1568
	(0:0782)	(0:0205)¤	(0:0121)	(0:012)¤
D	¡ 0:1124	¡ 0:1123	¡ 0:118	¡ 0:1157
	(0:0726)	(0:0729)	(0:0591)	(0:0645)

Correlation coe¢cients between logarithms of nominal living standards and logarithm of price indices

Quarter	es0	es1	es2	es3
A	¡ 0:1170	¡ 0:1349¤	¡ 0:1289¤	¡ 0:1176
	(0:0617)	(0:0310)	(0:0393)	(0:0602)
B	¡ 0:0371	¡ 0:0569	¡ 0:0740	¡ 0:0939
	(0:5547)	(0:3648)	(0:2380)	(0:1339)
C	¡ 0:0945	¡ 0:1179	¡ 0:1279¤	¡ 0:1305¤
	(0:1315)	(0:0596)	(0:0408)	(0:0369)
D	¡ 0:0471	¡ 0:0256	¡ 0:0304	¡ 0:0441
	(0:4529)	(0:6836)	(0:6279)	(0:4822)

*: signi…cant at 5 percent levels. P-value in parentheses.

Table 3: Independence tests

Quarternscale	es0	es1	es2	es3
A	0:340	0:131	0:415	0:265
	0:1928	0:2035	0:1899	0:1961
	A	R	R	R
	A	R	R	R
B	0:701	0:626	0:852	0:669
	0:1784	0:1817	0:1706	0:1798
	A	A	A	A
	A	A	A	A
C	0:304	0:005	0:217	0:144
	0:1943	0:2261	0:1984	0:2026
	A	A	A	A
	A	A	A	A
D	0:287	0:666	0:066	0:275
	0:1951	0:1804	0:2099	0:1956
	A	A	A	A
	A	A	A	A

In each cell, are shown successively: P-value of Â^{2} test; Cramer's V association measure; Result of ° test at 5 percent level (A = not rejected, R= rejected); Result of ¿$_{b}$ test at 5 percent level (A = not rejected, R= rejected).

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