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Estimation of the period of household interview effect on poverty measurement

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Abstract

Poverty analysis is generally based on the use of household economic survey data collected over a period of several months. This paper aims to estimate the poverty measurement bias due to the effect of the period of households' interview.
A new method is presented, based on the decomposition of the poverty severity index by estimating a composed error econometric model and using a semi-parametric estimation technique.
Empirical validation for the Tunisian case shows that the bias is important and is not constant; it varies from month to month and year to year.

Keywords: Economic survey, poverty measurement, period of interview, composed error model, semi-parametric

1 Introduction

Generally, a household economic survey used for poverty analysis lasts several months to collect information on household characteristics and expenditure. Gathered data on expenditure is then averaged to obtain an annual equivalent. For example, monthly household expenditure is multiplied by 12,

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quietly by 4, etc. Following this data aggregate procedure, the households interviewed during different dates in the year do not undergo any effect of seasonality. However, even if the same household is observed in different periods of the year, he doesn't necessarily exhibit the same consumer behaviour.

Many different factors may cause inter-monthly heterogeneity of household consumption baskets, in particular the poor. Indeed, the food consumption of poor people includes a large portion of cereal, fruit and vegetable that differ from season to season. Given their low purchasing power, they tend to consume exclusively fruits and vegetables of the current season. Thus, the composition of their subsistence basket has the lowest relative prices and is heterogeneous due to changes in fruit, vegetables and seeds from season to season.

In addition, seasonality also affects the income level of the poor. Indeed, the harvest seasons of wheat or olives can generate relatively high income among farm households and engender an over-consumption. Earnings of construction workers are often affected in winter. Some workers such as labourers or roofers may not work for several months. This reduces income among unskilled workers (most affected by poverty). Knowing that a large portion of poor does not have long period employments contracts, their income and hence their consumption changes from period to period depending on their income stream.

Household economic surveys data may then contain errors due to the effect of the period of interview. These errors may induce bias in the estimated poverty and therefore may affect the economic policy evaluation. Despite its statistical and economic influence, little attention has been devoted in the literature to the subject.

We generally assume that seasonality analysis needs panel data which relies upon a time unit which is less than a year. This kind of data is rare. Muller, C. (1997), for example, used quarterly panel data in a year period between 1982 and 1983 to estimate transient seasonal and chronic poverty of peasants in rural Rwanda.

The aim of this paper is to estimate the effect of the period of household interview on poverty measure when cross-sectional economic survey data are used. Then, a new method for the correction of the poverty severity index is presented and applied to the Tunisian case.

This paper is organized as follows. First, the authors present a theoretical illustration of their suggested econometric method for detecting the effect of the period of household interview and correcting the estimated poverty. Then, they give an empirical validation using Tunisian surveys.

2 Methodology

2.1 Econometric model

In order to detect the effect of the period of household interview on poverty

measurement, the authors suppose that the poverty index (P) is composed of two components: a component representing the effect of the month of interview (P^b), and a real component (P^r) defined as the remaining part of poverty index when the bias is released from (P). Thus, we assume that:

$$P = P^r + P^b \tag{1}$$

In addition, since (P^r) and (P^b) are not observable, we assume that the component (P^b) is explained by a set of dummy variables summarized by a matrix (*M)* indicating the month of household interview:

$$P_h^b = M'_h \delta + s_h \tag{2}$$

where δ is a vector of unknown parameters and s_h are the model residuals.

We also assume that the component (P^r) is determined by a set of explanatory variables, summarized by a matrix (*X*), indicating the sociodemographic characteristics of households. For any household h:

$$P_h^r = X'_h \beta + \varepsilon_h \tag{3}$$

Where β is a vector of unknown parameters and ε_h are the model residuals.

Then, the econometric model to be estimated is given by:

$$\begin{aligned} P_h &= P_h^* \quad \text{if} \quad Y_h < Z \\ &= 0 \quad \text{otherwise} \end{aligned} \tag{4}$$

where P_h^* is a latent variable given by:

$$\begin{aligned} P_h^* &= P_h^r + P_h^b \\ &= X'_h \beta + M'_h \delta + \varepsilon_h + s_h \end{aligned} \tag{5}$$

We assume that the two residual terms ε_h and s_h are independent.

Then, in order to identify the effect of the period of interview, the estimated model (5) is used to decompose the poverty index into the tow components (P^r) and (P^b).

Note that the decomposition requires that the used poverty index be additive and decomposable (This axiom has been used by Jalin and Ravallion (2000) to decompose poverty index into permanent and transient components). Thus, we use the Squared Poverty Gap (SPG) index of FGT class. In fact, according to Foster, Green and Thorbecke (1984), the SPG satisfies all required properties.
The SPG for household h is:

$$\begin{aligned} P_h &= \left(\frac{Z_h - Y_h}{Z_h}\right)^2 \quad \text{if} \quad Z < Y_h \\ &= 0 \quad \text{otherwise} \end{aligned} \tag{6}$$

where Y_h is the expenditure of household h and *Z* is the poverty line.

Note also that the dependent variable is censored. Thus, it is recommended in poverty literature to use censored regression estimation techniques like the Tobit models, where the underlying error distribution is assumed to be normally distributed. However, according to Powell (1984), the more censored the dependant variable is, the more the model is subjected to the risk of heteroscedasticity. In the presence of heteroscedasticity, Tobit estimates are not robust to misspecifications in the error distribution estimates and hence are inconsistent and inefficient.

This problem is particularly raised when poverty is estimated using survey data from the whole population and not from only the poor households. In this case, the majority of the surveyed households are not poor and then the most observed value of the dependant variable (P) is zero.

Recognizing the fragility of the Tobit type estimators, it is common practice to use semi-parametric estimation techniques like the Censored Quantile Regression (CQR) presented by Powell (1986). Indeed, the only assumptions required for the estimators to be consistent are that the errors are independently and identically distributed, with positive density at the chosen quantile.

For a given quantile θ, the CQR estimator is defined as the value of β in his parameter space B(θ) which minimizes:

$$Q_n\ (\beta\,;\theta\,)\ =\ \frac{1}{N}\ \sum_{h=1}^{N}\ \rho_\theta\ (\ P_h\ -\ \max\ \{\ 0,\ x'_h\beta\ \}\ ) \qquad (7)$$

Where:

$$\rho_\theta\ (\ \lambda\ ) \equiv \left[\ \theta\ I(\lambda\ \geq\ 0)\ -\ I\ (\ \lambda < 0\ )\right].\left|\lambda\right| \qquad (8)$$

is a weighting function used to centre the data and I(.) is an indicator function.

2.2 Decomposition procedure

After the estimation of the model (5), the decomposition procedure consists in the estimation of (P^b) and (P^r) according to equations (2) and (3). However, model (5) makes it possible to calculate the total errors terms ε_h+s_h and not ε_h and s_h separately. In order to be able to decompose the poverty index, there is a need to decompose the model error terms.

To this end, we were inspired from works carried within the framework of the permanent income estimation, such as King, M. and Dicks, M. (1982). For the decomposition of the current income into permanent and transient component, they use an econometric model with composed errors and propose to decompose the error terms using a parameter a $(0 \le a \le 1)$ such as $\varepsilon_h = a(\varepsilon_h + s_{th})$, where the underlying error distribution is assumed to be normally distributed.
Consequently, we assume that:

$$\varepsilon_h = a(\varepsilon_h + s_h) \qquad (9)$$

However, since our model is subject to the risk of heteroscedasticity, we propose an alternative method to estimate the parameter a.

From (9), we deduce that:

$$a = \frac{\sigma_{\varepsilon}}{\sigma_{\varepsilon+s}} \tag{10}$$

However, model (5) enables us to calculate $\sigma_{\varepsilon+s}$, but it does not give σ_{ε}. In order to overcome this problem, we consider the fact that any household who is interviewed during a month without any effect on poverty measurement has a component (P^b) null:

$$\begin{aligned} P_h^b &= M'_h \delta + s_h \quad \text{if the month effect is significant} \\ &= 0 \qquad\qquad\quad \text{otherwise} \end{aligned} \tag{11}$$

Then, we define a cohort noted C composed by households having a null component (P^b) i.e. interviewed during months without any effect on poverty measurement according to the estimated model (5).

Thus, given assuming that the errors ε are associated with the component (P^r) which is independent of the period of interview, σ_{ε}^2 can be approximated by the variance of the total error $\sigma_{\varepsilon+s}^2$ of the households cohort C using estimated model(5)

Moreover, since the specific effect of the period of interview is different from month to month, α will be estimated for each month t:

$$a_t = \frac{\sigma_{\varepsilon}^C}{\sigma_{\varepsilon+s}^t} \tag{12}$$

Once α_t is estimated for each period t with signified effect, the final equations which allow the decomposition of the poverty index take the following form:

$$\hat{P}_h^r = X'_h \hat{\beta} + a_t(\hat{\varepsilon}_h + s_h) \tag{13}$$

$$\hat{P}_h^b = M'_h \hat{\delta} + (1 - a_t)(\hat{\varepsilon}_h + s_h) \tag{14}$$

3 Empirical validation

We use data for empirical validation from the 1985 and 1990 Tunisian consumption survey conducted by the INS (National Statistical Institute of Tunisia). These surveys provide information on expenditure for 3283 and 3257 rural households respectively, as well as many other dimension of households' behaviour; geographic residence, demographic information, education, etc. In addition, these surveys are carried out by interviewing twelfth of the sample during each month of the considered survey year.

The estimation results of model (5) for the two surveys are presented in Table

(1) in appendix. The results show that the month of interview generates a significant effect on poverty severity index. Moreover, note that a positive (negative) estimated coefficient of a variable referring to the month of interview means that poverty severity index is overestimated (underestimated) during this month. So we find that, in 1990, poverty severity is overestimated for households interviewed in January, May, June, September, October, November or December. However, in 1985, poverty severity is overestimated in May and November and is underestimated in June.

Thus, on the one hand, the Tunisian poor households undergo significant effect due to the period of interview. On the other hand, this effect is not constant; it varies according to the month and the year of survey. More generally, the use of household economic survey lasting several months requires taking into consideration the period of interview effect. Poverty measure remains biased if it is not corrected from this effect.

The calculation of the error variance of model (5) for each household cohort and month of interview with a significant effect allowed estimating each α_t. The results are presented in Table (2).

Table 2: Estimation results of α_t for each month t with significant effect

Survey month	1985	1990
January	-	089
Mai	0,85	0,98
June	0,92	0,95
September	-	0,8
October	-	0,92
November	0.89	0,91
December	-	0,92

Let us note that in order to validate the assumption that we use to estimate each α_t, which allow the approximation of σ_ε^2 in (10) by the variance of the total errors $\sigma_{\varepsilon+s}^2$ of the cohort *C*, we estimate a constrained model which does not integrate the effect of the month of survey in model (5) (the variables indicating the month of interview associated to δ). Then, using only statistical units of cohort *C*, we carried out a test for difference in variances of the constrained model errors with those of the model (5). The results show that the variances of the two series of errors are significantly equal i.e. the variance of the errors associated with cohort *C* is independent of the estimated model (with or without effect of the period of interview).

Once α_t are calculated, we can decompose the error terms of the estimated model (5) using (12) and then decompose the poverty severity index (P) into the two components (P^r) and (P^b) based on (13) and (14) respectively.
Note that the measured poverty index of households interviewed during months without significant effect according to the estimated model (5) is considered as nonbiased ($P = P^r$ and $P^b = 0$).

Also, during the decomposition of the dependant variable, the observations having a negligible value of poverty severity index gave aberrant decomposition results. They are considered as completely non real ($P = P^b$ and $P^r = 0$).

This result makes sense, these households are interviewed during a month which, according to the estimated model (5), generates a statistically significant effect on poverty measure. Therefore, this negligible value of poverty index is actually the effect of the month of interview on poverty and it is not decomposable and indicates the corresponding measurement bias. Indeed, consider, for example, a household with a poverty severity index value of about P= 0.001 which is interviewed during a month with a significant effect on poverty measure. This effect can generate a bias greater than 0.001. Thus, (P^b) is greater than (P) and (P^r) becomes negative (given that $P = P^r + P^b$). We consider that the household poverty is not real, it is due in fact to the month of interview effect and we assume that ($P = P^b$).

Finally, the decomposition results of the poverty severity index are summarized in Table 3.

Table 3: Decomposition of the poverty severity index. Tunisia 1985 and 1990

Survey year	Poverty severity index (SPG)	Bias (Pb)	Corrected SPG (Pr)
1985	0.065	Overestimation: 0.003 (4.6%) Underestimation: 0.002(3.1%)	0.064
1995	0.063	Overestimation: 0.008 (13%) Underestimation: 0	0.055

The correction results show that in 1985 the aggregate poverty severity index is overestimated by 4.6% and underestimated by 3.1%. Thus, the poverty severity index after correction becomes 0.064 instead of 0.065. In 1990, we witness an important overestimation of the severity of poverty by about 13%.

5 Conclusion

The aim of this paper was to estimate the effect that can be generated by the period of household interview on poverty measure when household economic survey data is used. We have developed a new method based on the decomposition of the poverty severity index for detecting the month of interview effect and then correcting the poverty index. Econometric estimates for the Tunisian case in 1985 and in 1990 confirmed that this effect is significant and not constant; it varies according to the month and year of the survey.

Our results are important since the quality of a poverty analysis is crucial for directing an efficient poverty alleviation policy. However, the majority of poverty analysis in the literature is based on the use of household surveys data constructed over several months and are made without any consideration of the survey period effect.

Finally, note that we analyzed in this paper the period of interview effect only on poverty measure. However, the period of interview can affect results of all kind of analysis witch use consumer surveys data.

Appendix

Table 1: Estimation results of model (5) by CQR

Year of survey		1985		1990	
Variables		Coef	T-Std	Coef	T-Stud
Month of interview	January	0.0242	1.04	0.0494**	3.83
	February	-0.0051	-0.20	0.0211	0.56
	Mars	0.0257	1.28	0.0045	0.34
	April	-0.0177	-0.80	0.0168	1.26
	Mai	0.0492**	2.13	0.0240**	2.10
	June	-0.055**	-2.34	0.0258**	2.20
	July	0.0158	0.69	0.0088	0.66
	September	0.0004	0.02	0.0399**	3.29
	October	0.0133	0.59	0.0306**	2.55
	November	0.0498**	2.14	0.0447**	3.19
	December	0.0043	0.19	0.0321**	2.40
Socio-professional category of Household Head	Higher staff or manager	0.0399	1.12	-0.0201	-0.57
	Average staff	0.0075	0.19	-0.0047	-0.18
	Employed	-0.0104	-0.23	-0.0121	-0.51
	Boss	-0.0477	-0.72	-0.0232	-0.55
	Craftsmen	-0.061**	-2.45	0.0060	0.39
	Worker in non agricultural sector	-0.0046	-0.22	0.0060	0.46
	Agricultural exploiter	-0.039**	-1.97	0.0156	1.23
	Worker in agricultural sector	0.0009	0.04	0.0490**	3.68
	Unemployed	-	-	0.0306**	2.10
	Support abroad	-	-	0.0572**	2.90
Life cycles	LC 1	0.0306	0.79	0.0475*	1.68
	LC 2	-0.0003	-0.01	0.0046	0.25

	LC 3	0.0133	0.47	0.0451**	2.47
	LC 4	0.0151	0.56	0.0683*	4.22
	LC 5	-0.0038	-0.14	0.0195	1.19
	LC 6	-0.066**	-2.14	-0.0124	-0.58
	LC 7	0.0140	0.48	0.0200	1.11
	LC 8	0.0261	0.98	-0.0092	-0.49
	LC 9	-	-	-0.0144	-0.37
Housing type	Villa or floor	-	-	-0.0079	-0.52
	Apartment	-	-	-0.0565	-1.39
	Gourbi	-	-	0.1509**	11.23
	Part number	-	-	-0.0157**	-4.15
Household's place of residence	District of Tunis (capital)	-0.0136	-0.50	-0.0532**	-3.06
	North East	-0.0314	-1.59	-0.0368**	-2.60
	North West	0.0078	0.41	0.0170	1.30
	Middle East	-0.0371	-1.74	-0.0545**	-3.60
	Middle West	0.0038	0.20	-0.0118	-0.86
	South East	-0.056**	-2.39	-0.0728**	-4.93
	South West	-0.074**	-3.14	-0.0355**	-2.23
Education level of Childs (number of Childs)	Secondary level in private institute	-	-	-0.0107**	-2.98
	Secondary level in public institute	-	-	-0.0354**	-7.40
	higher level	-	-	0.0572**	2.90
Education level of the Household Head	Without instruction	0.0747**	2.84	0.0451**	6.04
	Primary level	0.0302	1.12	0.0053	0.68
	Secondary level	0.0015	0.05	-0.0043	-0.33
Number of actives in the Household	Males	-0.027**	-3.65	-0.0470**	-9.45
	Females	-0.0186	-1.42	-0.0194**	-3.97
Household size		0.0254**	11.51	0.0326**	14.93
Pseudo-R^2		0.22		0.25	

Notes - ** indicates that the Coefficient is statistically significant at the 5% level.
- See following details about life cycle categories.

Life cycles (Ben Rejeb, J.(2008)) :

- LC1: Young couple without children, household head under 45 years old**.**
- LC2: Couple with children under 6 years old
- LC3: Couple and all children under 11 years old, have at least one child between 7 and 11 years old
- LC4: Couple and all children under 18 years old, have at least one child between 12 and 18 years old
- LC5: Household with three or four adults, have at least one child under 18 years old
- LC6: Household with at least five adults and have at least one child under 18 years old
- LC7: Household with adults only
- LC8: Older couple without children (children have left home, age of head above 45 years old)

References

[1] J. Ben Rejeb, Estimation bayésienne des échelles d'équivalence par catégorie sociale Une application aux données tunisiennes, *Revue Economique*, **58**(4), (2007), 915-925.

[2] J. Ben Rejeb, Quantification de la pauvreté permanente sur la base de données non panélisées, *Revue Economique*, **59**(2), (2008), 291-305.

[3] F. Bourguignon and Gagay, Saisonnalité et comportements de consommation, DELTA *Working Paper*, **90**(27), (1991), 1-32.

[4] J. Foster, Green and E. Thorbeck, A class of decomposable poverty mesure, *Econometrica*, **52**(3), (1984), 761-765.

[5] J. Jalin, and M. Ravallion, Is transient poverty different? Evidence for rural China, *Journal of Development Studies*, **36**(6), (2000).

[6] E. James Foster and F. Anthony Shorrocks, Subgroup consistent poverty indices, *Econometrica*, **59**(3), (1991), 687-709.

[7] M. King and M. Dicks, Asset holdings and the life-cycle, *The Economic Journal*, **92**, (1982), 247-267.

[8] C. Muller, Transient seasonal and Chronic Poverty of Peasents : Evidence from Rwanda, Centre for the Study of African Economies, *Working Paper*, **WPS /97- 8**, (1997).

[9] J. Powell, Least absolute deviation estimation for the censored regression model, *Journal of Econometrics,* **25**, (1984), 303-325.

[10] J. Powell, Censored regression quantiles, *Journal of Econometrics*, **32**, (1986), 303-325.

[11] M. Ravallion, Expected poverty under risk-induced welfare variability, *Economic Journal*, **98**, (1988), 1171-1182.