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ASSESSING AGGREGATE WELFARE: GROWTH AND INEQUALITY IN ARGENTINA*

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ABSTRACT

The main goal of this paper is to complement the Argentine mean income series from National Accounts with inequality estimates in order to obtain aggregate welfare series, which are a better measure of economic performance than the commonly used per capita income statistics. Inequality indices are computed from household survey data adjusted for non-response and income underreporting. The statistical significance of changes in inequality and welfare measures is checked using bootstrapping techniques. One of the main conclusions of the paper is that while welfare assessments coincide among different value judgments in some periods (e.g. 1991-1994), they widely vary in some others, particularly between 1994 and 1998, when the economy experienced moderate growth and large increases in inequality. It is argued that the period

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1994-1998 provides an unprecedented laboratory for distinguishing the social preferences of different analysts, according to their evaluation of the performance of the Argentine economy.

RESUMEN

El objetivo central de este artículo es complementar la serie de ingreso medio de Cuentas Nacionales para la Argentina con estimaciones del nivel de desigualdad, con el propósito de obtener series de bienestar agregado. Estas series constituyen una mejor medida de desempeño económico que las tradicionales estadísticas de ingreso per cápita. Los índices de desigualdad son computados a partir de información de encuestas de hogares, practicando ajustes por no-respuesta y subdeclaración de ingresos. La significación estadística de los cambios en las medidas de desigualdad y bienestar es evaluada a través de técnicas de remuestreo. El trabajo muestra que las evaluaciones de bienestar coinciden entre diferentes juicios de valor en algunos períodos (ej. 1991-1994), mientras que varían sustancialmente en otros; particularmente entre 1994-1998, cuando la economía experimentó un crecimiento moderado y un gran aumento de la desigualdad. Se argumenta que el período 1994-1998 constituye un laboratorio sin precedentes para distinguir las preferencias sociales de diferentes analistas, de acuerdo a su evaluación del desempeño de la economía argentina.

I. Introduction

A traditional way of assessing the economic performance of a country is by means of its per capita income. However, this practice is valid only when the evaluator's welfare function is utilitarian. Except in this extreme case, measuring aggregate welfare involves not only knowing the mean but also other elements of the income distribution. Particularly relevant is the degree of inequality.

As it is the case of several Latin American countries, Argentina has recently undergone a period of drastic economic reforms aimed at stabilizing the economy and promoting growth. The implementation of the Convertibility Plan and several structural reforms succeeded in controlling prices, and the economy grew rapidly as measured by its per capita GDP. On the other hand, income inequality has significantly increased. This simultaneous increase in mean income and inequality implies that the global assessment of the Argentine economic performance becomes not obvious.

The main purpose of this paper is to complement the Argentine mean income series with inequality estimates, with the goal of obtaining aggregate welfare series which are a better measure of Argentina's economic performance than the commonly used per capita income statistics[1]. The strategy is to take as given the mean income statistics from National Accounts, in which the traditional evaluations of economic performance are based, and complement them with our inequality estimates based on microeconomic information from the Permanent Household Survey (EPH). In order to obtain a more accurate measure of the degree of inequality, the original income data is adjusted for non-response, underreporting and demographic factors.

Inequality and welfare indices are constructed using information originated in surveys and, therefore, are subject to sampling variability. Nevertheless, the usual practice is, for instance, to compare the value of some inequality index for two different years, and assert that the distribution has become more or less unequal according to the sign of the difference between these two values. This practice ignores the problem of sample variability, since the difference in values may not be large enough from a statistical point of view to state with relative certainty that it comes from distributions with different dispersion. In this paper we address this point by formally testing the significance of the changes in the inequality indices and the welfare measures.

The rest of the article is organized in the following way: in section II we briefly present the conceptual framework, and in section III some methodological aspects are discussed. Non parametric estimations of the distribution and basic statistics are presented in section IV, along with the significance analysis. In section V trends in mean income, inequality and aggregate welfare are illustrated and discussed. Finally, section VI presents some concluding remarks.

II. Conceptual framework

Let $W(y_1, y_2, ..., y_N)$ be a Bergson-Samuelson social welfare function, where y_i represents individual i's welfare level, usually approximated by household income adjusted by demographic factors, and N is the number of individuals in the economy. The function W should not be interpreted as the result of some social aggregation mechanism, but as an instrument of the analyst or the policy-maker for evaluating the aggregate welfare of an economy. This evaluation necessarily involves the aggregation of individual welfare levels: the W function proposes an ordered and consistent way of implementing this exercise.

Social welfare functions are naturally arbitrary since they depend on the analyst's value judgments. Nevertheless, it is common in the literature to work with anonymous, paretian, symmetric and quasiconcave functions[2]. Within the family of W functions, the *abbreviated welfare functions* are of special usefulness, since they only have as arguments the mean (μ) and an inequality parameter (I).

1 See Diéguez and Petrecolla (1976), Gasparini and Weinschelbaum (1991) and Gasparini (1999) for previous work on aggregate welfare in Argentina.

2 See, for example, Lambert (1993) and Mas Colell *et al.* (1995).

Naturally, it is expected that these functions be non decreasing in μ and non increasing in I. Additionally, other restrictions are necessary to assure the properties of Pareto, symmetry and quasiconcavity[3]. Even when restricted to the set of abbreviated functions that satisfy these requirements, the number of possible choices is infinite. In this paper we limit the analysis to welfare functions that consider the Gini coefficient (G) and the Atkinson index (A) as inequality measures, given their widespread use in the literature[4].

For the case of the Gini coefficient, we consider the abbreviated welfare functions proposed by Sen (1976).

(1) $$W_s = \mu.(1-G)$$

and Kakwani (1986)

(2) $$W_k = \frac{\mu}{(1+G)}$$

A more general welfare function, proposed by Atkinson (1970), is

(3) $$W_a(\varepsilon) = \left(\frac{1}{N} \sum_{i=1}^{N} \frac{Y_i^{1-\varepsilon}}{1-\varepsilon} \right)^{\frac{1}{1-\varepsilon}} \qquad \text{for } \varepsilon \geq 0, \varepsilon \neq 1$$

(4) $$\ln W_a = \frac{1}{N} \sum_{i=1}^{N} \ln y_i \qquad \text{for } \varepsilon = 1$$

The parameter *e* regulates the convexity of the social indifference curves and it can be interpreted as the degree of inequality aversion[5]. We work with the two most common values for the parameter of inequality aversion in the literature: 1 and 2. In these cases the welfare function takes the form[6]

(5) $$W_a(1) = \mu.(1-A(1))$$

and

[3] See Lambert (1993) and Amiel and Cowell (1996).

[4] See Cowell (2000) and Lambert (1993) for details and properties of these indices.

[5] When ε tends to 0, the social welfare function tends to the utilitarian one, *i.e.* inequality becomes irrelevant. When ε approaches infinity, the function converges to a Rawlsian one where only the income of the poorest individual is relevant.

[6] See Appendix for the derivation of (5) and (6).

(6) $$W_a(2) = -\mu.(1 - A(2))$$

where $A(\varepsilon)$ is Atkinson's inequality index with parameter ε.[7]

Finally, a utilitarian welfare function (or Bentham's function) reflects indifference to income inequality:

(7) $$W_b = \mu$$

The use of social welfare functions is not necessary to evaluate the economic performance of an economy when generalized Lorenz curves do not cross (Shorroks, 1983). In our case the number of intersections is large, since many years are compared. For this reason and for simplicity, we prefer presenting the analysis directly in terms of welfare functions.

III. Methodological Issues

In order to calculate welfare it is necessary to have estimates of the mean income μ and some inequality measure I. Ideally, both parameters should be estimated from the same source, typically a household survey. However, given the motivation of this paper –complementing with inequality considerations the traditional evaluation of the Argentine economy based on per capita income from National Accounts– the methodology used here is somewhat different. The rest of this section is devoted to explain it.

Individual welfare levels (y_i) are approximated by household income adjusted for equivalent adults and economies of scale within the household. Following Buhmann *et al.* (1988) we define an individual's equivalent household income as total household income divided by the number of equivalent adults in the family raised to a parameter θ, smaller than one. In our empirical implementation we take the adult equivalent scale calculated by the National Institute of Statistics and Census (INDEC) and assume a value .8 so as the parameter θ to reflect moderate economies of scale.

Inequality indices I are estimated from the Permanent Household Survey (EPH) for the Greater Buenos Aires area (GBA), for each year between 1980 and 1998. Inequality analysis is limited to the GBA since the EPH was extended to cover most of Argentina only in the mid-nineties.

Income from the survey is adjusted for non-response and under reporting. We use the predictions of an income determination model to assign income to

7 Notice that when $\varepsilon = 2$, the welfare measure (3) becomes negative. That explains the minus sign in (6). See Appendix for more details.

people who declare to work or to be retired, but who deny to answer how much they earn (see Appendix for details). We also adjust the data for differential under reporting by income source, by comparing total income coming from each source in the EPH to the corresponding values in National Accounts[8]. This adjustment implies that coefficients for underreporting are increasing in income. Adjustments for non-response and under-reporting significantly modify the level of inequality, but not the trends, implying that the basic results in the rest of paper are robust to these adjustments[9].

Mean equivalent household income μ could also be computed with data from the EPH. However, we decided to estimate changes in μ from National Accounts, as this is the traditional source for assessing the Argentine economic performance. Specifically, changes in equivalent household income are estimated from changes in disposable per capita income estimated with information from National Accounts.

Income data for GBA is not available from National Accounts, so we end up estimating μ for the whole country and indices I for a particular region. However, we do not expect a significant bias since the trend in both mean income and inequality are likely to be very similar between GBA and Argentina. For instance, the correlation between Gini coefficients for GBA and "Argentina" (17 cities covered by the EPH) is .995 for the period 1992-1999.

IV. Basic Results and Statistical Significance

In this section estimates of mean income, inequality and welfare are presented. After an illustration of the income distributions using non-parametric methods (IV.1), indices are calculated (IV.2), and their statistical significance is evaluated (IV.3). Comments on trends in the series are postponed until section V.

IV.1. Non-parametric estimations

Income studies are usually based on measures or indicators that capture some particular dimension of the income distribution. For instance, changes in mean income capture changes in the location of the distribution; inequality measures refer to the degree of concentration of the income mass, independently of its position; and welfare measures try to capture both characteristics jointly. Although these measures generally give enough information about relevant economic issues, it is sensible to start by estimating the income distribution itself. Given the exploratory character of these estimations, we use non-parametric

8 Adjustment coefficients are assumed to be constant at the 1993 values, since information for national income discriminated by income source was available only for 1993. (This series has been recently extended to 1997).

9 Correlation coefficients for inequality indices with and without adjustments are always above .8 (see Convenio, 1999).

techniques which provide relevant information about the underlying distribution without relying on arbitrary and probably unrealistic assumptions.

We used kernel based methods to estimate densities for equivalent household income in 1980, 1982, and 1985 to 1998 using the October waves of the EPH for Greater Buenos Aires. Due to space restrictions, only figures for the densities of the logarithm of equivalent household income for some selected years are presented. Details of the estimation process are presented in the Appendix. Figure 4.1 shows a strong shift to the left of the distribution between 1986 and 1989. The distribution of 1991 shifts again to the right, without reaching its position for 1986.

The three densities shown in figure 4.2 are representative of what happened in the nineties. An important part of the central mass of income shifts to the right, while also the lower tail of the distribution accumulates more income. This fact implies that the increase in mean income during the nineties was essentially due to a rising mass accumulation in the upper tail that more than compensated the accumulation in the lower tail. Naturally, this particular change in the income distribution has important consequences over the evaluation of aggregate welfare that will be analyzed in the next section.

FIGURE 4.1
DENSITY OF THE LOGARITHM OF EQUIVALENT HOUSEHOLD INCOME
GREATER BUENOS AIRES, 1986, 1989 AND 1991
NON-PARAMETRIC ESTIMATION

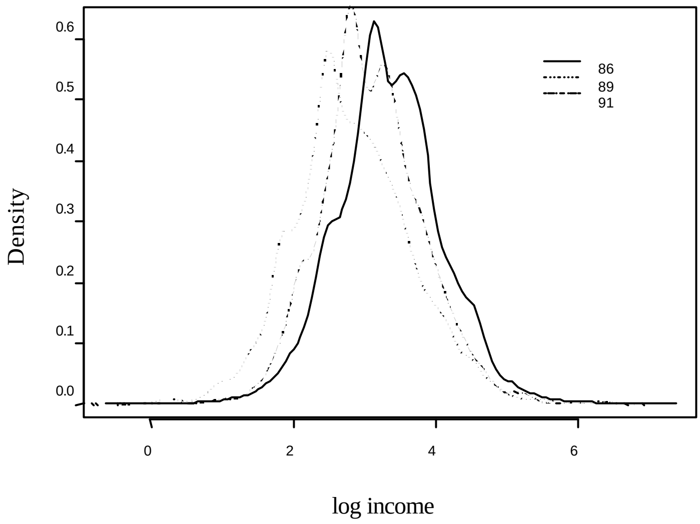
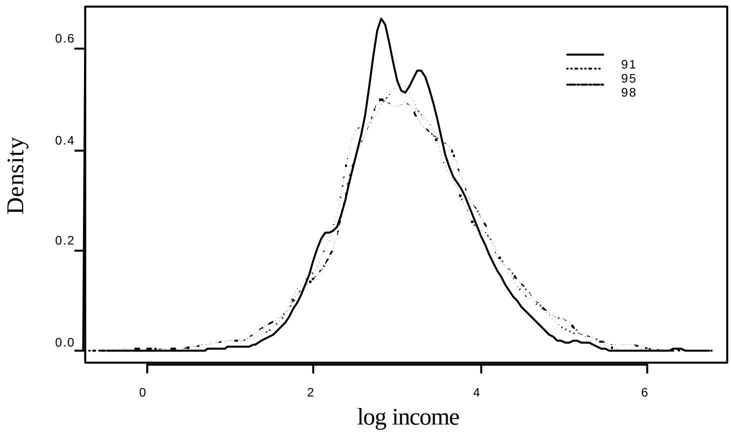


FIGURE 4.2
DENSITY OF THE LOGARITHM OF EQUIVALENT HOUSEHOLD INCOME
GREATER BUENOS AIRES, 1991, 1995 AND 1998
NON-PARAMETRIC ESTIMATION



IV.2. Summary measures

Table 4.1 presents the results of the estimations of the main series related to welfare analysis: mean equivalent household income, the Gini coefficient and Atkinson inequality indices, and several aggregate welfare functions calculated according to equations in section II. All series are normalized taking 1980 = 100.

Before analyzing this table, it is important to first check the statistical significance of the results. Since surveyed households change period by period, some of the changes shown in table 4.1 could be due simply to the fact of having different samples from the same income distribution.

IV.3. Statistical significance of the results

The problem of sample variability is studied for the inequality measures calculated with microdata from the EPH. While the computation of per capita income by National Accounts is surely subject to a similar problem, we did not have access to the microdata from that source to evaluate its relevance. We use resampling techniques like the *bootstrap*, which provide interval estimations and dispersion measures for the inequality indices, in a simple and efficient way. Additionally, the same tool is used to implement tests for evaluating the null hypothesis of no changes between two periods. For simplicity, the analysis concentrates in the Gini coefficient[10]. The implementation of the bootstrap method is explained in the Appendix[11].

TABLE 4.1
MEAN, INEQUALITY AND WELFARE INDICES
ARGENTINA, 1980-1998, INDEX BASE 1980 = 100

	Mean	Inequality			Welfare				
	income (i)	Gini (ii)	A(1) (iii)	A(2) (iv)	Wb (v)	Ws (vi)	Wk (vii)	Wa(1) (viii)	Wa(2) (ix)
1980	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1982	93.9	103.2	107.2	104.4	93.9	91.8	93.0	91.5	90.6
1985	82.4	102.4	103.6	102.8	82.4	81.0	81.9	81.4	80.6
1986	87.8	102.1	105.1	104.1	87.8	86.5	87.2	86.3	84.9
1987	93.6	107.9	113.5	110.3	93.6	88.5	91.5	89.3	86.0
1988	91.7	108.6	118.6	119.6	91.7	86.2	89.5	85.9	77.4
1989	82.5	99.8	99.9	102.4	80.9	81.0	80.9	80.9	78.3
1990	80.9	99.8	99.9	102.4	80.9	81.0	80.9	80.9	79.3
1991	85.4	97.4	93.1	92.2	85.4	86.9	86.0	87.4	90.6
1992	91.9	99.7	99.3	98.5	91.9	92.2	92.0	92.1	93.0
1993	97.5	99.7	99.3	104.2	97.5	97.7	97.6	97.7	94.3
1994	101.7	105.1	108.9	103.4	101.7	98.1	100.2	98.6	99.0
1995	98.9	112.5	124.1	120.5	98.9	90.3	95.4	90.8	82.8
1996	103.2	111.5	122.2	124.7	103.2	95.0	99.9	95.4	82.9
1997	108.8	112.5	126.6	122.5	108.8	99.3	104.9	98.9	89.3
1998	110.4	115.4	129.6	127.6	110.4	98.5	105.6	99.3	86.1

Note: A(ε)=Atkinson's inequality index with parameter ε. Welfare functions: W_b=Bentham, W_{sb}= Sen, W_k=Kakwani and W_a(ε) =Atkinson with parameter ε.
Source: Author's calculation based on National Accounts and the EPH. See text for details.

Table 4.2 shows the estimated Gini coefficient for each year, its bootstrapped standard error, and the corresponding confidence interval for a 95% of significance. Given the large size of the sample (around 3500 households or 11000 individuals), we can expect the Gini coefficients to be estimated with high precision. This is reflected in the low values of the standard errors. Column (iii) shows that the standard error is almost always smaller than 2% of the estimated coefficient.

10 Results for other indices are available from the authors upon request.

11 This subsection is based on Sosa Escudero and Gasparini (2000) which presents a careful discussion of the use of the *bootstrap* in inequality analysis, and hence we refer to this paper for technical details. The Appendix presents some basic results relevant for this case.

TABLE 4.2
SAMPLE VARIABILITY OF THE GINI COEFFICIENT
OBSERVED VALUES, STANDARD ERRORS, COEFFICIENTS OF VARIATION AND CONFIDENCE INTERVALS

Year	Observed	Standard error	Coefficient of variation	Confidence interval 95%	
	(i)	(ii)	(iii)	(iv)	(v)
1980	0.410	0.009	2.1%	0.393	0.427
1982	0.423	0.016	3.8%	0.393	0.458
1985	0.420	0.009	2.2%	0.402	0.438
1986	0.419	0.007	1.6%	0.407	0.433
1987	0.443	0.008	1.8%	0.427	0.458
1988	0.446	0.007	1.5%	0.433	0.461
1989	0.467	0.007	1.5%	0.453	0.480
1990	0.410	0.009	2.1%	0.394	0.428
1991	0.400	0.008	2.1%	0.385	0.415
1992	0.409	0.008	1.8%	0.394	0.424
1993	0.409	0.006	1.5%	0.398	0.420
1994	0.431	0.007	1.7%	0.415	0.445
1995	0.462	0.008	1.7%	0.448	0.477
1996	0.457	0.008	1.7%	0.443	0.474
1997	0.462	0.008	1.8%	0.444	0.476
1998	0.474	0.008	1.7%	0.459	0.489

Source: Author's calculations based on the EPH.

Table 4.3 shows results of the equality test for the Gini coefficients for several pairs of years[12]. Column (i) presents the difference between the Gini coefficients for each pair of years. Columns (ii) to (v) show the percentiles of the distribution of these differences. For example, the numbers in columns (iii) and (iv) correspond to a confidence interval of 90%. Based on the well known duality between hypothesis testing and confidence interval construction, the null hypothesis of equality between Gini coefficients of two periods is rejected if the confidence interval for this difference does not include the number zero. In each row it is indicated with a "*" whether the null hypothesis is rejected for a significance level of 0.95. For example, the table indicates that the computed Gini coefficient in 1998 was higher than in 1993 and 1995. However, while the result of the comparison between 1993 and 1998 holds when considering the problem of sample variability, the difference between Gini coefficients of 1995 and 1998 is not sufficiently large to reject the null of equality.

12 To save space, not all the possible combinations are shown. They could be obtained by request from the authors.

TABLE 4.3
EQUALITY TESTS FOR THE GINI COEFFICIENT

Year		Difference	Percentiles				Standard error	Rejects equality
			0.025	0.05	0.95	0.975		
		(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)
1982	1985	0.004	-0.033	-0.027	0.037	0.043	0.020	
1982	1987	-0.019	-0.051	-0.046	0.016	0.026	0.021	
1982	1989	-0.044	-0.076	-0.073	-0.011	-0.002	0.020	*
1982	1991	0.023	-0.009	-0.005	0.055	0.060	0.018	
1982	1993	0.014	-0.020	-0.014	0.047	0.052	0.019	
1982	1995	-0.038	-0.075	-0.069	-0.009	-0.005	0.018	*
1982	1997	-0.038	-0.074	-0.066	-0.005	-0.002	0.020	*
1982	1998	-0.050	-0.080	-0.078	-0.021	-0.017	0.016	*
1985	1987	-0.023	-0.043	-0.041	-0.005	-0.001	0.012	*
1985	1989	-0.048	-0.069	-0.066	-0.028	-0.026	0.012	*
1985	1991	0.020	-0.003	0.000	0.037	0.041	0.012	
1985	1993	0.010	-0.008	-0.005	0.028	0.030	0.010	
1985	1995	-0.042	-0.065	-0.063	-0.025	0.020	0.012	*
1985	1997	-0.042	-0.064	-0.062	-0.025	-0.021	0.012	*
1985	1998	-0.054	-0.078	-0.074	-0.035	-0.032	0.012	*
1987	1989	-0.024	-0.046	-0.042	-0.009	-0.007	0.010	*
1987	1991	0.043	0.027	0.029	0.061	0.065	0.011	*
1987	1993	0.033	0.016	0.018	0.048	0.051	0.009	*
1987	1995	-0.019	-0.037	-0.034	-0.002	0.001	0.010	*
1987	1997	-0.019	-0.039	-0.036	0.000	0.002	0.011	
1987	1998	-0.031	-0.055	-0.049	-0.013	-0.011	0.011	*
1989	1991	0.067	0.046	0.049	0.085	0.088	0.011	*
1989	1993	0.058	0.039	0.042	0.073	0.078	0.010	*
1989	1995	0.005	-0.016	-0.013	0.023	0.029	0.011	
1989	1997	0.005	-0.015	-0.012	0.025	0.028	0.011	
1989	1998	-0.007	-0.026	-0.023	0.009	0.011	0.010	
1991	1993	-0.009	-0.029	-0.026	0.006	0.012	0.010	
1991	1995	-0.062	-0.084	-0.080	-0.042	-0.038	0.012	*
1991	1997	-0.062	-0.082	-0.079	-0.044	-0.042	0.011	*
1991	1998	-0.074	-0.093	-0.091	-0.054	-0.051	0.011	*
1993	1995	-0.053	-0.076	-0.070	-0.036	-0.032	0.011	*
1993	1997	-0.052	-0.071	-0.068	-0.036	-0.034	0.010	*
1993	1998	-0.064	-0.082	-0.080	-0.050	-0.047	0.009	*
1995	1997	0.000	-0.020	-0.018	0.021	0.025	0.012	
1995	1998	-0.012	-0.031	-0.028	0.006	0.008	0.010	
1997	1998	-0.012	-0.031	-0.028	0.006	0.008	0.011	

Source: Author's calculations based on the EPH.

Table 4.4 shows the observed difference in the Gini coefficients for pairs of years in the nineties. The cases in which equality between coefficients can not be rejected correspond, in general, to comparisons between successive years. Except in two cases (1994 and 1995 with respect to their previous years), in the rest of the comparisons between consecutive years it is not possible to reject the null hypothesis of absence of changes in the Gini coefficient. This implies an important point: from a statistical point of view, changes in inequality usually occur slowly, even in periods of “rapid” inequality growth like the nineties in Argentina. In general it is precipitated to state propositions about changes in inequality from the observation of the Gini coefficient for two consecutive years.

TABLE 4.4
OBSERVED DIFFERENCE IN THE GINI COEFFICIENTS
EQUALITY TESTS, 1991-1998

	1991	1992	1993	1994	1995	1996	1997
1992	(-.009)						
1993	(-.009)	(-.000)					
1994	-0.031	-0.022	-0.022				
1995	-0.062	-0.053	-0.053	-0.030			
1996	-0.057	-0.048	-0.048	-0.026	(.0044)		
1997	-0.062	-0.053	-0.052	-0.030	(.0001)	(-.0043)	
1998	-0.074	-0.065	-0.064	-0.042	(-0120)	-0.016	(-.0120)

Note: The numbers between parenthesis correspond to the cases where equality between coefficients is not rejected. Source: Author’s calculations based on the EPH.

Welfare measures have two sources of sample variability: both the inequality measure and the mean come from sample information. The previous paragraphs discussed strategies for dealing with sample variability in inequality measures. Unfortunately, this procedure can not be applied to the estimation of per capita income from National Accounts since the relevant microdata is unavailable. Consequently, the analysis is exclusively concentrated in the sample variability of welfare measures that comes from the variability in inequality indices. To save space, only results for the Sen index are presented. Table 4.5 shows the observed value for this index with base 1980=100, and the estimates, using the *bootstrap* procedure, of their standard errors, coefficients of variation and confidence intervals at a 95%.

TABLE 4.5
SAMPLE VARIABILITY OF THE SEN WELFARE INDEX
OBSERVED VALUES, STANDARD ERRORS, COEFFICIENTS OF VARIATION
AND CONFIDENCE INTERVALS

Year	Observed (i)	Standard error (ii)	Coefficient of variation (iii)	Confidence interval 95% (iv)	(v)
1980	100.0	1.45	1.45%	97.2	102.9
1982	91.8	2.56	2.79%	86.4	96.7
1985	81.1	1.28	1.58%	78.5	83.6
1986	86.5	0.98	1.14%	84.5	88.3
1987	88.5	1.30	1.47%	86.0	90.9
1988	86.2	1.07	1.24%	83.9	88.1
1989	74.6	0.97	1.29%	72.7	76.5
1990	81.0	1.17	1.45%	78.5	83.2
1991	86.9	1.20	1.38%	84.7	89.0
1992	92.1	1.18	1.28%	89.7	94.4
1993	87.7	1.01	1.04%	95.9	99.6
1994	98.1	1.27	1.30%	95.7	100.9
1995	90.3	1.34	1.48%	87.8	92.5
1996	95.0	1.37	1.45%	92.1	97.5
1997	99.3	1.53	1.54%	96.6	102.5
1998	98.5	1.48	1.51%	95.7	101.2

Source: Author's calculations based on the EPH.

The inequality tests presented in Table 4.6 show a higher rate of rejection of the hypothesis of equality between two years than in the case of the Gini coefficient. For example, although the difference between the Gini coefficients for 1991 and 1993 is not statistically significant, the increase in mean income between these years was large enough to produce a statistically significant difference in the Sen index (assuming absence of sample variability for the mean). There are years in which an opposite phenomenon is observed. The Gini coefficient for 1993 is significantly lower than the one for 1997, but the Sen indices are not different in a statistical sense.

TABLE 4.6
EQUALITY TESTS FOR THE SEN WELFARE INDICES

Year		Difference (i)	Percentiles 0.025 (ii)	0.05 (iii)	0.95 (iv)	0.975 (v)	Standard error (vi)	Rejects equality (vii)
1982	1985	6.32	1.67	3.06	8.92	9.48	1.84	*
1982	1987	1.98	-1.81	-1.40	4.73	5.22	1.77	
1982	1989	10.18	6.09	6.98	12.89	13.07	1.78	*
1982	1991	2.90	-0.53	0.15	5.27	5.40	1.70	*
1982	1993	-3.45	-7.23	-6.56	-0.85	-0.57	1.72	*
1982	1995	0.91	-2.98	-2.30	3.62	3.94	1.76	
1982	1997	-4.42	-7.99	-7.50	-1.77	-1.54	1.80	*
1982	1998	-3.95	-7.96	-6.85	-1.74	-1.12	1.77	*
1985	1987	-4.34	-6.15	-5.95	-2.56	-2.31	1.04	*
1985	1989	3.86	2.18	2.51	5.42	5.67	0.90	*
1985	1991	-3.42	-5.11	-4.85	-1.73	-1.53	0.96	*
1985	1993	-9.77	-11.89	-11.31	-8.20	-7.85	1.00	*
1985	1995	-5.40	-7.48	-7.19	-3.60	-2.93	1.15	*
1985	1997	-10.74	-12.64	-12.28	-9.01	-8.72	1.07	*
1985	1998	-10.27	-12.36	-12.06	-8.34	-8.17	1.06	*
1987	1989	8.21	5.98	6.51	9.84	9.94	0.98	*
1987	1991	0.92	-0.99	-0.79	2.33	2.73	0.99	
1987	1993	-5.43	-7.42	-7.06	-3.95	-3.77	0.97	*
1987	1995	-1.06	-3.06	-2.83	0.48	0.91	1.03	
1987	1997	-6.40	-8.59	-8.25	-4.50	-4.22	1.14	*
1987	1998	-5.93	-8.30	-7.78	-4.18	-3.84	1.10	*
1989	1991	-7.28	-9.42	-8.94	-5.79	-5.70	0.96	*
1989	1993	-13.64	-15.18	-14.86	-12.12	-12.05	0.85	*
1989	1995	-9.27	-11.49	-10.89	-7.82	-7.66	0.99	*
1989	1997	-14.60	-16.96	-16.60	-12-93	-12.33	1.10	*
1989	1998	-14.14	-16-06	-15.65	-12-54	-12.17	1.00	*
1991	1993	-6.35	-8.33	-7.99	-4.69	-4.50	1.02	*
1991	1995	-1.98	-3.67	-3.41	-0.19	0.11	1.01	*
1991	1997	-7.32	-9.33	-9.00	-5.35	-4.94	1.13	*
1991	1998	-6.85	-8.82	-8.43	-5.19	-4.90	1.03	*
1993	1995	4.37	2.51	2.76	6.23	6.65	1.05	*
1993	1997	-0.97	-2.93	-2.67	0.99	1.46	1.12	
1993	1998	-0.50	-2.58	-2.29	0-98	1.13	1.04	
1995	1997	-5.33	-7.62	-7.19	-3.75	-3.46	1.13	*
1995	1998	-4.87	-7.00	-6.73	-3.05	-2.67	1.09	*
1997	1998	0.47	-1.79	-1.58	2.06	2.32	1.15	

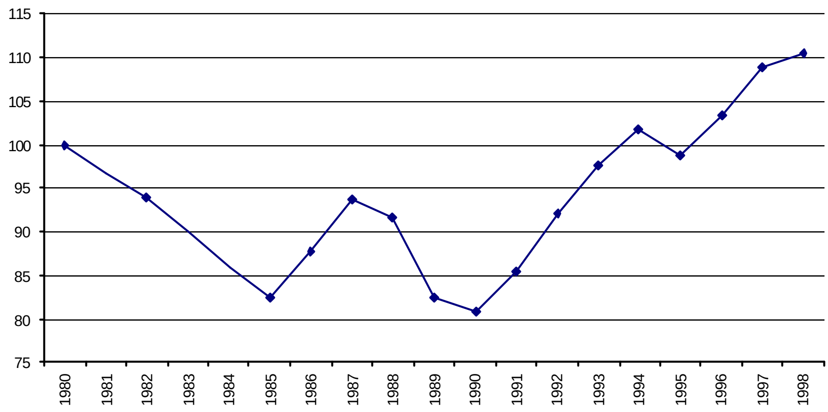
Note: The differences correspond to the level of the Sen welfare function (not the index with base 1980=100)

Source: Author's calculations based on the EPH.

V. Trends in Mean Income, Inequality and Welfare

Trends in mean income, inequality and welfare have been shown in Table 4.1. In this section we illustrate these trends with graphs and make some comments on the basic results. Average equivalent household income is shown in Figure 5.1. The average living standard fell strongly during the "lost decade". After the economic crises of the beginning of the 80's, income recovered until 1987, but decreased again in the period of very high inflation, reaching the minimum levels of the series in 1990. At the beginning of the nineties a phase of sustained growth started. Mean equivalent income grew at high rates since 1991 to 1994, fell in 1995 and increased again during the following three years, but at lower rates. The average standard of living in 1998 was the highest of all the period considered (according to National Accounts)[13].

FIGURE 5.1
MEAN EQUIVALENT HOUSEHOLD INCOME



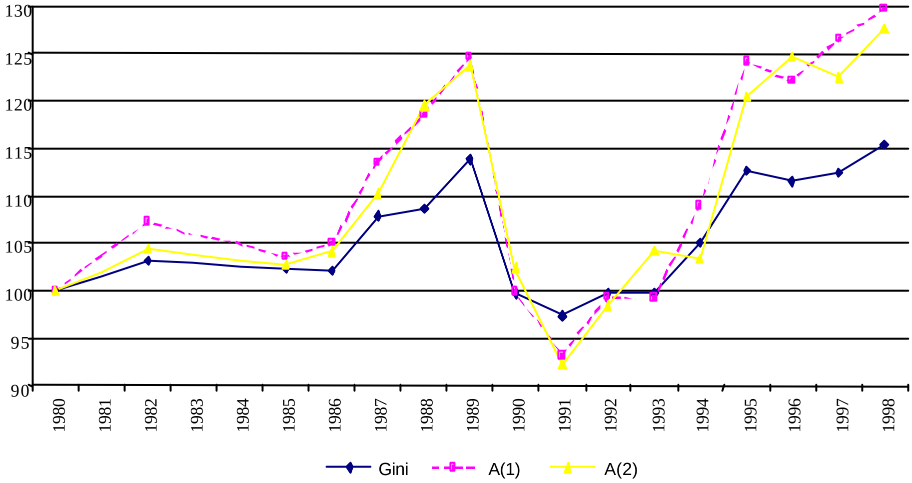
Source: Author's calculation based on National Accounts and the EPH. See text for details.

The trend in income inequality is illustrated in Figure 5.2. Although the computed indices show some movements, the statistical significance analysis suggests that income inequality did not significantly change in the first half of the eighties. In contrast, the distribution became more unequal in the second half

13 The evolution of mean equivalent household income estimated from the EPH for Greater Buenos Aires is fairly consistent with Figure 5.1. The greatest difference is the significantly lower levels of mean income registered in the EPH in the nineties, with respect to National Accounts. These differences remain a puzzle to be studied in the future.

of that decade, reaching a peak in 1989. In the next two years income dispersion declined substantially, reaching the most egalitarian point in 1991. Since then, a new period of increasing inequality begun. Almost all indices show a sustained increase until the present. In fact, 1998 appears to be the year of greatest inequality in the whole period for any of the indices considered.

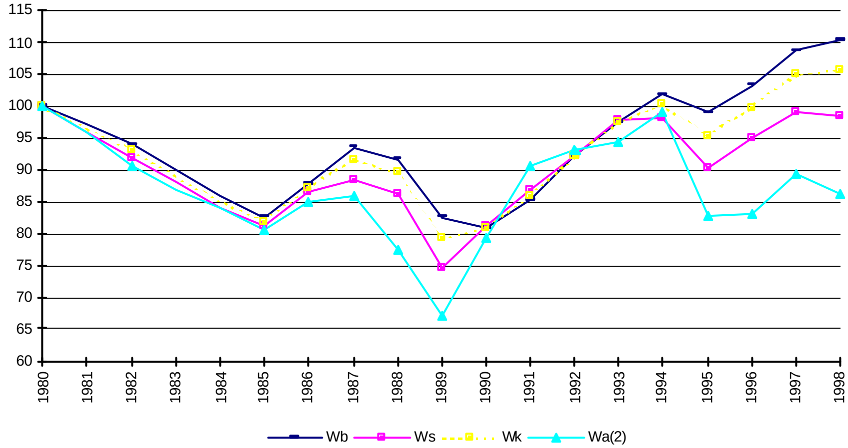
FIGURE 5.2
INEQUALITY IN THE DISTRIBUTION OF EQUIVALENT HOUSEHOLD INCOME
GREATER BUENOS AIRES, 1980-1998



Source: Author's calculation based on the EPH. See text for details.

Changes in social welfare are the result of changes in the mean and in the degree of inequality of the income distribution. It is interesting to investigate the joint assessment of these changes implied by alternative welfare functions. Figure 5.3 illustrates four welfare series presented in Table 4.1. Given that the trend in $W_a(1)$ does not significantly differ from the trend in W_s, only the latter is presented.

FIGURE 5.3
AGGREGATE WELFARE
ARGENTINA, 1980-1998



Note: W_b=Bentham, W_s=Sen, W_k=Kakwani and $W_a(\varepsilon)$=Atkinson with parameter ε.
Source: Author's calculation based on National Accounts and the EPH. See text for details.

In general, the sign of the annual change in the aggregate welfare is similar among the different functions considered in the analysis. Welfare falls drastically between 1980 and 1985 basically due to a strong mean income reduction. In the following two years welfare improved due to the increase in mean income, and in spite of the increase in inequality. During 1988/89 Argentina experimented a strong contraction in the average living standard and a substantial increase in inequality that led welfare to unprecedented low levels. In 1990 there was a new contraction, this time smaller, in the GDP, but inequality levels decreased substantially. Only the Bentham function does not show an increase in the aggregate welfare level.

Between 1991 and 1994 the Argentine economy had the highest growth rates of the last two decades. The magnitude of these changes more than compensated the increase in inequality. This is the reason why all the indices show successive increases in aggregate welfare. It is interesting to notice the coincidence between the value judgments implicit in the different functions in considering that aggregate welfare in Argentina returned in 1994 to the level of 1980.

In 1995 the Argentine economy experimented a strong contraction in its product and a substantial increase in inequality that was translated into an important decrease of aggregate welfare. The evaluation of the magnitude of this decrease greatly differs among the alternative welfare functions.

Since 1996 the growth path interrupted in 1995 resumed, driving all functions to show a rise in welfare. However, the magnitude of the improvement differs substantially across functions. While the Bentham function shows large increases in aggregate welfare, the change in $W_a(2)$ is small, due to the greater weight attached to the increase in inequality.

From the analysis of this section it is possible to conclude that the sign of the annual change in welfare is usually the same as the sign of the annual change in mean income. However, the magnitudes of these variations can differ significantly, especially for functions that give a greater weight to inequality. This implies that while almost every function coincides in the direction of the annual change in welfare, there may exist huge differences when comparing the extreme points of longer periods. Take the case of 1998 compared to 1994. While for the Bentham and Kakwani functions aggregate welfare in 1998 was clearly higher than in 1994; both years are similar for Sen and Atkinson with $\varepsilon = 1$. In contrast, for the Atkinson function with $\varepsilon = 2$ welfare in 1998 was lower than in 1994. In fact, the economic performance in 1998 is evaluated as inferior to 1991 and similar to 1987, two years that are clearly worse than 1998 for the other functions.

This point suggests that the different opinions about the economic performance of Argentina, especially in the second half of the nineties, could be caused by different value judgments applied to the same reality. Even after reaching a consensus about all empirical issues related to the measurement of aggregate welfare, it is probable that individuals with different value judgments have very different assessments of the Argentine economic performance, not only about the magnitude of welfare changes, but also about the signs. Note that the divergence among value judgments in the assessments of the performance of the economy is not an obvious phenomenon. In fact, it is noticed only in some periods of recent economic history, particularly in the last four years of the analysis.

This point also suggests that the experience of the period 1994-1998 can be used to learn the social preferences of a given evaluator. For example, a positive assessment of the economic performance in that period is consistent with some value judgments, and inconsistent with others. In accordance to Figure 5.3 these years are an unprecedented laboratory to distinguish the social preferences of different analysts.

VI. Concluding Remarks

The measurement of the economic performance of a country is an obviously relevant task. This paper presents results for the case of Argentina, which experienced a process of drastic economic reform in the last decade. Per-capita income series are complemented with estimates of the degree of inequality in the distribution, so as to obtain alternative aggregate welfare measures. The calculation of inequality includes some adjustments to the original household survey data that are generally not considered jointly in the literature. Finally, the article emphasizes the need of evaluating the statistical significance between two indices for stating propositions about the change in inequality or welfare.

One of the main conclusions of the paper is that though in general for all value judgments considered the sign of the annual change in welfare is the same as the sign of the annual change in mean income, the welfare assessment of longer periods widely varies across different value judgments. In particular, for some functions welfare has clearly increased in the period 1994-1998, while for some other functions it has decreased. This point suggests that the different opinions about the economic performance of the Argentine economy could be caused by different value judgments applied to the same reality. This divergence in the assessments of the economy is not an obvious phenomenon. In fact, it is noticed only in some periods of recent economic history, where a rapid GDP expansion and a marked increase in inequality leave room for divergences in the welfare appraisal of the economy. It is argued that the period 1994-1998 provides an unprecedented laboratory for distinguishing the social preferences of different analysts according to their evaluation of the performance of the Argentine economy.

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APPENDIX

Atkinson's abbreviated welfare function

The Atkinson's inequality index A is defined as

$$(A.1)\quad A = 1 - \frac{y^*}{\mu}$$

where y* is the *equally-distributed* income defined as

$$(A.2)\quad W(y_1,..., y_N) = W(y^*,..., y^*)$$

Using (3) and (4), the equally-distributed income becomes

$$(A.3)\quad y^*(\varepsilon) = \left(\frac{\sum_{i=1}^{N} y_i^{1-\varepsilon}}{N} \right)^{\frac{1}{1-\varepsilon}} \qquad \text{for } \varepsilon \geq 0,\ \varepsilon \neq 1$$

$$(A.4)\quad \ln y^* = \frac{1}{N} \sum_{i=1}^{N} \ln y_i \qquad \text{for } \varepsilon = 1$$

Notice that from (A.1) $\mu(1\text{-}A)=y^*$. It is straightforward from (4) and (A.4) that when $\varepsilon=1$, $\ln W_a = \ln y^*$ and hence $W_a(1) = \mu.(1 - A(1))$. From (3) and (A.3) when $\varepsilon=2$, $W_a = -y^*$ and hence $W_a(2) = -\mu.(1 - A(2))$.

Income imputation for non-response[14]

Not all the individuals selected to respond the EPH answer the questions about income. This phenomenon can bias the inequality estimations if (i) non-response depends on income, and (ii) if the proportion of non-response varies over time. Unfortunately, we have strong presumptions about the fulfilling of condition (i) and certainty about the fulfilling of condition (ii). The proportion of people with incomplete household income report was about 25% in the eighties. In the nineties the efforts of INDEC to mitigate the problem of non-response succeeded: the percentages fell all over the decade until they reached 8% in 1998. This fall can cause a bias in the inequality estimations that ignore non-response.

14 See Convenio (1999) for more details and results.

We impute income for non-response to workers and people who are retired. For the first group we run a regression of the logarithm of hourly labor income as a function of several independent variables that try to capture demographic characteristics (age, age squared, sex, marital status), occupational characteristics (work experience, formal or informal, sector of activity and skills) and the maximum educational level attained by the worker. The estimated model is used to predict the hourly labor income of workers who do not answer the income question of the survey. That hourly labor income is multiplied by the number of hours of work reported in the survey to obtain the monthly labor income. The model is estimated by least squares weighted by the importance of the household in the population (using the weights provided in the EPH)[15]. The regression is estimated for individuals who are between 14 and 74 years old with positive monthly working hours smaller than 85 and who declare to have incomes from wages or from self-employment. For 1998 the imputed average hourly wage was 18% higher than the average hourly wage of the workers who answered the income questions.

In the case of retired individuals the absence of potentially relevant variables in the survey decreases the explanatory power of the regression. The variables included (age, age squared, sex, marital status and maximum educational level) are all significant at 10%, with the expected signs and order of magnitudes. For 1998, in contrast to the case of active workers, the average value of the predictions arising from the model is slightly lower than the actual mean.

Non-parametric estimations[16]

Let Y be a continuous and positive random variable that represents the income distribution, that has the distribution function $F_y(y)=\Pr(Y \leq y)$, and denote with $f(y)$ its density function. For the estimation we have a sample of n observations, whose realizations are denoted with $Y_i=1,...,n$. The kernel estimator of f(y) is:

$$\hat{f}(y) = \frac{1}{n} \sum_{i=1}^{n} \frac{1}{h} K\left[\frac{y - Y_i}{h}\right]$$

15 The estimation by OLS could generate selection bias by ignoring those individuals who do not declare incomes. In this case it would be convenient to estimate the model using the Heckman correction. However, as we do not have a satisfactory model for the decision of not declaring incomes, we decided to use OLS. The possible selection bias is accepted to avoid the possible bias introduced by misspecification of the selection model. Several authors (see Maloney (1998)) have reported and quantified the fact that the selection bias is comparatively smaller than the bias introduced by misspecification.

16 Silverman (1986) and Pagan and Ullah (1999) present abundant details on the subject. Hall (1994) and Deaton (1997) are relevant references from an econometric point of view. Recent applications to the problem of estimation of income distribution are Schulter (1996), Burkhauser *et al.* (1999), and for the Argentine case, Botargues and Petrecolla (1999).

where K(z) is any continuous, symmetric at zero, and unit integral function. h is known as the bandwidth parameter. Intuitively, the estimator can be interpreted as the proportion of points that fall into a “window” of width h around the point y, where the contribution of each one of them to the total is regulated by the weight function K(z). For example, if K(z)=1 if $z \in (0,1)$ and 0 otherwise, then the estimator counts the proportion of observations that fall in a symmetric interval of width 2h around y, what usually corresponds to a histogram.

The choice of the smoothing parameter h implies a trade-off between bias and variance: a higher h implies considering information that is more far away from the point of interest y, what reduces the variance of the estimator by increasing the number of points, but with the cost of introducing a higher bias by considering less relevant information. A small h tends to produce unbiased but very variable estimations, while a very big h produces smooth but biased estimations. The problem of the choice of the bandwidth is crucial, and even being intensively studied in the literature, it does not exist an automatic and commonly accepted solution. Given the exploratory character of this work, several authors (Silverman (1986), Deaton (1997)) suggest choosing h by visual inspection, starting with a small h and increasing it until a reasonable smoothing has been reached. This is the procedure followed for this paper. The choice of the kernel is a less important problem (Silverman, 1986). For simplicity we have worked with a gaussian kernel, i.e. K(z) corresponds to the standardized normal density function.

Bootstrap

This section gives some details on the bootstrap methods used in the paper. It is largely based on a companion paper (Sosa Escudero and Gasparini (2000)) which gives abundant details on bootstrap techniques for evaluating the significance of the income distribution measures. Mills and Zanvakili (1997) is also a useful reference on the subject. Contreras, Bravo and Millan (2000) also apply the bootstrap in social topics. For the case of the Gini coefficient, the bootstrap is implemented as follows:

1. Using the original sample for a given period, compute the Gini coefficient.
2. Using the original sample as it were the population, take a sample (with replacement) and calculate the Gini coefficient for this subsample.
3. Repeat the previous step a sufficient number B of iterations. Now there will be B estimations of the Gini coefficient[17].

[17] The appropriate number of replications is an important issue, and is actually being discussed in the literature. Generally, it is recommended to use a number of replications not smaller than 200 for the estimations of the standard errors. See Buchinsky and Andrews (1997).

4. Using the estimations of the previous step, calculate the standard error of the estimated Gini coefficients. This represents the sample variability of the Gini estimated with the original sample.
5. For the calculation of the confidence interval (G_I, G_S) at a 95% of significance, sort the Gini coefficients estimated in (3) from lowest to highest. Take as inferior limit G_I the value that leaves below a 2.5% of the estimated coefficients, and as superior limit G_S, the value that leaves above the 2.5% of the estimated coefficients.
6. Repeat the procedure for all the periods desired.

The procedure used to evaluate the null hypothesis that the Gini coefficients for two distributions are the same is similar to the previous one. In this case, the population of interest consists of the incomes for a pair of given years. The bootstrap takes a sample with replacement for each of the years involved in the comparison, calculates the Gini coefficient for each and computes the difference between them. According to the duality between interval estimation and hypothesis testing, the test rejects the hypothesis of equality between coefficients if the confidence interval estimated for the difference of the Gini coefficients does not include zero. A simple formula to compute the Gini coefficient based on individual level per-capita income using sample weights is given in Deaton (1997) and it is the one used in this paper. Again, see Sosa Escudero and Gasparini (2000) for details.