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INCOME POLARIZATION IN ARGENTINA: PURE INCOME POLARIZATION, THEORY AND APPLICATIONS[1,2]

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Introduction

The polarization phenomenon is directly linked to the sources of social tension. The notion has its roots in sociology and political science, with Karl Marx arguably being the first social scientist to study it. In economics, its formal analysis has its origins in the nineties, in the work of Esteban and Ray (1991,1994), Foster and Wolfson (1992) and Wolfson (1994). It was subsequently extended, with the ultimate goal of developing not just an index that measured polarization, but also achieving an understanding of the possible causes which may affect it[5].

Polarization is a concept that is distinct from inequality, and can be traced to social, economic, and political factors. The motivation for this paper is to analyze the evolution of polarization in Argentina during the unstable period 1998-2002, with the aim of furthering our understanding of the nature of distributive changes.

This work is divided into two main sections: theoretical and empirical. The first has as goal to provide a brief survey of the evolution of the concept of polarization, beginning with an explanation for the simpler case of discrete variables. We subsequently discuss the latest developments in the measurement for the case of continuous variables. We wish to underscore the

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[2] We thank Joan Esteban and Jean-Yves Duclos, for their interest and help in the computation of the index. We also thank Leonardo Gasparini for his teaching and support, Martín Cicowiez for his programming lessons and to the anonymous referee for valuable suggestions which helped us to improve the paper. We also extend our gratitude to Maria Eugenia Garibotti for translating this paper, and to participants and organizers of the November 2004 Network of Inequality and Poverty (NIP) conference held at Universidad de San Andrés, Buenos Aires, Argentina.

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[5] Esteban and Ray (1994), Foster and Wolfson (1992), Wolfson (1994), Alesina and Spolaore (1997), Wang and Tsui (2000), Zhang and Kanbur (2001), D'Ambrosio and Wolf (2001), Duclos, Esteban and Ray (2004).

fact that we follow the approach of Esteban and Ray (1994) and Duclos, Esteban and Ray (2004) for discrete and continuous variables respectively[6].

The empirical section includes the results for Argentina and their analysis. It starts by tracing the evolution of polarization and comparing it with that of inequality, followed by a look at the robustness of our results and a study of the causes of the change over time – both by considering how the identification effect and the alienation effect affect the index, and by using a micro-simulation technique. It ends with a regional analysis.

I. Polarization: definition and measurement[7]

A population can be seen as a set of distinct groups that differ in the characteristics of their members. Thus, a group is "similar" to another one when their component members have similar features and "different" when their members have dissimilar characteristics[8]. A society will be deemed to be polarized when for a given joint distribution of characteristics, the population is clustered around a small number of distant points[9]. As a society becomes more polarized, conflict will be more likely.

The degree of clustering is important for a large number of social and economic variables. Among the former we find the issues of social class, race, religion, nationality, political parties, etc. In the economic case we find, among others, labor market segmentation and the distribution of firm size within an industry. This notion is also relevant when the defining characteristic of each group is their income.

We would like to emphasize that these first sections are based on the discussion by Esteban and Ray (1994) and Duclos, Esteban and Ray (2004), which should be consulted by the interested reader.

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[6] For a more detailed treatment of the subject we refer the reader to Esteban and Ray (1994) and Duclos, Esteban and Ray (2004).

[7] The reader who is familiar with the concepts developed in the work of Esteban and Ray (1994) and Duclos, Esteban and Ray (2004) may skip to the empirical section.

[8] Esteban and Ray (1994)

[9] Esteban (2002)

I.1 Polarization and inequality

For a distribution of individual characteristics to be considered polarized, it must display the following characteristics:

1. High level of *homogeneity* within each group
2. High level of *heterogeneity* between groups
3. Small number of big groups. In particular, groups of negligible size, such as one individual, should have a small influence on the whole.

Each of the previous conditions is linked to the emergence of social tension. In the case of one single person with very different characteristics from the rest, she would not have a significant role in the development of conflict. Thus, if a group consists of individuals who are "*similar*" among them, we would expect their goals to be the same, or at least similar enough that they feel a strong sense of unity given by their sense of "*identification*". In much the same way, the existence of a clear-cut difference between two groups, "*alienation*" would, ceteris paribus, lead to an increase in social tension. In other words, the goals of each group may conflict.

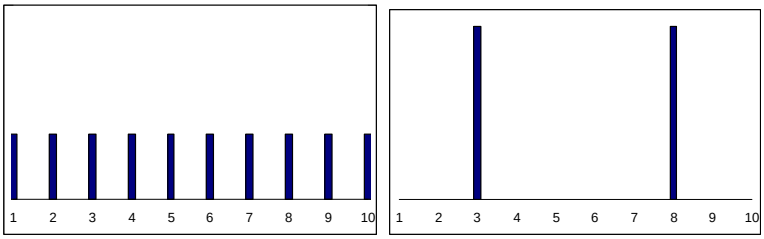
Esteban and Ray thus define a framework within which polarization may be summarized as the interaction between the identification and alienation that each individual feels with respect to the rest (*IA*).

The three postulates that were mentioned above allow us to clarify the difference between this concept and inequality. In order to capture the first feature, assume the existence of two distributions of income across a population, in two moments of time. In the first moment, population is evenly spread among 10 income values separated by a gap of one unit each. At time 2 the population is uniformly distributed between two income groups, clustered around points three and eight.

In the following figures we can observe that the second distribution is more polarized than the first. There exist two perfectly defined groups, which generate a high degree of identification when compared to the first, where the sense of group is vague. In the second distribution people are either "rich" or "poor", without the presence of a "middle class" to bridge the gap. This can be regarded as a situation with higher tension than that in the initial period.

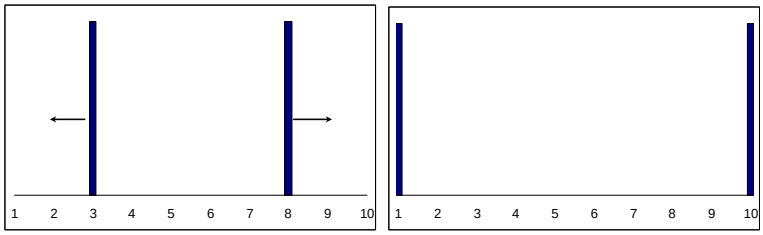
At the same time, it is important to note that while polarization increased in this case, there was a decrease in inequality as measured by any index consistent with Dalton's transfers principle.

Figure 1



It could further happen that income is concentrated in two peaks, but instead of 3 and 8 they are 1 and 10. Going to this case from the first distribution leads to higher heterogeneity between groups, or "alienation", as well as resulting in increased homogeneity within each group. In contrast to our previous argument, it is not just polarization that would grow, but inequality as well. Thus, we cannot assert that polarization and inequality are always at odds with each other.

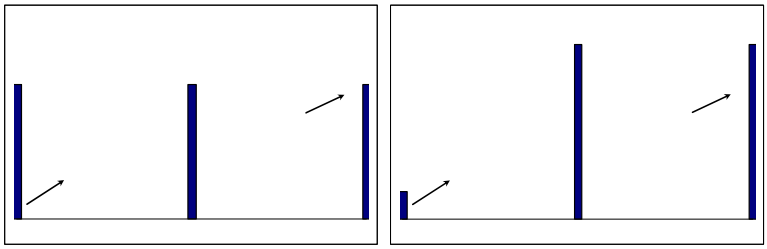
Figure 2



In order to interpret the third characteristic, we will consider a population that is distributed across three equally spaced points. Initially, the mass in the center and right are approximately the same. At a second stage, there is a small shift from the left end to the right. The problem is now more complex than in the first two cases. Despite the fact that such a move would tend to create two distinctly defined groups, the mass in the left could have originally been an instrument to introduce social tension, and the net effect is therefore not clearly defined.

If the group on the left were instead small compared with the other two, its initial influence on conflict would have been small, and it could be argued that a similar change would unambiguously increase polarization.

Figure 3



Two examples of polarization measures for discrete variables are the Wolfson and the Esteban, Gardin and Ray (1999) indices:

Wolfson:

$$P^W = \frac{\mu}{m}\left[0.5 - L(0.5) - \frac{G}{2}\right]$$

where μ = mean, m= median, L(0.5) = value of the Lorenz curve at the median income and G = Gini coefficient.

Esteban, Gardin and Ray (1999):

$$P^{EGR}(F,n;\alpha,\beta) \equiv P^{ER}(\alpha,\rho^*) - \beta\left[G(f) - G(\rho^*)\right]$$

where:

$P^{ER}(\alpha,\rho^*) = \sum_i \sum_j \pi_i^{1+\alpha}\pi_j\left|\mu_i - \mu_j\right|$, α = identification factor, ρ^* = vector of values that include bounds, quantity of individuals, and the mean income for each group that minimizes inequality within each of the n groups.

G(f) = Gini coefficient for the whole population

G(ρ^*)= Gini coefficient for the population defined by ρ^*

The Wolfson index measures a notion of distance from bipolarization with symmetric groups. The EGR index, on the other hand, captures the antagonism that results from the interplay of identification and alienation,

assuming that individuals are pre-assigned to n groups, and proposes a methodology to define the location of each group[10].

I. 2 The income polarization index

In the previous subsection we identified two forces that affect each individual: *identification* and *alienation*. Given that polarization is related to social tension, the measure that summarizes it must take into account both factors. Should any of those be absent, any antagonism would be eliminated.

Two problems arise when applying polarization indexes defined in terms of discrete variables to continuous variables, such as income, consumption, and the like. On the one hand, continuous changes in polarization are not captured in some cases, given that the population is divided into a finite number of groups. The ER (1994)[11] indexes have this problem.

On the other hand, these indices assume that the population is already divided into a small number of relevant groups[12]. In other words, there is a certain degree of arbitrariness in the choice of number of groups. For instance, the Wolfson index implicitly assumes the population is divided into two groups of similar size, and this precludes the accurate detection of changes in polarization when there exist more than two mass points. Another instance is provided by EGR (1999), who leave the definition of the number of groups or poles into which to divide the population to the researcher's discretion.

The Duclos-Esteban-Ray index (DER)[13], sets out to solve these problems. In order to do so, they redefine the axioms that must be satisfied by a polarization index for continuous variables and present a measure of "pure income polarization". This new index allows for individuals not to be clustered around discrete income intervals, and lets the size of each group be determined by nonparametric kernel techniques, avoiding arbitrary choices.

The following axioms that are satisfied by the DER index are based on a density with finite support (kernel), and symmetric reductions in dispersion that concentrate the density around its mean (squeezes).

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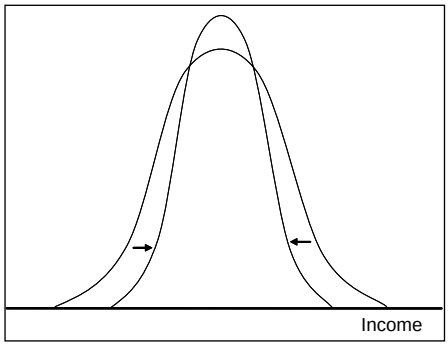
[10] For a more thorough analysis of each of the measures we refer the reader to: Wolfson (1994), Esteban, Gardin and Ray (1999)

[11] Esteban and Ray (1994) pp 845-847

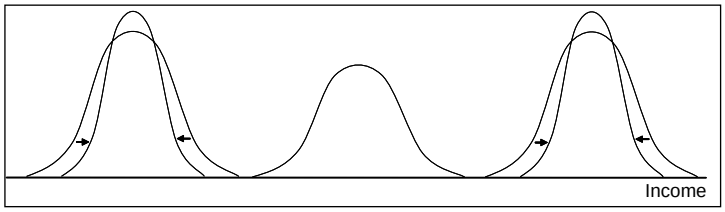
[12] Esteban and Ray (1994)

[13] Duclos, Esteban and Ray (2004)

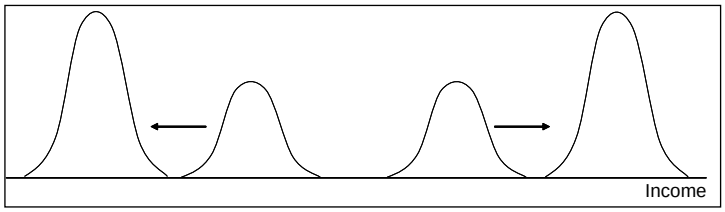
Axiom 1: if a distribution is made up of a basic density, then a squeeze cannot increase polarization.



Axiom 2: if a symmetric distribution is composed by three basic densities then a squeeze in the outer densities should not reduce polarization.



Axiom 3: if we consider a symmetric distribution made up of four basic densities with disjoint supports, then a move of the center distributions towards their outer neighbors, while keeping the disjoint supports, should increase polarization.



Axiom 4: Given two distributions F and G, if P(F) ≥ P(G), being P(F) and P(G) the respective polarization indexes, it must be that P(α F) ≥ P(α G), where α F and α G represent a rescaled version of F and G.

In this manner, the authors establish that a general polarization measure that respects the previous axioms must be proportional to:

$$P_\alpha(f) \equiv \iint f(x)^{1+\alpha} f(y)|y-x|dydx$$

Remark that in order to respect the axioms the α parameter must lie within the interval [0.25, 1][14]. The formula can be rewritten as:

$$P_\alpha(F) = \int f(y)^\alpha g(y)dF(y)$$

Where *g(y)* captures the "alienation" effect, and *f(y)* α the "identification". It is interesting to note that with α =0, the polarization index coincides with the Gini coefficient[15].

If we have a sample of incomes with independent and identically distributed observations ranked from smallest to highest, the indicator's operational formula is:

$$P_\alpha(\hat{F}) = n^{-1}\sum_{i=1}^{n} \hat{f}(y_i)^\alpha \left[\hat{\mu} + \left(y_i \left(\overline{w}^{-1} \left(2\sum_{j=1}^{i} w_j - w_i \right) - 1 \right) - \overline{w}^{-1} \left(2\sum_{j=1}^{i-1} w_j y_j - w_i y_i \right) \right) \right]$$

Where y_i is the ith individual income, $\hat{\mu}$ is the sample mean, w_i is the weight of individual i, and $\overline{w} = \sum_{j=1}^{n} w_j$.

[14] The infimum and supremum of the interval follow from axioms 2 and 1 respectively.

[15] For a more detailed analysis of how the parameter affects the indicator, read Duclos, Esteban and Ray (2004) pp 1746-1747.

The function $\hat{f}(y_i)$ is a nonparametric kernel estimate of the income density, using a bandwidth that minimizes the mean square error of the estimator h*, given by:

$$h^* = \sqrt{\frac{cov(a_\alpha(y), P''_\alpha(y))}{\alpha\sigma_k^2(\int f(y)P_\alpha(y)dy)^2}} n^{-\frac{1}{2}} + o(n^{-1})$$

with

$$a_\alpha(y) = (1+\alpha)P_\alpha(y) + y\int f(x)^\alpha dF(x) + 2\int_y^\infty (x-y)f(x)^\alpha dF(x)$$

Duclos, Esteban and Ray (2004) provide other formulas that are easier to compute. The first can be used with normal distributions and will not exceed the h* that minimizes the means square error by more than 5%.

$$h^* \cong 4.7n^{-5}\sigma\alpha^{-1}$$

The second is for distributions with skewness greater than 6:

$$h^* \cong n^{-5}IQ\frac{(3.76+14.7\sigma_{ln})}{(1+1.09*10^{-4}\sigma_{ln})^{(7268+15323\alpha)}}$$

where *IQ* is the interquantile range, and σ_{in} is the variance of log-income.

II. Application

In this section we present the results of the estimation of the pure income polarization index for Argentina, following the methodology explained in DER (2004). We also draw a comparison with an inequality index and with the previous polarization indexes of EGR (1999) and Wolfson (1994). We subsequently perform a microdecomposition with the goal of exploring the possible factors that might explain the evolution of the indicator. Lastly, we calculate the index by region and draw a comparison with regional inequality indicators.

II.1 Methodological aspects

The polarization indices are computed using the October wave of the Encuesta Permanente de Hogares (Permanent Household Survey – EPH) for the years 1998 to 2002. These include 28 urban conglomerates that allow the country to be divided into six regions: Greater Buenos Aires (GBA), Región Pampeana, Cuyo, Noroeste (NOA), Noreste (NEA) and Patagonia[16].

The variable we study is the mean normalized income per equivalent adult using the official equivalent adult scale of the Instituto de Estadísticas and Censos (INDEC). The observations with negative income and those that were more than 20 times the median were eliminated, as were those that the Institute discards[17].

II.2 Results

II. 2.1 Evolution and Causes

Evolution

The following table presents the evolution of the income polarization index in Argentina during the period 1998 to 2002[18], evaluated at different weights for the identification factor.

[16] GBA: City of Buenos Aires and Greater Buenos Aires; PAMPEANA: La Plata, Bahía Blanca, Rosario, Santa Fe, Paraná, Córdoba, Concordia, Santa Rosa, Mar del Plata and Río Cuarto; CUYO: Mendoza, San Juan and San Luis; NOA: Catamarca, Salta, La Rioja, Tucumán, Santiago del Estero and Jujuy; NEA: Corrientes, Formosa, Resistencia and Posadas; and PATAGONIA: Comodoro, Rivadavia, Neuquén, Río Gallegos, Tierra del Fuego and Alto Valle del Río Negro.

[17] Zero income observations are eliminated because we observe substantial variation in the proportion of individuals with zero income in different years. These changes presumably come from better recording of low income individuals.

[18] We used the bandwidth formula for normal distributions, following the recommendations of Duclos, Esteban and Ray (2004), because the skewness of the income distribution in each year is close to 3.5. However, the conclusions are not sensitive to a more robust choice of bandwidth.

Table 1: Polarization and Inequality – Countrywide

	Polarization α					OBS
	0	0.25	0.5	0.75	1	
1998	0.4851	0.3477	0.2792	0.2395	0.2135	92754
1999	0.4817	0.3450	0.2767	0.2368	0.2104	85343
2000	0.4940	0.3532	0.2826	0.2414	0.2144	77343
2001	0.5139	0.3650	0.2917	0.2495	0.2220	76945
2002	0.5181	0.3701	0.2978	0.2572	0.2315	77001

Source: Authors' elaboration based on EPH-INDEC data.

We observe that the index increased throughout the period, regardless of the choice of alpha. Furthermore, the evolution was similar to that of the inequality index – recall that if α=0 the polarization index equals the Gini coefficient.

The validity of the increase in polarization can be tested by using bootstrapping or resampling methods. This technique allows us to build 95% confidence intervals, thereby enabling us to test for the existence of a significant change. We find there is a significant change whenever these intervals do not overlap.

We performed the analysis on the polarization indexes with parameters 0.5 and 0.75, given that values nearby 0.25 and 1 may conflict with some of the axioms[19].

Table 2: Confidence intervals for polarization indexes (100 bootstrap samples)

	α = 0.5			α = 0.75		
	Observed	Lowest	Highest	Observed	Lowest	Highest
1998	0.2792	0.2773	0.2803	0.2395	0.2367	0.2410
1999	0.2767	0.2743	0.2776	0.2368	0.2341	0.2385
2000	0.2826	0.2806	0.2843	0.2414	0.2384	0.2434
2001	0.2917	0.2900	0.2933	0.2495	0.2471	0.2520
2002	0.2978	0.2947	0.2999	0.2572	0.2540	0.2607

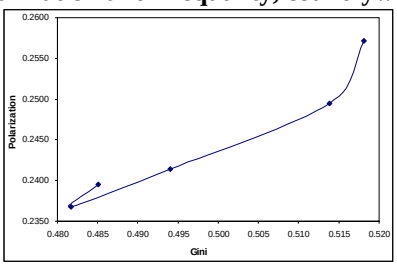
Source: Authors' elaboration based on EPH-INDEC data.

[19] Duclos, Esteban and Ray (2004) pp. 1744 and 1758.

From table 2 we can tell that for $\alpha = 0.5$ the yearly increases are significant from 1999 to 2002. Furthermore, for $\alpha = 0.75$ these increases were significant from 2000 onward. Thus, when comparing the endpoints of the period under study, Argentina not only witnessed an increase in inequality, but also turned out to have a more polarized income distribution in 2002 than in 1998[20]. In other words, "social tension" increased during this unstable period.

As was stated in the theoretical section, inequality and polarization may show opposite behavior. In figure 1 we show how the indexes changed in different proportions, almost in opposite directions.

Figure 3: Polarization and Inequality, countrywide – α =0.75



Source: Authors' elaboration based on EPH-INDEC data.

If we compare the new index with the discrete measures of polarization we find that the results for Argentina had the same upward trend than the pure polarization index. However, these results should be interpreted cautiously, bearing in mind the limitations described above.

Table 3: Bipolarization – Argentina
Income per Equivalent Adult

	DER		EGR	Wolfson
	$\alpha = 0.5$	$\alpha = 0.75$		
1998	0.279	0.239	0.154	0.441
2000	0.283	0.241	0.158	0.459
2002	0.298	0.257	0.167	0.483

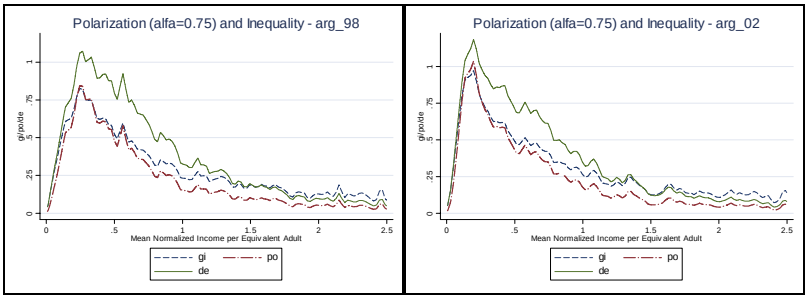
Source: Gasparini, L., "Argentina's distributional failure" (IADB, September 18, 2003)

[20] Using a 95% confidence interval, the Gini coefficient increased significantly between 1998 and 2002.

Possible causes for polarization

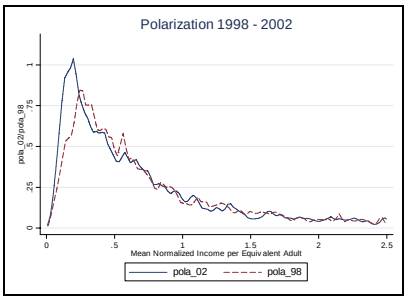
To further interpret the change in polarization it is helpful to show how each income level adds to the total value of the index. The following figures display three curves: income density (de), the polarization curve (po) and the alienation curve (gi). The integral of the polarization curve is the value of the polarization index, while the integral of the alienation curve is the Gini coefficient. In addition, the difference between these two integrals is the identification factor. By construction, the integral of the density function equals 1.

Figure 4: Polarization, Inequality and Density – Countrywide (Income per equivalent adult 1998-2002)



Source: Authors' elaboration based on EPH-INDEC data.

Figure 5: Polarization Index 1998-2002 (α =0.75)



Source: Authors' elaboration based on EPH-INDEC data.

From the previous figures we can observe that all curves become more leptokurtic and asymmetric. This means that low-income individuals provide a larger share of both polarization and inequality. This increase can be seen clearly by superimposing the polarization curves for 1998 and 2002 (Figure 5).

The increase in polarization at the lowest income levels was thus brought about by more intense alienation of the groups with highest identification. Ceteris paribus, there will be higher polarization the higher the correlation between identification and alienation.

This change in polarization reflects an increase in potential conflict, or tension, especially among income groups with 0 to 0.5 of the normalized income per equivalent adult. These added 0.12 and 0.15 index points in 1998 and 2002, respectively. This represents an increase in overall participation from 54% to 59% of total polarization in each year[21].

To further inquire as to the source of these changes we performed a micro-decomposition of the labor income per equivalent adult. This technique is based upon the computation of different distributions, the actual distribution for year t, and that resulting from simulating the labor income of each individual in year t by fixing some argument of their income-determination function at the level of another year, t'. The arguments considered include observable and unobservable characteristics of the individuals, and the parameters that link observable characteristics with wages[22].

The decomposition of the change in the DER polarization index was performed for the years 1998 and 2002 for values of the alpha parameter 0.5 and 0.75, changing education levels of the population, and parametric estimates of returns to education, gender gap, returns to experience, region effects, and unobservable factors. The methodology was based on Gasparini, Marchionni, and Sosa Escudero (2005)[23].

Given that the micro-simulation technique is path-dependent, we alternatively used 1998 and 2002 as base years and computed the average changes. Since these are not sensitive to the choice of alpha, we will conduct the analysis considering alpha = 0.75.

[21] To trace the evolution throughout the period, refer to the appendix.
[22] Gasparini, L, Marchionni, M and Sosa Escudero, W (2001)
[23] We thank Martín Cicowiez for the received wisdom regarding computation of micro-simulations.

Table 3: Decomposition of the change in the polarization index of equivalent labor income

Coefficients 2002

	α = 0.5		α = 0.75	
Indicator	Level	Change	Level	Change
1998 Observed	26.16		21.50	
2002 Observed	28.31	2.15	23.62	2.12
Effects				
Characteristics	26.13	-0.03	21.46	-0.04
Returns to education	26.21	0.06	21.56	0.06
Gender Gap	26.16	0.01	21.51	0.01
Returns to Experience	26.23	0.07	21.57	0.07
Region	26.26	0.10	21.65	0.15
Unobservables	28.09	1.93	23.37	1.87

Coefficients 1998

	α = 0.5		α = 0.75	
Indicator	Level	Change	Level	Change
1998 Observed	26.16	2.15	21.50	2.12
2002 Observed	28.31		23.62	
Effects				
Characteristics	28.19	0.12	23.48	0.14
Returns to Education	28.16	0.15	23.49	0.13
Gender Gap	28.29	0.01	23.61	0.01
Returns to Experience	28.13	0.18	23.45	0.17
Region	28.10	0.21	23.36	0.25
Unobservables	26.82	1.49	22.22	1.40

Average Change

	α=0.5	α=0.75
Indicator	Change	Change
1998-2002 Observed	2.15	2.12
Effects		
Characteristics	0.05	0.05
Returns to Education	0.10	0.10
Gender Gap	0.01	0.01
Returns to Experience	0.13	0.12
Region	0.15	0.20
Unobservables	1.71	1.64

Source: Authors' elaboration based on EPH-INDEC data.

Results show that on average all the effects led to an increase in polarization between 1998 and 2002[24]. Unobservable factors account for 77% of the change in the index, followed by region (9%), returns to experience (6%) and to education (5%). The lowest explanatory power comes from individual characteristics (2%) and gender (0.4%)[25].

II.2.2 Regional polarization and a comparison to inequality

In the previous section we verified that among the observable effects in the labor market that captured by regional factors was the most important. This motivates the analysis of the indicator by region. The analysis in this section is intended mainly as an illustration, as the analysis of statistical significance remains to be done.

When analyzing polarization within regions in the period 1998 to 2002, we observe an upward trend, just as in the country as a whole, in all regions except NEA. If we compare this with the regional inequality index, the rankings differ within the same year, depending on the value of alpha under consideration. For instance, in 1998 the rankings derived from inequality and polarization (with an alpha of 0.5) are identical, while there are differences if alpha is 0.75. When considering the changes in ranking for both years, GBA becomes the most unequal and polarized region of the country. Alienation in this region was most intense where identification was highest.

Another interesting case is NOA, which witnessed an increase in alienation, while the identification effect dampened this impact almost completely, achieving an almost constant polarization index when alpha equals 0.75.

[24] Only the educational characteristics effect had a sign reversal between both years, with the average effect being positive. For reasons such as this, the average should be interpreted cautiously.

[25] We cannot overemphasize the need for deeper research on the determinants of polarization in Argentina. In particular, for this time period we should give proper attention to issues of macroeconomic instability.

Table 5: Polarization and Inequality by region

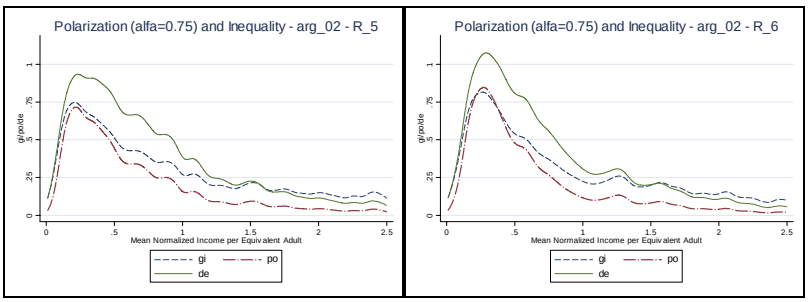
	1998					
	$\alpha = 0$		$\alpha = 0.5$		$\alpha = 0.75$	
	Index	Rank	Index	Rank	Index	Rank
NEA	0.500	1	0.287	1	0.250	1
GBA	0.489	2	0.279	2	0.239	3
NOA	0.483	3	0.279	3	0.242	2
Patagonia	0.460	4	0.265	4	0.226	5
Cuyo	0.445	5	0.263	5	0.226	4
Pampeana	0.441	6	0.257	6	0.218	6

	2002					
	$\alpha = 0$		$\alpha = 0.5$		$\alpha = 0.75$	
	Index	Rank	Index	Rank	Index	Rank
GBA	0.532	1	0.299	1	0.256	1
NOA	0.497	2	0.284	3	0.245	3
NEA	0.495	3	0.286	2	0.246	2
Patagonia	0.482	4	0.276	5	0.235	5
Cuyo	0.480	5	0.279	4	0.240	4
Pampeana	0.479	6	0.276	6	0.234	6

Source: Authors' elaboration based on EPH-INDEC data.

As is evident, inequality and polarization rankings differ. Two regions that provide an example of this are NEA and Patagonia. A comparison of all three curves in both regions for the year 2002 allows us to note that the structure of inequality and polarization are quite different. The distribution in the Northeast displays greater polarization at income levels below one half of the mean, when we compare it with Patagonia. In NEA, this income level represents 0.14 index points, which amounts to roughly 58% of the total. Patagonia, on the other hand, has a lower polarization for this same income level (11% lower).

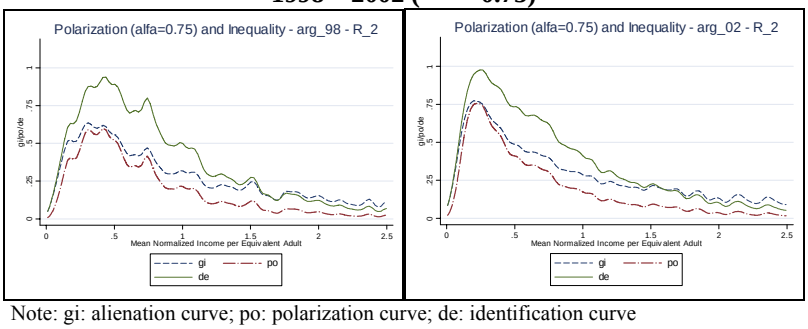
Figure 6: Polarization and Inequality in Patagonia (R5) and NEA (R6) – 2002 (α = 0.75)



Note: gi: alienation curve; po: polarization curve; de: identification curve
Source: Authors' elaboration based on EPH-INDEC data.

A final example is provided by the Pampeana region, which had the highest increase in polarization index with an alpha of 0.75. If we look at the following graphs for 1998 and 2002, we can observe how it goes from a relatively flat, multimodal polarization curve to a structure that is concentrated in the low-income levels and is clearly unimodal, quite similar to what is true for the country as a whole[26]. The share in the polarization index of people with incomes below half the mean went from 44% to 53%.

Figure 5: Polarization and Inequality in Pampeana region (R2) 1998 – 2002 (α = 0.75)



Note: gi: alienation curve; po: polarization curve; de: identification curve
Source: Authors' elaboration based on EPH-INDEC data.

[26] To follow the evolution of inequality and polarization throughout the period in different regions, refer to the appendix.

Conclusions

The analysis of income polarization in Argentina, following the new methodology proposed by Duclos-Esteban-Ray for continuous variables, revealed a significant increase between 1998 and 2002, for various values of the identification parameter.

This increase in "social tension" was fueled by two effects: the first was an increase in homogeneity within the group of low-income individuals; the second was an increase in heterogeneity between this group and the rest.

We explored different causes by means of a micro-decomposition technique, finding that on average all effects we considered increased polarization between 1998 and 2002. Although most of the change came from the distribution of unobservable factors, three elements were found to be of moderate importance: region, returns to education and returns to experience. The gender gap did not have any effects, while educational achievement reinforced the increase on average, but the sign of this effect was found to depend on the choice of the base year.

An exploratory analysis by region showed that the rankings according to polarization and inequality might differ, depending on the choice of alpha. We also found that polarization increased across regions, with the exception of NEA.

On the other hand, this generalized increase went in tandem with an increase in the share of low-income individuals in the index, with an associated increase of the correlation between identification and alienation. This change had different intensity throughout the regions, leading to distinct levels of "tension" within the country.

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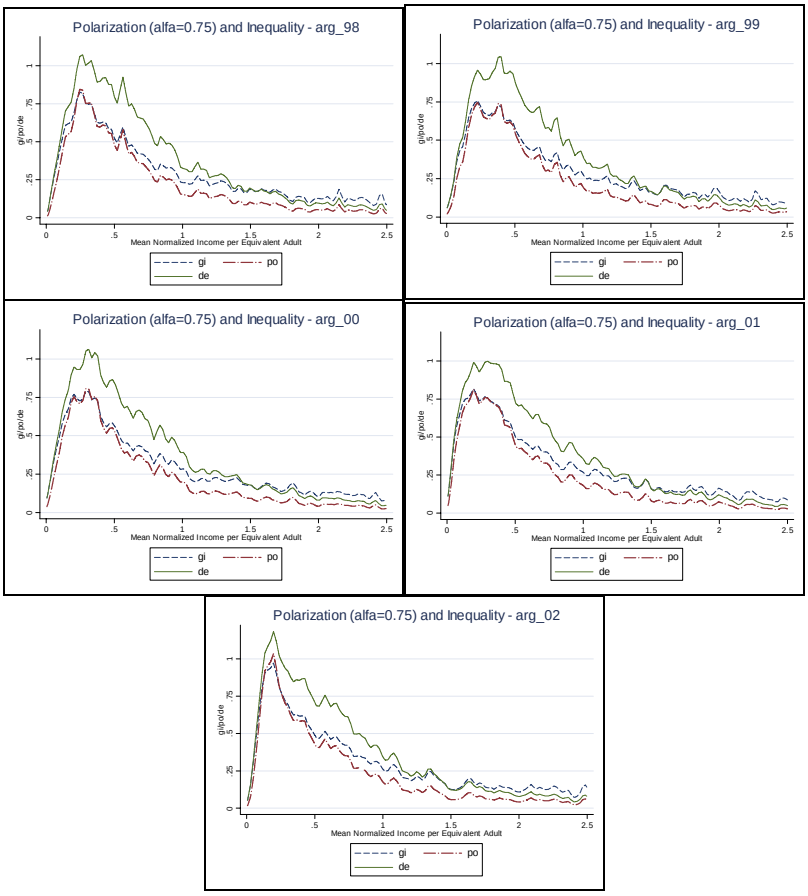
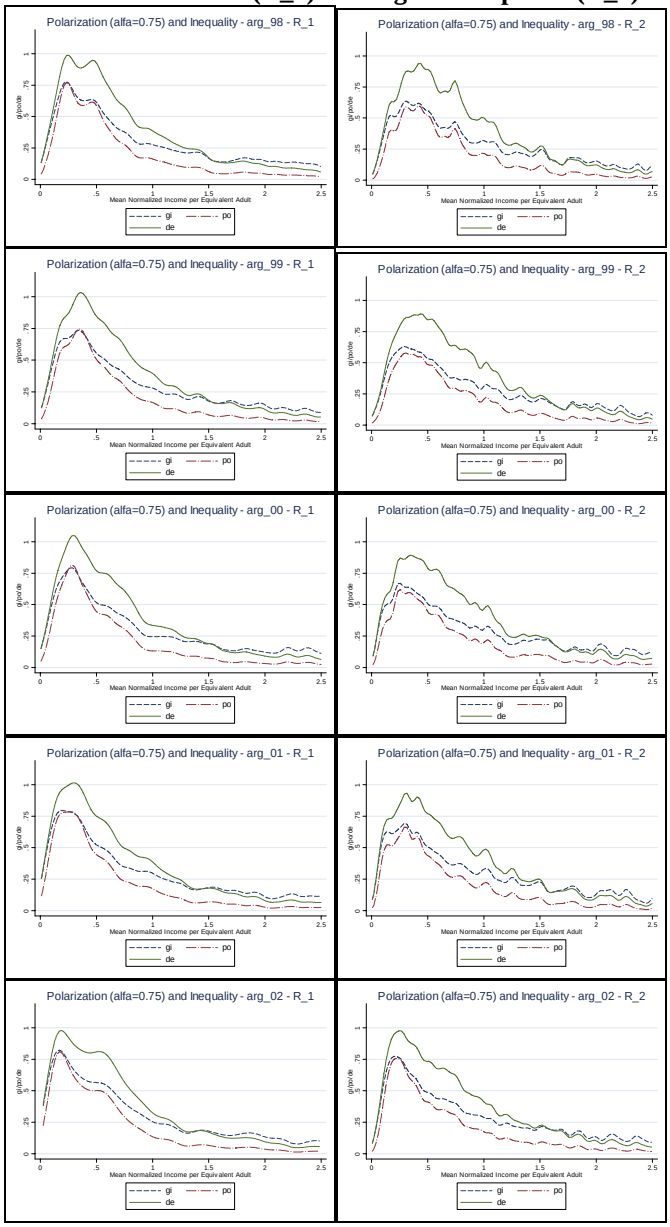
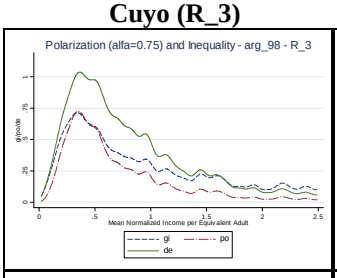
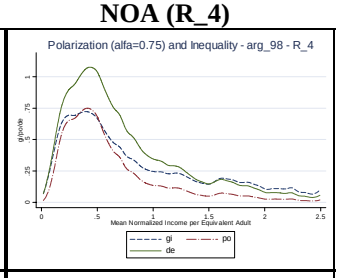
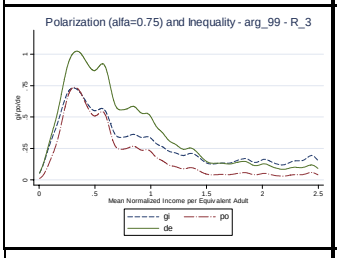
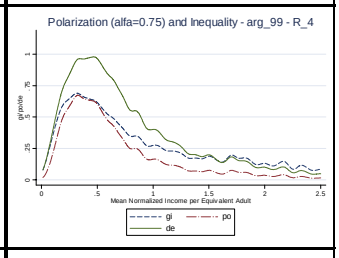
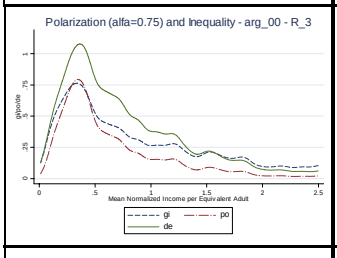
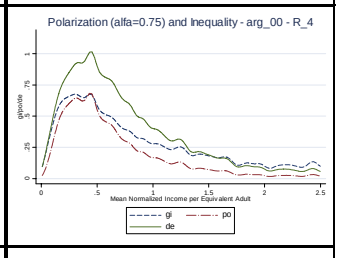
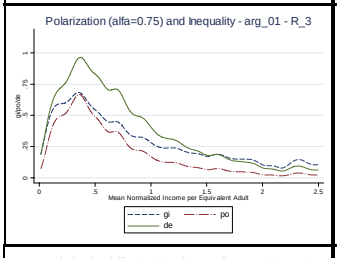
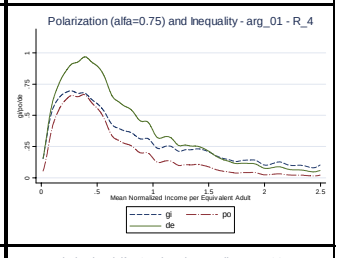
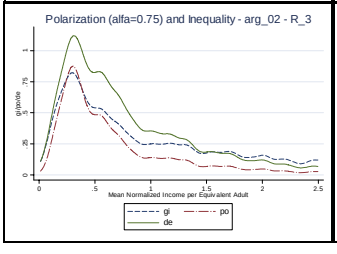
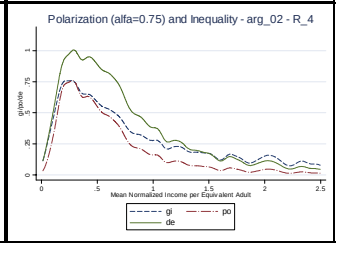
Graphical Appendix

ARGENTINA



Greater Buenos Aires (R_1) **Región Pampeana (R_2)**



Cuyo (R_3)	NOA (R_4)
	
	
	
	
	

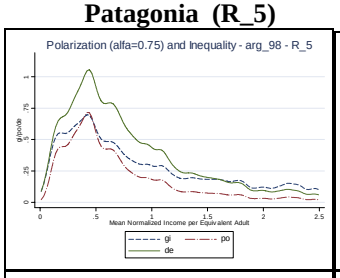
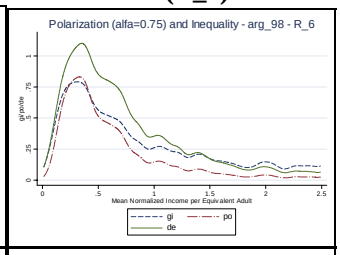
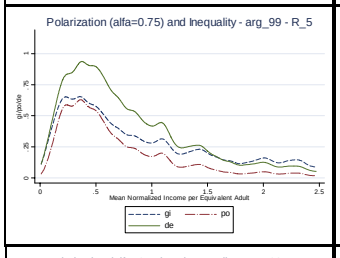
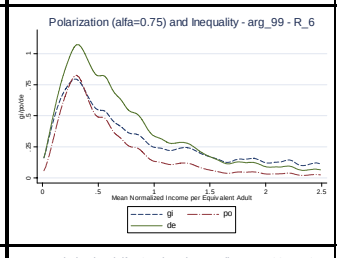
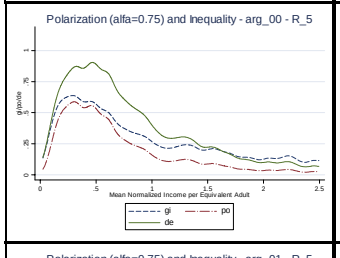
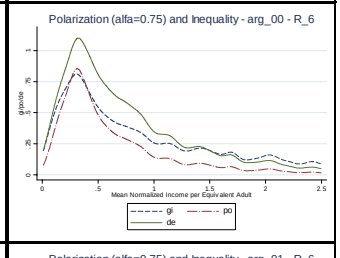
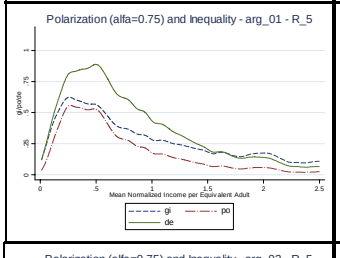
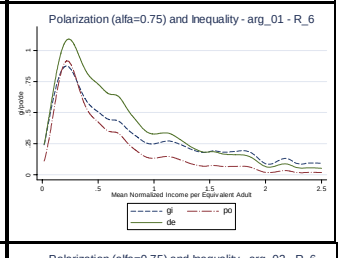
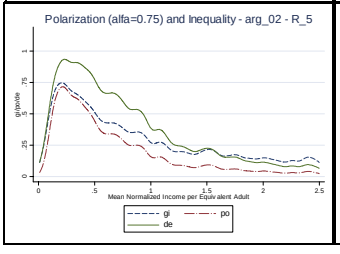
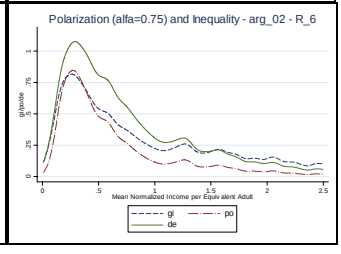
Patagonia (R_5)	**NEA (R_6)**
	
	
	
	
	

Table Appendix

Regional Polarization

	α	Country	GBA	Pampeana	Cuyo	NOA	Patagonia	NEA
1998	0	0.4851	0.4887	0.4411	0.4452	0.4826	0.4599	0.5003
1999	0	0.4817	0.4842	0.4437	0.4540	0.4666	0.4626	0.4982
2000	0	0.4940	0.4961	0.4540	0.4780	0.4788	0.4573	0.5041
2001	0	0.5139	0.5222	0.4701	0.4774	0.4922	0.4495	0.5161
2002	0	0.5181	0.5318	0.4788	0.4803	0.4970	0.4818	0.4950
1998	0.25	0.3477	0.3491	0.3204	0.3243	0.3452	0.3315	0.3549
1999	0.25	0.3450	0.3458	0.3221	0.3305	0.3360	0.3346	0.3541
2000	0.25	0.3532	0.3542	0.3296	0.3434	0.3413	0.3310	0.3559
2001	0.25	0.3650	0.3692	0.3402	0.3427	0.3500	0.3249	0.3672
2002	0.25	0.3701	0.3751	0.3449	0.3463	0.3532	0.3460	0.3547
1998	0.50	0.2792	0.2794	0.2571	0.2625	0.2791	0.2655	0.2869
1999	0.50	0.2767	0.2767	0.2577	0.2667	0.2700	0.2670	0.2839
2000	0.50	0.2826	0.2829	0.2628	0.2755	0.2734	0.2641	0.2849
2001	0.50	0.2917	0.2941	0.2710	0.2723	0.2796	0.2590	0.2937
2002	0.50	0.2978	0.2990	0.2757	0.2791	0.2839	0.2764	0.2857
1998	0.75	0.2395	0.2387	0.2181	0.2259	0.2423	0.2259	0.2496
1999	0.75	0.2368	0.2365	0.2178	0.2286	0.2313	0.2259	0.2438
2000	0.75	0.2414	0.2414	0.2210	0.2357	0.2338	0.2232	0.2446
2001	0.75	0.2495	0.2512	0.2282	0.2297	0.2384	0.2180	0.2516
2002	0.75	0.2572	0.2557	0.2338	0.2402	0.2449	0.2346	0.2462
1998	1	0.2135	0.2117	0.1910	0.2015	0.2190	0.1992	0.2262
1999	1	0.2104	0.2099	0.1902	0.2033	0.2058	0.1981	0.2178
2000	1	0.2144	0.2141	0.1920	0.2094	0.2075	0.1951	0.2186
2001	1	0.2220	0.2233	0.1985	0.2007	0.2110	0.1894	0.2242
2002	1	0.2315	0.2274	0.2053	0.2150	0.2199	0.2062	0.2209

Source: Authors' elaboration based on EPH-INDEC data.

Polarization Index by Region

(base 1998=100)

	α	Country	GBA	Pampeana	Cuyo	NOA	Patagonia	NEA
1998	0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1999	0	99.3	99.1	100.6	102.0	96.7	100.6	99.6
2000	0	101.8	101.5	102.9	107.4	99.2	99.4	100.7
2001	0	105.9	106.9	106.6	107.2	102.0	97.7	103.2
2002	0	106.8	108.8	108.6	107.9	103.0	104.8	98.9
1998	0.25	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1999	0.25	99.2	99.0	100.5	101.9	97.3	100.9	99.8
2000	0.25	101.6	101.5	102.9	105.9	98.9	99.8	100.3
2001	0.25	105.0	105.8	106.2	105.7	101.4	98.0	103.5
2002	0.25	106.4	107.5	107.7	106.8	102.3	104.4	99.9
1998	0.50	80.3	80.0	80.2	81.0	80.9	80.1	80.8
1999	0.50	79.6	79.3	80.4	82.2	78.2	80.5	80.0
2000	0.50	81.3	81.0	82.0	85.0	79.2	79.7	80.3
2001	0.50	83.9	84.2	84.6	84.0	81.0	78.1	82.8
2002	0.50	85.6	85.6	86.0	86.1	82.3	83.4	80.5
1998	0.75	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1999	0.75	98.9	99.1	99.9	101.2	95.5	100.0	97.7
2000	0.75	100.8	101.1	101.4	104.3	96.5	98.8	98.0
2001	0.75	104.2	105.2	104.6	101.7	98.4	96.5	100.8
2002	0.75	107.4	107.1	107.2	106.3	101.1	103.8	98.7
1998	1	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1999	1	98.5	99.1	99.6	100.9	94.0	99.4	96.3
2000	1	100.4	101.1	100.5	103.9	94.7	97.9	96.7
2001	1	104.0	105.5	103.9	99.6	96.3	95.1	99.1
2002	1	108.4	107.4	107.4	106.7	100.4	103.5	97.6

Source: Authors' elaboration based on EPH-INDEC data.

INCOME POLARIZATION IN ARGENTINA: PURE INCOME POLARIZATION, THEORY AND APPLICATIONS

MATÍAS HORENSTEIN AND SERGIO OLIVIERI

SUMMARY

JEL Classification: D31, D63, I32.

This paper applies newly developed methods for the computation of income polarization by Duclos-Esteban-Ray (2004) to the Argentine case between 1998 and 2002. We find that despite the slowdown in the growth of the inequality, the rate of growth of polarization increased every year. Low-income groups in the population were those who contributed the most to polarization. The results of a micro-decomposition show that on average all the effects led to an increase in polarization between 1998 and 2002. Although most of the change came from unobservable factors, region, returns to education and return to experience had a moderate impact. Furthermore, polarization increased within every geographic region. This change had different intensity throughout them leading to distinct levels of "tension" within the country.