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Tracing out the effects of demographic changes on the income distribution

The case of Greater Buenos Aires, 1980–1998

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Abstract During the 1980s and 1990s fertility decisions varied significantly and not uniformly along the income distribution in Argentina. In this paper we study the effects of these demographic changes on income poverty and inequality by applying microeconometric decomposition techniques. In particular, we simulate the equivalized household income distribution that would emerge if individuals observed in a given base year had taken fertility decisions as they did in another different year. The results suggest that these demographic factors have contributed considerably to the changes in poverty and inequality experienced by Argentina since the 1980s.

Key words Argentina · decompositions · demography · fertility · Greater Buenos Aires · income distribution · inequality · microsimulations · poverty

Abbreviations

EPH Permanent Household Survey *(Encuesta Permanente de Hogares)*
GBA Greater Buenos Aires area
GMS Gasparini, Marchionni, and Sosa Escudero (2004)

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1 Introduction

Argentina experienced significant demographic changes during the 1980s and 1990s.[1] Some of these changes were not uniform along the income distribution. In particular, the gap in the number of children between the top and the bottom income strata considerably widened. Between 1980 and 1998, the average number of children under 16 per household increased from 2.6 to 2.9 in the bottom quintile of the equivalized household income distribution, while this average fell from 1.3 to 0.7 for households in the top quintile of that distribution.

The distributive impact of these demographic changes could be sizeable. *Ceteris paribus*, an increase in the number of children in poor households and in those marginally above the poverty line raises income poverty, as measured by various indicators. Moreover, differential changes in family size across income strata, as the ones mentioned above, could increase income inequality.

This paper is aimed at assessing the extent to which changes in fertility contributed to the observed increase in poverty and inequality during the 1980s and 1990s in the Greater Buenos Aires (GBA) area in Argentina. To that aim we apply microeconometric decomposition techniques (or 'microsimulations'). In particular, we simulate the equivalized household income distribution that would emerge if individuals observed in a given base year had taken fertility decisions as they did in another different year.[2]

The main inputs to carry out these microsimulations are the estimates of the parameters that govern fertility decisions and the response of labor market participation to changes in family size. We assume that the number of children in a household follows a Poisson process, and that its parameters can be consistently estimated using a Poisson regression model. Hourly wages and hours of work are assumed to be simultaneously determined in an equilibrium model of the labor market.

After estimating the parameters, we proceed with the simulations. Poverty and inequality indicators are computed over the counterfactual income distribution that arises in a given base year by assuming that the population in that year takes fertility decisions according to the parameters estimated for another different year. The resulting poverty and inequality measures are compared to those actually observed in the base year. The difference between the simulated value of an indicator and its actual value is interpreted as a measure of the direct distributive impact of the change in fertility behavior.

The microeconometric decomposition methodology has an obvious caveat that originates from the fact that it is not derived from a general equilibrium model. When simulating the impact of changes in fertility decisions, we keep all other things constant in their values of the base year. Naturally, some of these things may covariate with fertility. For instance, the structure of wages may respond to changes in the labor supply triggered by a change in fertility. By ignoring this channel we may be biasing our estimate of the distributional impact of the changes in fertility. Additionally, changes in the reproductive behavior may have not been autonomous, but induced for instance by income changes, in

[1] See Marchionni [18], Torrado [25] and the National Census (www.indec.gov.ar) for documentation of these changes.

[2] For simplicity we use the term 'fertility decisions', although for the purpose of this paper it is irrelevant whether or not fertility occurs as a consequence of a free and rational decision of a couple. In fact, the term *fertility* is used in the paper as a shortcut for the number of children in the household, which in most cases changes as the consequence of fertility decisions.

which case the microsimulation only captures a round of effects (from fertility to incomes) of a more complicated process.

Unfortunately, it is very hard to compute a credible general equilibrium model able to trace all these effects, and therefore the microsimulations may be viewed as a second-best methodological option. The results of these techniques provide rigorously derived estimates of the direct distributional impact of a given change, keeping all other things constant. The usefulness of this ‘partial-equilibrium’ procedure depends on our assessment about the relevance of all the general equilibrium interactions.

The literature on microsimulations is not new. Blinder [6] and Oaxaca [21] propose microeconometric decompositions to study differences in the means of two distributions. Later, Almeida dos Reis and Paes de Barros [1] and Juhn et al. [15] extend the methodology to consider differences in the whole distribution, not only the means. Recently, Bourguignon et al. [8] generalize the approach, allowing its application to diverse functional forms, not necessarily linear. Gasparini et al. [13] apply this methodology to characterize inequality changes in Argentina.[3]

The microsimulation literature has been almost exclusively focused on the distributional impact of changes in the labor market and government transfers. Fertility changes, although recognized as potential relevant determinants of changes in the income distribution, have not been carefully modeled, or have directly been included as part of the residual.[4] This paper contributes to the microsimulation literature by estimating a rigorous model of reproductive decisions and carefully tracing the impact of fertility changes on the income distribution. It also contributes to the understanding of distributional changes in Argentina. Poverty and inequality have dramatically increased in this Latin American country in the last three decades. The proposed methodology contributes to the characterization of the role played by fertility changes in these distributional changes.

If we observe that family size increases for the poor and decreases for the rich, it is very likely that inequality measured over the distribution of household current income adjusted for demographics will increase. This paper contributes with at least two things to this intuition. First, it provides estimates of the magnitude of the inequality-increasing impact of the changes in fertility. How much of the actual increase in inequality can be accounted only by the change in the reproductive behavior? The paper deals with this kind of questions. Second, the proposed methodology allows tracing and measuring some not-so-obvious effects. The increase in the number of children in the bottom strata of the distribution may induce some low-income women to leave the labor market or to work fewer hours to raise their children. In that case the increase in inequality might be larger than what is expected by considering only the direct impact of the increase in family size over per capita household income.

The results of the paper suggest that changes in fertility decisions did affect the income distribution. The increase in the number of children in low and middle-income households experienced during the 1980s in the Greater Buenos Aires considerably raised the measured levels of income poverty and inequality. This effect acted both directly, through the increase in the number of family members in the household, and indirectly and with less intensity, through the reduction in the hours of work of spouses as a consequence of the larger

[3] Altimir et al. [2], and Menéndez and González Rozada [19] also apply this methodology to the case of Argentina.

[4] Ferreira and Leite [12] is an exception, since they include in a microsimulation framework fertility decisions through a multinomial choice model. However, the authors’ main interest is the distributive impact of changes in the population educational background.

number of children in the household. During the 1990s household size decreased for most groups, generating a poverty-decreasing effect without significantly altering the level of inequality. Finally, the negative relationship between the spouses's hours of work and the number of children weakened during the period under analysis. This pattern seems to have contributed to a reduction in poverty and inequality.

The rest of the paper is organized as follows. In Section 2 we show basic evidence on income distribution and fertility changes in the Greater Buenos Aires area. In Section 3 we outline the microeconometric decomposition methodology, and the strategies to estimate the parameters of the fertility, wages and hours-of-work equations. The main results of the paper are presented and discussed in Section 4. Section 5 gives some concluding remarks.

2 Preliminary evidence

During the 1980s and 1990s both the income distribution and the demographic structure significantly changed in the Greater Buenos Aires area (GBA), which is home to one third of Argentina's population.[5] In this section we briefly present the distributional and demographic changes that will be analyzed in the rest of the paper.

We measure poverty and inequality over the distribution of equivalized household income defined as

$$y_{it} = \frac{Y_{ht}}{A_{ht}} \quad \forall i \in h \quad \text{at time } t \tag{1}$$

where i indexes individuals, h households and t time periods (years). Y_{ht} denotes total income of household h at time t, and A_{ht} is the family size in adult equivalents.[6,7]

Figures 1 and 2 show poverty and inequality estimates computed over the equivalized household income distribution for the GBA between 1980 and 1998. The microdata come from the Permanent Household Survey (EPH), a survey of about 11,000 individual observations (more than 3,000 households) conducted by the local National Institute of Statistics and Census (INDEC). Poverty and inequality have dramatically increased in the GBA during the 1980s and 1990s.[8] The peaks in both series correspond to the deep macroeconomic crisis of the late 1980s that ended in some hyperinflation episodes during 1989 and 1990. A smaller jump also occurred during the Tequila crisis in 1995/1996. In this paper we work with four years of relative macroeconomic stability, by Argentinian standards, separated by equal time intervals: 1980, 1986, 1992 and 1998 (marked with squares in the Figures). The official moderate poverty headcount ratio rose around 12 points between 1980 and 1992 – a period of stagnation, inflation and a relatively closed and regulated economy, and 8 points between 1992 and 1998 – a period of strong GDP growth, price stability, and market-oriented reforms. Changes in inequality were also sizeable: the

[5] There is also evidence on these demographic changes at the national level in the 1990s, see Marchionni [18]. In this paper we only consider the GBA area since data is not available for the rest of the country in the 1980s.

[6] 'Household' and 'family' are used as synonyms in this paper.

[7] We take the adult equivalent scale used by the Argentina's National Institute of Statistics and Census (INDEC) to compute official poverty. See www.indec.gov.ar.

[8] See also, among others, Altimir et al. [2], Gasparini et al. [13], and Llach and Montoya [17].

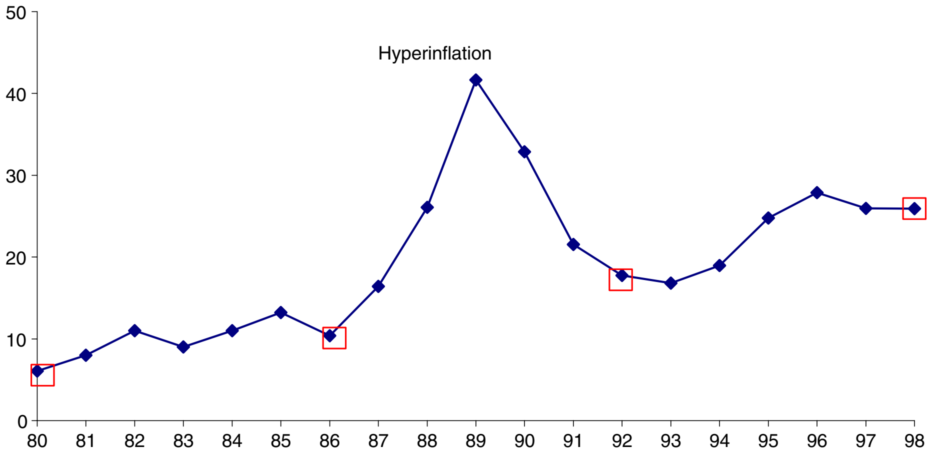


Figure 1 Poverty headcount ratio; official moderate poverty line, Greater Buenos Aires, 1980–1998. Source: Authors' calculations based on the EPH (October round). Years considered in the analysis are marked with *squares*.

Gini coefficient increased 4 points between 1980 and 1992, and climbed another 6 points between 1992 and 1998.[9] Few countries (or areas) in the world have experienced distributional changes of this magnitude in such a short period of time.[10]

The equivalized household income of an individual is affected by fertility decisions. The increase in the number of children raises the denominator in Equation (1), and thus, keeping other things constant, reduces the equivalized income of all household members.[11] Additionally, the number of children affects the labor participation decision of some household members, generally the mother's, modifying their propensity to work or the hours they work in the labor market, and thus affecting the numerator in Equation (1).

Fertility patterns are not homogeneous among income groups. In fact, the so-called *population problem* refers to the larger number of children in poor families. [12] This fact is illustrated in Table I which shows the average number of children under 16 for those households with heads aged 25 to 45, classified by different criteria: the educational level of the head, the head's hourly labor income, parental total income and equivalized household income. The table suggests that the disadvantaged groups (in terms of education, wages and income) tend to have more children. The gap in behavior across different social strata significantly widened during the 1980s (1980–1992), as fertility in the low and middle groups increased while it decreased in the upper groups. In contrast, over the 1990s (1992–1998) the number of children under 16 per household went significantly down for nearly all socioeconomic groups.

The evidence presented so far shows that the GBA experienced significant changes in the income distribution and the fertility decisions. Is there any relationship between both phenomena? Naturally, this is a difficult question to answer both theoretically and

[9] Using bootstrapping techniques Sosa Escudero and Gasparini [24] show that these changes are statistically significant.

[10] See World Bank [27, 28].

[11] Despite the fact that equivalized income falls, it is not clear how an increase in the number of children affects each family member's well-being. Particularly, it is likely that the utility of those taking the fertility decision rises. Though very relevant, this is a point that is beyond the scope of this paper.

[12] See Anand and Morduch [4].

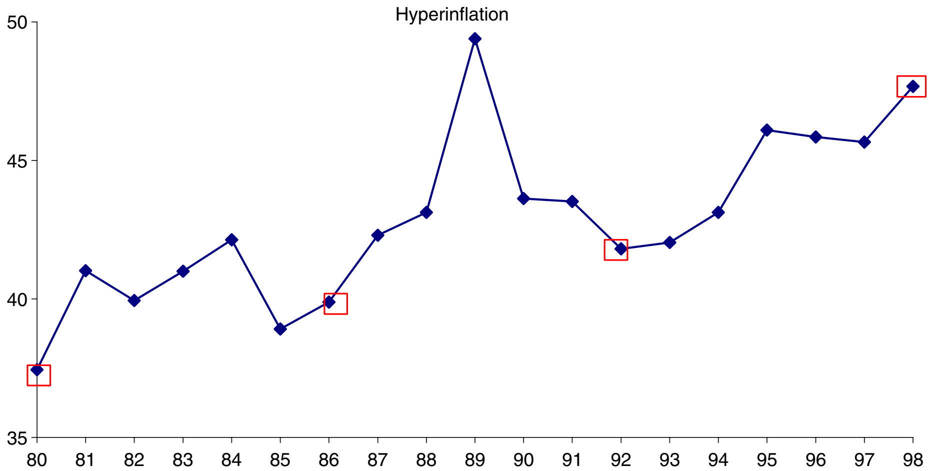


Figure 2 Gini coefficient; equivalized household income distribution, Greater Buenos Aires, 1980–1998. Source: Authors' calculations based on the EPH (October round). Years considered in the analysis are marked with *squares*.

empirically. Only the estimation of a complex general equilibrium model can fully take all the relationships between these two changes into account.

This paper takes a less ambitious route by simply trying to assess the distributive changes if only the reproductive behavior changed in a given time period. In particular, keeping all other things constant, the paper assesses the impact that the change in the parameters governing fertility decisions could have had on the equivalent household income distribution through two different channels: the change in the number of adult equivalents in each household and the change in the labor decisions of the head and his/her spouse.

A new child increases the denominator in Equation (1). However, when the child grows up and enters the labor force, he/she could share his/her income with the rest of the family, thus contributing to the numerator of Equation (1).[13] In fact, the decision of having a child could be affected by the perspective of this future contribution to the household income. Taking these considerations into account would imply the need for studying the impact of the reproductive decisions on the permanent income distribution, instead of the current income distribution. Unfortunately, this type of analysis faces not only analytical and conceptual difficulties, but also data constraints: almost all household surveys, including the EPH, are able to capture only current income. Therefore we concentrate on the analysis of the short run effects of fertility changes on income poverty and inequality.

3 The methodology

In this section we describe the microeconometric decomposition methodology outlined in the previous sections and discuss the estimation strategy. According to Equation (1), individual i's equivalized household income at time t (y_{it}) is defined as the ratio between total household income and the number of members (in adult equivalents). Total household income (Y_{ht}) is the sum of individual labor incomes (Y_{jt}^{L}) and non-labor incomes (Y_{jt}^{NL}) over all household members.

[13] Alternatively he/she can leave the household and transfer money to his/her parents.

Table I Number of children under 16 per household, Greater Buenos Aires, 1980–1998

	1980	1986	1992	1998
By educational level				
Primary incomplete	2.20	2.38	2.84	2.41
Primary complete	1.81	1.87	2.08	1.96
Secondary incomplete	1.45	1.82	1.94	1.78
Secondary complete	1.65	1.68	1.63	1.35
College incomplete	1.46	1.44	1.19	1.02
College complete	1.55	1.44	1.23	0.96
Total	1.74	1.82	1.85	1.60
By quintiles of the head's hourly wage distribution				
1	1.67	1.89	2.07	2.00
2	1.87	1.83	2.10	1.80
3	1.61	1.83	1.82	1.61
4	1.82	1.75	1.77	1.46
5	1.74	1.79	1.47	1.15
Total	1.74	1.82	1.85	1.60
By quintiles of the parental income distribution				
1	1.74	1.93	2.07	2.07
2	1.69	1.81	2.15	1.79
3	1.91	1.94	1.89	1.55
4	1.74	1.74	1.69	1.40
5	1.63	1.65	1.44	1.20
Total	1.74	1.82	1.85	1.60
By quintiles of the equivalized income distribution				
1	2.62	2.79	2.91	2.94
2	2.05	2.12	2.25	1.85
3	1.57	1.68	1.86	1.48
4	1.21	1.41	1.31	1.03
5	1.26	1.08	0.90	0.71
Total	1.74	1.82	1.85	1.60

Source: Authors' calculations based on the EPH.
The sample includes only families with household heads aged 25 to 45 years old.

$$Y_{ht} = \sum_{\forall j \in h} \left(Y^L_{jt} + Y^{NL}_{jt} \right) \tag{2}$$

It is assumed that non-labor incomes are exogenously determined. Individual i's labor income is the product of the hourly wage rate (w_{it}) and the number of hours of work (L_{it}).

$$Y^L_{it} = w_{it} L_{it} \tag{3}$$

We follow Gasparini et al. [13] (henceforth, GMS) in assuming that both wages and hours are determined in a reduced form model of the labor market equilibrium:

$$\ln w^*_{it} = X'_{1it}\beta_t + \varepsilon^W_{it} \tag{4}$$

$$L^*_{it} = X'_{2it}\gamma_t + \lambda_t H_{it} + \varepsilon^L_{it} \tag{5}$$

$$\begin{gathered} \text{with } w_{it} = w^*_{it} \text{ and } L_{it} = L^*_{it} \text{ if } L^*_{it} > 0 \\ w_{it} = 0 \quad \text{and } L_{it} = 0 \text{ if } L^*_{it} \leq 0 \\ \left(\varepsilon^W_{it}, \varepsilon^L_{it}\right) \sim N\left(0, 0, \sigma^2_{Wt}, \sigma^2_{Lt}, \rho_t\right) \end{gathered}$$

where w_{it}^* and L_{it}^* are latent variables, unobservable by the analyst. The column vectors X_{1it} and X_{2it} include all observable factors affecting hourly wages and hours of work, respectively. We assume that the number of children in the household where individual i lives (H_{it}) can affect the hours of work, but not the hourly wage.[14] β_t and γ_t (vectors), and λ_t (scalar) are the parameters to be estimated in the model, along with $\sigma_{Wt}^2, \sigma_{Lt}^2$ and ρ_t.

The specification of Equations (4) and (5) corresponds to the *Tobit Type III* model in Amemiya's [3] classification. It is possible to consistently estimate the parameters of this model by:[15] (1) estimating Equation (4) by Heckman's maximum likelihood method, using a censored version of Equation (5) as a selection equation, where instead of hours of work a binary indicator that captures whether the individual works or not is used, and (2) estimating Equation (5) using a Tobit model.

Regarding the much discussed issue of endogeneity of fertility on, in particular, women's labor force participation, Cruces and Galiani [11] carefully replicate Angrist and Evans' [5] methodology for Argentina, finding no significant evidence of endogeneity of the number of children on their mothers' labor participation decisions. Based on this empirical evidence and taking into account the computational complications involved in the microsimulations, we assume that variable H_{it} is exogenous in Equation (5).

3.1 Fertility decisions

According to economic theory, fertility decisions are the result of a maximization process in which parents evaluate the benefits of having a child against the opportunity costs associated with raising her. The assessment of these benefits and costs depends on characteristics of each spouse and on household characteristics. Fertility decisions can be represented by the following equation:

$$H_{ht} = H(Z_{ht}, e_{ht}; \eta_t) \tag{6}$$

where, as before, H_{ht} is the number of children in household h at time t, Z_{ht} is a column vector of household observable characteristics and e_{ht} includes all unobservable characteristics that influence family reproductive behavior.

For the estimation of this model, it is assumed that the number of children follows a Poisson process with parameter μ_{ht}. Formally,

$$H_{ht} \sim \text{Poisson}(\mu_{ht}) \quad \text{with} \quad \mu_{ht} = E(H_{ht}|Z_{ht}) = \exp(Z'_{ht}\eta_t) \tag{7}$$

Then,

$$\text{Prob}(H_{ht} = H_0) = \frac{\exp(-Z'_{ht}\eta_t)(Z'_{ht}\eta_t)^{H_0}}{H_0!} \quad \text{with} \quad H_0 = 0, 1, 2, ... \tag{8}$$

This is the Poisson regression model, from which it is possible to consistently estimate parameters η_t by the maximum likelihood procedure. It can be shown that consistency holds for the maximum likelihood estimators of η_t as long as the real distribution is any of the linear exponential family (to which the Poisson distribution belongs), provided the

[14] For a discussion of these issues see Killingsworth and Heckman [16], and Blundell and MaCurdy [7].

[15] This estimation strategy is consistent though not fully efficient. GMS argue that (1) this alternative has certain computational advantages over a full information procedure, and that (2) the efficiency loss is not necessarily significant for a given sample size.

conditional mean in Equation (7) is correctly specified.[16] The estimators of η (which for simplicity are also denoted by η) are used to perform the microsimulations.

3.2 Simulating the number of children

The simulated number of children in household h at year t, using the estimated fertility parameters for year t' is given by:

$$H_{ht}(\eta_{t'}) = F^{-1}_{\eta_{t'}|Z_{ht}} \circ F_{\eta_t|Z_{ht}}(H_{ht}) \tag{9}$$

where $F_{\eta_t|Z_{ht}}(\cdot)$ is the function that gives the relative ranking of its argument in year t distribution conditional to the observable characteristics Z_{ht}. In this particular case, $F_{\eta_t|Z_{ht}}(\cdot)$ is the cumulative probability function of a random variable that follows a Poisson distribution with $exp\left(Z'_{ht}\eta_t\right)$ parameter.

The advantage of simulating the number of children through Equation (9) instead of predicting the expected number of children from the estimated model becomes evident when unobservable factors affecting fertility decisions are taken into account. Two households with the same observable characteristics Z_{ht} but a different number of children clearly differ in their unobservable characteristics e_{ht}, although the prediction of the expected number of children for both households would be the same and equal to $exp\left(Z'_{ht}\eta_t\right)$. Since the objective is to simulate changes in the number of children as a consequence of changes only in the parameters η, it is necessary to keep unobservable factors fixed. Therefore, each household is characterized by the quantile it occupies in the distribution of children of year t. Let q_{ht} be the quantile for household h at time t, that is, $F_{\eta_t|Z_{ht}}(H_{ht}) = q_{ht}$. The simulated number of children in household h will be the one that place it in the q_{ht} quantile of the distribution of children with the relevant parameters of time $t'(\eta_{t'})$ conditional to the observable characteristics Z_{ht}.[17]

3.3 The microsimulations

Once the counterfactual number of children $H_{ht}(\eta_{t'})$ is estimated, two microsimulation exercises are carried out by replacing this estimate in the denominator of Equation (1),

[16] A more realistic assumption is that children follow a Negative Binomial distribution (see Rao et al. [22], Hamdan [14], and Wooldridge [26]). However, we use the Poisson model for two main reasons: (1) as mentioned above, estimators are still consistent when the real distribution is Negative Binomial (Poisson quasi-Maximum-Likelihood estimators), and (2) for two-parent households (that represent around 80% of the total households in the sample) it is not possible to reject the null hypothesis that the distribution of children per household is Poisson *versus* a Negative Binomial (model NB2, following Cameron and Trivedi [10]). We also used a sequential decision model where the head (and its spouse) decide whether or not to have children, and then the number of children. The results do not significantly differ from the ones that arise from the Poisson specification.

[17] Despite the fact that the assumptions on the distribution of children in Equation (7) is not crucial for estimation purposes, it is evident here that it is relevant for the simulations. The Negative Binomial distribution (model NB2) is characterized by a greater variance than a Poisson distribution with the same mean (overdispersion). However, as mentioned above, for most households the null hypothesis of equidispersion in the distribution of children cannot be rejected.

through its impact on the number of adult equivalents, and in the numerator of Equation (1), through its impact on the hours of work.

The first exercise implies transforming the simulated number of children into the simulated number of adult equivalents, and replacing this value into the denominator of Equation (1).[18] The change in the income distribution resulting as a consequence of this exercise is labeled as the *direct-size effect*. It is interpreted as the contribution of the change in fertility parameters η to the actual change in the income distribution through the direct channel – i.e., a change in the number of household members (in adult equivalents) among whom total household income should be distributed.

The second exercise involves using the simulated number of children $H_{ht}(\eta'_t)$ to recompute the individual hours of work using Equation (5). With a different number of children in the household some individuals may decide to work more or less hours, and that in turn will alter individual labor incomes, and thus total household income. The change in the income distribution as a consequence of this second exercise is named the *hours-size effect*. It is interpreted as the contribution of the change in fertility parameters η to the actual change in the income distribution through the indirect channel of affecting the hours of work decisions and then the numerator in Equation (1).[19]

We carry out a third exercise by simulating the counterfactual distribution in time t if the parameter λ in Equation (5) took the estimated value in year t'. Parameter λ measures the impact of a change in the number of children on the individual's hours of work. Unlike the previous effects, changes in λ do not reflect purely demographic changes, but changes in the way labor decisions are linked to demographic variables, or the way the labor market reacts to individuals with certain demographic characteristics. The distributional impact of changes in this parameter of the hours of work equation is labeled as the *hours-parameter effect*.[20]

Finally, we compute two aggregate effects: the *total-size effect* allows changes in fertility to affect incomes through both the numerator and the denominator of Equation (1) at the same time, while in the *total effect* we trace the distributional impact of changing parameters η and λ simultaneously.

So far, we have assumed that year t is the base year from which we 'import' the parameters of another year t'. Of course, we could instead have taken t' as the base year and 'imported' year t parameters. As it is well-understood in the microsimulation literature, the decompositions are path-dependent: the results are not exactly the same when taking alternatively year t or year t' as the base year.[21] In the next section we perform both exercises and report the average value for each of the five effects discussed above.

[18] Given the definition of equivalized household income, it is necessary to transform the simulated number of children in adult equivalents. Ideally, this implies considering their age and gender structure. However, because of the difficulties of including these dimensions into the analysis, a simpler adjustment was applied. Specifically, the simulated number of children is proportionally transformed by the ratio between the number of children in adult-equivalent units and the number of children in the household in year t.

[19] Notice that in this exercise we keep the family size in the denominator of the equivalent household income equation constant.

[20] To calculate both the *hours-size* and the *hours-parameter effects* it is necessary to simulate all individuals' hours of work, for which estimations of the λ coefficients and the errors ε^L in Equation (5) are required. The later procedure cannot be applied for individuals that do not work in year t. As in GMS, for this group the ε^W and ε^L are estimated by randomly sampling pairs of errors from the implicit distribution in the models (4)–(5), discarding those errors that are not consistent with the participation decision observed at year t.

[21] Intuitively, this occurs because the same changes in the coefficients are imputed to two different populations, with different distributions of observable and unobservable characteristics.

Table II Estimation of the fertility equation, two-parent households, Poisson regression model, dependent variable: number of children under 16

	1980	1986	1992	1998
Age_mother	0.114 (3.11)**	0.191 (5.39)**	0.146 (3.51)**	0.223 (5.50)**
Age_mother sq.	−0.002 (3.44)**	−0.003 (5.57)**	−0.002 (3.69)**	−0.003 (5.87)**
Age_father	0.256 (3.85)**	0.151 (2.58)**	0.181 (2.59)**	0.102 (1.45)
Age_father sq.	−0.003 (3.66)**	−0.002 (2.44)*	−0.002 (2.53)*	−0.001 (1.20)
PC Mother	−0.080 (1.16)	−0.172 (2.50)*	−0.121 (1.38)	−0.107 (1.00)
SI Mother	−0.317 (3.46)**	−0.230 (2.78)**	−0.261 (2.46)*	−0.073 (0.65)
SC Mother	−0.291 (2.78)**	−0.312 (3.67)**	−0.343 (3.14)**	−0.314 (2.46)*
CI Mother	−0.224 (1.51)	−0.494 (3.33)**	−0.478 (2.96)**	−0.426 (2.70)**
CC Mother	−0.466 (2.56)*	−0.322 (2.54)*	−0.380 (2.72)**	−0.430 (2.85)**
PC Father	−0.132 (1.91)	−0.209 (3.08)**	−0.194 (2.20)*	−0.282 (2.93)**
SI Father	−0.225 (2.50)*	−0.193 (2.57)*	−0.238 (2.34)*	−0.315 (3.04)**
SC Father	−0.091 (0.80)	−0.223 (2.52)*	−0.301 (2.63)**	−0.464 (3.88)**
CI Father	−0.236 (1.75)	−0.288 (2.58)*	−0.480 (3.20)**	−0.565 (3.72)**
CC Father	−0.068 (0.49)	−0.177 (1.49)	−0.382 (2.63)**	−0.481 (3.18)**
Female head	0.031 (0.09)	0.021 (0.08)	−0.146 (0.60)	−0.184 (1.26)
Constant	−5.511 (5.16)**	−4.797 (5.06)**	−4.400 (3.85)**	−4.488 (3.87)**
Observations	834	1,042	698	804

The sample only includes families with household heads aged 25 to 45 years old. Absolute value of *z*-statistics in parenthesis.
PC, *SI*, *SC*, *CI*, and *CC* indicate education level (primary complete, secondary incomplete, secondary complete, college incomplete, and college complete, respectively). The base category is less than primary complete.
*Significant at 5%; **significant at 1%.

4 The results

This section reports the results of carrying out the methodology described in the previous section in order to characterize the relationship between changes in fertility and changes in the income distribution.

The fertility model in Equation (8) is estimated separately for two-parent households (with a head and a spouse) and single-parent households (without a spouse). In both cases, the dependent variable is the number of children under 16 in the household. In order to reflect fertility decisions more closely the sample is limited to those families whose heads are older than 25 and younger than 45 years old. Tables II and III show the results of estimating fertility models for 1980, 1986, 1992 and 1998 in the GBA.

We include as covariates in the two-parent households' equations the mother's and father's age and educational level plus a control for female headed families.[22] In the single-parent households equation the covariates correspond to the head of the family. We add two binary indicators to control for her marital status: divorced and widowed, single being the base category. Fertility is higher in two-parent households than in single-parent households.

The effect of age on fertility is almost always significant and non-linear, implying an inverse U-shaped fertility-age profile. As expected, education has a significant negative

[22] On average only 2% of two-parent households are headed by a woman.

Table III Estimation of the fertility equation, single-parent households, Poisson regression model, dependent variable: number of children under 16

	1980	1986	1992	1998
Age	0.172 (0.73)	0.380 (1.97)*	0.434 (2.01)*	0.609 (4.03)**
Age squared	−0.002 (0.74)	−0.005 (1.97)*	−0.007 (2.21)*	−0.009 (4.24)**
PC	0.086 (0.34)	−0.211 (1.04)	−0.546 (2.44)*	−0.085 (0.44)
SI	0.007 (0.02)	−0.384 (1.73)	−0.758 (2.48)*	−0.388 (1.94)
SC	−0.017 (0.05)	−0.881 (3.21)**	−0.854 (3.38)**	−0.945 (3.58)**
CI	−0.247 (0.52)	−0.719 (2.23)*	−0.959 (2.56)*	−0.989 (3.60)**
CC	−0.459 (0.73)	−1.366 (3.69)**	−1.276 (4.27)**	−1.402 (5.08)**
Divorced	1.128 (4.19)**	1.066 (3.38)**	0.906 (4.26)**	0.981 (6.02)**
Widowed	1.146 (3.76)**	0.890 (5.34)**	1.038 (3.53)**	1.098 (5.34)**
Female head	1.093 (3.40)**	0.686 (3.40)**	1.370 (4.72)**	1.383 (6.91)**
Constant	−4.838 (1.16)	−7.405 (2.14)*	−7.933 (2.05)*	−11.366 (4.25)**
Observations	148	202	171	292

The sample only includes families with household heads aged 25 to 45 years old. Absolute value of *z*-statistics in parenthesis.
PC, *SI*, *SC*, *CI*, and *CC* indicate education level (primary complete, secondary incomplete, secondary complete, college incomplete, and college complete, respectively). The base category is less than primary complete.
*Significant at 5%; **significant at 1%

effect on fertility. Figure 3 illustrates the estimated effect of the father's education on fertility for two-parent households. From 1980 to 1992, the gap in the predicted number of children for the two extreme educational groups – incomplete primary (PI) and complete college (CC) – significantly widened, mainly because of increasing fertility among the less educated, but also as a result of a contraction in fertility for the highly educated group. The fertility gap between educational groups also widened for single-parent households (see Figure 4). After 1992 fertility decreased for all types of households and educational groups, implying a slight narrowing of the fertility gap.

Figure 3 Predicted number of children under 16; the effect of father's education; two-parent households. The number of children under 16 are predicted using the following values for the independent variables: *Age_mother* = 33 (the sample mean), *Age_ father* = 36 (the sample mean), *PC Mother* = 1, *SI Mother* = 0, *SC Mother* = 0, *CI Mother* = 0, *CC Mother* = 0, and *Female head* = 0

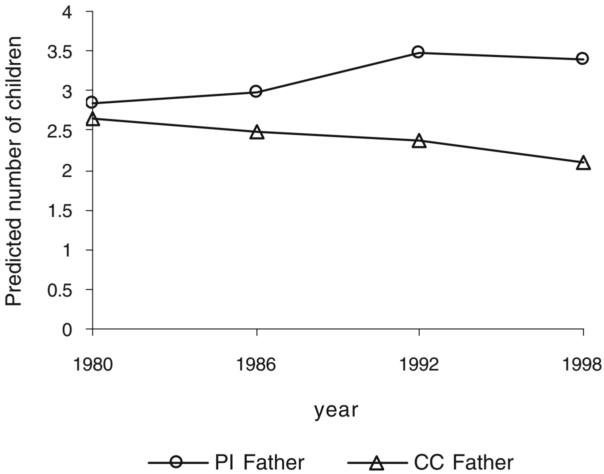
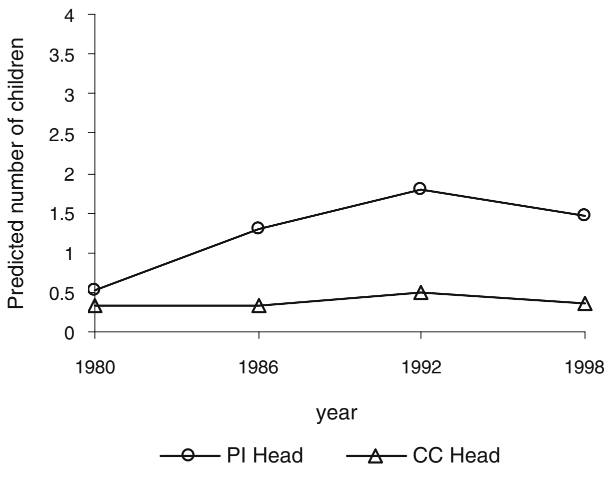


Figure 4 Predicted number of children under 16; the effect of household head's education; single-parent households. The number of children under 16 are predicted using the following values for the independent variables: *Age* = 33 (the sample mean), *Divorced* = 0, *Widowed* = 0, and *Female head* = 1.



Following GMS [13] the hourly wage Equation (4) and the hours of work Equation (5) are separately estimated for heads and spouses. Tables IV and V present the estimations of the hours of work model for heads and spouses, respectively.[23] For simplicity, it is assumed that the spouse's participation decision depends on the head's income while the participation of the head is assumed to be independent from any spouse's variable.[24] Both equations for hours of work include the number of children under 16 as an independent variable. It is assumed that the participation decisions of other household members (apart from the head and the spouse) do not depend on the number of children.

Tables IV and V suggest two interesting facts. First, mothers are the ones to adjust their participation decisions to changes in the number of children. The number of children has a significant effect on the hours of work equation for heads only when the family is headed by a woman, while it is always a significant determinant of the hours of work of the spouses (most of them women). The second phenomenon has to do with the reduction in the intensity of the association between hours worked and the number of children. That relationship has become weaker since mid-1980s for spouses: the elasticity fell (in absolute value) from −0.48 in 1986 to −0.38 in 1992, and −0.26 in 1998.[25, 26]

Once the parameters are estimated, it is possible to implement the methodology described in Section 3. The impact of demographic changes is analyzed on two dimensions of the income distribution: poverty and inequality. In this paper we use the most popular indicators: the headcount ratio for poverty and the Gini coefficient for inequality.[27] The

[23] The estimations of the hourly wage equations are not shown since the results are standard and they are not central to the paper. They are available upon request.

[24] This sequential specification is similar to the one presented in Bourguignon et al. [9].

[25] Notice that, instead, the elasticity slightly increased for female heads (a much smaller group than female spouses).

[26] These figures are of the same order of magnitude than others estimated in the literature. See Schultz [23] and Nakamura and Nakamura [20].

[27] The results are robust for a wide range of measures of poverty and inequality. The calculations are available upon request.

Table IV Estimation of the hours of work equation, household heads, Tobit method

	1980	1986	1992	1998
Age	−0.790 (0.62)	1.558 (1.37)	1.191 (0.81)	1.827 (1.15)
Age squared	0.011 (0.63)	−0.022 (1.35)	−0.020 (0.95)	−0.028 (1.26)
PC	1.220 (0.79)	3.241 (1.98)*	2.865 (1.24)	9.074 (3.05)**
SI	0.091 (0.05)	0.139 (0.08)	5.578 (2.22)*	8.429 (2.75)**
SC	0.306 (0.14)	3.272 (1.69)	2.611 (1.02)	9.210 (2.88)**
CI	−0.924 (0.35)	1.724 (0.73)	4.259 (1.36)	8.515 (2.28)*
CC	−6.072 (2.38)*	−0.731 (0.35)	4.179 (1.49)	11.086 (3.35)**
Male	17.487 (5.36)**	7.499 (3.00)**	7.195 (2.32)*	9.639 (3.48)**
Married	−0.790 (0.33)	−5.713 (4.11)**	1.118 (0.45)	2.750 (1.26)
Children	0.240 (0.51)	0.192 (0.48)	0.479 (0.91)	0.967 (1.65)
(1-male)* children	−1.938 (1.30)	−4.228 (3.11)**	−4.231 (3.53)**	−5.524 (4.72)**
School	−3.745 (0.84)	−9.688 (2.83)**	−12.808 (3.27)**	−11.212 (2.84)**
Constant	47.578 (2.14)*	15.029 (0.75)	20.852 (0.81)	−1.217 (0.04)
Observations	982	1,244	869	1,096

The sample only includes household heads aged 25 to 45 years old. Absolute value of *z*-statistics in parenthesis.
PC, *SI*, *SC*, *CI*, and *CC* indicate education level (primary complete, secondary incomplete, secondary complete, college incomplete, and college complete, respectively). The base category is less than primary complete. *Children* is the number of children under 16. *School* = 1 if the individual is attending school.
*Significant at 5%; **significant at 1%.

official moderate line proposed by INDEC is used in the poverty calculations. All poverty and inequality indicators are computed over the distribution of equivalized household income among individuals.[28]

Table VI shows the results of the microsimulations for the GBA between 1980 and 1998 in terms of the poverty headcount ratio. The table can be interpreted as follows. Between 1980 and 1986 the poverty headcount ratio increased 4.7 points in the sample of households with heads aged 25 to 45 (from an 8.3% in 1980 to a 13% in 1986). The average *direct-size effect* is 1.3.[29] This implies that if only the parameters that govern the fertility decisions had changed between 1980 and 1986, and if the resulting changes in the number of children had modified only the denominator in Equation (1) without affecting total household income, then the poverty headcount ratio would have increased 1.3 points in this period. The poverty-impact of the change in fertility decisions through the labor participation decisions (*hours-size effect*) is also positive, although its value is close to zero.[30] The *hours-parameter effect* is somewhat larger: the change in the parameters regulating the relationship between hours of work and the presence of young children in the household implied an increase in the headcount ratio of 0.5 points. Allowing the three effects to act simultaneously accounts for 40% of the actual change in the headcount ratio during the period 1980–1986.

[28] The results are also robust to different equivalence scales.

[29] The value 1.3 is the average of the direct-size effect taking alternatively 1980 and 1986 as the base year. As explained above, averages are reported because results are not independent of the base year (path dependence).

[30] Ideally, a hypothesis test should be carried out in order to determine the statistical significance of each result. This exercise implies some complications so it is left for future research.

Table V Estimation of the hours of work equation, spouses, Tobit method

	1980	1986	1992	1998
Age	5.625 (2.35)*	3.052 (1.42)	4.906 (2.32)*	0.188 (0.10)
Age squared	−0.071 (2.06)*	−0.034 (1.11)	−0.057 (1.92)	0.004 (0.16)
PC	−11.258 (1.83)	−10.838 (1.92)	1.471 (0.21)	−9.314 (1.22)
SI	−2.770 (0.37)	−15.286 (2.31)*	3.870 (0.50)	1.037 (0.13)
SC	11.483 (1.49)	−2.448 (0.40)	14.573 (1.92)	6.796 (0.86)
CI	36.847 (3.19)**	13.352 (1.44)	19.457 (1.92)	9.416 (0.98)
CC	56.118 (4.92)**	27.132 (3.40)**	36.891 (4.25)**	37.534 (4.40)**
Male	73.822 (3.22)**	49.921 (2.69)**	48.813 (3.94)**	45.247 (6.09)**
Children	−8.772 (4.72)**	−11.189 (7.46)**	−8.452 (5.78)**	−6.319 (4.61)**
School	−22.819 (1.23)	−7.944 (0.57)	6.354 (0.45)	8.022 (0.88)
Income_head	−0.000 (3.82)**	−0.008 (1.92)	−0.015 (4.25)**	−0.004 (1.72)
Constant	−104.657 (2.59)**	−52.614 (1.48)	−88.321 (2.41)*	−12.098 (0.38)
Observations	834	1,042	698	804

The sample only includes spouses living in families with household heads aged 25 to 45 years old. Absolute value of z-statistics in parenthesis.
PC, *SI*, *SC*, *CI*, and *CC* indicate education level (primary complete, secondary incomplete, secondary complete, college incomplete, and college complete, respectively). The base category is less than primary complete. *Children* is the number of children less than 16 years old. *School* = 1 if the individual is attending school.
*Significant at 5%; **significant at 1%.

Between 1980 and 1992 poverty in the sample increased 11.6 points. Demographic factors seem to have played a minor but not negligible role in this process. Table VI shows that the direct impact of changes in fertility parameters (*direct-size effect*) can account for 28% of the increase in the poverty headcount ratio between 1980 and 1986, and 8% between 1986 and 1992. In contrast, the generalized fall in fertility in the 1990s seems to have had a poverty-decreasing direct impact. The *hours-size effect* was positive in the 1980s and negative in the 1990s, although the estimated values are possibly non-significant. Values are generally higher, in absolute value, for the *hours-parameter effect*. This effect slightly reduced poverty over the whole period under analysis. The weakening in the association between hours of work and the number of children has contributed, although mildly, to the reduction in income poverty.

Table VI Changes in the poverty headcount ratio (points), Greater Buenos Aires, 1980–1998

	1980–1986	1986–1992	1980–1992	1992–1998	1980–1998
Real change	4.7	6.9	11.6	12.6	24.3
Effects					
Direct-size	1.3	0.6	2.9	−1.2	2.2
Hours-size	0.1	0.1	0.4	−0.2	0.1
Total-size	1.4	0.7	3.5	−1.2	2.4
Hours-parameter	0.5	−0.6	−0.2	−0.9	−1.0
Total	1.9	0.1	3.4	−2.0	1.7

Source: Own calculations.
The values of each effect are averages that result from taking alternatively each year in the comparison as the base year.

Table VII Changes in Gini coefficient (points), Greater Buenos Aires, 1980–1998

	1980–1986	1986–1992	1980–1992	1992–1998	1980–1998
Real change	2.5	2.3	4.8	5.9	10.7
Effects					
Direct-size	0.7	0.7	1.9	0.0	2.0
Hours-size	−0.1	0.0	0.0	−0.1	−0.2
Total-size	0.6	0.8	1.9	−0.1	1.8
Hours-parameter	0.0	−0.1	0.0	−0.2	−0.3
Total	0.8	0.7	1.9	−0.2	1.7

Source: Own calculations.
The values of each effect are averages that result from taking alternatively each year in the comparison as the base year.

Table VII shows changes in the Gini coefficient after the microsimulations. The *direct-size effect* is positive during the whole period. While between 1980 and 1992 this effect represents around 30% of the observed change in the Gini coefficient, between 1992 and 1998 the relevance of this effect vanishes. The *hours-size* and *hours-parameter effects* in Table VII are very small, particularly in the 1980s.

The results in Tables VI and VII can be explained as follows. During the 1980s the number of children in low and middle-income households increased, while it decreased in high-income families. The direct impact of these changes was, naturally, poverty-increasing and inequality-increasing. The results of the microsimulations suggest that these effects, although not dominant, can account for a significant proportion of the observed growth in poverty and inequality between 1980 and 1992. Additionally, the greater number of children in low and middle-income families pushed some mothers to leave their jobs or reduce hours of work. However, the impact of this effect on poverty and inequality seems to have been small. Overall, changes in fertility patterns account for 30% of the increase in the poverty headcount ratio and almost 40% of the growth in the Gini coefficient between 1980 and 1992. Any assessment of the distributional changes in Argentina in the 1980s should not ignore the relevant role played by demographic factors.

During the 1990s the size of low-income households decreased in the GBA, a fact that contributed to the reduction in the poverty headcount ratio. The contribution was sizeable, although it looks small compared to the dramatic increase in poverty that occurred due to other reasons over that decade. Since the family size reduction was rather generalized across groups, inequality levels were not affected. The reduction in the number of children stimulated some mothers to get a job or to work more hours. However, it seems that the impact of this change on poverty and inequality has not been quantitatively relevant.

The negative relationship between the spouses' hours of work and the number of children has been weakening over time. The microsimulation exercises suggest that this change in behavior has reduced income poverty and inequality in the GBA.

5 Concluding remarks

During the 1980s and 1990s poverty and income inequality dramatically increased in Argentina. At the same time, important demographic transformations occurred. This paper empirically studies the relationship between changes in fertility decisions and the household income distribution.

The study concludes that even though demographic phenomena do not seem to have a central role in explaining the distributional changes in Argentina, they cannot be ignored as sources of changes in income poverty and inequality. The increase in the family size in low and middle-income households considerably contributed to the observed growth in poverty and inequality during the 1980s. The reversion of this demographic trend in the 1990s had a poverty-decreasing effect without affecting inequality. The weakening of the relationship between hours of work and the number of children for spouses, mostly mothers, had a small poverty and inequality-decreasing effect.

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