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Does family size hinder family living standards?

Evidence from a quasi-experiment in Madagascar

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Does family size hinder family living standards? Evidence from a quasi-experiment in Madagascar

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Abstract

In this paper we try to identify the causal impact of fertility on household welfare in Madagascar using gender of the two first-born children as a source of exogenous variation. The issue of the link between fertility and economic well-being has been widely treated in the literature but we improve on existing studies through some methodological innovations. First of all, instead of using instrumental linear regressions, we rely on instrumental quantile regressions techniques, which have two main advantages over the IV linear regressions: the first is that they are less sensitive to extreme values and outliers. The second added value is that quantile regressions allow the exploration of the heterogeneity of the potential effect of fertility on different parts of the living standards distribution and not only at the mean or at the poverty-line cutoff as is generally done in the literature. Lastly and more importantly, given the richness of our data, we are able to disentangle the living standard indicator in different expenditures items: food expenditures, durable goods expenditures, human capital, etc., and test whether households facing exogenous fertility increase reduce their living standards more in some dimensions than in the others. The results show that an exogenous increase in fertility reduces total consumption per capita, and that this result is statistically significant. But its magnitude is less than that of a regression without controlling for endogeneity. When the total consumption per capita is broken down into different items (food, human capital, housing and durable goods), analyses show that all consumption items are affected by the impact of the fertility burden, and that this detrimental effect occurs at any quantile of living standard distribution. These results should be understood in the context of Madagascar, characterized by an endemic high level of poverty that affects nearly three quarters of the population.

Keywords: Fertility, Poverty, Household behaviour, social capillarity

JEL Codes: I11, I31, D81, D82, O15

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1. Introduction

Sub-Saharan Africa is the only region in the world where the demographic transition is blocked in the second phase characterized by a significant decline in mortality but with continuing very high fertility. As a result, there has been sustained population growth at a pace never before seen in history. This demographic dynamic poses enormous challenges in terms of the ever-increasing resources to be mobilized to feed, educate, care for and create decent jobs for youth. Even if its demographic parameters are not the worst of the continent, Madagascar is no exception to the sub-Saharan Africa demographic dynamic since the total fertility rate is 5 children per woman and the population growth rate is 2.7% per year, resulting in a population doubling in 26 years. So, precisely assessing the influence of this high fertility on socioeconomic outcomes is of first importance. In this study, our objective is to measure the impact of fertility on household living conditions in Madagascar. In the literature, the nature of the relation between the two phenomena is controversial (Blanchet 2001). While some studies have concluded that there is a negative relationship between fertility level and living standard, others have found no clear evidence (cf. the literature review in the following section). Nonetheless, it is important to acknowledge that clearly identifying the causal impact of fertility on living conditions is a challenging issue because of endogeneity due to reverse causality or non-observable heterogeneity. However, even studies which correctly handle this problem still lead to disputed results. A common weakness to almost all the studies encountered in the literature is that authors generally consider only one indicator of living standard, generally the level of total consumption per capital or household poverty status. A second shortcoming of empirical studies on the subject is that most authors only focus on the mean effect of fertility on living standard while there could be heterogeneity depending on the household position on the wealth distribution.

In this paper, we try to identify the causal impact of fertility on household welfare in Madagascar but in the meantime we improve on the different above-mentioned limits. First of all, instead of using instrumental (using gender of the two first-born children as a source of exogenous variation) linear regressions, we rely on instrumental quantile regression techniques (Kowalski, 2016; Chernozhukov, Fernandez-Val and Kowalski, 2015) which have two main advantages over the IV linear regressions: the first is that they are less sensitive to extreme values and outliers. Given that consumption is a skewed distribution, using methods that are robust to extreme values is of prime interest. The second added value is that quantile regressions allow exploration of the heterogeneity of the potential effect of fertility on different parts of the living standards distribution and not only at the mean or at the poverty line cutoff as is generally done in the literature. Lastly and more importantly, given the richness of our data, we are able to decompose the living standard indicator into different expenditures items: food expenditures, durable goods expenditures and human capital and test whether households facing exogenous fertility increase reduce their living standards more sharply in some dimensions than in others. Intuitively, in the case of increase in fertility, we should expect households to reduce the consumption of goods with low marginal utilities, in order to minimize the decrease in their total utility. Being able to decompose the effect of fertility on different consumption items also enables us to understand the relative importance of these items in the consumption function.

The data we use come from a recent and unique survey conducted by the National Institute of Statistics in 2012/2013 in Madagascar. This survey combines both modules on consumption and living conditions on the one hand, and on fertility and women's reproductive behavior on the other. Thus we can extensively analyze the interaction between households' economic and demographic behaviors, which is not the case of many surveys in sub-Saharan Africa.

Estimations controlling for endogeneity lead to the results that an exogenous increase in fertility reduces total consumption per capita, and that this result is statistically significant. However, its magnitude is less than that of a regression without controlling for endogeneity. When total consumption per capita is broken down into different items (foods, human capital, housing and durable goods), analyses show that all consumption items are similarly affected by the effect of the fertility burden. Another important result is that the detrimental effects of fertility are of comparable magnitudes across different quantiles of welfare indicators.

The remainder of this study is organized as follows: in section 2 we explore the literature on the link between fertility and economic well-being. The third section deals with the context, data and methodology, the fourth presents the findings, and the last concludes.

2. Literature review

The demographic focus on analyzing the links between fertility and socioeconomic status dates back to the late 18th century when Malthus (1798) first laid down the principles of a positive link between demographic growth and poverty. At microeconomic level, this link is said to be due to the fact that a large number of children are likely to induce impoverishment by diluting the families' economic resources and assets. Such is the theory of social capillarity defined by Arsène Dumont (1990) in the last century as, "*Just as a column of liquid has to be thin in order to rise under the force of capillarity, so a family must be small in order to rise in the social scale.*" Contrary to this theory, which sees high fertility rates merely as a source of impoverishment, pro-natalist theories have argued that the pressure exerted by strong demographic growth on resources actually stimulates technological progress and that a high birth rate is actually a source of productivity and wealth (Boserup, 1970). Blanchet (2001) contends that both Malthusian and pro-natalist theories exaggerate the strength of the linkages between demographic growth and economic growth. He shows that it is an eminently complex relationship, which can generate positive, negative or zero correlations depending on underlying intermediate factors.

Many empirical studies have tried to determine the nature and importance of the links between procreative behaviour and poverty (Schoumaker, 1998; Cosio-Zavala, 1995; Gwatkin, Rutstein et al., 2000; Eastwood & Lipton, 2001; Talnan & Vimard, 2008). Although these studies generally conclude that fertility is lower among the wealthy social classes and higher among poor people (for example, see Eastwood & Lipton, 2001), Cosio-Zavala (2002) shows in Latin America that fertility can, in certain circumstances (especially where there is a suitable and accessible supply of family planning), also fall among the poor strata of the population. Yet in most cases, these studies are confined to establishing an association between poverty and fertility without really

seeking to empirically demonstrate a causal link in one direction or another. Even if Dumont's premise, together with most non-causal studies, gives the immediate impression that a high level of fertility will automatically have a negative impact on the living standard or socioeconomic status of households, there could actually be other reasons for the observed negative correlation: reverse causality (i.e., economic conditions impact on the fertility level) and heterogeneity due to unobservable factors. We need methods that can overcome the problems of endogeneity if we are to be able to identify the specific impact of fertility on living conditions.

As Sinding (2009) so rightly pointed out, microeconomic studies on whether family size has an impact on poverty are still sparse in developing countries. The few robust studies on the subject tend to support the assertion that fertility has a negative impact on living standards. Canning and Schoefield (2007), for example, used Indonesian panel data to show that each additional child significantly raises the risks of poverty and prevents already-poor households from moving out of poverty. Also in Indonesia, Kim et al (2009), using panel data and matching methods, came to the conclusion that additional child births indeed dilute household welfare but the magnitude of the dilution depends on how the economy of scale and the adult equivalent parameters are taken into account. Shareen and Schultz (2007), based on data from a pilot family planning program in Bangladesh, found a sharp drop in birth rates in the programme villages along with a positive effect on welfare indicators for participating households compared with control group households. Another noteworthy study is Arpino and Aassve's (2013). Using on the Vietnamese household panel data, these authors analyze the impact of fertility on household well-being using different instruments. Their main result is that fertility has a negative impact on household living conditions but the magnitude of the effect depends on the identification strategy. Hence, the effect of using as an instrument the availability of contraceptive methods is more important than the one driven by the "same sex" instrument. The authors justify the difference by the fact that compliers with the first instrument are different from those with the second, each instrument generating a specific local average treatment effect. Gupta & Dubey (2006), also use same sex instrumentation strategy, but came out with a disappearance of the effect of fertility on household economic poverty status once endogeneity was controlled for. Excepting the latter, all studies in Asia aimed at measuring the impact of the fertility burden on household living standards lead to the results that there is a negative effect. What about Africa?

In sub-Saharan Africa, we are aware of only two studies that provide a measure of the impact of fertility on poverty controlling for endogeneity (Mussa, 2014 and Desta, 2014). These studies both resort to the sex composition of siblings to control for endogenous fertility[2]. In the first study, on Malawi, Mussa (2014) finds that an exogenous increase in fertility significantly raises the incidence of objective poverty in the country and that this result is robust to different sorts of specifications (shifting the poverty line and treating the household's living standard as a continuous variable). In the second study, on Ethiopia, Desta (2014) also find that an exogenous shift in fertility decreases household expenditures and hence may push households into poverty, especially in Ethiopian rural areas.

[2] The author shows that, in Malawian and Kenyan societies, families which have two girls first are more likely to have more children than those who have two boys first.

Finally, this literature review shows that the link between fertility and economic well-being tends to be negative, once endogeneity is controlled for. It also brings to light the scarcity of studies on the subject in Africa, which is a paradox since the continent is facing high fertility levels. A caveat of previous studies is that even when the issue of endogeneity is correctly tackled, they are still limited methodologically due to the lack of rich data and the use of less innovative econometric methods. In the next section, we present, among other things, how innovative our approach is.

3. Context, data and methods

In this section, we start by presenting the socio-economic and demographic contexts of Madagascar, characterized by high population growth and by massive and structural poverty. In the second sub-section we describe the original survey and data used in this study and in the last one, we present our innovative econometric methods.

3.1 Context

Madagascar[3] is a country of about 21 million inhabitants, where about one fifth live in urban areas. Its population is very young: around 50% are under 15 years old and those older than 60 comprise less than 5%. This age structure results from a high fertility level (total fertility rate of 5 children per women). Mortality is still high (62 per thousand for children under five years old) but has dramatically decreased over the last decade (it was 94 per thousand in 2003). The high fertility rate is due to early marriage (the average age at marriage for women is 19), early childbearing (one third of 15- to 19-year-olds are already mothers) and low contraceptive use (only 27% of sexually active women are using a modern contraceptive method).

Table 1: Some socio-economics characteristics of Madagascar

Demography	
Total population	21 million
Share of <15 years	50%
Older than 60 years	5%
Total fertility rate	5 children per women
Under 5 years mortality	62 per 1000
Age at first marriage	19 years
Teenage mothers (under 20 years old)	33%
contraceptive use	27%

[3] Figures from this section come from INSTAT, PNLP, IPM, et ICF International (2013). INSTAT (INSTAT, 2013a, b, c, d, e, f)

Socio-Economic	
Evolution of GDP/C since independence	-33%
National poverty rate (monetary) between 2010 to 2013	>70%
Poverty rate (monetary) at $2 PPA threshold between 2010 and 2013	>90%
HDI/rank	0.510 (154/180)
share of employment in agriculture	78%
share non agricultural informal sector	75%

Source: INSTAT (2013a, b,c,d,d,f)

Concerning economic indicators, Madagascar is an underdeveloped country and one of the poorest in the world. Since independence, its national gross product per capita has steadily decreased, losing one third of its value in the fifty years after 1960 (Razafindrakoto, Roubaud and Wachsberger, 2015). These authors attribute this regression to a lack of sustainable political stability, since any economic recovery has always been hampered by a political crisis. On the other hand, demographic growth rate has been consistently high (more than 2.5%) for decades. The last constitutional order was restored in 2014 through resolving the political crisis that has rocked Madagascar since 2009. But the political situation is still characterized by a certain degree of turbulence that is undermining national development efforts (IMF, 2015). The poor macroeconomic and political performances reflect on living conditions: monetary poverty has always been very high in Madagascar with levels above 70% since the beginning of years 2000 (INSTAT, 2013b). The situation is even worse if we consider the $2 threshold, with more than 90% of the population classified as poor during that period. The Human development index is 0.510, which ranks Madagascar in 154th place over 180 countries (UNDP, 2015). As regards the labor market and working conditions, two thirds of Malagasy working population are involved in agriculture, and the large majority (75%) of those not in agriculture are in the informal sector (INSTAT 2013g).

3.2 Presentation of the survey

The data used in this study come from a Malagasy National Survey conducted in 2012/2013 aimed at monitoring the MDGs. Given the large scope of the MDGs, the survey covered a wide range of topics: poverty, employment, education, fertility, etc. The sample size totaled 16.900 households and was representative of each of the 22 regions of Madagascar and of rural and urban areas. Given its scope, this database is unique for Madagascar because it is the first time that both household economic and demographic detailed characteristics have been collected within a single survey.

In each sampled household, the fertility module was addressed to all women in the reproductive age group (aged 15-49 years). About 17000 women were concerned. The fertility module traces the fertility history of all the women surveyed. For each birth, the year and month of birth, gender and the survival status of the child are recorded. In addition to these basic characteristics,

detailed information is recorded on children born within a five-year interval before the survey: care received during pregnancy and delivery, newborn feeding, immunization, etc. Information is also collected on the availability and use of contraceptive methods.

The poverty module was also very detailed and covered the whole spectrum of consumption: durable goods, housing and everyday expenditures. It is important to stress that assessing the financial value of durable goods is not an easy task. Hence, they were not included as such in consumption aggregate, but were processed to consider only their annual usage values. This is a common practice when dealing with the measurement of living standards. Regarding housing expenditures, they are mainly composed of the rent paid by the tenant and the imputed rent for homeowners. Imputed rents are obtained following a two-stage procedure: in the first stage, rents paid by tenants are regressed on the housing characteristics. In the second stage, regression coefficients from tenants are then used to predict the amount of rent that homeowners would pay if they were tenants, or alternatively, the amount of money they would receive if they were to rent their house. With respect to everyday expenditures, they were collected on the basis of a medium reference month, in order to control for intra-annual variations. To avoid omissions, a list of about 135 products was provided and each household had to indicate the amount of money it usually spends on each. More precisely, for a given product, the standard question was "*how much do you spend on [Product]..... per month on average?*". In order to derive prices, a similar question was asked on average monthly amounts.

It is important to underline that 63% of Malagasy households are farmers and essentially consume food they produce. To properly measure farmers' living conditions, a comprehensive module on agriculture was included in the survey. As for the common expenditures sub-module, the list of all agricultural products, livestock, fish, etc. was drawn up and for each product, every household had to answer a set of questions aimed at assessing agricultural production and its allocation in different usages: self-consumption, sales, seeds and gifts. The quantities of each product self-consumed were valorized using local market prices. Finally, households' total consumption is a comprehensive addition of all goods and services consumed, whether they have been bought on the market, self-produced or received as gifts by the households.

In this study, we consider not only the total consumption of households, but also main consumption items. In any case, in order to obtain an indicator of household living standard, total consumption or consumption items are divided by household size.

Even though about 17000 women were interviewed, not all of them can be included in our sample of analysis for the following reason: our identification strategy relies on the fact that in Madagascar, parents are sensitive to the gender composition of their offspring. So we should consider women with more than one child in order to have the heterogeneity in gender composition. As a result, the identification strategy constrains us to work with women who have at least 2 children. We will later expand on this. We also exclude women who are neither heads of household nor spouses because we want to include corresponding household's resources and the household's fertility. But in the robustness check, we relax this constraint. Finally, our analysis sample includes 6653 women.

3.3 Econometric models

In this study, our main econometric method is a quantile regression. As we argued in the introduction, this method allows for the probing of the heterogeneity of the effects of the independent variable (here, fertility) along the entire distribution profile of the dependent variable (here, the living standard), and not just at a central point (the mean) as is the case in the classical regression method. But even if the effect of the fertility were constant across the living standard distribution, resorting to the quantile regression would remain preferable since it is less sensitive to extreme values than mean-based regression. We begin with a general presentation of the method. In a second step, we deal with the issue of endogenous fertility. In both cases we provide general principles. Readers interested in a thorough presentation of this method can refer to Kowalski (2016); Chernozhukov, Fernandez-Val, and Kowalski (2015) Givord and D'Haultfoeuille (2013) and Koenker and Hallock, (2001), among others.

3.3.1 Modelling the effect of fertility on living standard through quantile regression

Let L be a measure of living standard, X the explanatory variables including fertility, and q_α, the α^{th} quantile ($0<\alpha<1$). The objective of the quantile regressions of X on L at q_α quantile is to estimate the following regression:

$L=X'\beta_\alpha + \varepsilon_\alpha$ (EQ1),

In the absence of endogeneity, X is as usual independent of the error term:

$q_\alpha(\varepsilon_\alpha|X)=0$. (EQ2)

Generally, one considers different levels of α (10%, 20%, 50%, 90%, etc.) and simultaneously estimates the corresponding set of coefficients β_α. The coefficients are estimated through solving the following program (*cf.* Koenker, and Hallock, 2001):

$\hat{\beta}_\alpha = argmin_\beta \sum_{i=1}^{n} \rho_\alpha(L_i - X_i'\beta)$ (EQ3)

where ϱ_α (.) is a check function defined as follows: $\varrho_\alpha(u)=u(\alpha-I(u< \alpha))$. EQ3 can be solved using linear programming methods.

3.3.2 Dealing with the endogeneity issue in the framework of quantile regression

In the presence of endogeneity, the condition stated by (EQ2) is no longer true, so we need to resort to instrumental variables, which in this study are the gender composition of the two first-born children. Let F be the total number of children and "Gender _R" the gender composition of the two first-born children and X_1 the remaining explanatory variables, supposed to be exogenous: we rewrite EQ3 as following:

$L=X_1'\beta_\alpha +\gamma_\alpha F +\varepsilon_\alpha$ (EQ4),

With $q_\alpha(\varepsilon_\alpha|X_1)=0$; $q_\alpha(\varepsilon_\alpha|F)\neq 0$ and $q_\alpha(\varepsilon_\alpha|$ Gender_R$)=0$ (EQ5)

According to Givord and D'Haultfoeuille (2012), EQ4 and EQ5 lead to the following equation:

$q_\alpha(L - \gamma_\alpha F|(\text{Gender\_R}, X_1)) = X_1'\beta_{1\alpha}$ (EQ6)

based on EQ6, Chernozhukov, Fernandez-Val, and Kowalski (2015) proposed an estimation method that yields robust estimators of γ_α and $\beta_{1\alpha}$. This method is implemented thanks to the STATA module cqiv developed by these authors.

4. Results

4.1 Descriptive analysis of the link between fertility and living conditions

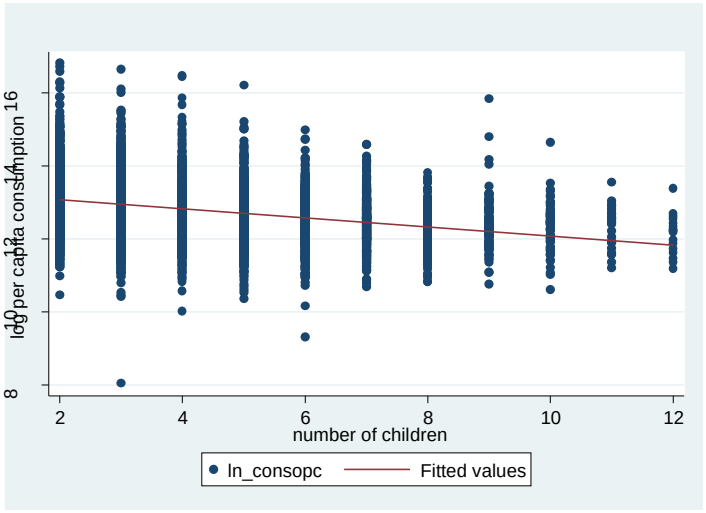

Figure 1. Scatter plot of household the log per capita consumption and fertility measured with the number of children ever born.

In Madagascar, there is clearly a negative relationship between cumulative parity at the time of the surveys and the household's per capita consumption (Figure 1). At this descriptive level of the analysis, the correlation looks weak (linear correlation coefficient of approximately -0.32), but it is statistically significant. For information, the slope of the regression line is -0.11, which suggests an underlying downward trend in per capita consumption with the increase in the number of children ever born and vice versa. Similarly, the 20% of women living in households with the highest per capita consumption have, on average, fewer children than those living in the less well-off households (3.2 as opposed to 5.3).

Table 2 Average number of children per consumption quintile

Consumption quintile	Average number of children	Number
1st quintile	5.3	1330
2nd quintile	4.6	1329
3rd quintile	4.1	1329
4th quintile	3.7	1332
5th quintile	3.2	1333

Yet to what extent can these differences be interpreted as a causal impact of fertility on living standard? To answer this question, we need first of all to assess the relevance of the instrument.

4.2 Instrument relevance

This section starts by describing the instrument distribution. Then we empirically test its correlation with the endogenous fertility.

4.2.1 Distribution of the gender of the two first-born children

The variable "gender of the two first-born children" includes four categories as follows: GB BG, BB GG, where B stands for boy and G for girl. GB is girl at first birth and boy at second, BG is the reverse, BB boys at first and second births, GG, girls at first and second births. Table 3 gives the distribution of this instrumental variable in our analysis sample. Globally, GB and GG have the same weights (between 24.3% and 24.6%), followed by BG (25.1%) while BB counts a little bit more (26.0%). This configuration is in line with the fact that the probability of giving birth to a boy is slightly greater than a girl's.

Table 3 Gender of the two first-born children of women of reproductive age in Madagascar

	Number	%
Boy first; Girl second (BG)	1668	25.1
Girl first; Boy second (GB)	1618	24.3
Boy first; Boy second (BB)	1730	26.0
Girl first; Girl second (GG)	1637	24.6
Total	6653	100.0

As we have already argued, the gender of the two first-born children is potentially an appropriate instrument if it is out of couples' control. For example in a context with selective abortion (generally of female foetus), the gender of the two first children cannot be used as instrument since it can be the outcome of the woman's choice and thus endogenous. Generally, selective abortion is practised in countries where medical services are of rather high quality, with ultrasound or X-ray machines permitting detection of the child's gender before their birth. But in the case of Madagascar, medical services are very poor and such practices, if they exist, would be very rare. So the gender of the first two children can be considered as exogenous as it is not an outcome of women's choice. In the case the household cares about the gender composition of her offspring, the gender of the first two children can force it to revise its optimal fertility level.

4.2.2 Correlation between fertility and the instrumental variable

Even if the gender of the two first-born children can be considered as randomly assigned in Madagascar, it should also be sufficiently correlated to the total fertility to be used as an instrument. This condition can be empirically tested by regressing the total fertility on the gender composition of the two first-born children. Given that GB and BG are theoretically similar, we used these two categories as reference categories. In the regression, we also include the following control variables: the woman's age, her level of education, religion and childhood place of residence. We also added the partner's education and socio-professional position and finally the household's current place of residence. All these variables are presumably exogenous determinants of both fertility and household living standard. Table 4 shows that, compared to mix gender, having same gender at the first two births increases the total fertility, especially when they are GG. In this case fertility increases by 0.17 and this effect is statistically significant at 1%. When the first two children are BB, the increase is only 0.05 and not statistically significant. So these results mean that in Madagascar, families prefer having at least one boy and if it is not the case after at least two births, they tend to increase their fertility to achieve that goal. Given that the BB coefficient is not statistically significant, we will exclude this category from the upcoming estimations because not significant instrument leads to imprecise estimates in the second stage. Doing so, our reference group will be at least one boy after two births.

Table 4. Regression of the number of children of women with at least two children on gender composition of the two first-born children and on other control variables.

	(1)
VARIABLES	Number of children
Gender of the two first-born	
Both boys (BB)	0.0577
	(0.0515)
Both girls (GG)	0.160***
	(0.0524)
Woman if not head of household	0.675***
	(0.0613)
Woman's age	0.267***
	(0.0211)
Woman's age square	-0.00168***
	(0.000312)
Woman's education level: primary	-0.142**
	(0.0601)
Woman's education level: lower secondary	-0.686***
	(0.0810)
Woman's education level: upper secondary/high education	-1.363***
	(0.112)
Household head's education level: primary	-0.228***
	(0.0574)

Household head's education level: lower secondary	-0.543***
	(0.0765)
Household head's education level: upper secondary/high education	-0.669***
	(0.100)
Household head's professional status: white collar	-0.297***
	(0.0955)
Household head's professional status: blue collar	-0.299***
	(0.0886)
Household head's professional status: Self employed	-0.246***
	(0.0743)
Childhood place of residence: large city	-0.0732
	(0.108)
Childhood place of residence: medium city	-0.253***
	(0.0801)
Childhood place of residence: rural	0.139***
	(0.0475)
Catholic	-0.121
	(0.0918)
Protestant	-0.124
	(0.0914)
Animist	0.138
	(0.0991)
Current place of residence: capital	-0.519***
	(0.0868)
Current place of residence: medium city	-0.123*
	(0.0673)
Constant	-2.604***
	(0.362)
Observations	6,653
R-squared	0.373

4.3 The net influence of fertility on living standard

Once the different methodological problems have been identified and/or solved, we can then turn to the substantive analysis of the impact of fertility on household living standard. This section opens with a discussion on the overall impact of fertility on total consumption per capita. Secondly, it conducts separate estimations for each consumption item (durable goods and housing, food consumption, human capital expenditures) and then examines the variation of these effects across different quantiles of the consumption item distributions. In a final sub-section, we test the robustness of our estimates to changes in sample selection and compare our results to alternative estimation methods: the exogenous fertility hypothesis and the classical instrumental variable regressions.

4.3.1 Overall impact of fertility on the household assets indicator

In keeping with Malthus and Arsène Dumont, the assumption underlying this study is that a high fertility level, because of the pressure it exerts on resources and investment, should reduce the household's living standard. The descriptive analyses show the existence of a negative link between the number of children and the consumption level. What happens in a multivariate framework when endogeneity is controlled for?

The IV quantile regression estimations confirm that fertility negatively affects the household living standard (Table 5). After endogeneity is controlled for, each additional child reduces the household per capita consumption by 3.4% and this reduction is statistically significant at the 5% threshold. This result, found in Madagascar, is in line with those observed in African countries: Malawi (Mussa 2014) and Kenya (Desta, 2014); and in some Asian countries: Indonesia (Schoefield 2007); Bangladesh (Shareen and Schultz 2007) and Vietnam (Arpino and Aassve 2013). It also adds to the existing studies on the detrimental effects of fertility on other socioeconomic outcomes: women's labor market integration (Agüero and Marks, 2011; Kuépié, 2016; etc.); children's education (Cáceres-Delpiano, 2012; Kuépié et al, 2014; etc.).

Table 5 Quantile (at Q50) instrumental variable regression of the log per capita consumption on the number of children and other control variables in Madagascar

	Coefficient([a])	95% Confidence interval([a])	
ln_consopc		Lower bound	Upper bound
number of children	**-0.0342**	**-0.0695**	**-0.0196**
Woman if not head of household	0.0165	-0.0258	0.0754
Woman's age	-0.0167	-0.0358	0.0006
Woman's age square	0.0003	0.0000	0.0006
Woman's education level: primary	0.1154	0.0786	0.1511
Woman's education level: lower secondary	0.2594	0.2098	0.3048
Woman's education level: upper secondary/high education	0.5432	0.4012	0.6151
Household head's education level: primary	0.1362	0.1044	0.1882
Household head's education level: lower secondary	0.2707	0.2313	0.3248
Household head's education level: upper secondary/high education	0.4856	0.4212	0.5734
Household head's professional status: white collar	0.3012	0.1876	0.3429
Household head's professional status: blue collar	0.1105	0.0583	0.1685
Household head's professional status: Self employed	0.2573	0.1461	0.2929
Childhood place of residence: large city	0.1046	-0.0015	0.1799
Childhood place of residence: medium city	0.0197	-0.0444	0.0676
Childhood place of residence: rural	0.0170	-0.0144	0.0374
Catholic	-0.0391	-0.1182	0.0113
Protestant	-0.0740	-0.1730	-0.0231

Animist	-0.1946	-0.2834	-0.1488
Current place of residence: capital	0.0355	-0.0759	0.1028
Current place of residence: medium city	0.1098	0.0310	0.1590
_cons	12.8341	12.5135	13.1232
E_hat	-0.1303	-0.1664	-0.0851

([a]) The stata command (cqiv) command, instead providing, in addition to coefficients standard errors and p-value, displays the lower and upper bounds of the 95% confidence interval. The interpretation is straightforward: if the bounds are of opposite signs, the coefficient is not statistically significant (the 95% level). If they are of the same sign, the coefficient is significant.

It is important to go beyond the overall impact and examine the effect of fertility on different consumption items: food, durables goods and housing, human capital expenditures (health and education). Estimations (Table 6) show that all three items are negatively impacted by fertility, with a magnitude of about 4%. But only two of the three coefficients are statistically significant at the 5% threshold. But since all the confidence intervals overlap, we can deduce that the fertility burden affects all the items by the same magnitude. We were expecting that households would not equally reduce their expenditure across consumption items. Indeed, we can consider that fertility increase leads to a reduction of the household (per capita) budget. According to the basic utility theory, households should adjust each consumption item according to its marginal utility, those with high marginal utility being reduced less than those with low marginal utility. To understand the counter-intuitive result found here, it is important to recall that in Madagascar poverty affects about three fourth of households and these estimations from Table 6 are at the median. So these estimations reflect the behavior of a part of population living below the poverty line. In the following section, we examine the effect of fertility on other quantiles of the consumption items.

Table 6 Quantile (at Q50) instrumental variable regressions of the log per capita expenditures or consumption of durable goods/housing, food, and human capital (education and health expenditures) on the number of children and other control variables in Madagascar

	durable goods/housing			food			human capital		
Variables	Coef	Lower	upper	coef	lower	upper	coef	lower	upper
number of children	**-0.039**	**-0.073**	**-0.022**	**-0.041**	**-0.060**	**-0.018**	**-0.044**	**-0.087**	**0.073**
Woman is not head of household	-0.217	-0.264	-0.178	0.036	-0.007	0.073	0.201	0.051	0.331
Woman's age	-0.047	-0.060	-0.023	-0.016	-0.028	-0.004	0.371	0.295	0.446
Woman's age square	0.001	0.000	0.001	0.000	0.000	0.001	-0.005	-0.006	-0.004
Woman's education level: primary	0.088	0.059	0.123	0.108	0.076	0.153	0.557	0.453	0.666
Woman's education level: lower secondary	0.265	0.231	0.320	0.197	0.153	0.244	0.943	0.872	1.107
Woman's education level: upper secondary/high education	0.487	0.431	0.542	0.355	0.258	0.445	1.220	1.041	1.491
Household head's education level: primary	0.102	0.058	0.125	0.142	0.095	0.210	0.491	0.300	0.682
Household head's education level: lower secondary	0.209	0.154	0.234	0.218	0.155	0.291	0.760	0.592	0.905
Household head's education level: upper secondary/high education	0.345	0.286	0.414	0.378	0.312	0.444	1.067	0.889	1.211
Household head's professional status: white collar	0.291	0.251	0.370	0.068	0.031	0.141	0.618	0.526	0.812
Household head's professional status: blue collar	0.196	0.178	0.273	-0.024	-0.128	0.042	0.237	0.105	0.440
Household head's professional status: Self employed	0.222	0.189	0.288	0.133	0.055	0.178	0.550	0.452	0.734
Childhood place of residence: large city	0.136	0.044	0.192	0.075	-0.009	0.150	0.045	-0.147	0.199
Childhood place of residence: medium city	0.133	0.086	0.157	0.005	-0.027	0.048	0.196	-0.026	0.326
Childhood place of residence: rural	0.006	-0.019	0.036	0.033	0.009	0.059	-0.021	-0.177	0.114
Catholic	-0.038	-0.082	0.008	0.006	-0.067	0.066	-0.116	-0.215	-0.011
Protestant	-0.044	-0.086	-0.009	-0.058	-0.148	0.005	-0.187	-0.284	-0.080
Animist	-0.212	-0.251	-0.171	-0.166	-0.269	-0.096	-0.532	-0.719	-0.399
Current place of residence: capital	0.438	0.351	0.462	-0.108	-0.192	-0.041	0.300	0.110	0.440
Current place of residence: medium city	0.300	0.219	0.353	0.015	-0.046	0.046	0.293	0.183	0.383
_cons	11.608	11.312	11.774	12.492	12.214	12.801	1.148	-0.146	2.237
Ehat	-0.187	-0.211	-0.118	-0.099	-0.141	-0.061	-0.016	-0.252	0.082

4.3.2 Effect of fertility on other quantiles of consumption items

As we argued in the methodological section, one advantage of using quantile regressions is that we can assess the influence of fertility on different parts of the welfare distribution and not only at the central point (mean for linear regression, median for quantile regression) as with linear regressions. So in this sub-section we explore the variation of the effect of fertility at q(25), q(50), q(75) and q(90), where q(x) is the x^{th} percentile. Table 7 shows that as total consumption is concerned, the influence of fertility does not statistically differ from one quantile to another, the coefficient fluctuating between -3.2 and -3.4%. So the estimations are remarkably stable across the total per capita consumption distribution. This result is surprising since we were expecting a more severe detrimental effect of fertility on well-being in the poorer households than in the wealthier ones, because they actually have no savings and hence have no choice other than being forced to reduce their living conditions in case of an increase in family size. The fact that this explanation does not hold in this setting could be due to the fact that about three quarters of the population are living below the absolute poverty line in Madagascar and even more (90%) if we consider the $2 threshold. A second explanation can be the buffering effect already highlighted in the case of the influence of fertility on education by Eloundou-Enyegue (2006). This buffering effect may act as follows: poor households are already living in very difficult conditions, around the incompressible living standards level. At such low levels, living standards are less elastic to its main determinants. So in case of exogenous increase in fertility and given this low elasticity, they activate strategies like child labour (Kuépié, 2005) and resorting to remittance and family solidarity (Eloundou-Enyegue, 2006). Of course these survival strategies are not able to free concerned households from poverty, but just help them keep their heads above water.

Whatever item is considered, the a priori hypothesis that fertility burden should be more detrimental on households at the bottom of the welfare distribution is not supported by estimations (Table 7). Instead, as durable goods are concerned, an increase in fertility clearly reduces households' welfare more at the top of the distribution than at the bottom. For other items, estimations do not provide a clear cutoff between quantiles since differences are either small or not significant.

Table 7 Quantile (at q25, q50, q75 and q90) instrumental variable regressions of the log per capita expenditure or consumption of durable goods/housing, food, and human capital (education and health expenditures) on the number of children and other control variables in Madagascar

	q(25)	q(50)	q(75)	q(90)
Total consumption per capita				
Coefficient	-0.0333	-0.0342	-0.0320	-0.0337
Lower	-0.0754	-0.0695	-0.0631	-0.0685
Upper	-0.0080	-0.0196	-0.0038	-0.0077

Durable goods/housing expenditure per capita				
Coefficient	-0.0400	-0.0392	-0.0418	-0.0799
Lower	-0.0781	-0.0733	-0.0750	-0.1079
Upper	-0.0164	-0.0225	-0.0177	-0.0682
Food expenditure per capita				
Coefficient	-0.0264	-0.0414	-0.0366	-0.0437
Lower	-0.0704	-0.0604	-0.0624	-0.0654
Upper	0.0011	-0.0185	-0.0213	-0.0084
Human capital expenditures (education and health) per capita				
Coefficient	-0.0841	-0.0436	-0.0315	-0.0633
Lower	-0.2169	-0.0872	-0.0918	-0.1416
Upper	0.1292	0.0735	0.0065	0.0472

Our main hypotheses were twofold: the first was that an exogenous increase in fertility should hamper living standard. The second that this effect should be heterogeneous both along the distribution of the well-being indicator and between its different components. Even if only the first hypothesis is validated by the data, our study remains innovative since it is the first one to explore the heterogeneity of the fertility impact on living standard in a high fertility and poverty context. Before moving to the conclusion, it is important to conduct robustness check analyses.

4.3.3 Robustness test to alternative specification

In this sub-section, we conduct a certain number of robustness checks. First of all, we test how important it is to have tackled the issue of endogeneity. Secondly, we compare IV quantile regressions to IV linear regressions. And lastly, we examine the issue of sample restriction.

a) Median and OLS regressions without controlling for endogeneity.

Table 8 provides median and OLS regression of the log per capita consumption on the number of children and other control variables. The results of the two models are remarkably similar: the coefficient of the number of children is -0.0976 and -0.0956 respectively for the median regression and for the OLS regression. These coefficients are more than twice higher in magnitude than the results from IV quantile regression. If we consider that the main source of endogeneity in the relationship between living standard and fertility is reverse causality, the gap between the two estimations may suggest that the link between living standard and fertility is also driven by the influence of the former on the latter. Saying this, we should also bear in mind that our IV-quantile coefficients are local average treatment effects (LATE) and as such, they strictly reflect the behavior of households whose family size has been modified due to the sex composition of the two first-born children.

Table 8. Quantile (at Q50) and OLS regressions of the log per capita consumption on the number of children and other control variables in Madagascar, without controlling for endogeneity

VARIABLES	Quantile (Q50)	OLS
Number of children ever born	-0.0976***	-0.0956***
	(0.00451)	(0.00419)
Woman if not head of household	0.0704***	0.0585***
	(0.0227)	(0.0211)
Woman's age	-0.000810	-0.00325
	(0.00783)	(0.00728)
Woman's age square	0.000227**	0.000263**
	(0.000115)	(0.000107)
Woman's education level: primary	0.119***	0.128***
	(0.0221)	(0.0205)
Woman's education level: lower secondary	0.244***	0.254***
	(0.0299)	(0.0278)
Woman's education level: upper secondary/high education	0.493***	0.492***
	(0.0415)	(0.0385)
Household head's education level: primary	0.126***	0.150***
	(0.0211)	(0.0196)
Household head's education level: lower secondary	0.232***	0.262***
	(0.0282)	(0.0262)
Household head's education level: upper secondary/high education	0.440***	0.484***
	(0.0369)	(0.0343)
Household head's professional status: white collar	0.254***	0.229***
	(0.0351)	(0.0326)
Household head's professional status: blue collar	0.0757**	0.0445
	(0.0326)	(0.0302)
Household head's professional status: Self employed	0.223***	0.210***
	(0.0273)	(0.0254)
Childhood place of residence: large city	0.0927**	0.109***
	(0.0395)	(0.0367)
Childhood place of residence: medium city	0.0232	0.0280
	(0.0295)	(0.0274)
Childhood place of residence: rural	0.0241	0.0130
	(0.0175)	(0.0162)
Catholic	-0.0577*	-0.0458
	(0.0337)	(0.0313)

Protestant	-0.0951***	-0.0768**
	(0.0336)	(0.0312)
Animist	-0.181***	-0.163***
	(0.0364)	(0.0338)
Current place of residence: capital	-0.0106	0.0330
	(0.0320)	(0.0297)
Current place of residence: medium city	0.0969***	0.115***
	(0.0247)	(0.0230)
Constant	12.66***	12.66***
	(0.133)	(0.124)
Observations	6,653	6,653

b) OLS regressions with control for the endogeneity.

Whereas median regression and OLS are very similar, controlling for endogeneity leads to divergent results. Indeed, Table 9 shows that once endogeneity is controlled for, 2SLS regression coefficient of the family size is no longer statistically significant, except as durable goods are concerned. But even in the latter case, the coefficient is very far from the IV quantile estimate. As we argued in the methodological section, linear regression, contrary to median regression, is sensitive to outliers and other extreme values. The results yielded by IV regressions suggest that this problem is amplified in the IV framework.

Table 9. Two stage linear regressions of the log per capita consumption on the number of children and other control variables in Madagascar

	Per capita expenditures of...			
VARIABLES	Overall consumption	Durable goods	food	Human capital
Number of children ever born	0.0651	-0.187**	0.0895	-0.294
	(0.132)	(0.0894)	(0.160)	(0.624)
Woman if not head of household	-0.0495	-0.144**	-0.0372	0.681
	(0.0917)	(0.0621)	(0.111)	(0.434)
Woman's age	-0.0462	-0.00567	-0.0503	0.594***
	(0.0362)	(0.0245)	(0.0438)	(0.171)
Woman's age square	0.000534**	0.000395**	0.000530*	-0.00711***
	(0.000252)	(0.000170)	(0.000305)	(0.00119)
Woman's education level: primary	0.151***	0.0865***	0.153***	0.602***
	(0.0294)	(0.0199)	(0.0357)	(0.139)
Woman's education level: lower secondary	0.364***	0.179***	0.317***	1.004**
	(0.0955)	(0.0647)	(0.116)	(0.452)
Woman's education level: upper secondary/high education	0.711***	0.268**	0.536**	1.317
	(0.185)	(0.125)	(0.224)	(0.875)
Household head's education level: primary	0.187***	0.0610**	0.216***	0.945***
	(0.0372)	(0.0252)	(0.0451)	(0.176)
Household head's education level: lower secondary	0.349***	0.136***	0.336***	1.076***
	(0.0773)	(0.0524)	(0.0937)	(0.366)
Household head's education level: upper secondary/high education	0.591***	0.271***	0.527***	1.092**

	(0.0960)	(0.0650)	(0.116)	(0.454)
Household head's professional status: white collar	0.277***	0.232***	0.0710	0.692***
	(0.0530)	(0.0359)	(0.0642)	(0.251)
Household head's professional status: blue collar	0.0921*	0.169***	-0.0634	0.262
	(0.0514)	(0.0348)	(0.0623)	(0.243)
Household head's professional status: Self employed	0.250***	0.228***	0.0888*	0.630***
	(0.0430)	(0.0291)	(0.0521)	(0.204)
Childhood place of residence: large city	0.120***	0.121***	0.102**	-0.105
	(0.0416)	(0.0282)	(0.0503)	(0.197)
Childhood place of residence: medium city	0.0686	0.0961***	0.0913*	0.0495
	(0.0450)	(0.0305)	(0.0545)	(0.213)
Childhood place of residence: rural	-0.00890	0.0227	-0.001000	0.0460
	(0.0254)	(0.0172)	(0.0308)	(0.120)
Catholic	-0.0263	-0.0630**	-0.00200	-0.125
	(0.0381)	(0.0258)	(0.0462)	(0.180)
Protestant	-0.0567	-0.0695***	-0.0655	-0.231
	(0.0382)	(0.0259)	(0.0462)	(0.181)
Animist	-0.185***	-0.171***	-0.187***	-0.751***
	(0.0415)	(0.0281)	(0.0502)	(0.196)
Current place of residence: capital	0.117	0.343***	-0.00314	0.286
	(0.0763)	(0.0517)	(0.0924)	(0.361)
Current place of residence: medium city	0.135***	0.259***	0.0133	0.377***
	(0.0303)	(0.0205)	(0.0367)	(0.143)
Constant	13.07***	11.19***	12.73***	-3.960**

	(0.364)	(0.246)	(0.440)	(1.720)
Observations	6,653	6,653	6,653	6,653
R-squared	0.257	0.598	0.021	0.209

c*) Extension of the analyses to overall sample of women.*

This study has so far considered women who are heads of household or wives/partners of the head of household and who have not divorced or changed partners along their lives. The objective of this restriction was to make sure that women's total fertility and the household resources have always both been generated by the same households. Table 10 shows that when we relax this restriction, the link between fertility and per capita consumption becomes weaker and is only statistically significant at q(50). This result is in line with our initial intuition and justify, a posteriori, why we limited our core analyses to the stable nuclear households.

Table 10 Quantile (at q25, q50, q75 and q90) instrumental variable regressions of the log per capita expenditure , sample extended to all women with at least two children

	q(25)	q(50)	q(75)	q(90)
Total consumption per capita				
Coefficient	-0.0188	-0.0238	-0.0254	-0.0240
Lower	-0.0442	-0.0492	-0.0492	-0.0599
Upper	0.0038	-0.0047	0.0067	0.0166

5. Conclusion

The purpose of this study was to measure the impact of family size on household living standards Madagascar. This study ties in, at the macroeconomic level, with the debate on the links between demographic and economic growth. The debate is basically between the supporters of Malthusian theory and the upholders of Boserupian theory. Malthusian supporters maintain that demographic growth always leads to poverty due to pressure and resource dilution (especially per capita capital). Contrary to the Malthusians, champions of Boserupian theory see demographic growth as a stimulus for technological progress and innovation, which ultimately drive economic growth. At the microeconomic level, the debate finds its theoretical extension in what is known as social capillarity theory, which posits that the smaller the family, the more likely it is to climb the social ladder and that, conversely, a high number of offspring hampers the chances of social mobility and can therefore impoverish families.

A certain number of empirical studies have analyzed the links between households' demographic behavior and poverty or welfare in general. The vast majority of these studies reach the conclusion of a negative correlation between standard of living and fertility. Yet we have found that, for the most part, the econometric methods used do not always handle the potential methodological issues properly (endogeneity biases, accurate econometric methods). Due to data limitations, former studies are also limited to one indicator of living standard. In this study using Malagasy data, we are able to overcome all the constraints faced by previous studies. Indeed, the data we use come from a recent and unique survey conducted by the National Institute of Statistics in 2012/2013 in Madagascar. This survey combines both modules on consumption and living conditions on the one hand, and on fertility and women's reproductive behavior on the other. So we can extensively analysize the interaction between households' economic and demographic behaviors, which is not the case of many surveys in sub-Saharan Africa.

Analyses controlling for endogeneity lead to the results that an exogenous increase in fertility reduces the total consumption per capita, and that this result is statistically significant. But its magnitude is less than that of a regression without controlling for endogeneity. When the total consumption per capita is broken down into different items (food, human capital, housing and durable goods), analyses show that all consumption items are affected by the effect of the fertility burden, and that this detrimental effect occurs at any quantile of living standard distribution, with comparable magnitudes. We were expecting heterogeneous impacts across different consumption items and quantiles. But these results should be considered taking into account the context of Madagascar, characterized by endemic poverty that affects nearly three quarters of the population (more than 90% if we consider the $2PPA threshold).

The political recommendation of this study is straightforward: Madagascar, like most African countries, is trying through different socioeconomic programs to offer better living conditions to its population. Our study shows that accelerating fertility transition may be part of the solution.

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