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Microeconomic analysis of fertility choice: Evidence from Republic of Benin

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ABSTRACT

This article presents the economic theories of fertility choice within a framework of microeconomic analysis. It focuses principally on the determinants of fertility choice, such as the income and cost of children, education, and parents' time availability, particularly female parents. After analyzing the Becker model of household fertility choice, we link the demand for both the quality and quantity of children with time allocation in fertility behavior, following the Schultz model. From the Becker model of fertility choice to Schultz's model of time allocation, the common hypothesis is the relationship between fertility choice and income. For quantitative results, we perform a calibration by calculating the elasticity of demand for children both in terms of quantity and quality. Through this calibration, we find that as income rises, parents reallocate resources from quantity to quality of children: while fertility declines over the years, investments per child increase significantly, leading to a rise in the average years of total schooling to improve child quality. A 1% increase in income raises total household expenditure on children by at least 0.65%, despite lower fertility; the opportunity cost of parents' time also rises. The results further reveal that children's services are more time-intensive than other household production goods, and female parents' time is used more for household production, which reduces female labor market participation.

Contribution/Originality: A key contribution of the article is its application of microeconomic fertility theory to a developing country, particularly in Africa, which has been rare in previous research. The results find in this research offer a novel path and evidence of the fertility dynamic in Africa.

1. INTRODUCTION

For a long time in the literature on the relationships between economic development and demographic phenomena, the macroeconomic dimension has always been privileged, forgetting that the questions of fertility and birth rates are primarily an individual and family rational decision. For a deep and exhaustive analysis of demo-economic theory, we must consider the disaggregation of demographic questions and the economics of fertility. The microeconomic framework is essential in the analysis of the economic determinants of fertility. After years spent on the macroeconomic aspects of demo-economic theory, with Malthusian and orthodox theories of demographic analysis based on aggregates, recent work in demography and economics has made it possible to understand the individual or family mechanisms of behaviors whose aggregation ultimately imposed the dynamics of these populations (Sandron, 2002).

In the 1990s, Cassen, Coale, and McNicoll (1994) identified a new perception of demo-economic theory in a number of studies, which pointed out the consequences of population growth by emphasizing its negative aspect.

First, there was strong population growth despite the decline in mortality, especially in several African countries but also in other countries of the world such as Latin America, and under conditions of high fertility, obvious negative effects at individuals and family's level, in particular on the health and economic opportunities of women and young people. Secondly, strong population expansion also constitutes a significant constraint for the provision of adequate public services, with a high dependency rate in education and health, and reduces the assurance of employment opportunities for a growing workforce (Rougier, 1999; Sandron, 2002).

Despite the efforts of governments and lobbying by international institutions and foreign governments, in particular the United States of America and the United Nations, why is there still reluctance regarding the decline in fertility rates in Africa? To explain this slow decline in fertility, some authors, notably (Cassen & Bates, 1994; Sandron, 2002) have discussed the relationship between production and reproduction by acting on population problems as well as analyses of individual decisions. This new perception of demo-economic theory has led to the waiver of traditional macroeconomic rationality based on aggregates to focus on microeconomic theories of the family because the negative effects of population expansion are mostly visible at the individual and family level. Thus, Cassen et al. (1994) stated in their book entitled: '*Population and development: old debates, new conclusions*' that "the available empirical evidence does not clearly show that population growth has a negative influence on development".

In African traditions, the choice to give birth was not always based on economic decisions but rather emanated from rational decisions that can sometimes depend on community and religious logic. Unlike in northern countries where the decision is primarily economic, in southern countries societies are governed by beliefs and traditions where the spirit of sharing is often dominant. Therefore, economic issues are relegated to the background in parents' decision-making. Families evolved in an economy of risk where everything depended on the community or the population, at this moment, we are talking about economics of externality[1]. Regarding collective wealth or the community of property regime in a population, Lee and Miller (1991) said that the most basic form of reproductive externality appears when there is some form of collectively held asset that community members have the right to use freely and without any restriction. In this perspective, having a high fertility rate, and therefore a large family, was considered as an insurance to perpetuate the tradition by ensuring offspring. Moreover, if microeconomic argumentation has highlighted the negative economic consequences of rapid population expansion, it is precisely by basing itself on the differences between social and private costs of having an additional child (Rougier, 1999). But things have changed, notably thanks to the interventions of institutions and governments by investing more in girls' education and promoting fertility control practices such as family planning. What has legitimized the intervention of politicians and institutions in decision-making concerning demographic dynamics in the countries of the South, some speak of the invisible hand.

This new interventionist policy has put forward the microeconomic perspectives of demo-economic theory, which has since been criticized for failing to find solutions to the theory based on macroeconomic perspectives. The analysis of the relationship between development and economic growth from a macroeconomic perspective has caused a lot of harm, especially for developing countries, because the first developments of the theory were purely theoretical and the few empirical works were based on the example of northern countries, two regions that do not have the same realities[2]. New reflections and perspectives are then put in place around the question of controlling the growth of the world population with the implication of public policies in order to reconcile population growth and development. All this with as its central core the scrupulous respect of microeconomic problems linked to the social and cultural realities

[1] Economic externality in a narrower sense, such as the maternity externality which is ours here, is the cost and benefit of children who have passed from the responsibility of the parents to the responsibility of society or the community.

[2] The first conclusions of the demo-economic theory were made with the available data from the northern countries and whose essence was that only the reduction of fertility could lead to prosperity, obviously ignoring the realities and traditions of the southern countries. This has also led the United Nations and the population study centers in the United States of America to have a pessimistic view of population growth in Africa.

of female reproduction and the right to procreation, with the aim of harmonious and sustainable development, because it is not enough just to limit births to have sustainable economic development (Rougier, 1999; Sandron, 2002; United Nations, 1994).

1.1. Quantity or Quality of Children?

We cannot talk about the relationship between economics and fertility without mentioning the name of Gary Becker in the United States, who was one of the first pioneers of the economic analysis of fertility. Indeed, microeconomic theories of consumer and reproductive behavior analysis were first introduced in the 1960s by Becker (1960); Guilmoto (1996) and Sandron (2002). Doepke, Hannusch, Kindermann, and Tertilt (2023) summarized Becker's general idea by saying that: rather than being fixed in an economic trade-off faced by a consumer in maximizing income, the reduction in fertility could suggest a decrease in the "taste" for having children, perhaps due to changes in cultural and social norms (such as education, crime, or religion) beyond the influence of economics. Hence the concept of the trade-off between quantity and quality of children. According to Sandron (2002) the main idea behind Becker's concept is that, in matters of fertility, decisions can be analyzed in economic terms by assuming that offspring are a durable good.

In this trade-off between quantity and quality, the child is not only considered a good that parents can "buy", but they can also invest in this good. Therefore, they will be led to make a rational decision about the number of children (the quantity) to have, therefore "purchased" in terms of good, and the future of these children (the quality) by investing in their well-being, education and health. Further, Delventhal, Fernández-Villaverde, and Guner (2021) demonstrate that a unified growth model based on the quantity-quality tradeoff that also allows for technological spillovers across countries may be crucial for the demographic transition in a large set of countries.

2. LITERATURE AND THEORETICAL FRAMEWORK

The microeconomic analysis of parental behavior in child choice was made possible by Becker's early work in 1960 within a neoclassical theoretical framework. Becker sought to address questions about income growth and family size by applying consumer theory to show that these centuries-long changes and cross-sectional differences in the size of already complete households in developed countries result from changes in family income and the "prices," or opportunity costs, of children (Hotz, Klerman, & Willis, 1997).

The new family economics[3] was developed in the 1950s by Becker (1960) and Leibenstein (1975) before being fully formalized by Willis (1973) who said that "income growth is accompanied by a secular decline in fertility and that family income is inversely proportional to cross-sectional gaps in industrialized countries" and it is the work of Willis (1973) that has guided many researchers in fertility economics.

The neoclassical economic analysis model used was intended to account for the reduction in the fertility rate in industrialized countries. In the literature on economics and population, several factors have been identified that have led to a reduction in the fertility rate, such as sociocultural realities referring to environmental realities (Leibowitz & Klerman, 1995; Lesthaeghe, 1983) and also economic motivations that refer to the cost-benefit ratio of having a child (Becker, 1960; Easterlin, Pollak, & Wachter, 1980; Willis, 1973). Some parent for career reasons, delay the childbearing as find by Miller (2007), who say that “delay in childbirth leads to a substantial increase in earnings, wage rates, and hours worked”.

In economic terms, the child is considered as a consumer good[4] and if it becomes a source of income, it is considered as a production good. Moreover, the various expenses made on the child or the income it could generate

[3] New family economics should be understood as economic theories that are applied in the economic analyses of decisions taken in the domestic or family context.

[4] The use of economic terms to describe children may seem unorthodox, but our intention here is purely scientific, guided by research and laudable intentions to analyze parental behavior when it comes to family decisions.

is not known in advance but varies in amount with the child's development, which makes the latter a consumer good and a sustainable production (G. S. Becker, 1960). So, for the parents who will make the choice, children will be a source of income or psychological satisfaction - consumption utility -, labor productivity utility, and old-age security insurance (Becker, 1960; Robinson, 1997). Cain (2018) and Hammer (1984) add that having more children does not in itself constitute an additional burden for parents, since these children can also be a source of insurance against various risks that can be realized in the long term (aging, infirmity, unemployment, etc.)

2.1. Preference or "Taste"

In a neoclassical approach to demand theory, the analysis of consumer behavior begins with these preferences based on the availability of goods, with the goal of maximizing utility. In our analysis, parents represent the consumer, and the goods they "consume" are children. The parents' choice, in planning to have children, is assumed to provide them with a certain "utility." It is assumed that parents act rationally and have full information regarding the choice to have offspring. As in the case of goods, the utility of having children is measured by the utility function, denoted U, whose indifference curve shape will be determined by the parents' preference. This preference or "taste," in turn, will be determined by the parents' religion, race, age, and other sociocultural factors (Becker, 1960).

2.2. Income

It is well known that when our income increases, our spending also increases, at least on some goods. In fertility economics, income is positively related to fertility, meaning that when income increases, the couple's fertility rate will also increase; this is called the income effect in microeconomic theory. But the question is whether this hypothesis holds everywhere. In our analyses, we will attempt to provide some answers.

While parents attempt to maximize their well-being, they will be subject to a budgetary constraint on their income and also on their time, because each child they wish to have needs to be fed, and this comes at a price, as does the time that the mother will devote to them. The concept of parental income depends on their productivity. In the case where both parents work, there will be two sources of income: the man's and the woman. But when the woman decides to devote her working time to taking care of the child, then at that moment the opportunity cost of having children will increase (Lee, 1979; Leibowitz & Klerman, 1995; Sandron, 2002).

3. APPLICATION OF THE CHILD QUANTITY AND QUALITY TRADE-OFF

3.1. The Basic Model

The relationship between economics and fertility has been explained extensively using economic theories in various literatures, with microeconomic theories of the family as the field of analysis. Thus, the concept of new family economics has been put to use.

By considering parents as consumers who will choose between the quantity (number) of children with the aim of maximizing their satisfaction (utility), they will be subject to the acquisition price of a child and the budget constraint. This is a neoclassical approach to consumer demand analysis that has been used by several authors[5]. The parents' preference is represented by the utility function U, which will maximize their satisfaction on three essentially domestic products: the quantity or number of children n, the quality of the child or a measure of the child's quality q (the quality of the child corresponds to all the investments that the parents will make to guarantee them a better future and maintain their health), and c as other expenses. The utility function is therefore:

$$U = f(n, q, c)$$

The budget constraint to which parents are subject is:

$$I = nq\alpha + c\pi_c$$

[5] For more details see: Becker (1960); Hotz et al. (1997) and Easterlin et al. (1980)

With I the total income of parents, α the price of goods and services dedicated to children and π_c the price of other consumption goods. Becker and Lewis (1973), in their article, assumed that the quantity of children n and the quality of children q have the same elasticity. This means that the price α is the price of the quality and quantity of children nq, so nq can be interpreted as the total expenditure observed for children by parents, which is determined by both quantity and quality.

If children are considered normal goods, then the demand for children will increase with the increase in parents' income. In other words, as family income increases, parents will want to have more children. Since children are normal goods in the sense that total expenditure on children is an increasing function of income, then the sum of the income elasticities[6] of the number n and quality q children must be positive. However, it is possible that the income elasticity of demand for the number of children n to be negative if the income elasticity of demand for the quality q of children is too large (Becker, 1960).

We know that each parent will try to maximize their well-being but will be subject to the budget constraint. Following the model of Becker and Lewis (1973), we will use the Lagrange multiplier to solve the parents' optimization choice. Then our objective function, which is the function to be maximized is:

$$L = U(n, q, c) + \lambda(I - nq\alpha - c\pi_c)$$

The first-order condition gives us:

For the number of children

$$\frac{\partial L}{\partial n} = \frac{\partial U}{\partial n} - \lambda q\alpha = 0$$

For the quality of the child

$$\frac{\partial L}{\partial q} = \frac{\partial U}{\partial q} - \lambda n\alpha = 0$$

For other expenses

$$\frac{\partial L}{\partial c} = \frac{\partial U}{\partial c} - \lambda \pi_c = 0$$

By solving these first-degree conditions, we will have:

$$MU_n = \lambda q\alpha = \lambda p_n$$
$$MU_q = \lambda n\alpha = \lambda p_q$$
$$MU_c = \lambda \pi_c = \lambda p_c$$

With λ representing the marginal utility of income, MU the marginal utilities of each choice of the parents and p the marginal costs. In other words, MU_n is the marginal utility obtained when the number of children increases and p_n the marginal cost of having one more child. MU_q is the marginal utility obtained when the quality of each child is increased by 1 and p_q the marginal cost when the quality of each child increases by 1. The quality of each child is produced through the investment of the parents in their education in particular. Becker and Lewis did not mention this parameter in their study. However, they considered the marginal costs as the shadow price. In these conditions we can say that the shadow price of the number of children n is an increasing function of the quality of children q and vice versa. The choice of the number of children n and the quality of the child q being at the discretion of the parents, then the shadow prices will be endogenous.

The marginal cost of each good that parents will want to maximize is $q\alpha = p_n$ for the number of children, $n\alpha = p_q$ for quality and $\pi_c = p_c$ for the other goods. So, what does this tell us about the parents' optimization choices? If parents decide to have another child, the marginal cost of quality will increase, and if they also decide to invest more in the education of children, thus increasing quality, the marginal cost of the number of children will increase. So,

[6] Income elasticity of demand aims to measure the response or sensitivity of a child's demand to a change in consumption when income changes.

$e_n = \frac{\Delta n}{\Delta I}$, $e_q = \frac{\Delta q}{\Delta I}$ with e_n and e_q being the income elasticity of demand and child quality, respectively.

parents cannot choose to invest only in the education of one child,;if there is an investment it is for all children, so that when they have one more child, this child should have the same qualities as those before them. The interaction between the number of children n and the quality of the child q makes the budget constraint non-linear. This non-linearity implies that when income increases, this leads to a substitution effect induced against the number of children and in favor of quality per child if the income elasticity of demand for quality exceeds the income elasticity of demand for the number of children (Hotz et al., 1997). It is in this sense that Becker said that "There are no good substitutes for children, but there may be many that are not necessarily good." So, the marginal utility obtained by spending one more dollar on the quantity of children must be equal to the marginal utility obtained by spending one more dollar on their quality. In other words, the marginal rate of substitution between the quantity and quality of children is: $\frac{MU_n}{MU_q} = \frac{p_n}{p_q} = \frac{q}{n}$ and this means that the relative cost of the number of children tends to increase as the quality-quantity ratio $\frac{q}{n}$ increases.

Becker and Lewis (1973) generalized the previous budget constraint by including in budget expenditures costs that depend neither on the quantity nor on the quality of children. Thus, the new budget constraint to which parents are subject is:

$$I = nq\alpha + n\alpha_n + q\alpha_q + c\pi_c$$

With α_n and α_q representing the new independent costs of the number of children and the quality of the child. Thus, the new marginal cost of having an additional child or the shadow price of an additional child is $q\alpha + \alpha_n = p_n$ and the new marginal cost of increasing the quality of the child is $n\alpha + \alpha_q = p_q$.

3.2. Implications of the Model

Following Becker and Lewis (1973) analyses, we will attempt to understand what happens when marginal costs change and how this affects parents' preferences for the number and quality of children. To do this, we will start from the new budget constraint with independent costs of the quantity and quality of children.

$$I = nq\alpha + n\alpha_n + q\alpha_q + c\pi_c$$

In this budget constraint, the component $n\alpha_n$ in the cost of the child depends only on the cost of the number of children n and not also on the quality of children q. Becker and Lewis (1973) indicated that this cost associated with the number of children can be identified with the costs of contraceptives[7] or prenatal consultation. As for the component $q\alpha_q$, it depends on the quality of children q and not on the number of children n and which can be identified by the family assets such as the space dedicated to the child (the size of the room) with all the amenities. The authors assumed that the fixed component of the quantity of children $n\alpha_n$ is more important than the quality of children $q\alpha_q$ therefore, $n\alpha_n > q\alpha_q$.

First angle of analysis: an increase in the cost of the number of children α_n.

Given that the cost α_n is independent of the cost of child quality and is a fixed component of the shadow price p_n ($p_n = q\alpha + \alpha_n$), if α_n increases, for example, due to improvements in contraceptive methods or the payment of prenatal consultations, then the shadow price p_n will also increase relative to the other shadow prices p_q and p_c, which directly leads to a decrease in the number of children n. However, since the number of children n is a component of the shadow price of child quality $p_q = n\alpha + \alpha_q$), the decrease in the number of children n will also lower the shadow price p_q, which leads to a substitution in favor of child quality. This is called the substitution effect. Therefore, parents will choose to have fewer children in favor of child quality, which becomes less expensive. The effect of the increase in cost α_n is not limited only to the decrease in the number of children n but also a relative increase in the quality of children q and also of other consumer goods c, but more pronounced for quality.

[7] Contraceptive methods were not known to everyone, especially in less developed countries, but in recent years, with the assistance of NGOs and the WHO, family planning methods are now available everywhere.

Second angle of analysis: a decrease in the cost of child quality α_q.

If the cost of quality α_q decreases due to the increase in the cost of education, for example (more educated parents), the shadow price of child quality p_q ($p_q = n\alpha + \alpha_q$) will also decrease. This decrease in the shadow price will increase the quality of the child, which in turn will increase the shadow price of the number of children p_n, knowing that quality q is a component of the shadow price of the number of children ($p_n = q\alpha + \alpha_n$), and consequently, this will lead to a decrease in the number of children n.

In short, the analyses show the same result, the number of children n decreases and the quality of child q increases, which demonstrates the substitution effect between the number of children n and the quality of children q. The quantity and quality of children are interdependent. The marginal cost of quantity n depends on quality q ($p_n = q\alpha + \alpha_n$) and the marginal cost of quality q depends on quantity n ($p_q = n\alpha + \alpha_q$).

From these two angles of analysis, it emerges that contraceptive methods, whatever the one adopted, are of great importance for reducing the number of births. These methods are not only reducing births but they also increase the quality of children. Having children provides a certain satisfaction but it also comes at a cost. As Becker (1960) and De Tray (1973) said; increased knowledge of contraceptive methods increases the quality of the child but also reduces the quantity. Moreover, it emerges from the analysis that when parents are more educated, the quality of the child increases.

Third angle of analysis: a simultaneous increase in α_n, α_q and α at an equal percentage.

For this analysis, Becker and Lewis (1973) assumed that: $\alpha_q = 0 \; and \; \alpha_n > 0$. Since $\alpha_n > 0$, then α_n represents the opportunity cost of fertility control. The increase in the various prices can be attributed to the increase in wages. The growth of these costs α_n, α_q and α at an equal rate relative to the cost of other consumer goods π_c is due to the decrease in price π_c. And we know that the marginal cost of other consumer goods is given by $p_c = \pi_c$, and since π_c decreases, then logically, the marginal cost will also decrease, which will then increase the consumption of other goods c by decreasing the quantity n and the quality q at an equal rate, assuming, of course, that n and q are substitutes for c. However, since quantity n and quality q will decrease at an equal rate, this decrease will be more pronounced for marginal cost p_q compared to p_n because it was assumed that $\alpha_n > 0$. Then n would decrease relative to q. Therefore, the quality of the child will increase relative to quantity.

We can conclude that following an increase in income, fertility will decrease in favor of the quality of the child by also increasing the expenditure on other consumable goods. In economic terms, we say that the income elasticity of the quantity of children is larger than the income elasticity of the quality of children, if the increase in costs α_n, α_q and α is made equally.

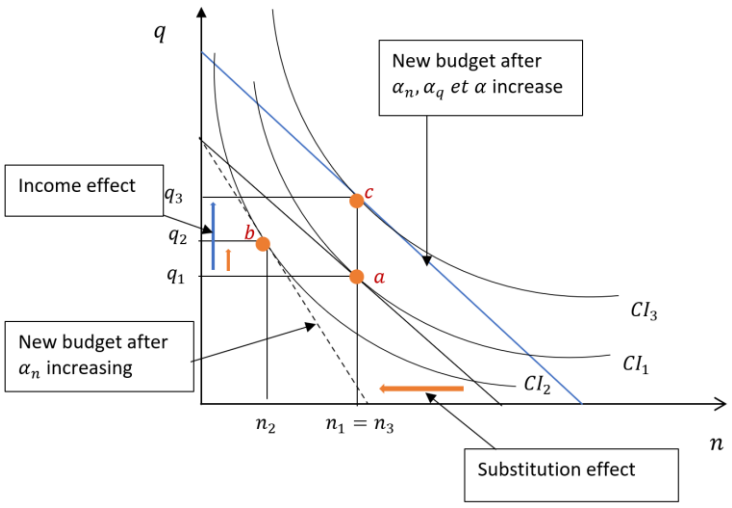

Figure 1. Interaction between quantity and quality demand of children.

Figure 1 summarizes everything that has been said in the analysis of the Becker and Lewis (1973) model. It is easy to see that after the increase in α_n the budget line has pivoted downwards which has moved the optimal point **a**. As a direct effect, the couple will choose to have a quality child rather than have many children which brings the optimal choice back to point **b**. This is the substitution effect. But when the costs α_n, α_q and α increase at an equal percentage, we see a parallel shift in the budget line which reflects the increase in purchasing power. This increase in purchasing power will also increase the general expenditure of the family on children which raises the indifference curve to a higher level for an optimal consumption choice at point **c**. This is called the income effect.

The price change undoubtedly has an influence on the behavior of parents regarding their choice of children and consumption. This price effect is manifested by two effects: the substitution effect and the income effect. However, it should be noted that the increase in total income leaves the number of children unchanged for the simple reason that the income effect, which tends to increase fertility, is offset by a substitution effect against fertility induced by the increase in expenditure per child so that they receive a better education and a more fulfilling life. As Birdsall (1988) and Tommasi and Ierulli (1995) said; an increase in wages pushes households to choose a small family size with a significant investment in each child.

In the model discussed above, only the man has an income and represents the total income of the family. The woman, on the other hand, devotes all her time to the production of household goods such as motherhood and taking care of children. Taking care of children requires a lot of time and availability and the best person for this job is the woman. Therefore, considering that motherhood requires a lot of sacrifice and time, then the opportunity cost of having children will increase compared to psychological satisfaction. Having a child will then become expensive, so parents will substitute the demand for children for other goods, in this case increasing the quality of the child by investing in his education and well-being.

3.3. Time Allocation

Childbearing comes with a cost, and parents are often forced to make choices about the number of children, the type (quality) of children, and also the time available for leisure activities. Parents' time is not only a determining factor in the decision to have a child; it also plays a role in the quality of the child. In the previous model, we ignored the time factor, especially for both parents, but here we will discuss the importance of time in the child's needs in a model.

The notion of the time factor in fertility behavior has been mentioned and theoretically studied by authors such as: Becker (1960); Lancaster (1966); Willis (1973); Ben-Porath (1973); Michael (1973); De Tray (1973) and Nerlove, Razin, and Sadka (2014). As Becker said "the main ingredient of domestic production will be the available time of family members, and above all that of the mother". All domestic goods require time but children require much more time because they are considered durable goods with a return on investment. Therefore, the opportunity cost of children will have a very significant share in the total expenditure of the family than the opportunity cost of other goods (Doliger, 2008). Therefore, if the income of parents increases, having children will become expensive compared to other goods. Becker speaks of the opportunity cost of children rising faster than the cost of other goods and services.

To analyze this theory of time allocation in fertility behavior, we will add the parents' time factor to our budget constraint. In doing so, we will follow Schultz (1986) theoretical framework on the value and allocation of time. Just as in Becker's previous model, the couple will decide how many children they want to have based on the available resources. The parents' utility (U) in this specific case will depend on the satisfaction they get from the number of children (n) and the consumption of other goods (c). Regarding the quality of the child, we consider that the satisfaction provided from having children is measured by "child services", which we note $x = nq$ as in Becker. Therefore, the interaction between the number of children n and the quality of children n will disappear, we will then have a linear budget constraint. The parents' utility function is then:

$$U = f(x, c)$$

Since the two commodities of the parents (children and goods) are produced with the available home "technology[8]" and by investing the necessary time and resources, then their functions are represented as follows:

$$x = x(T_{xh}, T_{xf}, X_x)$$
$$c = c(T_{ch}, T_{cf}, X_c)$$

With T_{xh} and T_{xf} representing the time spent on childcare by the man and woman, respectively, T_{ch} and T_{cf} the time spent by the man and woman on other goods, X_x and X_c the resources devoted to childcare and other market goods.

The production technology or economic opportunity available to parents can be defined as their budget constraint, which is:

$$I = W_f T + W_h T$$

Where W_f and W_h represent the wife's and husband's wages respectively, since both parents are in the labor market and earn an income, T the total time available for each parent. With both parents working, their time constraint will be:

$T = T_{fx} + T_{fc} + T_{fm}$ for the husband.

$T = T_{hx} + T_{hc} + T_{hm}$ for the wife.

With T_{fm} and T_{hm} the time spent respectively by the wife and husband at work. We can then rewrite the total income of the parents which comes to:

$$I = W_f(T_{fx} + T_{fc} + T_{fm}) + W_h(T_{hx} + T_{hc} + T_{hm})$$

If we assume that the commodity production function is a constant return to scale as in the Becker model, then the overall budget constraint can be written as:

$$I = \pi_x x + \pi_c c$$

With π_x and π_c the shadow price of childcare and other goods, respectively. The shadow price is considered exogenous, and parents are assumed to have made a choice from the beginning of their relationship regarding the number of children to have, the time devoted to childcare, and work, and so on, without any change.

In this analysis of time allocation in the demand for children, it is assumed that children are more time-intensive relative to the production of other goods because they are considered as durable goods. Both parents care for children. For parents' total available time to be more devoted to childcare, the opportunity cost of children relative to parents' time will have a very large share in the latter's total expenditure, as will the opportunity cost of other goods relative to parents' time. Thus, we have the following relationships.

$$\frac{(W_f T_{fx} + W_h T_{hx})}{\pi_x x}$$
$$\frac{(W_f T_{fc} + W_h T_{hc})}{\pi_c c}$$

If we denote $s_{fx} = \frac{W_f T_{fx}}{\pi_x x}$ the cost of childcare services in relation to the mother's time spent and $s_{hx} = \frac{W_h T_{hx}}{\pi_x x}$ that of the father; $s_{fc} = \frac{W_f T_{fc}}{\pi_c c}$ the cost of other goods due to the time spent by the mother and $s_{hc} = \frac{W_h T_{hc}}{\pi_c c}$ that of the father, then the "technology" of child production will be more time intensive on the condition that:

$$s_{fx} + s_{hx} > s_{fc} + s_{hc}$$

It has been said that both parents devote time to children, but we know that the woman spends more time in the production of domestic goods such as the child for example. So, for the woman to be more time intensive in the "production" of children than the husband, she must spend more time with the children than in the production of other domestic goods. Then, we have:

$$s_{fx} - s_{fc} > s_{hx} - s_{hc}$$

[8] The home technology available here refers to the different economic opportunities and constraints that parents may encounter in the production of household goods.

When the income of both parents increases with economic growth, for example, how will parents choose to have children? Earlier in the analysis of the Becker model, we arrived at a result saying that when total income increases, the demand for children remains unchanged and that parents will prefer to invest in the quality of the child, for example, in education, what we called the income effect. Even if the income effect tends to increase the level of fertility when children are considered as normal durable goods.

This income effect is also the same for the Schultz model that we have just analyzed. Because with the increase in W_f and W_h, the couple will potentially choose more children by expanding services and also it will increase the consumption of other domestic goods. However, it is very possible to have a negative price effect because the salary W_f that the mother earns is very important for the couple's budget and therefore for the cost of the child. In addition, the price effect gives more value to time because the mother's time is crucial for the child more than that of the husband at home. Smith (1972) said to this effect that with the increase in the number of children at home, the man works more in the year while the woman considerably reduces her paid working time.

We can therefore easily conclude that with the income effect, the opportunity cost of childcare increases compared to the cost of other goods, which can potentially increase the number of children. However, if the price effect, given the importance of the mother's time devoted to the production of household goods, outweighs the income effect, then the couple will choose to have fewer children. Therefore, the demand for children will decrease.

The demand for children among parents is determined by exogenous variables such as the parents' salary, therefore total income, the market price of goods as well as the price of childcare, and often also preference; which can be formalized as:

$$N = D_n(W_f, W_h, P_s, P_c)$$

Beyond these determinants that condition the number of children a family can choose to have; there are hidden cultural and traditional social realities. Nowadays, the demand for children no longer, or almost never, obeys the logic of economic theory, which is often based on the allocation of resources and available time. Perhaps this still exists in developed countries, where couples plan the number of children they want based on their income and time availability. But in developing countries, this is the opposite, except for more educated couples.

4. CALIBRATION

To quantitatively analyze child demand in Benin, we will calculate the income elasticity of child demand. Income elasticity here measures couples' response to an increase in income regarding the type of child to have (quality or quantity). The formula for calculating income elasticity is the percentage change in the number of children n or the quality of children q over the percentage change in income. For the income elasticity of the number of children, we have:

$$\varepsilon_n = \frac{\partial \mathrm{N}}{\partial \log \mathrm{C}}$$

With N being the number of children and C being the household total consumption.

For the income elasticity of child quality, we have:

$$\varepsilon_q = \frac{\partial \mathrm{Q}}{\partial \log \mathrm{C}}$$

With Q representing the quality of the child and C representing the household total consumption.

In developing countries like Benin, we face data constraints and informality particularly microeconomic data. So, to calibrate the elasticity, we use wanted fertility rate proxy for the number of children from world development indicators dataset, and the household total consumption from Benin household survey dataset. Regarding the quality of the child, we considered the average year of total schooling between 15 to 64 ages from Barro and Lee (2013). The periods chosen are between 2009 and 2011 and also between 2011 and 2015. We choose these times periods based on the availability of data.

For the period between 2009 and 2011 we have:

$$\varepsilon_n\ 2009 - 2011 = -5.55$$

The income elasticity of demand for children is negative, which means that despite income growth in Benin, the demand for children is falling in favor of the quality of child. In order words, a 1% increase in household income reduce the desired fertility by 5.55.

$$\mathrm{E}_q\ 2009 - 2011 = 6.2$$

The income elasticity of child quality is positive. This means that an increase in income is more than proportional to the increase in the child's quality. In other words, the percentage of expenditures devoted to child education increases more as the couple's real income increases. So, it is highly income elastic.

- For the period 2011 and 2015, we have:

$$\varepsilon_n\ 2011 - 2015 = 4.53$$

We see that the income elasticity of the number of children is positive and significant. The increase in income during this period pushed couples to have more children. Therefore, for a given proportional increase in a couple's monetary income, the number of children increases proportionally more. Children are now becoming very valuable and also a source of satisfaction for parents, as is the case with luxury goods.

$$\mathrm{E}_q\ 2011 - 2015 = 4.16$$

The income elasticity of child quality is positive, which means that an increase in household consumption increases the children schooling year. Thus, income increase rise the education level of children. One might think that education has become a normal good in the eyes of parents. What happens now when we add the income elasticities of the number and quality of children? Answering this question is like finding the overall effect of total income on fertility.

According to the theory of the new economics of the family, developed in the 1950s by Leibenstein (1975) and Becker (1960) the total effect of income is positively linked to fertility. Clearly, when income increases, couples tend to increase the number of children, obviously considering children as a normal good. When we calculate the total effect of income elasticity, we have:

- For the period 2009 and 2011 we have:

$$\varepsilon_{2009-2011} = \varepsilon n_{2009-2011} + \varepsilon q_{2009-2011}$$

$$= 0.65 > 0$$

- For the period 2011 and 2015 we have:

$$\varepsilon_{2011-2015} = \varepsilon n_{2011-2015} + \varepsilon q_{2011-2015}$$

$$= 8.7 > 0$$

We note that the sums of the income elasticities of the first and second period are positive with a high percentage point and significant in the second period. The negative income elasticity can be explained by the decline in the desire to have children. As Becker said and cited by Hotz et al. (1997) and Jones, Schoonbroodt, and Tertilt (2008) "If children are normal goods, in the sense that total expenditure on children is an increasing function of income, then the sum of the income elasticities of the number and quality of children must be positive." So, our results are in line with the literature. The increase observed in the period from 2011 to 2015 can be explained by the growth in Benin's per capita income and also the rise of the middle class with the participation of women in the labor market. Although higher income reduces the demand for children, it significantly increases investment per child (average year of total schooling). Consequently, resources devoted to children increase with income, which corresponds to a quantity-quality substitution. Thus, child services will increase with the diversification of consumption of other goods.

5. CONCLUSION AND REMARK

The article analyzes fertility choices in the Republic of Benin within a microeconomic framework. We find that the children demand is positive and less than 1, meaning that an increase in income leads to a less than proportional increase in the quantity of children demanded, which keeps the demand for children unchanged despite income growth. Rising incomes have led parents to prioritize quality over quantity in their children. This results in a lower demand for children but a greater investment in each child, illustrating the trade-off between quantity and quality in the demand for children. This trade-off is often more pronounced in developing countries like the Republic of Benin.

The analysis of fertility choice in this work is principally based on the model of Becker and Lewis. After macroeconomic theories fail to explicitly explain the determinants and choices of rising fertility, microeconomic theory of new family economics has tried to find answers to fertility behavior. The demand for children is based on a rational decision of a couple, such as the total salary the couple has and the price of goods. However, there are also factors like traditional and socio-cultural influences that can determine the demand for children. It is well known in the analysis of fertility choice and income that an increase in revenue leads to an increase in the number of children per family when considering a child as a normal good. The quantitative analysis also shows that as long as the total income of the parents increases, the desire to have more children rises. Therefore, a positive relationship exists between income and family size. In the first period considered in the analysis, the income elasticity of demand with respect to quantity is negative, while the income elasticity of demand with respect to quality is positive; the opposite occurs in the second period. When summing the two income elasticities, the overall elasticity is positive. An increase in income does not automatically lead to an increase in family size, but it can happen in the long term as long as income levels are rising. Additionally, in the Republic of Benin, as income increases, children's quality improves, but the quantity may remain unchanged because, as income increases, the consumption of other commodities may also increase. Furthermore, when we link the time allocation and the choice of fertility, it's revealed that children's services are more time intensive than other household production goods and women's time is used more for household production. Although we considered children as a normal good, they cannot be purchase in the normal market but they are goods produced at home with the participation of both parents with time and disposable income. It is now clear that women participate less in the labor market compared to men because she has to reduce her working time for home goods production. The results in this study reveal how society in Republic of Benin and in particular couple and those who are eager to have children behave. The material wealth is one of the factors that guide the decision of a couple in our modern society whether or not to have children and how many. As Malthus said, an increase in the wealth will also increase the size of the family, the living standard however, will fall sharply. The modern civilization is very demanding in terms of material wealth and parent attention toward children because life can also be cruel if you are not well prepared to face it. There is however one exception, in Africa traditions can sometimes prevail over material wealth. So, we cannot generalize the behavior of couple when deciding the size of family because each region has his own realities. But we have also to recognize that while in Africa couple sometimes make decision to have children base on social, religion and traditional factors, they care less about the quality of children which is more frequent with a couple of low revenue low education. To ensure quality of children, some politics should be undertaken like the availability of educational infrastructure and the require human capital. The quality of children should not only be exclusively bended to parent's; government has also his responsibility in ensuring children quality by investing in education. Furthermore, government should also take measure to raise awareness of people about different contraception method to control the number of births and put parent toward their responsibility *vis a vis* of their progeniture.

5.1. Limits and Future Researches

Like many other research studies, this one has some limitations. We focus principally on the economy as the main determinant of fertility choice; however, there are other factors we did not discuss, such as morals, religion, and age

of marriage. In African societies like the Republic of Benin, morals and religion can be very important in determining fertility choices. Some religions allow a man to marry many wives legally without considering the economic situation. Further research can be conducted in this area to enrich the literature on fertility choice.

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REFERENCES

Barro, R. J., & Lee, J. W. (2013). A new data set of educational attainment in the world, 1950–2010. *Journal of development economics*, *104*, 184-198. https://doi.org/10.1016/j.jdeveco.2012.10.001

Becker, G. S. (1960). An economic analysis of fertility. In Demographic and economic change in developed countries. In (pp. 209-240). United States: Columbia University Press

Becker, G. S., & Lewis, H. G. (1973). On the interaction between the quantity and quality of children. *Journal of political Economy*, *81*(2, Part 2), S279-S288.

Ben-Porath, Y. (1973). Labor-force participation rates and the supply of labor. *Journal of Political Economy*, *81*(3), 697-704.

Birdsall, N. (1988). *Economic approaches to population growth and development. In H.B. Chenery and T.N. Srinivasan (Eds.), Handbook of Development Economics*. Amsterdam: Elsevier.

Cain, M. (2018). Fertility as an adjustment to risk. In Gender and the life course. In (pp. 145-159). United Kingdom: Routledge

Cassen, R., & Bates, L. M. (1994). *Population policy: A new consensus*. Washington, D.C: ODC Policy Essay N°12, Overseas Development Council.

Cassen, R., Coale, A. J., & McNicoll, G. (1994). *Population and development: Old debates, new conclusions*. United States: Transaction Publishers.

De Tray, D. N. (1973). Child quality and the demand for children. *Journal of Political Economy*, *81*(2, Part 2), S70-S95.

Delventhal, M. J., Fernández-Villaverde, J., & Guner, N. (2021). Demographic transitions across time and space. NBER Working Paper No. 29480. National Bureau of Economic Research.

Doepke, M., Hannusch, A., Kindermann, F., & Tertilt, M. (2023). The economics of fertility: A new era, Handbook of the Economics of the Family. In (Vol. 1, pp. 151-254). Netherlands: Elsevier

Doliger, C. (2008). Fertility and its economic determinants. *Revue Economique*, *59*(5), 955-971.

Easterlin, R., Pollak, R., & Wachter, M. L. (1980). Toward a more general economic model of fertility determination: Endogenous preferences and natural fertility. In Population and economic change in developing countries. In (pp. 81-150). USA: University of Chicago Press

Guilmoto, C. (1996). *Microeconomics of fertility: Some reflections based on the Indian case* (Vol. 2). France: ORSTOM, French Institute of Scientific Research for Development in Cooperation.

Hammer, J. S. (1984). Population growth and savings in developing countries: A survey. World Bank Staff Working Paper No. 687; Population and Development Series No. 12. Washington, DC: World Bank.

Hotz, V. J., Klerman, J. A., & Willis, R. J. (1997). The economics of fertility in developed countries. *Handbook of Population and Family Economics*, *1*, 275-347. https://doi.org/10.1016/S1574-003X(97)80024-4

Jones, L. E., Schoonbroodt, A., & Tertilt, M. (2008). *Fertility theories: Can they explain the negative fertility-income relationship?* National Bureau of Economic Research, No. w14266.

Lancaster, K. J. (1966). A new approach to consumer theory. *Journal of Political Economy*, *74*(2), 132-157.

Lee, R. D. (1979). *The economic consequences of population change: The effect of population growth on income and welfare*. United States: The University of Chicago Press.

Lee, R. D., & Miller, T. (1991). *Population growth, externalities to childbearing and fertility policy in developing countries.* Paper presented at the Proceedings of the World Bank Annual Conference on Development Economics 1990, Washington, World Bank.

Leibenstein, H. (1975). The economic theory of fertility decline. *The Quarterly Journal of Economics, 89*(1), 1-31.

Leibowitz, A., & Klerman, J. A. (1995). Explaining changes in married mothers' employment over time. *Demography, 32*(3), 365-378. https://doi.org/10.2307/2061686

Lesthaeghe, R. (1983). A century of demographic and cultural change in Western Europe: An exploration of underlying dimensions. *Population and Development Review, 9*(3), 411-435. https://doi.org/10.2307/1973316

Michael, R. T. (1973). Education and the derived demand for children. *Journal of Political Economy, 81*(2, Part 2), S128-S164.

Miller, A. (2007). *The effects of motherhood timing on career path.* United States: University of Virginia.

Nerlove, M., Razin, A., & Sadka, E. (2014). *Household and economy: Welfare economics of endogenous fertility.* United States: Academic Press.

Robinson, W. C. (1997). The economic theory of fertility over three decades. *Population Studies, 51*(1), 63-74. https://doi.org/10.1080/0032472031000149736

Rougier, E. (1999). *The economic consequences of population growth: 35 years of debate between orthodoxy and relativism.* Bordeaux, Centre for Development Economics, Working Paper No. (33).

Sandron, F. (2002). Economic growth and population growth: Theories, situations, policies. The developing world: Demography and socio-economic issues. In (pp. 15-71). Paris: French Documentation

Schultz, T. P. (1986). The value and allocation of time in high-income countries: Implications for fertility. *Population and Development Review, 12*, 87-108. https://doi.org/10.2307/2807895

Smith, J. (1972). The life cycle allocation of time in a family context. Doctoral Dissertation, The University of Chicago.

Tommasi, M., & Ierulli, K. (1995). *The new economics of human behaviour.* Cambridge: Cambridge University Press.

United Nations. (1994). *Population and development: Programme of action.* Paper presented at the International Conference on Population and Development, United Nations Population Fund (UNFPA).

Willis, R. J. (1973). A new approach to the economic theory of fertility behavior. *Journal of political Economy, 81*(2, Part 2), S14-S64.