Household size and productivity

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1 Introduction

The effect of an increase of the income per capita on the diminution of the household size has been now acknowledged for a long time. For example, the increase in female wages have increased the value of their time, which in turn made them work more and bear less children (Mincer[1963]). Also, higher income is accompanied by the development of markets, which also tends to diminish the household size. For example, the development of long term saving market makes unnecessary the family as a social security contract: parents do not have to produce many children such that some of these take care of them when old (Neher[1971], Raut[1991]). Furthermore, higher income is accompanied as well by a larger provision of public goods. This also represents an incentive to reduce household size. For example, the presence of public security makes no necessary a large household to defend property and members (Field[2002]).

Economists emphasized the causality from higher income to smaller family size. In general, in these papers, the female wages, the depth of the savings market and the extent of provision of public goods are taken as exogenous, and the individuals then make decisions about marriage, fertility, separation and reunion in a household.

In this paper I want to consider the possibility of an opposite direction of causality, the effects of household size on productivity, income and development of markets and of public goods.

How can a change in household size affect productivity? I offer three channels through which household size affect income per capita: i) through inefficient matchings (here efficiency is defined narrowly as the best matching for the single person); ii) through human and physical capital accumulation; iii) through the development of markets. In what follows I will describe these channels more precisely and refer to previous work related to each of them.

i) One clear example of the influence of household composition on income per capita is the one studied by Mincer (1978). Married couples waive their preferred job, which implies migration, because of the marital relationship. Mincer finds that married people migrates less than half the proportion of single people. If the incentives to marry are other than economies of scale, let say love or, in Becker's terms, altruistic incentives, then productivity per capita will be higher in a society with less marriages or less duration of marriages (though utility might be lower).

A similar case is the one of college students. In United States a high proportion of students separate from their family and often migrate when entering college. In most other parts of the world this is not so: students study in their hometown or not study at all. I conjecture that the matchings between students and colleges are poorer in terms of efficiency when separation and migration are not options.

ii) While these two examples are cases of static efficiency, we conjecture that changes in household sizes can also affect the dynamics of the economy, through physical and human capital accumulation.

Let's think the case of China. In 197. the government enforced the new law that families could have at most one child. What were the effects of this law? First, married women started working outside the house as they substitute away time dedicated to children. Second, both, married men and women had more time to invest in human capital. Third, both had more income to invest in physical capital as they do not have to spend in children. While the law might have diminished lifetime utility, I conjecture that it increased income and productivity per capita. Of course, this conjecture deserves a detailed empirical study on its own.

There is some work in the effect of household composition on capital formation and income. Fernandez (2002) tries to "understand both how family structure -with all its associated economic aspects such as the accumulation of human and physical capital, labor market participation and work effort, and propensity to have and educate children- influences the macroeconomy and inequality and how family structure itself is determined". And in a simple simulated example finds that "a change in household sorting, by decreasing the amount of human capital in the economy, increases wage inequality and decreases per capita output in a quantitatively significant fashion".

Similarly, Cubeddu and Rios-Rull (2002) argue that "the type of family structure in which an individual lives and its changes over time play a major role in shaping economic decisions". They model marital status as shocks and, by simulation, find that "the effects of the specific patterns that

determine marital status can be huge, much larger than what is typically imputed to precautionary savings due to earnings uncertainty."

In a more specific but equally suggestive paper, The Macroeconomics of Polygyny, Tertilt (2004) finds that "banning polygyny [in the Subsaharan Africa] decreases fertility by 40%, increases the savings rate by 35% and increases output per capita by 140%". Again, the result is driven by changes in the accumulation of capital.

All these is not to deny the effect from income to family size, but to emphasize the bi-causality, by conjecturing that the effect in opposite direction might be significant as well.

The close determinants of family size are: 1) fertility, 2) mortality and 3) union and separation. In some way, the interaction between family size and productivity have been addressed in previous work, through the recognition of the interaction betweeen fertility and income per capita. Malthus considered the relationship in 179.. A recent wave of papers have updated the research. Barro and Becker (1989) consider a neoclassical growth model with endogenous fertility. Though fertility affects income per capita, technological progress is still exogenous. Becker, Murphy and Tamura (1990) consider a model with endogenous fertility and possible endogenous growth. They do a quite unusual assumption: "a rising rate of return on human capital as the stock of human capital increases" (at least for some range). The model is characterized by two stable steady-states: a low income- high fertility steady state and a high income-low fertility steady state. If decreasing returns to human capital are not obtained for any amount of human capital, then the second steady state is one of high growth-low fertility. Galor and Weil (2000) addition to that model a relation between stock of human capital and technology progress. By this, Becker et al. assumption is interpreted: "higher human capital raises technological progress, which in turn raises the value of human capital". In a similar vein, Lucas (2002) extends his own work of 1988 by including endogenous fertility: "By focusing on forces that raise the return to human capital accumulation, the model isolates dynamics that can simultaneously influence production growth, fertility, and investment in human capital in the directions we have observed in economy after economy".

iii) A third channel by which household size might influence productivity is through the development of markets. If families are small, there are less possibilities of economies of scale inside the household, and household production will be substituted by market production (Note: Locay [1990] develops a model where exogenous population growth triggers the development of markets; the increase in the number of households with a reduction in size will obtain the same effect). The "atomistic society" is an incentive

for the development of markets, from laundries to restaurants to all kind of services. And markets are a huge incentive for discoveries and innovations (Romer[1990]: "The premise here is that market incentives play an essential role in the process whereby new knowledge is translated into goods with practical value"). Up to my knowledge, an explicit model of the relationship between family size and development of markets has not been presented before.

The substitution of market production for home production affects measured income per capita in two ways. One is merely a national accounting issue, though not a minor: Deveraux and Locay (1992) estimate that the upward accounting bias is near half an annual percentage point; for the U.S. in the period 1930-1985 the market production grew at 1.8 percent annually, while total production (including home production) grew at 1.3-1.4 percent annually. The other effect is the one that we are conjecturing in iii). One side objective of this paper is to be able to determine how much of the increase in income per capita is due to accounting bias and how much to real change in production quantity through the specified channels.

The general objective of this paper is to pin down both models and parameters by analyzing household survey data.

While we can think as plausible a pattern of development where income per capita and household size reinforce each other, one is taken to ask why there were and there are still some societies with big families and low growth rates of income. In other words: given that by reducing household size each individual can obtain a higher income, why they do not go for it? Part of the answer has been given: love (in other words, preferences for company or for children). Another answer, probably more important, is related to coordination. If everybody is living in a small household (1 to 3 persons) then to be part of a small household is optimal from both points of view, individual and social. But if everybody is living in big households then, to be alone or part of a small household is not optimal for the individual. This can be observed in traditional societies where it is optimal to be part of clans. This is, of course, an example of a coordination game with two equilibria, as illustrated by the following diagram (the diagram is for two players but we should think it for a large number of players so that to coordinate for a change of equilibrium is difficult):

	small	big
small	6,6	0,4
big	4,0	3,3

This resembles a lot the two-stable-steady-state models of Becker et al. (1990) and Galor and Weil (2000). But in this case the mechanism that

takes the economy from one steady state to the other is not human capital accumulation but the development of markets. One objective of the paper is to try to determine which type of mechanism (if any) is more significant.

The paper is organized as follows. In section 2 I present the data and some stylized facts. In section 3 I develop a model that tries to capture the effects described before and I derive the main implications of this model. In section 4 I estimate the model using the data. In section 5 I discuss and conclude.

2 Data

I will have two types of data: i) general data on average household size and income per capita cross country and long series for some countries, to determine worldwide trends; ii) household survey data for an specific country: Brazil between 1976 and 2002.

The household survey consist in 23 cross-sections, one for each year (the survey was not done in the years 1980, 1991, 1994, 2001).

Table 1 presents some characteristics for the first and last years of the sample. Some trends, usually being associated to development, can be noticed.

Year		1976	2002
Households	Observations	84,213	105,984
	Pct. Urban	70.5	86.8
	Number of persons per household	4.6	3.6
	Nr. of persons per household older than 10	3.4	3.0
	Monthly Household Income (2002 R$)	1003.1	1841.5
Persons	Observations	393,869	385,431
	Age	23.95	29.06
	Pct. Women	51.0	51.3
	Years of Study	3.05	5.16
	Hours of Work per week	47.2	40.3
	Pct. Work	36.8	43.1
	Pct. Employers	2.51	4.5
	Pct. Employees	63.2	60.8
	Pct. Self-Employed	19.7	21.6
	Pct. White	54.0	49.1
	Number of sons and daughters alive	2.45	3.04
	Pct. Illiterate	27.8	21.7
	Pct. Urban		85.7
	Pct. Household Work		68.6
	Hours of household works (weekly)		21.7
	Pct. Agriculture Work		19.2
	Pct. Born in County		58.8
	Pct. Born in State		84.1
	Age Start to Work		13.9

1. Although the quantity of households surveyed increased (20%), the total persons in those households slightly decreased. This is reflected in the diminution of number of persons per household from 4.6 to 3.6.

2. The percentage of urban households increased.

3. The monthly household income increased 80% in 2002 constante prices, which implies a still higher increased in per capita income.

4. The average age of the sample increased from 24 to 29, presumably as a result of both less fertility and less mortality.

5. The average quantity years of study increased from 3.05 to 5.16.

6. The average hours of work diminished (from 47 weekly hours to 40) while the work participation increased (from 37 to 43 percent), presumably as more women incorporate to the labor force.

7. Despite the fall in fertility, the number of children alive (the sum of both in and outside the household) increased due to less mortality.

8. The illiterate persons fall to near 20%.

Other interesting characteristics that we have for the latest years of the sample but not for the first years are household work, migration and age in which the person started working.

3 A model

The economy is populated by a large number of individuals of different ages who live at most T years. Each agent maximizes his expected lifetime utility:

$$E[\sum_{t=0}^{T} \beta^t U(c_t, j_t, l_t, P_t)].$$

Here c is goods, j is the household size, P is a measure of public goods (including existence of various markets) and l is leisure.

The two non-standard variables here are j and P. The first indicates that an activity (let say, eating or looking at television) is more pleasurable if it is done with other person. The second one indicates that an agent obtains pleasure from public goods. For example, the utility of "eating in a restaurant" will be given by the food eaten (c) in combination with the persons with whom you are eating (j), the existence of a variety of restaurants as well as some public security (P), and time spent eating (l).

We assume that the agents are involved in non-working activities only with their household members. Also that the agent can always find immediately a household of the size she wants.

Important features of the model will be the parameters that govern the substitutability and complementarity between these sources of pleasure. For example, we might think j and P are highly substitutable, and that seem to be the case with respect to defense or social security. Similarly, j and l might be highly complementary, in the sense that big households incentive members to use their time in non-working, non accumulating human capital activities.

The agent can accumulate both human and physical capital. The latter is tradable while the former is not.

The constraints faced by the agent are the following. First he has limited time, normalized to 1 per period that he uses for working (h), investment in human capital (m) and leisure (l):

$$h + l + m \leq 1. \tag{2}$$

Second, he faces an income constraint, given by the proceeds of his labor and the rent of his physical capital:

$$c + i \leq rk + w\frac{e(k^h)h}{j}. \tag{3}$$

The new feature here is that his income is diminished by the household size. This is given by the assumption that his productivity is reduced by sticking to other members. (I just divided by j, but it can enter in a more complex way). We assume that the consumption good can be used also for investment in physical capital.

The investment in human capital is produced by a service of previously acquired human capital and time spent in new investment:

$$i^h \leq g(k^h, t^h). \tag{4}$$

The law of motion for physical capital and human capital are respectively:

$$k_{t+1} \leq (1 - \delta)k_t + i_t \tag{5}$$

$$k_{t+1}{}^h \leq k_t{}^h + i_t{}^h. \tag{6}$$

There is only one firm with constant returns to scale that behaves competitively.

The market clearing condition for the good market is:

$$Y = \sum^{N}(c + i) = zf(K, H). \tag{7}$$

In the right hand side we have aggregate quantities of physical capital and efficient units of labor.

Finally we postulate that the aggregate provision of public goods depends positively on the total income:

$$P = P(Y). \tag{8}$$

We include the externality P to obtain at least two equilibria, one with big families and low income per capita, and other with small families and high income. (I am not sure if I should work with growth rates instead of level of income).

4 References

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