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Does Income Affect Fertility or Does Fertility Affect Income?

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This paper tests for the dynamic causal connection between real income per capita and the birth rate for a subset of developing countries. These countries are Costa Rica, El Salvador, Guatemala, Mexico, and Uruguay. Our empirical findings show that, for the historical period under review, in several countries real income per capita affected the birth rate. Virtually no evidence is found to support the hypothesis that the birth rate affected real income per capita.

I. INTRODUCTION

Classical economic thought regularly dealt with a wide range of "social" issues, including population, fertility and the family. These issues fell into a state of almost total analytical neglect with the emergence of post-Marshallian neoclassical economics. As is widely recognized, the seminal post-1960 work of Gary S. Becker on human capital, the allocation of time, fertility, marriage, altruism, crime, and intergenerational mobility prompted the return of micro-analysis to many areas it previously had abandoned, or had never entered.[1]

One result of this renewed interest is what has become commonly known as the "new household economics" (NHE). However, the research agenda of the NHE adheres strictly to the precepts of neoclassical micro-economic analysis. Thus, modern NHE researchers are methodologically a world apart from the more inductive, historical, "institutionally" oriented classical economists.

In the NHE, the substance of the parent-child relationship—and of parents' desires to have and raise children—finds expression in terms of the costs and benefits associated with children and other parental preferences and activities. The theoretical treatment of fertility in NHE begins with the postulate that parents seek to maximize a utility function in which desired number of children, or quantity of desired "child services," and other goods and services appear as arguments, and with utility maximization subject to price effects and income and time constraints. Such a formulation of the fertility decision-making process—and the incorporation of implied changes in family resources and scarcities—is designed to analytically penetrate beneath unhelpful generalities about "taste" differences to predict the family size that parents desire.[2]

Particularly troublesome, however, is what Easterlin called "the puzzle of the true nature of the income—fertility relation [which] has plagued and perplexed fertility research down through the years. . . ."[3] The association between income and fertility occupies a central position both in the neoclassical NHE and its precursor in classical economic thought, which Joseph Schumpeter termed the "minimum-of-existence" theorem. In the modern NHE, the *independent,* or exogenous variable is seen as family real income, with the appropriately lagged

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dependent, or endogenous variable being demographic behavior, primarily a fluctuating number of desired children or quantity of desired "child services." The NHE normally anticipates a positive effect of income change on demand for children when full prices (i.e., shadow prices) are considered. However, with strong negative price effects of children (and the assumption of constant tastes), *measured* income elasticity on quantity of children could be negative.[4]

On the other hand, in primitive and premodern societies and among the lowest socioeconomic classes of contemporary less-developed countries the NHE approach may be largely inapplicable. Deliberate fertility control is essential to parents' family planning efforts in achieving their number of desired children, yet numerous KAP surveys indicate that in these societies and socioeconomic classes little or no conscious fertility control is practiced.[5] Moreover, these societies and socioeconomic classes often hover at or near subsistence level, with drought, famine, plague and war frequently resulting in dramatic population changes. Such large-scale population shifts can, and historically have led to significant wage changes, with population shrinkage driving wages upward[6] and population expansion pressing wages downward.

This line of argument, based primarily on historical example rather than deductive reasoning, suggests that demographic behavior (fertility or population change) is the *independent,* or exogenous variable, with the appropriate lagged *dependent,* or endogenous variable being the effect on real per capita income. As indicated above, the argument would normally anticipate a negative association between population change and real per capita income.

In summary, two differing viewpoints exist that suggest a lagged but opposite causality between population change (or fertility) and real per capita income. Therefore, it seems appropriate to apply time-series causality tests developed by Granger[7] and Sims[8] to the income-fertility relation.

II. METHODOLOGY

The concept of causation used in this study is the one proposed by Granger (1969). It is purely an atheoretical definition of causal ordering, and causality is defined relative to a given information set. We present here, in the spirit of brevity, only the relevant empirical analog of Granger's technique to test the above hypotheses concerning real income per capita and the demographic variable. Consider the following bivariate model:

$$(1) \qquad GDPP_t = a_0 + \sum_{j=1}^{m} b_j GDPP_{t-j} + \sum_{j=1}^{m} c_j BIR_{t-j} + d\,LT + e_t,$$

$$(2) \qquad BIR_t = a_0^* + \sum_{j=1}^{m} b_j^* BIR_{t-j} + \sum_{j=1}^{m} c_j^* GDPP_{t-j} + d^*\,LT + e_t^*.$$

Where $GDPP_t$ is real gross domestic product per capita and BIR_t is the birth rate. Further, a, b, c, d, a*, b*, c*, and d* are regression coefficients estimated by ordinary least squares and LT is a time trend variable. To test for Granger causality all variables are assumed to be covariance stationary, which may be accomplished by estimating equations (1) and (2) in double natural log form and including a linear trend variable in the model specification. Moreover, the innovations in equations (1) and (2) are assumed to be two uncorrelated white-noise series, i.e., $E[e_t, e_s] = 0 = E[e_t^*, e_s^*]$ for $s \neq t$, and $E[e_t, e_s^*] = 0$ for all t, s.

Rejection of the null hypothesis that the demographic variable does not Granger-cause $GDPP_t$ requires the lag coefficients of BIR_t in equation (1) to be statistically significant as a

group. If this statistical significance occurs, then birth rate is said to unidirectionally Granger-cause real income per capita. On the other hand, to reject the null hypothesis that $GDPP_t$ does not Granger-cause BIR_t, the c_j^*'s coefficients in equation (2) must be statistically significant at conventional levels. If this statistical significance occurs, then $GDPP_t$ is said to unidirectionally Granger-cause BIR_t. If Granger causality is present in both equations (1) and (2), then there is causality with feedback, i.e., bidirectional causality, between $GDPP_t$ and the demographic variable. The F-test is used to determine the statistical significance of the group of lag lengths associated with each theorized Granger-causal variable.

After the appropriate lag distributions are determined, the model is inverted to a linear combination of the innovations in $GDPP_t$ and BIR_t so as to calculate the impulse function, i.e., the responses of each variable to a one standard-deviation shock in the innovations of the other variable. This is achieved by expressing $GDPP_t$ in equation (1) in the form of a moving average model (MAR) in its innovations and BIR_t in equation (2) in the same form.

III. EMPIRICAL FINDINGS

Table I reports the F-statistics on three, five and seven lag coefficients associated with Granger-causality tests between real per capita gross domestic product and the birth rate. Our results support the acceptance of the thesis of unidirectional causality running from real per capita income to the birth rate for three of the five countries under study. We reject, however, the hypothesis of unidirectional causality from the birth rate to real income per capita. Table 2 is based on the impulse function, which expresses the birth rate as a moving average of the innovations, or residuals in equation (2). Cumulative responses of the birth rate to one standard deviation shocks in real per capita income are reported for three, five, seven, and ten year time

TABLE 1

Granger's Test of Causaity Between the Birth Rate and Per Capita Real Income

Country	F.GDPP.BIR	F.BIR.GDPP	d.f.	Sample Period	(N)
Costa Rica	1.32	1.24	3,23	1953–1983	(31)
	1.33	1.29	5,17	1955–1983	(29)
	1.86	1.05	7,11	1957–1983	(27)
El Salvador	5.80*	2.66***	3,22	1954–1983	(30)
	3.29**	1.18	5,16	1956–1983	(28)
	2.91***	.98	7,10	1958–1983	(26)
Guatemala	8.46*	.99	3,23	1953–1983	(31)
	4.70*	.43	5,17	1955–1983	(29)
	2.53***	1.65	7,11	1957–1983	(27)
Mexico	1.73	.50	3,23	1953–1983	(31)
	2.13	.19	5,17	1955–1983	(29)
	1.66	1.68	7,11	1957–1983	(27)
Uruguay	.12	.64	3,18	1958–1983	(26)
	4.25**	.14	5,12	1960–1983	(24)
	3.10***	2.06	7,6	1962–1983	(22)

Table 1 is to read as follows: F.GDPP.BIR is the F-Statistic for the test of unidirectional Granger causality from GDPP to BIR, etc.

*Significant at the 1% level.

**Significant at the 5% level.

***Significant at the 10% level.

TABLE 2
Cumulative Impulse Responses of Per Capita Real Income on the Birth Rate in T Years Ahead

Country	T	GDPP → B/R*
El Salvador	3	7.43
	5	7.67
	7	3.23
	10	−7.39
Guatemala	3	2.27
	5	8.37
	7	8.37
	10	6.36
Uruguay	3	3.47
	5	4.41
	7	.44
	10	2.66

*GDPP → BIR indicates the cumulative responses of the birth rate in T years ahead to a one standard-deviation shock in the innovation in per capita real gross domestic product.

horizons. The results indicate that an increase in real per capita income resulted in a rising birth rate.

IV. CONCLUSIONS

Our empirical findings indicate that a dynamic causal connection exists running from real income per capita to the birth rate in El Salvador, Guatemala, and Uruguay. The impulse function relates that an increase in real per capita income results in an increase in the birth rate. Both the direction of causality and the positive association between real per capita income and the birth rate are as hypothesized by NHE.

On the other hand, virtually no support is found for the hypothesis that the birth rate affected real per capita income. The lack of statistical significance supporting a causal relationship running from birth rate to real income per capita could be due to problems associated with small sample sizes, namely the few number of years for which income data is available for the five countries plus the need to employ distributed lags when testing for Granger causality. This possibility suggests extending the present research to include a selection of developed countries for which income and birth rate data exist over a much longer number of years.

FOOTNOTES

1. Yoram Ben-Porath, "Economics and the Family—Match or Mismatch? A Review of Becker's *A Treatise on the Family*." *Journal of Economic Literature,* Vol. XX, Number 1, March 1982, p. 52.
2. David T. Geithman and Manuel J. Carvajal, "Population and the Economist: The New Economic Approach to Fertility, "*Social Science,* Vol. 50, Number 4, Autumn 1975, p. 207.
3. Richard A. Easterlin, "Towards a Socioeconomic Theory of Fertility: A Survey of Recent Research on Economic Factors in American Fertility," in S. J. Behrman, Leslie Corsa, and Ronald Freeman (eds.), *Fertility and Family Planning—A World View* (Ann Arbor: The University of Michigan Press, 1969), p. 141.
4. Manuel J. Carvajal and David T. Geithman, "Socioeconomic Fertility Determinants in Costa Rica, 1963–1973," *New Perspectives on the Demographic Transition,* Occasional Monograph Series, Number Four (Washington, D.C.: The Smithsonian Institution, 1976), p. 105.
5. Richard A. Easterlin, "An Economic Framework for Fertility Analysis," *Studies in Family Planning,* Vol. 6, Number 3, March 1975, p. 62.
6. In discussing the pneumonic and bubonic plagues that struck England in three waves between August 1348 and 1369, Johnson notes: "The cumulative impact [of the Black Death] on the population was dramatic. Over the country as a whole it fell by about one-third; in many areas by a half or more. There was an immediate and rapid increase in wage-rates, which rose 30 per cent in the decade 1340–50, 60 per cent in the next decade, and continued to rise. There was also a steady upward movement in what we would call 'wage-drift', with employers forced to concede a range of amenities to get any labour at all." Paul Johnson, *A History of the English People* (New York: Harper and Row, Perennial Library edition, 1985), p. 141.
7. C.W. Granger, "Investigating Causal Relations by Econometric Models and Cross-Spectral Methods," *Econometrica,* (July, 1969), Vol. 37, No. 3, pp. 424–438.
8. Christopher A. Sims, "Money, Income, and Causality." *American Economic Review,* Vol. 62, (September 1972), pp. 540–552.