14 En cambio, una reducción del salario real permite mejorar a la vez la balanza comercial y el nivel de empleo. Este resultado "antikeynesiano" se explica por la hipótesis de ausencia de restricciones de demanda en el mercado de comerciables, y por la no inclusión de efectos de distribución en la demanda de bienes no comerciables.

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ECONOMIC DEVELOPMENT AND POPULATION GROWTH: INTERNATIONAL EVIDENCE BASED ON CAUSALITY TESTS*

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Abstract:

The paper usses Granger causality tests on economic development and population growth for 44 countries to discriminate among several alternative hypotheses. The time series evidence does not provide an unambiguous picture as to the exact nature of the relationship. Therefore, previous attempts to generalize such relationship based on simple cross-section data are strongly suspect.

I. Introduction

The relationship between economic development and population growth has been subjected to a great deal of research[1]. This is not surprising because these are perhaps the two most important variables in demography and economics which concern national planners[2].

A review of the current literature yields a rich array of theoretical hypotheses and empirical tests concerning the interrelationship of economic development and population growth. Table 1 summarizes some of the representative works on the alternative theories[3]. As the table indicates, most of these studies have depended on international cross-section evidence. Typically, these studies regress a population growth variable on one or more explanatory variables.

Three distinct features emerge from the studies included in the table. First, of the different variables used by the researchers to explain fertility, the most important seems to be a measure of economic development[4]. Second, inspite of the large number of studies, many of which use identical data sets and econometric techniques, there seems no consensus about the precise nature of the relationship between population growth

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TABLE 1

PREVIOUS EMPIRICAL STUDIES OF ECONOMIC GROWTH AND POPULATION CHANGE

Study	Data Set	Econometric Techniques	Other Variables	Results
Weintraub (1962)	Cross-section (30) (Early 1950's averages)	OLS (birth rate on per capita income)	Radio of population in farming Infant mortatily rate	EDPPG
Adelman (1963)	Cross-section (37) (1950)	OLS (birth rate on per capita income)	Newspaper per thousand Labor force outside agriculture Population density	EDPPG
Heer (1966)	Cross-section (41) (1950's) Developed and LDC's	OLS (birth rate on per capita income)	Newspaper per thousand Infant mortatily Population density Increase in energy consumption 1937-53	EDPPG
Ekanem (1972)	Cross-section (24) (1950's and 1960's) Only LDC's	OLS (birth on per capita income)	Percent illiteracy Labor force in agriculture Percent urban Infant mortality rate	EDNPG
Janowitz (1973)	Pooled cross-section and time series (17)	OLS (gross reproduction rate on per capita income)	Illiteracy rate Mortality rate Percent urban Life expectancy	EDNPG
Repetto (1974)	Cross-section (64) (Early 1960's)	OLS; Stepwise procedure (fertility index on GNP per head)	Gini's coeefficient Life expectancy Literacy rate Population density	EDNPG
Repetto (1978)	Cross-section (45) (Early 1960's)	OLS and 2SLS (fertility rate on income per capita)	Gini's coeefficient Infant mortality rate Newspaper circulation rate	EDNPG

Table 1 – (continued)

Study	Data Set	Econometric Techniques	Other Variables	Results
Bhattacharya (1975)	Cross-section (52) (1950)	OLS (crude birth rate on income per head)	Rural-urban income inequality Infant mortality rate Education	EDPPG
Hazledine and Moreland (1977)	Cros-section (82) (1968)	OLS; Log-linear form (crude birth rate on income per capita)	None	EDNPG
	DCs and LDCs grouped separately	Sames as above	None	EDNPG
	Grouped into DCs, Africa, Asia, and Latin America	Sames as avobe	Percentage of population living in rural area Infant mortality rate	Ambiguos
Flegg (1979)	Cross-section (60) DCs and LDCs grouped separately (various years)	OLS and 2SLS (crude birth rate on real and nominal GDP per head)	Atkinson's index of income Infant mortality rate Percentage of illiterate females Percentage of economically active females	EDNPG
Flegg (1980)	Cross-section (45) (Early 1960's)	OLS and 2SLS (fertility rate on income per capita)	Infant mortality rate Income distribution Female illiteracy	EDNPG

Notes:

EDPPG; Economic development positively affects population growth.
EDNPG; Economic development negatively affects population growth.

and economic growth[5]. Third, and most important, none of these studies considers the direction of the causal link between these two variables. They start by assuming a certaing causal relationship and then proceed to test the magnitudes of correlation or the regression coefficient among plausible variables. Not surprisingly the range of these studies in terms of direction of causality and sign is fairly wide[6]. Finally, with the exception of one authour, all others have used cross-section evidence to derive conclusions about what is essentially a dynamic phenomeno[7].

In this paper we attempt to redress some of these problems by using a statistical technique of time series analysis not used before in the field of demographic economics[8]. This technique has certain advantages over the cross-section regression analysis previously used in the literature[9]. Our results cast strong doubt on the credibility of the claim that any one of these hypotheses is universally representative of the real world.

The most common view in the literature is perhaps that development reduces the growth rate of population by lowering fertility rates due to factors such as education[10], urbanization, shift in emphasis from the quantity to the quality of children[11], increasing probability of raising healthy children due to improved medical facilities, greater participation of women in the labor force[12], etc.[13]. An underlying assumption throughout seems to be that economic development, accompanied by better income distribution, will reduce fertility rate to a degree greater than the parallel decline in the mortality rate[14]. The widespread experience of developed societies in the western hemisphere, almost all of which exhibit a tapering off in the population growth rate after a certain point in the development process, is presented as strong empirical evidence of this relationship[15]. Even though it is difficult to pin-point this phase because the diversity in development is so great, the pattern appears convincing to many[16]. Countries such as Japan, South Korea, and Taiwan, which have only recently matured or become industrialized, are also cited as showing a similar pattern to a casual observer. There has been a discernable decline in their fertility rates as development reaches a greater percentage of the populace[17].

The alternate view that economic development positively influences population growth stems from the observation that in the early phases of development in very poor societies, the decline in mortality is much more rapid than changes in fertility[18]. Indeed many ascribe the present stalemate in population growth in the third world precisely to this phenomenon[19]. Part of the explanation lies in the very nature of modern medical technology which enables governments and international bodies to eliminate historical mass killers such as plague, malaria and small pox, rather quickly and with only limited budgets. The fruits of economic development which have fertility reducing effects, however, have a long gestation period at least for the vast majority of population[20]. What is clear is that this hypothesis in no way contradicts the first one. It might very well be the case that they have different time frameworks. In the short run, as modernization proceeds, declining mortality may cause population growth rates to increase; but, as the decrease in the fertility rate begins to catch up, this increase might be stalled or even reversed[21].

The causal link between economic development and population growth may in fact be reversed. A recurrent theme in the literature on population and economics has been that population growth could act as an obstacle to rapid economic development. The idea is that periods and regions with high population growth rates are often characterized by a younger population, causing a reduction in the average savings ratio, and therefore, investment and the pace of economic development. The antecedents of this view can be traced back to Malthus who argued that the natural check and balance mechanism

works through high populations, high consumption levels, declining savings level, and finally reduced income levels. Again, researchers refer to the experience of many poor overpopulated countries in the third world such as India, Pakistan, and Bangladesh, when looking for modern day examples of this Malthusian trap[22]. Besides the savings-investment link authors have proposed other possible links which can cause such a result. One such hypothesis is that higher population growth rates tend to put strain on the balance of payments and may therefore reduce income. It is argued that in the developing economies there is little room to maneuver the capital-labor ratio in the manufacturing sector. This leaves the burden of absorbing the vast majority of new entrants to the labor force on the labor intensive agriculture sector. Since the terms of trade of this sector is gradually declining, the balance of payment position of the economy will be under increasing pressure[23]. Again it is often claimed that higher population rates create bottlenecks in education, health, and labor absorption. Increased govermental expenditure may result in budgetary deficits, which often reduces investments in more productive channels. Yet another source of linkage between population and income growth is through food supply[24]. Recurrent food deficits can be a big strain on the economy and the balance of payments. Lastly, we have the human capital argument which maitains that the adverse consequences of high fertility for individual families ultimately affect the socio-economic development of the country. The loss of individual potential due to malnutrition and lack of educational oppurtunity can be translated into losses for a nation because of lower aggregate labor productivity, entreprenuerial ability and technological innovation[25].

The companion theory, one with which economic historians will be most familiar, maintains that population growth may in fact boost economic growth[26]. A growing population may contribute to economic development for one or more of the following reasons. First, many nations suffer from a dearth of productive labor, and rising population accompanied reasonable opportunities for training the new entrants to the labor force, will assit in economic growth. In this context, examples may be drawn from sparsely populated regions of the oil-rich middle east today, many of which have to depend on a large number of skilled and unskilled foreign workers to implement their development program. Other historical cases where low population growth rates have been known to inhibit economic growth process at some stage of their development, are countries in East Europe and the Soviet Union. Another hypothesis maintains that faster growing population may have a stimulation influence on demand and reduce investment risks. A third view is that population pressure often encourages technological progress, especially in the agriculture sector[27]. Lastly, some economists have argued a larger population will permit the economy to enjoy the benefits of economies of scale[28].

To summarize, we have found that the literature provides support for the following statements: (1) Economic development negatively affects population growth rate, (2) Economic development has a positive causal impact on population growth, (3) Population growth positively influences economic progress, and (4) Population growth has a negative impact on economic development.

II. Tests of Causal Directions Between Population and Economic Growth

The literature contains plausible hypotheses that the causal link between economic development and population growth may run in either direction and can have either sign. Unfortunately, most of the empirical work is based on cross-sectional regression

analysis where one of the variables is taken as the dependent and the others independent in a priori manner. A strong correlation between population and development is an insufficient basis for establishing causal linkage. Causality tests, however have an advantage over the traditional regression-based analysis in that they allow us to discriminate between both the direction of causation and the sign of the effects[29]. In the present paper, using time-series instead of the usual cross-section data, we are able to rely on temporal predictability as an indication of the possble causation between these two variables.

The general technique follows Granger (1969), where a variable P is said to cause variable Y, with respect to a given information set that includes both P and Y, if current Y can be predicted better by using past values of P than by not doing so, given that all other past information in the information set is used[30]. In other words, the ability of variable P to improve the prediction of variable Y is taken to be an operationally meaningful interpretation of the statement that P causes Y. Formally, let A_t, t = ..., −1, 0, 1, ,..., be the given information set. A_t includes at least (P_t, Y_t), the bivariate process of interest. Let $\bar{A}_t = \{A_s; s < t\}$. Define $\bar{P}_t$ and $\bar{Y}_t$ similarly. Then P causes Y if

$$\sigma^2 (Y_t | \bar{A}_t) < \sigma^2 (Y_t | \bar{A}_t - \bar{P}_t) \qquad (1)$$

where $\sigma^2 (Y|Z)$ denotes the variance of the minimum variance unbiased predicter of Y, given an information set Z.

In what follows, the usual assumption that A = (P, Y) is made. P and Y are presumed to be a pair of linear, covariance-stationary time series. Thus P and Y can be written as

$$P_t = \sum_{i=1}^{m} a_i P_{t-i} + \sum_{j=1}^{n} b_j Y_{t-j} + U_t$$

$$Y_t = \sum_{i=1}^{r} c_i Y_{t-i} + \sum_{j=1}^{s} d_j P_{t-j} + V_t \qquad (2)$$

where (U_t, V_t) is a serially independent random vector with mean zero and finite covariance matrix. The causality tests to be performed can be stated simply:

(a) P causes Y if H: $d_j = 0, j = 1, 2, ..., s$ can be rejected,

(b) Y causes P if H: $b_j = 0, j = 1, 2, ..., n$ can be rejected.

Feedback is said to occur if both (a) and (b) hold.

These causality tests have certain advantages over simple (contemporaneous) correlation-based tests employed in most of the previous studies. Two variables may be correlated yet not causally related because they are both associated with other factors. By including lagged values of the dependent variables and by paying attention to the time series properties of the residuals, the Granger test removes several important sources of spurious correlation.

The interpretation of these causality tests, however, should be subject to some caution. The Granger defination of causality is certainly not equivalent to philosophical notions of causations. Moreover, the test of whether P causes Y will fail to detect the effect of contemporaneous innovations in P and Y.

In a bivariate causality test such as the one adopted here, the question of bias due to omission of variables is natural. However, it must be understood that the purpose of such a test is different from that of ordinary regression analysis. Causality tests address a different problem and ask a different set of questions than regression analysis. Instead of explaining a variable as completely as possible, here we focus on the hypothesized connection between two variables only. Results indicating causality are not considered strong finding as correlation may exist without causality. Negative results, however, create a strong presumption against the causal hypothesis. Thus if the test rejects the hypothesis that P causes Y, a researcher claiming otherwise must now explain why he presumes that to be true.

As indicated, the question of causality is not the only interesting issue at hand: The sign of the effect is also of some importance. Given a finding that P causes Y the sign of the effect can be checked using an F test of whether $\sum_{j=1}^{s} d_j$ is positive or negative. Statistical support for a positive effect indicates that a steady state increase in P leads to an increase in Y.

These tests are performed using annual data for each of the 44 countries, including 19 developed countries. These are chosen on the basis of availability of data on GNP and population from *International Financial Statistics*, with no country having fewer than 15 observations. The data on crude birth rates are taken from *Demographic Yearbook* by the United Nations. We have chosen to use the per-capita GNP because it has been extensively used in the literature as the variable which provides the single most comprehensive measure of economic growth. Crude birth rate, on the other hand, has been used as the measure of population change on grounds that the mortality rate, at least its major portion, is declining more or less independently of the development process[31]. In each country, the growth rate in crude births is regressed on the past values of itself, on past values of the per-capita-GNP growth rate and on a constant. The per-capita-GNP growth rate is regressed on the same variables.

Since in causality tests we attempt to explain one variable in terms of current and past values of a second variable, the question of appropriate lag length arises. Basically, we adopt the criteria of allowing higher lags as long as any explanatory value is left in these variables. Consequently, we follow the strategy of checking the residuals for autocorrelation. Because of the limited number of observations, the lag length is initially limited to two for each of the right-hand-side variables in all the equations (m = n = r = s = 2). In order to whiten the residuals, a maximum likelihood correction of the first-order autocorrelation of the residuals is used in all regressions[32]. A modified Box-Pierce statistic is utilized to test for general autocorrelation in the residuals. When the statistic fails to reject the hypothesis of no autocorrelation in both equations for each country, the causality results are reported. Otherwise, a higher lag length (m = n = r = s = 3) is tried. Out of 44 countries in the sample, only 6 countries showed serially correlated residuals with the shorter lag length, of which three countries passed the test with the higher lag length.

III. Results

Table 2 reports the test results for each country. The F-statistics in the first two columns are for the causality tests indicated at the head of each column. Asterisks indicate cases where the test provides statistically significant support for the causal

TABLE 2

CAUSALITY TEST RESULTS

	F - Statistcis			
	Economic Growth Causes Population Growth	Population Growth Causes Economic Growth	Income Inequality as Measured by Gini-Coefficient (Period)	Causality Character-ization
Developing Countries				
Argentina (1954-73)	.03 (2.43)	1.76 (+) (2.18)	increasing (1961-1963)	
Bolivia (1954-69)	.78 (1.82)	.41 (.34)	unavailable	
Colombia (1954-78)	.05 (6.62)	1.40 (4.37)	increasing (1962-1970)	
Costa Rica (1960-1980)	.42 (3.29)	1.39 (7.69)	decreasing (1961-1971)	
Dominican R. (1954-78)	3.44* (1.51)	.78 (4.71)	unavailable	
Ecuador (1954-78)	3.49** (+) (5.16)	.87 (2.30)	increasing (1965-19700	EDPPG
Egypt (1965-79)	.54 (2.23)	2.62 (+) (3.87)	unavailable	
El Salvador (1954-80)	1.26 (11.96)	.92 (4.92)	decreasing (1967-1969)	
Greece (1956-80)	.32 (12.46**)	.04 (1.65)	unavailable	
Guatemala (1954-80)	.38 (3.63)	.68 (5.59)	unavailable	
Guyana (1960-74)	.54 (.62)	3.26 (.66)	unavailable	
Honduras (1954-76)	4.18** (6.28)	.15 (2.80)	unavailable	
Iran (1959-77)	1.55 (6.78*)	4.29** (–) (2.68)	decreasing (1959-1968)	PGNEG
Israel (1954-78)	.84 (8.25)	.37 (6.77)	increasing (1967-1969)	
Jamaica (1960-80)	1.79 (3.27)	.21 (.42)	unavailable	
México (1954-81)	1.06 (5.62)	1.79 (+) (6.32)	increasing	
Perú (1963-81)	.39 (.47)	5.45** (+) (2.56)	decreasing (1961-1970)	PGPEC
Philippines (1954-73)	.37 (2.44)	.99 (2.50)	decreasing (1961-1971)	
Portugal (1956-80)	2.67* (4.03)	3.36* (–) (8.52)	unavailable	PGNEG
South Africa (1954-75)	.16 (5.03)	.33 (2.68)	unavailable	
Sri Lanka (1954-80)	3.43* (+) 6.16)	2.37 (4.29)	decreasing (1963-1973)	EDPPG
Taiwan (1952-77)	3.91** (–) (3.82)	.23 (5.34)	decreasing (1953-1972)	EDNPG
Tunisia (1960-1978)	7.39** (+) (1.70)	2.26 (–) (2.58)	decreasing (1961-1970)	EDPPG
Uruguay (1955-76)	.77 (5.03)	.56 (3.25)	unavailable	
Venezuela (1954-72)	.58 (1.99)	1.79 (1.72)	increasing (1962-1971)	

(continued)

	F - Statistics			
	Economic Growth Causes Population Growth	Population Growth Causes Economic Growth	Income Inequality as Measured by Gini-Coefficient (Period)[g]	Causality Character-ization
Industrial Countries				
Australia (1955-80)	1.48 (8.16)	.90 (5.81)	unavailable	
Austria (1954-80)	.66 (4.95)	1.36 (8.84)	unavailable	
Belgium (1954-80)	3.52** (–) (2.72)	2.00 (+) (1.69)	unavailable	EDNPG
Canadá (1954-80)	4.68** (–) (4.81)	.79 (2.71)	increasing (1961-1965)	EDNPG
Denmark (1954-80)	5.98** (+) (11.92*)	1.14 (11.66*)	decreasing (1953-1966)	EDPPG
Finland (1954-80)	.98 (4.32)	3.29** (–) (6.97)	increasing (1952-1963)	PGNED
France (1954-80)	1.01 (7.69)	.71 (4.03)	increasing (1956-1962)	
Germany (1954-81)	.14 (4.90)	2.29 (5.76)	decreasing (1955-1964)	
Ireland (1954-80)	2.14 (9.79)	.16 (2.15)	unavailable	
Italy (1960-80)[h]	2.27 (+) (4.27)	.31 (.50)	unavailable	
Japan (1959-81)[h]	3.44** (+) (1.10)	.75 (1.68)	decreasing (1902-1921)	EDPPG
Netherland (1954-80)	.38 (6.79)	.34 (5.07)	increasing (1952-1967)	
New Zealand (1954-80)[h]	.31 (4.25)	4.04** (+) (1.87)	decreasing (1957-1963)	PGPED
Norway (1954-80)	3.82** (5.55)	1.33 (9.07)	decreasing (1957-1966)	
Spain (1954-79)	1.96 (+) (5.86)	.08 (3.75)	unavailable	
Sweden (1954-79)	.41 (7.24)	1.35 (7.94)	increasing (1954-1970)	
Switzerland (1954-80)	.59 (3.34)	1.75 (9.62)	unavailable	
U.K. (1954-80)	.59 (6.19)	3.30** (4.38)	decreasing (1954-1967)	
U.S.A. (1954-81)	.06 (1.98)	3.91** (4.63)	increasing (1960-1972)	

Notes:

*; significant at the 10% level
**; significant at the 5% level
(+) or (–); sign of the sum of the coefficients of the causal variable if it is significant at the 10% level
h; higher log lengths
EDPPG; economic development positively affects population growth
EDNPG; economic development negatively affects population growth
PGPED; population growth positively affects economic development
PGNED; population growth negatively affects economic development
g; Data pertains to income distribution for any *one* of the three groups; Households, Income recipients, and economically active population. The information is from Jain (1973).

hypothese (one asterisk for the 10% level, two for the 5% level). Following the F-statistic, a plus or minus sign in parentheses indicates the sign of the sum of the coefficients of the causal variable if it is significant at the 10% level. The number in parentheses is the value of the modified Box-Pierce statistic. For example, for Belgium F-statistic of 3.52 means that one can reject the null hypothesis that economic growth does not cause population growth at the 5% level. The sum of the effects of lagged income growth on population growth is significantly negative at the 10% level in Belgium. However, one cannot reject, at the 10% level, the hypothesis that the residuals are not autocorrelated.

The final column provides a simple characterization of the test outcome for each country. If the hypothesis that economic development as measured by income growth causes changes in population growth is statistically significant, and if the sum of the coefficients of income growth is significantly negative, then the country is characterized as EDNPG (Economic Development Negatively causes Population Growth). On the other hand, if income growth causes population growth, but the sum of coefficients of income variables is positive then we characterize the case as EDPPG (Economic Development Positively causes Population Growth). Reverse causality patterns are similary defined. In case where the sign of the sum of coefficients of the causal variable is significant but there is no support for causal hypotesis, no label is attached. This follows from the fact that without evidence of causation, the sign of the effect has little economic meaning. On similar grounds, if the sign of the sum of coefficients is insignificant, we do not attach any label even if the causal direction is clear.

The final column shows the remarkable lack of support for any one particular hypothesis. Countries which pass the causality test with a positive sign from economic development to population growth are Ecuador, Tunisia, and Sri Lanka in the developing world, and Denmark and Japan in the class of developed countries. Countries supporting the opposite sign to this causal linkage are Taiwan in the former group, and Belgium and Canada in the latter. Not only is the number of countries with definite causal relations relatively small, but also there seem to be no meaningful patterns of causality characterizations among these countries. For example, according to suggested theories it might well be conjectured that EDPPG characterizes countries at their relatively early stages of economic development, whereas matured economies are associtaed with EDNPG if they are at all. The eight countries with the causal directions from economic development to population growth, however, do not appear to support this conjecture. Notice the sign of Sri Lanka and Tunisia, and compare with that of Denmark and Japan.

A very similar conclusion emerges on the causal direction from population to economic growth. The five countries with significant signs do not tell reasonable stories at all. As an example, consider Finland and Iran which have a negative causal relationship. One would expect these countries to reveal a positive effect of population growth on economic development.

The question naturally arises: Why do we get these results? There can be several explanations. A lack of widespread support for a strong causality between these two variables and the apparent non-existence of causal charaterization among countries passing the test suggest that in fact there may be no consistent causal relationship between these two variables. A second reason may be that the structural complexity surrounding population and economic growth in each country is too great to be captured in a simple bivariate analysis. Associated with this is a possibility of specification error resulting from leaving out some important variables. Since income distribution seems to be an important variable in explaining the difference in population growth rates, we examined the possibility that it might distinguish the different signs. Unfortunately,

the the third column of the table clearly shows that this additional factor is not of much help[33].

Finally, some countries might have undergone structural changes during the short sample period included in the study. Taiwan and South Korea are such examples which transformed themselves from the stage of a poor, resourceless agrarian economy to that of a successful semi-industrialized economy. Such being the case, the fundamental assumption underlying the test that the two variables can be represented as covariance-stationary linear time series is not a valid one[34].

Despite these possible shortcomings, the test in this paper pay more attention to the time series properties of the variables than most of the previous studies which employed international cross-section data. Cross-sectional data could be very troublesome because of the dubious structural stability of coefficients across countries. The tests in this paper are preferable, not only because they emphasize the direction of causation, but also because they do not presume a strong similiarity among different countries.

IV. Concluding Remarks

The Granger notion of causality was utilized to test the various hypotheses on the relationship between economic and population growth rates. The time series results from 44 coutries do not give an unambiguous picture as to the exact nature of this relationship. Thus, attempts to generalize such relationships based on simple cross-section data are strongly suspect.

One should not go too far in putting faith in these results. Admittedly, they have their shortcomings. Nevertheless, the failure to provide a consensus may already be significant for demographers and economic planners.

NOTES

1 For an extensive and up-to-date survey of the literature see Cassen (1976) and Birdsall (1977).

2 The unprecedented amount of research on topics concerning population can only be explained by the interest shown by international organizations and national governments for these issues, which in turn is due to the relevance of these issues to policy questions.

3 This table is not meant to be comprehensive. It is presented to give the reader a flavor of the enormous research on these topics. The interested reader is encouraged to consult one of the excellent survey articles mentioned in footnote 1.

4 Most of the studies mentioned here have used per capita income level as the proxy variable for measuring economic development.

5 Admittedly, as the last column of table 1 shows, most researchers have found negative coefficients on the variable representing economic development in their regression of population growth.

6 This indicates the lack of firm consensus in the profession about the precise relationship between these two important variables. In a recent survey of this literature, Cassen (1976) concludes that 'little support is found for any strong positive or negative relationship between growth of population and that of real output'.

7 This is true inspite of the many simulation models constructed to project the macro implications of population growth on important socio-economic variables. Coale and Hoover (1958) is the pioneering work along this line of research. Ignoring the past trend was justifiable as long as such data were scarce. However, sample data on such trends are currently available. Although the quality of the data and the methodological problems involved make such a analysis exacting, the degree of realism it promises to bring about warrants the effort.

8 To the authors' knowledge this is the first application of this technique in demographic economics.

9 Granger's causality tests that we have employed here help in focussing on two important variables which are potentially interdependent. Thus our objective is not to find the determinants of fertility but to establish the temporal nature of the relationship between economic development and fertility.

10 See Ben-Porath (1973) for tests pertaining to data from Israel.

11 See Schultz (1973) for a theoretical analysis of this issue.

12 De Tray (1973) presents some evidence on this point.

13 The literature also mentions the following factors: a rise in literacy, lesser dependence on future generations to act as insurance, and declining ratio of labor force in agriculture, and higher expectations of life at birth, higher primary and secondary school enrollment. See Adelman (1963), Cassen (1976) and Schultz (1973) for further discussion of some of these variables.

14 Cassen (1976) contains further discussion on this point.

15 This is the essence of the so-called 'demographic transition theory'. See McNicoll (1978) for further references.

16 For such an attempt see Oeschli and Kirk (1975) who construct a development index to show that countries above a certain level experience rapid fertility declines. The value of socio-economic indicators which characterize this particular level of development are a literacy rate of 79 percent, a life expectancy at birth of 60 years, primary shool enrollment ratio of 65 percent, labor force ratio in nonagriculture of 52 percent, an urbanization rate of 40 percent, and a secondary school enrollment ratio of 22 percent.

17 Anker (1978) presents an empirical analysis which tends to support this view mainly in the context of developing countries. Cavanough (1979) points out some pitfalls involved in deriving conclusions from Anker's data.

18 The seeds of this idea, as of many others in the field of demography is contained in Malthus's original tract on population dynamics. See Malthus (1914) for details of this theory.

19 The United Nations report (1973) puts this idea succintly: 'The co-existence of high birth rates characteristic of one type of society with the low death rates typical of a quite different society implies a potential for explosive growth'.

20 Here the distribution of income becomes an important variable. The more equitable the distribution is the larger the number of people affected by development and the greater the decline in fertility expected to be. See Bhattacharya (1975) for additional analysis of this issue.

21 Cassen (1976) mentions that mortality rates in many countries, after undergoing a rapid decline, stabalizes as more complex factors are faced. Bangladesh is a good case in point, where mortality rates have remained unchanged for almost a decade now after a rapid fall in the 60's.

22 The analytical foundation of this theory is found in Nelson (1956) and Leibenstein (1954). The former presents the theory of 'low level equilibrium trap' where population is introduced as an endogenous variable which is influenced by economic development and in turn affects economic growth.

23 See Sen (1975) for a discussion on capital-labor and capital-output ratios for third world economies.

24 One of the first proponents of this particular link was of course Malthus. It might be claimed that history has proved Malthus's contention to be incorrect on this score. However it is scarce possible to deny that famines and malnutrition remain a living threat to much of the third world population even today. See Schultz (1971) for a discussion of the food problem as related to population growth.

25 The importance of human capital argument is underlined by Harbinson (1973) who entitles his book 'Human Resources as the wealth of Nations'.

26 The experience of Europe and Norh America during the industrial revolution is a case in point. One may argue that for most of the third world the situation is radically different today. Not only is the international situation not conducive to development but also the magnitud of growth in population is much greater. However, a vigorous minority disagrees with this pessimistic view. Two of the most well known members of this group are Julian Simon and Ester Boserup. They argue that increasing population, through a variety of channels, such as increased savings and investment in agriculture has a salutary impact on the level of economic development of the society. Simon also argues that the supposed positive impact of economic growth on population growth –the assumption behind the low level equilibrium trap– is non-existant. For these views see Simon (1969, 1976) and Boserup (1976, 1983).

27 See Easterlin (1967) for a slightly different line of argument.

28 Of course most of these linkages may work under special circumstances only. Therefore, one must be wary of generalizing them. Our purpose here was to merely catalouge all possible linkages mentioned in the literature. For a fuller discussion the interested reader is advised to consult the references given.

29 See, for example, Granger (1969), Sims (1972), Pierce and Haugh (1977), and Geweke, Meese, and Dent (1983).

30 There are other methods of testing causality, as in Sims (1972) and in Pierce and Haugh (1977). The Granger test is selected here because of its straightforwardness and especially because it saves degrees of freedom. Since the number of observations is limited, the latter is an important consideration in the present study.

31 See Preston (1975) for some arguments in favor of and against this assumption.

32 This procedure increases the total lag length from 2 to 3, but it leaves only 5 unrestricted coefficients for the 6 lagged variables.

33 Repetto (1974) presents some evidence that gini-coefficient and crude birth rate may be inversely related.

34 If these countries have long enough time series data, then it might be interesting to see how the causal pattern evolves over time.

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LABOR MARKET MALADJUSTMENT IN CHILE; STRUCTURAL ECONOMIC REFORMS AND FRICTION AMONG SUB-MARKETS

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Abstract:

This paper discusses the main features of the labor market performance in the Chilean economy during the 1970s. Its purpose is to analyse several explanation for Chile's high unemployment levels on the basis of the stylized facts surrounding labor market behavior. Several interpretations on the heavy unemployment prevailing in Chile have been based on the role played by either the labor demand downfall or the abnormal increase in the labor supply. However, those hypotheses have failed in providing a satisfactory explanation for the lack of adjustment seen in the labor market. In this paper, the available evidence on sectoral shifts of production and employment is analyzed in terms of their implications for the unemployment persistence. Owing to the demands for inter-industry labor reallocation stemming from the change in the productive structure, the role played by the existence of industry-specific human capital is stressed. The results detailed here suggest that the persistence of heavy unemployment can be importantly attached to a series of disruptions in different industries; that these disruptions could not be accomodated smoothly in the short run; and that the market has been responding but only slowly.

1. Introduction

The economic reforms carried out in the Chilean economy since 1973 seem to have affected the functioning of the labor market both directly (through deregulation) and indirectly (as a by-product of the objective of improving macro-efficiency). Predictably,

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