LIFE CYCLE HYPOTHESIS AND HUMAN CAPITAL:

AN APPLICATION FOR MEXICO

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I

INTRODUCTION

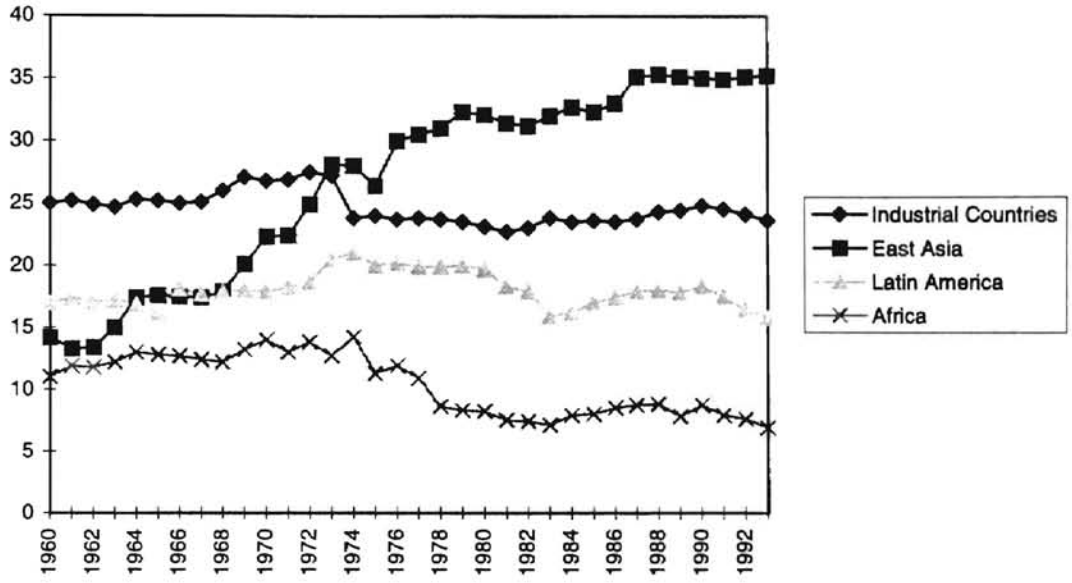
In the past few years, a renewed interest in issues related to economic growth has arisen. It reflects a new consensus among economists that better standards of living and the elimination of poverty must be based on sustained economic growth.

This interest has been particularly high in Latin America, where some authors have argued that low saving rates are one of the most important restrictions affecting many countries.[1] Some data illustrate this argument and exemplify the well established strong relationship between saving and income growth. According to the World Bank (1993), the ratio of gross domestic saving to GDP was 20% in Latin America in 1991, more than 15% below that of the East Asian Countries. However, in the last 20 years, GDP per capita growth averaged almost 5% in East Asia, and only about 1% in Latin America. Both, developing and developed countries are concerned with saving and growth, however, not all countries posses the necessary conditions and instruments to stimulate saving. Figure 1 shows the increasing disparity of saving rates in the world during the past 30 years.

[1] For a review see Schmidt-Hebbel, et al. 1996. Household Saving in Developing Countries. *World Bank Economic Review* 6 (September): 48-71.

Figure 1

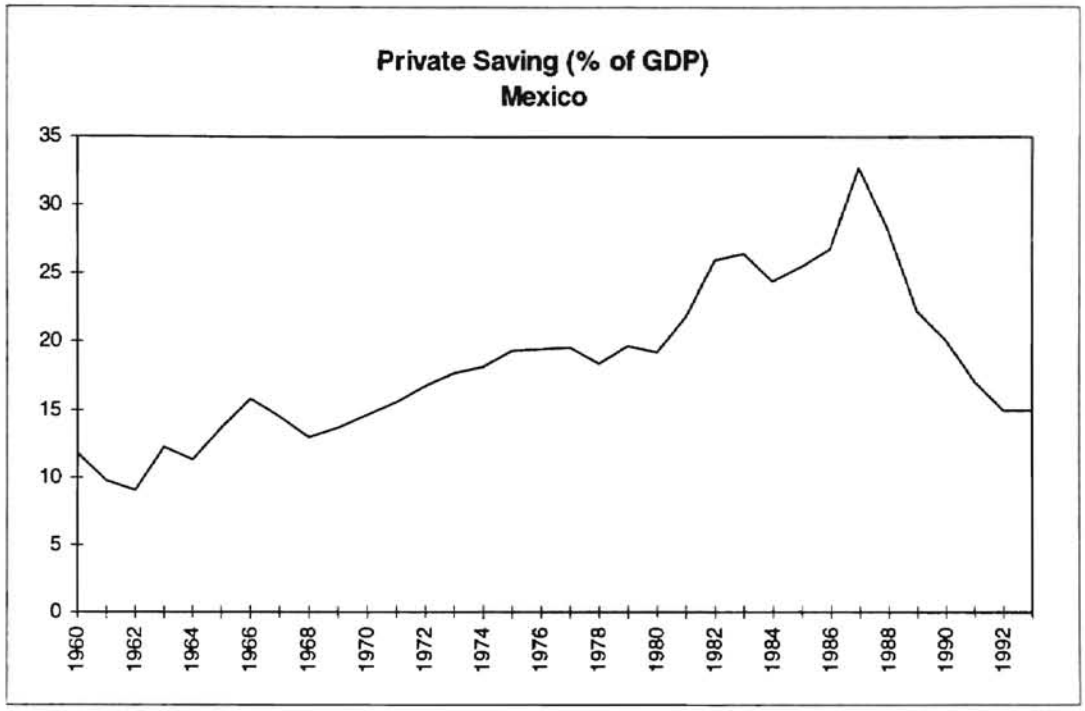
Gross Domestic Saving (% of GDP)



Source: World Bank Social Indicators of Development

In the case of Mexico, a decrease in saving has been observed in recent years (Figure 2). Gross domestic saving shrank from 26.4% of GDP during 1980-1987 to 20.7% during 1988-1994. Consequently, issues related to national saving have became of great importance, at least from the policy point of view. During the last two federal administrations, the promotion of saving has been a major piece in the structure of the national policy. The 1995-2000 National Development Plan (Gobierno de la República 1995) proposed in one of the five strategy guidelines to promote sustainable economic growth "to make domestic savings the cornerstone of national development financing and assign foreign saving a complementary role for the purpose of promoting productive investment." Within this plan, private saving have had special attention.

Figure 2



Source: Aspe (1993)

According to Aspe (1993), "for the past forty years, a vast majority of the population has lacked access to instruments through which to save for retirement and insure against a variety of risks. Because people have not been able to make intertemporal and intergenerational transfers through the financial system, they have had to rely on other means, such as having more children to look after them when they get old, or by buying durables, which are certainly not registered as savings."[2] Within this scenario, the government has undertaken a process of deep reform in two strategic economic areas, the

[2] Pedro Aspe was Minister of Finance from 1988 to 1994.

social security system and the financial system (Coorey 1992). These policies are expected to have a positive impact on private saving.

Apparently, the Mexican government is following the international trend of recent years, where market liberalization and privatization of strategic sectors are the dominant consideration. This approach to the problem and its treatment, however, could be incomplete. There is no explicit recognition of the role of population demographics and human capital on the determination of private saving. Formulation and implementation of policies devoted to increase saving seem to ignore the importance of a young and relatively illiterate population in Mexico. As Deaton (1989) has pointed out, "developing-countries households tend to be large and poor; they have a different demographic structure [from that of developed countries]; more of them are likely to be engaged in agriculture; and their income prospects are much more uncertain." Then, saving behavior needs to be analyzed from a more 'domestic' point of view, that is, to consider the particular characteristics and distinctive elements of the country under research. A good example of this approach is Japan (Horioka 1991).

The purpose of this study is to investigate the effects of demographic factors and human capital accumulation on private saving in Mexico. The discussion pays special attention to the age distribution of the population as well as to its education level. In spite of the fact that this is not a policy-oriented paper, in the sense of formulating and recommending policies, the intention is to emphasize the importance of population demographics and human capital accumulation, as an attempt to contribute to the

improvement of the design and implementation of policies, by enriching the knowledge of the problem and its approach.

Section II presents a literature review with regard to previous studies on demographics, human capital and saving. Section III contains the theoretical foundation of the model used. The analysis is within the framework of the standard life cycle hypothesis model, but it also emphasizes the role of education and urbanization in determining saving. The empirical specification and results are presented in section IV. Finally, in section V, some conclusions are commented.

II

RELATED LITERATURE

There is a large literature dealing with the relationship of demographic changes and aggregate saving, and much work has been done on the ability of the life cycle model to explain aggregate saving. An excellent survey can be found in Gersovitz (1988). This section presents a review of studies on demographics, human capital and saving.

According to Bilsborrow (1979), the idea that high rates of population growth exert negative effects on saving,--which he calls the Coale-Hoover-Enke-Demeny hypothesis[1],-- has received substantial empirical support beginning with the work of Leff (1969), which was one of the first investigators to provide statistical evidence of such hypothesis, showing that high dependency ratios have a negative impact on saving. His results, however, have been criticized by some economists for a variety of reasons. Adams (1971), for example, argues that a pressure of an increased family could have a positive effect on the motivation of the head of the family, and his or her response will affect favorably productivity and output. So, the effect of higher population rates can generate higher levels of saving and capital formation. Leff (1971) answered to this by

[1] References are to A. Coale and E. Hoover. 1958. *Population Growth and Economic Development in Low-Income Countries*. Princeton: Princeton University Press. S. Enke. 1960. The Economics of Government Payments to Limit Population. *Economic Development and Cultural Change* 8 (July): 339-348, and P. Demeny. 1965. Investment Allocation and Population Growth. *Demography* 2: 203-232.

reasoning that such argument would imply that small families suboptimize household resources, which goes against the abundant evidence concerning the economic rationality of micro-decision making. Larger family size has a debilitating effect and reduce capacity to work harder. Then, there exists a positive relationship between consumption and young dependency ratios.

Bilsborrow (1980) has also criticized the work of Leff by suggesting that his results may not be the same under a more careful analysis. He argues that Leff's results are "partly a consequence of a scaling error in one of the independent variables and several conceptual and methodological difficulties compromise the entire procedure". Responding to Bilsborrow, Leff (1980) himself surveyed the literature and the evidence supporting his results. He concludes that the findings on his original paper stand.

Even though several users of Leff's results have been quite cautious, considerable credence has been given to them in the last years. Evidence based on aggregate data typically supports the predictions of the life cycle model regarding demographics and saving. A summary of results obtained by several investigators in the past is shown in Table 1. In most cases, demographic effects are statistically significant.

The impact of a change in the elderly dependency ratio typically exceeds that of the youth dependency ratio. Despite this apparent consensus, however, some authors claim that models built upon the life cycle hypothesis do not seem to perform very well in empirical applications (Bosworth 1991).

Table 1[2]

Effect on Saving Rate of 1% point rise in Demographic Ratio

	Youth[3]	Elderly[4]
Aggregate cross section studies	(t-statistics in parenthesis)	
Modigliani (1970)	-0.20 (3.7)	-0.88 (3.1)
Modigliani and Sterling (1983)	-0.13 (1.4)	-0.51 (4.3)
Feldstein (1980)	-0.77 (3.9)	-1.21 (2.7)
Graham (1987)	-0.87 (2.9)	-0.12 (0.3)
Koskela and Viren (1989)	-0.73 (1.7)	-0.76 (0.8)
Horioka (1991)	-0.44 (1.7)	-1.09 (2.4)
OECD (1990)	NA	-0.93 (2.4)
Time Series Studies		
Shibuya (1987)	NA	-0.34 (3.8)
Horioka (1991)	-0.30 (5.1)	-1.13 (3.7)
Masson and Tyron (1990)	-1.10	-1.10

One major point of disagreement originated in the dynasty models, in which saving of the elderly arises primarily from accumulation intended for bequests, so that the effect on saving of elderly households might be less than that predicted by the life cycle hypothesis (see Hayashi, Ando and Ferris 1988). This alternative explanation for the saving by elder households is mainly based on the experience of wealthy economies such as Japan, on which there is some evidence supporting this idea (Horioka 1993).

[2] Partially taken from Meredith (1995)

[3] Young dependency ratio is defined by the World Bank as population younger than 16 years old relative to working-age population (those between 16 and 64 years old).

[4] Old dependency ratio is defined by the World Bank as population older than 64 years old relative to working-age population (those between 16 and 64 years old).

Few authors include the urbanization effect of the population in their studies. Edwards (1995), for instance, finds a negative effect of the urbanization rate[5] on private saving. A possible explanation for this result is that consumers save so that they can shield their consumption against unpredictable fluctuations in income. Because income derived from agricultural activities is more volatile than income dependent on other non-agricultural activities, additional saving in rural areas is required to provide a buffer between an uncertain income and a consumption level. This behavior of building a reserve against unforeseen contingencies, the precautionary demand for saving, is usually described as extra saving caused by future income being random rather than determinate (Leland 1968). Deaton (1989) support this idea by arguing that even multiple earners will not ensure a consumption level for the household if all are dependent on local agriculture. So, saving is required to provide a buffer between a uncertain income and a low consumption level.

Little attention has been paid to the relationship between saving and the accumulation of human capital through increases in the coverage and quality of education. Recent empirical studies like Barro and Lee (1994) have found that higher education attainment promotes higher economic growth rates. Gradual increases in saving are necessary in order to finance the educational needs of future generations and keep the stock of human capital growing. This intergenerational approach has been studied by Azariades and Drazen (1990). Mankiw, Romer and Weil (1992) analyze how educational attainment of the labor force affects output and the growth of the economy. Morisset and Revoredo (1995) in a panel of 74 countries have found that the relationship between

[5] Proportion of total population that live in urban areas.

saving and the stock of human capital is far from uniform across regions. It appears strongly positive in Asia, but negative in Latin America over the last 3 decades. They have found that, in the long run, education improves national saving and hence growth, but this positive effect takes time to be completely realized and it varies across regions and levels of development. Finally, Michael (1972) has found that human capital has a positive effect on the efficiency in consumption.

III

THE MODEL

The life cycle hypothesis (Modigliani and Brumberg 1954, and Ando and Modigliani 1963) posits a relationship between the age structure of the population and saving. Demographic changes, on the other hand, produce important shifts in the behavior and geographic distribution of populations.

The standard life cycle model[1] envisions an individual with a flow of earnings through time and an initial endowment of wealth, choosing a consumption path to maximize lifetime utility. Consumption is financed from lifetime earnings and inherited assets, where the choice is governed by a set of intertemporal preferences. Rational forward looking individuals attempt to keep the marginal utility of expenditure constant over time, because they will not want expenditure to be worth more (in discounted utility terms) in one period than in any other. According to Deaton (1992), the most widely used assumption is that preferences are intertemporally additive. Additivity means that the marginal rate of substitution between any two periods is independent of the level of consumption in any other period. In addition, additivity rules out phenomena such as

[1] This model is considered an extension of the hypothesis of optimal allocation over time, elaborated by Irving Fisher (1930). Following Tobin (1967 pp. 231-256), "Irving Fisher provided the foundations of the theory of saving and interest a half-century ago. Much recent and contemporary work is rediscovery or elaboration of what Fisher knew and wrote."

habit formation or the existence of goods whose benefits persist beyond the act of consumption. It should be noted, however, that the utility maximization process comes from consumption, not expenditure (see Magrabi, et al. 1991). Thus, even if the consumer prefers to maintain the same level of consumption in each time period, that does not mean that expenditures need to be equal. In other words, durable goods bought in the past, may contribute to the flow of consumption without adding to expenditure. With a perfect capital market assumed, consumers from some given generation are supposed to choose how to allocate their lifetime assets over the life cycle.[2]

One approach to this problem for finitely lived individuals is as follows:[3]

$$\textbf{max}\ U = \sum_{t=1}^{T} (1+\delta)^{-t}\, u_t(C_t, Z_t) \qquad (1)$$

$$\textbf{s.t.}\quad \sum_{t=1}^{T} C_t/(1+r)^t = A_t + \sum_{t=1}^{T} I_t/(1+r)^t \qquad (2)$$

where:

[2] The assumptions of intertemporal additive quadratic utility functions, perfect capital markets and rational expectations, are used to construct the Certainty Equivalence Model (CEQ). See Browing and Lusardi (1996) for a more complete description of the model. A difference to the CEQ model, the model presented here permits for non-quadratic preferences in order to allow for the precautionary motive.

[3] This approach was taken from Deaton (1992)

U is an additive utility function. δ is the rate of time preference. It measures whether an increase in current consumption increases utility by a greater amount than an equal increase in future consumption, that is, utility in the future is discounted to the present at rate δ. C_t is consumption in period t. I_t is income in period t. The real interest rate is r, it is held constant over time to avoid the notation of multiple discount factors. A_t are assets in period t. In the last period T, there is no reason to save due that in the basic model bequest motives and no uncertainity[4] are ruled out, so $A_T = 0$. Z_t is the private saver demographic structure variable vector. It contains variables that affect the desirability of consumption at different points in the life cycle. This vector is discussed below. T is the lifespan of individuals.

The combination of additive utility and the budget constraint gives a useful characterization of life cycle behavior. The first order condition for maximizing (1) subject to (2) is:

$$\mu\{(1+\delta)/(1+r)\}^t = u'_t(C_t,Z_t) \qquad (3)$$

Because it applies to the lifetime constraint, μ, the Lagrange multiplier, is constant over time. The marginal rate of substitution between two periods equals the discount factor $(1+r)/(1+\delta)$, which is identical to the usual formulation of consumer choice:

[4] In some recent literature, expected utility theory has been abandoned; consumers are endowed with preferences that violate the axioms of choice under uncertainty. According to Deaton (1992) "there are some good arguments for such a strategy. First, there is a good deal of evidence, experimental and otherwise, that the axioms of choice are frequently violated by the actual choices that people make in uncertain situations. Second, decision theorists have developed different non-expected utility models that can be used to generate simple, empirically useful models that break the restriction between risk-aversion and intertemporal substitutability".

$$u'_t / u'_{t+1} = (1+r)/(1+\delta) \qquad (4)$$

If the incentive to wait (r) overcomes impatience (δ), it pays to postpone consumption. The results of consumer theory are applicable to choices over time. Then, the effects of assets, income and interest rates can be studied using the standard tools of demand analysis. The central discussion however deals with the 'taste shifters' Z_t. Suppose that $r = \delta$ so that the right side of equation (4) is constant equal to 1. It can be shown that in particular periods in the life cycle the variables in the vector Z make the marginal utility of consumption high, then, since the marginal utility function is decreasing in its first argument C_t, consumption in that period must also be higher. This reasoning provides an explanation for several life cycle phenomena. For example, if there are a increasing number of young people in a society (this effect is captured in the Z variables), the marginal utility of additional consumption will be higher, so that consumption can be expected to be positively related to the number of young people.

IV

EMPIRICAL SPECIFICATION AND RESULTS

A. Empirical Specification

Solving equation (3) for C_t and for a positive Lagrange multiplier:

$$C_t = \phi \{\mu[(1+\delta)/(1+r)]^t, Z_t\} \quad (5)$$

where ϕ is a function not indexed on t and C_t depends exclusively on its arguments. Equation (5) can be used for empirical purposes in analyzing the role of demographic factors.

The vector of demographic variables Z is defined as:

$$Z = (YAGE, OAGE, AGEDEP, BIRR, URBR, PRIR, SECR, TERR, RGDPCG, RGDPC) \quad (6)$$

where:

$YAGE_t$ = Young dependency ratio defined as population younger than 16 years old relative to working-age population (from 16 to 64 years) in period t.

$OAGE_t$ = Old dependency ratio defined as population older than 64 years relative to working-age population (from 16 to 64 years) in period t.

$AGEDEP_t$ = Age dependency ratio defined as the summation of $YAGE_t$ and $OAGE_t$ in period t.

$BIRR_t$ = Number of live births per thousand in period t.

$URBR_t$ = Urban population relative to total population in period t.

$PRIR_t$ = Number of students enrolled in first level of education (primary and secondary school) relative to total population in period t.

$SECR_t$ = Number of students enrolled in second level of education (high school and technical education) relative to total population in period t.

$TERR_t$ = Number of students enrolled in third level of education (college and other superior education) relative to total population in period t.

$RGDPC_t$ = Real gross domestic product per capita in period t.

$RGDPCG_t$ = Real gross domestic product per capita growth in period t.

The basic following consumption function is tested:

$$C_t = \alpha_0 + \alpha_1 YAGE_t + \alpha_2 OAGE_t + \alpha_3 BIRR_t + \alpha_4 URBR_t + \alpha_5 PRIR_t + \alpha_6 SECR_t + \alpha_7 TERR_t + \alpha_8 RGDPC_t + \alpha_9 RGDPCG_t + \varepsilon_t \quad (7)$$

The dependent variable C, represents real consumption per capita. Nominal consumption and nominal GDP are deflated using CPI (1990=100). Consumption time

series tend to be nonstationary, so that, by using real consumption per capita, the stationariety of the series is ensured.[1] The Two Stages Least Squares (TSLS) estimation procedure was used to account for the simultaneity between consumption and GDP[2] .

Data for demographic and human capital variables were taken from the UNESCO Demographic Yearbook, the UNESCO Statistical Yearbook and The World Bank Social Indicators of Development. National accounts data were taken from the IMF International Financial Statistics (several issues from 1960 to 1995).

Saving is more difficult to measure in developing than in advanced economies. The standard data sources for Mexico tend to leave saving in a penumbruos area. Gross national saving (GNS), as defined in the national accounts, represents a residual between gross national product (GNP) and total (private plus public sector) consumption. Net national saving is obtained by reducing this amount by an estimate of capital consumption allowances (true economic depreciation). Finally, to obtain private sector saving from the national accounts data, one reduces national saving by some estimate of government saving. As is apparent, the residual nature of the saving measure results in some inadequacies. For this reason, consumption date are used instead of saving data, with the intention of avoid such inadequacies.

Demographic theory indicates that a prolonged high birth rate affects the age composition of a population, resulting in a relatively large percentage of it in the younger age side (Coale 1972). The logic of a positive relationship between young dependency ratio (YAGE) and consumption, is that children constitute a heavy expenditure. They

[1] See appendix A for unit root tests.
[2] See appendix B for TSLS implementation.

contribute to consumption but not to income. Then, a high number of dependents relative to those in their working-age years, might be expected to reduce saving. Another factor supporting this arguments is the fact that children demand time to take care of -time that could be used to work- besides their simple consumption needs, as well as energy.

With regard to the relationship between saving and the older age side of the population, the reasoning is that since the later part of the life is typically spent retired from market activity, assets accumulated in the working age will be liquidated to finance consumption; thus, a positive relationship is expected. However, as Kotlikoff and Summers (1981) argue, this relationship may be negative if the bequest motive is particularly strong.[3] This does not imply that intentional saving for gifts and bequests is the principal motive for saving, but as Kotlikoff (1988) shows, there is strong evidence that intergenerational transfers play a very important role in the U. S. wealth accumulation. He also argues that intergenerational transfers could arise in the life cycle model in the absence of well-functioning financial markets, and then, bequests would be involuntary and potentially quite sizeable. The life cycle hypothesis, on the other hand, claims that wealth is not strongly related to bequests, since this accumulated saving will be used to consume in later stages of the life cycle. Furthermore, because a perfect capital market is assumed, a positive relationship between consumption and old dependency ratio is expected.

A positive sign is expected for the urbanization variable (URBR). Two major arguments support this expectation. According to the Buffer-Stock theory of saving

[3] For many years the bequest motive was considered as the most important source of saving and of the existence of wealth.

consumers hold assets mainly so that they can shield their consumption against unpredictable fluctuations in income (Carroll 1992). Given that income derived from agricultural activities is inherently uncertain, the household accordingly will save during "good times" to provide for the "bad times". In this sense, saving provide a buffer between uncertain income and a low consumption level by smoothing consumption through time (Deaton 1989). This means that agricultural-dependent sectors of the economy, namely rural areas, tend to save more because of their uncertain income.

The second argument supporting this positive relationship is given by the idea of the rural-urban migration decision, where unemployment expectations play a fundamental role.[4] Typically, the most drastic fluctuations in household income are those associated with unemployment situations, so that if each potential migrant decides whether or not to move to the city on the basis of an implicit expected income maximization objective, their decision will be affected by two principal factors. The first, relates to the existing rural-urban real wage differential that prevails for different skill and educational categories of workers. The second relates to the probability that a migrant will be successful in securing an urban job. Both factors suggest that people who move to the cities do it because they expect to get a job and, ultimately, a higher and more stable income. Then, the expectation of a less uncertain income can have a negative impact on saving, which explained by the reasoning of the Buffer-Stock theory of saving.

Accumulation of human capital through increases in the coverage and quality of education has a positive impact on labor productivity, technology and consequently in economic growth (Romer, 1990). It is generally accepted that education and saving are

[4] For a formal rural-urban migration model see Todaro (1969)

related and that higher education level will increase current saving due to its positive effect on expected income. This relationship, however, can also be negative, specially in the earlier years of education, when instruction expenses increase consumption and reduce disposable income. In order to capture these effects, the vector of variables Z contains three human capital proxy variables representing three levels of education, PRIR, SECR and TERR. The approach on this paper follows the work of Mankiw, Romer and Weil (1992), in which in order to measure human capital, they use the percentage of the working-age population enrolled in secondary school as a human capital proxy variable.

B. Results

In Table 2, columns 1 through 7 summarize the regression based on equation (7) for Mexico, for the period 1960-1994, using annual data.

The intercept is statistically significant in all models. It captures the effect of variables not included in the model. The regression coefficients are interpreted as elasticities.

The results support the hypothesis concerning the effect of young dependency ratio over consumption, but they do not support the effect of old dependency ratio over consumption. Columns 1 and 2 show a positive relationship for both, young and old dependency ratios, however, the relationship is statistically significant only for the young dependency ratio. This results implies that elder population has no effect over consumption suggesting that, as bequest motive models propose (Kotlikoff and Summers 1981), life cycle saving is used for intergenerational transfers as well as than for retirement. So, it is possible that the older segment of the population do not spend as much as the theory predicts, even after retirement. Supporting this idea, column 3 presents the combined effect of young and old dependency ratios over consumption. The coefficient for AGEDEP (0.535) is almost identical to the coefficient for YAGE (0.524 in column 1 and 0.537 in column 2), showing that OAGE adds nothing to the impact on consumption.

Table 2

	Dependent Variable: Real Consumption per Capita Deflated by CPI (1990=100) (t-statistics in parenthesis) Mexico 1960-94 (annual)						
	1	2	3	4	5	6	7
Intercept	**8.56** (2.083)	**4.796** (2.124)	**3.584** (2.106)	**2.98** (2.156)	**6.82** (2.706)	**5.785** (2.370)	**5.731** (2.280)
YAGE	**0.524** (2.033)	**0.537** (2.023)					
OAGE	**0.232** (0.412)	**0.211** (0.719)					
AGEDEP			**0.535** (2.354)				**0.436** (2.77)
BIRR				**0.303** (2.599)			
URBR	**2.212** (2.064)	**1.78** (2.763)	**1.37** (2.650)	**0.894** (2.724)	**2.078** (2.32)	**1.048** (2.929)	**1.074** (2.145)
PRIR	**0.764** (2.187)				**0.748** (2.430)	**0.394** (2.667)	**0.371** (2.128)
SECR	**-0.183** (-1.773)				**-0.196** (-1.356)		
TERR	**0.006** (0.070)				**0.019** (0.239)		
RGDPCapita	**0.322** (2.177)	**0.604** (3.542)	**0.625** (3.572)	**0.93** (9.802)	**0.372** (2.197)	**0.427** (2.207)	**0.433** (2.184)
RGDPCGrowth	**1.22** (4.634)	**1.174** (4.846)	**1.19** (4.910)	**0.959** (3.776)	**1.218** (4.807)	**1.253** (5.205)	**1.25** (5.057)
adj r2	0.9648	0.9659	0.9655	0.9667	0.9668	0.967	0.9658
prob>F	0.001	0.001	0.001	0.001	0.001	0.001	0.001
DW	1.888	1.819	1.811	1.98	1.961	1.832	1.828

All variables are expressed in log with exception of RGDPGrowth.
TSLS has been used in all regressions.

The effect of the birth rate is shown in Column 4. As expected, it is positive and statistically significant.

With regard to the human capital proxy variables, columns 1, 5, 6 and 7 show a similar pattern. The number of persons enrolled in the first level of education (PRIR) is directly related to consumption, while the second and third levels have no effect. In columns 1 and 5 the sign for SECR is negative and positive for TERR, but they are not statistically significant. As expected, at earlier stages of education, as primary and secondary school, more children imply an higher level of consumption.

Mankiw and Romer (1992) use second level of education (SECR) as their human capital proxy variable. In this study the relevant variable appears to be the first level of education (PRIR). The reasons for this result are unknown.

As the theory predicts, there is a positive effect of income and income growth over consumption. According to Friedman (1957), consumption depends primarily on permanent income but the data reflect a combination of permanent and transitory income. Then, these results suggest that in this 34-year period , Mexico has experienced increases in permanent income that have been reflected on consumption levels. The coefficients in all regressions for real GDP per capita are very consistent and statistically significant.

The expected positive effect of urbanization on consumption appears to be very important. In all models it is statistically significant and is the variable with the biggest elasticity. On accordance to Edwards (1995), the degree of urbanization plays a significant negative role over saving, specially in Latin America. As stated in the previous section, a possible explanation for this relationship is that income derived from

agricultural activities is more uncertain than income derived from non-agricultural activities, so, greater saving is needed in rural areas, relative to urban areas, to smooth consumption through time.

Another possible explanation for these results is that urban clustering implies some problems and costs that are uniquely urban, such as public health dangers, noise, pollution, congestion and disorders, which directly or indirectly, increase the cost of living in the cities. Thus, these diseconomies of urban scale can have a positive impact on the household consumption level.

The results in table 2 suggest that there is a causal relationship between real consumption per capita and urban rate, and not a simple statistical relationship. Smith (1975) for instance, found a positive relationship between urbanization and per capita GNP in a cross section study.[1] He argued that if there is causal relationship between urbanization and income, it is possible that the relationship works in the opposite direction, that is, after a nation achieves a higher income level, people move into the cities where they spend their money. However, it has been suggested in the literature that at the initial phase of development, economic growth of a country leads to populations concentration in a few cities where growth can be realized, and that this is followed by a second phase of development when economic growth leads to population dispersal.[2]

In the case of Mexico, sustained economic growth was observed until 1981, when the country experienced a fall in real GDP per capita of about 2.9% which broke the upward trend of the previous 20 years.

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[1] Data were limited to those nations with total populations of more than ten million in 1960.
[2] See for instance Alperovich (1992).

Figure 3

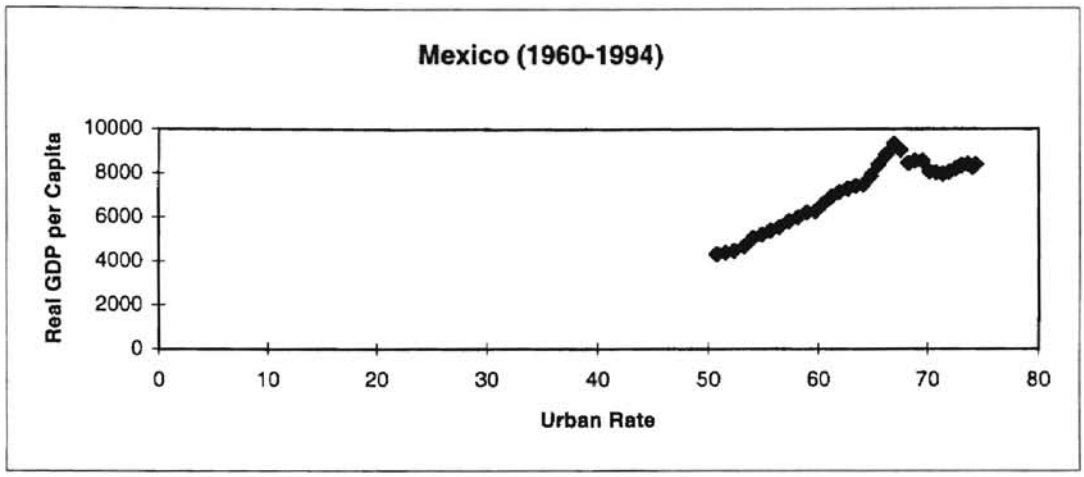


Figure 4

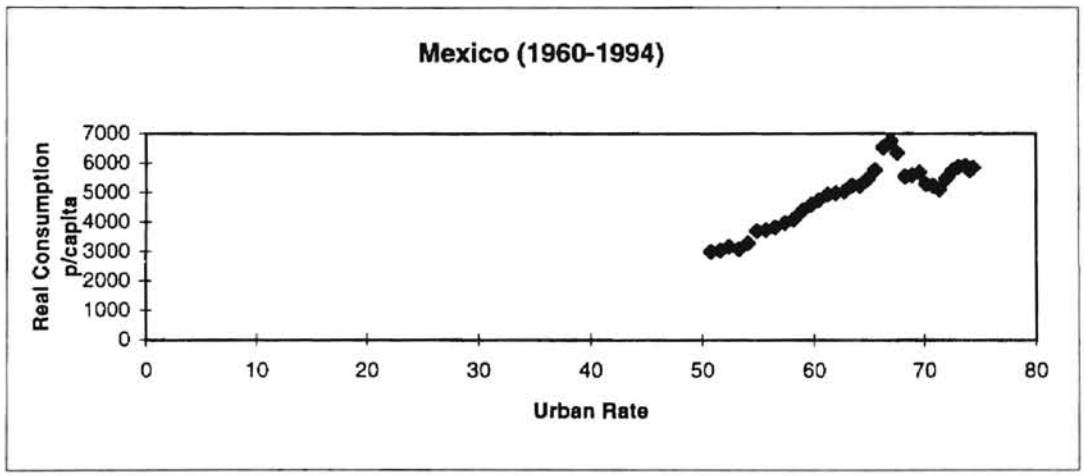
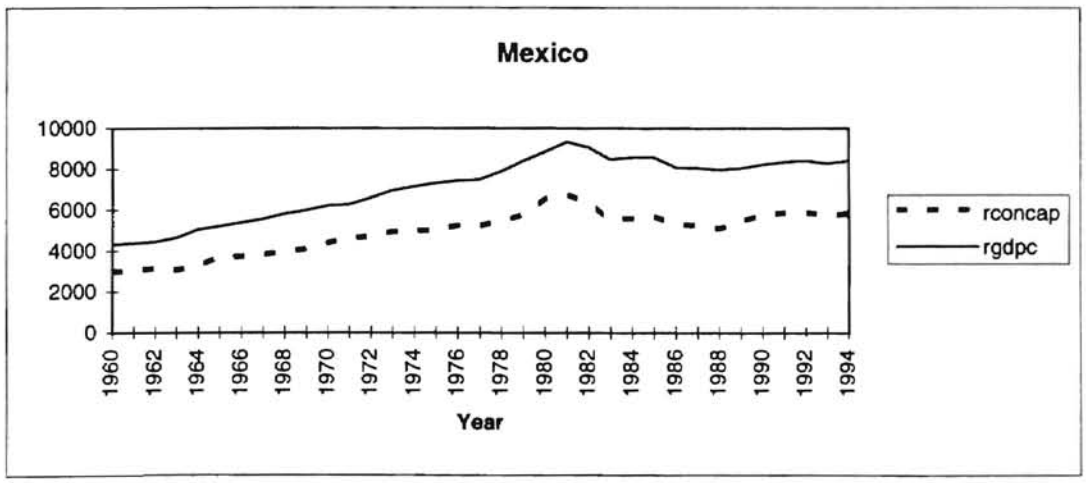


Figure 5



The urban rate, on the other hand, continued growing in spite of the negative economic scenario while the real consumption per capita was also falling as a consequence of the income reduction (see Figures 3, 4 and 5 on the previous page). This observation raises the question about the existence of an "optimal" urban rate, where the consumption level is at a maximum.

Columns 1 through 3 in Table 3 show that real consumption per capita can be thought to be a quadratic function of the urban rate. The negative sign of URBSQR implies that an 'optimal' urban rate can be derived in the sense that because of consumption grows at a decreasing rate, a maximum consumption level can be found. This 'optimal' urban rate is the one at which the slope of this curve equals zero and the sign of this relationship is reversed becoming negative. The calculated 'optimal' urban rate is 62.4%[3] which is close to the 67% registered for the year 1981 when the maximum level of real consumption per capita was registered.

The economic literature remains inconclusive respect to the relationship between urban concentration and economic variables such as economic growth and consumption; time-series studies and cross-section studies have given contradictory results. For the case of Mexico, a few more observations will be helpful to clarify the nature of this relationship.

[3] It is the average of the 'optimal' rates calculated for columns 1, 2 and 3 in table 3.

Table 3

	Dependent Variable: Real Consumption per Capita Deflated by CPI (1990=100) (t-statistics in parenthesis) Mexico 1960-94 (annual)		
	1	2	3
Intercept	**4.64**	**5.427**	**7.93**
	(2.249)	(2.610)	(1.891)
YAGE			**0.305**
			(1.473)
OAGE			**0.193**
			(1.055)
AGEDEP		**0.279**	
		(2.236)	
BIRR	**0.194**		
	(2.283)		
URBR	**1.515**	**1.351**	**1.43**
	(2.719)	(2.211)	(2.363)
URBSQR *	**-0.415**	**-0.36**	**-0.402**
	(-0.218)	(-0.139)	(-0.667)
PRIR	**0.301**	**0.362**	**0.517**
	(1.892)	(2.662)	(2.416)
RGDPCapita	**0.573**	**0.448**	**0.369**
	(2.052)	(2.062)	(2.322)
RGDPCGrowth	**1.106**	**1.237**	**1.227**
	(3.974)	(4.592)	(4.561)
adj r2	0.966	0.9645	0.9647
prob>F	0.001	0.001	0.001
DW	1.933	1.839	1.844

All variables are expressed in log with exception of RGDPGrowth.
TSLS has been used in all regressions.

*** URBSQR = (log URBRATE) ^ 2**

V

CONCLUSIONS

The age composition of the population in Mexico constitutes an important factor determining consumption and saving. An increasing number of young people relative to total population has a negative impact on saving. Demographic tendency in Mexico shows that that the age dependency ratio has been declining over the years and that it will continue this decreasing tendency, which implies an increase in the population that will be working and saving. However, changes in the age distribution occur slowly, so that the effects on saving and consumption can only be seen in the long run.

Investment in human capital may be a key factor in promoting development and economic growth, but not to increase saving. Second and third education levels have no effect on consumption during the period studied, while the first level has a positive impact. This last result goes in line with the ones obtained for the age distribution, where younger people, that is, those attending primary school, are the sector of the population which more contribute in the household consumption.

Finally, instruments to reduce migration to the cities should be seriously considered. It is a popular misconception that high population growth induce urbanization, but rapid population growth is unnecessary for urbanization. The process of

urbanization is a mere movement of people to industry and services sectors from agricultural activities. The period analyzed include ten years of the period 1955 and 1970, known as " Stabilizing Development", during which Mexico experienced rapid industrialization and urbanization. During this period of relative economic expansion, the industrialization process was not accompanied by an effective urbanization policy, which conduced to the highly concentrated Mexican cities of these days affecting negatively the creation of saving.

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APPENDIX A

UNIT ROOT TESTS

The finding of a unit root in a time series indicates nonstationarity (Darnell 1994, 386-387). Unit root tests were performed on both, real consumption and real consumption per capita. The "Augmented Dickey-Fuller" regression equation (Dickey and Fuller 1981, 1057-1072) of the following form was utilized:[1]

$$\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \alpha_2 t + \sum_{j=1}^{p} \gamma_j \Delta Y_{t-j} + e_t$$

where e_t for t=1,....N, is assumed to be white noise. The test statistics calculated are:

Null hypothesis	Test statistic
$\alpha_1=0$	t - test[2]
$\alpha_0= \alpha_1= \alpha_2=0$	F-test[3] (ϕ_2)
$\alpha_1= \alpha_2=0$	F-test (ϕ_3)

[1] Shazam was used to perform these calculations.

[2] When $\alpha_1=0$ the time series is nonstationary. Null hypothesis can be rejected if the t-test is smaller than the critical value.

[3] Null hypothesis can be rejected if the F-test is bigger than the critical value.

The results of these tests are:[4]

Real Consumption	t = -3.47	$\phi_2 = 5.02$	$\phi_3 = 5.80$
Real consumption per capita	t = -3.50	$\phi_2 = 4.75$	$\phi_3 = 6.16$

Hypothesis of unit root are rejected.[5]

Neither real consumption nor real consumption per capita are nonstationary.

[4] The number of lagged terms is p=2.

[5] Critical values for a 5% of significance are t=-3.41, ϕ_2=4.68 and ϕ_3=6.25.

APPENDIX B

TWO STAGES LEAST SQUARES ESTIMATION

Two Stages Least Squares (TSLS) is a limited information estimation technique applied to over-identified equations of a simultaneous system, it yields consistent estimators of the structural parameters (Darnell 1994, 404-410). The first stage regresses each variable on the exogenous variables in the model. Then, this reduced form regression yields an estimated series, which it is hoped will display less correlation with the errors than does the original series (Johnston 1991, 442-450)

The simultaneity arises between real consumption and real GDP. The instruments utilized are lagged real consumption and lagged real GDP, as Barro and Lee (1994) suggest.

The following results are obtained:[1]

$$\underset{}{RGDP} = \underset{(1.98)}{7580.74} + \underset{(19.72)}{0.0852\ LRGDP} + \underset{(3.45)}{0.231\ LRCON}$$

$$\text{Adj } R^2 = .97 \qquad DW = 1.92$$

The estimated real GDP series from this reduced form equation is used in all regressions.

[1] t - statistics in parenthesis

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