

Economic Crises and Health Risk:

Evidence from Mexico

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Introduction

There are many investigations probing the relationship between health outcomes (such as mortality rate, fertility rate) and economic variables (such as rise in income) and other variables (such as level of education, availability of clean water). Usually, these results are demonstrated using data from countries where economic conditions are improving over time along with health outcomes.

Why Mexico

Mexico during 1980-2000 period gives us a unique laboratory where we get a very paradoxical situation: General mortality conditions improved during the period but income fell. Table 1 illustrates the situation with mortality. Between 1980 and 1997, the mortality rate of the general population fell by almost 50%. The results are more dramatic for specific age groups. Mortality rate for children under age 1 fell by almost 60%, mortality rate for children between age 1 and 4 fell by more than 70%. Maternal mortality fell by more than 50% during the same period.

What are the main sources of death in Mexico? Data provided by the Mexican Secretariat of Health for 1998, show that the 10 main causes of death in Mexico, in order of importance are: (1) heart diseases, (2) cancer (3) diabetes, (4) accidents, (5) cerebrovascular diseases, (6) cirrhosis and other liver problems, (7) pneumonia and influenza, (8) perinatal problems, (9) homicide and (10) nephrosis and nephritis.

However, the cost of treatment by the main provider of health services, IMSS in Mexico, does not correspond to the diseases above (see Table 2). The most costly items are problems of digestive diseases and problems of genital diseases. This implies that these diseases (though costly for the system) are not necessarily fatal.

Mexico, in theory, has universal health coverage. The joint coverage by SSA (the Secretariat of Health) and IMSS cover about 70% of the population. Additional coverage is provided for the government employees and various semi-autonomous institutions such as PEMEX (the state oil monopoly), Mexico City Government (DDF). This still leaves around 10% of Mexican population without any kind of health coverage (see Figure 1). Expenditure per capita is the lowest in the IMSS-Solidaridad category. This group consists of people who depend on government clinics, mostly in the rural areas of the country. These clinics are equipped with nothing more than very simple medical instruments. Some do not even have electricity or running water in the clinic. People without any coverage are the marginal population in Mexico. Not surprisingly, they are also the indigenous population of Mexico.

To illustrate how Mexican economic conditions have evolved over time, we plot per capita real income during 1982-2000 in four states: Aguascalientes (AC), Baja California BC), Baja California Sur (BCS) and Campeche (Camp). They all follow very similar trajectories. They all fall dramatically between 1982 and 1987, in some cases, by 50%. These results are consistent with others such as the study by (Murphy et al, 1992). They take a microeconomic sample of the state of Oaxaca in 1977 and a similar one in 1987. They found that the median family income fell from US\$111 a month to US\$55 a month during that period - a reduction of 50%. If we repeat the exercise with all the Federal entities in Mexico (that includes 31 states and one Federal District), the pattern will be virtually the same (see Figure 2). Not surprisingly, the 1980s became known as the lost decade in Mexico (the same happened with a number of other Latin American countries during the same period).

To get a national perspective of per capita income adjusted for purchasing power parity, we also plot per capita income over a slightly different time period (1979-1997, later

data with the Khamis Geary adjustment is not available for later time periods). It shows clearly that the per capita income suffered three clear periods of drop (see Figure 3): 1982-3, 1985-6, and 1994-5. In our study, we will use these dates as the reference points for economic crises. Figure 2 and 3 also illustrates another important point: Mexico has sustained generally falling per capita income during 1982-2000. Very few countries in the world in recent times have suffered so much loss over such a sustained time period. Therefore, it permits us to study not just the effects of one time economic downturn but also the effects of a sustained economic downturn.

Nexus between health and economic conditions

Conventional wisdom says that there should be a nexus between the economic conditions and health conditions. Common sense suggests that there should be bi-directional relationship between health conditions and economic conditions. Healthier persons are more productive and therefore should be reflected in the output growth of the economy. Robert Fogel, the Nobel Prize winning economist, has studied the effects of health conditions on economic growth. His careful analysis found that at least 30% of GDP growth in England over a period of 200 years could be attributed to better health. Similarly, Robert Barro found that post World War II economic growth is also related to growth in life expectancy. Specifically, a 10% rise in life expectancy is associated with 1.4% growth in real GDP. However, all these studies look at evidence with economic *growth* and *reduction* in mortality and other health outcomes. Most countries do not suffer from sustained fall in income and a rise in negative health outcomes (such as rise in mortality). Thus, Mexico provides an ideal test-bed for checking the relationship where things go bad.

Why should there be a relationship between economic crises and negative health outcome? There are four interrelated reasons. First, there is a direct effect. Any crisis will reduce the resources of a family. Therefore, there will likely be a reduction in the consumption in the family. In particular, it will reduce the medical resources of the family. Crisis may be accompanied by inflation and devaluation. If medicine is imported, the price will rise as a consequence. That could adversely impact medical resources. In addition, consumption of food might fall leading to reduced nutrition, health care and well-being.

Second, crises might affect health by reducing public sector resources. Loss of salaried employment often involves loss of the access to high-quality health services and increased reliance on private health care or lower-quality public services (see Langer, Lozano and Bobadilla, 1991 an illustration of this issue in the Mexican context).

Third, a crisis can cause more people (mostly women) to work outside of homes and thereby reducing care given to the elderly and children at home. Since a market for care-giving is not readily available in a country like Mexico, this effect can be very different from what might be observed in more developed economies. Fourth, crisis can lead more people to work longer hours and thereby reducing the “due care” they have of their own health.

Crises in Mexico

Mexico has had uninterrupted economic growth between 1945 and 1982. With the sudden rise in interest rate in 1982, Mexico fell into a deep recession that was to last the rest of the decade. With 1982, debt crisis arrived in Mexico. Falling oil prices, bloated government budget with huge dependence on oil revenue made sure that the country could not get out of the crisis for the rest of the decade. Technically, there are different methods of identifying crisis using macroeconomic variable. Most common method is to consider GDP

in real terms either total real GDP or per capita real GDP. Other methods are to study other macroeconomic variables such as the unemployment rate, inflation rate, interest rate and exchange rate. In case of Mexico, they all point to the same (only the real per capita GDP at the state and the national level are reported in this paper, but other methods point to the same time frame for the crises identified in this paper).

Data

In this study, we use the following health outcome variable: Total mortality rate, Infant mortality rate, Health care Federal expenditure in real terms (Health Secretariat), Per capita annual consultation (external), Per capita annual consultation (pediatric), Per capita annual consultation (gynecological).

We also use the following socio-economic and demographic variables: Average daily salary in real terms, Average education (age>15), Rate of illiteracy, Conditional life expectancy at age 1. The abbreviations used for each variable are listed in Table 3.

The data in this study applies to (in most cases) from 1980 to 2000. There are various sources. For example, population data comes from various publication of the INEGI (*Instituto Nacional de Estadística, Geografía e Informática*) either from censuses or from special questionnaires. Consultation to doctors comes from IMSS (*Instituto Mexicano del Seguro Social*). IMSS is a government run social security system, similar to the Canadian system (it includes healthcare). It is not like the US Social Security system as it includes healthcare as an integral part of the system. The eligible population (mostly the population that works in the private formal sector of Mexico) can access to a network of clinics and hospitals dotted around the country. SSA (*Secretaría de Salud*) provided data on some other health outcome variables. CONAPO (*Consejo Nacional de Población*) and SEP

(*Secretaría de Educación Pública*) sources were used to get state level data on education and illiteracy. We also used the *Secretaría de Energía, Minas e Industria Paraestatal* for data on electricity availability state by state. Ultimately, the data was not used because they had extremely high correlation with some other variables (such as the average level of education by state). Therefore the results reported do not contain data for energy use.

Model Specification

The model used in this paper has a generic structure similar to other models used in the literature. The general idea is to relate socio-economic and demographic data to explain health outcomes. Thus, the general nature of the model is as follows:

$$\text{Health Outcomes} = f(\text{socioeconomic and demographic variables})$$

In our case, the model takes very specific forms. We will discuss them below. First, note that the general form does not explicitly say anything about how variables interact over time. In other words, the model specified above can contain one set of variables over time on the right hand side. In other words, with this formulation it is possible to do a time series analysis as well as a cross section analysis. Whatever the form, when we specify such a function f , we are implicitly assuming that there is a causal relationship between the left hand variable and the right hand variable(s). If we were to do a time series analysis, the feedback effect will indeed confound the estimates. There are however, too few observations (21 or less) to permit us to do a time series analysis. A complete general specification would mean we do a vector autoregressive analysis. But, with less than two dozen time series observations and 32 Federal entities, it is not possible to carry out such an analysis. It is not even possible to perform a "standard" time series analysis of unit roots and cointegration. Therefore, we fall back on the standard method of cross section analysis only.

We permit six dependent variables (separately): TMB (total mortality rate of the population), TMI (mortality rate of the children - children of less than one year of age), CTP (per capita external consultation that does not require hospitalization), CPP (per capita pediatric consultation), CGP (per capita gynecological consultation), $E(X=1)$ (life expectancy of a one year old).

The logic behind the choice of these variables is as follows. Total mortality gives us an overall measure of the worst possible outcome. We wanted a separate measure for a subgroup of population. Child mortality was the result. As explained in the beginning, a reduction in family resources due to a crisis can lead to an asymmetric and severe impact on the health of more vulnerable members of the family: children. By the same logic, we could expect a higher impact on the elderly. However, we did not have any variable to measure that directly. In order to assess the impact of family members over the age of 1, we calculated the conditional life expectancy of people given that they have survived to be one year old for each of the 21 years for each of the 32 Federal identities. This gave rise to our variable $E(X=1)$.

Most deaths do not occur suddenly. They tend to be preceded by more frequent visits to the doctors. As a proxy of general medical consultation by people of all ages, we use the number of visits (per capita) to the hospitals that do not require hospitalization (sometimes called "outdoor" visits). Record is also available from the IMSS about hospital visits for gynecological examinations and pediatric consultations. These numbers were converted into per capita figures by taking into account the number of "members" of the IMSS in each Federal entity for each year.

Analysis and Results

Cross section multiple linear regression analysis was carried out for each year using each dependent variable described above. In Table 4, we report the results of the analysis. Actual analysis was carried out for every year (whenever data was available) between 1982 and 2000. In Table 4, we only report the results if at least one independent variable is significantly different from zero. For example, in the first box of Table 4, the regression result is that of total mortality rate and per capita income for each year between 1982 and 2000. The relationships noted are for the same year. In other words, do variation in per capita income contribute to total mortality rate across different Federal entities? If so, exactly what is the relationship?

Hypothesis: We expect a negative relationship between income level and mortality level. This hypothesis is true quite strongly after the 1994 crisis. The relationship shows up only for one year before that: in 1990.

Hypothesis: We expect a negative relationship between income level and child mortality level. This hypothesis holds only from 1989 onwards for every single year (second box of Table 4). Thus, the effect of income level has a stronger influence on child mortality than general mortality.

Hypothesis: We expect a negative relationship between visits to doctors (of all type) with the level of income. This hypothesis holds for most of the years for general visits and for pediatric visits but not for visits to gynecologists except for the years 1990 and 1991 (third box of Table 4).

Hypothesis: We expect a positive relationship between conditional life expectancy and income level. This hypothesis holds only from 1994 onwards (last box of Table 4).

Table 5 represents the experiments to uncover a relationship between a change in per capita real GDP and the level values of the six variables. As is evident, in most cases they do not show up with anything significant.

Is income the right determinant of health outcomes or is it merely a proxy of other more relevant variables? For example, it is quite possible that the level of education in each Federal entity is really the underlying cause for changing health outcomes. It is also possible that the availability of good drainage, potable water or other available modern amenities are the real contributors to income. To test this, we collected data on percent of population with available sewage, access to drinking water and with electricity (to proxy amenities). With the exception of illiteracy, all the other variables showed very high correlation with income (more than 0.9, and in most cases more than 0.95). Hence, we could not use any of these variables for our regression results. The only ones reported in Table 6 are with two independent variables per capita income and illiteracy (they showed a correlation of less than 0.5). Table 6 shows that in the case of total mortality rate, the illiteracy variable has completely taken away the significance of per capita income. In the case of child mortality variable, both per capita income and illiteracy are significant variables although the strength of the illiteracy variable is higher in terms of statistical significance (and coefficients for both variables are of similar order of magnitude). In case of visits to pediatrics, however, illiteracy seems to play no role at all. The most significant role of illiteracy is in the context of life expectancy. It plays a big significant role for all the years under study. In this regression (Table 7, final box), illiteracy has completely stolen the thunder from per capita real income as an explanatory variable while improving upon the fit (as measured by R^2).

Policy Implications

Our results have strong policy implications. Initial analysis (Table 5) shows that per capita income is a strong indicator of mortality, especially child mortality. Therefore, policies that can lift the income level will have an impact on mortality. More importantly, visits to doctors, tend to fall with rising income. This shows how important income is to reduce the pressure on the public health system. On closer examination, something else emerges as well. Many of the above results get sharper when we include the additional variable of illiteracy. Thus emerges another policy implication: eradication of illiteracy yields dividend in terms of health outcomes.

Thus, our results show, in the context of a middle-income country that pro economic growth policies and raising education level policies (in particular, the policy of illiteracy reduction) lead to better health outcomes in six clearly measurable dimensions.

References

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Murphy, Arthur D., Mary Winter, Earl W. Morris, Martha W. Rees, *The Sociodemographic Effects of the Crisis in Mexico*, mimeo, paper presented April 23-25, 1992, at the Mexican Center of the Institute of Latin American Studies, University of Texas at Austin.

Table 1: Mortality Index Per 1000 inhabitants

<i>Range</i>	<i>1980</i>	<i>1997</i>
General population	6.5	4.6
Population under 1 year	39.9	16.4
Population between 1-4 years	3.4	1.1
Population between 5-14 years	8.3	3.7
Maternal mortality	9.5	4.7

Table 2: Cost of Treatment

Cost of Each group in thousands of pesos
INSTITUTO MEXICANO DEL SEGURO SOCIAL, 1995

Category	Cause	Total Costs	%
	Total	1,887,294	100.00
I	Infectious and parasitic	55,761	2.95
II	Tumors	103616	5.49
III	Glandular diseases	75,984	4.03
	endocrine, nutrition metabolism		
	immunological		
IV	Diseases of the blood	10704	0.57
	other blood diseases		
V	Nervous system	46644	2.47
	other sensory organs		
VI	Circulatory diseases	106,250	5.63
VII	Respiratory diseases	121,856	6.46
VIII	Digestive systems diseases	183,828	9.74
IX	Genital diseases	198,584	10.52
X	Bone diseases	54115	2.87
XI	Congenital diseases	34,674	1.84
XII	Perinatal diseases	85,954	4.55
XIII	Others	38,275	2.03

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Figure 1: Coverage of population and expenditure per capita in each category

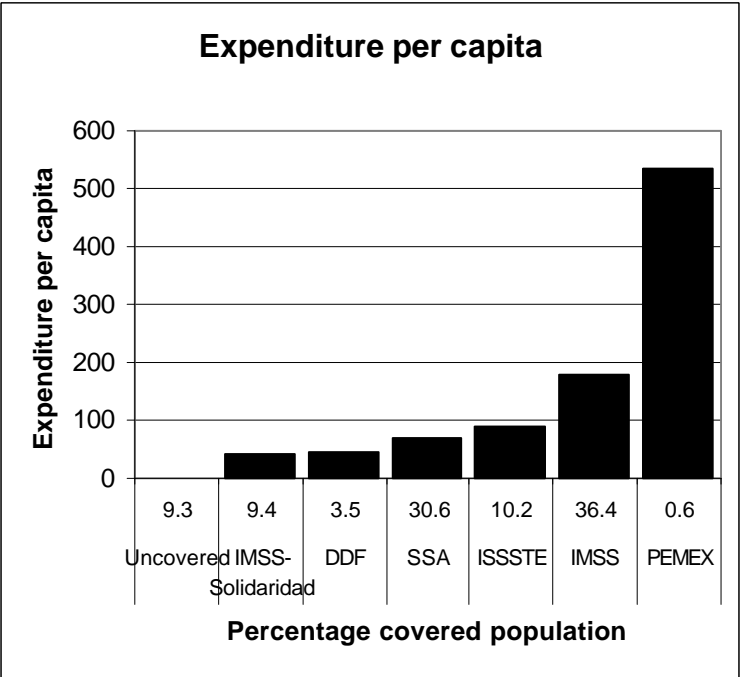


Figure 2: Per capita income in four states (1982-2000)

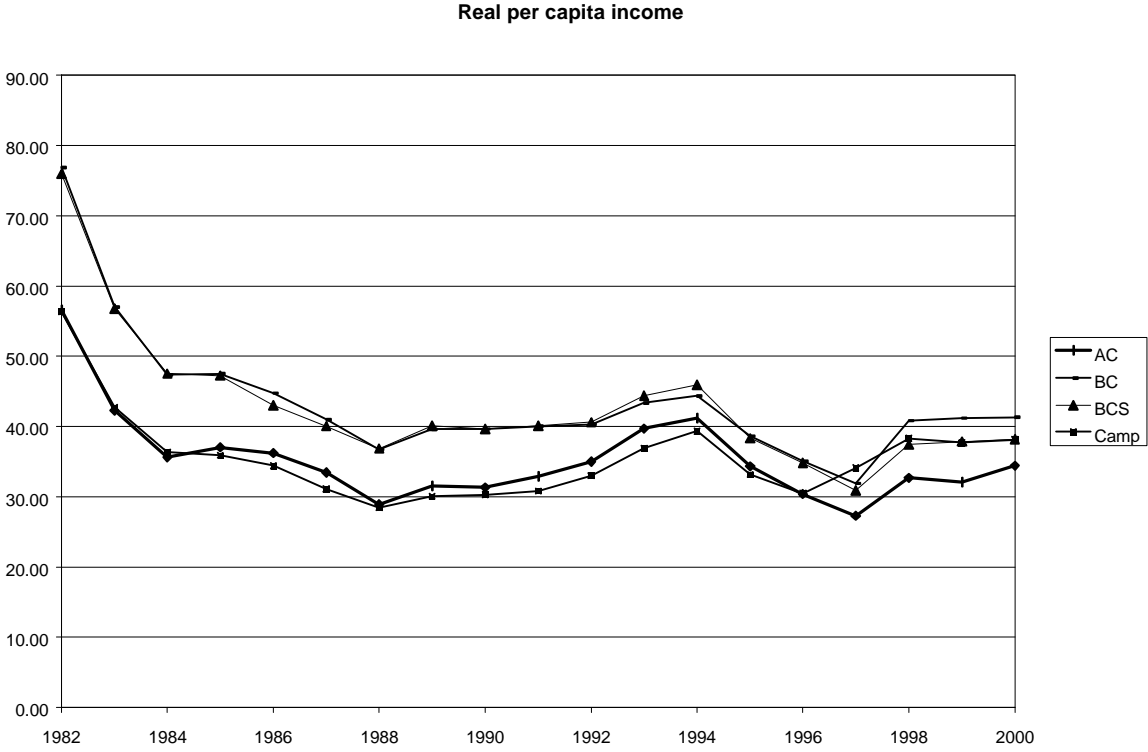


Figure 3: Per capita GDP in Mexico in real terms (Khamis Geary Dollars, 1979-97)

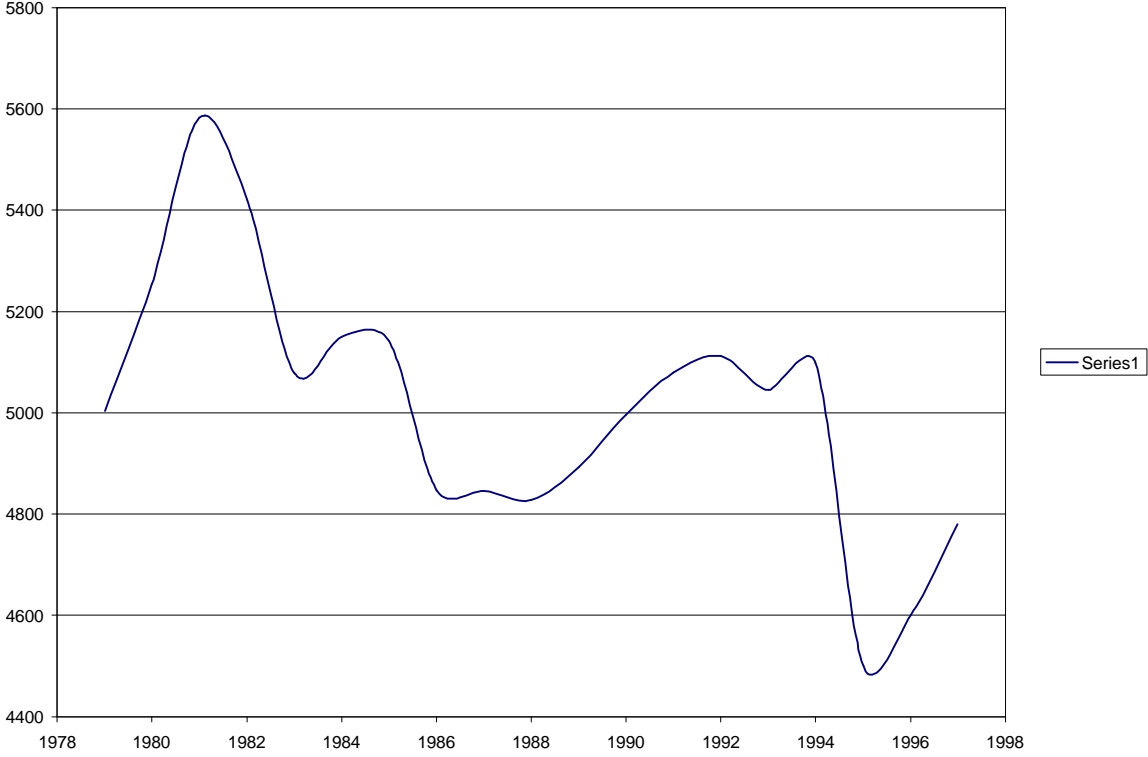


Table 3: List of variable used in the study

Variables

TMB	Total mortality rate
TMI	Infant mortality rate
SBC	Average daily salary in real terms
GPS	Health care Federal expenditure in real terms (Health Secretariat)
CTP	Per capita annual consultation (external)
CPP	Per capita annual consultation (pediatric)
CGP	Per capita annual consultation (gynecological)
GPE	Average education (age>15)
TAN	Rate of illiteracy
GASTO	Sum of GPSIMSS, GPSISSSTE, GPS
E(X=1)	Conditional life expectancy at age 1

Regression in Level variables

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	
TMB																				
SBC _t									-0.480					-0.431	-0.404	-0.291	-0.393	-0.387	-0.374	
Prob of t									0.039					0.004	0.006	0.033	0.006	0.004	0.005	
R ²									0.105					0.223	0.198	0.114	0.200	0.219	0.210	
Jarque Bera									2.003					1.107	2.500	3.404	15.622	14.256	15.275	
TMI																				
SBC _t									1.220	-1.099	1.539	1.585	1.274	1.248	-0.431	-0.416	-0.297	-0.447	-0.442	-0.437
Prob of t									0.045	0.001	0.016	0.015	0.016	0.023	0.000	0.000	0.009	0.000	0.000	0.000
R ²									0.098	0.287	0.150	0.154	0.150	0.134	0.355	0.324	0.180	0.377	0.403	0.400
Jarque Bera									1.527	1.413	1.928	9.181	7.241	7.824	2.522	2.843	1.872	2.471	2.298	2.481
CTP																				
SBC _t									-0.631	-0.736	-0.663	-0.589	-0.450		-0.412	-0.394	-0.464			
Prob of t									0.034	0.007	0.012	0.016	0.035		0.050	0.047	0.040			
R ²									0.112	0.193	0.165	0.153	0.112		0.093	0.096	0.105			
Jarque Bera									1.501	0.933	1.238	1.416	0.703		0.509	0.072	0.712			
CPP																				
SBC _t									-0.950	-1.665	-1.472	-1.239	-1.393	-0.828	-0.751	-0.812	-0.881	-0.876		
Prob of t									0.044	0.006	0.002	0.008	0.007	0.035	0.056	0.045	0.015	0.028		
R ²									0.099	0.200	0.253	0.186	0.195	0.111	0.087	0.098	0.156	0.123		
Jarque Bera									3.306	1.764	5.251	4.350	1.316	0.970	0.438	1.176	0.984	0.910		
CGP																				
SBC _t									-0.729	-1.016										
Prob of t									0.053	0.008										
R ²									0.089	0.187										
Jarque Bera									0.704	0.372										
E(X=1)																				
SBC _t													0.050	0.053	0.050	0.034	0.051	0.049	0.047	
Prob of t													0.001	0.001	0.001	0.014	0.000	0.000	0.000	
R ²													0.279	0.313	0.285	0.157	0.346	0.377	0.393	
Jarque Bera													5.222	3.597	4.093	3.022	2.965	2.655	2.924	

Table 4

expression in differenced variables

	1982-1983	1983-1984	1984-1985	1985-1986	1986-1987	1987-1988	1988-1989	1989-1990	1990-1991	1991-1992	1992-1993	1993-1994	1994-1995	1995-1996
TMB														
SBC _t -SBC _{t+1}														-3.302
Prob of t														0.004
R ²														0.218
Jarque Bera														4.274
TMI														
SBC _t -SBC _{t+1}			4.933											
Prob of t			0.004											
R ²			0.209											
Jarque Bera			1.245											
CTP														
SBC _t -SBC _{t+1}											0.775	-0.724		
Prob of t											0.055	0.057		
R ²											0.088	0.086		
Jarque Bera											0.080	0.925		
CPP														
SBC _t -SBC _{t+1}										-3.596				
Prob of t										0.019				
R ²										0.144				
Jarque Bera										9.573				
CGP														
SBC _t -SBC _{t+1}														
Prob of t														
R ²														
Jarque Bera														
E(X=1)														
SBC _t -SBC _{t+1}					0.019	-0.225								-0.698
Prob of t					0.027	0.045								0.001
R ²					0.125	0.099								0.273
Jarque Bera					0.117	3.375								2.718

Table 5

gression in Level variables

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
TMB																			
SBC _t																			
Prob of t																			
TAN _t	0.151		0.169	0.177	0.165			0.185				0.129	0.126	0.129	0.107	0.100	0.099		
Prob of t	0.015		0.022	0.023	0.038			0.000				0.002	0.003	0.002	0.015	0.022	0.022		
R ²	0.133		0.123	0.109	0.082			0.409				0.421	0.390	0.338	0.327	0.328	0.320		
Jarque Bera	1.009		4.434	7.139	1.498			0.149				21.583	24.859	22.022	34.081	29.874	26.977		
TMI																			
SBC _t								1.476	-0.494	1.837	1.729	1.460	1.366	-0.186	-0.162		-0.145	-0.158	-0.166
Prob of t								0.028	0.035	0.011	0.017	0.012	0.024	0.002	0.009		0.032	0.013	0.008
TAN _t								0.311						0.159	0.163	0.174	0.159	0.158	0.158
Prob of t								0.000						0.000	0.000	0.000	0.000	0.000	0.000
R ²								0.099	0.681	0.150	0.133	0.143	0.112	0.850	0.834	0.802	0.820	0.832	0.836
Jarque Bera								2.404	0.553	2.530	12.768	12.022	9.834	1.276	1.147	0.390	1.289	1.366	1.109
CTP																			
SBC _t									-0.723	-0.669	-0.621	-0.476			-0.467		-0.552		
Prob of t									0.018	0.022	0.020	0.043			0.051		0.042		
TAN _t																			
Prob of t																			
R ²									0.166	0.137	0.127	0.084			0.071				
Jarque Bera									0.937	1.219	1.296	0.590			0.336				
CPP																			
SBC _t									-1.135	-1.816	-1.681	-1.462	-1.625	-0.937	-0.917	-0.933	-0.964	-1.103	-0.977
Prob of t									0.029	0.008	0.002	0.005	0.004	0.031	0.039	0.043	0.016	0.021	0.046
TAN _t																			
Prob of t																			
R ²									0.095	0.180	0.195	0.195	0.203	0.094	0.080	0.079	0.136	0.119	0.071
Jarque Bera									3.384	1.639	3.416	2.092	0.212	0.887	0.855	2.568	2.308	2.841	1.068
CGP																			
SBC _t																			
Prob of t																			
TAN _t																			
Prob of t																			
R ²																			
Jarque Bera																			
E(X=1)																			
SBC _t														0.024	0.021	0.017		0.016	0.016
Prob of t														0.018	0.013	0.039		0.032	0.020
TAN _t	-0.071	-0.067	-0.064	-0.062	-0.060	-0.056	-0.054	-0.050	-0.040	-0.047	-0.045	-0.043	-0.018	-0.021	-0.021	-0.021	-0.019	-0.018	-0.017
Prob of t	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
R ²	0.413	0.388	0.396	0.423	0.444	0.565	0.539	0.531	0.390	0.505	0.520	0.501	0.706	0.818	0.805	0.780	0.795	0.812	0.830
Jarque Bera	25.144	19.911	22.118	18.781	25.174	5.485	7.410	6.305	7.510	2.735	6.471	4.459	2.097	0.300	0.284	0.273	0.441	0.700	0.789

Table 6

ression in differenced variables

	1982-1983	1983-1984	1984-1985	1985-1986	1986-1987	1987-1988	1988-1989	1989-1990	1990-1991	1991-1992	1992-1993	1993-1994	1994-1995	1995-1996
TMB														
SBC _t													0.231	
Prob of t													0.044	
TAN _t														
Prob of t														
R ²													0.349	
Jarque Bera													12.323	
TMI														
SBC _t			5.148											
Prob of t			0.007											
TAN _t													18.622	
Prob of t													0.006	
R ²			0.186										0.255	
Jarque Bera			1.711										7.196	
CTP														
SBC _t													-0.980	
Prob of t													0.008	
TAN _t													-1.461	
Prob of t													0.011	
R ²													0.245	
Jarque Bera													3.295	
CPP														
SBC _t										-3.766		3.982		
Prob of t										0.026		0.001		
TAN _t														
Prob of t														
R ²										0.116		0.303		
Jarque Bera										10.501		0.457		
CGP														
SBC _t														
Prob of t														
TAN _t			7.550											
Prob of t			0.044											
R ²			0.104											
Jarque Bera			4.633											
E(X=1)														
SBC _t						0.019	-0.237						-0.723	
Prob of t						0.029	0.039						0.001	
TAN _t														
Prob of t														
R ²						0.099	0.084						0.259	
Jarque Bera						0.137	3.044						2.398	

Table 7