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Paulo de Andrade Jacinto[I]

César Augusto Oviedo Tejada[II]

Tanara Rosângela Vieira de Sousa[III]

Effects of macroeconomic conditions on health in Brazil

ABSTRACT

OBJECTIVE: To analyze the relationship between macroeconomic conditions and health in Brazil.

METHODS: The analysis of the impact of employment and income on mortality in Brazil was based on panel data from Brazilian states between 1981 and 2002. Mortality rates obtained from the national mortality database was used as a proxy for health status, whereas the variables employment, income, and illiteracy rates were used as proxies for macroeconomic and socioeconomic conditions. Static and dynamic models were applied for the analysis of two hypotheses: a) there is a positive relationship between mortality rates and income and employment, as suggested by Ruhm; b) there is a negative relationship between mortality rates and income and employment, as suggested by Brenner.

RESULTS: There was found a negative relationship between mortality rates (proxy for health) and macroeconomic conditions (measured by employment rate). The estimates indicated that the overall mortality rate was higher during economic recession, suggesting that as macroeconomic conditions improved, increasing employment rates, there was a decrease in the mortality rate. The estimate for the relationship between illiteracy (proxy for education level) and mortality rate showed that higher levels of education can improve health.

CONCLUSIONS: The results from the static and dynamic models support Brenner's hypothesis that there is a negative relationship between mortality rates and macroeconomic conditions.

DESCRIPTORS: Employment. Income. Educational Status. Mortality. Economic Indexes. Socioeconomic Factors.

[I] Programa de Pós-Graduação em Economia. Faculdade de Administração, Contabilidade e Economia. Pontifícia Universidade Católica do Rio Grande do Sul. Porto Alegre, RS, Brasil

[II] Departamento de Economia. Instituto de Ciências Humanas. Universidade Federal de Pelotas. Pelotas, RS, Brasil

[III] Programa de Pós-Graduação em Economia. Universidade Federal do Rio Grande do Sul, Porto Alegre, RS, Brasil

Correspondence:
Paulo de Andrade Jacinto
Programa de Pós-Graduação em Economia - PPGE
Faculdade de Administração, Contabilidade e Economia
Pontifícia Universidade Católica do Rio Grande do Sul
Av. Ipiranga, 6681 - Prédio 50 – Sala 1001
90619-900 Porto Alegre, RS, Brasil
E-mail: paulo.jacinto@pucrs.br

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INTRODUCTION

Studies from the 1970s show no consensus that economic recessions may have a favorable impact on people's health status and there is evidence in the literature supporting opposing hypotheses. Brenner[4-9] empirical studies support the hypothesis that times of downturn and economic instability have a negative impact on people's health status, increasing the overall mortality as well as mortality due to specific causes such as cardiovascular disease, cirrhosis, suicides, homicides, among others. The author also suggests there is increased morbidity, for instance, measured by increased rates of diseases associated to the consumption and dependence of alcohol and other psychoactive substances, such as stress and depression, or even due to external causes such as urban violence and traffic accidents.

In contrast, Ruhm has recently postulated[15-17] that economic downturns with higher unemployment favor an improvement in health and consequent reduction in mortality. This phenomenon may be explained by the fact that unemployed individuals during recessions have more time for leisure and develop healthy habits.

Although the arguments supporting both hypotheses are reasonable, Ruhm's hypothesis does not make much sense in the epidemiology field, since it recommends promoting recessions to improve public health. For purposes of economic policy, the evidence presented by Brenner is less counter-intuitive. However, inconsistencies between both hypotheses are not relevant as both can be supported by data.

Empirical evidence supporting Brenner's hypothesis has been gathered from the analysis of time series data in a specific region (e.g., the United States) while Ruhm's hypothesis has been supported by evidence gathered from panel data models (that can show changes over time and individual characteristics of each region as well) to control for multiple geographic locations at different time points. Søgaard (1992)[18] and Wagstaff (1985)[21] claimed that the results based on time series are sensitive to the choice of countries and time periods and are affected by omitted variables that cause spurious correlations with regressors, compromising evidence for Brenner's hypothesis.

More recent studies have failed to come to a conclusion about which hypothesis offers a better explanation for the relationship between health and economic instability. The discussion remains open and further studies as well as new evidence are needed.

The objective of the present study was to analyze the relationship between macroeconomic conditions and health in Brazil.

METHODS

A sample of data from 26 Brazilian states (except the recently created state of Tocantins) for the period 1981–2002 was collected.[a] Information on mortality rates, used as a proxy for health status, was obtained from the national mortality database (SIM). The mortality database includes information from death certificates that are compulsorily completed nationwide and made available by the National Health System Department of Health Information (DATASUS)[b] and provides the number of deaths per 100,000 inhabitants. This is an aggregated variable since it comprises mortality from all causes.

For macroeconomic conditions, the economic literature suggests employment and mean income as good proxy data. As for socioeconomic variables that may affect health, we used education level or even illiteracy rate.

The variable employment is the percentage of people with a formal contract (number of regular jobs by the total population), which is considered an effective measure of job market conditions for those who are entering and exiting the work force, as proposed by Ruhm (2000).[15] Education level can be represented by both schooling (average years of study) and illiteracy rate. For consistency between data sources, this information was obtained from the Ipeadata website.[c]

Based on the literature on economic fluctuations and health, the following model was devised to identify the type of relationship between macroeconomic conditions (expressed as employment and income variables), education level and overall mortality rate. The static econometric model shows the contemporaneous effects and can be expressed as follows:

$$h_{it} = \beta_0 + X_{it}\,\hat{a}_j + \mathring{a}_{it} \quad (1)$$

where $\mathring{a}_{it} = \acute{a}_i + u_{it}$.

h_{it} represents the logarithm of overall mortality rate (all causes); X_{it} represents the vector of explanatory variables including employment rate, income and education level in each Brazilian state (also in logarithm); the error

[a] There were used only data until 2002. The most recent data were not included because the employment series was not continuous and no other variable covering the period between 1980s and 1990s of high economic instability was available.
[b] Brazilian Ministry of Health. The National Health System (SUS) Department of Health Information. Vital Statistics: Mortality. [cited 2010 Feb 05]. Available from: http://w3.datasus.gov.br/datasus/index.php?area=0205&VObj=http://tabnet.datasus.gov.br/cgi/deftohtm.exe?sim/cnv/ext
[c] Brazilian Ministry of Planning. Institute of Applied Economic Research. Job Market. [cited 2010 Feb 05]. Available from: http://www.ipeadata.gov.br/ipeaweb.dll/ipeadata?SessionID=1294795247&Tick=1265375197096&VAR_FUNCAO=Ser_Temas%282060023838%29&Mod=S

term, μ_{it}, includes a state-specific idiosyncratic effect α_i; t is the time index and i is the indexer of states.

The term α_i represents the specific effect of each state I and is constant over time. It allows to including each state's specific mortality and employment rates. The equation (1) is estimated using the fixed effects estimator by taking the mean of equation (1) in time, and then subtracting it from the equation itself (1). The idiosyncratic effect is eliminated and the resulting equation can be easily estimated. This procedure is known as the within estimator.

If the relationship being modeled has dynamic aspects, it is recommended to specify a dynamic model with fixed effects. The main property of this model is that it contains lagged variables among the regressors, which allows to identifying the degree of persistence of the mortality rate from one year to the next and at the same time it provides an analysis in the short and long term.

The estimation is performed by a generalized method of moments (GMM) estimator, as proposed by Arellano & Bond (1991).[1] Two versions of GMM estimators are applied. In the first one, known as one-step estimator, it is assumed that the error terms are independent, homocedastic units in the cross-section and over time. In the second one, known as two-step estimator, residuals generated in the first step are used to obtain a consistent estimate of the variance-covariance matrix, allowing to relaxing the assumptions of independence and consistency. The two estimators are asymptotically equivalent.

RESULTS

Table 1 shows the correlations between variables. A high correlation was found between the explanatory variables, i.e., between illiteracy rate and schooling, or even between employment and schooling. The correlation between mortality rate and the explanatory variables was more sensitive to the variable mean income.

Table 2 presents the results from the static models including only the contemporaneous effects. The coefficient of the employment variable is negative and is statistically significant, reporting that the overall mortality rate decreases as employment increases. This result validates Brenner's hypothesis, which suggests that economic instability has a negative impact on health, thus increasing mortality.

With regard to the variable income, the coefficient was positive and statistically significant. It indicates that the higher the income, the higher the mortality rate. It supports Ruhm's hypothesis, which suggests that economic expansions are harmful to health. However, the economic literature shows evidence favorable to both Ruhm's and Brenner's hypothesis, indicating that it has an ambiguous impact on mortality.

Variations in income, consumption of goods and their impacts on health should be considered to understand this ambiguity. On one hand, health care is a normal good (a product that is more consumed as income increases) as people spend more on health insurance as a result of an increase in average income. But on the other hand, there are many health risks associated with lifestyle such as high consumption of alcohol and cigarettes, which are also normal goods (Table 2). The present result of income may suggest that the negative effects are overcoming health care due to income variation.

The estimate for education level represented by the variable illiteracy rate (the variable schooling was not used here due to higher correlation with the variables employment and income) had the expected behavior, suggesting a positive relationship between illiteracy and mortality rate. This result indirectly showed the role of education in improving health.

Overall, the results for the static model were statistically significant for all variables. Based on the variable used to analyze the impact of macroeconomic conditions on health, positive evidence was obtained either to Brenner's or Ruhm's hypothesis. The Hausman test showed that the fixed effects estimator was the most appropriate one to estimate the model (Table 2).

The results for the dynamic model for three versions of the Arellano and Bond GMM estimator (1991)[1] were similar to those from the static model in terms of coefficient sign and statistical significance for the variable employment. The negative relationship between employment and mortality suggests that when employment increases, there is a reduction in mortality. However, the estimates of the coefficient of illiteracy rate and average income were not statistically significant (Table 3).

Table 3 shows the persistence of mortality rates from one year to the next, seen by the coefficient of the variable lagged mortality rate ($Lnmort_{t-1}$). This coefficient is positive and statistically significant, suggesting that although mortality rates may be declining over time, it has not been eliminated even with the improvement or worsening of macroeconomic conditions. This persistence can be understood by an example. Consider a situation in which the Brenner's hypothesis prevails over Ruhm's. Thus, even with great improvement of macroeconomic conditions, the effects resulting from this improvement would not eliminate deaths due to myocardial infarction. There would be definitely a reduction, but not an elimination of this type of mortality.

Table 1. Estimates of the correlation between macroeconomic variables and socioeconomic conditions. Brazil, 1981–2002.

Variable	Mortality rate	Illiteracy rate	Income	Employment	Schooling
Mortality rate	1.0000	-	-	-	-
Illiteracy rate	-0.1232	1.0000	-	-	-
Income	0.2450	-0.7473	1.0000	-	-
Employment	0.1075	-0.8057	0.6848	1.0000	-
Schooling	0.0883	-0.8806	0.7988	0.9192	1.0000

Source: Vital statistics obtained from DATASUS and Ipeadata websites.

Table 4 presents the short- and long-term dynamics between mortality and employment. The effect of employment on the mortality rate is –0.12% in the static models. The greatest impact was seen in the short-term dynamics in the dynamic models, –0.38%, –0.38% and –0.37% for one-step homocedastic, robust heterocedastic and two-step versions, respectively. A change in the long-term relationship was seen as the coefficient was positive.

DISCUSSION

The economic recession measured by a decline in employment level is a factor for deterioration of health. Good evidence supporting this conclusion is provided by the estimated coefficients of the relationship between mortality rate and employment obtained from the static and dynamic models.

The results for the static model are consistent with those reported in numerous studies on the impacts of economic downturns on health conditions. The arguments supporting an inverse relationship between employment and mortality are usually related to the social and psychological damage caused by an economic downturn that affects people's behavior.

Studies[15,21] have showed that material losses associated with unemployment or material insecurity among workers who are employed but at risk of losing their jobs during recession may lead to reduced health-related expenses and at the same time to unhealthy diets.

Furthermore, periods of recession are characterized by high stress, anxiety and psychological problems due to job loss or fear of losing one's job that can adversely affect health and make people turn to medications, alcohol and other drugs to alleviate their stress and depression.

Unemployed people, besides their potential material loss, suffer a potential loss of social networking, self-esteem, self-confidence, planned life, sense of identity, and possibly a purpose for their lives.[4] There is solid evidence[2,19] indicating that many workers withdraw from the labor market, known as the "discouraged worker effect". [19]

Alternatively, the arguments supporting evidence of a positive relationship between income variations and mortality rate are associated with job offer, especially an increase in the number of hours worked. During economic expansion, the opportunity cost of leisure

Table 2. Estimates of random and fixed effects in the static model. Brazil, 1981–2002.

Variable	Fixed effect (SD) n=494	Random effect (SD) n=494
Constant	5.478*** (0.199)	5.424*** (0.204)
Illiteracy rate	0.0523** (0.0258)	0.0520** (0.0257)
Income	0.0871*** (0.0301)	0.0975*** (0.0298)
Employment	-0.121*** (0.0331)	-0.117*** (0.0331)
F test (3.465)	15.68 Prob (0.0000)	-
Wald test	-	45.08 Prob (0.0000)
Hausman test	c^2= 12.24 Prob(0.0066)	

Source: Vital statistics obtained from DATASUS and Ipeadata websites.
* Significant at 10%
** Significant at 5%
*** Significant at 1%

Table 3. Dynamic estimate of employment effect on mortality rate. Brazil, 1981–2002.

Variable	Homocedastic n=364	Robust n=364	Two-step n=364
$Lnmort_{t-1}$	0.739*** (0.109)	0.739*** (0.123)	0.747*** (0.174)
$Illiteracy\ rate_t$	-0.0516 (0.0326)	-0.0516** (0.0240)	-0.0465 (0.0335)
Income	0.00959 (0.0250)	0.00959 (0.0256)	0.0101 (0.0324)
$Employment_t$	-0.386*** (0.0688)	-0.386*** (0.0617)	-0.379*** (0.0768)
Wald test	103.5	87.82	56.59
First self-correlation	-6.25	-3.71	-3.04
Second self-correlation	1.96	1.30	1.28
Sargan test	χ^2 (14) = 66.18 Prob (0.0000)	-	-

Source: Vital statistics obtained from DATASUS and Ipeadata websites.
* Significant at 10%
** Significant at 5%
*** Significant at 1%

time tends to increase and people spend more hours at work than leisure. As a consequence, there is a reduction of time spent in activities for health maintenance and in medical checkups.

It is expected that, by increasing the number of hours of work, people will reduce the time spent in activities such as home cooking. This behavior usually causes an increase in consumption of high-calorie foods. In addition, excessive working hours leads to increased stress.[13] Some individuals eventually increase their use of tobacco, alcohol, medications and drugs to alleviate stress.

Another issue reported during periods of expansion associated with an increase in the number of working hours is an increase in work-related injuries. It is seen especially in those industries that tend to pro-cyclically advance with the economy such as civil construction and transport that are particularly more prone to high rates of injuries.[12]

The results from the static model suggest that both hypotheses may be valid depending on the variable analyzed. The variable employment validates Brenner's hypothesis, while income validates Ruhm's hypothesis. In this sense, the dynamic model indicated that only the variable employment is statistically significant, which validates Brenner's hypothesis.

In the present study, there was found a positive effect between employment and health in the static and dynamic models, suggesting that an increase in employment rates improves health (i.e., reduces mortality). One possible plausible explanation for this result is that, in developing countries such as Brazil, the effect from increased employment rates on income leads to better nutrition and improved access to health services in the short run. But over time, with greater economic development, the income effect prevails leading to deterioration in health status, which validates Ruhm's hypothesis.

Indirectly, the main implication of the relationship between employment and health in Brazil between 1981 and 2002 is that it shows that public policies are highly important to create jobs that will not only help improving the economy, but also improve people's quality of life and consequently reduce mortality. Although there is a social safety network for the unemployed in Brazil, e.g. unemployment insurance, for one's security the best is to be employed and have a steady secure income.

Table 4. Percent variations of mortality due to 1% increase in employment and illiteracy rate. Brazil, 1981–2002.

Variable	Static	Short-term dynamic			Long-term dynamic
		Homocedastic	Robust	Two-step	
Employment	-0.12%	-0.38%	-0.38%	-0.37%	0.05%
Illiteracy rate	0.05%	-	-	-	-
Income	0.08%	-	-	-	-

Source: Vital statistics obtained from DATASUS and Ipeadata websites.

The results from the static and dynamic models provide evidence supporting Brenner's hypothesis that economic downturns tend to cause an increase in mortality rates. While this result apparently contrasts with Ruhm studies (2000, 2003, 2005),[15,16,17] it is not inconsistent from an epidemiological perspective as shown by Neumayer (2004).[14]

However, the results confirming Ruhm's hypothesis based on aggregate data, and confirming Brenner's hypothesis based on data at the individual level are not necessarily inconsistent. Epidemiological studies investigating people who lose their jobs have showed that they experience deterioration in health (morbidity and mortality), while those who remain employed may improve their health. The net effect may be an improvement in health after a recession if the effect on those remaining employed is higher.[10,16,20]

Given the Brazilian economic development, it might be a long-term reality, because today the effects of increased employment (improved access to quality health care, health insurance, food, among others) on health are positive and can counterbalance potential negative effects (increased alcohol consumption, traffic accidents, lack of time to engage in healthy activities, among others). The evidence found in static and dynamic models do not suggest that economic downturns can reduce the mortality rate in Brazil in the short run. But, in the long run, recessions seem to have some effect, validating thus Ruhm's hypothesis. These results are interesting and similar to those reported by Forbes & McGregor (1987)[11] while studying mortality in post-war Scotland. Their results suggested that, in the long run, positive changes in employment are associated with higher mortality rate. In fact, this discussion remains open.

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