THE EFFECTS OF HEALTH FLUCTUATIONS ON ECONOMIC ACTIVITY IN IRAN

by

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I hereby recommend that this dissertation prepared under my direction by Paul Uwe Pawlik entitled The Effects of Health Fluctuations on Economic Activity in Iran be accepted as fulfilling the dissertation requirement of the degree of Doctor of Philosophy

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November 7, 1972 — Date

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PREFACE

This study examines the relationship between morbidity fluctuations of short-term illnesses in Iran and fluctuations of absenteeism, firms' output, industries' output, and general economic activity. Moreover, it examines the relationship in each province (Ostan) between the concentration of industrialization and the standard of health.

The subject matter was chosen while teaching in the Department of Economics at Pahlavi University in Iran and after traveling in Iran and other developing nations. In these countries the large magnitude of ill health was strikingly apparent. It was thought to be a valuable task to determine how fluctuations in the health of the population affect economic development through influencing absenteeism, firms' output, industries' output, and economic activity. Relatedly, the question was asked if a shift of labor from rural (agricultural) areas to urban (more industrialized) areas affects output as a result of labor being transferred to an area characterized by a different standard of health.

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ABSTRACT

The significance of labor productivity increases resulting from increases in the quality of labor has long been recognized by economists. However, literature dealing with the impact of short-term illnesses of the general population upon absenteeism and production in developing countries is scarce.

This project examines this impact as well as related questions: (1) the relationship between short-term illnesses of the general population and firms' output, industries' output, and aggregate economic activity in Iran is investigated; (2) the association between health fluctuations of the general population and fluctuations in the health of the non-agriculturally employed workers as well as absenteeism are studied; and (3) the relationship between the concentration of industrialization and the standard of health of the population in each province (Ostan) is examined.

The investigation revealed that increases in short-term illnesses of the general population do not impede firms' output, industries' output, or aggregate economic activity because (1) the ill health of the general population does not translate itself into the health and absenteeism of the non-agriculturally employed, and (2)

absenteeism in firms is not inversely related to firms' output. Explanation (1) is traced, in part, to health-related benefits which are made available to the non-agriculturally employed but not to the general population. Explanation (2) partially rests on the firms' practice of employing quantities of labor large enough to hedge against possible adverse output effects resulting from absenteeism.

The investigation of the question whether or not an association exists between the intensity of the geographical concentration of industrialization and the population's standards of health yielded a significant negative relationship. This relationship was, in part, explained by the crowded conditions in industrialized (urban) areas which are seedbeds for the spread of communicable diseases.

The main economic implications of the findings are that (1) a reallocation of resources directed toward reducing short-term illnesses of the population by itself is not expected to increase output; and (2) since the industrially concentrated areas are characterized by a lower standard of health and, at the same time, industry is well endowed with labor, there is a likelihood that a transfer of redundant labor from agricultural (rural) areas to industrial (urban) areas is likely not to increase total output to the extent that is implied in the literature.

CHAPTER 1

INTRODUCTION

The quality of the human element is of prime importance in the productive capacity of a nation. Schultz (1961) states that "economists have long known that people are an important part of the wealth of nations. Measured by what labor contributes to output, the productive capacity of human beings is now vastly larger than all other forms of wealth taken together" (p. 2).

The purpose of this study is to examine how fluctuations in health in the short run affect productivity in Iran. Specifically, the impact of monthly health fluctuations of the general population in Iran will be examined to determine effects on: (1) firms' output, industries' output, aggregate economic activity, and firms' absenteeism; (2) the health of the general population will be compared with the health of the non-agriculturally employed sector of the population; (3) the relationship between firms' output, absenteeism, and health fluctuations of the general population will be determined; and (4) the standard of health in less industrialized areas in Iran will be compared to the standard of health in more industrialized areas.

Modern Health/Output Literature

The two most prominent authors in modern literature which deals with the short-term effects of ill health upon the quantity of goods produced are Mushkin (1962) and Weisbrod (1961). The former points out that poor health contributing to absenteeism results in production losses. The losses occur not only as a result of death or disability of a person but also because of short-term debilities. Weisbrod's discussion is in full agreement with Mushkin's conclusion regarding debility of workers and the impact on output. He adds that diseases with the greatest effects on output through absenteeism are those which (1) cause short-term rather than long-term absences of employees, and (2) those illnesses which are characterized by highly fluctuating incidence rates. He traces his conclusion to the fact that long-term absences are highly predictable as to duration of the sickness and the workers' absences. Subsequently, adverse production effects may be diminished by employment, if necessary, of newly trained individuals. In contrast, unpredictable short-term absences do not lend themselves to this type of replacement since absenteeism is generally not discovered until the worker fails to show up for work. Thus, the higher the worker absentee frequency the more time is lost in finding and/or training suitable replacements.

Although Professor Weisbrod defines the basic problem of health with respect to output, he does not address himself directly to the above-mentioned problem. His analysis centers around three diseases: (1) cancer, (2) tuberculosis, and (3) poliomyelitis. These diseases, in general, cannot be classified as diseases typically resulting in short-term absences (Bowen and Finegan, 1969, pp. 62-66; Cho, 1963, p. 122; Hunter, 1959, Chapters 1, 2, and 3; Jakubauskas and Baumel, 1967, p. 93; Lampman, 1966, pp. 45-47). Moreover, both authors failed to test their conclusions in any developing countries. For example, while in a developed economy characterized by a general labor shortage the cost of short-term illnesses is high, measured in terms of output lost due to workers' debility, this cost may be relatively low in developing countries where no labor shortage exists. Development models which are based on full employment may not predict the accurate magnitude or even direction of output changes resulting from the commitment of resources toward the improvement of health in a developing nation.

Since in developing nations more output may be a matter of life rather than death for many individuals, it is important to determine to what extent additional allocations of resources directed toward the reduction of short-term illnesses would, ceteris paribus, result in additional output.

Relatedly, the question is asked if a shift of labor from rural (agricultural) areas to urban (more industrialized) areas affects output as a result of labor being transferred to an area characterized by a different standard of health.

Outline of the Project

Methodology--Chapter 2

In Chapter 2 the methodological approach for the investigation of the health/output relationships as well as associated relationships will be specified. A detailed description of the method used to collect the data will be presented along with statistical tools used to test each relationship. In addition, a portion of this chapter will be devoted to discussing the strengths and weaknesses of the methodology as well as the steps taken to mitigate these weaknesses.

Results of Statistical Studies--Chapter 3

In Chapter 3 the findings of statistical tests will be presented. Specific variables regressed include (1) short-term health fluctuations and production fluctuations, (2) fluctuations of health in the short run and fluctuations of aggregate economic activity, (3) short-term health fluctuations and absenteeism, and (4) the geographical standards of health and the geographical industrial concentration. Besides the period of observation and the number of observations, the results include correlation coefficients, means, standard deviations, levels of significance, Durbin-Watson statistics, and Kendall's coefficients of concordance.

Interpretation of Results of Statistical Tests--Chapter 4

In the light of the limitations of data as well as of the specific statistical tools used, factors leading to the statistical results for each of the relationships in Chapter 3 will be analyzed. Economic as well as non-economic factors leading to these results will be treated. The analysis of the former will then be discussed in the framework of development models associated with Gustav Ranis, Walter W. Rostow, W. Arthur Lewis, and Ragnar Nurkse.

Conclusion--Chapter 5

In the concluding chapter the complete study will be summarized and relevant conclusions will be drawn.

CHAPTER 2

METHODOLOGY

Investigation of Relationships

The methodology used to test the relationship between health fluctuations of the Iranian population and short-term production fluctuations will be presented in this chapter. In addition to this primary relationship, the health/output association (Relationship A), affiliated relationships will be stated formally and associated logically. They consist of the following relationships: indicators of aggregate economic activity/health (Relationship B), absenteeism/health (Relationship C), and health/geographical concentration of industry (Relationship D). Also, the statistical tools for testing each of these relationships will be specified and explained.

Relationship A

The primary question to be examined is whether or not a statistical association exists between short-term fluctuations in the health of the population in general (as opposed to specific socioeconomic groups) and short-term production fluctuations on the firm level, the industry level, and the aggregate level.

National as well as Ostan (State) disease statistics related to the population as a whole were collected in printed form from the Ministry of Health in Tehran as well as from the health departments of the Ostans of Tehran, Esfahan, and Fars (Ministry of Health of Iran, 1967, pp. 2-16, 1968, pp. 1-347, 1969, pp. 1-43, 1971; Ministry of Health of Esfahan, 1971; Ministry of Health of Shiraz, 1971).[1]

Since this investigation primarily revolves around short-term fluctuations of both output and health, diseases which were highly volatile, temporal, and frequent were isolated. The last distinction is of special importance, because a volatile and temporal disease with a low morbidity rate, perhaps one out of a million persons, usually cannot be expected to significantly influence production. The only reported diseases which met these three criteria were influenza and dysentery. For example, during the Iranian year 1348--March 21, 1969 to March 20, 1970 by Gregorian calendar--the national monthly morbidity frequency in Iran for dysentery fluctuated between a low of 43,649 in the first month of the year to a high of

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1. Iran is divided into thirteen Ostans. An Ostan is like a province but the type of government in Iran is a unitary type rather than a federation (see Appendix A).

130,034 during the fourth month.[1] The low frequency for influenza was 65,368 in the fourth month and the high reached 145,154 in the eleventh month during the same year. The morbidity rate, during the year 1348, for these two diseases individually, was higher than that of any other disease.[2] During the same year influenza ranked highest with 4,287 reported cases per 100,000 population and dysentery second highest with 3,393 (Ministry of Health of Iran, 1969, pp. 1, 2).

The individual Ostan statistics similarly reflect the same violent morbidity fluctuations. For example, in Ostan Gilan, according to Table 1, during 1348, the morbidity frequency for dysentery fluctuated between 1,245 for the eleventh month and 4,607 for the fourth month. For influenza it fluctuated between 2,948 during the eighth month and 7,246 during the second month.

It seems likely that these morbidity frequencies are vastly understated since many isolated parts of the country are not served by Ministry of Health reporting stations. It is felt, though, that the reported statistics are reliable samples of the actual fluctuations in the number of people afflicted with these particular diseases.

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1. The morbidity frequency is defined as the number of persons struck by an illness.

2. The morbidity rate is defined as the number of persons struck by disease in relation to the size of the population under consideration.

Table 1. Morbidity Frequency for Dysentery and Influenza Gilan Ostan (1348)

Month Number	Reported Dysentery Cases	Reported Influenza Cases
1	1657	6536
2	3097	7246
3	3244	3398
4	3607	3726
5	3441	3068
6	4281	4407
7	2406	3597
8	1437	2948
9	1693	3911
10	1369	5543
11	1245	5814
12	1347	5260

Source: Ministry of Health of Iran (1969, p. 6).

In order to relate illness fluctuations resulting from monthly disease fluctuations to potential abseenteeism and possible production fluctuations, a weight of one and two, respectively, was assigned to dysentery and influenza. This means that expected work absenteeism or debility not resulting in absenteeism but only in loss of work efficiency caused by influenza is twice as long as the impact from dysentery. This estimate is based on interviews with doctors (Medical staff, Namazie Hospital, 1971) and factory managers (Karimi and associates, 1971; Shabankari, 1971; Schuler, 1971; Accounting personnel, Fars Cement Company, 1971) in Iran as well as the general literature related to the estimated average duration of these two individual diseases (Gordon, 1965, pp. 24-26, 82-83, 123-126, 213-214). For these two illnesses the monthly morbidity frequency reported in each Ostan then was multiplied by the assigned weights. The resulting sum is labeled the weighted monthly health indicator ($w_{1:2}$WMHI).[1]

The WMHI is designed to reflect the intensity with which these two diseases could make themselves felt upon the economically active population, assuming that this group of individuals suffers from the same short-term illnesses as the general population.

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1. If, for example, in an Ostan during the month of Mehr the disease frequency for dysentery and influenza was 1000 and 2000 respectively, the $w_{1:2}$WMHI would equal (1000 x 1 and 2000 x 2) = 5000.

The WMHI referring to specific <u>Ostans</u> will be identified by superscripts as follows:

$WMHI^{c}$--Central <u>Ostan</u>

$WMHI^{g}$--Gilan <u>Ostan</u>

$WMHI^{m}$--Mazandaran <u>Ostan</u>

$WMHI^{ea}$--East Azarbayejan <u>Ostan</u>

$WMHI^{wa}$--West Azarbayejan <u>Ostan</u>

$WMHI^{k}$--Kermanshan <u>Ostan</u>

$WMHI^{kh}$--Khuzestan <u>Ostan</u>

$WMHI^{f}$--Fars <u>Ostan</u>

$WMHI^{ke}$--Kerman <u>Ostan</u>

$WMHI^{ko}$--Korasan <u>Ostan</u>

$WMHI^{e}$--Esfahan <u>Ostan</u>

$WMHI^{s}$--Sistan <u>Ostan</u>

$WMHI^{kd}$--Kordestan <u>Ostan</u>

The monthly computed $w_{1:2}$WMHI for every <u>Ostan</u> is then added to arrive at the total Iranian $w_{1:2}$WMHI, labeled hereafter the national weighted monthly health indicator ($w_{1:2}$NWMHI). This indicator will be used when dealing with aggregate production and general aggregate economic activity, and the $w_{1:2}$WMHI, with proper superscripts, will be used when dealing with statistics related to specific <u>Ostans</u>.

The $w_{1:2}$ notation, preceding the WMHI abbreviation reflects the dysentery-influenza weight ratio of 1:2, as in the WMHI notation. Since there may be a monthly variation of this average intensity of each disease with respect to the potential impact upon absenteeism and/or reductions in worker's effectiveness, the WMHI for each Ostan as well as the NWMHI will also be computed by using the surrounding weights for dysentery and influenza of one to three as well as three to five. The results will be identified as the $w_{1:3}$WMHI and $w_{3:5}$WMHI when referring to Ostans and $w_{1:3}$NWMHI and $w_{3:5}$NWMHI when referring to the addition of all Ostans' monthly $w_{1:3}$WMHI and $w_{3:5}$WMHI. These ratios were arbitrarily chosen to show how minor changes in the ratio in either direction from 1:2 would affect the outcome.

All variations of the WMHI and the NWMHI will be used as independent variables when statistically testing the main relationship (Relationship A) which, as mentioned earlier, is designed to test the health/output relationship. The dependent variable in each regression consists of production statistics on the firm level (Relationship A-1), the industry level (Relationship A-2), or the aggregate level (Relationship A-3).

Firms' Output Fluctuations vs. Health Fluctuations (Relationship A-1)

Unlike health statistics, firms' production data were not available in published form except for several divisions of the National Iranian Oil Co. (National Iranian Petroleum Company, 1968, pp. 14-24; 1969, pp. 14-24; 1970, pp. 14-24). Questionnaires in both English and Farsi were sent out to obtain companies' production data, but no replies filling specific data requests were received. Subsequently, firms were visited in order to obtain production information.[1] Randomly chosen firms were sampled until the budget allocated to this portion of the study was exhausted. Those firms which had undertaken major expansion of their facilities were excluded from the sample, because it was feared that those expansions may distort output in a manner not directly related to health (Production information, 1971).

Firms' output is hereafter abbreviated as FO. The following superscripts will be used to indicate the name of firms.

FO^{fc}--Fars Cement Co.

FO^{sm}--Shiraz Milk Products Co.

FO^{ns}--Nargess Shortening Co.

FO^{ps}--Pahlavi Self Service

FO^{re}--Regional Electric Co., Fars

FO^{tr}--Tehran NIOC Refinery

FO^{ar}--Abadan NIOC Refinery

FO^{mp}--Mashhad Pepsi Co.

FO^{et}--Esfahan Tobacco Co.

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1. The author spent the 1970-71 school year as an instructor in the Department of Economics at Pahlavi University, Iran. During this period the original and secondary data for this study were collected.

The null hypothesis for Relationship A-1 is that there is no relationship between an individual firm's monthly production fluctuations and fluctuations of the weighted monthly health indicator of the general population in the region in which the firm is located (Null Hypothesis A-1). The general regression equations used to test null hypothesis A-1 are:

$$FO_j^i = a + b(w_k WMHI_j^i) \tag{A-1A}$$

and

$$PFO_j^i = a + b(w_k WMHI_j^i) \tag{A-1B}$$

FO = Monthly production of firm

PFO = Per worker monthly production

WMHI = Weighted monthly health indicator

i = fc, ..., et. Specific firms as identified before.

w_k = Weight of the monthly health indicator

k = 1:2, 1:3, and 3:5 as explained in the text

j = c, ..., kd. Ostans c through kd as listed earlier in text.

Equation A-1B was included because several firms' output was reduced from a monthly total to a per worker basis in order to obtain a measure of productivity which is adjusted for increases in the workforce. While none of the productive concerns were strictly seasonal operations, the production fluctuations resulting from large increases or decreases in the number of employees would be offset by this data modification. Per employee firm output is hereafter referred to as "PFO."

Industries' Output Fluctuations vs. Health Fluctuations (Relationship A-2)

Industries' production data, unlike firms' production data, were available in limited amounts in published form. Production figures for the slaughter industry (SIO) (Ministry of Economy, 1968, pp. 7-102; 1969a, pp. 14-106) as well as an aggregate production index of selected industries for Iran (IO) (Ministry of Economy, 1969b, p. 13; 1970, p. 14) were obtained in printed form from the Iranian Ministry of Economy.

The null hypothesis is that no association exists between monthly industrial output fluctuations and fluctuations in the weighted monthly health indicator.

Equations A-2A and A-2B will be used to test this relationship:

$$IO^{i} = a + b\ (w_k NWMHI) \qquad \text{(A-2A)}$$

and

$$SIO_j = a + b\ (w_k WMHI_j) \qquad \text{(A-2B)}$$

IO = Index of industrial production

SIO = Slaughter industry output

NWMHI = National weighted monthly health indicator

WMHI = Weighted monthly health indicator

w_k = Weight of monthly health indicator

k = 1:2, 1:3, 3:5

j = c, ..., kd. Each Ostan as abbreviated earlier

i = F, ..., TR. Individual industries as abbreviated below:

F	Food manufacturing
B	Beverage
T	Textile
W	Wearing Apparel
FW	Wood and Furniture
P	Paper and Cardboard
L	Leather and Hide
R	Rubber and rubber products
C	Chemical
M	Construction and non-metallic minerals
BM	Basic metal
MP	Metal products
MM	Machinery manufacturing (non-electrical)
E	Electrical equipment
TR	Transport equipment

The examination of expression A-2B concludes the testing of what was broadly classified under Relationship A.

Criticism of the Testing Procedure for Relationship A

The simple bivariate regression models A-1 through A-2B, broadly classified under Relationship A are subject to certain observational and methodological weaknesses. The former are composed of the following:

Observational Weaknesses.

1. Output processes may involve many steps and many firms and industries. Generally, only a portion of such processes is analyzed.
2. Ill health could affect output at the time the worker becomes ill and the illness is officially reported. There may be a lag between the time the illness is reported and the output is affected.
3. Often data were unavailable to this investigator because none had been collected or the results were not released. Subsequently, the number of firms' production samples is less than desired.
4. As mentioned before, health data reports primarily were compiled from health department reporting stations in relatively highly populated areas. Since tribes or small villages do not have such reporting stations, reports may be biased toward urban areas.
5. The weighting of data with respect to the number of work days expected to be missed because of ill

health may not be completely correct, even though communicable disease books, Iranian doctors, and Iranian factory managers advanced the estimate that the comparative length of debility resulting from dysentery and influenza is about twice as long for the latter than for the former.

6. Another major weakness is the observation frequency. Only a few firms could supply output data for 48 months or even 36 months.

Methodological Weaknesses. The methodology can be criticized because:

1. Not all illnesses reported are used in the construction of the health indicator.
2. The short-term relation between the dependent variable (output fluctuations) and the independent variable (health fluctuations) was only examined on a month by month basis rather than on a daily basis.
3. The numerical samples taken may be somewhat biased because no health and output related data could be collected from firms without records--so called "backward firms"--while the more "advanced firms" kept records and could supply information. Thus the sample analyzed is biased in favor of the latter.

4. Most important, in addition to conducting interviews and making site inspections, the major testing tool to be used is regression analysis. Unfortunately, regression results do not establish causality.

In summary, the methodological weaknesses revolve primarily around the number of diseases used in the WMHI and the NWMHI computations, the availability of samples primarily from "advanced firms," and the use of the regression tool for testing.

Qualification of Weaknesses

<u>Methodological Weaknesses</u>. These weaknesses will not significantly detract from the validity of the study because:

1. The diseases afflicting most persons will be reflected in the WMHI.
2. The sampling bias in favor of the "advanced firms" should not invalidate the results since the interest of this research project is to predict, by means of making statistical inferences from samples (inductively), the impact of short-term health fluctuations upon production. In 1967 the "advanced sector" contributed over seventy-five per cent to the value of total gross domestic product (Ministry

of Economy, 1967, p. 1). It is therefore unlikely that results in the traditional sector could reverse the results obtained with the afore-mentioned sample bias.

3. The weakness of the regression tool, i.e., of not establishing causality by itself, will be overcome by using it in conjunction with a meaningful theoretical construction.

Observational weaknesses.

1. The incomplete observation of each production process should not be of major concern since major fluctuations anywhere during the production process are likely to be reflected in final production.
2. The fear that ill health on output will not be noticed during the month the disease is reported should not be of major importance since the diseases chosen--influenza and dysentery--would most likely affect production when the worker is afflicted by the illness and the report is made to the health department.
3. The inavailability of much data from firms has in part been overcome by also testing industry output as well as indicators of aggregate economic activity.

4. The bias of health data toward relatively highly populated areas should not invalidate the study, because health fluctuations of the relatively small portion of the population not covered are not expected to be able to offset the health fluctuations of the vast majority.
5. The weighting of the diseases with respect to expected days absent from work may not be completely accurate. It has been diminished by testing the surrounding ratios 1:3 and 3:5.
6. The limited number of observations (maximum of forty-eight months), while less than desired, does yield statistically acceptable results.

Relationship B

A point of major interest is whether or not a relationship exists between the national weighted monthly health indicator (NWMHI) and fluctuations in monthly aggregate economic activity (Relationship B).

One of the better indicators of monthly economic activity is monthly Gross National Product, but this datum is not available in Iran. Consequently, individual categories of data which reflect the level of economic activity (as dependent variables) were individually regressed against the NWMHI (the independent variable). The dependent variables are (1) the aggregate monthly production index of selected items (AO)--a standard economic indicator (Ministry of Economy, 1969b, p. 13; 1970, p. 14); (2) monthly fuel oil sales (FOS) (National Iranian Petroleum Company, 1968, pp. 14-24; 1969, pp. 14-24; 1970, pp. 14-24)--a reflection of operation length of commercial motors used in generators, trucks, and buses, etc.; (3) monthly total direct tax collections (DT) (Bank Markazi Iran, January-February, 1970, pp. 637-638; March-April, 1970, pp. 778-779; May-June, 1970, pp. 50-51; July-August, 1970, pp. 180-181; September-October, 1970, pp. 311-312; November-December, 1970, pp. 439-440; January-February, 1971, pp. 608-609)--an indicator of days worked because of payroll deductions; (4) monthly total indirect tax collections (IT) (Bank Markazi Iran, January-February, 1970, pp. 637-638; March-April, 1970, pp. 778-779; May-June, 1970, pp. 50-51; July-August, 1970, pp. 180-181; September-October, 1970, pp. 311-312; November-December, 1970, pp. 439-440; January-February, 1971, pp. 608-609)--a reflection of retail sales; and (5) the national electrical production index (NEP) (Ministry of Economy, 1969b, p. 13; 1970, p. 14)--an indicator of commercial activity since business enterprises use approximately seventy-five per cent of all electricity sold (The Echo of Iran, 1970, p. 295).

The null hypothesis for Relationship B is that there is no relationship between the independent variables:

$w_{1:2}NWMHI$, $w_{1:3}NWMHI$, and $w_{3:5}NWMHI$ and the dependent variables: AO, FOS, DT, IT, NEP.

This null hypothesis is tested with the general equation B-1.

$$IAP^{i} = a + b(w_{k}NWMHI) \tag{B-1}$$

IAP = Indicator of economic activity

NWMHI = National monthly health indicator

w_k = The weight assigned to the NWMHI

k = 1:2, 1:3, 3:5

i = AO, FOS, DT, IT, and NEP as abbreviated above

The testing of expression B-1 concludes the investigation of the relationship between the dependent and the independent variables broadly classified under Relationship B.

It should be noted at this point that all of these indicators of aggregate economic activity deal with items which can be measured with ease. Items like village manufacturing are excluded. Such exclusions can be justified because manufacturing of this nature constitutes a relatively small and diminishing portion of aggregate economic activity. In 1346 (1967), for example, it is estimated that village manufacturing, a portion of which undoubtedly does not enter the market formally, constituted only 10 per cent of the total contribution made by the manufacturing sector to GNP (Ministry of Economy, 1967, p. 1).

Relationship C

The interviews with Iranian factory managers and factory foremen revealed that they felt that ill health does not affect production, because they never encountered a labor shortage even if some workers were absent (Karimi and associates, 1971; Shabankari, 1971; Schuler, 1971; Accounting personnel, Fars Cement Company, 1971).

If the results of regressions classified under Relationships A and B are in compliance with the interview results, i.e., lead to the acceptance of all null hypotheses, it would be valuable to determine if production is merely unaffected because of the alleged abundance of labor or if, in addition, production is not impeded because ill health of the general populace is not reflected in the health of the workforce.

In order to answer this question it will be ascertained under Relationship C if (1) fluctuations in the general health of the population translate themselves into health fluctuations of the non-agriculturally employed so as to result in absenteeism, and (2) absences of employees reduce a firm's output.

Relationship C-1

The null hypothesis (C-1) is that no significant association exists between absenteeism and the WMHI. The general equation used to test this null hypothesis is:

$$AB_j^i = a + b(w_k WMHI_j) \tag{C-1}$$

AB = Absenteeism

WMHI = Weighted monthly health indicator

j = f = Fars <u>Ostan</u>

k = 1:2, 1:3, 3:5

i = nr, ..., si

nr--NIOC Refining Co., Shiraz Distribution Center

pc--Petro-Chemical Co.

ms--Masonry Stone Co.

fc--Fars Cement Co.

re--Regional Electric Co.

ps--Pahlavi Self Service

si--Siemens Co.

Where possible the raw absentee data were converted to the number of workdays or the number of workhours lost as a percentage of total scheduled workdays or workhours. This was done in order to minimize distortion in the monthly raw absentee data caused by (1) the varying number of workdays per month, and (2) variations in the number of employed.

Unfortunately, most firms contacted were not able to supply this investigator with absentee data. The reason was that no absenteeism records were kept. Subsequently, the number of the absentee samples was smaller than desired. The problem was compounded by the lack of published data.

Relationship C-2

In order to overcome this problem, data closely related to absenteeism as well as to health fluctuations of the non-agriculturally employed labor force (the dependent variable) were collected and regressed against an unweighted health indicator. The latter data consist of illness frequency reports by the Government Insurance Company (1971a).

Allegedly, firms in Iran are required to cover their employees and their immediate families with government issued health insurance. In 1346 (1967), for example, of the 461,688 (Ministry of Economy, 1967) persons employed in non-agricultural industries more than 100,000 (Government Insurance Company, 1971b) were insured.

The number of claims filed every month for selected <u>Ostans</u> was obtained from this insurance company. This number is assumed to be an indicator of the general health of the non-agriculturally employed workers and their families (HINAE); reduced to a per insured basis it is then expressed as (PHINAE) (Government Insurance Company, 1971a).

Since many more Iranians suffered from dysentery and influenza than any other disease, the monthly morbidity frequencies of these two diseases were combined to form a monthly health indicator of the general population (MHI)--an unweighted indicator. This indicator, unlike the weighted monthly health indicator, is designed to reflect only the number of individuals afflicted by dysentery and influenza. It is not an estimate of work days lost due to absenteeism as is the case with the WMHI.[1]

The null hypothesis to be tested C-2, like C-1, is that no significant correlation exists between health fluctuations of the population in general (MHI)--the independent variable, and health fluctuations of the non-agriculturally employed labor force (HINAE and PHINAE)--the dependent variable.

To test this null hypothesis the health indicator of non-agriculturally employed workers (HINAE and PHINAE) of selected provinces is regressed bivariately against the monthly health indicator of the general population (MHI) of

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1. For example, if in the first month in 1348 the morbidity frequencies for dysentery and influenza were 1,000 and 2,000 respectively, the monthly health indicator for that month would be 3,000. Thus, the higher the monthly health indicator, the higher the ill health of the general population.

selected provinces as expressed in the following equations:

$$HINAE_j = a + b(MHI_j) \qquad \text{(C-2A)}$$

$$PHINAE_j = a + b(MHI_j) \qquad \text{(C-2B)}$$

HINAE = Health indicator of the non-agriculturally employed workers

PHINAE = Per insured health indicator of the non-agriculturally employed workers

MHI = Health indicator of the general population

j = c, f

c = Central Ostan

f = Fars Ostan

Relationship C-3

Null hypotheses C-1 and C-2 are modified somewhat to reflect the relationship between the following three variables: firms' output, firms' absenteeism, and the WMHI for the corresponding Ostan. Null hypothesis C-3 is that there is no relationship between firms' absenteeism and the WMHI in the corresponding Ostan (the independent variables) and firms' output (the dependent variable).

This compound null hypothesis will be investigated by using the following regression equation:

$$FO^i_f = a + b(AB^i_f, w_k WMHI_f) \qquad \text{(C-3)}$$

FO = Firms' output

AB = Absenteeism

WMHI = Weighted monthly health indicator

i = fc, re, ps

fc = Fars Cement Co.

re = Regional Electric Co.

ps = Pahlavi Self Service

f = Fars <u>Ostan</u>

k = 1:2, 1:3, 3:5.[1]

When this null hypothesis C-3 is either accepted or rejected it will lend important insights into the production-absenteeism-health relationship and its individual components. If the null hypotheses C-1 and C-2 are rejected and the same is true for the null hypothesis C-3, the result of the latter hypothesis would reinforce the results of C-1 and C-2. For example, let us assume that a significant positive relationship does exist between absenteeism and the WMHI and the same is true between the HINAE and the MHI. If our theory is that upward fluctuations in ill health, as measured by the WMHI, result in an upward fluctuation in absenteeism, it is supported by the

1. A modified BMD 02R stepwise regression program on the CDC 6400 computer is used. In addition to calculating the correlation coefficients, the program also provides for the calculation of the Durbin-Watson statistics.

positive relationships between the health indicator of the non-agriculturally employed (HINAE) and the monthly health indicator of the general population (MHI), according to the results of our simple model.

Let us assume that a portion of all ill workers will not report for work. Moreover, let us project that null hypotheses C-1, C-2, and C-3 are rejected with a positive correlation coefficient for Equation C-1, C-2A, and C-2B and a negative correlation coefficient for Equation C-3. Then, according to our model, fluctuations in the ill health of the population correspond positively to fluctuations in ill health of the non-agriculturally employed labor force as well as work absenteeism of the non-agriculturally employed. Moreover, ill health of the general population and, therefore, ill health of the non-agriculturally employed labor force fluctuate in a negative direction with firms' output.

To this point we are only projecting possible outcomes. The empirical results will be presented in Chapter 3.

Qualifications of Relationships C-1 through C-3

As stated under Relationship A a larger and perhaps geographically more diverse sample of individual firms' production and absenteeism data would have been desirable. Unfortunately firms kept poor or no records, especially of absenteeism. However, the government health insurance data overcome, in part, the lack of firms' absentee data.

Relationship D

The answers to the questions raised under Relationships A, B, and C will reveal how the short-term fluctuations in the health of the general population translate themselves into the health of the industrially employed labor force, into absenteeism, into production, and into aggregate economic activity.

In order to analyze the results of the statistical tests, it is also of interest to ascertain whether a relationship exists between the health of the population in more industrialized as compared to less industrialized areas. In other words, if the industrially employed are healthier than the population in general, does this better health spill over onto the general population to make the latter healthier in industrialized (urban) areas.[1]

The null hypothesis governing this question is that there is no relationship between the health of the general population in an Ostan and the Ostan's indicator of industrialization (D-1).

1. The actual result will be discussed in Chapter 4.

Definitions and Testing

The indicator of industrialization (IOI) is defined as the number of industrially employed per 100,000 of general population per Ostan (Ministry of Economy, 1967, p. 129). Thus, the higher the IOI in a particular Ostan the larger is the percentage of the general population in that Ostan which is employed in industry.

The dependent variables consist of per Ostan morbidity rates of major diseases, i.e., diseases with the highest morbidity rate nationally. In 1348 (1967-1968), the five diseases meeting this criterion, ranked in order from the highest to the fifth highest, were (1) influenza (INF), (2) dysentery (DY), (3) conjunctivitis (CON), (4) trachoma (TRA), and (5) measles (MEA) (Ministry of Health of Iran, 1969, p. 1).

These variables will then be associated by means of the Kendall's coefficients of concordance (w) method against the IOI per Ostan, as expressed in Equation D-1:

$$IOI_j = b(DY_j, INF_j, CON_j, TRA_j, MEA_j) \qquad \text{(D-1)}$$

j = Ostan 1, ..., Ostan 13

IOI = Indicator of industrialization (Variable 1)

DY = Dysentery (Variable 2)

INF = Influenza (Variable 3)

CON = Conjunctivitis (Variable 4)

TRA = Trachoma (Variable 5)

MEA = Measles (Variable 6)

The results will reveal whether or not a significant association exists between the IOI rankings of each Ostan and the morbidity rate rankings of the five diseases for the respective Ostans.

Qualifications of the Methodology

This test can be criticized on the basis that not all diseases were included in the test. It should be noted, though, that this equation did include the diseases with the highest morbidity rates which, at the same time, were short term in nature. This test also can be criticized because the Kendall's coefficients of concordance method averages rankings of the independent variables. In order to minimize the importance of this criticism, the individual rank order correlations between each of the variables and all other variables are also computed.

Conclusion

The primary purpose of this chapter is to examine methods of testing the relationship between health fluctuations and output (Relationship A). Relatedly, Relationships B through D are proposed to be examined, i.e., "B" the aggregate economic activity/health relationship, "C" the production/absenteeism/health relationship, and "D" the industrial concentration/health relationship.

Only in a sound theoretical framework can the results of individual regressions display or not display causality between the dependent and independent variables of all specific relationships tested. The question is whether or not in these four simple models (Relationships A through D), the independent variables, in the given theoretical framework, exercise the influence upon the dependent variable which is predicted by the current literature in this area.

The literature exemplified in Chapter 1 suggests strongly that a negative relation exists between ill-health and production. The task of this paper is not only to test the short-term health/output relationship (for Iran), via the simple models outlined under Relationships A, B, and C, but also to explain the findings in a theoretical context. Such explanations will be aided by the results of the regression model D--the industrial concentration/health relationship. These findings will be analyzed with respect to answering the primary health/output question (Relationship A), as well as with respect to expressing underlying reasons for the findings after examining all related questions (Relationships B, C, and D).

CHAPTER 3

RESULTS OF STATISTICAL STUDIES

Introduction

Chapter 3 consists of the presentation of results which were computed according to the methodology outlined in the preceding chapter. The presentation of each null hypothesis for relationships broadly classified from A through D will be followed by the correlation coefficient of each regression. Additionally, the mean and the standard deviation for each variable along with an evaluation of the level of significance of each correlation coefficient will be listed for both the bivariate and multivariate regressions. For the latter the Durbin-Watson statistics as well as the multiple R will be revealed.

The presentation of these detailed findings will aid in the analysis of statistical results in Chapter 4.

Firms' Output vs. Health (Relationship A-1)

The first relationship to be examined is whether or not a statistical association exists between short-term physical production fluctuations on the firm level, the industry level, and the aggregate level (the dependent variables) and short-term health fluctuations (the independent variable). The null hypothesis (A-1) is that no relationship exists between an individual firm's monthly production fluctuations and fluctuations of the weighted monthly health indicator of the general population in the region in which the firm is located.

The general regression equations (Equations A-1A and A-1B) used to test null hypothesis A-1 are:

$$FO_j^i = a + b(w_k WMHI_j) \tag{A-1A}$$

and

$$PFO_j^i = a + b(w_k WMHI_j) \tag{A-1B}$$

FO = monthly production of firm

PFO = per worker monthly production

WMHI = weighted monthly health indicator

i = fc, ..., et all firms for which output data were collected as listed below:

fc--Fars Cement Co.

sm--Shiraz Milk Products Co.

ns--Nargess Shortening Co.

ps--Pahlavi Self Service

re--Regional Electric Co. Fars

tr--Tehran NIOC Refinery

ar--Abadan NIOC Refinery

mp--Mashhad Pepsi Co.

et--Esfahan Tobacco Co.

w_k = weight of the monthly health indicator

k = 1:2, 1:3, 3:5 absentee weights resulting from dysentery and influenza respectively

j = c, ..., kd *Ostans* c through kd as listed below:

c--Central *Ostan*

g--Gilan *Ostan*

m--Mazandaran *Ostan*

ee--East Azarbayejan *Ostan*

wa--West Azarbayejan *Ostan*

k--Kermanshan *Ostan*

kh--Khuzestan *Ostan*

f--Fars *Ostan*

ke--Kerman *Ostan*

ko--Korasan *Ostan*

e--Esfahan *Ostan*

s--Sistan *Ostan*

kd--Kordestan *Ostan*

Relationship A-1A

The solutions to the specific equations for Relationship A-1A are found in Table 2.

Relationship A-1B

Where possible, firms' physical output was reduced to the per worker level (PFO) by dividing monthly production by the average number of workers employed during the corresponding month. The results of the individual regressions are found in Table 3.

Table 2. Results of Regressions Between Firms' Output and the Weighted Monthly Health Indicator -- Period of Observation (PO), Number of Observations (N), Correlation Coefficients (R), Means ($\overline{X}$), Standard Deviations (SD), and Determinations of Significance.

	PO	N	R	$\overline{X}$	SD	Significant at 5% level?
A-1Aa:	1346	48	-.0789	20120*	6540*	No
	1347					
$FO_f^{fc} = a + b(w_{1:2}WMHI_f)$	1348			6175**	3009**	
	1349					
A-1Ab:	1346	48	-.0444	20120*	6540*	No
	1347					
$FO_f^{fc} = a + b(w_{1:3}WMHI_f)$	1348			8445**	4286**	
	1349					
A-1Ac:	1346	48	-.0793	20120*	6540*	No
	1347					
$FO_f^{fc} = a + b(w_{3:5}WMHI_f)$	1348			16240**	8247**	
	1349					
A-1Ad:	1347	24	.2992	277100*	71890*	No
	1348					
$FO_f^{sm} = a + b(w_{1:2}WMHI_f)$				7230**	2788**	
A-1Ae:	1347	24	.2781	277100*	71890*	No
	1348					
$FO_f^{sm} = a + b(w_{1:3}WMHI_f)$				10100**	4173**	
A-1Af:	1347	24	.3117	277100*	71890*	No
	1348					
$FO_f^{sm} = a + b(w_{3:5}WMHI_f)$				18600**	6995**	

Table 2.--Continued Results of Regressions Between Firms' Output and the Weighted Monthly Health Indicator -- Period of Observation (PO), Number of Observations (N), Correlation Coefficients (R), Means ($\overline{X}$), Standard Deviations (SD), and Determinations of Significance.

	PO	N	R	$\overline{X}$	SD	Significant at 5% level?
A-1Ag:	1346	36	-.0767	579900*	139600*	No
	1347					
$FO_f^{ns} = a + b(w_{1:2}WMHI_f)$	1348			8420**	10180**	
A-1Ah:	1346	36	.3691	579900*	139600*	No
	1347					
$FO_f^{ns} = a + b(w_{1:3}WMHI_f)$	1348			9203**	5715**	
A-1Ai:	1346	36	.1669	579900*	139600*	No
	1347					
$FO_f^{ns} = a + b(w_{3:5}WMHI_f)$	1348			17880**	7002**	
A-1Aj:	1346	30	-.0440	17130*	7462*	No
	1347					
$FO_f^{ps} = a + b(w_{1:2}WMHI_f)$	1348			8753**	11120**	
A-1Ak:	1346	30	.0280	17130*	7462*	No
	1347					
$FO_f^{ps} = a + b(w_{1:3}WMHI_f)$	1348			9124**	3881**	
A-1Al:	1346	30	.0150	17130*	7462*	No
	1347					
$FO_f^{ps} = a + b(w_{3:5}WMHI_f)$	1348			17320**	6476**	
A-1Am:	1346	36	.2207	58020*	10710*	No
	1347					
$FO_f^{re} = a + b(w_{1:2}WMHI_f)$	1348			6772**	2481**	

Table 2.--Continued Results of Regressions Between Firms' Output and the Weighted Monthly Health Indicator -- Period of Observation (PO), Number of Observations (N), Correlation Coefficients (R), Means ($\overline{X}$), Standard Deviations (SD), and Determinations of Significance.

	PO	N	R	$\overline{X}$	SD	Significant at 5% level?
A-1An:	1346	36	.2797	58020*	10710*	No
	1347					
$FO_{f}^{re} = a + b(w_{1:3}WMHI_{f})$	1348			9202**	3715**	
A-1Ao:	1346	36	.2330	58020*	10710*	No
	1347					
$FO_{f}^{re} = a + b(w_{3:5}WMHI_{f})$	1348			17870**	7002**	
A-1Ap:	1347	18	.3277	2639*	301.1*	No
	1348					
$FO_{c}^{tr} = a + b(w_{1:2}WMHI_{c})$	1349			63860**	15830**	
A-1Aq:	1347	18	.2862	2639*	301.1*	No
	1348					
$FO_{c}^{tr} = a + b(w_{1:3}WMHI_{c})$	1349			86290**	23100**	
A-1Ar:	1347	18	.3655	2639*	301.1*	No
	1348					
$FO_{c}^{tr} = a + b(w_{3:5}WMHI_{c})$	1349			16690**	40650**	
A-1As:	1347	18	.4230	1191*	85.40*	No
	1348					
$FO_{kh}^{ar} = a + b(w_{1:2}WMHI_{kh})$	1349	18		29130**	8096**	
A-1At:	1347	18	.3707	1191*	85.40*	No
	1348					
$FO_{kh}^{ar} = a + b(w_{1:3}WMHI_{kh})$	1349			39740**	11520**	

Table 2.--Continued Results of Regressions Between Firms' Output and the Weighted Monthly Health Indicator -- Period of Observation (PO), Number of Observations (N), Correlation Coefficients (R), Means ($\overline{X}$), Standard Deviations (SD), and Determinations of Significance.

	PO	N	R	$\overline{X}$	SD	Significant at 5% level?
A-1Au:	1347	18	.4056	1191*	85.40*	No
	1348					
$FO^{ar}_{kh} = a + b(w_{3:5}WMHI_{kh})$	1349			77540**	21400**	
A-1Av:	1346	36	.0547	71590*	78070*	No
	1347					
$FO^{mp}_{ko} = a + b(w_{1:2}WMHI_{ko})$	1348			29580**	9420**	
A-1Aw:	1346	36	-.1094	71590*	78070*	No
	1347					
$FO^{mp}_{ko} = a + b(w_{1:3}WMHI_{ko})$	1348			42510**	10610**	
A-1Ax:	1346	36	-.0266	71590*	78070*	No
	1347					
$FO^{mp}_{ko} = a + b(w_{3:5}WMHI_{ko})$	1348			80650**	19520**	
A-1Ay:	1346	36	-.2003	236600*	36180*	No
	1347					
$FO^{et}_{e} = a + b(w_{1:2}WMHI_{e})^{a}$	1348			32970**	11940**	
A-1Az:	1346	36	-.1382	236600*	36180*	No
	1347					
$FO^{et}_{e} = a + b(w_{1:3}WMHI_{e})^{a}$	1348			4435**	17630**	

Table 2.--Continued Results of Regressions Between Firms' Output and the Weighted Monthly Health Indicator -- Period of Observation (PO), Number of Observations (N), Correlation Coefficients (R), Means ($\overline{X}$), Standard Deviations (SD), and Determinations of Significance.

	PO	N	R	$\overline{X}$	SD	Significant at 5% level?
A-1Azz:	1346	36	-.1862	236600*	36180*	No
	1347					
$FO_e^{et} = a + b(w_{3:5}WMHI_e)^a$	1348			85520**	30710**	

*Dependent Variable.

**Independent Variable.

[a]In Equations A-1Ay through A-1Azz, FO refers to the major tobacco product produced by the Esfahan Tobacco Co. Output of minor products were regressed in the same manner as the major product. The correlation coefficients did not differ significantly from the results of regressions A-1Ay through A-1Azz.

Table 3. Results of Regressions Between Firms' Per Worker Output and the Weighted Monthly Health Indicator -- Period of Observation (PO), Number of Observations (N), Correlation Coefficients (R), Means ($\overline{X}$), Standard Deviations (SD), and Determinations of Significance.

	PO	N	R	$\overline{X}$	SD	Significant at 5% level?
A-1Ba:	1346	48	.0853	426.40*	95.36*	No
	1347					
$PFO_f^{fc} = a + b(w_{1:2}WMHI_f)$	1348			7230**	2788**	
	1349					
A-1Bb:	1346	48	.0644	426.40*	95.36*	No
	1347					
$PFO_f^{fc} = a + b(w_{1:3}WMHI_f)$	1348			10100**	4173**	
	1349					
A-1Bc:	1346	48	.1593	426.40*	95.36*	No
	1347					
$PFO_f^{fc} = a + b(w_{3:5}WMHI_f)$	1348			18600**	6995**	
	1349					
A-1Bd:	1347	24	-.1597	228900*	488200*	No
	1348					
$PFO_f^{ns} = a + b(w_{1:2}WMHI_f)$				7230**	2788**	
A-1Be:	1347	24	-.1404	228900*	2188200*	No
	1348					
$PFO_f^{ns} = a + b(w_{1:3}WMHI_f)$				10100**	4173**	
A-1Bf:	1347	24	-.1660	228900*	2188200*	No
	1348					
$PFO_f^{ns} = a + b(w_{3:5}WMHI_f)$				18600**	6995**	

Table 3.--Continued

	PO	N	R	$\overline{X}$	SD	Significant at 5% level?
A-1Bg:	1346	36	.0718	230000*	27290*	No
	1347					
$PFO_{f}^{re} = a + b(w_{1:2}WMHI_{f})$	1348			6772**	2481**	
A-1Bh:	1346	36	.1001	230000*	27290*	No
	1347					
$PFO_{f}^{re} = a + b(w_{1:3}WMHI_{f})$	1348			9202**	3715**	
A-1Bi:	1346	36	.0276	230000*	27290*	No
	1347					
$PFO_{f}^{re} = a + b(w_{3:5}WMHI_{f})$	1348			17870**	7002**	
A-1Bj:	1346	36	-.2200	1897*	1660*	No
	1347					
$PFO_{ko}^{mp} = a + b(w_{1:2}WMHI_{ko})$	1348			29580**	9420**	
A-1Bk:	1346	36	-.3131	1897*	1660*	
	1347					
$PFO_{ko}^{mp} = a + b(w_{1:3}WMHI_{ko})$	1348			42510**	10610**	
A-1Bl:	1346	36	-.0909	1897*	1660*	No
	1347					
$PFO_{ko}^{mp} = a + b(w_{3:5}WMHI_{ko})$	1348			80650**	19520**	

*Dependent Variable.

**Independent Variable.

Industries' Output vs. Health (Relationship A-2)

Real output of selected national industries was regressed against the national weighted monthly health indicator (NWMHI) according to the following general regression equations.

$$IO^{i} = a + b(w_k NWMHI) \tag{A-2A}$$

and

$$SIO_j = a + b(w_k WMHI_j) \tag{A-2B}$$

IO = Index of industrial production

SIO = Slaughter industry output

WMHI = Weighted monthly health indicator

NWMHI = National weighted monthly health indicator

w_k = Weight of monthly health indicator

k = 1:2, 1:3, 3:5

j = c, ..., kd (each Ostan as abbreviated earlier)

i = F, ..., S all industries for which output data were collected as listed below:

F--food manufacturing

B--beverage

T--textile

W--wearing apparel

FW--furniture and wood

P--paper and cardboard

L--leather and hide

R--rubber and rubber products

C--chemical

M--construction and non-metallic minerals

BM--basic metal

MP--metal products

MM--machinery manufacturing (non-electrical)

E--electrical equipment

TR--transport equipment

S--aggregate index of selected industries

The null hypothesis to be tested (A-2) is that no significant association exists between the monthly industrial output fluctuations and the monthly health indicator. The results of the specific regressions are listed in Table 4. Equation A-2Bmm concludes the testing of Relationship A. The next relationship to be tested is Relationship B.

Aggregate Economic Activity vs. Health (Relationship B)

Null hypothesis B is that there is no significant relationship between the independent variables $w_{1:2}NWMHI$, $w_{1:3}NWMHI$, $w_{3:5}NWMHI$ and the dependent variables--indicators of aggregate economic activity: (1) aggregate monthly production index of selected products (AO), (2) monthly fuel oil sales (FOS), (3) monthly total direct tax collections (DT), (4) monthly total indirect tax collections (IT), and (5) the national electrical production

Table 4. Results of Regressions Between Industries' Output and the Weighted Monthly Health Indicator -- Period of Observation (PO), Number of Observations (N), Correlation Coefficients (R), Means ($\overline{X}$), Standard Deviations (SD), and Determinations of Significance.

	PO	N	R	$\overline{X}$	SD	Significant at 5% level?
A-2Aa:	1347	21	.3687	101.8*	9.3*	No
	1348					
$IO^F = a + b(w_{1:2}NWMHI)$	1349			2375**	427.1*	
A-2Ab:	1347	21	.3615	101.8*	9.3*	No
	1348					
$IO^F = a + b(w_{1:3}NWMHI)$	1349			3165**	501.1**	
A-2Ac:	1347	21	.2079	101.8*	9.3*	No
	1348					
$IO^F = a + b(w_{3:5}NWMHI)$	1349			7214**	1164**	
A-2Ad:	1347	21	.3684	148.4*	43.58*	Yes
	1348					
$IO^B = a + b(w_{1:2}NWMHI)$	1349			2375**	427.1**	
A-2Ae:	1347	21	.2695	148.4*	43.58*	Yes
	1348					
$IO^B = a + b(w_{1:3}NWMHI)$	1349			3165**	501.1**	
A-2Af:	1347	21	.4002	148.4*	43.58*	Yes
	1348					
$IO^B = a + b(w_{3:5}NWMHI)$	1349			7219**	1164**	
A-2Ag:	1347	21	.7224	99.29*	15.56*	Yes
	1348					
$IO^T = a + b(w_{1:2}NWMHI)$	1349			2375**	427.1**	

Table 4.--Continued Results of Regressions Between Industries' Output and the Weighted Monthly Health Indicator -- Period of Observation (PO), Number of Observations (N), Correlation Coefficients (R), Means ($\overline{X}$), Standard Deviations (SD), and Determinations of Significance.

	PO	N	R	$\overline{X}$	SD	Significant at 5% level?
A-2Ah:	1347	21	.7267	99.29*	15.56*	Yes
	1348					
$IO^T = a + b(w_{1:3}NWMHI)$	1349			3165**	501.1**	
A-2Ai:	1347	21	.5896	99.29*	15.56*	Yes
	1348					
$IO^T = a + b(w_{3:5}NWMHI)$	1349			7214**	1164**	
A-2Aj:	1347	21	.2795	108.1*	17.45*	No
	1348					
$IO^W = a + b(w_{1:2}NWMHI)$	1349			2375**	42701**	
A-2Ak:	1347	21	.3069	108.1*	17.45*	No
	1348					
$IO^W = a + b(w_{1:3}NWMHI)$	1349			3165**	501.1**	
A-2Al:	1347	21	.2990	108.1*	17.45*	No
	1348					
$IO^W = a + b(w_{3:5}NWMHI)$	1349			7214**	1164**	
A-2Am:	1347	21	.2595	93.67*	24.71*	No
	1348					
$IO^{FW} = a + b(w_{1:2}NWMHI)$	1349			2375**	427.1**	
A-2An:	1347	21	.1524	93.67*	24.71*	No
	1348					
$IO^{FW} = a + b(w_{1:3}NWMHI)$	1349			3165**	501.1**	

Table 4.--Continued Results of Regressions Between Industries' Output and the Weighted Monthly Health Indicator -- Period of Observation (PO), Number of Observations (N), Correlation Coefficients (R), Means ($\overline{X}$), Standard Deviations (SD), and Determinations of Significance.

	PO	N	R	$\overline{X}$	SD	Significant at 5% level?
A-2Ao:	1347	21	.3584	93.67*	24.71*	No
	1348					
$IO^{FW} = a + b(w_{3:5}NWMHI)$	1349			7214**	1164**	
A-2Ap:	1347	21	.5868	148.0*	28.12*	Yes
	1348					
$IO^{P} = a + b(w_{1:2}NWMHI)$	1349			2375**	427.1**	
A-2Aq:	1347	21	.5811	148.0*	28.12*	Yes
	1348					
$IO^{P} = a + b(w_{1:3}NWMHI)$	1349			3165**	501.1**	
A-2Ar:	1347	21	.4576	148.0*	28.12*	Yes
	1348					
$IO^{P} = a + b(w_{3:5}NWMHI)$	1349			7214**	1164**	
A-2As:	1347	21	.1811	140.3*	13.63*	No
	1348					
$IO^{L} = a + b(w_{1:2}NWMHI)$	1349			2375**	427.1**	
A-2At:	1347	21	.0797	140.3*	13.63*	No
	1348					
$IO^{L} = a + b(w_{1:3}NWMHI)$	1349			3165**	501.1**	
A-2Au:	1347	21	.3025	140.3*	13.63*	No
	1348					
$IO^{L} = a + b(w_{3:5}NWMHI)$	1349			7214**	1164**	

Table 4.--Continued Results of Regressions Between Industries' Output and the Weighted Monthly Health Indicator -- Period of Observation (PO), Number of Observations (N), Correlation Coefficients (R), Means ($\overline{X}$), Standard Deviations (SD), and Determinations of Significance.

	PO	N	R	$\overline{X}$	SD	Significant at 5% level?
A-2Av:	1347	21	.3042	105.0*	18.29*	No
	1348					
$IO^R = a + b(w_{1:2}NWMHI)$	1349			2375**	427.10**	
A-2Aw:	1347	21	.3196	105.0*	18.29*	No
	1348					
$IO^R = a + b(w_{1:3}NWMHI)$	1349			3165**	501.1**	
A-2Ax:	1347	21	.1759	105.0*	18.29*	No
	1348					
$IO^R = a + b(w_{3:5}NWMHI)$	1349			7214**	1164**	
A-2Ay:	1347	21	.3145	180.0*	42.19*	No
	1348					
$IO^C = a + b(w_{1:2}NWMHI)$	1349			2375**	427.1**	
A-2Az:	1347	21	.3002	180.0*	42.19*	No
	1348					
$IO^C = a + b(w_{1:3}NWMHI)$	1349			3165**	501.1**	
A-2Aaa:	1347	21	.0270	180.0*	42.19*	No
	1348					
$IO^C = a + b(w_{3:5}NWMHI)$	1349			7214**	1164**	
A-2Abb:	1347	21	.3584	105.5*	18.85*	No
	1348					
$IO^M = a + b(w_{1:2}NWMHI)$	1349			2375**	427.1**	

Table 4.--Continued Results of Regressions Between Industries' Output and the Weighted Monthly Health Indicator -- Period of Observation (PO), Number of Observations (N), Correlation Coefficients (R), Means ($\overline{X}$), Standard Deviations (SD), and Determinations of Significance.

	PO	N	R	$\overline{X}$	SD	Significant at 5% level?
A-2Acc:	1347	21	.2460	105.5*	18.85*	No
	1348					
$IO^{M} = a + b(w_{1:3}NWMHI)$	1349			3165**	501.1**	
A-2Add:	1347	21	.3319	105.5*	18.85*	No
	1348					
$IO^{M} = a + b(w_{3:5}NWMHI)$	1349			7214**	1164**	
A-2Aee:	1347	21	-.1860	115.3*	24.13*	No
	1348					
$IO^{BM} = a + b(w_{1:2}NWMHI)$	1349			2375**	427.1**	
A-2Aff:	1347	21	-.1442	115.3*	24.13*	No
	1348					
$IO^{BM} = a + b(w_{1:3}NWMHI)$	1349			3165**	501.1**	
A-2Agg:	1347	21	-.4292	115.3*	24.13*	No
	1348					
$IO^{BM} = a + b(w_{3:5}NWMHI)$	1349			7214**	1164**	
A-2Ahh:	1347	21	.5638	122.7*	13.12*	Yes
	1348					
$IO^{MP} = a + b(w_{1:2}NWMHI)$	1349			2375**	427.1**	
A-2Aii:	1347	21	.5808	122.7*	13.12*	Yes
	1348					
$IO^{MP} = a + b(w_{1:3}NWMHI)$	1349			3165**	501.1**	

Table 4.--Continued Results of Regressions Between Industries' Output and the Weighted Monthly Health Indicator -- Period of Observation (PO), Number of Observations (N), Correlation Coefficients (R), Means ($\overline{X}$), Standard Deviations (SD), and Determinations of Significance.

	PO	N	R	$\overline{X}$	SD	Significant at 5% level?
A-2Ajj:	1347	21	.4464	122.7*	13.12*	Yes
	1348					
$IO^{MP} = a + b(w_{3:5}NWMHI)$	1349			7214**	1164**	
A-2Akk:	1347	21	.4820	94.0*	36.24*	Yes
	1348					
$IO^{MM} = a + b(w_{1:2}NWMHI)$	1349			2375**	427.1**	
A-2All:	1347	21	.4731	94.0*	36.24*	Yes
	1348					
$IO^{MM} = a + b(w_{1:3}NWMHI)$	1349			3165**	501.1**	
A-2Amm:	1347	21	.4126	94.0*	36.24*	No
	1348					
$IO^{MM} = a + b(w_{3:5}NWMHI)$	1349			7214**	1164**	
A-2Ann:	1347	21	-.2358	110.2*	39.17*	No
	1348					
$IO^{E} = a + b(w_{1:2}NWMHI)$	1349			2375**	427.1**	
A-2Aoo:	1347	21	-.2588	110.2*	39.17*	No
	1348					
$IO^{E} = a + b(w_{1:3}NWMHI)$	1349			3165**	501.1**	
A-2App:	1347	21	-.4126	110.2*	39.17*	No
	1348					
$IO^{E} = a + b(w_{3:5}NWMHI)$	1349			7214**	1164**	

Table 4.--Continued Results of Regressions Between Industries' Output and the Weighted Monthly Health Indicator -- Period of Observation (PO), Number of Observations (N), Correlation Coefficients (R), Means ($\overline{X}$), Standard Deviations (SD), and Determinations of Significance.

	PO	N	R	$\overline{X}$	SD	Significant at 5% level?
A-2Aqq:	1347	21	.4900	153.1*	39.87*	Yes
	1348					
$IO^{TR} = a + b(w_{1:2}NWMHI)$	1349			2375**	427.1**	
A-2Arr:	1347	21	.5293	153.1*	39.87*	Yes
	1348					
$IO^{TR} = a + b(w_{1:3}NWMHI)$	1349			3165**	501.1**	
A-2Ass:	1347	21	.2794	153.1*	39.87*	No
	1348					
$IO^{TR} = a + b(w_{3:5}NWMHI)$	1349			7214**	1164**	
A-2Att:	1347	21	.5905	119.9*	13.19*	Yes
	1348					
$IO^{S} = a + b(w_{1:2}NWMHI)$	1349			2375**	427.1**	
A-2Auu:	1347	21	.5593	119.9*	13.19*	Yes
	1348					
$IO^{S} = a + b(w_{1:3}NWMHI)$	1349			3165**	501.1**	
A-2Avv:	1347	21	.5194	14960*	1849*	Yes
	1348					
$IO^{S} = a + b(w_{3:5}NWMHI)$	1349			7214**	1164**	
A-2Ba:	1347	24	.3469	240100*	51670*	No
$SIO_c = a + b(w_{1:2}WMHI_c)$	1348			63090**	15200**	

Table 4.--Continued Results of Regressions Between Industries' Output and the Weighted Monthly Health Indicator -- Period of Observation (PO), Number of Observations (N), Correlation Coefficients (R), Means ($\overline{X}$), Standard Deviations (SD), and Determinations of Significance.

	PO	N	R	$\overline{X}$	SD	Significant at 5% level?
A-2Bb:	1347	24	.2403	240100*	51670*	No
$SIO_c = a + b(w_{1:3}WMHI_c)$	1348			85410**	22150**	
A-2Bc:	1347	24	.4013	240100*	51670*	No
$SIO_c = a + b(w_{3:5}WMHI_c)$	1348			166900**	39300**	
A-2Bd:	1347	24	-.0921	17280*	4236*	No
$SIO_g = a + b(w_{1:2}WMHI_g)$	1348			11170**	2879**	
A-2Be:	1347	24	-.1035	17280*	4236*	No
$SIO_g = a + b(w_{1:3}WMHI_g)$	1348			15440**	4309**	
A-2Bf:	1347	24	-.0842	17280*	4236*	No
$SIO_g = a + b(w_{3:5}WMHI_g)$	1348			29250**	7259**	
A-2Bg:	1347	24	-.2191	28570*	4251*	No
$SIO_m = a + b(w_{1:2}WMHI_m)$	1348			16190**	2965**	
A-2Bh:	1347	24	-.3211	28570*	4251*	No
$SIO_m = a + b(w_{1:3}WMHI_m)$	1348			21940**	4454**	
A-2Bi:	1347	24	-.3531	38570*	4251*	No
$SIO_m = a + b(w_{3:5}WMHI_m)$	1348			141300**	7959**	
A-2Bj:	1347	24	.1444	31620*	7220*	No
$SIO_{ea} = a + b(w_{1:2}WMHI_{ea})$	1348			10650**	4638**	

Table 4.--Continued Results of Regressions Between Industries' Output and the Weighted Monthly Health Indicator -- Period of Observation (PO), Number of Observations (N), Correlation Coefficients (R), Means ($\overline{X}$), Standard Deviations (SD), and Determinations of Significance.

	PO	N	R	$\overline{X}$	SD	Significant at 5% level?
A-2Bk:	1347	24	-.0183	31620*	7220*	No
$SIO_{ea} = a + b(w_{1:3}WMHI_{ea})$	1348			13370**	4638**	
A-2Bl:	1347	24	.1624	31620*	7220*	No
$SIO_{ea} = a + b(w_{3:5}WMHI_{ea})$	1348			28970**	10120**	
A-2Bm:	1347	24	-.1459	12210*	2630*	No
$SIO_{wa} = a + b(w_{1:2}WMHI_{wa})$	1348			3125**	1870**	
A-2Bn:	1347	24	-.2738	12210*	2630*	No
$SIO_{wa} = a + b(w_{1:3}WMHI_{wa})$	1348			4408**	2865**	
A-2Bo:	1347	24	-.0994	12210*	2630*	No
$SIO_{wa} = a + b(w_{3:5}WMHI_{wa})$	1348			7980**	4727**	
A-2Bp:	1347	24	-.4143	11930*	2210*	Yes
$SIO_{k} = a + b(w_{1:2}WMHI_{k})$	1348			2571**	1701**	
A-2Bq:	1347	24	-.4917	11930*	2210*	Yes
$SIO_{k} = a + b(w_{1:3}WMHI_{k})$	1348			3254**	2525**	
A-2Br:	1347	24	-.3285	11930*	2210*	No
$SIO_{k} = a + b(w_{3:5}WMHI_{k})$	1348			6946**	4355**	
A-2Bs:	1347	24	-.0467	50150*	6182*	No
$SIO_{kh} = a + b(w_{1:2}WMHI_{kh})$	1348			25880**	8212**	

Table 4.--Continued Results of Regressions Between Industries' Output and the Weighted Monthly Health Indicator -- Period of Observation (PO), Number of Observations (N), Correlation Coefficients (R), Means ($\overline{X}$), Standard Deviations (SD), and Determinations of Significance.

	PO	N	R	$\overline{X}$	SD	Significant at 5% level?
A-2Bt:	1347	24	-.0122	50150*	6182*	No
$SIO_{kh} = a + b(w_{1:3}WMHI_{kh})$	1348			35050**	11880**	
A-2Bu:	1347	24	.0697	50150*	6182*	No
$SIO_{kh} = a + b(w_{3:5}WMHI_{kh})$	1348			67470**	23420**	
A-2Bv:	1347	24	-.2720	30640*	7560*	No
$SIO_{f} = a + b(w_{1:2}WMHI_{f})$	1348			7230**	2788**	
A-2Bw:	1347	24	-.3404	30640*	7560*	No
$SIO_{f} = a + b(w_{1:3}WMHI_{f})$	1348			10100**	4173**	
A-2Bx:	1347	24	-.3404	30640*	7560*	No
$SIO_{f} = a + b(w_{3:5}WMHI_{f})$	1348			18600**	6995**	
A-2By:	1347	24	-.0531	11160*	1989*	No
$SIO_{ke} = a + b(w_{1:2}WMHI_{ke})$	1348			11330**	4125**	
A-2Bz:	1347	24	-.1143	11160*	1989*	No
$SIO_{ke} = a + b(w_{1:3}WMHI_{ke})$	1348			15720**	6241**	
A-2Baa:	1347	24	.0441	11160*	1989*	No
$SIO_{ke} = a + b(w_{3:5}WMHI_{ke})$	1348			30380**	10850**	
A-2Bbb:	1347	24	.0815	48800*	10710*	No
$SIO_{ko} = a + b(w_{1:2}WMHI_{ko})$	1348			27920**	9713**	

Table 4.--Continued Results of Regressions Between Industries' Output and the Weighted Monthly Health Indicator -- Period of Observation (PO), Number of Observations (N), Correlation Coefficients (R), Means ($\overline{X}$), Standard Deviations (SD), and Determinations of Significance.

	PO	N	R	$\overline{X}$	SD	Significant at 5% level?
A-2Bcc:	1347	24	-.1078	48800*	10710*	No
$SIO_{ko} = a + b(w_{1:3}WMHI_{ko})$	1348			41510**	10080**	
A-2Bdd:	1347	24	.2002	48800*	10710*	No
$SIO_{ko} = a + b(w_{3:5}WMHI_{ko})$	1348			78190**	18940**	
A-2Bee:	1347	24	.0351	47240*	10440*	No
$SIO_{e} = a + b(w_{1:2}WMHI_{e})$	1348			33700**	13700**	
A-2Bff:	1347	24	-.1055	47240*	10440*	No
$SIO_{e} = a + b(w_{1:3}WMHI_{e})$	1348			44250**	19110**	
A-2Bgg:	1347	24	.0816	47240*	10440*	No
$SIO_{e} = a + b(w_{3:5}WMHI_{e})$	1348			87090**	33840**	
A-2Bhh:	1347	24	.2322	2694*	177.8*	No
$SIO_{s} = a + b(w_{1:2}WMHI_{s})$	1348			5935**	2867**	
A-2Bii:	1347	24	.1933	2694*	177.8*	No
$SIO_{s} = a + b(w_{1:3}WMHI_{s})$	1348			7999**	4133**	
A-2Bjj:	1347	24	.2555	2694*	177.8*	No
$SIO_{s} = a + b(w_{3:5}WMHI_{s})$	1348			15710**	7401**	
A-2Bkk:	1347	24	.2086	6640*	903.1*	No
$SIO_{kd} = a + b(w_{1:2}WMHI_{kd})$	1348			4502**	1347**	

Table 4.--Continued Results of Regressions Between Industries' Output and the Weighted Monthly Health Indicator -- Period of Observation (PO), Number of Observations (N), Correlation Coefficients (R), Means ($\overline{X}$), Standard Deviations (SD), and Determinations of Significance.

	PO	N	R	$\overline{X}$	SD	Significant at 5% level?
A-2B11:	1347	24	.0943	6640*	903.1*	No
$SIO_{kd} = a + b(w_{1:3}WMHI_{kd})$	1348			5870**	1685**	
A-2Bmm:	1347	24	.2451	6640*	903.1*	No
$SIO_{kd} = a + b(w_{3:5}WMHI_{kd})$	1348			12050**	3786**	

*Dependent Variable.

**Independent Variable.

index (NEP). This null hypothesis is tested with general equation B-1.

$$IAP^i = a + b(w_k NWMHI) \tag{B-1}$$

IAP = Indicator of economic activity

w_k = The weight assigned to the NWMHI

k = 1:2, 1:3, 3:5

i = AO, FOS, DT, IT, and NEP as abbreviated in the null hypothesis

The results of the specific equations are found in Table 5. The testing of Relationship B is concluded with Equation B-1o.

Firms' Output-Absenteeism-Health Association (Relationship C)

Under the general Relationship C classification, specific tests will determine (1) the health-absentee association, (2) the health indicator of non-agriculturally employed workers-general population's health relationship, and (3) the firms' output-absenteeism-health association.

Relationship C-1

The null hypothesis (C-1) is that no significant association exists between absenteeism and the WMHI. The general equation used to test this null hypothesis is:

$$AB_j^i = a + b(w_k WMHI_j) \tag{C-1}$$

Table 5. Results of Regressions Between Indicators of Aggregate Economic Activity and the NWMHI -- Period of Observation (PO), Number of Observations (N), Correlation Coefficients (R), Means ($\overline{X}$), Standard Deviations (SD), and Determinations of Significance.

	PO	N	R	$\overline{X}$	SD	Significant at 5% level?
B-1a:	1347	21	.5905	119.9*	13.19*	Yes
	1348					
$IAP^{AO} = a + b(w_{1:2}NWMHI)$	1349			2375**	427.1**	
B-1b:	1347	21	.5593	119.9*	13.19*	Yes
	1348					
$IAP^{AO} = a + b(w_{1:3}NWMHI)$	1349			3165**	501.1**	
B-1c:	1347	21	.5194	119.9*	13.19*	Yes
	1348					
$IAP^{AO} = a + b(w_{3:5}NWMHI)$	1349			7214**	11.64**	
B-1d:	1347	18	.2422	14960*	1849*	No
	1348			2688**	492**	
$IAP^{FOS} = a + b(w_{1:2}NWMHI)$						
B-1e:	1347	18	.1151	14960*	1849*	No
	1348			3681**	7284**	
$IAP^{FOS} = a + b(w_{1:3}NWMHI)$						
B-1f:	1347	18	.1494	14960*	1849*	No
	1348			7897**	1395**	
$IAP^{FOS} = a + b(w_{3:5}NWMHI)$						
B-1g:	1347	24	.1747	1302*	542.8*	No
	1348			2556**	511.2**	
$IAP^{DT} = a + b(w_{1:2}NWMHI)$						

Table 5.--<u>Continued</u> Results of Regressions Between Indicators of Aggregate Economic Activity and the NWMHI -- Period of Observation (PO), Number of Observations (N), Correlation Coefficients (R), Means ($\overline{X}$), Standard Deviations (SD), and Determinations of Significance.

	PO	N	R	$\overline{X}$	SD	Significant at 5% level?
B-1h: $IAP^{DT} = a + b(w_{1:3}NWMHI)$	1347 1348	24	.0837	1302* 3480**	554.8* 733**	No
B-1i: $IAP^{DT} = a + b(w_{3:5}NWMHI)$	1347 1348	24	.1986	13.2* 7773**	554.8* 1208**	No
B-1j: $IAP^{IT} = a + b(w_{1:2}NWMHI)$	1347 1348	24	.4998	3227* 2556**	659* 511.2**	Yes
B-1k: $IAP^{IT} = a + b(w_{1:3}NWMHI)$	1347 1348	24	.5063	3227* 3480**	659* 733**	Yes
B-1l: $IAP^{IT} = a + b(w_{3:5}NWMHI)$	1347 1348	24	.4927	3227* 7773**	659* 1208**	Yes
B-1m: $IAP^{NEP} = a + b(w_{1:2}NWMHI)$	1347 1348 1349	21	.4571	161.3* 2375**	36.49* 427.1*	Yes

Table 5.--Continued Results of Regressions Between Indicators of Aggregate Economic Activity and the NWMHI -- Period of Observation (PO), Number of Observations (N), Correlation Coefficients (R), Means ($\overline{X}$), Standard Deviations (SD), and Determinations of Significance.

	PO	N	R	$\overline{X}$	SD	Significant at 5% level?
B-1n: $IAP^{NEP} = a + b(w_{1:3}NWMHI)$	1348 1349	21	.4018	161.3* 3165**	36.49* 501.1**	No
B-1o: $IAP^{NEP} = a + b(w_{3:5}NWMHI)$	1348 1349	21	.2958	161.3* 7214**	36.49* 1164**	No

*Dependent Variable.

**Independent Variable

AB = Absenteeism

$WMHI$ = Weighted monthly health indicator

$j = f$ = Fars Province

$i = nr, \ldots, si$

nr--NIOC Refining Co., Shiraz Distribution Center

pc--Petro-Chemical Co.

ms--Masonry Stone Co.

fc--Fars Cement Co.

re--Regional Electric Co.

ps--Pahlavi Self Service

si--Siemens Co.

k = 1:2, 1:3, 3:5

w_k = Weight

Results of specific regressions are presented in Table 6. Equation C-1u concludes the testing of null hypothesis C-1.

Relationship C-2

The null hypothesis (C-2) to be tested under Relationship C is that no significant relationship exists between the health indicator of the non-agriculturally employed workers and the monthly health indicator of the general population. The general equations for testing this relationship are C-2A and C-2B:

$$HINAE_j = a + b(MHI_j) \qquad \text{(C-2A)}$$

Table 6. Results of Regressions Between Firms' Absenteeism and the WMHI -- Period of Observation (PO), Number of Observations (N), Correlation Coefficients (R), Means ($\overline{X}$), Standard Deviations (SD), and Determinations of Significance.

	PO	N	R	$\overline{X}$	SD	Significant at 5% level?
C-1a: $AB_f^{nr} = a + b(w_{1:2}WMHI_f)$	1347 1348 1349	36	.0151	3.42* 6495**	6.65* 3364**	No
C-1b: $AB_f^{nr} = a + b(w_{1:3}WMHI_f)$	1347 1348 1349	36	.0136	3.42* 9083**	6.65* 4824**	No
C-1c: $AB_f^{nr} = a + b(w_{3:5}WMHI_f)$	1347 1348 1349	36	.0253	3.42* 16750**	6.65* 8614**	No
C-1d: $AB_f^{pc} = a + b(w_{1:2}WMHI_f)$	1347 1348	24	.1857	13810* 7230**	10380* 2788**	No
C-1e: $AB_f^{pc} = a + b(w_{1:3}WMHI_f)$	1347 1348	24	.2058	13810* 10100**	10380* 4173**	No
C-1f: $AB_f^{pc} = a + b(w_{3:5}WMHI_f)$	1347 1348	24	.1896	131810* 18600**	10380* 6994**	No

Table 6.--Continued Results of Regressions Between Firms' Absenteeism and the WMHI -- Period of Observation (PO), Number of Observations (N), Correlation Coefficients (R), Means ($\overline{X}$), Standard Deviations (SD), and Determinations of Significance.

	PO	N	R	$\overline{X}$	SD	Significant at 5% level?
C-1g:	1346	33	.0134	5.79*	8.16*	No
	1347					
$AB_f^{ms} = a + b(w_{1:2}WMHI_f)$	1348			6764**	2558**	
C-1h:	1346	33	-.0384	5.79*	8.16*	No
	1347					
$AB_f^{ms} = a + b(w_{1:3}WMHI_f)$	1348			9143**	3825**	
C-1i:	1346	33	.2345	5.79*	8.16*	No
	1347					
$AB_f^{ms} = a + b(w_{3:5}WMHI_f)$	1348			17900**	7239**	
C-1j:	1348	24	.1436	2.93*	1.30*	No
	1349			4767**	3522**	
$AB_f^{fc} = a + b(w_{1:2}WMHI_f)$						
C-1k:	1348	24	.1017	2.93*	1.30*	No
	1349			8049**	4880**	
$AB_f^{fc} = a + b(w_{1:3}WMHI_f)$						
C-1l:	1348	24	.1661	2.93*	1.30*	No
	1349			15010**	9221**	
$AB_f^{fc} = a + b(w_{3:5}WMHI_f)$						

Table 6.--Continued Results of Regressions Between Firms' Absenteeism and the WMHI -- Period of Observation (PO), Number of Observations (N), Correlation Coefficients (R), Means ($\overline{X}$), Standard Deviations (SD), and Determinations of Significance.

	PO	N	R	$\overline{X}$	SD	Significant at 5% level?
C-1m: $AB_f^{re} = a + b(w_{1:2}WMHI_f)$	1347 1348	36	.1133	2.34* 6772**	.95* 2481**	No
C-1n: $AB_f^{re} = a + b(w_{1:3}WMHI_f)$	1346 1347 1348	36	.1460	2.34* 9202**	.94* 3715**	No
C-1o: $AB_f^{re} = a + b(w_{3:5}WMHI_f)$	1346 1347 1348	36	.1416	2.34* 17870**	.95* 7002**	No
C-1p: $AB_f^{ps} = a + b(w_{1:2}WMHI_f)$	1346 1347 1348	33	-.1561	1.61* 6765**	2.32* 2558**	No
C-1q: $AB_f^{ps} = a + b(w_{1:3}WMHI_f)$	1346 1347 1348	33	-.1183	1.61* 9143**	2.32* 3826**	No
C-1r: $AB_f^{ps} = a + b(w_{3:5}WMHI_f)$	1346 1347 1348	33	-.1365	1.61* 17910**	2.32* 7240**	No

Table 6.--<u>Continued</u> Results of Regressions Between Firms' Absenteeism and the WMHI -- Period of Observation (PO), Number of Observations (N), Correlation Coefficients (R), Means ($\overline{X}$), Standard Deviations (SD), and Determinations of Significance.

	PO	N	R	$\overline{X}$	SD	Significant at 5% level?
C-1s:	1348	24	.4731	4.84*	1.0*	Yes
	1349			5767**	3522**	
$AB_f^{si} = a + b(w_{1:2}WMHI_f)$						
C-1t:	1348	24	.4572	4.84*	1.0*	Yes
	1349			8049**	4880**	
$AB_f^{si} = a + b(w_{1:3}WMHI_f)$						
C-1u:	1348	24	.4802	4.84*	1.0*	Yes
	1349			15010**	9221**	
$AB_f^{si} = a + b(w_{3:5}WMHI_f)$						

*Dependent Variable.

**Independent Variable.

and

$$PHINAE_j = a + b(MHI_j) \tag{C-2B}$$

HINAE = Health indicator of the non-agriculturally employed workers

PHINAE = Per insured health indicator of the non-agriculturally employed workers

MHI = Health indicator of the general population

j = c, f

c--Central <u>Ostan</u>

f--Fars <u>Ostan</u>

The results for the specific equations are listed in Table 7. Equation C-2d concludes the testing of Relationship C-2.

Relationship C-3

The testing of Relationship C-3 consists of testing the firms' output-absenteeism-weighted monthly health indicator association. The null hypothesis (C-3) is that there exists no significant relation between firms' production, absenteeism, and the weighted monthly health indicator. The general equation applied in this case is C-3.

$$FO^i_f = a + b(AB^i_f, w_k NMHI_f) \tag{C-3}$$

FO = Monthly firms' output

PFO = Per worker monthly firms' output

Table 7. Results of Regressions Between the Health Indicator of the Non-Agricultural Workers and the Health Indicator of the General Population -- Period of Observation (PO), Number of Observations (N), Correlation Coefficients (R), Means ($\overline{X}$), Standard Deviations (SD), and Determinations of Significance.

	PO	N	R	$\overline{X}$	SD	Significant at 5% level?
C-2a:	1346	29	-.1123	16880*	34900*	No
	1347					
$HINAE_c = a + b(MHI_c)$	1348			37400**	11350**	
	1349					
C-2b:	1346	48	.1690	1084*	105.4*	No
	1347					
$HINAE_f = a + b(MHI_f)$	1348			3642**	1491**	
	1349					
C-2c:	1346	29	-.2504	327.9*	84.90*	No
	1347					
$PHINAE_c = a + b(MHI_c)$	1348			37400**	11350**	
	1349					
C-2d:	1346	48	.1960	3804000*	496000*	No
	1347					
$PHINAE_f = a + b(MHI_f)$	1348			3642**	1491**	
	1349					

*Dependent Variable

**Independent Variable.

AB = Absenteeism (percentage of scheduled work hours lost)

WMHI = Weighted monthly health indicator

i = fc, re, ps

fc--Fars Cement Co.

re--Regional Electric Co.

ps--Pahlavi Self Service

f = Fars Province

k = 1:2, 1:3, 3:5

w_k = Weight

The results of the specific equations are as follows:

$$PFO_f^{fc} = a + b(AB_f^{fc}, w_{1:2}WMHI_f, w_{1:3}WMHI_f, w_{3:5}WMHI_f) \quad \text{(C-3a)}$$

Years during which monthly observations were made:

1347, 1348 (1968, 1969)

Number of observations: 24

Standard Deviations: variables 1 through 5: (1) 95.37, (2) 13.25, (3) 2788.38, (4) 4173.50, (5) 6995.17

Means: variables 1 through 5: (1) 426.42, (2) 29.33, (3) 7230.83, (4) 10101.92, (5) 18606.75

Correlation coefficient matrix:

FO_f^{fc} = variable 1

AB_f^{fc} = variable 2

$w_{1:2}WMHI_f$ = variable 3

$w_{1:3}WMHI_f$ = variable 4

$w_{3:5}WMHI$ = variable 5

Correlation Matrix:

Variable Number	1	2	3	4	5
1	1.000	.147	.085	.064	.159
2		1.000	-.501	-.545	-.443
3			1.000	.996	.987
4				1.000	.977
5					1.000

Multiple R: -.4783

Is the correlation coefficient between the following variables significant at the 5% level? If yes, with (-) or (+) sign.

variables 1, 2, 3, 4, 5: no

variables 1, 2: no

variables 1, 3: no

variables 1, 4: no

variables 1, 5: no

variables 2, 3: yes (-)

variables 2, 4: yes (-)

variables 2, 5: yes (-)

Durbin-Watson Statistic: 1.25 The hypothesis of autocorrelation is inconclusive.

$$PFO_f^{re} = a + b(AB_f^{re}, w_{1:2}WMHI_f, w_{1:3}WMHI_f, w_{3:5}WMHI_f) \quad \text{(C-3b)}$$

Years during which monthly observations were made:

1346, 1347, 1348 (1967, 1968, 1969)

Number of observations: 35

Standard deviations: variables 1 through 5: (1) 25387.22, (2) 9.50, (3) 2475.89, (4) 3720.31, (5) 6998.56

Means: variables 1 through 5: (1) 231834.60, (2) 23.69, (3) 6847.11, (4) 9302.31, (5) 18076.54

Correlation coefficient matrix:

FO_f^{re} = variable 1

AB_f^{re} = variable 2

$w_{1:2}WMHI_f$ = variable 3

$w_{1:3}WMHI_f$ = variable 4

$w_{3:5}WMHI_f$ = variable 5

Correlation Matrix:

Variable Number	1	2	3	4	5
1	1.000	-.107	-.001	.040	.154
2		1.000	.085	.122	.116
3			1.000	.969	.852
4				1.000	.857
5					1.000

Multiple R: -.3428

Is the correlation coefficient between the following variables significant at the 5% level:

variables 1, 2, 3, 4, 5: no

variables 1, 2: no

variables 1, 3: no

variables 1, 4: no

variables 1, 5: no

variables 2, 3: no

variables 2, 4: no

variables 2, 5: no

Durbin-Watson Statistic: 1.65 The hypothesis of autocorrelation is rejected.

$$FO_f^{ps} = a + b(AB_f^{ps}, w_{1:2}WMHI_f, w_{1:3}WMHI_f, w_{3:5}WMHI_f) \tag{C-3c}$$

Years during which monthly observations were made: 1346, 1347, 1348 (1967, 1968, 1969)

Number of observations: 29

Standard deviations: variables 1 through 5: (1) 7373.04, (2) 0.199, (3) 2592.28, (4) 3871.89, (5) 7424.32

Means: variables 1 through 5: (1) 17454.45, (2) 0.129, (3) 6907.86, (4) 9324.93, (5) 18296.17

Correlation coefficient matrix:

FO_f^{ps} = variable 1

AB_f^{ps} = variable 2

$w_{1:2}WMHI_f$ = variable 3

$w_{1:3}WMHI_f$ = variable 4

$w_{3:5}WMHI_f$ = variable 5

Correlation Matrix:

Variable Number	1	2	3	4	5
1	1.000	.271	-.043	-.001	.013
2		1.000	-.070	-.024	-.057
3			1.000	.967	.840
4				1.000	.849
5					1.000

Multiple R: -.3011

Is the correlation coefficient between the following variables significant at the 5% level?

variables 1, 2, 3, 4, 5: no

variables 1, 2: no

variables 1, 3: no

variables 1, 4: no

variables 1, 5: no

variables 2, 3: no

variables 2, 4: no

variables 2, 5: no

Durbin-Watson Statistic: 1.33 The hypothesis of autocorrelation is inconclusive.

The testing of Equation C-3c concludes the testing done under the broad classification of Relationship C.

It should also be noted that in Relationships A through C all WMHI's and NWMHI's were lagged one month. The results reveal that such lagging did not significantly change the results obtained from non-lagged regressions. Thus, the lagged regressions were not specified individually.

Industrialization vs. Morbidity Frequencies (Relationship D)

Under Relationship D the degree of association of the indicator of industrialization per Ostan versus the per Ostan morbidity frequencies for influenza, dysentery, conjunctivitis, trachoma, and measles is analyzed by means of the Kendall's coefficient of concordance (w) method.

The null hypothesis (D-1) is that there is no significant association of the indicator of industrialization (per Ostan) versus the morbidity frequency for influenza, dysentery, conjunctivitis, trachoma, and measles (per Ostan). The null hypothesis is tested with Equation D-1.

$$IOI_j = b(DY_j, INF_j, CON_j, TRA_j, MEA_j) \qquad \text{(D-1)}$$

j = Ostan 1, ..., Ostan 13

IOI = Indicator of industrialization (variable 1)

DY = Dysentery (variable 2)

INF = Influenza (variable 3)

CON = Conjunctivitis (variable 4)

TRA = Trachoma (variable 5)

MEA = Measles (variable 6)

The solution of D-1 is w = .3819. This w is significant at the .007 level.

The w of associations of individual variables with all others is significant at the following levels:

variable 2--1 per cent

variable 3--1 per cent

variable 4--5 per cent

variable 5--5 per cent

variable 6--5 per cent

variable 7--5 per cent

The presentation of these results concludes Chapter 3. In Chapter 4 these results will be interpreted with respect to their importance in Iran's development process.

CHAPTER 4

INTERPRETATION OF RESULTS OF STATISTICAL TESTS

This chapter is composed of a detailed analysis of each major proposition examined statistically in Chapter 3, i.e., Relationships A through D.

1. Each null hypothesis will be restated.
2. The results of specific equations used to test each null hypothesis will be summarized in order to determine if the corresponding null hypothesis can be rejected.
3. The conclusions, as summarized in Table 8, will be discussed with respect to their microeconomic and macroeconomic implications for economic development.

The relationships summarized in Table 8 will now be dissected in detail.

Relationship A

The individual equations tested under the broad Relationship A in Chapter 3 established (1) the degree of statistical association between firms' output vs. health (Relationship A-1A), (2) per worker firms' output vs. health (Relationship A-1B), (3) industry output (national in scope) vs. health (Relationship A-2A), and (4)

Table 8. Answers to Questions Raised in Relationships A Through D

Relationship	Question	Answer
A-1A	Is there an inverse relationship between firms' output and the ill health of the general population?	No
A-1B	Was an inverse relationship established between firms' per worker output and the ill health of the general population?	No
A-2A	Does a negative association exist between the ill health of the general population in Iran and the output indices of industries?	No
A-2B	Is there a general negative relationship between <u>Ostan</u> slaughter industry statistics and the ill health of the general population in the respective <u>Ostans</u>?	No
B	Does a negative association exist between selected indicators of aggregate economic activity and the ill health of the general population?	No
C-1	Was a general positive association established between individual firm's absenteeism and sickness of the general population in the area of the firm's location?	No
C-2	Is there a relationship between the health of the non-agriculturally employed and the health of the general population?	No
C-3	Was a relationship established between firms' output, absenteeism, and illness of the general population?	No

slaughter industry output (per Ostan) vs. health (Rel

tionship A-2B).

The results of the regressions classified und

Relationship A are summarized in Table 9.

Table 9. Summary of Regression Results Classified Un Relationship A -- A-1A: Firms' Output/Weigh Monthly Health Indicator (WMHI), A-1B: Firm Worker Output/WMHI, A-2A: National Industri Output/(National)WMHI, A-2B: Slaughter Industries' Output/WMHI.

Relationship	Number of Insignificant Correlations at the 5% Level	Number of Significant Correlations			T Num Re si
		Total	With a - sign	With a + sign	
A-1A Firms' Output/WMHI	27	0	0	0	
A-1B Firms' Per Worker Output/WMHI	12	0	0	0	
A-2A National Industries' Output/NWMHI	29	19	0	19	
A-2B Slaughter Industries' Output/WMHI	37	2	2	0	

Table 8.--Continued

Relationship	Question	Answer
D	Was a positive relationship established between the geographic concentration of industry and the frequency of major communicable diseases?	Yes

slaughter industry output (per Ostan) vs. health (Relationship A-2B).

The results of the regressions classified under Relationship A are summarized in Table 9.

Table 9. Summary of Regression Results Classified Under Relationship A -- A-1A: Firms' Output/Weighted Monthly Health Indicator (WMHI), A-1B: Firms' Per Worker Output/WMHI, A-2A: National Industries' Output/(National)WMHI, A-2B: Slaughter Industries' Output/WMHI.

Relationship	Number of Insignificant Correlations at the 5% Level	Number of Significant Correlations			Total Number of Regressions
		Total	With a - sign	With a + sign	
A-1A Firms' Output/WMHI	27	0	0	0	27
A-1B Firms' Per Worker Output/WMHI	12	0	0	0	12
A-2A National Industries' Output/NWMHI	29	19	0	19	48
A-2B Slaughter Industries' Output/WMHI	37	2	2	0	39

Relationship A-1A

Null hypothesis A-1 is that no relationship exists between an individual firm's monthly production fluctuations and fluctuations of the weighted monthly health indicator of the general population in the region in which the firm is located. It was tested with Equations A-1Aa, ..., A-1Azz. The results revealed that none of the twenty-seven equations led to the rejection of the null hypothesis at the five per cent level (see Table 9). Since no significant association was established between the dependent variable (firms' output) and the independent variable (health), the null hypothesis A-1 is accepted.

Relationship A-1B

The dependent variable of Relationship A-1A was modified in Relationship A-1B by reducing each firm's output to the level of per worker output. The independent variables (the weighted monthly health indicator), however, remain unchanged. The newly formed regression equations, A-1Ba, ..., A-1Bl, were also used to test null hypothesis A-1.

The results of each equation in the A-1B series, as was the case in the A-1A series, led to the acceptance of the null hypothesis A-1 (see Table 9).

Summary of Relationship A-1

There is no statistical evidence to indicate that fluctuations in the incidence of short-term diseases explain fluctuations of individual firm's output. These results contradict the outcomes expected by applying recent literature dealing with health vs. output in the short run.

Relationship A-2

Monthly production indices of industries which were operated on the national level were regressed against the national weighted monthly health indicator (NWMHI). In addition, per Ostan monthly slaughter industry output was regressed against the respective Ostan's weighted monthly health indicator (WMHI).

Relationship A-2A

Null hypothesis A-2A, that no significant association exists between monthly industrial output fluctuations and the national monthly health indicator, was tested with Equations A-2Aa, ..., A-2Avv. As summarized in Table 9, of forty-eight equations nineteen correlation coefficients were significant at the five per cent level. The null hypothesis was, therefore, accepted approximately in three-fifths of the cases and rejected two-fifths of the time.

None of the significant correlations in Relationship A-2 were negative. Recent short-term health/output studies, however, predict that a negative relationship exists between ill health and output. This literature is not supported by the results of this model.

It would be interesting, at this point, to seek an explanation for the significant positive correlation coefficients between the output of several industries and the NWMHI. These could be explained by seasonal fluctuations. During times when a significant portion of the general population was ill increases in production were not held back since sufficient labor was available to take care of the continuation of the production process. This conclusion has not been tested empirically. It appears logical, however, and it is supported by the conclusions under Relationship C.

Relationship A-2B

Equations A-2a, ..., A-2Bmm were used in regressing each Ostan's slaughter industry output against the weighted monthly health indicator of the corresponding Ostan. The results of thirty-nine equations led to the acceptance of the null hypothesis (at the five per cent level) in thirty-seven instances. Equations A-2Bq and A-2Bx, however, revealed correlation coefficients of -.4143 and -.4917 respectively. These correlation coefficients were significant at the five per cent level (see Table 9). Generally, with the exception of two cases, results from equations classified under Relationship A-2B, therefore, led to the conclusion that short-term health fluctuations in each province do not explain fluctuations in the respective Ostan's slaughter industry output.

Recent short-term health/output literature conclusions, which would predict a significant negative correlation between ill health and output, are, therefore, not confirmed by this empirical test.

Summary of Relationship A

The results of regressions, summarized in Tables 8 and 9, between individual firm's output and fluctuations of ill health (Relationship A-1) as well as between individual industry's output and fluctuations of ill health (Relationship A-2) revealed that fluctuations of major short-term illnesses in Iran (consisting of dysentery and influenza), in general, do not by themselves explain fluctuations of individual firm's as well as individual industry's output. Generally, the correlation coefficients were not significant at the five per cent level. In the few instances when a significant relationship between health and output fluctuations was established, the sign of the relationship was positive, unlike the direction predicted by recent short-term health/output literature.

Relationship B

The results obtained under the Relationship A classification, which in general did not support short-term health/output theory, were supported by the results of equations classified under Relationship B.

Null hypothesis B states that there is no significant relationship between indicators of economic activity (the dependent variable)--composed of (1) the aggregate monthly production index of selected products, (2) monthly fuel oil sales, (3) monthly total direct tax collections, and (4) the national electrical production index--and the independent variables consisting of the national weighted monthly health indicator (weighted 1:2, 1:3, and 3:5).

Regression equations B-1a, ..., B-1o were used to test this null hypothesis. Results, summarized in Table 10, revealed that of these fifteen individual equations seven led to the rejection of the null hypothesis at the five per cent level and eight to the acceptance at the same level. None of the seven correlation coefficients which led to the rejection of null hypothesis B were negative. In other words, when a statistical relationship between ill health and economic activity was established, none of the relationships were negative in direction as predicted by the modern short-term health/output literature.

It is interesting to speculate about the factors leading to positive significant correlation coefficients resulting from regressing industrial output against the national weighted monthly health indicator. One explanation is postulated for future research. Perhaps the

Table 10. Summary of Regression Results Classified Under Relationship B -- Indicators of Aggregate Economic Activity/National Weighted Monthly Health Indicator (NWMHI).

Number of Regressions Between Indicators of Aggregate Economic Activity versus NWMHI:	15
Number of Insignificant Correlation Coefficients:	8
Number of Significant Correlation Coefficients:	7
Number of Significant Correlation Coefficients with a Positive Sign:	7
Number of Significant Correlation Coefficients with a Negative Sign:	0

illnesses of the general population do not translate themselves into the physical well-being of the non-agriculturally employed labor force. Thus, upward fluctuations in production due to other reasons, possibly seasonal or cyclical in nature, are not offset by ill health. Subsequently, significant positive correlations between selected industry's output and the national weighted monthly health indicator exist.

Relationship C

The results obtained from regressions classified under Relationship C, i.e., C-1, C-2, and C-3, shed some light on the results of associations examined under

Relationships A and B. The components of Relationship C are (1) the health-absentee association, (2) the health indicator of non-agriculturally employed workers-health of the general population relationship, and (3) the individual firm's output-absenteeism-health association.

Relationship C-1

If absenteeism of a firm's workforce is not influenced by the ill health of the general population, it cannot be expected that the ill health of the general population would influence firms' output through its impact on the health of the firms' workforce.

Regression equations C-1a, ..., C-1u which were used to test the absenteeism-health relationship revealed that only three of the twenty-one results led to the rejection of the null hypothesis C-1. (Null hypothesis C-1 states that there is no relationship between the health of the general population and absenteeism in firms.) (See Table 11.)

The general conclusion, based on the regressions between the dependent variable (absenteeism) and the independent variable (ill health), is that the latter does not explain the former.

Relationship C-2

The latter conclusion is reinforced by the results of Equations C-2a, ..., C-2d. These results led to the

Table 11. Summary of Regression Results Classified Under Relationship C -- C-1: Firms' Absenteeism/WMHI, C-2: Health Indicator of the Non-Agricultural Workers' (HINAE and PHINAE)/Monthly Health Indicator (MHI), C-3: Firms' Output/Absenteeism/WMHI.

Relationship	Number of Insignificant Correlations at the 5% Level	Number of Significant Correlations			Total Number of Regressions
		Total	With a - sign	With a + sign	
C-1 Firms' Absenteeism/ WMHI	18	3	0	3	21
C-2 HINAE and PHINAE MHI	4	0	0	0	4
C-3 Firms' Output/ Absenteeism/ WMHI	3	0	0	0	3

acceptance of the null hypothesis (C-2) at the five per cent level for every equation (see Table 11). Null hypothesis C-2 is that no significant relationship exists between the health indicator of the general population in selected Ostans (the independent variable) and health fluctuations of the non-agriculturally employed labor force (the dependent variable).

Given this result, as well as the result to Relationship C-1, it appears that fluctuations in ill health of the general population do not reflect themselves in the health and absenteeism of the non-agriculturally employed labor force.

Relationship C-3

In Relationship C-3 three variables--the dependent variable, individual firm's production, and the two independent variables: firms' absenteeism and the weighted monthly health indicator (with weights 1:2, 1:3, and 3:5)--are regressed in a stepwise manner. The null hypothesis C-3 is that no relationship exists between the dependent variable and the independent variables.

The results of Equations C-3a, ..., C-3c, as summarized in Table 11, called for the acceptance of the null hypothesis, since the multiple correlation coefficient was not significant at the five per cent level for every equation. Moreover, according to the results of Relationship C it should be noted that (1) no significant correlation coefficient was calculated between selected firm's output and the respective firm's absenteeism, and (2) no significant positive correlation coefficient was found between these firms' absenteeism and the respective weighted monthly health indicator. Again, these results contradict those results suggested by current short-term health/output literature.

Summary of Relationship C

By testing of Relationships C-1 through C-3, it was established that there is no significant positive correspondence between health fluctuations of the general population and health fluctuations and absenteeism of the non-agriculturally employed workers. Moreover, according to the simple model developed, there is no significant relationship between each firm's output and absenteeism as well as between all three variables--firm's output, absenteeism, and the WMHI.

It appears, therefore, that even if the ill health of the general population would translate itself into ill health of the non-agriculturally employed and absenteeism, individual firm's output would not be adversely affected because there is no significant association between output and absenteeism. This conclusion is contrary to the modern short-term health/output theory.

Analysis of Relationships A, B, and C

The results of the models revealed that (1) fluctuations in health of the general population in Iran do not explain fluctuations in individual firm's output, individual industry's output, and economic activity in accordance with current short-term health output theory;

(2) the health fluctuations of the general population are not positively related to health fluctuations of the non-agriculturally employed workers; and (3) absentee fluctuations within enterprises do not explain output fluctuations.

Non-Correspondence of Health Fluctuations of the General Population to the Non-Agriculturally Employed

Current health output discussions imply that a major part of the population is composed of gainfully employed (Mushkin, 1962, pp. 141-142). Thus, if the morbidity frequency of the general population increases, the non-agriculturally employed would correspondingly become ill. In Iran, however, only 24 per cent of the workforce was engaged in non-agricultural industries in 1346 (1967-1968) (Plan Organization, 1968, p. 12). In addition, this small portion of the population is paid well relative to the agricultural sector.[1] For example, in 1960 the average wage earned in agricultural industries was approximately 1,500 rials per month ($18.00). Social service workers' average monthly wages were approximately twice as high (The Echo of Iran, 1970, p. 536). Also, many

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1. In the Fourth National Development Plan 1968-1972 an explicit note was made of the fact that a significant gap exists between income of the rural population (consisting primarily of agricultural workers) and the income of the urban population (consisting largely of non-agricultural workers). See: Plan Organization (1968, pp. 33, 49).

non-agricultural workers are covered by mandatory government health insurance. These factors undoubtedly contributed heavily to the non-correspondence of debilitating health fluctuations of the general population to those of the non-agriculturally employed workers. Of course, these are only partial explanations of this general non-correspondence. Other factors such as better education, company housing (equipped with running water and electricity), less expensive company cooperative stores, and company cafeterias, among many other advantages, may partially explain this non-correspondence.

Non-Translation of Absenteeism to Output

Even if disabling illnesses of the general population had corresponded with those of the non-agricultural workers, it is likely, according to results of Relationship C-3, that the resulting absenteeism would not affect production. The postulated reason is that the number of employees in relation to capital is large, and many idle workers are at hand. Increases in absenteeism are likely not to influence firms' output adversely because these idle workers can be activated. It was noted by the Plan Organization (1968) of Iran that there is an ". . . existence of a considerable measure of unemployment, both apparent and concealed, . . ." (p. 34) in Iranian industries.

There are three broad reasons why firms employ idle labor. They are (1) political, (2) religious, and (3) economic in nature.

Political Reasons. The wish of the Iranian government is that social pressures should be relieved by employing as many individuals as possible. The official Fourth National Development Plan states that creative human forces should be as fully utilized as possible so that ". . . the optimum level of economic and social growth can be achieved." It continues: "Furthermore, this policy will ameliorate social discontent and will guarantee a healthy political milieu suitable for the stimulation of interest and confidence in the public to participate in development efforts" (Plan Organization, 1968, p. 49). Adhering to this policy means to employ as much labor as possible so that the producer can reap the rewards in forms of subsidies and capital equipment importation allotments, etc. The quantity of extra labor employed can be demonstrated by the following model.

In nations without government subsidies the producer would employ the factors of production to the point where the value of the marginal product (VMP = marginal physical product [MPP] x price of the output) would equal the price of the factor. Let us assume that a producer wishes to maximize profits. His objective function is expressed as follows:

$$\pi = P_x X(K,L) - w_K \cdot K - w_L \cdot L \tag{1}$$

where: π = profit

P_x = price of the output

X = quantity of output

K = quantity of capital

L = quantity of labor

w_K = price of capital

w_L = price of labor

To maximize profits the total differential of π must be equal to zero. This is guaranteed if the partial derivatives with respect to capital and labor are zero. This first order condition is fulfilled as follows. (It is assumed that the second order condition is met.)

$$\frac{\partial \pi}{\partial L} = P_x \frac{\partial X}{\partial L} - w_L = 0 \qquad VMP_L = w_L \tag{2}$$

Note: $VMP_L = MPP_L \cdot P_x$

$$MPP_L = \frac{\partial X}{\partial L}$$

The value of the marginal product of labor is equal to the wage of labor.

$$\frac{\partial \pi}{\partial K} = P_x \frac{\partial X}{\partial K} - w_K = 0 \qquad VMP_K = w_K \tag{3}$$

Note: $VMP_K = MPP_K \cdot P_x$

$$MPP_K = \frac{\partial X}{\partial K}$$

The value of the marginal product of capital is equal to the price of capital.

According to this model the producer would employ labor to the point where the value of the marginal product of labor (VMP_L) is equal to the wage of labor (w_L), and he would employ capital to the point where the value of the marginal product of capital (VMP_K) is equal to the price of capital (w_K).

Given that $w_L > 0$, the producer would not employ labor to the point at which the marginal physical product of labor (MPP_L) is equal to zero or negative.

In Iran, however, it is possible that a producer can employ labor when its $MPP_L \leqq 0$. At the same time the producer would use labor to the point at which the $VMP_L = w_L$. This is possible because the government rewards the user of a labor intensive production process by means of subsidies as mentioned earlier. One of the ways this is done is through subsidizing production concerns for the use of redundant labor. Profit to a producer would then be defined as follows:

$$\pi = P_x \cdot X(K,L) - w_K \cdot K - w_L \cdot L + P_s(L) \tag{4}$$

(P_s is a subsidy)

Profit is thus defined as the price of the output times the number of units sold minus the cost of production, i.e., minus $w_L \cdot L$ (the cost of labor) and $w_K \cdot K$ (the cost of capital), plus the subsidy payments received by the government.

To maximize profit the total differential of profit ($D\pi$) must be equal to zero. This condition is assured if the partial of profit with respect to labor, as well as capital is equal to zero. (It is assumed that the second order condition is met.)

$$\frac{\partial \pi}{\partial K} = P_x \frac{\partial X}{\partial K} - w_K = 0 \tag{5}$$

$$\frac{\partial \pi}{\partial L} = P_x \frac{\partial X}{\partial L} - w_L + P_s = 0 \tag{6}$$

Note: $P_x \frac{\partial X}{\partial K} = P_x \cdot MPP_K = VMP_K$

$P_x \frac{\partial X}{\partial L} = P_x \cdot MPP_L = VMP_L$

$$\text{or } P_x \frac{\partial X}{\partial K} = w_K \tag{7}$$

$$\text{or } P_x \frac{\partial X}{\partial L} = w_L - P_s \tag{8}$$

We can see in expression (8) that even if the MPP_L is $\leqq 0$ VMP_L can be equated with a positive wage, given that the subsidy will reduce the wage of labor to the point where it is equal to or smaller than zero.

It is economically rational, therefore, for an Iranian producer, given this situation, to use what is generally referred to as a "redundant element" (i.e., $MPP_L \lesseqgtr 0$) among his employees since he maximizes profits where the $VMP_K = w_K$ and the $VMP_L = w_L$ (see Figure 1).

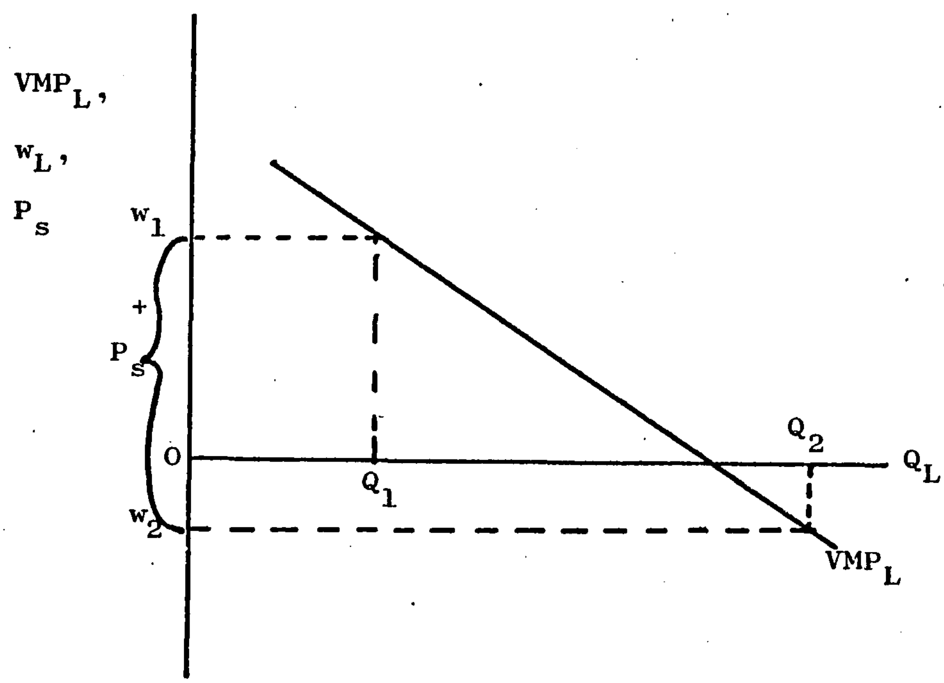

Figure 1. Quantity of Labor Used Before and After Subsidization

Let us assume that the wage being paid by the producer prior to subsidization from the government is w_1. The quantity of labor employed is Q_1. After subsidization, let us assume that the wage of labor to the employer is w_2 below the horizontal axis, i.e., w_2 is equal to w_1 minus P_s (the subsidy from government). Employers can use labor rationally, in this case, even if the $VMP_L < 0$ due to the MPP_L being less than zero.

Another reason for the employment of an apparent overabundance of labor is that if the firms demonstrate to the government that they produce labor-intensively, they meet a national priority, and they are likely to obtain financial backing for further capital expansion (Plan Organization, 1968, p. 71).

The macroeconomic implications of employing redundant labor in industry are difficult to estimate, given that the government subsidizes the negative marginal productivity of labor. The effect upon economic growth and development in part depends on the source of tax revenues used to subsidize the redundant workforce. If the funds for these subsidies were granted to Iran by foreign governments, there would not have to be a real resource withdrawal from the domestic economy and economic growth, *ceteris paribus*, would not be adversely affected. When domestic resources are used, however, growth and development could be impeded. Let us assume that the country is an oil producing and exporting country, and that these exports give rise to a significant portion of total government revenues. Given the shape of the oil industry demand curve (D) and the industry supply curve (S), prior to the imposition of the tax to finance the subsidy to employers with a redundant workforce, such a per unit tax is likely to shift the supply curve to the left[1] (S^1 in Figure 2). Assuming a price elastic demand, the percentage decrease in output would be greater than the percentage increase in price. The result would be a loss in revenue from oil exports and, ceteris paribus, a subsequent reduction of foreign exchange earnings. This could retard this country's ability to expand its capital stock from foreign sources and thus impede economic development. There are, of course, numerous other sources for government revenues to finance these subsidies. Effects upon economic development may vary, of course, accordingly.

It should not be overlooked, however, that this type of subsidy may serve the purpose of training individuals. In the future when the capital stock is expanded, labor productivity could possibly be larger than without such subsidies in previous time periods.

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1. This S curve shift need not be equal to the amount of the tax. It is assumed, however, that the producer will not absorb the total amount of the tax, and a leftward shift of the S curve will result.

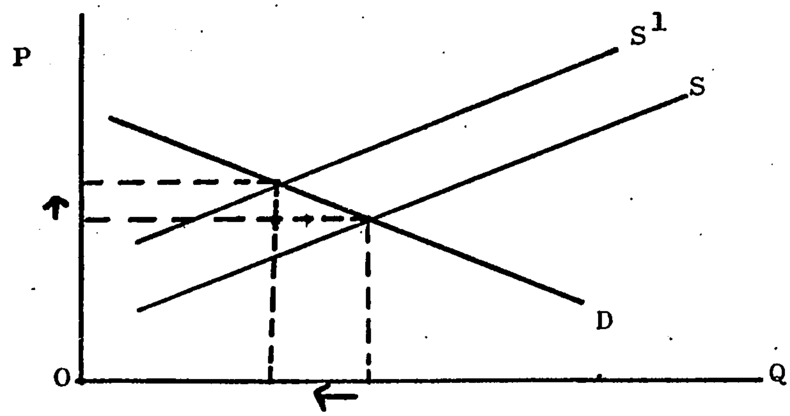

Figure 2. Effect of a Per Unit Tax on Oil Industry Output

In order to completely assess the net effect on the growth and development of an under-developed country arising from the employment and subsidization of labor whose marginal physical productivity is possibly equal to or less than zero, a detailed analysis of aggregate and dis-aggregate aspects of the economy related to this problem must be made. Such an analysis is beyond the scope of this paper, however.

Religious Reasons. Whereas in developed countries a slump in sales or poor work habits may prompt firms to discharge workers, in Iran such action is less likely because of religious reasons. This investigator observed that the operators of enterprises, who are instilled with the Moslem doctrine, find it morally unjust to withdraw the source of support from an employee's immediate and/or extended family. In many cases, when employees were discharged they gathered their families and camped in front of the factory gate. The managers were reminded in this manner of their religious responsibility, and often the discharged workers were re-hired.

Lewis (1954) observed the same practices in other countries. He stated:

> Most businesses in under-developed countries employ a large number of "messengers," whose contribution is almost negligible; you see them sitting outside office doors, or hanging around the courtyard. And even in the severest slump the agricultural or commercial employer is expected to keep his labour force somehow or other--it would be immoral to turn them out, for how would they eat, in countries where the only form of unemployment assistance is the charity of relatives? So it comes about that even in sectors where people are working for wages, and above all the domestic sector, marginal productivity may be negligible or even zero (p. 142).

Economic Reasons. It may well be to the employer's advantage to maintain a very large workforce if he wants to maximize profits in the long run. To make profits he must stay in business. In order to stay in business it is wise, of course, to adhere to the government's wishes, as discussed under "political reasons," as well as social mores, as exemplified under "religious reasons."

Another contributing factor justifying the keeping of a huge workforce, more economic in nature, is that there is a shortage of capital equipment. The reason for the shortage is that capital, relative to labor, is expensive because most of it has to be imported. For example in 1347 (1968-1969) over seventy-five per cent of all machinery and equipment purchased by manufacturing industries was imported. The quantity of imports is constrained by Iran's limited amount of foreign exchange. Bank Markazi Iran (1969) reported that in 1347 "considerable pressure was placed on the foreign exchange reserves of the country" (pp. 41, 47).

To make matters worse, the cost of imported capital increased sharply when, during the 1972 international currency realignments, Iran's rial was held at pre-currency realignment parity with the U. S. dollar. Subsequently, the price of Iran's imports from Japan, West Germany, and Great Britain increased approximately seventeen per cent, thirteen per cent, and eight per cent respectively. At the same time these countries ranked number three, one, and four in terms of value of imports (U. S. Department of Commerce, 1972, pp. 5, 6).

Labor, on the other hand, is relatively inexpensive in Iran. The monthly wages range from about 2,000 to 3,000 rials ($24 to $36) for workers in food industries to 2,700 to 3,700 rials ($32 to $42) for power station workers (The Echo of Iran, 1970, p. 536).

Subsequently, rather than taking the chance of letting expensive equipment stand idle if workers become ill, the employer acts quite rationally when he backs the machines with additional operators. In this manner he also provides enough labor to maintain the equipment properly.

Assume that a producer is endowed with one unit of capital (see Table 12). In order for him to produce continuously, without interrupting the chain of production, let us assume he requires 120 persons to operate the machinery. If the resulting output is 100 units and the unit price is $3.00, the total revenue from the sale of these units is $300.

If the profit maximizing producer expects that up to 25 per cent of his workforce could be absent during a production period, it may be rational for him to have a number of workers on hand who could be used in the event absenteeism occurs.

Specifically, if the employer wants to be certain that at least 120 workers tend the machines, so that he can maximize the physical output of these machines, he would have to employ 160 workers (.75(X) = 120). Under conditions specified in Table 12 it is more profitable to hire 160 workers, given the possibility that up to 25 per cent of the workers are absent and that some of the workers would possibly stand by idly.

Table 12. Derivation of Profits for a Hypothetical Firm

Description	A	B
Number of Workers	120	160
Maximum Expected Absenteeism (Maximum 25% of Workforce)	30	40
Minimum Workers on Job	90	120
Wage ($1 per Unit) ($)	1	1
Fixed Cost ($)	50	50
Variable Cost ($1 per Unit of Labor) ($)	120	160
Total Cost ($)	170	210
Physical Product	70	100
Price of Output per Unit ($)	3	3
Total Revenue (Price x Quantity) ($)	210	300
Profit (Total Revenue Minus Total Cost) ($)	40	90

As summarized in Table 12, Column A, if the employer were only to hire 120 workers and of the 120 the maximum 25 per cent absenteeism occurred, only 90 persons would be present to operate the machinery. Let us assume that the total cost (TC) of production is \$170 (120 salaried individuals x \$1.00 plus \$50 fixed expenditures). In addition, let us assume that the physical output is 70 units, and the price per unit is \$3.00. The total revenue (TR) thus obtained is \$210. The profit (TR\$210 - TC\$170) is \$40.

If the employer hedges against the possible absenteeism by hiring 160 workers, as demonstrated in Table 12, Column B, of which 120 will produce all that can be produced, even if 25 per cent of the workers are absent the full amount of production, i.e., 100 units valued at \$3.00 per unit, will be produced. The profit to the producer in this case is TR\$300 - TC\$210 = \$90. In the latter example total cost is comprised of 160 x \$1 + \$50 = 210.

This simple exposition demonstrates that under certain conditions producers can rationally hire labor to hedge against absenteeism even if the possibility exists that at times labor may stand around idly and add nothing to production.

It should be pointed out that this demonstration does not deal with a breakdown in monthly probability of absenteeism or other pertinent points. Regarding the latter, it should be noted that idle workers who at times add nothing to production may learn by observing. In the future they may utilize skills gained in this manner.

While the three broad reasons listed for the employment of large amounts of labor, which the Plan Organization calls "concealed unemployment"--(1) political, (2) religious, and (3) economic--are in no way exhaustive or mutually exclusive, they do point out that the employers may act rationally, with respect to accepted economic theory, when they carry "concealed unemployment."

Relationship D

The existence of a relatively high concentration of industry in certain areas, like a magnet, draws the population from non-industrialized areas to industrialized areas. The relevant question is: what impact does this type of migration have on the standard of health in these geographical areas?

It is generally known that areas with high population concentration, especially when they develop into slum areas, are seedbeds for communicable diseases (U. S. Department of Health, Education, and Welfare, 1959, pp. 1-27). Under Relationship C it was pointed out that the non-agriculturally employed labor force's health is relatively good. Absenteeism in factories, as a result, is low. For example, Table 6 indicates that the mean percentage of the workforce absent in sampled firms does not exceed five per cent. The question is whether or not the good health of the non-agricultural workers spills over to the general population in the industrialized areas to the extent that it offsets the adverse effects of the high population concentration. Moreover, does such a spillover result in a standard of health which is higher than the standard of health in less industrialized areas?

The standard of health/industrialization concentration relationship was examined under Relationship D. The null hypothesis examined is that there is no significant association between the indicator of industrialization (per Ostan) vs. the standard of health (consisting of the morbidity frequency for influenza, dysentery, conjunctivitis, trachoma, and measles per Ostan).

According to results of Table 13, this null hypothesis was rejected at the five per cent level. In fact it was rejected at the one per cent level with a positive sign. This means that there is a strong positive association (according to rank) of each Ostan's morbidity frequency of the five major illnesses and the intensity of each Ostan's indicator of industrialization.

It appears then that the population growth in industrialized areas through area immigration and natural population expansion resulted in a higher population concentration and more ill health. Thus, the conducive

Table 13. Summary of Association Results Classified Under Relationship D -- Indicator of Industrialization vs. Morbidity Frequency for Influenza, Dysentery, Conjunctivitis, Trachoma, and Measles.

Kendall's Coefficient of Concordance (W):	.3819 (Significant at the 1% level)

environment for communicable diseases appears to have nullified any positive health spillovers the industrial workers, who are generally considered healthier (as determined under Relationship C) may otherwise have had upon the health of the general population.

It should be noted here that it was pointed out in the methodology chapter that it is possible that health statistics may be biased in favor of urban areas because of the better data collecting machinery present in those areas. Results under Relationship D, even though they were significant at less than one per cent, must be qualified by the possibility of this sample bias.

Summary of Interpretations of Relationships A Through D

The results of Chapter 3 revealed that fluctuations of health in Iran do not explain fluctuations of individual firm's output, individual industry's output, and general economic activity, as predicted by current short-term health/output literature. Moreover, upward fluctuations of the morbidity rate for major illnesses of the general population do not explain upward fluctuations of firms' absenteeism. In addition, fluctuations in each individual firm's absenteeisms do not explain individual firm's output fluctuations.

The explanation, at least in part, for the insignificant correspondence between health fluctuation of the general population and firm's absenteeism is the heterogeneity of the population with respect to income and the availability of health care, etc. The non-agriculturally employed group, for example carries health insurance, and is not as poor as the agricultural workers. This group is subsequently expected to be healthier.

The non-correspondence between individual firm's absenteeism and output, on the other hand, is explained, in part, by the large amount of redundant labor used in the production process. It should be noted again that the employment of this type of labor is perfectly rational because of the government policy of subsidies and the shortage of machinery. To utilize both, the employer employs huge amounts of labor. The impact upon economic development is difficult to assess. To a large extent it depends on the source of subsidy revenues.

In addition, it was revealed that high industry concentration attracts the agriculturally employed as well as the unemployed population from lower to higher industrialized areas. Such population increases make it difficult for the non-agriculturally employed with their better health to affect the health of the general population in a positive manner, i.e., unhealthy conditions in industrialized areas are not neutralized.

These results, obtained by testing Relationships A through D, are important and interesting to economists in Iran who are charged with constructing development plans with rather limited budgets. For example, prominent development theories, associated with names like Lewis (1961, pp. 82-85), Rostow (1965, pp. 22-23), Nurkse (1953, pp. 36-47), as well as Ranis and Fei (1961, pp. 533-565) and others, suggest that the economic development process involves a transfer of labor, i.e., the redundant agricultural labor force is in part transferred from the agricultural sector to the industrial sector in order to aid the economic development of such a nation. For example, let us assume that the total workforce is equal to O-A in Figure 3 and Figure 4. In addition, let us assume that of this total labor force an amount equal to O-B is allocated to the agricultural sector (Figure 4) and the remaining portion, B-A, is employed in the industrial sector (this portion is equal to O-B in Figure 3). It can be observed that if we can transfer B-C amount of labor, which has zero marginal physical productivity (MPP), to the

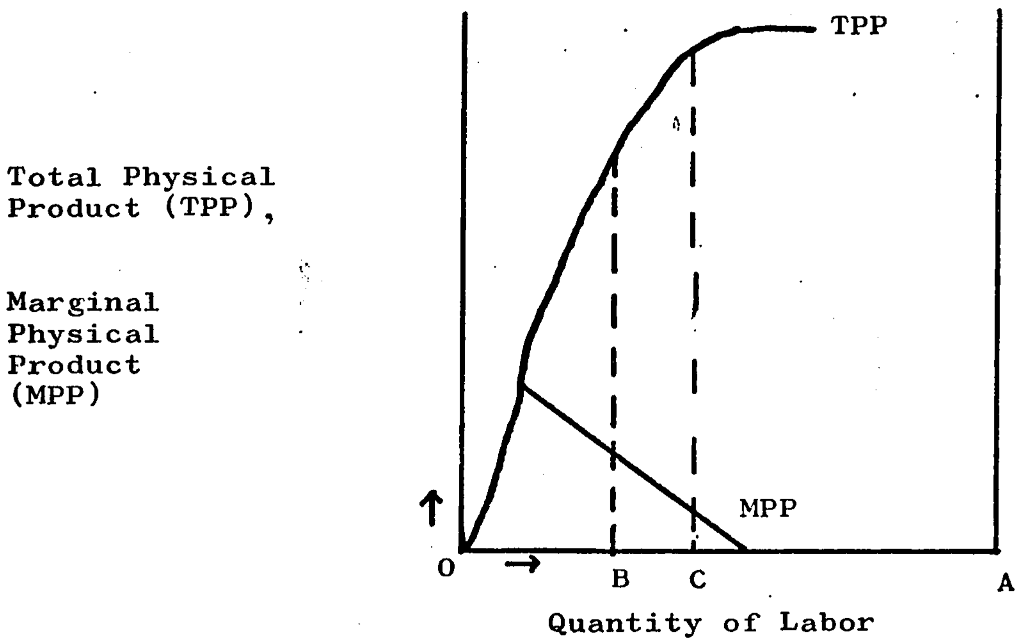

Figure 3. Labor Input and Industrial Output (General)

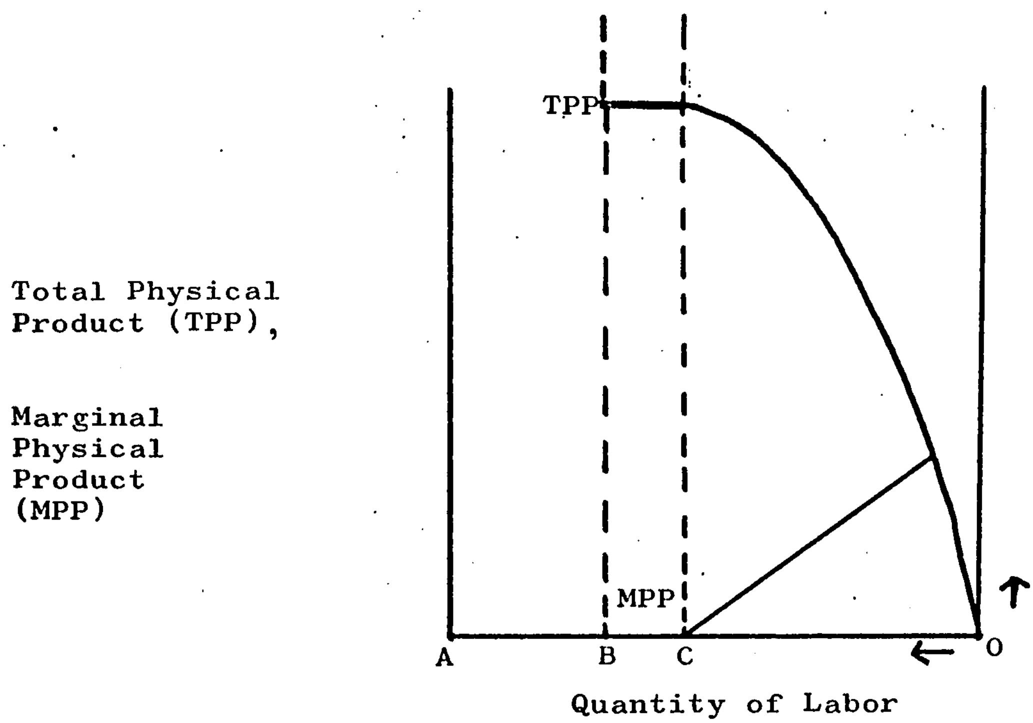

Figure 4. Labor Input and Agricultural Output (General)

industrial sector where the MPP is positive, the net result would be an increase in the joint total physical product, consisting of both industrial and agricultural output.

The situation in Iran, however, does not appear to be like the one suggested here. Reports from the Plan Organization (1968, p. 71) in Iran revealed that the industrial sector is also plagued with a high level of "concealed unemployment."

Because firms adhere to traditional practices of employing redundant labor, which is also encouraged by government through subsidies and favors, this situation is perhaps reflected more accurately by Figures 5 and 6. According to these figures, if the total labor endowment is O-A on the horizontal axis as in Figure 3 and Figure 4, and if amount O-B is used in the agricultural sector and the remaining portion B-A, equal to O-B in the industrial sector, is used in the industrial sector, a transfer of unproductive labor from the agricultural sector to the industrial sector will not increase total product because in the latter sector, according to Figure 3, labor's marginal physical product is also zero.

Nurkse (1953, pp. 36-47) takes that analysis one step further and analyzes this labor transfer with respect to capital formation. He feels that the positive output of the transferred labor less their minimum maintenance

Total Physical
Product (TPP),

Marginal Physical
Product (MPP)

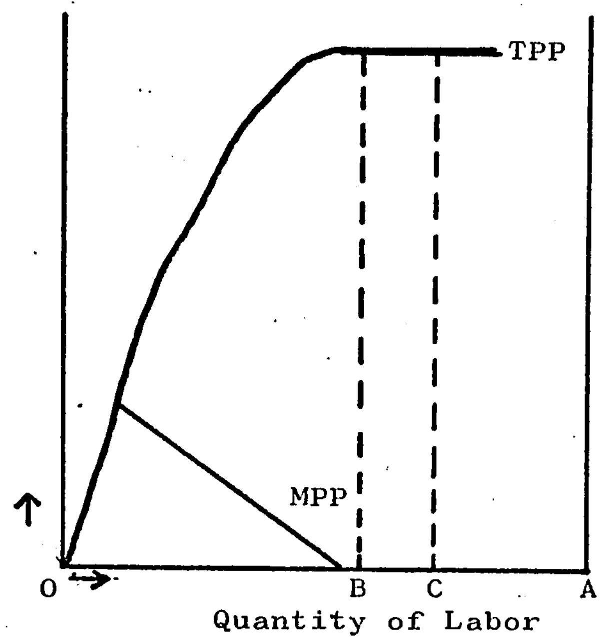

Figure 5. Labor Input and Industrial Output (Iran)

Total Physical
Product (TPP),

Marginal Physical
Product (MPP)

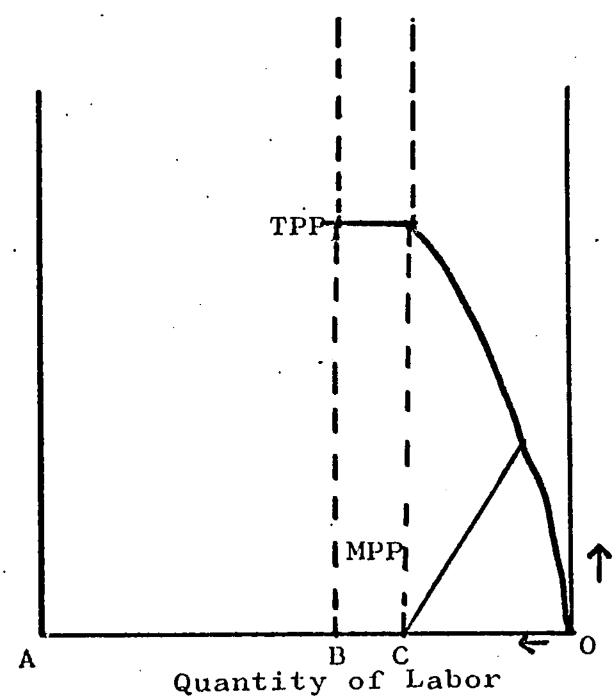

Figure 6. Labor Input and Agricultural Output (Iran)

costs, if smaller than the additional output, is equal to the potential increase of the capital accumulation capacity in a developing country.

There is no guarantee that Iran's society will be better off after such labor transfers to the industrial sector because displaced labor possibly will not add a positive net output (output less maintenance cost). Moreover, the resulting urbanization may make communicable diseases spread more rapidly, as pointed out under Relationship D. As a result scarce resources may have to be drawn from the industrial sector to treat the ill. This would increase the total maintenance cost of labor further and impede capital accumulation.

CHAPTER 5

CONCLUSIONS

The Health/Output Relationship

This study empirically determines that modern health/output theory, which concludes that short-term illnesses affect output (in the short run) in an adverse manner, cannot be applied to the developing nation of Iran. While better health would, ceteris paribus, undoubtedly enhance the general welfare of the population, there is no evidence in the short run that such welfare changes translate themselves immediately into increases in industrial production.

Tests revealed that firms' monthly production fluctuations cannot be explained by fluctuations in short-term illnesses of the general population. This conclusion can be reached by examining a number of regression results which are summarized under four bivariate associations and one multivariate regression in Table 14.

This summary table reveals that ill health which is short term in nature does not affect firms' output or industries' output adversely. The underlying reasons are:

1. The fluctuations of short-term illnesses of the general population do not translate themselves

Table 14. Five Relationships Which Explain the Results of the Health/Output Relationship

Relationships	General Description of Relationship Determined
A. Bivariate Regressions:	
1. Firms' absenteeism vs. short-term health fluctuations of the general population.	The independent variable, in general, does not explain the dependent variable.
2. Short-term health fluctuations of the general population vs. health fluctuations of the non-agriculturally employed	The independent variable, in general, does not explain the dependent variable.
3. Firms' output vs. firms' absenteeism	The independent variable, in general, does not explain the dependent variable.
4. Industries' output vs. health fluctuations of the general population	Fluctuations in ill health, generally, do not explain inverse fluctuations in output.
B. Multivariate Regression:	
5. Firms' output vs. firms' absenteeism vs. short-term health fluctuations of the general population	The independent variables do not explain the dependent variable.

directly into health fluctuations of the non-agriculturally employed. This is so in part because the non-agriculturally employed individuals are often provided with free health care. In addition, the provision of items such as heated homes, electricity, and inexpensive clothing supplied to the non-agriculturally employed workers by firms and/or government partially protects them from short-term illnesses which strike the population in general.

2. Absenteeism of workers does not reduce firms' output. The major reason is that firms employ replacement labor to offset absenteeism. Also, in order to gain financial and non-financial benefits from government, abundant amounts of labor are hired. Thus, even if short-term illnesses of the general population would translate themselves directly into workers' absenteeism, resulting fluctuations in workers' absenteeism would not result in firms' output fluctuations because of the offsetting actions taken by firms.

Relationship 5 in Table 14 supports the contention that upward fluctuations in the ill health of the population in general do not increase absenteeism and the upward fluctuations in absenteeism do not affect output adversely.

The Health/Aggregate Economic Activity Relationship

The health/output conclusions are reinforced by the fact that short-run fluctuations in the ill health of the general population do not explain inverse fluctuations in aggregate economic activity. These results were computed in Chapter 3 by regressing selected indicators of aggregate economic activity against health indicators.

The Geographical Industry Concentration/ Health Relationship

Literature associated with names like Ranis, Fei, Rostow, Lewis, and Nurkse suggests that the economic development process involves a transfer of labor from the rural (generally agricultural) areas to the urban (generally industrialized) areas, i.e., from where labor productivity is low to where labor productivity is relatively high. It is emphasized that when redundant labor is removed from agriculture and transferred to industry it would add to total industrial product. Subsequently, given that the maintenance cost of labor is lower than the value of its marginal product, the capital accumulation potential is raised.

Results of tests of the two previous relationships (analyzed in detail in Chapter 4)--the health/output relationship and the health/aggregate economic activity relationship--suggest that industries carrying over traditional practices which are encouraged by government use amounts of labor large enough to absorb absenteeism without reducing production. This supports the Plan Organization's contention that industry employs redundant labor. At the same time, maintenance costs of individuals are generally higher in urban areas than in rural areas. In part, this is so because the lower standard of health in the former, as concluded in Chapter 3, is likely to result in higher medical costs. Moreover, non-health-related living expenses, such as housing, food, and clothing, are generally more expensive in urban areas.

Given the higher maintenance costs in urban areas and the existence of a redundant element in the industrial labor force, a transfer of redundant labor out of agriculture into industry, *ceteris paribus*, is likely not to result in a net increase of output or an increase in the capacity to create capital. At best an increase will be considerably smaller than implied by the literature. The attempt to increase aggregate output by transferring labor from agricultural areas to industrialized areas should, therefore, be carefully considered on a case by case basis since there is no guarantee that such transfers will in fact result in more output.

Principal Conclusions

Explanation of Differences of Results Predicted by Modern Health/Output Literature with Results Arrived at in This Project

The results of this paper seem to conflict with those predicted by recent literature which explicitly and implicitly predicts that upward movements of short-term illnesses affect output adversely. Results of this study do not confirm these predictions.

Several possible reasons for the differences are offered: (1) the literature draws no clear distinction between long-run impacts and short-run impacts of ill health, while this research project specifically deals with effects of short-term health fluctuations; (2) the recent literature deals primarily with health and output in developed nations; and (3) differences between current literature and this paper may be the result of errors in inductive logic in recent health/output literature.

The Long Run vs. the Short Run. Of course, short-run effects need not necessarily correspond with long-run outcomes. While presently there is no evidence that short-term fluctuations in the health of the Iranian population affect output adversely, conditions may change in the future so that ill health may affect output adversely. For example, if a labor shortage would develop and the productive process would become highly capital intensive, the prediction of modern health/output literature may become true.

Health and Output in Developed Nations. Germany, a developed country, produces, generally, in a capital intensive manner. In the recent past this country was also plagued by a labor shortage. Such a setting is more likely to result in the health/output relationship predicted by the current literature rather than in the Iranian setting which is characterized by labor surplus and a labor-intensive production process.

Errors in Inductive Logic. Observers in a production concern may note that a person who is not feeling well may not operate at peak efficiency. Moreover, it seems that when a worker is absent he cannot contribute to the output at his place of employment. Logically then, absenteeism caused by ill health affects output adversely. This is a fallacy of composition. It is, of course, true that a person absent from work does not produce at his place of employment, but it was empirically shown that such absences do not interfere with the production process when absent workers can be replaced easily.

Economic Implications of Findings

General Implications. The general implication of the contrasting results of modern health/output theory with the results of this study is that important theoretical findings should be tested even when the logic appears to be flawless. This is especially true when the outcome is possibly contrary to the one predicted and would result in sizeable opportunities foregone.

Specific Implications. Modern development models tend to ignore the short-run health/output relationship in the discussion of the development process. Given the results of this study, it appears that this omission was warranted in the case of Iran. It should be remembered that this study dwelled only on the short-term health/output relationship and that long-term relationships will likely yield different results, especially as more nations enter the "hyperdeveloped" state and production processes of poor countries are likely to become capital intensive.[1]

Also, it was suggested earlier that because of the prevalence of the lower standard of health in industrialized (urban) areas which contributes to the higher cost of maintaining the population, increased urbanization, in the short run, is not expected to aid Iran's capital accumulation capacity. Development models referred to in this

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1. Hyperdevelopment is defined as the state of economic development characterized by a highly capital-intensive production process operated by highly specialized workers.

paper have not, however, incorporated the possibility of aiding the capital accumulation ability of a developing nation by impeding or reversing rural to urban population transfers.

Expected Returns from the Allocation of Scarce Resources to Health. Results of Chapter 3 indicate that the allocation of scarce resources directed toward the reduction of short-term illnesses, *ceteris paribus*, would yield no significant short-run additions to industrial output. Health expenditures can be justified, nevertheless, because better health can be considered as an increase in the population's general welfare, even though no additional industrial production may result from such expenditures. If scarce resources were allocated solely on the basis of the resulting relative value of the marginal product, in the short run, health would be a relatively low priority item.

In Iran's economy a portion of the total resources is allocated by the Plan Organization. This body's decisions are in part influenced by religion and politics. Presently, these influences result in allocating resources for the treatment and prevention of ill health even though the value of additional output in the short run resulting from such expenditures is expected to be negligible.

Significance of the Study

The human element is undoubtedly of tremendous importance in the determination of a nation's productive capacity. This does not mean, however, that (1) an increase in the quality of human life resulting from better health in the short run automatically translates itself into more production, (2) the short-run marginal returns from investments in people are necessarily higher than the marginal returns from investments in non-human capital, or (3) a transfer of people from agricultural (rural) areas to industrialized (urban) areas increases aggregate output.

This study points out that factors such as the stage of economic development, the nature of governmental practices with respect to subsidies, the extent of labor employed redundantly in agriculture and industry, the amount of unemployment, the scope of heterogeneity between the employed and the unemployed, and the geographic industrial concentration, along with other factors, may individually and/or jointly affect the ability of humans to contribute to aggregate output. Therefore, each nation's population, and related items, must be carefully analyzed before predicting whether or not an improvement of the quality of its population resulting from better health will, in the short run, raise aggregate output.

APPENDIX A

PROVINCES (<u>OSTANS</u>) OF IRAN

Source: Ministry of Interior, 1961.

REFERENCES

Accounting personnel, Fars Cement Company, Shiraz, Iran. Interviews April 8, May 18, 1971.

Bank Markazi Iran. Annual Report and Balance Sheet. Tehran, Iran: Bank Melli Iran Press, July, 1969.

Bank Markazi Iran. Bulletin, Vol. 8, No. 47. Tehran, Iran: Bank Markazi Iran, January-February, 1970.

Bank Markazi Iran. Bulletin, Vol. 8, No. 48. Tehran, Iran: Bank Markazi Iran, March-April, 1970.

Bank Markazi Iran. Bulletin, Vol. 9, No. 49. Tehran, Iran: Bank Markazi Iran, May-June, 1970.

Bank Markazi Iran. Bulletin, Vol. 9, No. 50. Tehran, Iran: Bank Markazi Iran, July-August, 1970.

Bank Markazi Iran. Bulletin, Vol. 9, No. 51. Tehran, Iran: Bank Markazi Iran, September-October, 1970.

Bank Markazi Iran. Bulletin, Vol. 9, No. 52. Tehran, Iran: Bank Markazi Iran, November-December, 1970.

Bank Markazi Iran. Bulletin, Vol. 9, No. 53. Tehran, Iran: Bank Markazi Iran, January-February, 1971.

Bowen, William G., and Finegan, Aldrich. The Economics of Labor Force Participation. Princeton: Princeton University Press, 1969.

Cho, Yong Sam. Disguised Unemployment in Underdeveloped Areas: With Special Reference to South Korean Agriculture. Berkeley: University of California Press, 1963.

The Echo of Iran. Iran Almanac 1970. Tehran, Iran: The Echo of Iran, 1970.

Gordon, John E. (ed.). Control of Communicable Diseases in Man. New York: The American Public Health Association, 1965.

Government Insurance Company, Tehran, Iran. Extractions from working records, June 14, 15, 1971(a).

Government Insurance Company, Tehran, Iran. Typed report dated April 14, 1971(b).

Hunter, Donald. Health in Industry. Harmondsworth, England: Penguin Books, Ltd., 1959.

Jakubauskas, Edward B., and Baumel, Phillip (ed.). Human Resources Development. Ames: Iowa State University Press, 1967.

Karimi, Mr. and Associates, Marvdasht Sugar Company, Marvdasht, Iran. Interview, January 12, 1971.

Lampman, Robert J. "Towards an Economics of Health, Education, and Welfare," Journal of Human Resources, 1 (Summer, 1966).

Lewis, W. Arthur. "Economic Development with Unlimited Supplies of Labour," Manchester School of Economics and Social Studies, XXII, No. 2 (May, 1954).

Lewis, W. Arthur. The Principles of Economic Planning. London: George Allen and Unwin, Ltd., 1961.

Medical Staff, Namazie Hospital, Shiraz, Iran. Interview, February 8, 1971.

Ministry of Economy. Report on the Results of Annual Industrial Survey in 1967 (1346). Tehran, Iran: Bureau of Statistics, 1967.

Ministry of Economy. Slaughter Statistics, 1347 (1968). Tehran, Iran: Ministry of Economy, 1968.

Ministry of Economy. Slaughter Statistics, 1348 (1969). Tehran, Iran: Ministry of Economy, 1969(a).

Ministry of Economy. Trends in Industrial and Commercial Statistics, 1348 (1969). Tehran, Iran: Ministry of Economy, 1969(b).

Ministry of Economy. Trends in Industrial and Commercial Statistics, 1349 (1970). Tehran, Iran: Ministry of Economy, 1970.

Ministry of Health of Esfahan. Typed report dated May 4, 1971.

Ministry of Health of Iran. Annual Morbidity Report Iran, 1346 (1967). Tehran, Iran: Bureau of Statistics, 1967.

Ministry of Health of Iran. Annual Morbidity Report Iran, 1347 (1968). Tehran, Iran: Bureau of Statistics, 1968.

Ministry of Health of Iran. Annual Morbidity Report Iran, 1348 (1969). Tehran, Iran: Bureau of Statistics, 1969.

Ministry of Health of Iran. Typed report dated April 14, 1971.

Ministry of Health of Shiraz. Extractions from working records, May 9. 1971.

Ministry of Interior. National and Province Statistics of the First Census of Iran: November 1956. Tehran, Iran: Ministry of Interior, 1961.

Mushkin, Selma. "What is the Contribution of Changes in the Quality of People to Economic Growth?," Journal of Political Economy. 70 (October, 1962).

National Iranian Petroleum Company. Iran Petroleum, January-December, 1968 inclusive. Tehran, Iran: National Iranian Petroleum Company, 1968.

National Iranian Petroleum Company. Iran Petroleum, January-December, 1969 inclusive. Tehran, Iran: National Iranian Petroleum Company, 1969.

National Iranian Petroleum Company. Iran Petroleum, January-May, 1970 inclusive. Tehran, Iran: National Iranian Petroleum Company, 1970.

Nurkse, Ragnar. Problems of Capital Formation in Underdeveloped Countries. New York: Oxford University Press, 1953.

Plan Organization. Fourth National Development Plan 1968-1972. Tehran, Iran: Offset Press, Inc., 1968.

Production Information, information supplied by the management of the following firms out of their accounting records during the spring of 1971: Fars Cement Co.; Shiraz Milk Products Co.; Nargess Shortening Co.; Pahlavi Self Service; Regional Electric Co., Fars; Tehran NIOC Refinery; Abadan NIOC Refinery; Mashhad Pepsi Co.; and Esfahan Tobacco Co.

Ranis, G., and Fei, J. C. H. "A Theory of Economic Development," The American Economic Review, LI (September, 1961), 533-565.

Rostow, Walter W. The Stages of Economic Growth. Cambridge: Murray Printing Company, 1965.

Schuler, Mr., Siemens Co., Shiraz, Iran. Interview, May 20, 1971.

Schultz, Theodore W. "Investment in Human Capital," The American Economic Review, LI (March, 1961).

Shabankari, Mr., Shabankari Industries, Shiraz, Iran. Interview, May 12, 1971.

U. S. Department of Commerce. "Market Factors in Iran," Overseas Business Reports (OBR 72-015). Washington, D. C.: U. S. Department of Commerce, May, 1972.

U. S. Department of Health, Education, and Welfare. Housing and Health, No. 29 (Public Health Service Publication No. 718). Washington, D. C.: U. S. Government Printing Office, October, 1959.

Weisbrod, Burton A. Economics of Public Health. Philadelphia: University of Pennsylvania Press, 1961.