A SAS®/ETS Application: Forecasting Iran's Agricultural Self-Sufficiency Program

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ABSTRACT

This paper intends to make a comparative analysis of the average amount of food required to nourish the growing Iranian population and the amount which is actually available for consumption. The SAS System is used to develop simulation models to forecast the time-frame in which agricultural self-sufficiency may be achieved based on alternative growth rate scenarios for the Iranian economy. The following models are estimated and used in the simulation:

$D_s = C_m - C_a$ or $(B_m) * (pop) - (P_a + I_a)$

where: D_s is the consumption deprivation gap

and $C_m = C_a = B_m (pop_o) = P_a (1 + i)^t$

where: C_m and C_a represent minimum and actual consumption respectively.

Input data for the Iranian economy from 1974 to 1991 is used in the analysis. The SAS/ETS procedures: PROC REG, PROC PLOT, PROC UNIVARIATE and PROC ARIMA are used in the simulation. The paper concludes that unless Iran gains control of its population by the year 2000 and increases the rate of agricultural production, the country will face a drastic decline in consumption standards. This will result in an increasing dependency on foreign imports and the use of oil revenues to fill the consumption deprivation gap.

INTRODUCTION

In recent years there has been much talk about agricultural self sufficiency programs in Iran and the implementation of development plans to accomplish this goal. This study examines the feasibility of reaching such goal. First it tries to quantify the extent of the gap between the agricultural food production and the food consumption. Then it estimates their trends by projecting into the distant future. Finally, by manipulation of the production growth and population growth rates it shows when and how the self-sufficiency goal can be achieved.

The main contribution of this study is to make a comparative analysis of the average amount of basic food required to nourish the Iranian growing population and the amount which is actually available for consumption. The paper will argue that deficit would be to the disadvantage of the poor as the gap between the aggregate consumption based on per capita basic food requirement and the actually available food grows wider. This would cause the number of poor families who cannot compete with the well to do consumers in the market place to multiply. In order to present the reality of the distant future when the crude oil will eventually quit flowing, the oil revenue is kept out of this investigation.

IRAN'S AGRICULTURAL CONSTRAINTS

Iran, lying between the Persian Gulf and the Caspian Sea, has diverse physical features with harsh geographical characteristics. Of some 642,720 square miles of surface area only one fourth has a favorable geology, climate, and soil suitable for agriculture, herding and forestry. With the exception of the mountain ranges, which constitute about one-fourth of the land, the remainder, one-half, has climatical and physiographical features of arid and semi-arid land with indifferent fertility, poor soil and low average rainfall. The main plateau of Iranian mainland lies in the center of Iran. This region is dominated by two vast deserts called Desert Plain (Dasht-e-Kavir) and Bare Plain (Dasht-e-Lute). The surrounding basins, however, constitutes some of the most fertile agricultural land.

Iran's average rainfall ranges from 4 to 40 inches within an irregular interval. In some regions heavy downpour floods the basins and ruins the agricultural products.

The two mountain systems, Albors range in the North and Zagros in the West and the Southwest, attract moisture from the Caspian Sea, Mediterranean Sea and in the South Oman Bay, causing good rain and snow falls. With the exception of the regions enjoying mild weather, most of Iran has extreme climate: hot in the summer and very cold in the winter. At the other extreme the Caspian Sea region in the North enjoys mild Mediterranean climate with above average rainfall and unique natural beauty suitable for productive orchards and groves. Figures I and II show Iran's climatic diversion and approximate measures of rainfall.

IRAN'S FOOD PRODUCTION AND FOOD CONSUMPTION

Statement Of Hypothesis

In view of Iran's rapid population growth and the present rate of agricultural food production, the present author asserts that the country will become permanently dependent on the outside world to satisfy the demand for the basic food stuffs. Unless the Iranian population growth rate is reduced to zero and simultaneously an effective program of improvement and expansion of agriculture put into action, Iran will be confronting a widening gap between food production and food consumption. It would consequently result in a depressed standard of food consumption and dietary deprivation. Iran would remain an oil-supported food consumption economy using its oil revenue to import its basic food supplies. Permanent diversion of oil revenues from long-term capital investment in industrial, and agricultural projects and in human capital formation to the importation of food for consumption would eventually drive Iran to a state of declining economy and poverty.

Deprivation Gap and Self-sufficiency Simulation Models

A first order time series regression model is developed to establish the magnitude of a possible food consumption and production gap. This gap will constitute the volume of basic food import necessary to meet the shortage of food supply. The model employs such variables as production, population, consumption, and imports. It uses eight basic food items, namely: wheat, rice, sugar, tea, meat, butter and vegetable oil, eggs and cheese. These are the most predominant food items in the Iranian dietary habits. The intention of this model is to arrive at two distinctly different aggregate volumes of consumption - the minimum requirement and the actual. These two expressions are specified below:

1. The food deprivation gap:

$$D_s = C_m - C_a \quad \text{or} \quad (B_m)(pop) - (P_a + I_a)$$

where:

$$C_m = B_m(pop) \text{ and } C_a = P_a + I_a$$

where C_m is the minimum consumption requirement, P_a is the actual production of the basic eight food items, I_a is the import volume of the basic eight, Bm is the volume of the basic eight, pop is the population, C_a is the actual consumption of the same items and D_s is the gap signifying the depressed standard of consumption. The model assumes that B_m remains constant throughout.

2. The self-sufficiency simulation:

$$C_m = C_a = B_m(POP_o) = P_a(1 + i)^t$$

where POP_o is constant population (zero growth rate), i is the agricultural improvement rate, and t is the number of years it would take C_m to be equal to C_a or when the deprivation gap will be closed.

The Component Data

The data for the actual import and production of the eight basic foods mentioned earlier are compiled from the Yearbook of International Trade Statistics, United Nations. Population figures are obtained from the National Trade Data Bank, USDOC, Bureau of Census.

In order to arrive at the data for minimum per capita requirement, twenty average families from Shiraz (South), Rasht (North), Teheran (Upper Central), Esfahan (Lower Central), and Kerman (East) were surveyed. Pertinent inputs were also obtained from the Department of Agriculture, University of Shiraz. In addition the observation of the present author (a native Iranian) during his recent trip to Iran, helped significantly in the compilation of the following food consumption table:

Average Annual Minimum Basic Food Requirement in lb.

Food Item	Cheese (all types)	Sugar	Bread	Tea	Meat	Butter & Veg. Oil	Rice	Eggs	Total
Annual Per capita	39.92	17.39	365	19.16	23.95	12.78	111.78	49.9	639.98

Findings

Except for the period of early 1990s when the basic food consumption more or less matches the agricultural production, the results show a widening gap between the two which necessitates the expansion of import of the basic food items to meet the growing demand. The estimate D_s obtained by the difference between C_m and C_a alarmingly accelerates in passage of time due to the high rate of population growth and low rate of agricultural production. A logarithmic growth rate analysis shows that Cm grows by 0.03 and Ca by 0.013. Figure II depicts both $C_m - P_a$ = Import and $C_m - C_a$ = Deprivation gap. The simulation gap model which was used to determine how and when Iran may succeed to restore self-sufficiency with zero population growth rate indicates that by the year 2060 P_a will match C_m. When the production rate was simulated to grow at 10% and then at 15% the state of self-sufficiency reached in the year 2040 and 2020 respectively. Figure III exhibit the result of this simulation procedure.

The Deprivation Gap Model

Dependent Variable: PROD

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	2.4183079E14	2.4183079E14	128.001	0.0001
Error	24	4.5342854E13	1.8892856E12		
C Total	25	2.8717364E14			

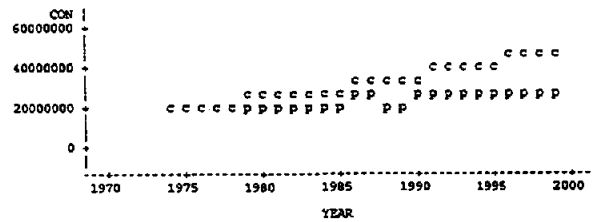
Root MSE	1374512.85175	R-square	0.8421
Dep Mean	22276270.4700	Adj R-sq	0.8355
C.V.	6.17030		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	-785509927	71399066.248	-11.002	0.0001
YEAR	1	406638	35941.886424	11.314	0.0001

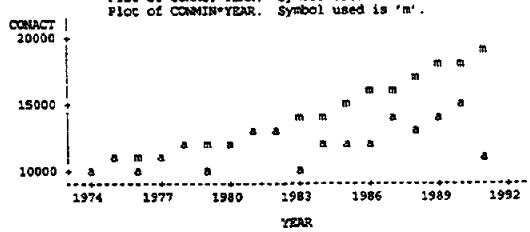
Required Consumption and Production:

Plot of CON*YEAR. Symbol used is 'c'.
Plot of PROD*YEAR. Symbol used is 'p'.



Deprivation Gap: $C_a - C_s$

Plot of CONACT*YEAR. Symbol used is 'a'.
Plot of CONMIN*YEAR. Symbol used is 'm'.



Dependent Variable: REQCON

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	1.2110615E16	1.2110615E16	235.298	0.0001
Error	109	5.6101483E15	5.1469251E13		
C Total	110	1.7720763E16			

Root MSE	7174207.30984	R-square	0.6834
Dep Mean	41850238.0621	Adj R-sq	0.6805
C.V.	17.14257		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	-615023540	42827986.109	-14.360	0.0001
YEAR	1	325992	21251.896974	15.339	0.0001

Dependent Variable: PROD

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	1.8843817E16	1.8843817E16	45298.781	0.0001
Error	109	4.5342855E13	415889493909		
C Total	110	1.888916E16			

Root MSE	644972.47531	R-square	0.9976
Dep Mean	33865458.4240	Adj R-sq	0.9976
C.V.	1.90451		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	-785510595	3850303.0398	-204.013	0.0001
YEAR	1	406638	1910.5788284	212.835	0.0001

Dependent Variable: PROD10

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	2.2801018E16	2.2801018E16	45298.781	0.0001
Error	109	5.4864854E13	503347287610		
C Total	110	2.2855883E16			

Root MSE	709469.72283	R-square	0.9976
Dep Mean	37252004.2664	Adj R-sq	0.9976
C.V.	1.90451		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	-864061654	4235333.3437	-204.013	0.0001
YEAR	1	447302	2101.6367112	212.835	0.0001

Dependent Variable: PROD15

Analysis of Variance

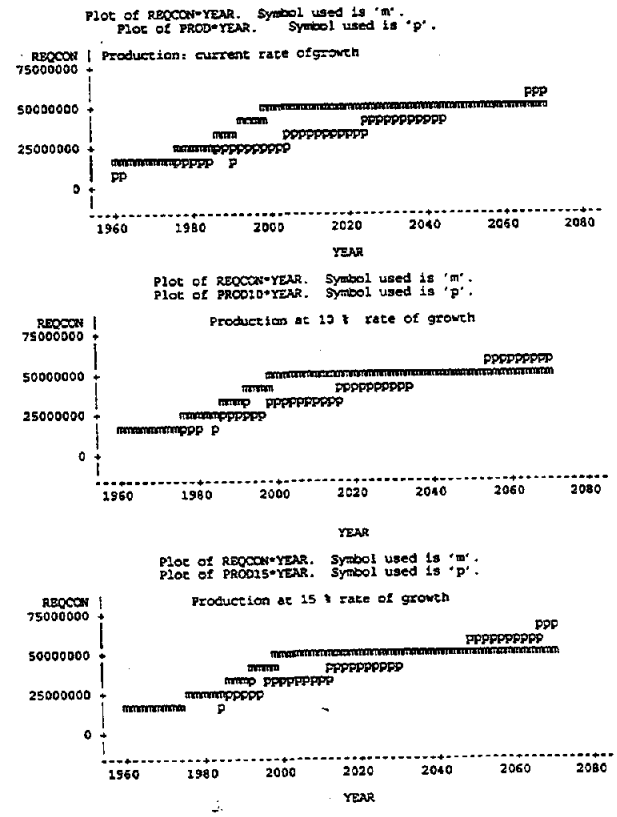
Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	2.4920948E16	2.4920948E16	45298.781	0.0001
Error	109	5.9965926E13	550146105714		
C Total	110	2.4980914E16			

Root MSE	741718.34662	R-square	0.9976
Dep Mean	38945277.1876	Adj R-sq	0.9976
C.V.	1.90451		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	-903337184	4427848.4958	-204.013	0.0001
YEAR	1	467634	2197.1656526	212.835	0.0001

Self-Sufficiency Simulation Model



Steps to Improve Agricultural Growth Rate

It is easy to show by way of manipulation of the mathematical model how Iran's rate of agricultural growth can be improved. However, when one deals with the real situation, especially in the face of unfavorable natural constraints and the existing bureaucracy, such a task would be extremely difficult. Below are some suggestions based on the harsh reality learned from the past inappropriate agricultural policies and neglect.

1. To strengthen Iran's traditional agriculture and mode of production in the countryside farm community. Where a harsh and hostile natural environment reigns, skillful irrigation and agronomic technique prove to render high performance. Many of these small farms have been abandoned due either to the expansion of urban development or neglect as a result of inappropriate government policies and agrarian reform.

2. To plan accurately the time and the extent of dry farming by way of scientific forecast of the rainfall cycle.

3. To develop a drip irrigation system, which would promote the efficient use of water for many types of crops.

4. To improve the qanat (underground gravity waterflows) system of water supply. Many of the qanat systems have been abandoned because of neglect. The system has been for years the main water source of the Iranian agriculture as well as urban use.

5. To make available manageable loans and credits to small farmers so that they will be able to acquire seeds, equipment and fertilizer.

6. To adopt appropriate agricultural pricing policies which will induce farmers to grow high priority crops.

Conclusion

For Iran and Iranian officials there lies a very difficult task ahead if the policy of self-sufficiency is to be pursued. The easy way out is to continue using oil revenues to support food import. In this case the future generation will be robbed of the land resources and inherit poverty as the present generation depletes what is expected to be the foundation of their future livelihood. With no appropriate action on the part of the Iranian officials to seriously control the population growth rate and to improve the agricultural production rate, a great number of Iranians will have to live below the basic food requirement level and the deprivation gap as shown in this inquiry will widen unless more and more oil revenues are allocated to the imports. With the present high inflation rate, the less fortunate have to subsist on one or two food items such as bread and tea to survive, and this is already prevalent to a large extent in Iran.

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