THE RUSSIAN POULTRY INDUSTRY SINCE THE ADVENT OF A MARKET ECONOMY: IMPORTS FROM THE UNITED STATES 1993 TO 1996

By

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PREFACE

The first three chapters are introduction chapters which may be skipped by people who are in the field of Russian poultry analysis. The first chapter gives an overall view of world poultry trends including production, consumption, and trade. It allows one to compare the Russian poultry industry to those in other parts of the world. The second chapter is devoted to the Russian poultry industry specifically. It offers statistics which bring to light the problems within the industry and reasonings behind the decline. The third chapter describes the changes which have been occurring within agriculture since the breakup of the Soviet Union. I felt this was an important chapter to add for anyone who is not a "Soviet" expert so that everyone will go into the heart of this thesis with an understanding of the changing structure of agriculture in Russia and the skepticism with which I enter into much of the analysis.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

NOMENCLATURE

ACF	A Shazam function that prints the Autocorrelation Function of residuals and associated test statistics
AKKOR	Russian Association of Private Farmers
BLUE	Best Linear Unbiased Estimator used to define properties of OLS
ERS	Economic Research Service of the United States Department of Agriculture
FAS	Foreign Agricultural Service of the United States Department of Agriculture
FSU	Former Soviet Union
GDP	Gross Domestic Product
ILO	International Labor Organization
OLS	Ordinary Least Squares Estimator
Shazam	An Econometrics Computer Program
USDA	United States Department of Agriculture

LIST OF SYMBOLS

C	Consumption of Poultry (1,000's of birds)
CNST	Construction of New Poultry Production Facilities
CPWG	Cost of Production in Rubles Per 100kg of Weight Gain
DP	Retail Price in Dollars per Kilogram
DW	Durbin-Watson Statistic
DTF	Dummy Variable indicating period of Tariffs
F	F test statistic in Shazam
FARMP	Farmgate Prices with Subsidies in Rubles
FDP	Feed Price In Dollars
FEED	Production Of Feed (1,000 Metric Tons)
FX	Ave. Exchange Rate (Ruble/$)
GF	Goodness of Fit with 1 degree of freedom
I	Inflation
IAO	Index of Ag Output
IMPT	Russian Imports of U.S. Poultry in Metric Tons
INV	Inventory Of Poultry (1,000 birds)
JCMT	Joint Conditional Mean Test
JCVT	Joint Conditional Variance Test

LM	Lagrange Multiplier with 2 degrees of freedom
M	Imports of poultry (1,000's birds)
NS	Not significant
Omnibus	Omnibus Test for Normality in Shazam
PCC	Per Capita Consumption Of Poultry in Kilgrams
PMF	Price Of Mixed Feeds Per Metric Ton in Rubles
PRF	Profitability Levels (With Subsidies)
R2	R-squared statistic in Shazam
R2A	R-squared adjusted statistic in Shazam
RC	Real Consumption
RFX	Real Foreign Exchange Rate in Rubles per Dollar
RGDP	Real Gross Domestic Product
RP	Retail Price in Rubles/Kilo of Poultry Meat
RUV	Real Unit Value of Poultry Meat Imports
S	Significant with a 10% chance or less of a Type I Error
TBT	Total Trade Balance
VIT	Vitamin Supplies for Poultry Feed (1,000 Metric Tons)

Chapter 1

Introduction

Purpose and Objectives

Russian poultry production has declined since the breakup of the Soviet Union. The industry has experienced a drop in production by over one million broilers from 1990 to 1996. The United States has been able to benefit from the decline by exporting poultry parts to Russia. Russia has become the top importer of U.S. poultry, surpassing even Hong Kong and Japan, at a value of $912,573,324 for 1996. The poultry industry has become concerned with how long this export market will exist. Determining how long it will take for Russian domestic production to return to previous levels is important. In addition, determining how certain factors are influencing the Russians' import decisions is vital. Studies in transitional economies are just now possible because of the availability of data and although still sketchy in some areas, it is important to examine the data available to provide guidance in these areas.

The general objective of this study is to understand how the privatization of the Russian poultry industry will affect the long-run U.S. poultry export market in Russia. The first specific objective is to determine the factors influencing Russian poultry production. The second objective is to estimate the current productivity level of Russian poultry production. The final objective is to determine the effect of real unit value, real

exchange rates, real GDP, tariffs, agricultural output, real consumption, and total trade balance on Russian poultry import decisions.

Overview

This paper begins with an introduction into the global poultry industry with sections on world trends, regional trends, and individual country trends. This is followed by background information on the Russian poultry industry including problems within poultry production. It also examines the consumption side and trade issues. The next chapter discusses the restructuring of agriculture in the post-Soviet era. It is split into three sections including managerial style and labor efficiency, lack of information and education, and social priorities. The literature review will discuss articles which are beneficial to this field of study. It is divided into background or current situation articles, data analysis articles, and articles which offer possible solutions to aid the Russian poultry industry. The theory chapter provides the economic basis for the study. The three theories, corresponding to the three specific objectives, are the production theory, productivity theory, and import demand theory. The data methodology chapter applies econometric analysis to the theory by using a production correlation matrix, a productivity index, and regression models for import demand. The results chapter reveals the findings from the analyses. The final chapter provides the conclusions from the study and suggestions for application of this work.

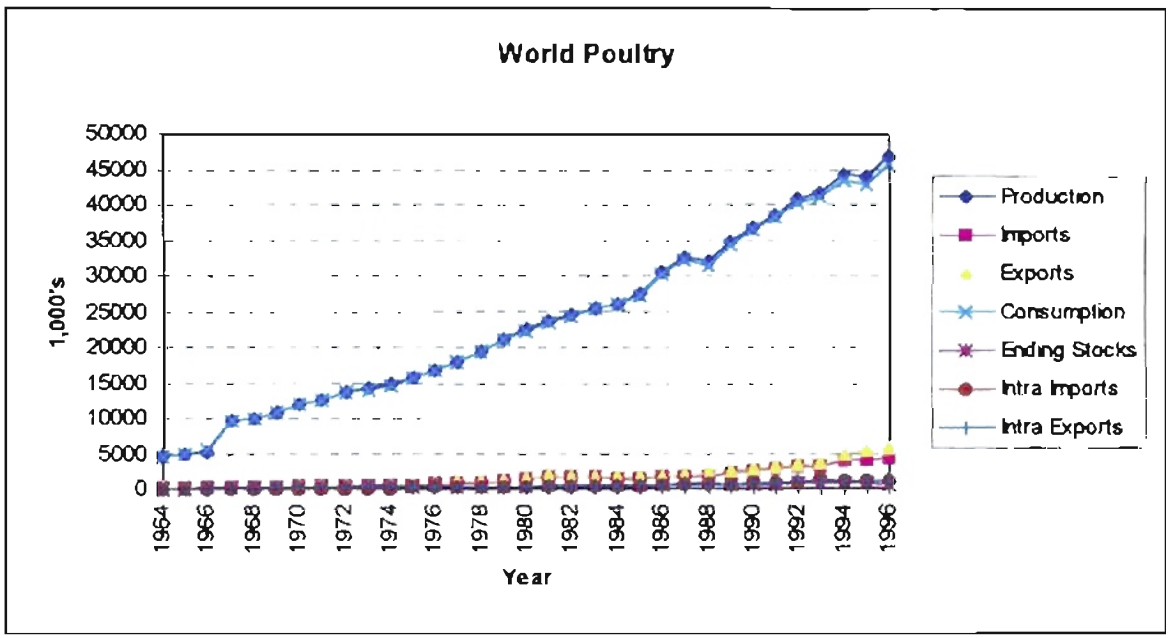
CHAPTER 2

THE GLOBAL POULTRY INDUSTRY

World

World production and consumption levels of poultry have risen dramatically since 1964 and have followed identical trends until 1993 when production started to exceed consumption slightly (Figure 1).

Figure 1, World Poultry

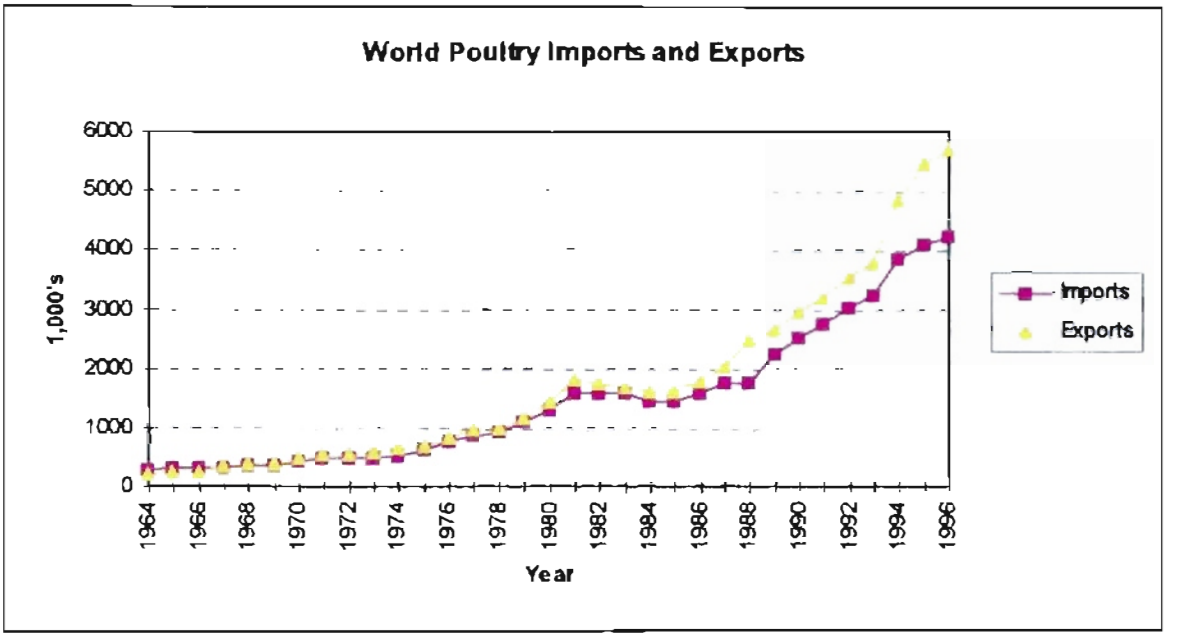


Source: U.S. Department of Agriculture, ERS, PS&D

Production and consumption levels have outpaced world trade in poultry. Production and consumption went from 5 million tons in 1966 to approximately 44 million tons in 1995. Most countries have been able to produce enough to satisfy their own consumption.

Poultry International notes that there was a significant growth in world trade in the second half of the 1980's when trade moved from a stagnant 1.0 million tons of poultry traded to 1.4 million tons ("World Broilermeat Trade"). By these figures, world trade increased by almost 50% in 5 years and more recent figures indicate that it continued to grow by another 50% in the early 1990's. The majority of this increase was due to the increase in exports from the United States and Europe. The United States has been able to become a world contender because of its own heightened internal consumption. American tastes have turned towards poultry for a variety of reasons—cost, health, and convenience, etc. However, the tastes have become more selective in the parts of the chicken that consumers will buy. U.S. consumption has turned towards poultry parts and away from the whole bird. In addition, consumption has risen for chicken breast and away from the dark meat. What this has caused is an abundance of leg quarters which can be exported at a lower price than broilers. World imports and exports have also drifted apart in the last few years which indicates that import or export records may not be completely accurate (Figure 2).

Figure 2, World Poultry Imports and Exports



Source: U.S. Department of Agriculture, ERS, PS&D

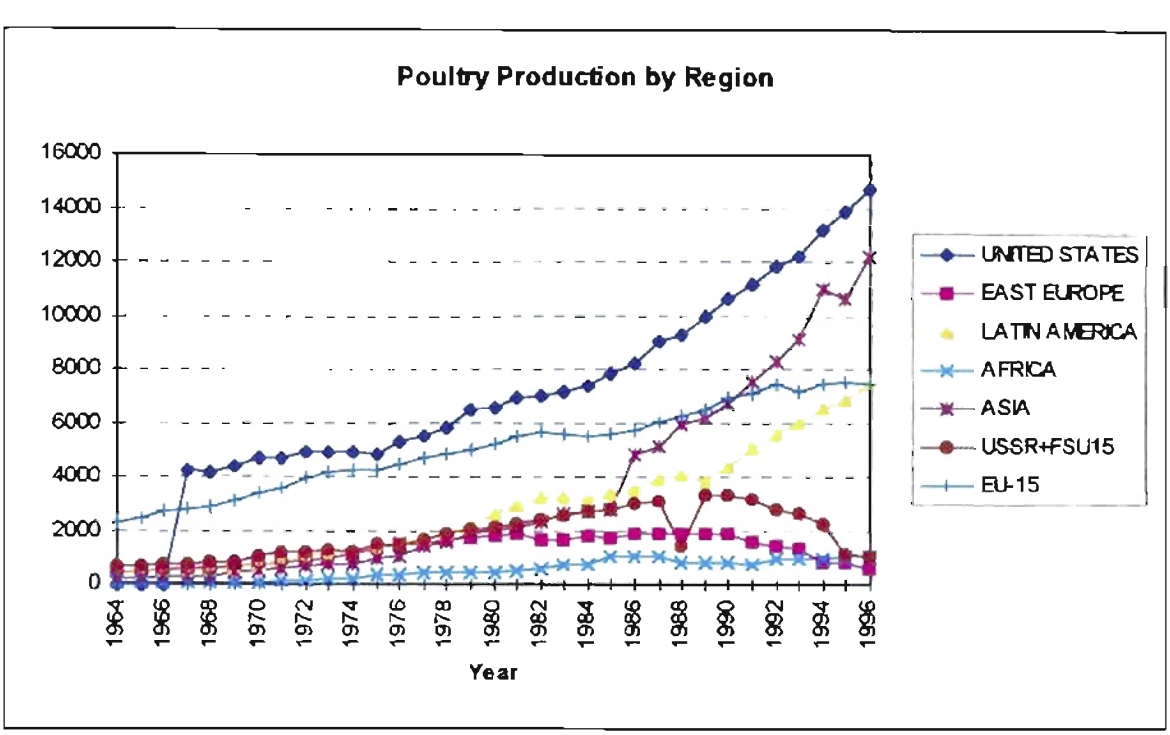
"Illegal" trade or trade outside of government bureaucracy may be occurring in addition to inaccuracies in data collection.

Regional

Since 1985, poultry production has been led by the United States[1] and followed by Asia, Europe (EU-15), and Latin America (Figure 3).

[1] For the purpose of this discussion, it was more interesting to compare the United States against other regions of the world to really see the levels at which the U.S. is producing. If Mexico and Canada were included, they would add approximately 2 million poultry to the production in North America.

Figure 3, Poultry Production by Region

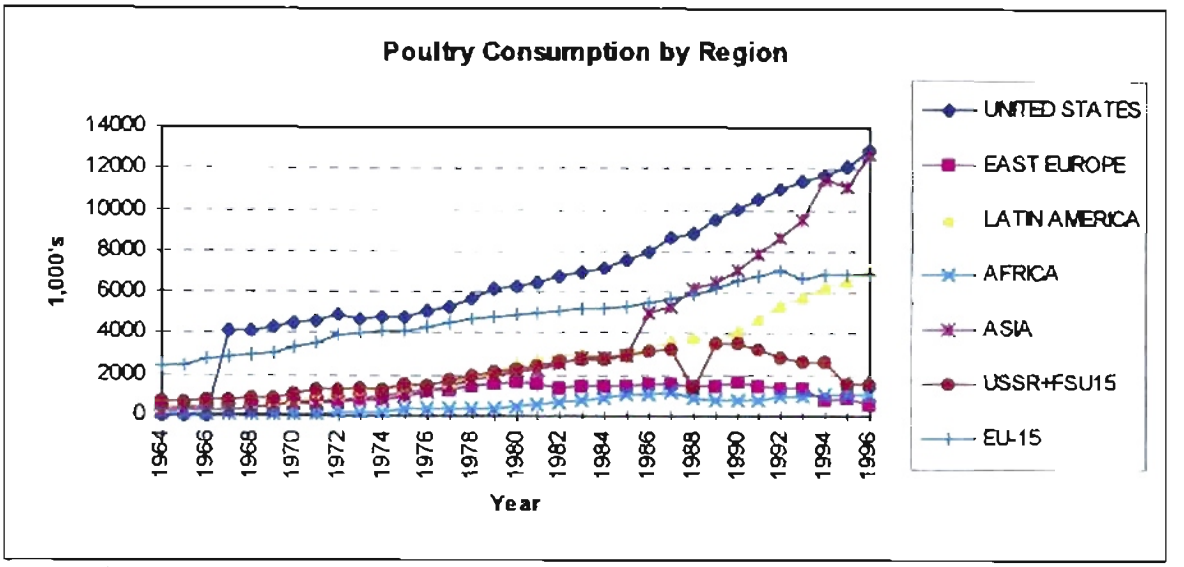


Source: U.S. Department of Agriculture, ERS, PS&D

The Former Soviet Union (USSR + FSU), Eastern Europe, and Africa have not been as successful in recent years. Until 1985, the United States and Europe led poultry production while the production in the rest of the world was minimal. However, in 1985, Asia started its sharp incline in production and is now second only to the U.S. Latin America has also increased production and is now at the level of European production.

Consumption has very closely followed the regional distribution of production except for in the United States where production has outpaced consumption leading to major exports of poultry from the U.S. (Figure 4).

Figure 4, Poultry Consumption by Region

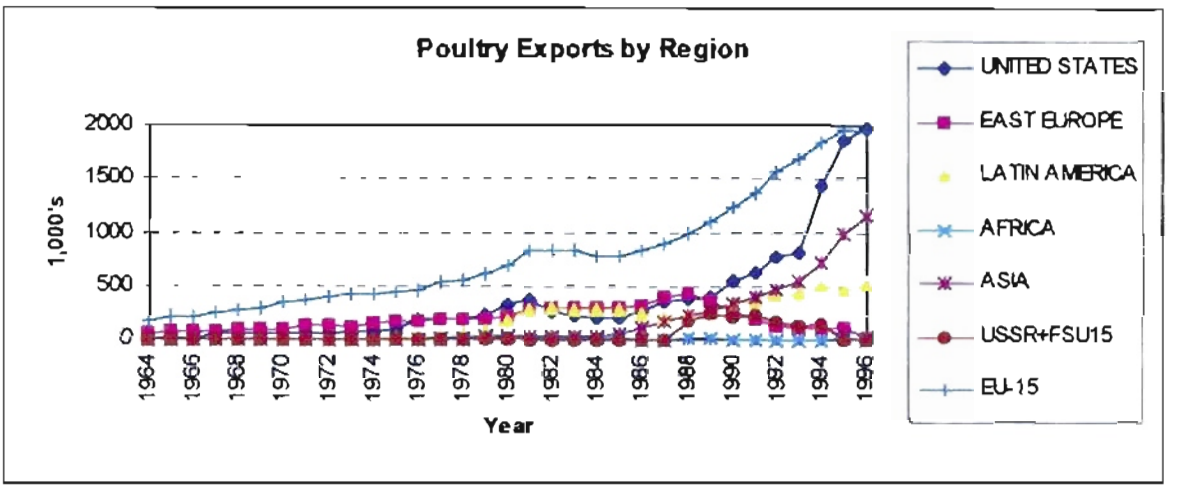


Source: U.S. Department of Agriculture, ERS, PS&D

Consumption within the United States has risen as consumers look towards healthier food. Poultry is considered lower in fat and is being substituted for other types of meat. With the new processing methods that are being used in the United States, chicken is being used more often in fast food restaurants and as convenience style foods from the grocer. This accommodates the move of women towards the workplace as the consumer tries to find quicker and easier ways of producing meals. Finally, the price of chicken has gone down over the years. Through vertical integration and other efficiency methods, the poultry industry has been able to meet a higher demand with a lower cost product which is a phenomenon almost unknown in any other agricultural industry. The vertical integration allows poultry producers to work with a single supplier. In theory, this should drive costs up and quality down as the number of suppliers diminishes However, Dr Benoff (April 1990) explains that having more suppliers actually has the opposite effect by creating more variation which must be adjusted downstream. The overall costs actually decrease and provide a higher quality by coordinating with the single supplier.

The largest regional exporters of poultry are the United States and Europe followed by Asia. Eastern Europe was keeping pace with the U.S. until 1988 when Eastern Europe hit its peak and began to decline as a significant poultry exporter (Figure 5)

Figure 5, Poultry Exports by Region

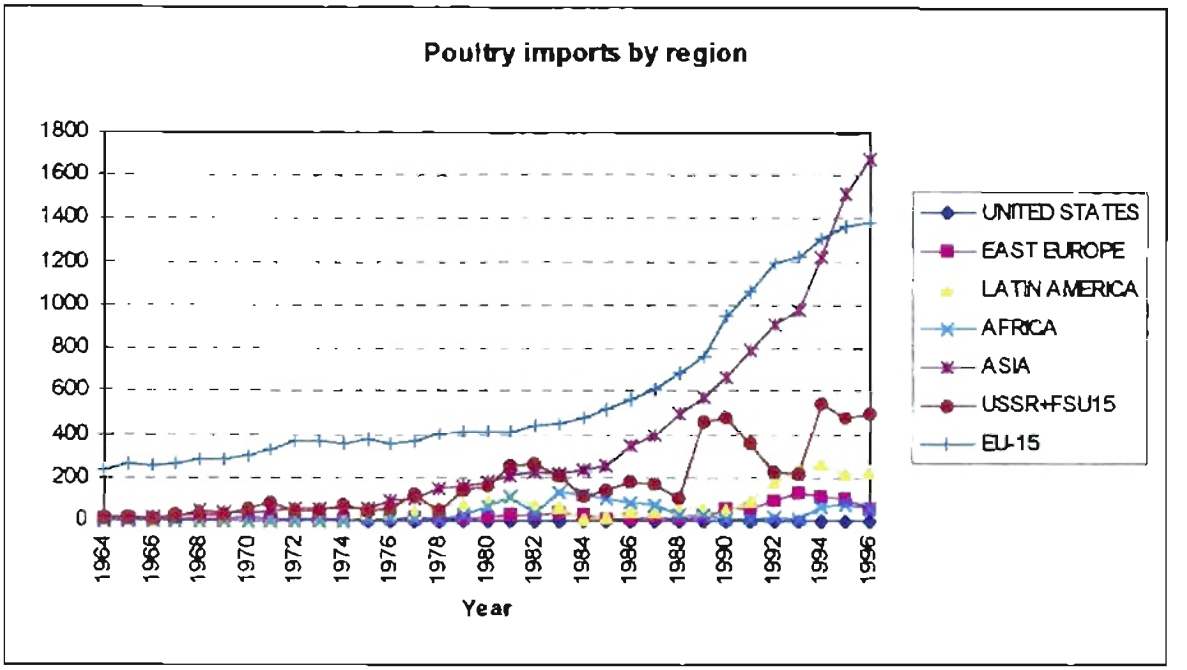


Source: U.S. Department of Agriculture, ERS, PS&D

It is no coincidence that this is during the time of Gorbachev in Russia. Gorbachev allowed the Eastern European nations to split from the Soviet bloc and begin making decisions about their own fate. Therefore, in the years that have followed, a lot of turmoil has been present within these countries as they search for a better system. Having been a primary supplier for the Soviet Union, other regions look to take over the slack

Although Europe and Asia are two of the three largest exporting regions, they are also the two largest importing regions (Figure 6).

Figure 6 , Poultry Imports by Region



Source: U.S. Department of Agriculture, ERS, PS&D

A large amount of this trade is occurring within each region. The USSR separated from the other regions and became a significant importer in 1988. However, the upward trend in poultry imports for the USSR has been a rocky one with a sharp decline in the early 1990's followed by another increase in 1994. The United States with its cheap leg quarters has been able to fulfill much of the increased import demand from Asia and the Former Soviet Union[2].

Individual Countries

The United States dominates the world production with almost 14,000,000 tons of poultry produced in 1995. China follows at 7,500,000 tons The only other countries

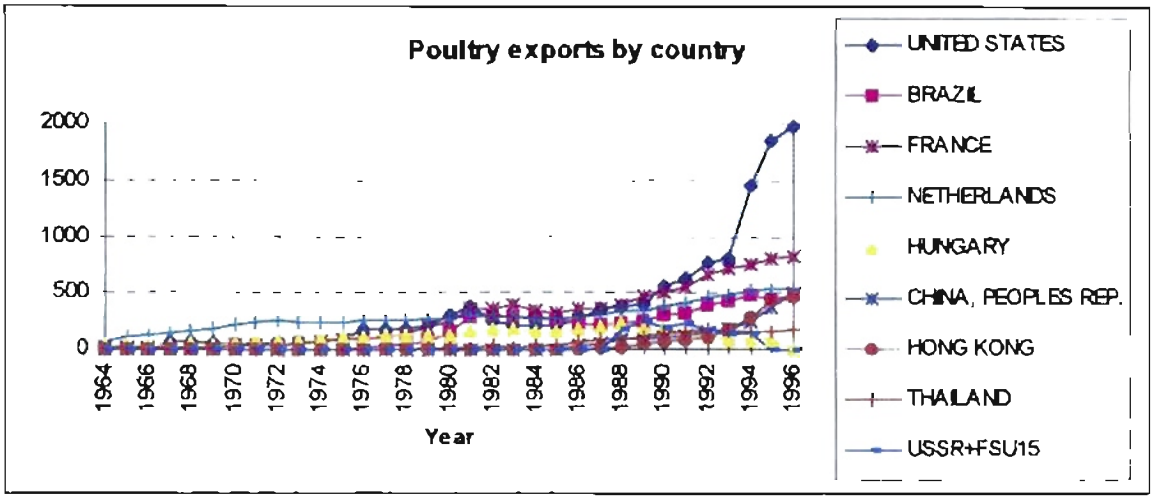
[2] The Former Soviet Union is referring to the 15 republics which were included in the USSR or Soviet Union. When discussing events before 1989, this nation will be referred to as the USSR or the Soviet Union, but it will be labeled the Former Soviet Union after this period to continue the same data sequence Russia is the largest republic within the Former Soviet Union and will often be referred to individually beginning in 1989.

which have produced more than 1.6 million tons of poultry from the mid-1980's are the Former Soviet Union and the Russian Republic, Brazil and France. This increasing production trend should continue as the production methods which have been proven to be so efficient in the United States are duplicated in other parts of the world. In addition, many of the Eastern European countries may soon show a turn-around in their production trends as they become more stable and productive.

Consumption has almost identical trends with the U.S. leading by over 12 million tons in 1995, China following with 7.5 million tons, and Brazil, the Former Soviet Union, Russia, and Japan following as the only countries with over 1.7 million tons consumed. AgExporter revealed that poultry consumption in most other countries has a lot of room to grow (Young, 1990). In 1989, the American per capita consumption was 30 kilograms. By contrast, Hungary was the next highest with 17 kilograms of consumption per capita and Japan was at 12 kilos. Even though world poultry consumption has been rising at significant rates, it appears that it is not likely to slow down anytime soon (at least outside of the United States). Poultry is being supplied at lower prices than in the past and in greater varieties. The poultry industry has been responsive to demands from its consumers as it supplies these new forms of poultry meat.

The export market is once again dominated by the United States, then France, the Netherlands, and Brazil (Figure 7).

Figure 7, Poultry Exports by Country

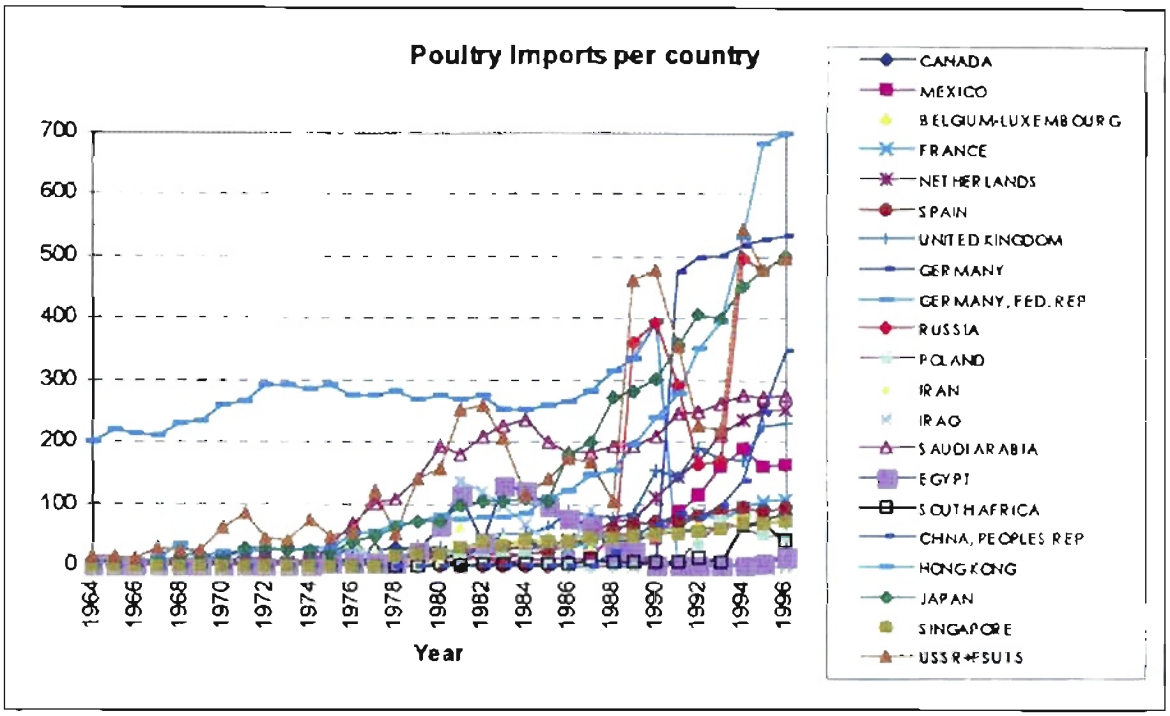


Source: U.S. Department of Agriculture, ERS, PS&D

The United States did not become a major exporter of poultry until 1993. This area may not change much in the near future as countries with increased production continue to meet their internal consumption.

The import market by country is interesting since it is the only view of the global poultry market where the United States is not in the picture (Figure 8).

Figure 8, Poultry Imports By Country



Source: U.S. Department of Agriculture, ERS, PS&D

Import levels are erratic particularly since 1988 which points to the political upheavals that began in that time frame. USSR officially broke up in 1989 and East and West Germany united in 1990. Several Asian countries have advanced significantly since the late 1980's and with the rise in standard of living comes the rise in demand for meat products. Three of the top ten importers are Asian countries including Hong Kong, Japan, and China. It is difficult to identify even the top 20 importers since it varies so much from year to year. However, the top five in the mid-1990's would include (in descending order) Hong Kong, the Former Soviet Union, the Russian Republic, Germany, and Japan. In 1983, this order was Western Germany, Saudi Arabia, the USSR, Egypt, and Japan. The quantity imported individually by these top five has more than doubled since 1983. The import

quantities ranged from 100,000 to less than 300,000 tons in 1983. By the mid 1990's, that quantity range was 450,000 to 700,000 tons.

Chapter 3

Russian Poultry Industry

Trade

The Soviet Union had been a significant importer of poultry since the early 1980's and in 1989, 1990, and 1995 the Former Soviet Union (including all 15 republics) was the top importing country in the world. The Russian Republic was a large proportion of this and in 1989, became the number two importer in the world, second only to the 15 republics of the Former Soviet Union. As of 1995, Russia trailed only Hong Kong and Germany in the importation of poultry. Out of the almost 200,000 tons of poultry that the Soviet Union imported in 1988, Poultry International reports that Hungary supplied almost 65%, Romania and Bulgaria accounting for most of the remainder ("World Broilermeat Trade Goes on Growing"). However, in recent years, Russia has had to turn to outside sources for the poultry. Three primary reasons explain this anomaly. First of all, Eastern Europe's production has fallen. Second, internal consumption has risen within many of these countries. Finally, these countries are requiring hard currency and are not so eager to take the Russian ruble anymore. Instead of working on a ruble clearing account or barter basis with Russia, David Young reports, "East European countries will be inclined to offer their products at prices consistent with the international market to earn convertible foreign exchange (p. 12)." This is confirmed by reported offers by Hungarian and Bulgarian poultry farms to sell poultry in the Middle East (Young, July 1990). As of

1993, the United States became the largest source of imported poultry products in Russia. The primary type of poultry shipped to Russia consists of leg quarters. Due to the high demand for white meat in the United States, there is a large supply of leg quarters that can be exported at a very low cost. U.S. leg quarters can be sold at a much lower cost than whole broilers from Europe and the high quality causes them to be a favorite among the Russian consumer (USDA, 10/18/94). However, in recent years, the domestic Russian poultry industry has begun to speak out against the importation of such large amounts of U.S. poultry. The Russian poultry industry argues that the large inflow of cheap chicken is killing the domestic poultry industry. Russian poultry trade restrictions began in 1993 when an agreement on sanitary standards of imported poultry was signed declaring that only poultry certified by the Veterinary Department of the Russian Ministry of Agriculture may be imported. This was in addition to all of the regular poultry standards already in place. Tariff restrictions followed with an import duty of 20% which was implemented on July 1, 1994, then increased to 25% on July 1, 1995, and then to 30% on February 2, 1996. Finally, on February 16, 1996, the Russian government suspended the imports of American poultry. The "official" reasoning for the ban was given by V. Avilov the Chief Veterinary Inspector of the Russian Federation who stated a dissatisfaction with the quality (USDA, 4/22/96). Although the ban has been worked out, the domestic poultry opposition to imports is still there. U.S. producers need to know approximately how many years that they will have left to benefit from this untapped demand before the Russian supply recovers. Politically, the best way for the United States to continue a good relationship and to maintain such a large consumer is to show that they are not just feeding

off of the Russian problems, but putting something back into the system. For these reasons, it is important to analyze the Russian demand and supply of poultry and look at the best ways to assist their domestic needs.

Consumption

Consumption of meat products in Russia could be higher and the government has often attempted to raise this level of consumption so that the Russian consumer would be on the same level as Western Europe. The Soviet Food Program which was presented in 1982, attempted to "achieve a significant improvement in Soviet diets by 1990 while simultaneously reversing the decline in agricultural performance" and this called for per capita meat consumption to reach 70 kilograms by 1990 (Cook, 1985, p. 1049). Soviet officials stated that their consumers would eat 30-35 percent more meat if it were available (Young, 1990). The government realizes that in such a time of political reform, it is necessary to continue a high supply of food in order to keep the populace happy. Although Russians do eat meat in their diets, the portions are below Western Europe and the United States. This is not primarily due to tastes or preferences, as Russians do like meat, but instead due to the price of meat relative to other food items and the consumer's income level. Cook states, "Western estimates of income elasticity of demand for meat in the USSR generally range from .7 to .9. Some Soviet sources even indicate values above unity (p. 1049)." The USDA report in October 1994, shows that the current level of meat consumption is 15 kilograms per capita which indicates a 30% reduction due to the declining purchasing power of the population. Per capita broiler consumption in 1989 was 6.8 kilograms per year. In the United States, per capita consumption in the same year was

29.9 kilograms (Young). Since poultry prices have increased at a slower rate than other food products and the U.S. leg quarters are selling at a lower price than whole birds (USDA, 7/18/95), the United States can expect the demand for the American leg quarters to remain high and even increase. In addition, the Russians prefer the dark meat of the chicken and consider the U.S. poultry cuts to be of high quality (USDA, 10/18/94). As the Russian purchasing power increases, the quality of the leg quarters should allow for an even higher demand. After a decline in poultry consumption in 1992-93, the consumption of poultry meat resumed its climb (USDA, 1/17/96). As the Russians are exposed to relatively inexpensive and high quality meat products such as American poultry, they will not easily be persuaded back into the old consumption habits (less poultry and more pork and beef) just due to an increase in income. Other than advertising the ways to use poultry, consumption levels are near impossible to raise without raising the purchasing power of the Russian people. In any case, the demand function for poultry consumption is functioning properly and therefore, attention should be directed to production.

Production

The Russian poultry[3] industry hit a high point in 1988-89 producing 2 million tons of poultry meat, however, only 1.2 million tons of chicken were produced in 1994 (USDA, 7/18/95). Poultry productivity has fallen with a daily increment weight gain at 19 grams per day in 1993 compared with 22 grams per day in 1991 (USDA, 10/18/94). Conversion rates describe the amount of feed that it takes to add one unit of weight to

[3] Russian poultry consists of primarily chickens with an insignificant amount of geese, turkey and ducks (USDA, 7/18/95).

livestock. Poultry conversion rates in Russia are estimated at 4–4.5 kilograms/kilo (USDA, 1/17/96) while the United States can brag of a conversion rate of two to one (Christensen). Therefore, the U.S. is able to use half of the amount of feed that the Russian side needs to put on the same amount of weight per chicken. In the United States, feed is comprised of approximately 20-25% protein, depending on the growth stage of the bird, whereas, Russian feed only consists of 17% protein (USDA, 1/17/96). Russian poultry production profitability in 1994 was -9% with subsidies and -22% without subsidies and this data does not even include the effect of inflation which averaged about 350% in 1994 (USDA, 7/18/95).

Production consists of inputs and output. The efficiency of the production depends on the allocation of inputs to produce the most output. The profitability depends on the costs of the inputs versus the price the producer receives. Although it is not entirely appropriate to compare costs among different countries due to the differences in purchasing power, it is interesting to just look at the differences. The cost of feed in the United States was approximately $167.77 per ton in 1992 (Christensen)and was reported in the January 1996 attache reports to be between $220-320 per ton in Russia (USDA). In contrast, the market price in the U.S. was 52.58 cents per pound in 1992 (Christensen) and 40 cents per pound in Russia in May of 1993 (USDA, 1/17/96). However, exactly one year later, the Russian poultry price had increased to $1 per pound (USDA, 1/17/96). To become profitable, one can either lower the cost of the inputs or increase the cost of the output. The Soviet government has attempted to do both for years. The Soviets subsidized inputs, bought back the outputs at high prices and then provided these to the consumer at low prices. In this way, producers profit and consumers benefit, but the

government goes broke. The problem was that under such a system, there was no incentive to be efficient. As the Soviet government collapsed, the system of distribution and price fixing fell apart as well and the costs rose to market level prices. This is not bad, this is simply an adjustment, difficult as it may be. Even today, complaints from producers are that input costs are too high and output prices too low. Input availability will be addressed in three sections: feed, technology, and labor; and the output side with price disparity and marketing. This will prove that what the industry needs most is a restructuring of the management, not a tampering with the cost structure.

Input Availability

Feed

Under Soviet rule, the government was responsible for the provision of inputs. Now that the farm is responsible for its own inputs, these large production units are economically inefficient. The government sector still is the primary supplier of most inputs including fertilizer and machinery as the supply side distribution has not fully developed at this stage. The amount of subsidized feed has fallen from 12 million tons in 1991 to 8.8 in 1992 (USDA, 10/18/94), so the shift in distribution from the government to the private sector is occurring. One of the attache reports by the USDA (7/18/95) shows a decline in feed production of 61% in 1994 in comparison with 1991 which reduces the availability of feed. However, the farms report that the availability of inputs is not a problem (Brooks and Lerman), but instead it is the high price which makes many of the inputs prohibitive. Russian farmers do not have the variety of feed available that U.S. farmers do and the high

price of feed additives means that feed quality has fallen while costs have increased. This feed lacks the necessary vitamins and proteins since the protein-vitamin additives have decreased by 98% (USDA, 7/18/95). Feed has risen to 80% of poultry production costs and the prices of other inputs (gas, machinery, and electricity) have risen at high rates as well (USDA, 10/18/94). However, in comparison with the United States, one finds that feed costs are also a major portion (60%) of liveweight production costs (Cristensen, 1993).

Lack of Technology

In Western technology, there are three weight categories: portion chicken (400-1500 grams), average type (1500-2000 grams), and hard (more than 2000 grams), but the Russian producers do not produce the third type at all (USDA, 7/18/95). High quality poultry breeds are not prevalent and technology is outdated on 80% of the poultry farms with the equipment having been in operation for 10 to 20 years (USDA, 10/18/94). As the technology becomes obsolete with no hope of replacing it due to the lack of funds, inefficiency increases and increases production costs. As Grigoriy Nerubenko, the director of Rosptitseprom, the joint stock company which represents the nation's poultry factories, stated, "The Russian poultry industry could collapse within three to four years if 65% of the factory equipment which is worn out is not replaced" (USDA, 7/18/95, p.9). Consultants need to examine the existing technology and evaluate which equipment is salvageable, which is not, and the cost of getting these firms to the minimum operational state. No firm in a market economy would purchase equipment for a dying industry if it does not foresee potential profits. If the industry can make improvements in other areas,

such as labor efficiency, which offer more concrete evidence or proof of the intentions of the industry to become efficient and profit in the market system, then investment will increase. An increase in technology without significant changes in the fundamental structure of the farm would be futile. The Soviet government tried increasing technology by supplying it at subsidized rates for 70 years but the system was still inefficient. New technology alone will not bail out this industry.

Worker and Management Problems

There are management inefficiencies due to a lack of adherence to the technological process and a low labor discipline. The USDA reports that producers are forced to keep many more young birds than necessary to compensate for the high rate of poultry losses which is the equivalent of close to $10 million or 10 billion rubles (10/18/94). In addition, they are substituting cocks for broilers which consume more feed and yield less meat at a loss of approximately 2 billion rubles (USDA, 10/18/94). In addition, most of the poultry factories contain too large a staff and the workers have no responsibility for their work (USDA, 7/18/95). The workers are paid by quantity of hours worked, not by the quality, and firing someone has never been a part of the communist system. In Leibenstein's article on "X-efficiency" (1966), he examines the level of inefficiency caused in worker productivity due to monopolies. He uses Kilby's table summarizing the results of a number of International Labor Organizations (ILO) productivity missions which show that by applying various changes in management styles in countries all over the world (see Table 1) that an increase in labor productivity ranged from 5 to 500%.

Table 1, ILO Productivity Mission Results

Factory or Operation	Method*	Increase in Labor Productivity %	Impact on the Firm (Unit Cost Reduction)	
			Labor Savings %	Capital[1] Savings %
India				
Seven textile mills	n.a.	5-to-250	5-71	5-71
Engineering firms				
All operations	F,B	102	50	50
One operation	F	385	79	79
One operation	F	500	83	83
Burma				
Molding railroad brake shoes	A, F, B	100	50	50
Smithy	A	40	29	29
Chair assembly	A,B	100	50	50
Match manufacture	A,F	24	19	–
Indonesia				
Knitting	A,B	15	13	–
Radio Assembly	A,F	40	29	29
Printing	A,F	30	23	–
Enamel ware	F	30	23	–
Malaya				
Furniture	A,D	10	9	9
Engineering workshop	A,D	10	9	9
Pottery	A,B	20	17	17
Thailand				
Locomotive maintenance	A,F	44	31	31
Saucepan polishing	E,D	50	33	–
Saucepan assembly	B,F	42	30	–
Cigarettes	A,B	5	5	–
Pakistan				
Textile plants	C,H,G			
Weaving		50	33	33
Weaving		10	9	9
Bleaching		59	37	37
Weaving		141	29	29
Israel				
Locomotive repair	F,B,G	30	23	23
Diamond cutting and polishing	C,B,G	45	31	–
Refrigerator assembly	F,B,G	75	43	43
Orange picking	F	91	47	–

*A=plant layout reorganized
B=machine utilization and flow
C=simple technical alterations
D=materials handling
E=waste control
F=work method
G=payment by results
H=workers training and supervision

[1]Limited to plant and equipment, excluding increased depreciation costs.

Source: **Leibenstein, p. 225.**

This study left all other inputs, including the level of technology and capital exactly the same, and only adjusted the workers and existing technology with methods such as: plant layout reorganization, machine utilization and flow, simple technical alterations, materials handling, waste control, work method, payment by results, and workers training and supervision. Most of these studies were done in the manufacturing areas. However, even the "orange picking" operation in Israel was able to increase labor productivity by 91% simply by changing the work method. Leibenstein states that there have been a variety of studies on the effects of introducing payments by results schemes. Davison, Florence, Gray, and Ross summarize their findings from British manufacturing operations as follows:

> "The change in output per worker was found to vary among the different operations all of the way from an increase of 7.5 percent to one of 291 percent, about half the cases falling between 43 percent and 76 percent. Such increases in output, most of them large, from our 'first-line' case histories and from additional evidence, were found not to be just a 'flash in the pan' but were sustained over the whole period of study (Leibenstein, p.226)."

Leibenstein then states that appropriate incentives can change a worker's tempo and reduce costs, without any changes in purchasable inputs per unit. If Russian collectives are to be seen as efficient firms, then labor productivity analysis should be done in this area as well. It is already well-known that there are a tremendous lack of incentives associated with the communist style of management. Workers are paid just by showing up to work, with no incentives to produce more or at a higher quality. They have almost zero fear of unemployment as the Soviet government would not allow any unemployment and

managers continue this system. Probably no system in the studies done have had as much worker inefficiency as exists in the communist system. Even with the privatization of the land, workers continue to work in the collectives and under the same managerial system. If the responsibility for the future of the poultry collective was put in the hands of the worker, then the firm might become profitable. These workers are now shareholders in a company, but they still do not see either the profits from a good year, nor the negatives from a bad year because the management system handles it all and pays the workers the same wage as always. Wages do not fluctuate from year to year, nor from person to person due to productivity. If the workers had the incentive of receiving profits, like real shareholders, they would have an incentive to work harder and lost worker time would decrease. In addition to all of the increased productivity and profitability within the collective, one would see an increase in pride and happiness among the workers as they are able to really make something prosper and an increase in prosperity as they take home extra pay for their families.

Output Difficulties

Price Disparity and Profitability

The price disparity between the increase in poultry input costs and the selling prices is significant. For example, in the Tyumen oblast, mixed feed prices grew by 429% but poultry purchase prices only grew by 71% (USDA, 7/18/95). Due to a small number of poultry processing plants, it appears that the processor can dictate a low price to the producer which is usually too low to provide a significant margin to pay decent salaries to the workers which in turn, affects both production and productivity. Farm managers

adjust for this by delaying payments to their workers (Brooks and Lerman). Profitability does vary by region with the best average financial results in the Ural poultry complexes and the worst in the Far East, primarily because of the use of imported feeds and expensive energy (USDA, 7/18/95). Although 92.3% of the collective farm enterprises report that poultry production is unprofitable, 79.7% of private farmers report it as profitable and 37.2% of the private farmers plan to increase production with only 1.6% planning a decrease. Unfortunately, even with over 90% of the enterprises stating unprofitability in the poultry sector, less than 1/3 plan to decrease poultry production.

Table 2, Perceived Profitability and Planned Production

Perceived Profitability and Planned Production for 1993 As Reported by Private Farmers and Collective Farm Managers (percent of respondents by category)

				Planned production for 1993		
		Profitable	*Unprofitable*	*increase*	*decrease*	*same*
Beef	Private farmer	54.3		38.8	12.8	44.6
	Farm manager		84.1	17.9	15.9	60.2
Pork	Private farmer	51.1		30.7	11.9	54.2
	Farm manager		89.6	18.6	22.2	53.3
Mutton	Private farmer	67.5		40.4	13.2	43.9
	Farm manager		73.1	9.7	25.0	55.6
Eggs	Private farmer	82.8		31.9	0.7	65.1
	Farm manager		88.0	3.9	26.9	61.5
Poultry	Private farmer	79.7		37.2	1.6	59.0
	Farm manager		92.3	14.3	28.6	46.4
Milk	Private farmer	68.6		34.9	4.7	57.7
	Farm manager		73.7	23.4	11.1	59.4
Grain	Private farmer			50.7	10.5	33.2
	Farm manager			28.0	5.6	65.0
Sunflower	Private farmer			28.4	38.9	27.6
	Farm manager			15.6	14.8	68.0
Hay	Private farmer			34.5	11.6	49.0
	Farm manager			20.2	9.2	67.2

Source: Brooks and Lerman, Table 7.2, p. 79.

If private farmers claim profitability, while collective farm managers do not, at least one of three things is happening. Private farmers are buying inputs at a lower price, they are selling at higher prices, or they are more efficiently allocating their inputs (including feed,

technology, and labor). One other thing supports the profitability of poultry. The attache report in January of 1996 states, "Adding taxes, transportation expenses and profit of traders, the minimum retail price that will provide growers with zero profits will be about 10,000 rub/kilo ($2.10) (USDA, p. 3)." Then, in the same report, they show that the average retail price of poultry from July through December of 1995 ranged from $2.32 to $2.54 (p. 12). The farmers are complaining that the foreign poultry firms are supplying poultry which could make a profit starting at $1.85 per kilo, but since market prices are far above this, then there are extra profits available that the domestic poultry industry should be jumping on, not complaining about. Therefore, it appears that it is not the cost of the feed nor the low prices for poultry, but the inefficient use of the feed, technology, and labor that is primarily responsible for the unprofitability in the large farms.

Marketing

Marketing in the broad definition (which encompasses all activities from the producer to the consumer) also should undergo serious investigation. First, there is a lack of information flow from consumer to producer. In the Soviet era, the government dictated a quota which the farm had to fill (or at least attempt to fill). If a farm produced above the quota, then there was a high probability that the quota would be raised the next year and everyone would have to work harder. Therefore, the smarter route was to simply meet the order, but not overfill the order so that the quota would remain at the same level. The government "knew" what the people needed and that is what it would supply. Other than through the black market, real prices were not even in the equation since the government bought directly from the producer and then supplied the consumers

with subsidized food. The Russian government has backed away from this policy and is allowing the producer to sell directly to the consumer. However, due to the difficulties of the Russian consumer to purchase even the basic necessities, there is little information flowing back to the producer and there is the question of whether the producers would even recognize any information if they received it after having spent their entire lives depending on government information.

Second, there is the difficulty of transportation. Roads have always been a joke when discussing the Russian transportation, but it is true. Even most of the main highways are difficult terrain. Many farms probably do not even have paved roads to move their materials from the farm into the market. Even if there were decent roads from some of the farms, the government has not been able to afford to mend them even to the levels that they used to be. In addition to roads, finding trucks to haul the poultry to the processor could be a large obstacle, especially to the new private farmers. Once the poultry has been processed, then there is the question of chilled trucks to transport the poultry without spoilage. Locating these trucks is hard, but even if a farm has its own trucks, there is the difficulty of obtaining gasoline and parts to keep the trucks running.

Finally, marketing margins should be analyzed. If retail prices are truly above "break-even costs", but producers are still experiencing negative profitability levels, then the marketing margin for the processor may be too high as producers are stating. The poultry processing sector should be examined. If there are few processors, then they may be operating on monopoly profits at the expense of the producer.

Trade, consumption and production of Russian poultry should all be evaluated. However, with consumers making decisions based on prices, attention should be focused on trade and production. Production analysis should consider both input and output factors. Trade analysis should determine which factors are most significant in poultry import decisions.

Chapter 4

Restructuring of Agriculture in the Post-Soviet Era

Russian farms have gone through much restructuring as state and collective farms are sold and divided among private farmers. However, most of these previously collective farms are remaining in collective form even with private ownership (Brooks and Lerman). It has been argued that these large farms are inefficient as there are no large economies of scale as in manufacturing industries. Mancur Olson states, "The considerable costs of coordination and monitoring in large firms are vastly increased if a firm operates over a huge amount of space (p. 932)." He also goes on to show that with the "survivor method" most surviving firms are relatively small and even uses the Soviet style, large-scale farms as an example of the inefficiencies. With most farming, the difficulty of managing such a farm does increase significantly over distance. However, the poultry industry is unlike most farming in that it does not require a lot of space. A poultry farm can be large while occupying a small area. This eliminates the argument of distance hampering efficiency for the poultry industry. Although the "survivor method" is usually used to demonstrate why surviving farms are small, it can be used to support the large poultry firms because the American poultry industry has prospered and has done so while increasing the size of the farm. The poultry industry is more like an industrial industry than an agricultural industry when it comes to spatial intensity. Graham Hallett, when discussing the large non-family firms in the Soviet Union states, "Only in modern poultry production is there any likelihood of a situation developing which could become similar to

that in manufacturing industry (p. 22)." Therefore, is it the size of the poultry farm that really matters? As most of the Russian collectives are now privately owned, but continue to be farmed together, what are the determining factors of efficiency? Perhaps it is not the size of the plot, but the other inputs, such as managerial efficiency and lack of education which determine the efficiency.

Managerial Style and Labor Efficiency

The way in which the units are managed is extremely important. If they are operated in the same way as the communist version of the past, where prices and output efficiency are irrelevant, then these farms are no more efficient than before. However, if they are managed as a cooperative with individual leadership and responsibility, then it should be no more inefficient than neighboring farms assisting one another. Unfortunately, because of the lack of education towards new farming methods, the first version is more likely. In Brooks' and Lerman's' study, most of the managers responded that they either anticipated conditions to worsen or stay the same with the reorganization.

Table 3, Expected Changes as a Result of Farm Reorganization

Expected Changes as a Result of Farm -Enterprise Reorganization (percent of managers responding)			
	Decrease	*No change*	
Total work force in 1993	30.0	48.8	
Administrative staff	59.7	34.6	
Production workers	43.6	39.9	
	Improve	*Deteriorate*	*No change*
Access to farm inputs	9.8	58.4	22.0
Access to credit	6.2	51.0	26.3
Marketing conditions	17.6	34.7	38
Conditions for household farming	41.2	13.5	40.8
Output	28.2	31.8	29.4
Degree of economic autonomy	54.3	5.3	27.8
Labor discipline	36.3	13.5	34.3

Source: Brooks and Lerman, Table 5.4, p. 65.

If they are anticipating no changes or deterioration in inputs, labor discipline, output, and marketing conditions, then these managers are not looking at the positive side of the reorganization. They do not realize that the manager and the workers now have the power to make the farm profitable.

Most of the farms in the survey recognized individual ownership, but the lots are not designated to specific owners. One person may own 10 hectares, but will work the whole farm without knowledge of any specific section belonging to him/her. When Brooks and Lerman surveyed the employees of these farms, they "uniformly excluded the land share when asked to describe land they considered to be 'their own'. When asked about land ownership, employees included only land they held in individual private ownership, i.e. the portion of the household plot (p. 50)." In addition to the workers not recognizing the concept of private ownership and still feeling a part of the whole farm, the farm labor has not decreased even with a 15% loss of farm enterprise land over the last two years (Brooks and Lerman). Land has been given out to the private farmers, but the total labor force per collective has not decreased. This shows diminishing production

efficiency if the same amount of labor is being used to work less land. Much of this falls under the managerial decision not to create unemployment which was always an objective under the communist system. Unlike the western philosophy of reducing costs by reducing staff when profits do not meet expenditures, over 80% of Russian managers said that they would not dismiss workers or relocate workers to other jobs, and almost 90% said that they would not reduce wages. Instead, the majority cited that they would rather delay wage payments, delay other payments, or take debt in order to meet payroll.

Table 4, Management Strategies

Management Strategies: What to Do If No Money to Meet Payroll? (percent of managers responding)		
	Yes	*No*
Dismiss some workers	13.2	80.6
Keep workers, reduce wages	7.8	87.2
Delay wage payments	57.0	39.1
Delay other payments	64.7	31.4
Take debt	69.8	27.9
Shift workers to outside jobs	8.9	82.2

Source: Brooks and Lerman, Table 5.5, p. 66.

Also, the incentive of private ownership to boost production is obviously not working if the workers do not even recognize the responsibility to their individual land. These workers are now shareholders, and as shareholders, they should be rewarded as their productivity increases.

Lack of Information and Education

David Sedik states that with the restructuring, inefficient livestock production falls and cheaper imports are taking over which is more efficient. However, if the farms do not have the knowledge of how to change to become more efficient, how is the market helping? In the United States, farms go out of business because they are inefficient and

didn't adjust to a new system. In America, information is available on how to be more efficient and the companies in business are practicing these policies. But, what do you do in a nation where no one knows how to adjust? Private farmers who tend to be more educated are prospering (Brooks and Lerman), but most of them are strictly in subsistence farming. Christian Foster provides insight into this when he states that private plot holders often feed animals with household waste, grains from in-kind farm payments or through grazing. These farmers face physical constraints and marketing problems that limit their activity to just a few animals each which will not allow them to expand much further. These private plots are not enough to feed a nation. As large, inefficient firms go out of business, it benefits the consumer, but the trade balance worsens as Russia has few production facilities to allow it to compete with the imports and has less exports to help balance the massive influx of imports. In addition to the trade imbalance, unemployment starts occurring as these inefficient facilities collapse. The last 70 years in Soviet history has not allowed for unemployment. Perhaps it is more efficient to allow for the possibility for unemployment as an incentive to produce efficiently, but when shutdowns occur, they not only lay off the inefficient worker, but the efficient ones as well. Looking at the many factors which make a production unit inefficient (high production costs including high feed costs and high costs of electricity and other inputs, low quality feed, and old technology), one cannot blame all of the production problems on the workers and when these workers are laid off, they become voices of opposition to change. After all, change only looks good as long as it will benefit the individual. Once food is no longer being put on the table and a roof provided over a person's head, that person will not be supportive of further

"improvements". Finally, in a country which has always been very proud to have the resources to care for its own, it is now dependent on the countries against whom it fought so hard for many years. This is a difficult blow to the pride of a country. Russians want to improve and to allow for the changes in order to improve, but perhaps not at the point of becoming so dependent on other nations for their own food supply.

Social Priorities

As farms are restructured, this restructuring brings with it many social questions. As U.S. companies often supply health insurance or other benefits, the state and collective farms have provided social structure far beyond any U.S. firm including housing, health care, education, home maintenance, fuel and utilities, transport, recreation, and price discounts on the purchase of some foods (Brooks and Lerman). The collectives have continued supplying these goods even as people leave the collective. Many of the private farmers are still living in houses provided by the collective and so far, the collectives have absorbed these losses. However, as more and more employees become competition to the collective, it not only becomes a question of whether the collectives will be willing to continue this, but for how long will they be able to afford this? These types of public goods could be turned over to the government to handle directly, but what about the majority of these services which do not fall under the "public good" envelope such as housing and utilities? Just as U.S. welfare recipients find it difficult to go back to work for minimum wage and a hard day's work in return for a loss of benefits and lower salary, so do these Soviet workers find it difficult to leave the security of the collective in search of high risk and an unknown future.

Is there some way, then, to transform these inefficient large collectives into useful and productive farms? Although livestock production is not succeeding on these collectives, grain yields are significantly higher than on private farms (Brooks and Lerman). Would it be possible with proper training of the managers that these farms could be run as a company? The manager would essentially be the CEO and the employees would be stock holders. The manager could even assign specific people to be in charge of obtaining the necessary inputs, locating the best buyers, and keeping the accounting records. Although, there may be people within the collectives who already have these job titles, this part of the management system would also need to be educated. Finally, the workers would need to start receiving pay on the basis of the quality of the work (production levels), not just the quantity or type of the work. This last step would probably be the most difficult to implement within the previously communist system, where everyone receives equal pay for the same type of work, but it would be a necessity for the system to work. As long as the number of collectives was high, there would not be a problem of monopolistic power. Also, larger inputs, such as machinery and start-up costs, would be easier to handle in the large companies versus very small private farms. With new technology and new management skills, even these large firms have the potential to become profitable.

If a change in management style and X-efficiency can make a recognizable difference in the quantity and quality of the output, then investors will recognize this as an industry that has learned to adapt and overcome the difficulties of the transformation into a market economy. Mukhetdinova wrote an article in the Russian and East European Finance and Trade Journal describing the horribly low amounts of investment being

undertaken in Russia. She recognizes that the unstable Russian economy is unattractive to investors at this point and that the Russian government has often been a cause for hesitation as well. Mukhetdinova states, "our country has to draw *above all* upon its own efforts and resources to extricate itself from its economic crisis (p. 96)." She then concludes, "Progress in economic reform in Russia will to a considerable degree be determined by the level of activity of foreign investors on its territory (p. 96)."

Chapter 5

Literature Review

The first group of articles contains the background or current situation. These articles will not be as analytically oriented as the later ones. It is of primary importance that an analyst understands the background and overall situation before one pursues a data analysis. This is especially true in the Soviet system since it has been in a period of transformation for the last decade. Most research that has been done in the area of development has focused on the "third-world". It has only been in the last ten years in which serious thought has been given to the conversion of a second-world (communist) country into a market economy. The transition economies are unique because there are different variables involved. For example, education is not an issue as the literacy rate in the centrally-planned economies is very high. Social issues such as equality of women in the work-place are also not much of a factor. For although women may not be seen as complete equals, education is at similar levels for both genders and acceptance of women in the workplace is the norm. Population growth is also not a problem as most of the Russians averaged two children per family. Technology may not be near the levels in the United States, but it is far above that in most third-world countries and the potential for improvement of the technology exists. What will be a greater issue than in most third-world countries is the reorganization of land and management. The communist system has been drilled into at least two or three generations which make thoughts of private ownership, incentives, and profits unknown.

The second section deals with the data analysis articles. These are regression models which are used in forecasting and assisting poultry analysis and will be used to assist in building models for the Russian poultry industry. The models are based on U.S. poultry data and, therefore, it will be interesting to compare and contrast the areas within the model which can be used or must be modified to fit the Russian poultry industry.

The third and final section addresses solution possibilities. Although many suggestions often are made in development, very few have been made addressing the transformation from a centrally-planned society to a market system. These articles offer potential solutions which could be used in the Russian situation. Three types of assistance are considered for the Russian poultry industry. They include Russian government assistance, internal restructuring of the industry, and assistance from other countries through investment. These articles will be analyzed in order to correctly assess which solutions are real potentials for growth in the Russian poultry industry.

Background or Current Situation

Articles in the background section are split into three primary areas: poultry trade in the world, consumption and production of poultry within Russia, and the restructuring process. The poultry trade section is substantial because it reveals both the level of poultry trade in the world and the extent to which Russia is a player on the world market. Internal consumption and production difficulties reveal why Russia has become a major participant in poultry trade and also begins to reveal the basis for such a study. The final section on the restructuring shows the progress which the Russian system has made in this transformation towards a market economy.

Poultry Trade

The World Poultry Industry by Richard Henry and Graeme Rothwell is published by the International Finance Corporation of the World Bank. It is a study of world poultry trends, including trade, consumption and production around the world. This publication is a solid standard by which to compare Russian trade, consumption, and production.

The article in *Poultry International* titled "World Broilermeat Trade Goes on Growing" looks at the expansion in world broilermeat trade. It includes a table of the top broiler exporters and importers. This article primarily outlines the areas where poultry trade has increased and the areas where it has decreased. The article is very proficient at giving an overall description of the flow of trade especially from the United States. It gives statistical numbers and percentages to lend credence to an analysis of the Russian poultry industry. Analysis made in the United States is considered more relevant if it can be shown to be applicable to American interests. The large increase of American poultry exports to Russia indicates that the Russian poultry industry is of primary interest to the U.S. poultry industry. Russia has become one of our largest export markets and what happens internally in the Russian poultry production will affect our trade. "World Broilermeat Trade" glances at the usage of the Export Enhancement Program (EEP) in its assistance for U.S. exports of poultry. However, there is little analysis done by *Poultry International*. It would have been useful if they had been able to cite some of the work done in this field, but this was not the article's primary objective.

David Young's article, "U.S. Broilers Find New Markets As Exports Continue to Set Records" is similar to the article above featured in *Poultry International*. Young

wrote the article for the *AgExporter*, so it leans toward the same audience. The article examines U.S. trade patterns, the areas of growth, and future markets. The USSR is seen as a large potential market as the first serious requests are made for poultry from the United States. This article more closely examines why the Soviet government had begun to request poultry from the United States. These purchases were made from state import agencies with no USDA credit guarantees, nor were they under the EEP. The Soviet government has decided that it is important to improve the food supply and increase poultry consumption, especially during such a time of turmoil (the dissolution of the Soviet system). Increasing the food supply is seen as a step to ease the pain of the Russian consumer and citizen as the government attempts to transform itself from the bureaucratic nightmare of the communist system into a market economy. U.S. produced leg quarters have been well received and the product is recognized as an excellent meat value for the price. An additional benefit is that U.S. leg quarters can be bought at a cheaper price than whole broilers from France or the European Community. This article shows how important U.S. exports of poultry will be to Russia and, therefore, how the American poultry industry will prosper from this extended, untapped market.

The articles by Christian Foster ("Russian Meat Imports Surge as Consumption Outpaces Domestic Output") and Sharon Sheffield and William Liefert ("FSU Trade Policies: Import Controls Increasing") are both from the May 1995 issue of *Former USSR, Situation and Outlook Series* by the Economic Research Service of the USDA. These articles are applicable in the background portion of the research as they concentrate specifically on Russia and the Former Soviet Union. The Economic Research Service analyzes economic, social, and political changes and how they are currently affecting and

will continue to affect future growth in different sectors within the Former Soviet Union. Christian Foster addresses the fallen animal productivity which has created higher demand for imports. The Former Soviet Union livestock inventories and output are continuing to fall due to less State support, worsening terms of trade, and increased competition from imports. He explains that although animal productivity in the private sector is higher than in the state farms, only slight improvements have been made per animal. In addition, the private sector holds livestock primarily for subsistence and therefore, cannot absorb the extra demand from such a fall in supply. He discusses the tariffs which were levied on meat products, but leaves much of this analysis up to Sheffield and Liefert.

Sheffield and Liefert view the trend that the primary republics from the Former Soviet Union began to restrict agricultural imports while significantly reducing controls on agricultural exports in 1994. They explain that although this trend involves economic costs, it shows that the reform towards a market system is working. As farms compete on the market for inputs and have more responsibility towards finding outlets for their outputs, they have begun to lobby the government for assistance in thwarting off foreign competition. Sheffield and Liefert expect that this move from export to import restrictions will continue as the reforms continue to put more stress on the farm sector. Obviously, this will have an effect on the U.S. ability to export to Russia.

Six *AgWorld Attache Reports* from the United States Department of Agriculture (USDA), Foreign Agricultural Service (FAS) were used. These were the Annual Poultry Reports for the Russian Federation in October of 1994, July of 1995, and August of 1996. In addition there were a Voluntary Reports issued in January of 1996, April of 1996, and June of 1996. The annual reports cover issues ranging from trade to production,

consumption, tariffs, and marketing. These reports are indispensable because they offer current data directly from Russia. In a country where things are changing so rapidly and laws can change monthly, it is important to have the most current data available.

The annual report from 1994 shows an increase in poultry imports of 62% in 1993 and an anticipated higher percentage for 1994. The United States is the top exporter of poultry to Russia, followed by countries in Western Europe, Poland, Hungary, and Argentina. Primarily, leg quarters are shipped to Russia due to the price competitiveness and Russians' taste preference. Russia had become the U.S.'s third biggest export market. The 1994 report listed the current tariff on poultry at 20%. It also provided details on which certificates had to accompany poultry if it was to be exported to Russia. These included a food safety certificate, a veterinary certificate, and the FSIS Certificate of Wholesomeness.

The 1995 report indicates massive imports of poultry at over 600% of the previous year. The USDA anticipates a slight decline in imports due to higher duties and overstocking of the food market but are forecast to rise again in 1996 due to insufficient supply of meat and increase in per capita personal income. The State is increasing its protective measure through higher tariffs and the implementation of a Hygiene Certificate in addition to those already required. Negative advertising has also been seen declaring that U.S. chicken leg quarters are not wholesome enough for Americans and contain harmful additives.

The 1996 voluntary reports are an update on a potential situation.' In the January report, it states that a petition has been submitted to Yeltsin urging him to provide support

to the Russian poultry industry or it will collapse by March-April 1996 as U.S. poultry meat exports to Russia continue to set records. The import volume is large, officially accounting for 1/3 of the Russian poultry supply and up to 75% of the poultry consumed in big cities. The State Duma will meet in mid-January where the Communists will push for support and protection for domestic producers. The April report announces that after increasing the tariff at the beginning of February to 30%, imports of American poultry were banned and then goes on to explain the reasons that were given by the Russian government. The ban was later lifted after talks at the highest levels, but it shows how valuable these reports are in trying to determine the primary production difficulties and how best to advise solutions so that the American poultry industry will know what to expect.

The 1996 Annual Report follows the continuing decline of the Russian poultry industry and the increase in imports of poultry from the United States. Imports are accounting for almost half of total Russian poultry meat supply. This was an increase of 65% in 1995 over 1994 figures. Quotas are listed as a possibility for 1997 and are accounted in all forecasts given by the attache. Poultry consumption appears to have stabilized. Productivity levels, prices and imports are placed in tables for usage by researchers. Tariffs are also listed with the exact types of poultry affected. This report will be valuable in gathering data and current levels of production.

Russian Poultry Production and Consumption

Edward Cook in his journal article "Soviet Agricultural Policies and the Feed-Livestock Sector" discusses both the consumption and production side of Soviet

agriculture. He addresses policies that were used during the early 1980's to attempt to stimulate the consumption of meat in the Soviet Union. He defines the elasticity of demand for meat at approximately 1 (ranging from .7 to .9 in some areas to over 1 in others). He also illustrates the production policies which were attempted including financial policies, organizational/management policies, and technical/input policies. He adds that costs will not decrease easily as production costs are high and there are few worker incentives. This journal article is relevant to this research because it gives an understanding of the policies that were being used and the Soviet attempts to account for inefficiencies. The major critique of this article is the lack of data analysis; the article is strictly descriptive.

In addition to examining the trade sector, Christian Foster also depicts the private production level of livestock. Foster points out that although private production has been more productive, it is not likely to expand to meet the Russian consumption. This counters arguments which state that all of the large collective and state farms should be broken down into private farms. Such arguments look strictly at the productivity level of the private farm versus the large farms and do not consider the maximum capacity of production on these private farms which are producing primarily for subsistence. Brooks' and Lerman's analysis with World Bank data supports Foster's view.

The USDA, FAS *AgWorld Attache Reports*, are also mentioned in the section of production and consumption because they are the primary source of information stating specific levels of production and consumption. They reveal retail prices, monthly and yearly price changes, and the costs of inputs. They are supposed to be relatively unbiased

reports simply stating the facts of the poultry industry at the time. These are a few of the sources of the data which will be used in the data analysis of the Russian poultry industry.

Russian Restructuring

In "Space, Agriculture, and Organization, Mancur Olson argues against large farms as efficient possibilities due to spatial intensity. Agriculture which is spread over a large area is difficult to manage. The time that it takes for a manager to inspect the fields and manage the staff would not allow for efficient supervision in contrast to an industrial firm. Industrial firms usually do not require a large amount of space. A small farm of 10 acres would house a huge industrial firm. Olson's theory of spatial intensity appears to hold true and would justify breaking up the large, inefficient farms from past-Soviet society. This can be used in contrast, however, to the modern poultry industry which is much closer in description to the industrial firm than an agricultural farm. Modern poultry farms are not space intensive and a different conclusion from the "survival theory" is relevant. Since the trend in the most efficient poultry farms has been to increase in size, the survival theory would conclude that the poultry industry produces large but efficient firms.

David Sedik ("Restructuring of Agriculture Continues in Russia, May Spread to Ukraine") looks at the comprehensive reforms which have occurred in fiscal, monetary, foreign trade, and price policies and the result on the restructuring of agricultural production, consumption, and trade. He explains that producers are now influenced by market forces and consumer preferences as never before. The effect has been a provision of higher quality food for the consumer and more private production and marketing of

food. Brooks' and Lerman's paper contradicts Sedik in some aspects because data collected directly from the farm managers indicates that market forces and consumer preferences are not yet having the effect which Sedik describes.

Karen Brooks and Zvi Lerman wrote a *World Bank Discussion Paper* on "Land Reform and Farm Restructuring in Russia" which takes a different angle on the restructuring. This paper focuses more on the actual land restructuring rather than all policies. However, it overlaps much of the time. The thing that sets this paper apart from the others is that it actually contains data which is gathered directly from surveys of the Russian farmers. The major disagreement that this paper would have with Sedik's is that it shows that although the farm managers think that almost all areas of livestock production is inefficient, they do not plan to do anything about it. This challenges the view by Sedik that market forces are finally influencing the producer. It demonstrates that people under a communist system for 70 years cannot be just forced into a market economy and expected to succeed. The idea of being able to make decisions without both government interference and assistance is a foreign concept and something that will need to be taught.

Data analysis for poultry

Lee Christensen in the article "Updating the ERS Broiler Cost and Returns Estimates", updates the model used for estimating costs and returns in the U.S. broiler industry. The variables which are used are production costs, feed costs, other live bird production costs, processing costs, distribution costs, total wholesale costs, market price, and net returns. The revisions were to reflect changes in key technical coefficients and

costs based on information from industry sources and an updating of definitions and computational procedures used in the model. This model creates a foundation upon which to prepare the Russian model since it reveals which variables are relevant in calculating costs and returns estimates under a market system. The estimates can then be used to answer questions regarding the general profitability of broiler production and in formulating the outlook for the industry. The major area of concern is that this model does not reflect any level of government involvement nor does it indicate if the costs are calculated using individual measures for labor, technology, etc. If all of the individual variables are used, then the degrees of freedom are way too low. If instead, only the primary variables as listed above are used (such as "other production costs"), then it is difficult to determine the exact amount of importance for the subsections within each , for example, of labor on the productivity.

John Goodwin, Sergio Madrigal, and James Martin published *Supply and Demand Responses in the U.S. Broiler Industry* with the objective of estimating the supply and demand responses for broilers in the United States over the past 15 years. They derive a model with good forecasting properties accounting for changes in technology, new product development, consumer taste preferences, etc. which have occurred on both sides of the market. The distributed lag model performed best with high levels of significance for all the explanatory variables and an R^2 which explains 94% of the variation of broiler production. The lagged model also allows for forecasting up to eight months in advance. An alternative model was almost as accurate and allowed for eleven months of forecasting. This model is significant for comparison analysis with Russia. The 15 years worth of variables is used because of the significant changes which have occured within

that time period. However, it creates a low number of degrees of freedom which is about the only critique of their method.

Henry and Rothwell's publication, The World Poultry Industry, defines the technical productivity index by which countries can be compared. The major critique of the index is that it is only measuring one instant in time which can fluctuate over the years. However, the index does give a measurement which can be analyzed across country borders as it evaluates weight of the bird at slaughter, the time of a cycle from hatching to slaughter and the amount of feed for one unit of weight gain. If this were gathered for every year, detailed econometric analysis might be possible.

Possible Solutions in Aiding the Russian Poultry Industry

An all-encompassing solution or a "miracle cure" for the Russian poultry sector would be impossible to find. However, there are many ideas for development that could assist the process towards a market economy. The Russian government might be able to provide some assistance, although many problems from the Soviet farming system were created by an overpowering government. Internal production has already begun some changes as the restructuring unfolds, but there may still be areas of improvement and guidance. Finally, the outside world might aid in the transition. All of these areas need to be analyzed in order to offer the best advice and assistance possible.

Government Role in Assisting the Process

Graham Hallett's book The Economics of Agricultural Policy, serves as a good basic reference on agricultural policy. Hallett describes the fundamentals of policy and

how policies affect supply, demand, and trade. Written in 1968, many of the examples and references which he uses are not surprisingly very relevant today. Examining agricultural policy in all areas of the world, Hallett relates effects to almost every system and outlines the pros and cons of internal and trade policies.

Vanek's article "Tariffs, Economic Welfare, and Development Potential" explores the usage of a tariff to raise revenues for a country. Having taken the position of a small importing (price-taking) country and that the country has no other way to raise revenues outside of a tariff, he analyzes the social gains and losses from a tariff and decides in favor of the tariff as the investment provided will give additional gains in future years. He is viewing the importance of investment in the development of the country and that internal taxing systems can often not support that investment. The level of the optimum tariff depends on the rate of social time preference, the elasticity of demand for imports, and on the incremental capital-output ratio which leads into James Feehan's article, "The Optimal Revenue Tariff for Public Input Provision." Feehan uses Vanek's article as the basis for this theory and then argues for the use of the tariff towards public input provision such as creating roads. He believes that the government provision of such a public input is more efficient than if the private sector were to provide such a good. This can be adapted to the Russian situation easily. First of all, the Russian producers are insisting upon a tariff to "save" the poultry industry. Applying the tariff eases the pressure upon the government. In addition, the tariff raises revenue for the infrastructure. Providing better infrastructure assists all industries in these areas and all firms within the poultry industry without singling out one firm over another. The firms within the industry will still have to minimize costs in order to compete. My primary concern with Feehan's application of a tariff to the

provision of a public input is that the consumers of one specific item (such as poultry) will be paying for the public input (such as roads) which will be used by everyone. However, this is one possible solution that must be explored in the assistance of Russian poultry production.

A. M. Thompson's *FAO Economic and Social Development Paper*, "Institutional Changes in Agricultural Product and Input Markets and Their Impact on Agricultural Performance" addresses the role of government in economic reform. Thompson outlines the theoretical framework of liberalization and then looks at specific examples within Africa. He reviews the role of government in the production of outputs and inputs, noting where governments may be able to assist and areas where government assistance will only make things worse. His guidelines for institutional reform are presented in the context of how the marketing system *actually* works instead of how it is *meant* to function and therefore, is of immense relevance to the study of Russian poultry industry reform. This paper is quite thorough, looking at basically all options and stating both pros and cons to each option. Thompson even gives guidelines for analysts when they must decide which reform options to utilize.

Internal production changes

Dr. Fred Benoff's article "Work with a Single Supplier" discusses Dr. W. Edwards Deming's statement that companies should end the practice of awarding business on price alone, but instead look to minimizing the total cost and work with a single supplier. Dr. Deming is a world-renowned authority on the subject of quality, productivity, and the competitive edge. Dr. Benoff expands on this theory and states that buying from multiple

sources which in theory, drives costs down and quality up, actually has the opposite effect. More suppliers create more variation and therefore, for producers to produce a consistent product, more effort must be used downstream to adjust for the variation in supply. In addition, a customer needs suppliers who are willing to learn about the problems associated with their products and who are on a path of continuous improvement. While it could be argued that Russia is not be ready to embark on this level of cooperation since producers are still working on getting their internal productivity up to standards, it may be exactly what is needed. Under Soviet rule, producers sold their goods directly back to the government who set the standards. Vertical integration, as discussed by Benoff, would require the processors to determine quality and quantity whereas before this was dictated by the government.

Klaus Deininger explores the possibility of collectives being transformed into cooperatives. In "Collective Agricultural Production: A Solution for Transition Economies", Deininger discusses the inefficiency of collectives and reasons why this form of farms often still remain, even after the country moves towards a market economy. He understands the feeling that collectives are less risky as they do not have to survive in the market economy as individuals, but explains that inefficiencies exist in the collectives due to the lack of incentives and that any type of production cooperative is very inadequate. Non-production cooperatives would allow a combined effort between several farms in the input market and also in processing and marketing beyond the actual production. It would allow for less risk, but would allow for the efficiency of market economies within production. This is a logical approach to the transition from collective farms and must be considered beneficial to Russian farms. The question which evolves is why Deininger does

not discuss the possibility of the collective farm being transformed into a firm with shareholders as the workers. He mentions a similar type of system, but never compares its advantages or disadvantages to either the collective or the cooperative. Statistical calculation of the loss in each of these systems would have been useful.

"Allocative Efficiency vs. 'X-Efficiency'" by Harvey Leibenstein examines studies which find only a small amount of loss due to allocative inefficiency and instead points to an X-efficiency model in which labor productivity can be increased which increases output and efficiency by large percentages without any other additional inputs such as capital or technology. A study needs to be done in the Russian transformation because these farms do not have the money nor the investment potential for increasing capital or technology at this time. Concentrating on management and labor organization appears to be an area where significant improvements can be made. Leibenstein concludes that in addition to X-efficiency being very significant, the assumption that all firms are cost minimizing is not valid and that most firms produce well below the production possibility frontier. Since Soviet firms have never had to minimize costs, this could be a significant initial step. A critique of Leibenstein's article is that it doesn't show which steps or adjustments produced the highest level of productivity changes. More attention should be given to the specifics within the X-efficiency model so that the theory can be converted into practical applications which can be given to industries.

External Assistance Through Investment

N.M. Mukhetdinova writes an accurate and fair analysis of the foreign investment situation in her article "Foreign Investment in Russia". She looks at the hesitancy of

foreign investors to invest in Russia, and does not blame the investors, but instead looks at government policies or lack, thereof, which have placed a higher level of risk on any investment. Knowing that Russia is in desperate need of foreign investment, she explains exactly what the Russian government should be doing to encourage this and which laws need to be changed. Stating, "economic reform in Russia will to a considerable degree be determined by the level of activity of foreign investors on its territory," she also believes that the incentive for this investment must begin within the Russian society. This article is very comprehensive and honest. The only critique is that she does not address the role of the mafia in Russian society. The mafia is very strong and wishes to control all levels of investment. As shown by the recent murder of an American businessman in Moscow, the mafia opposes any resistance to their complete control. Whereas protection from government intervention was the primary concern in the past, personal safety has become an investment risk which must be addressed in such times.

Articles within these three sections should provide a comprehensive overview of the Russian poultry situation and reasoning for a study which attempts to analyze production problems and offer solutions. The best way for the United States to assist an industry in another country is not to simply throw money at it, but to dissect it piece by piece. It is true that this is not the easiest way to lend a helping hand, but it is the most effective.

Chapter 6

Theory

The theory chapter is divided into three sections—production theory, productivity theory, and trade theory. The production theory section will focus on problems with the domestic supply of poultry as discussed in Chapter 2 and will define which factors are determining domestic poultry production in Russia. The productivity theory identifies inefficiencies in the production system. The trade theory section determines which factors are most significant to Russian imports of poultry.

Production Theory

The economic problems within the Russian poultry industry are significant. From inadequate feeding techniques and inefficient management skills to a lack of an institutional system with which to support the move towards market beliefs, the industry has been and will continue to be operating inefficiently for some time. It is important to evaluate the significance that different factors have on Russian poultry production in order to see where market theory has infiltrated the industry and which areas need improvement.

Theoretically, economists determine that supply is dependent on the cost of inputs and price of outputs. Profit maximization often is assumed to be the primary goal of production. Under the assumptions that the prices producers receive relay all one needs to know about consumer demand and that producers try to maximize profits while minimizing costs, one should be able to develop a regression function with domestic

production as a function of input costs and output prices (Pr = Pr(C, P)). Within this model, one assumes that the producer acts "as if" he has an empirical understanding of the marginal cost curve. However, Russian poultry production never depended on price under the Soviet regime. Therefore, it is unknown if Russian poultry producers are basing their current production decisions on costs and profits.

Labor may not be a factor which the poultry managers are rationally analyzing or they might be considering it a fixed cost. For example, in the United States labor is considered to be a variable cost. The Soviet system attempted to attain full employment for so long that production decisions which lower the employment level may not be fully considered by managers. Instead, they delay wages, delay payments to input suppliers, or refuse to pay the government taxes. Sometimes managers even increase production to maintain revenue levels (see Table 2). These are short-term solutions and many farms are beginning to realize this as they eventually go into bankruptcy. However, in the meantime, many firms operate at negative profitability levels for extended periods.

Determining the importance of price, cost, and profitability on supply decisions is significant. Production should be positively related to price. Assuming an upward sloping supply curve, as the prices received for poultry increase (all other factors remaining constant), production should increase. As the cost of inputs increases with all other factors constant, production should decline. This would indicate a negative relationship between input costs and production. Since costs and prices often move at the same time, but not necessarily in the same amounts, profitability should be considered. Maximizing

profits includes looking at both output prices and input costs. Production should be positively related to profitability since profit is the difference between revenue and cost.

Since it appears that Russian poultry farmers are not minimizing costs nor maximizing profits, it is not clear upon what Russian poultry managers are basing their production decisions. With only six years of yearly data, it would be impossible to properly estimate a time series model. As an alternative, one may attempt to locate correlations between elements of Russian poultry production to detect which variables may be determining production decisions. This approach would examine the possible correlation of consumption of poultry (total and per capita), imports of poultry, poultry inventory, retail price of poultry meat in both dollars and rubles, farmgate prices, exchange rates, inflation, feed supply, vitamin supplement supply, cost of production per weight gain, and profitability. In several years, it may be possible to collect enough data to estimate time series regressions.

Output Prices of Poultry

One of the signs of a market system is that it responds to price incentives. Where price equals marginal cost in a perfectly competitive market, prices should determine the quantity produced. Formerly in the Soviet Union, prices and quantities were set by the State, not by supply and demand. It is uncertain whether retail or farmgate prices have yet begun to influence the quantity supplied. The retail price of poultry in dollars and retail price of poultry in rubles are both analyzed in order to examine the correlation in more "real" terms so as to escape the possibility of inflation interacting with the correlation. Retail prices that are not correlated with production decisions may indicate inefficiencies

within the marketing and processing system. Farmgate prices are the prices that producers directly receive from processors. Through price correlations, economists may determine whether Russia is becoming more dependent upon market factors. Theoretically with an upward sloping supply curve, as the price received by the producer increases, production should be increasing as well. The supposition is that the industry has not become more dependent on prices for supply decisions. Therefore, the correlation matrix will determine if prices have in fact become significantly related to supply. Imports have an inverse effect on prices since a higher quantity of poultry imports should cause retail price to fall. If the domestic poultry industry is producing at inefficient levels, the lower retail price could cause a drop in production. Profitability should be positively correlated so that as poultry production becomes more profitable, more poultry is produced. Profitability accounts for both the output prices and the costs of production. In the World Bank study (1994) by Brooks and Lerman, most Russian farm managers, although admitting that poultry production was not profitable, did not intend to reduce the quantity produced. Survey results like this cause researchers to wonder whether production decisions are being based on either price or profitability.

Input Costs of Poultry Production

Feed and vitamin supply should be positively related to poultry production. As the feed and vitamin supplies decrease, the cost increases. As the cost of production increases, production should decrease. Since it is unknown if the pricing system is functioning efficiently, both input supply and price should be considered. As feed costs

rise, inventories should fall and the slaughter amounts (production) should eventually fall as well. However, an initial a drop in inventories could indicate a rise in slaughter until inventories are at a profitable level. Profitability accounts for the change in costs as well as revenues. Inflation affects profitability because prices of inputs and outputs rise so that interpretation of prices becomes more difficult. The prices of inputs and outputs may not rise at the same rate either. Finally, construction of new facilities (signifying investments into the industry) would increase production.

Demand for Poultry

Total consumption and per capita consumption of poultry should be positively related to poultry production. As consumption increases, poultry prices rise and production should increase as well. If the market is working properly, increased consumption should correspond with prices. As a producer sees a higher output price, additional profits should stimulate production. Under the Soviet system, consumption and production were not related by prices, only by government dictates. The government determined what the level of consumption should be and then demanded that those quotas be met by the industry. The government subsidized both the production side and the consumption side (at great expense). Increases in real GDP should induce higher consumption, particularly of meat products. The opposite scenario would imply that poultry in Russia is considered an inferior product in comparison with beef or pork and a higher GDP would induce a shift from poultry to beef or pork.

Productivity Theory

Technology in the sense of high-tech machinery may be useful in poultry processing, but it is not necessary in poultry production. Instead, more relevant indicators such as technical performance can be used which capture how advanced the industry is in areas such as feed applicability and productivity. An indicator of technical performance is the productivity index which is used in the International Finance Corporation (IFC) report, The World Poultry Industry (Henry and Rothwell, 1995). The index equation is as follows:

$$\frac{\text{(liveweight)(10,000)}}{\text{(feed conversion ratio)(days of age)}} \qquad (1)$$

The results of the IFC findings for many countries will be compared with the data for Russia in the following chapter to illustrate how Russian productivity compares with other countries of the world. The higher the index, the better since liveweight at the time of slaughter should be as high as possible while the feed conversion ratio and the days of age should be as low as possible. Each of these statistics individually provides an indication of productivity levels. For example, higher slaughter liveweights show that the feed is of high quality. Low feed conversion ratios mean that a relatively small amount of feed is needed to add one unit of weight to the bird. Finally, fewer days to slaughter indicates a short cycle from the hatching of the bird to slaughter weight which in turn means less feeding days. Low productivity is an indication of poor management, lack of knowledge, and/or low quality feed which leads to lower profitability levels.

Import Demand Theory

A trade model for Russian imports of U.S. poultry meat may assist U.S. producers to identify factors will affect future export potential. Such a model would include some or all of the following variables: real unit value, tariffs, real exchange rate, domestic production levels, consumption, real GDP, and total trade balance.

The real unit value is the price of U.S. poultry meat in dollars per metric ton adjusted for inflation using the U.S. consumer price index. As the unit value of poultry imports from the United States increases, the quantity of imports should decline assuming quality remains the same.

The existence of tariffs should also induce a drop in imports as it causes the price to rise. Beginning in July 1994, tariffs were levied at 15% of declared cost. By May 1996, they had increased to 30%. To determine the effect that the tariffs had on poultry imports from the United States, a dummy variable for the tariff could represent the time period during which tariffs were levied on poultry imports.

Theory predicts that the real exchange rate valued in rubles per dollar should be negatively related to imports since a rise in the exchange rate is a depreciation of the ruble. As the ruble depreciates in real terms, imports become more expensive and the quantity of imports demanded decreases. The real exchange rate is the exchange rate adjusted for inflation.

Domestic production levels are not reported for poultry on a monthly time period in Russia. Therefore, an index of agricultural output is used to represent the overall trends among agricultural production variables. In general, the index of agricultural output

should be negatively related to imports since increases in agricultural output could shift the domestic supply curve rightward and lessen the need for imports. If personal income and consumption were rising at the same time as domestic agricultural production, the demand curve would shift out and imports demanded might decrease, remain the same, or increase depending on the levels of the shifts.

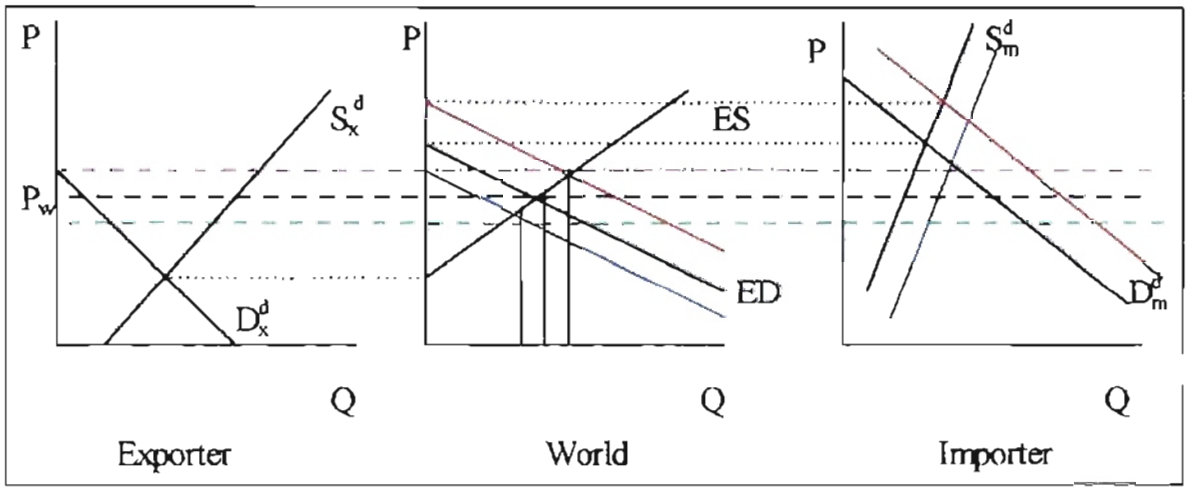
Increases in poultry consumption and real GDP should correspond with increased domestic poultry demand (a shift outward in the domestic demand curve) and stimulate increases in imports. The increase in domestic demand should cause price to rise, and if production decisions are based on price, then domestic production should increase as well. However, even if production is based on price, it may take time to expand production to take advantage of the higher prices. Imports can be increased rather quickly if suppliers are already available.

The total trade balance depicts an openness to trade and an ability to pay for imports. Since the total trade balance consists of the net difference between exports and imports, a decrease in the total trade balance would signify an increase in imports or a decrease in exports.

A time trend (which generally measures technological advances or increases in productivity not accountable by other variables) is not practical since only four years are used. The time trend can be tested, but if multicollinearity is prevalent, it can be eliminated because this would indicate that any changes accounted for by the time trend are already accounted for by other variables.

The three-panel diagram (see Figure 9) can be used to illustrate any shift in the excess demand curve due to changes in the importing country's domestic supply and demand. In this model, both countries have the ability to affect world price because they are "large countries." The term "large" means that these countries supply or demand enough poultry on the world market that an increase or decrease in supply or demand can affect world price. This would be proper for the poultry trade between the United States and Russia.

Figure 9, Three Panel Diagram of Two Large Countries Trading on the World Market[4]



Regression equations may be estimated with the dependent variable of Russian imports of U S. poultry as a function of the independent variables of real unit value, tariffs, real exchange rate, domestic production levels, consumption, real GDP, and the total trade balance (IMPT = IMPT(RUV,DTF, RFX, IAO, RC, RGDP, TBT)). Total Russian imports of poultry from all sources might improve the import equation. However,

[4] For more in-depth discussion of movements within a three-panel diagram, see Agricultural Policies and World Markets by Alex F. McCalla and Timothy E. Josling.

locating accurate monthly data for total Russian poultry imports was not possible. U.S. exports to Russia comprise approximately 75% of all Russian imports of poultry and this percentage has been rising steadily. The remainder of Russian poultry imports are split among the Netherlands (9%), France (4.5%), and other countries. Therefore, import demand can be relatively accurately measured using only U.S. export data. This also makes it easier to apply suggestions for the U.S. poultry industry. Estimating a relevant import demand model will give U.S. exporters leverage in determining how the Russians will react to changes in one or more of these factors.

To conclude, the Russian poultry industry may not fit perfectly into our neoclassical models as economists make the assumption that farmers maximize profits and minimize costs. Russian farmers were not educated in a free market environment and may not understand many of the concepts which citizens in market-based economies take for granted. Researchers must look at reality and create models to explain the transition from a centrally planned to a market based economy in the former Soviet Union. In understanding what determines production, productivity, and import decisions, exporters in the United States will be able to watch for signs in the industry which will have the greatest impact on their export earnings in that market.

Chapter 7

Data and Methodology

The data analysis chapter follows the structural organization of the theory chapter by developing analysis for the three parts of the poultry situation in Russia. The production matrix attempts to define variables which are heavily correlated with Russian poultry production. The productivity index is utilized to illustrate the productivity level in Russia. The import demand model is developed to interpret the factors which determine imports of U.S. poultry. These three sets of models apply data to the existing theory.

Production Model

The production model consists of a correlation matrix. The correlation matrix will determine the factors correlated with production. It will reveal whether poultry producers are responding to input and output prices as would be expected in a market system.

To determine which variables are correlated with production, a correlation matrix was estimated through Shazam, an econometrics computer program. This calculation measures the correlation of each variable with all other variables, both independent and dependent. The column which corresponds with the dependent variable of production is the primary focus of the results.

Yearly variables were used since production of poultry in Russia is only reported on a yearly basis. This limits the correlation matrix to six observations (1990-1995) and for a few variables limits it to five (1991-1995). Therefore the first correlation matrix

contains only the variables with six observations and the second correlation matrix includes all of the variables using only five observations. The independent variables are in the following table:

Table 5, Definition of Production Variables

Variable	Definition	Observations
M	Total Russian Imports of poultry (1,000's birds)	6
C	Russian Consumption of Poultry(1,000's birds)	6
PCC	Per Capita Consumption of Poultry, Kg	6
INV	Inventory of Poultry (1,000 birds)	6
RP	Retail Price in Rubles/Kilo of Poultry Meat	6
FX	Average Exchange Rate (Rb/$)	6
DP	Retail Price of Poultry Meat in $/Kilo	6
I	Inflation	6
FEED	Production of Feed (1,000 MT)	6
VIT	Vitamin Supplies for Poultry Feed (1,000 MT)	6
CPWG	Cost of Production in Rubles Per 100kg of Weight Gain	6
PRF	Profitability Levels with Subsidies	6
FARMP	Farmgate Prices with Subsidies	6
RGDP	Real Gross Domestic Product	5
PMF	Price of Mixed Feeds per Metric Ton	5
FDP	Feed Price in Dollars	5
CNST	Construction of New Poultry Production Facilities	5

All of these variables were compared to the dependent variable, production of poultry (1,000's of birds), represented by "PR". Careful attention was paid to output prices of poultry (RP, DP, FARMP, PRF) and the cost or supply of inputs (FEED, VIT, CPWG, PMF, FDP, CNST) as these are often significant determinants of production in a market system. Several measurements of output prices and input costs are used in order to determine which indicators poultry producers are using to base their production decisions. If the pricing and marketing systems are working efficiently, then most of the output factors should be equally correlated to production (it should not matter if one is analyzing

retail or farmgate price, dollar or ruble price). Similarly, the input factors should also be equally correlated to production. Since the efficiency of the system is unknown, all of the variables are attempted.

Correlations can range from -1 to 1 with zero indicating no correlation between the variables and one or negative one indicating perfect correlation. Any number above zero and below one indicates a positive correlation between the variables. As one variable rises, the other variable rises as well. Any number below zero but above negative one indicates a negative relationship. As one variable rises, the other falls. The general hypotheses supported by theory are that prices of poultry and profitability of producing poultry should be positively correlated with production. Costs of inputs and production should be negatively correlated to production and input supply should be positively related to production.

Productivity Index

The productivity index is a technical measurement of the level of productivity within Russia which can be compared to other areas of the world including both market-based economies and economies in transition. The International Finance Corporation of the World Bank published "The World Poultry Industry" in 1995 (Henry and Rothwell) which compared eleven countries but did not include Russia. The index equation utilized in this source is as follows:

$$\frac{(\text{liveweight})(10{,}000)}{(\text{feed conversion ratio})(\text{days of age})} \qquad (2).$$

The attache report for August 1996 (USDA) reports the following numbers for the most common breed for broiler meat ("Smena") in 1994:

((2.27 kg)(10,000))/((1.99)(49 days))=232.7. (3)

The genetic potential of this breed is fairly high. These numbers, if correct, place Russian productivity at the same levels as the United States and the Netherlands. However, other attache reports reveal different numbers. The attache report for July 1995 (USDA) states "Russian poultry producers do not produce the 3rd type of poultry [greater than 2,000 grams] at all (p. 16)." In addition the attache report for January 1996 (USDA) reports conversion rates of 4-4.5 kilograms/kilo and that maturity time for poultry is longer than the United States because of the cold weather and poor quality feed. The IFC report confirms that there are inefficiencies at all levels of the Russian poultry production process. Given the less efficient statistics, the index can be re-estimated as the following:

((1.99 kg)(10,000))/((4)(60 days))=83 (4)

This was calculated using the new information which causes the index to fall below even Poland's index levels. Henry and Rothwell state, "The genetic potential for broiler production under ideal conditions can be estimated from the claims of the breeding companies. An example is the standard (sic) published by Arbor Acres, which claims the following:

Liveweight	2.57 kgs
Feed conversion ratio	1.91
Age at slaughter	49 days
Index value	274.6

(p. 33)." A sample from the IFC chart is given below including the new Russian statistics:

Table 6, Poultry Productivity Indexes as Reported by the World Bank with the Addition of Russia Calculated from Data in Attache Reports

	Russia *1994*	U.S. *1994*	China *1994*	Hungary *1994*	Brazil *1993*	France *1993*	Netherlands *1993*	Poland *1993*
FCR	4	2	2.3	2.3	2	2	1.9	2.4
Weight	1.9	1.9	2.6	1.9	1.9	1.9	1.8	1.8
Age	60	42	56	46	41.9	43	42	49
Index	83	230	201	182	227	225	232	153

FCR = Feed Conversion Ratio
Weight = Liveweight in kilograms
Age = Days of age at slaughter
Index = Index value
Source: Henry, Richard and Graeme Rothwell. The World Poultry Industry. IFC Global Agribusiness Series. The World Bank, Washington, DC, 1995.

Henry and Rothwell caution against comparing cost differences because "costs of production capture relative costs at a specific time (p. 30)." In addition, one dollar of cost per kilogram may be relatively minor in the United States. However, the same amount is a major expense in Russia when converted to rubles using standard exchange rates.

Import Demand Model

Ordinary Least Squares (OLS) is used for all of the regression models. This estimator estimates parameters by minimizing the sum of squared errors. It is considered "BLUE", the best linear unbiased estimator. OLS makes several assumptions in order to maintain these properties. The dependent variable can be written as a linear function of the independent variables and an error term. The error terms must have a mean of zero, a constant variance, and be independent of each other (zero covariance). The independent variables should not have exact linear relationships and there must be more observations than independent variables. They must also have a zero covariance with the error term. Based on these assumptions, OLS will be used to run all regressions. Peter Kennedy

defines a regression, "The process whereby the OLS estimator is applied to the data at hand is usually referred to by the terminology 'running a regression'. The dependent variable (the 'regressand') is said to be 'regressed' on the independent variables (the 'regressors') to produce the OLS estimates. This terminology comes from a pioneering empirical study in which it was found that the mean height of children born of parents of a given height tends to 'regress' or move toward the population average height (p. 45)."

Four regression models of Russian import demand were estimated, including two linear models and two log-log models. The linear models measure the magnitude of the coefficient and measure the change in the dependent variable resulting from a change in the independent variable. The log-log models are used to estimate coefficients of elasticity (the percentage change in the dependent variable with a one percent change in the independent variable). All models were run with Russian imports of poultry from the United States (IPMT) as the dependent variable. A table for the variables used in the 1st and 3rd models (the first linear and the first log-log models) consisting of the definition, mean, standard deviation, and source is as follows (Table 7):

Table 7, Variables for Models 1 and 3

Name of variable	Explanation of variable	Mean	Standard Deviation	Source
IPMT	Imports of Poultry Meat from the United States (Metric Tons)	43094	30272	FATUS reports from ERS
RUV	Real Unit Value of Poultry Meat Imports in Dollars	600.4	350.88	FATUS reports from ERS and Bureau of Labor Statistics
RFX	Real Exchange Rate (Rubles/dollar)	120.31	76.796	"Russian Economic Trends"
DTF	Dummy variable for tariffs, 1 when tariff (beginning in July 1994), 0 when no tariff	.6087	.49344	Attache Reports by FAS
IAO	Index of Total Agricultural Output	107.74	12.261	"Russian Economic Trends"
RC	Real Total Consumption	100.72	7.5442	"Russian Economic Trends"
D1	Dummy variable for observation of February 1996			

This set of data consists of 46 monthly observations from January 1993-October 1996.

The second and fourth models (the second linear and log-log models) contain the following variables with 34 monthly observations from January of 1994 to October 1996 (Table 8):

Table 8, Variables for Models 2 and 4

Name of variable	Explanation of variable	Mean	Standard Deviation	Source
IPMT	Imports of poultry (Metric Tons)	54997	25385	FATUS reports from ERS
RUV	Real Unit Value	565.73	55.528	FATUS reports from ERS and Bureau of Labor Statistics
RFX	Real Exchange Rate	83.329	22.017	"Russian Economic Trends"
DTF	Dummy variable for tariffs, 1 when tariff, 0 when no tariff	.82353	.38695	Attache Reports by FAS
IAO	Index of Agricultural Output	102.07	8.0217	"Russian Economic Trends"
RC	Real Consumption	101.9	7.3365	"Russian Economic Trends"
D1	Dummy variable for observation of February 1996			
RGDP	Real GDP	99.574	7.4921	"Russian Economic Trends"
TBT	Total Trade Balance	1.6485	.54752	"Russian Economic Trends"

The first model estimates the following equation:

$$IPMT = B_0 + B_1RUV + B_2RFX + B_3DTF + B_4IAO + B_5RC + B_6D1 + e_t \qquad (5).$$

The second model estimates the following equation:

$$IPMT = B_0 + B_1RUV + B_2RFX + B_3DTF + B_4IAO + B_5RC + B_6D1 + B_7RGDP + B_8TBT + e_t \qquad (6).$$

The first log-log model uses the same observations and variables as the first linear model which generates a third equation:

$$lnIPMT = B_0 + B_1lnRUV + B_2lnRFX + B_3DTF + B_4lnIAO + B_5lnRC + B_6D1 + e_t \qquad (7).$$

Dummy variables are not logged in a log-log model since they define which observation(s) break from the standard. The second log-log model uses the same observations and variables as the second linear model generating a fourth equation to estimate:

$$lnIPMT = B_0 + B_1 lnRUV + B_2 lnRFX + B_3 DTF + B_4 lnIAO + B_5 lnRC + B_6 D1 + B_7 lnRGDP + B_8 lnTBT + e_t \quad (8).$$

Tests were run on each model to determine normality, structural change, heteroskedasticity, and autocorrelation. Normality is the assumption upon which all of the model tests depend. The normal probability density function is a symmetric bell-shaped curve centered at the mean with the variance spread out about the mean. Normality is tested by the omnibus test (D'Agostino-Pearson K^2 test) which tests for both skewness and kurtosis and the LM (Bera-Jarque test) and GF (Goodness of Fit) functions in Shazam. Structural change occurs when the model indicates that the market conditions have changed. Structural change is tested by the joint conditional mean test, the joint conditional variance test, and the Chow test. The existence of heteroskedasticity (when the error variance is not constant) is tested by the joint conditional variance test and the Het statistic in Shazam. The Het statistic identifies several individual tests including the "Harvey test" for heteroskedasticity. Autocorrelation (a violation of the assumption that the error terms from different observations are not correlated) is detected by the joint conditional means test and the Durbin-Watson statistic. The Durbin-Watson value around two indicates no autocorrelation and can range from zero to four. A statistic close to zero indicates positive autocorrelation and close to four indicates negative autocorrelation. The "ACF" function in Shazam also tests for autocorrelation.

A few additional variables were suggested and soon eliminated. Time trend and money supply were originally included as independent variables, but they created multicollinearity. The time trend was accounted for by the other independent variables and money supply was almost perfectly correlated with the real exchange rate. Therefore, these variables were deleted from the models, but tests for multicollinearity are left in the output (Appendix A). Since monthly data were used for the trade models, seasonal fluctuation was considered, but with the non-seasonal nature of poultry, additional variables accounting for this were unnecessary.

A dummy variable for the month of February 1996 is included to account for the suspension in signing of licenses for imports of American poultry. The suspension was signed on February 16, 1996 to go into effect on March 3, 1996 which caused the imports of U.S. poultry to double for February in preparation for the fall in March. Political figures from the United States and Russia came to an agreement in March which lifted the ban and imports began to rise again. The ban had several short-term repercussions as the demand for poultry increased so that people would have stocks at home and therefore, prices of poultry increased. In some areas, a price increases from 9,000 rubles to 28,000 rubles were reported. The dummy variable might logically be placed on March since that is the month of the ban. However, an agreement was settled early enough in March that although imports were lower for that month, the total did not deviate as far from the mean as the rise in February.

The null hypotheses presented are that the models are not correct and the independent variables presented are not significant (H_0: $B_1=0$, $B_2=0$, $B_3=0$, $B_4=0$, $B_5=0$,

and B_6=0 for models 1 and 3 and H_0: B_1=0, B_2=0, B_3=0, B_4=0, B_5=0, B_6=0, B_7=0, and B_8=0 for models 2 and 4). The alternative hypothesis is that the model is correctly identified (H_A: one of the B's is not equal to zero). Theory states that real unit value, real foreign exchange rate, tariffs, and the index of agricultural output (domestic production) should be negatively related to imports. Therefore, the opposite is tested which is that the coefficients of each of these variables should be greater than or equal to zero (H_0: $B_1 \geq 0$; H_0: $B_2 \geq 0$; H_0: $B_3 \geq 0$; H_0: $B_4 \geq 0$) and the alternative hypotheses would be that these are less than zero (H_A: $B_1 < 0$; H_A: $B_2 < 0$; H_A: $B_3 < 0$; H_A: $B_4 < 0$). Real consumption should be positively related to imports, so the null hypothesis is that the coefficient for consumption is less than or equal to zero (H_0: $B_5 \leq 0$) and the alternative hypothesis is that the coefficient for real consumption is greater than zero (H_0: $B_5 > 0$). For the second and fourth models, additional hypotheses are made that real GDP should be positively related to imports and the total trade balance should be negatively related to imports (H_0: $B_7 \leq 0$; H_0: $B_8 \geq 0$ and H_A: $B_7 > 0$; H_A: $B_8 < 0$). To test for the individual hypotheses, it is necessary to test the opposite of the theory and if rejected, then accept the alternative hypothesis.

Chapter 8

Empirical Results

The results of the production correlation matrix, the productivity index, and the import demand models are reported in this chapter.

Production Model

The results of the correlation matrix are as follows (Table 9):

Table 9, Correlation Matrix of Variables Against Russian Poultry Production

Variables	Production*	Number of Observations
M	-.58189	6
C	.63328	6
PCC	.30104	6
INV	**.93177***	6
RP	**-.88364***	6
FX	**-.89551***	6
DP	**-.86697***	6
I	-.02841	6
FEED	**.98402***	6
VIT	**.77084***	6
CPWG	**-.83340***	6
PRF	**.93510***	6
FARMP	**-.83697***	6
PMF	**-.86014***	5
FDP	**-.94123***	5
CNST	**.95387***	5
RGDP	-.58585	5

*Values that are heavily correlated with production.

All output prices, both retail and farmgate were heavily correlated with production. The retail price of poultry in rubles/kilo (RP) was negatively correlated with production. Even the retail price in dollars (DP) which accounts for the depreciation of the ruble during the

time period, was negatively related to production. Farmgate prices (FARMP) (the prices which the producers actually receive instead of retail prices) was negatively related as well. In addition, these variables were all correlated by approximately the same amounts as would be expected under a market system. However, under a market system, positive correlation would be expected with the output prices. Profitability was the only output variable which was heavily positively related. The reasoning for this is that if the prices of inputs are rising faster than the prices of the outputs, then profitability would be negative (revenue - costs) and production should decline in correspondence with profitability, instead of increasing just because of the increase in output prices. This is important because the significant correlation (.935) illustrates that producers are making production decisions based on profitability and that it is positively related so as profitability declines, the production is declining as well.

Input supplies and costs were heavily correlated with poultry production. Feed production (FEED) and vitamin supplies (VIT) were positively correlated with production of poultry. The cost of production in rubles per 100 kg of weight gain (CPWG) was negatively correlated. The price of mixed feeds (PMF) and the dollar price of feed (FDP) were negatively correlated. The price of mixed feeds and cost of production per 100 kg of weight gain are similarly correlated to production. The dollar price of feed is more heavily correlated with production, but is accounting for some inflation and depreciation of the ruble. Finally, construction of new facilities (CNST) was positively correlated. This illustrates that as supplies decrease and costs increase, poultry producers are decreasing production as would be expected under a market-based system.

Except for inventory of poultry and the exchange rate, which were heavily correlated with production, all other variables were not significant. Inventory was positively related so as inventory declines, production declines. The exchange rate, theoretically, should not be as important as inflation in domestic production, but was strongly and negatively related. Inflation on the other hand, was not strongly related to production even though it is an indication of the rise in prices. The strength of the correlation could indicate that the Russians are using the exchange rate with the dollar as a measurement of inflation instead of the actual inflation rate. Inflation can be more difficult to measure and not reported as often as the exchange rate which is reported daily. So as the exchange rate rises and the ruble depreciates, production is decreasing. Imports, consumption, and inflation had the theoretically anticipated signs (negative, positive, and negative, respectively), but were not as correlated with production as the previous factors. Real GDP was negatively related to production, but not heavily correlated.

The production matrix is important because it illustrates that pricing and profitability decisions are becoming important to poultry producers. Contrary to the World Bank surveys, producers are now considering profitability in their production decisions.

Productivity Index

The comparison of Russia's productivity index with the indexes of other countries (Table 6), illustrates that Russia is still below average in the area of technical efficiency. This could be due in part to managerial decisions to reduce costs by limiting vitamins and additives to feed. Poor quality feed mixes may also be a factor. The attache report for

1995 reported that the Leningrad oblast substituted local feeds for feed from Finland and reported a 13-15% shorter poultry growing period. However, the higher cost of imported feed and location of many of the poultry factories do not allow for this to be a viable option. Other decisions such as poultry farm lighting, temperature control, and housing could be reducing efficiency. The lower index could also be due to genetic factors. Although some of the broiler breeds may have high genetic potential, the most common breeds of poultry which are being used in Russia may not have the potential for quick weight gain that other breeds may exhibit. Training of managers and new breeding stocks could overcome many of the problems revealed in the productivity index.

Import Demand Model

The linear model coefficients (the first two models) reveal magnitude of the effect of the independent variables on the dependent variable and the log-log models (the second two models) reveal the elasticity. The results of the four trade models are summarized in the following table:

Table 10, Regression Coefficients and Statistical Tests on Four Models of Russian Import Demand for U.S. Poultry, 1993-1996 and 1994-1996

	1st Model	2nd Model	3rd Model	4th Model
Obs.	**46**	**34**	**46**	**34**
Variables	Linear	Linear	Log-log	Log-log
RUV	**3.896***	65.475	**-2.7044***	.14025
RFX	**-203.41***	**-532.1***	**-3.9209***	**-.97056***
DTF	**27684***	**33947***	-.10347	**.67272***
IAO	242.52	411.26	**3.0466***	.82765
RC	-83.971	379.66	1.878	.29054
D1	**61088***	**50139***	.26596	**.54265***
RGDP		-314.77		-.30245
TBT		**-13917***		**-.22902***
Constant	29376	6487.4	**22.397***	**9.9245***
Tests				
R2	0.7739	0.7614	0.8554	0.6791
R2A	0.7391	0.6851	0.8332	0.5764
F	22.249	9.973	38.453	6.614
DW	1.2458	1.7426	1.5793	1.5448
GF w/1DF	9.9358	4.2035	25.5783	9.2741
LM w/2DF	2.2682	0.3647	23.436	27.3391
Omnibus	3.0895	3.2502	7.147	16.776
JCMT	NS	NS	NS	NS
JCVT	NS	NS	S	NS

Codes

RUV=Real Unit Value

RFX=Real Foreign Exchange Rate

DTF=Dummy Tariff

IAO=Index of Ag Output

RC= Real Consumption

RGDP=Real GDP

TBT=Total Trade Balance

NS = Not significant

GF=Goodness of Fit with 1 degree of freedom

LM=Lagrange Multiplier with 2 degrees of freedom

Omnibus=Omnibus Test

JCMT=Joint Conditional Mean Test

JCVT=Joint Conditional Variance Test

F=F test

R2=R-squared

R2A = R-squared adjusted

S = Significant

*Variables that were significant at the 10% level or higher.

All four models are statistically significant with relatively high R2 values. The two models with 46 observations generated higher F-test statistics. All of the models showed signs of heteroskedasticity, so the "HetCov" option in Shazam was used to correct for the heteroskedasticity.

Real consumption was not significant in any of the models. Real consumption was an aggregate variable of total consumption not specific to meat products or poultry, so total consumption of food products could be falling in monetary value while poultry consumption could be increasing or vice versa. Total consumption might be rising but faster than poultry consumption is rising. Any of these theories would allow for poultry consumption to possibly have an effect on imports while real (total) consumption would not. In addition, the Soviet history may account for an insignificance of consumption levels on imports. Under the Soviet regime, the government decided how much the consumer should be consuming and dictated that to the producers. Some of the same mentality may still exist, in which case imports would be simply substituting for the fall in domestic production and not accounting for actual consumer wants.

Real Russian GDP was also not significant in either the second or the fourth models which can also be explained by the two reasons stated above. In addition to the aggregate measurement and government policy, as real GDP rises, consumption could be shifting from poultry to beef or pork which have been more expensive than poultry. Russians have always been known for their consumption of sausage, but with lower incomes, they may have temporarily switched to poultry to complement their diets.

The real foreign exchange rate was negative and significant at the 5% level for all models. This variable is important because it accounts for money supply, inflation, and ability to pay for imports. Negative is the anticipated sign since as the real exchange rate rises (Rb/$), the ruble is actually depreciating which makes imports more expensive. Finally, the total trade balance was negative and significant in the two models where it was

tested. This is as expected because as the total trade balance decreases (or the deficit increases) this indicates a rise in imports.

Regression Model 1: A Linear Model of Russian Imports of U.S. Poultry

The first model was a linear regression with 46 monthly observations from January 1993 to October 1996. It contained the following independent variables: real unit value, real foreign exchange rate, a dummy variable for tariffs, the index of agricultural output, real consumption, and a dummy variable for February 1996. A constant term is also generated, but was not significant for the first linear model. The coefficients for the linear models determine the relative strength of the independent variable on the dependent variable.

Real foreign exchange rate was negative and significant at the 1% level. The coefficient of -203.41 means that as the real foreign exchange rate (the foreign exchange rate in rubles/dollar adjusted for inflation) increases by 1, imports decrease by 203.41 metric tons.

In the first model, real unit value is positive and significant at the 10% level but not at the 5% level. Real unit value is the actual price paid for each unit of poultry imports from the United States. As the real unit value rises, traditional economic theory would predict that imports should fall and be negatively related. However, the coefficient is 3.896 so as real unit value rises by $1, the Russian import demand for U.S. poultry rises by almost 4 metric tons.

The dummy variable for February 1996 is significant and the dummy tariff which signified the period during which tariffs were enacted was positive and significant at the

1% level. The coefficient is 27684 which would mean that the addition on a tariff caused a rise of 27684 metric tons of poultry imports. Normally, tariffs should be associated with a drop in trade. However, if domestic production has fallen to low enough levels, it is possible that tariffs are not slowing imports at all. The excess demand could be overriding the higher cost. Over time, as contacts are established within the trading community, trade becomes easier than before and tariffs may not slow the inflow. Finally, it has been reported that many "non-profit" organizations are importing poultry which may allow a loophole to avoid tariffs.

The two insignificant variables in the first model are IAO and RC. The index of agricultural output was positive but not significant to imports in the first model. Once again, the index of agricultural output is an aggregate number but even so, it would be estimated that it would be negative (as agricultural production increases, agricultural imports such as poultry should decrease). However, if poultry production is still declining while consumption stabilizes or increases, poultry imports would increase regardless of the trend in index of agricultural output. In addition, if the IAO ends up measuring the income of the agricultural community then an increase in imports could occur with the increase in income. Real consumption (RC) was negative, but not significant. The negative correlation seems contrary to theory because as real consumption falls, imports should fall. However, the fact that production is falling faster than consumption is falling indicates that the excess demand is increasing which increases imports.

Regression Model 2: The Linear Model with GDP and Trade Balance

The second linear model reduces the observations to 34 and adds two more variables (Real GDP and the Total Trade Balance). The dummy tariff variable continues to be positive and significant at the 1% level. The coefficient is 33947 which is even higher than the first model (which included 1993). The dummy variable for February 1996 is also significant

Real foreign exchange rate is negative and significant at the 1% level. The coefficient is -532.1 which indicates that a with a one ruble increase in the foreign exchange rate, the import demand for U.S. poultry falls by 532 metric tons.

Total trade balance (TBT) was negative and significant at the 5% level. The coefficient for total trade balance is -13917. This signifies that for every one unit drop in the total trade balance, Russian poultry imports from the United States is increasing by 13917 tons.

In the second model, real unit value is still positive, but no longer significant. Real consumption is positive although not significant. The index of agricultural output also continues to be positive and not significant. The constant is still not significant. Real GDP was negative but not significant.

Regression Model 3: A Log-log Model of Russian Imports of U.S. Poultry

The third model is the first log-log model and contains 46 observations. The coefficients now reveal the elasticities. For a 1% change in the independent variable, the dependent variable should change by the percentage of the coefficient. Real unit value

becomes negative as theory would predict and it becomes significant at the 1% level. The price elasticity (elasticity for RUV) is -2.7. This indicates that as price increases by 1%, imports are decreasing by 2.7% which is elastic.

Real foreign exchange rate is significant as in all the other models and the elasticity is -3.9 meaning that as the real foreign exchange rate rises by 1%, imports fall by almost 4%.

The index of agricultural output remains positive, but becomes significant at the 10% level. Its elasticity is 3.04. The constant is significant in both of the log-log models. All of the significant variables have high elasticities as well.

The dummy tariff does become negative in the log-log model as predicted by theory, but it is not significant. This is the only model where the dummy variable for February 1996 is not significant. Real consumption was positive but not significant as in all of the models.

Regression Model 4: The Log-log Model with GDP and Trade Balance

The final model is a log-log model with 34 observations and the two additional variables of real GDP and total trade balance. The dummy variable for tariffs reverts to a positive sign after the third model and is significant at the 1% level. The elasticity is .67272 so for the addition of tariffs, poultry imports from the U.S. increase by .67%. As stated before, the addition of tariffs to poultry may not be capable of slowing the rate of imports during this period of time. The dummy variable for February 1996 is significant and the constant term is significant.

Total trade balance is negative and significant at the 10% level. The coefficient is only -.22902 which indicates that for each percent decrease in the total trade balance, imports of poultry from the United States rise by .22 percent.

Real foreign exchange rate is still negative and significant at the 5% level. However, the coefficient of the real foreign exchange rate rises to a -1 from almost -4 in the third model. So with the elimination of the first twelve observations, the real foreign exchange rate has a 1:1 ratio with imports. As RFX rises by 1%, imports fall by 1%.

The elasticities of all of the independent variables other than the constant are between 1 and -1. This signifies that the elimination of the initial twelve observations from the third model and the addition of the two extra variables (RGDP and TBT) reduces the elasticities of almost all of the variables. The dependent variable has become less elastic which means that it will show less of a percentage change with a change in almost any of the independent variables.

The real unit value in the fourth model reverts to a positive sign after the third model and is no longer significant. Real GDP is negative but not significant. Real consumption is positive and not significant. The index of agricultural output remains positive but is not significant.

Tests of the Assumptions of the Model

As stated before, heteroskedasticity was detected by the Harvey test statistic and all models were corrected for heteroskedasticity with the HetCov command in Shazam. The Durbin-Watson test statistic tests for autocorrelation. The Durbin-Watson statistic can range from zero to four with the center at two. The closer the number is to two, the

better. Before the dummy variable for observation February 1996 was used, the statistic was very near two for all of the models. However, since that observation was such a heavy positive influence on the results, the elimination was necessary. Therefore, the DW statistic is lower than before, but still between one and two for all of the models and between 1.5 and 2 for three of the four models. This means that estimations are now appear positively biased. The GF, LM, and Omnibus tests all test for normality, but the Omnibus test is generally held with higher esteem due to its accuracy of detecting both skewness and kurtosis. Normality appears to hold in all of the models except the fourth (the log-log model with 34 observations). Structural change was detected by the Chow test using splitting the first 7 observations and the final 39 observations. The reason for this is that poultry trade was just beginning to occur between Russia and the western world in 1993. Therefore, the first observations are minor in comparison with later imports.

The significance levels stated (1%, 5%, 10%) are the percentage levels of rejecting the null hypothesis (accepting a variable as significant) when it should not be rejected (the variable is not significant). The smaller the percentage, the less chance of having this "Type I" error, but the greater chance of a Type II error (accepting the null hypothesis when it is incorrect). Cross-model testing is not attempted because of different time periods and linear forms. The F-test statistic is the primary test statistic when defining whether a model is significant. All four of the models are significant.

The primary implication of the trade models is that real foreign exchange rate which accounts for inflation and money supply is the overriding factor which determines

the level of poultry imports for Russia. However, all of the models are significant which means that all of the variables are necessary. The fact that total trade balance and real foreign exchange rates are both negative and significant is important. Poultry imports are rising as the total trade deficit grows. As a trade deficit grows, the currency in that country is usually expected to depreciate. By this model, a depreciation in the ruble (a rise in the foreign exchange rate) causes imports to fall. Therefore, these variables could be counteractive on each other. Finally, the second and fourth models are eliminating several observations which do not fit the model as well. The Chow Test determined that there was a structural break in the model after the first seven observations as imports increased dramatically at that point. Therefore, these two models may more closely represent the current state of import decisions.

The use of the three types of models: production, productivity, and import demand give a clearer picture as to the overall structure of the poultry industry than the individual models. Domestic production is essential in determining import demand and productivity levels affect production. One should not be analyzed without the consideration of the other.

Chapter 9

Conclusions and Recommendations for the Russian Poultry Industry

Conclusions

Despite surveys from the World Bank which indicate that poultry managers are not responding to price or profitability indicators, the tests reveal that poultry managers do respond to profitability since as profitability has decreased so has production. It is possible that this contradiction could simply be timing. Brooks and Lerman performed most of these surveys in 1993 (which was the beginning of Russian poultry imports from the United States), only three years after the break-up of the Soviet Union. The fact that it takes people time to adjust and learn could account for the fact that by 1996 it does appear that the poultry industry is responding to profitability. The production correlation matrix provided valuable information about the Russian transition into a market system. However, if monthly or quarterly data can be obtained a more complete domestic production equation can be evaluated.

The productivity index comparison reveals that Russian poultry productivity is well below other countries. This measurement should be done on a yearly or even quarterly basis to determine whether productivity is increasing or decreasing.

It can be concluded from the trade models that the price of poultry imports is important to the level of poultry imported into Russia. Real foreign exchange rates are also significant. This indicates that as long as the United States can maintain its low cost leadership in the world poultry industry, it will continue to hold the highest market share of Russian poultry imports. Also, continued depreciation of the ruble will hamper future export opportunities.

It appears significant that the United States begins to advertise in Russia to overcome preferences for pork and beef so that as income rises, the Russians will not substitute pork for poultry. The negative coefficient value for real GDP indicates that with a rise in GDP, adjusted for inflation, imports of poultry will fall. Further studies need to be evaluated on the substitutability of beef, pork, and poultry. However, the combination of advertising and price has contributed to the change in eating habits in the United States from beef to poultry and it should be beneficial in Russia. The Russians might purchase poultry now because it is cheaper, but might be convinced through advertising that it is better than beef and pork and therefore, they might keep more poultry in their diets even with an increase in income.

A way to compete with pork products would be through low cost processed poultry such as hot dogs and sausages. The combination of summer sausage and bread is a common snack or meal in Russia. Hot dogs and poultry sausages should be able to compete in this area as long as costs were competitive.

Investment through joint ventures could be profitable for U.S. poultry investors. With U.S. knowledge of the poultry industry and cheap Russian labor, poultry factories

could be renovated and made profitable. If feed and additives were available for import at competitive prices, poultry productivity would increase. Since U.S. poultry producers are largely vertically integrated, they might be able to furnish their Russian partners with feed at lower prices than might be available on the world market. In addition, the exposure in the import demand model from exchange rate fluctuations would be eliminated. Finally, the threat from tariffs would be reduced (if importing supplies, tariff factors could be considered, but if using domestic feeds, tariffs are no longer an issue).

One step further than a joint venture would be to completely begin a new subsidiary in the Russian poultry industry. The old poultry factories which were built in the United States in the 1950's which used high levels of labor and low levels of capital might be ideal for Russia at this time. Labor is cheap and managerial skills from the west could be beneficial. Russian poultry managers may be responding to profitability levels, but they contribute to the negative profitability through poor management skills. With complete control of the facility, U.S. expertise could not be ignored. The downside is that laws based on levels of international investment must be evaluated. In the early 1990's, joint ventures were just beginning and international firms were not allowed complete control of their company. Some of the laws have probably changed, but restrictions may still remain.

This study is limited by the use of aggregate data. Additional research should be done as more data becomes available on domestic poultry production and poultry consumption. In addition, price and consumption data for pork and beef are necessary to determine the cross price elasticities for poultry meat. More research needs to be done in

the area of Russian poultry and Russian agriculture in general as Russia attempts the transition into a market economy. Simultaneous equation methods might reveal even more useful suggestions as the information becomes available.

Suggestions for the Russian Poultry Industry

Management

Improvement of management skills appears to be a primary necessity. Training is probably one of the easiest and most beneficial solutions. Teaching managers how to evaluate cost is vital. Managers must understand that feed without nutrients is almost worthless. It would be more efficient to have smaller poultry farms (fewer birds) which are being fed nutritious feed with weight gains that could compete with imports than to feed all of the birds without weight gain. Such understanding would increase the productivity index as it would increase liveweight, decrease the feed conversion ratio, and decrease the number of days in the Russian poultry cycle. Employment skills must be taught and managers must determine how many employees each farm really needs. As explained by Leibenstein (1966), changes in management styles can make dramatic changes in labor productivity. The International Labor Organization (ILO) should be performing similar experiments in Russian agriculture.

Cooperatives or Investor-owned Farms

According to Deininger and most economists, production cooperatives, such as collectives, are very inefficient. However, cooperatives which assist in purchasing inputs

and output marketing can be beneficial and offer less risk to the cooperative members. In Brooks' and Lerman's' study, 95% of the respondents participated in "some form of joint activity in provision or use of farm services. Between 30 and 40 percent of farmers in the sample indicated that they join with other private farmers for production, marketing, input supply, use of machinery, and provision or receipt of credit. More than half the private farmers in the sample cooperate in their use of consulting services. Cooperation in processing, on the other hand, is virtually nonexistent at this stage (p. 82)." This shows that the desire for cooperation is there. Cooperatives can assist with this in a more formalized environment. Hallett supports cooperatives in agriculture and states, "In the absence of co-operative or statutory groupings a large number of competing farmers face a much smaller number of distributors, and may therefore be in a weak bargaining position (p. 24)." In Russia, the feed distributors are in a monopoly position and the processors are so few in number that they also operate with monopoly pricing. Poultry producers and especially those who privatize are at a higher risk of losing their share of the marketing margin. Vertical coordination has been adopted in many countries in the poultry industry to reduce costs and provide a standardized quality. Contracting and vertical integration will eventually be needed in Russia to compete with the levels of productivity which have been attained at the global level.

Optimal Tariff for Development

Since the regressions indicated that tariffs have not been able to decrease the rate of poultry imports into Russia, there is the possibility of using Vanek and Feehan's optimal tariff theory (1971 and 1992). Vanek and Feehan present the concept of an optimal tariff

to be used to raise revenues. The revenues from the tariff could be used towards public input provision such as creating roads or providing re-education to managers. If Russia used an import tariff for the purpose of improving public inputs (roads, transportation, electricity), then it would reduce production costs and allow poultry production to become competitive (by improving the marketing system for all). Feehan supports the theory that government provision of public inputs are more efficient than if the private sector were to provide such goods. Providing better infrastructure would assist the poultry industry and the firms within the industry would still have to minimize costs in order to compete. When analyzing Vanek's model for usage in the Russian poultry industry, several adjustments must be made. On the positive side, since Russia is one of the major poultry importers, it might be able to influence the world price, unlike the small country model which Vanek uses in which price is given. In this case, the incidence of the tariff is split between the exporter and the importer, instead of targeting the domestic consumer as much as in the small country case. Vanek reports that often countries cannot directly tax the citizens for public goods because the taxpayer cannot absorb the additional tax. In Russia, tax collection is minimal and many companies do not pay taxes because government is unable to enforce the collection. If the tariff rate did not greatly reduce imports, then the tariff would be beneficial in replacing some of the uncollected taxes from within the country. However, Sheffield and Liefert point out that 72 percent of imported food in 1994 entered Russia duty-free, thereby, bringing up the question of the effectiveness of import tariffs. The optimal tariff is a possibility but not a highly

recommended one unless the government exhibits more capacity to manage the tax system.

Credit and loan system

A stable banking system which allows for credit and loans for new farms must be established. Incentives for investment within the new capitalist system should be increased. Large amounts of capital are leaving Russia for investment abroad when the investment is needed so badly at home. In the Financial Times on February 3, 1997, Chote reports that investment outflows from Russia totaled almost $30 billion in 1996. This much-needed investment could be staying within the country if financial institutions were stabilized and investments in agriculture and food processing were profitable.

AKKOR, the Russian Association of Private Farmers, is currently the primary guarantor of credit to new farms. About half of the farmers responding to Brooks' and Lerman's' report stated that it is important for land to be legally mortgageable since they must put up some form of collateral or guarantee in order to qualify for a loan. Since new farmers generally do not have sufficient personal items valuable enough to be put down as collateral, their land is the only viable alternative.

Stabilization of Political and Institutional Influences

High levels of risk occur due to instability of legal processes, lack of police protection from the mafia, and fluctuations in the taxing system. These things discourage foreign investment. If political decisions or legal rulings were made in the United States which affected the poultry industry, one would witness an almost immediate change in

supply. There might be a lag in response for major supply shifts, but with the seven-week turn-around from egg to broiler sales in poultry, the lag should not be extensive. Information flow and future expected changes would affect the length of the lag. If information is available quickly and the change is expected to be permanent or not reverse within the near future, there will be a relatively short lag as the poultry industry will respond as quickly as possible in order to continue maximizing profits. However, if information flows slowly and/or the change is not expected to be permanent, there will be a longer lag. If the Russian poultry industry is unsure as to how long the current ruling will last, managers may foresee no drastic production changes to be the best solution. Stable institutional changes (ones that do not quickly reverse) and a belief that the system will support these changes would cause reactions to the rulings to be more certain.

Americans are often suspicious of politics and their leaders. From disbelief during elections time to conspiracy theories (Kennedy assassination, Watergate, Whitewater), Americans place great distrust in their leaders. However, as a whole, U.S. citizens believe in the system. Although there are occasionally mistakes in the judicial or legislative system (intentional or not), the citizens trust the system enough to turn to it when things go wrong. This allows the market to function effectively. When things are not decided fairly, the media is willing to expose the story. The system is far from perfect, but the citizenry believe in it. This is stability which the people trust.

Russia is 180° from this scenario. The Russian Constitution, beautifully written, is often overlooked and disregarded. It is filled with rights for ownership of property and entrepreneurial freedom. However, politicians make new laws at whim and the judicial

system is supposedly filled with corruption. The Russian people feel more confident giving bribes than turning to such a system. It is true that things are changing with the break-up of the Soviet Union. But how different is the system really? The Soviet Constitution also guaranteed many rights and for the most part, the same people are in power now. New laws, although a move in the right direction, must be proven to withstand the test of time and politics. The risk of completely trusting a new system which could be changed at nay minute is too high. So instead of widespread market reforms, observers may only see tiny movements towards a market system. The Pizza Hut and McDonald's signs in Moscow may give the impression that things are changing quickly, but they are deceiving as they are only window dressings. The underlying population has yet to develop the full entrepreneurial spirit. This will take time, guidance through a flow of information, and a solid foundation in the political and judicial system.

One must always keep in mind that an economic system does not operate independently from the social and political systems. People will react in a rational way taking into account all variables, including political and social. It may be in their economic best interest to minimize input costs, but if that includes firing workers which would have great social costs or importing feed which could have political consequences, these decision makers may not pursue it. If a person did decide to minimize input costs, the net result on the individual could possibly be negative. Minimizing total costs would mean minimizing all of these costs including risk. Doing this would be in the person's best interests. Risk or perceived risk must be taken into account.

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Appendixes

Appendix A

Trade Model Output

```
 UNIT  6 IS NOW ASSIGNED TO: c:\thout.txt
 |_file input c:/thesis.txt
 UNIT  5 IS NOW ASSIGNED TO: c:\thesis.txt
 |_SAMPLE 1 48
 |_READ MTH IPMT VI CPI RUV RGDP RFX DTF IAO M2 RC TBT D1
   13 VARIABLES AND       48 OBSERVATIONS STARTING AT OBS
1

 |_SAMPLE 1 46
 |_GENR T1=TIME(0)

 |_OLS IPMT RUV RFX DTF IAO RC D1/ANOVA LM GF RESID=E1
PREDICT=YHAT1 hetcov

 REQUIRED MEMORY IS PAR=   11 CURRENT PAR=  500
  OLS ESTIMATION
      46 OBSERVATIONS     DEPENDENT VARIABLE = IPMT
 ...NOTE..SAMPLE RANGE SET TO:     1,   46

 USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX

  R-SQUARE =    0.7739     R-SQUARE ADJUSTED =    0.7391
 VARIANCE OF THE ESTIMATE-SIGMA**2 =  0.23907E+09
 STANDARD ERROR OF THE ESTIMATE-SIGMA =   15462.
 SUM OF SQUARED ERRORS-SSE=  0.93237E+10
 MEAN OF DEPENDENT VARIABLE =   43094.
 LOG OF THE LIKELIHOOD FUNCTION = -505.196

 MODEL SELECTION TESTS - SEE JUDGE ET.AL.(1985, P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR- FPE =   0.27545E+09
    (FPE ALSO KNOWN AS AMEMIYA PREDICTION CRITERION -PC)
  AKAIKE (1973) INFORMATION CRITERION- LOG AIC =   19.432
  SCHWARZ(1978) CRITERION-LOG SC =   19.710
 MODEL SELECTION TESTS - SEE RAMANATHAN(1992,P.167)
  CRAVEN-WAHBA(1979) GENERALIZED CROSS VALIDATION(1979) -
GCV=  0.28198E+09
  HANNAN AND QUINN(1979) CRITERION -HQ=  0.30499E+09
  RICE (1984) CRITERION-RICE=  0.29137E+09
  SHIBATA (1981) CRITERION-SHIBATA=  0.26438E+09
  SCHWARTZ (1978) CRITERION-SC=  0.36296E+09
  AKAIKE (1974)INFORMATION CRITERION-AIC=  0.27479E+09

                      ANALYSIS OF VARIANCE - FROM MEAN
```

	SS	DF	MS	F
REGRESSION	0.31914E+11	6.	0.53190E+10	22.249
ERROR	0.93237E+10	39.	0.23907E+09	
TOTAL	0.41238E+11	45.	0.91640E+09	

ANALYSIS OF VARIANCE - FROM ZERO

	SS	DF	MS	F
REGRESSION	0.11734E+12	7.	0.16763E+11	70.116
ERROR	0.93237E+10	39.	0.23907E+09	
TOTAL	0.12666E+12	46.	0.27535E+10	

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	T-RATIO 39 DF	PARTIAL P-VALUE	STANDARDIZED CORR. COEFFICIENT	ELASTICITY AT MEANS
RUV	3.8960	2.293	1.699	0.097	0.263	0.0452
RFX	-203.41	47.82	-4.253	0.000	-0.563	-0.5160
DTF	27684.	7328.	3.778	0.001	0.518	0.4513
IAO	242.52	485.6	0.4995	0.620	0.080	0.0982
RC	-83.971	315.6	-0.2661	0.792	-0.043	-0.0209
D1	61088.	3950.	15.46	0.000	0.927	0.2975
CONSTANT	29376.	0.5568E+05	0.5276	0.601	0.084	0.0000

DURBIN-WATSON = 1.2458 VON NEUMANN RATIO = 1.2735 RHO = 0.35577
RESIDUAL SUM = 0.24011E-09 RESIDUAL VARIANCE = 0.23907E+09
SUM OF ABSOLUTE ERRORS= 0.49160E+06
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.7739
RUNS TEST: 19 RUNS, 24 POSITIVE, 22 NEGATIVE, NORMAL STATISTIC = -1.4810
COEFFICIENT OF SKEWNESS = 0.2248 WITH STANDARD DEVIATION OF 0.3501
COEFFICIENT OF EXCESS KURTOSIS = 1.2574 WITH STANDARD DEVIATION OF 0.6876

GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 10 GROUPS

OBSERVED	1.0	0.0	2.0	8.0	11.0	16.0	3.0	3.0	1.0	1.0
EXPECTED	0.4	1.3	3.6	7.3	10.4	10.4	7.3	3.6	1.3	0.4

CHI-SQUARE = 9.9358 WITH 1 DEGREES OF FREEDOM

```
 JARQUE-BERA ASYMPTOTIC LM NORMALITY TEST
 CHI-SQUARE =     2.2682 WITH  2 DEGREES OF FREEDOM
 |_DIAGNOS/ HET ACF CHOWONE=7 RESET

 REQUIRED MEMORY IS PAR=    14 CURRENT PAR=  500
 DEPENDENT VARIABLE = IPMT              46 OBSERVATIONS
 REGRESSION COEFFICIENTS
    3.89602072003       -203.407160261        27684.4759715
242.518924848
   -83.9709018376        61088.0469101        29375.6244546

 HETEROSKEDASTICITY TESTS
   E**2 ON YHAT:           CHI-SQUARE =       3.614 WITH 1 D.F.
   E**2 ON YHAT**2:        CHI-SQUARE =       1.474 WITH 1 D.F.
   E**2 ON LOG(YHAT**2): CHI-SQUARE =         3.894 WITH 1 D.F.
   E**2 ON X (B-P-G) TEST:         CHI-SQUARE =       9.111
WITH   6 D.F.
   E**2 ON LAG(E**2)  ARCH TEST: CHI-SQUARE =         0.090
WITH    1 D.F.
   LOG(E**2) ON X (HARVEY) TEST: CHI-SQUARE =     876.980
WITH   6 D.F.
   ABS(E) ON X (GLEJSER) TEST:    CHI-SQUARE =      13.842
WITH   6 D.F.

 RAMSEY RESET SPECIFICATION TESTS USING POWERS OF YHAT
  RESET(2)=   19.274      - F WITH DF1=   1 AND DF2=  38
  RESET(3)=   9.4069      - F WITH DF1=   2 AND DF2=  37
  RESET(4)=   6.1112      - F WITH DF1=   3 AND DF2=  36

 RESIDUAL CORRELOGRAM
  LM-TEST FOR HJ:RHO(J)=0, STATISTIC IS STANDARD NORMAL
  LAG      RHO        STD ERR      T-STAT      LM-STAT     DW-
TEST BOX-PIERCE-LJUNG
    1      0.3158      0.1474      2.1420      2.4608      1.2458
4.8942
    2      0.3293      0.1474      2.2334      2.5802      1.2124
10.3357
    3      0.0032      0.1474      0.0214      0.0249      1.7921
10.3362
    4     -0.0396      0.1474     -0.2683      0.3297      1.8356
10.4185
    5      0.0592      0.1474      0.4017      0.5113      1.6333
10.6074
    6     -0.0417      0.1474     -0.2828      0.3489      1.8035
10.7034
    7      0.0818      0.1474      0.5548      0.6780      1.5364
11.0822
    8      0.0954      0.1474      0.6472      0.8214      1.4394
11.6114
    9      0.2258      0.1474      1.5313      1.9368      1.1722
14.6532
   10      0.2784      0.1474      1.8884      2.5525      1.0592
19.4077
```

```
   11     0.0117     0.1474     0.0791     0.1294     1.4226
19.4163
   12     0.1341     0.1474     0.9094     1.4274     1.1677
20.5837
   13    -0.1985     0.1474    -1.3462     2.5236     1.7706
23.2198
   14    -0.0290     0.1474    -0.1966     0.3501     1.4113
23.2778
 LM CHI-SQUARE STATISTIC WITH  14  D.F. IS    19.212
 ...MATRIX IS NOT POSITIVE DEFINITE..FAILED IN ROW    3

 ...MATRIX IS NOT POSITIVE DEFINITE..FAILED IN ROW    3

 ...MATRIX IS NOT POSITIVE DEFINITE..FAILED IN ROW    3

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 ...MATRIX IS NOT POSITIVE DEFINITE..FAILED IN ROW    6

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  ...MATRIX IS NOT POSITIVE DEFINITE..FAILED IN ROW     7

  ...MATRIX IS NOT POSITIVE DEFINITE..FAILED IN ROW     7

  ...MATRIX IS NOT POSITIVE DEFINITE..FAILED IN ROW     7


  SEQUENTIAL CHOW AND GOLDFELD-QUANDT TESTS
      N1     N2      SSE1            SSE2           CHOW          G-Q
DF1    DF2

               CHOW TEST - F DISTRIBUTION WITH DF1=    7 AND
DF2=  32
  |_STAT IPMT RUV RFX DTF IAO RC E1 YHAT1 /PCOR PCOV
  NAME          N    MEAN          ST. DEV       VARIANCE
MINIMUM       MAXIMUM
  IPMT          46    43094.         30272.       0.91640E+09
4.0000       0.12404E+06
  RUV           46    600.40         350.88       0.12311E+06
352.16        2867.2
  RFX           46    120.31         76.796        5897.7
57.800        319.40
  DTF           46   0.60870        0.49344       0.24348
0.00000        1.0000
  IAO           46    107.74         12.261        150.34
87.100        132.70
  RC            46    100.72         7.5442        56.915
87.800        115.90
  E1            46   0.52197E-11     14394.       0.20719E+09   -
39234.        38791.
  YHAT1         46    43094.         26631.       0.70921E+09   -
9772.9       0.12403E+06

   CORRELATION MATRIX OF VARIABLES -        46 OBSERVATIONS


 IPMT         1.0000
 RUV        -0.14008         1.0000
 RFX        -0.76580         0.28302         1.0000
 DTF         0.75359        -0.14446        -0.69577         1.0000
 IAO        -0.73254         0.23572         0.83121        -0.82655
1.0000
 RC          0.14072        -0.18623        -0.27668         0.21714
-0.19843
             1.0000
 E1          0.47550         0.22342E-15 -0.36363E-15   0.24601E-
15 -0.21622E-15
            0.55316E-16      1.0000
 YHAT1       0.87972        -0.15924        -0.87051         0.85662
-0.83269
            0.15996         0.33110E-15     1.0000
```

```
                IPMT            RUV             RFX             DTF
IAO
                RC              E1              YHAT1

  COVARIANCE MATRIX OF VARIABLES -       46 OBSERVATIONS


 IPMT       0.91640E+09
 RUV       -0.14879E+07  0.12311E+06
 RFX       -0.17803E+07   7626.3        5897.7
 DTF         11257.      -25.011       -26.365        0.24348
 IAO       -0.27190E+06   1014.1        782.68        -5.0008
150.34
 RC          32137.      -492.96       -160.30        0.80831
-18.355
            56.915
 E1         0.20719E+09  0.11284E-08 -0.40196E-09   0.17473E-
11 -0.38162E-10
           0.60069E-11  0.20719E+09
 YHAT1      0.70921E+09 -0.14879E+07 -0.17803E+07    11257.
-0.27190E+06
            32137.      0.12692E-06  0.70921E+09
              IPMT          RUV             RFX             DTF
IAO
              RC            E1              YHAT1

 |_ols ruv rfx dtf iao m2 rc t1 d1

 REQUIRED MEMORY IS PAR=   11 CURRENT PAR=  500
  OLS ESTIMATION
       46 OBSERVATIONS     DEPENDENT VARIABLE = RUV
 ...NOTE..SAMPLE RANGE SET TO:     1,   46

  R-SQUARE =    0.1319     R-SQUARE ADJUSTED =  -0.0280
 VARIANCE OF THE ESTIMATE-SIGMA**2 =  0.12656E+06
 STANDARD ERROR OF THE ESTIMATE-SIGMA =   355.75
 SUM OF SQUARED ERRORS-SSE=  0.48093E+07
 MEAN OF DEPENDENT VARIABLE =   600.40
 LOG OF THE LIKELIHOOD FUNCTION = -331.092

 MODEL SELECTION TESTS - SEE JUDGE ET.AL.(1985, P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR- FPE =   0.14857E+06
    (FPE ALSO KNOWN AS AMEMIYA PREDICTION CRITERION -PC)
  AKAIKE (1973) INFORMATION CRITERION- LOG AIC =   11.905
  SCHWARZ(1978) CRITERION-LOG SC =   12.223
 MODEL SELECTION TESTS - SEE RAMANATHAN(1992,P.167)
  CRAVEN-WAHBA(1979) GENERALIZED CROSS VALIDATION(1979) -
GCV=  0.15320E+06
  HANNAN AND QUINN(1979) CRITERION -HQ=  0.16677E+06
  RICE (1984) CRITERION-RICE=  0.16031E+06
  SHIBATA (1981) CRITERION-SHIBATA=  0.14091E+06
  SCHWARTZ (1978) CRITERION-SC=  0.20347E+06
  AKAIKE (1974)INFORMATION CRITERION-AIC=  0.14804E+06
```

```
                    ANALYSIS OF VARIANCE - FROM MEAN
                      SS             DF              MS
F
 REGRESSION      0.73088E+06        7.        0.10441E+06
0.825
 ERROR           0.48093E+07       38.        0.12656E+06
 TOTAL           0.55402E+07       45.        0.12311E+06

                    ANALYSIS OF VARIANCE - FROM ZERO
                      SS             DF              MS
F
 REGRESSION      0.17313E+08        8.        0.21641E+07
17.100
 ERROR           0.48093E+07       38.        0.12656E+06
 TOTAL           0.22122E+08       46.        0.48092E+06


 VARIABLE   ESTIMATED  STANDARD    T-RATIO         PARTIAL
STANDARDIZED ELASTICITY
   NAME     COEFFICIENT   ERROR      38 DF    P-VALUE CORR.
COEFFICIENT  AT MEANS
 RFX         0.72628      2.347      0.3095      0.759 0.050
0.1590      0.1455
 DTF          112.54      274.8      0.4095      0.684 0.066
0.1583      0.1141
 IAO          7.3814      10.36      0.7125      0.481 0.115
0.2579      1.3245
 M2           2.8513      4.837      0.5895      0.559 0.095
0.7588      0.5528
 RC          -3.6044      8.033     -0.4487      0.656-0.073
-0.0775     -0.6046
 T1          -17.091      47.37     -0.3608      0.720-0.058
-0.6538     -0.6689
 D1          -24.797      376.1     -0.6593E-01 0.948-0.011
-0.0104     -0.0009
 CONSTANT     82.574      1667.      0.4954E-01 0.961 0.008
0.0000      0.1375

 |_ols rfx ruv dtf iao m2 rc t1 d1

 REQUIRED MEMORY IS PAR=   11 CURRENT PAR=  500
  OLS ESTIMATION
       46 OBSERVATIONS     DEPENDENT VARIABLE = RFX
 ...NOTE..SAMPLE RANGE SET TO:     1,   46

  R-SQUARE =    0.9136     R-SQUARE ADJUSTED =    0.8977
 VARIANCE OF THE ESTIMATE-SIGMA**2 =    603.30
 STANDARD ERROR OF THE ESTIMATE-SIGMA =    24.562
 SUM OF SQUARED ERRORS-SSE=    22925.
 MEAN OF DEPENDENT VARIABLE =    120.31
 LOG OF THE LIKELIHOOD FUNCTION = -208.132

 MODEL SELECTION TESTS - SEE JUDGE ET.AL.(1985, P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR- FPE =    708.22
```

```
    (FPE ALSO KNOWN AS AMEMIYA PREDICTION CRITERION -PC)
  AKAIKE (1973) INFORMATION CRITERION- LOG AIC =   6.5592
  SCHWARZ(1978) CRITERION-LOG SC =   6.8772
 MODEL SELECTION TESTS - SEE RAMANATHAN(1992,P.167)
  CRAVEN-WAHBA(1979) GENERALIZED CROSS VALIDATION(1979) -
GCV=   730.31
  HANNAN AND QUINN(1979) CRITERION -HQ=   794.98
  RICE (1984) CRITERION-RICE=   764.18
  SHIBATA (1981) CRITERION-SHIBATA=   671.73
  SCHWARTZ (1978) CRITERION-SC=   969.92
  AKAIKE (1974)INFORMATION CRITERION-AIC=   705.70

                    ANALYSIS OF VARIANCE - FROM MEAN
                     SS          DF              MS
F
 REGRESSION      0.24247E+06      7.         34639.
57.415
 ERROR            22925.         38.         603.30
 TOTAL           0.26540E+06     45.         5897.7

                    ANALYSIS OF VARIANCE - FROM ZERO
                     SS          DF              MS
F
 REGRESSION      0.90828E+06      8.       0.11354E+06
188.191
 ERROR            22925.         38.         603.30
 TOTAL           0.93121E+06     46.         20244.


 VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL
STANDARDIZED ELASTICITY
   NAME    COEFFICIENT   ERROR      38 DF   P-VALUE CORR.
COEFFICIENT  AT MEANS
 RUV       0.34621E-02 0.1119E-01  0.3095     0.759 0.050
0.0158     0.0173
 DTF        67.107      15.59       4.305     0.000 0.573
0.4312     0.3395
 IAO        1.1218      0.6967      1.610     0.116 0.253
0.1791     1.0045
 M2         1.5911      0.2143      7.424     0.000 0.769
1.9347     1.5394
 RC        -0.89437     0.5368     -1.666     0.104-0.261
-0.0879    -0.7487
 T1        -16.660       1.852     -8.997     0.000-0.825
-2.9119    -3.2542
 D1        -20.613       25.75     -0.8003    0.428-0.129
-0.0396    -0.0037
 CONSTANT   253.36       107.5       2.357     0.024 0.357
0.0000     2.1059

 |_ols iao ruv rfx dtf m2 rc t1 d1

 REQUIRED MEMORY IS PAR=   11 CURRENT PAR=  500
  OLS ESTIMATION
```

```
      46 OBSERVATIONS     DEPENDENT VARIABLE = IAO
 ...NOTE..SAMPLE RANGE SET TO:     1,   46

  R-SQUARE =    0.8280     R-SQUARE ADJUSTED =    0.7963
 VARIANCE OF THE ESTIMATE-SIGMA**2 =    30.622
 STANDARD ERROR OF THE ESTIMATE-SIGMA =    5.5338
 SUM OF SQUARED ERRORS-SSE=    1163.7
 MEAN OF DEPENDENT VARIABLE =    107.74
 LOG OF THE LIKELIHOOD FUNCTION = -139.577

 MODEL SELECTION TESTS - SEE JUDGE ET.AL.(1985, P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR- FPE =     35.948
    (FPE ALSO KNOWN AS AMEMIYA PREDICTION CRITERION -PC)
  AKAIKE (1973) INFORMATION CRITERION- LOG AIC =    3.5785
  SCHWARZ(1978) CRITERION-LOG SC =    3.8965
 MODEL SELECTION TESTS - SEE RAMANATHAN(1992,P.167)
  CRAVEN-WAHBA(1979) GENERALIZED CROSS VALIDATION(1979) -
GCV=    37.069
  HANNAN AND QUINN(1979) CRITERION -HQ=    40.352
  RICE (1984) CRITERION-RICE=    38.788
  SHIBATA (1981) CRITERION-SHIBATA=    34.096
  SCHWARTZ (1978) CRITERION-SC=    49.231
  AKAIKE (1974)INFORMATION CRITERION-AIC=    35.820

                      ANALYSIS OF VARIANCE - FROM MEAN
                        SS          DF              MS
F
 REGRESSION         5601.6           7.         800.23
26.132
 ERROR              1163.7          38.         30.622
 TOTAL              6765.2          45.         150.34

                      ANALYSIS OF VARIANCE - FROM ZERO
                        SS          DF              MS
F
 REGRESSION       0.53954E+06       8.         67442.
2202.365
 ERROR             1163.7          38.         30.622
 TOTAL            0.54070E+06      46.         11754.


 VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL
STANDARDIZED ELASTICITY
   NAME    COEFFICIENT   ERROR      38 DF   P-VALUE CORR.
COEFFICIENT  AT MEANS
 RUV       0.17860E-02 0.2507E-02  0.7125     0.481 0.115
0.0511     0.0100
 RFX       0.56939E-01 0.3536E-01   1.610     0.116 0.253
0.3566     0.0636
 DTF       -8.4469       4.059      -2.081     0.044-0.320
-0.3399    -0.0477
 M2       -0.12302E-01 0.7556E-01 -0.1628     0.872-0.026
-0.0937    -0.0133
```

```
 RC          0.20540E-02 0.1253       0.1639E-01 0.987 0.003
0.0013      0.0019
 T1         -0.16905      0.7376      -0.2292      0.820-0.037
-0.1851     -0.0369
 D1          -1.2744       5.847      -0.2179      0.829-0.035
-0.0153     -0.0003
 CONSTANT     110.18       18.78        5.866      0.000 0.689
0.0000      1.0227

 |_ols t1 ruv rfx dtf iao m2 rc d1

 REQUIRED MEMORY IS PAR=   11 CURRENT PAR=  500
  OLS ESTIMATION
       46 OBSERVATIONS     DEPENDENT VARIABLE = T1
 ...NOTE..SAMPLE RANGE SET TO:     1,   46

  R-SQUARE =    0.9931     R-SQUARE ADJUSTED =    0.9918
 VARIANCE OF THE ESTIMATE-SIGMA**2 =    1.4791
 STANDARD ERROR OF THE ESTIMATE-SIGMA =    1.2162
 SUM OF SQUARED ERRORS-SSE=    56.207
 MEAN OF DEPENDENT VARIABLE =    23.500
 LOG OF THE LIKELIHOOD FUNCTION = -69.8803

 MODEL SELECTION TESTS - SEE JUDGE ET.AL.(1985, P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR- FPE =     1.7364
    (FPE ALSO KNOWN AS AMEMIYA PREDICTION CRITERION -PC)
  AKAIKE (1973) INFORMATION CRITERION- LOG AIC =  0.54822
  SCHWARZ(1978) CRITERION-LOG SC =  0.86625
 MODEL SELECTION TESTS - SEE RAMANATHAN(1992,P.167)
  CRAVEN-WAHBA(1979) GENERALIZED CROSS VALIDATION(1979) -
GCV=    1.7905
  HANNAN AND QUINN(1979) CRITERION -HQ=    1.9491
  RICE (1984) CRITERION-RICE=    1.8736
  SHIBATA (1981) CRITERION-SHIBATA=    1.6469
  SCHWARTZ (1978) CRITERION-SC=    2.3780
  AKAIKE (1974)INFORMATION CRITERION-AIC=    1.7302

                     ANALYSIS OF VARIANCE - FROM MEAN
                       SS          DF              MS
F
 REGRESSION        8051.3           7.         1150.2
777.609
 ERROR             56.207          38.         1.4791
 TOTAL             8107.5          45.         180.17

                     ANALYSIS OF VARIANCE - FROM ZERO
                       SS          DF              MS
F
 REGRESSION        33455.           8.         4181.8
2827.237
 ERROR             56.207          38.         1.4791
 TOTAL             33511.          46.         728.50
```

```
 VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL
STANDARDIZED ELASTICITY
   NAME     COEFFICIENT   ERROR      38 DF   P-VALUE CORR.
COEFFICIENT  AT MEANS
 RUV       -0.19974E-03 0.5536E-03 -0.3608      0.720-0.058
-0.0052     -0.0051
 RFX       -0.40846E-01 0.4540E-02  -8.997      0.000-0.825
-0.2337     -0.2091
 DTF         3.7940      0.7125       5.325      0.000 0.654
0.1395      0.0983
 IAO       -0.81653E-02 0.3563E-01 -0.2292      0.820-0.037
-0.0075     -0.0374
 M2         0.99682E-01 0.3804E-02   26.20      0.000 0.973
0.6935      0.4937
 RC        -0.24766E-01 0.2724E-01 -0.9092      0.369-0.146
-0.0139     -0.1061
 D1         -1.0857       1.274     -0.8523      0.399-0.137
-0.0119     -0.0010
 CONSTANT    18.019       4.891       3.684      0.001 0.513
0.0000      0.7668

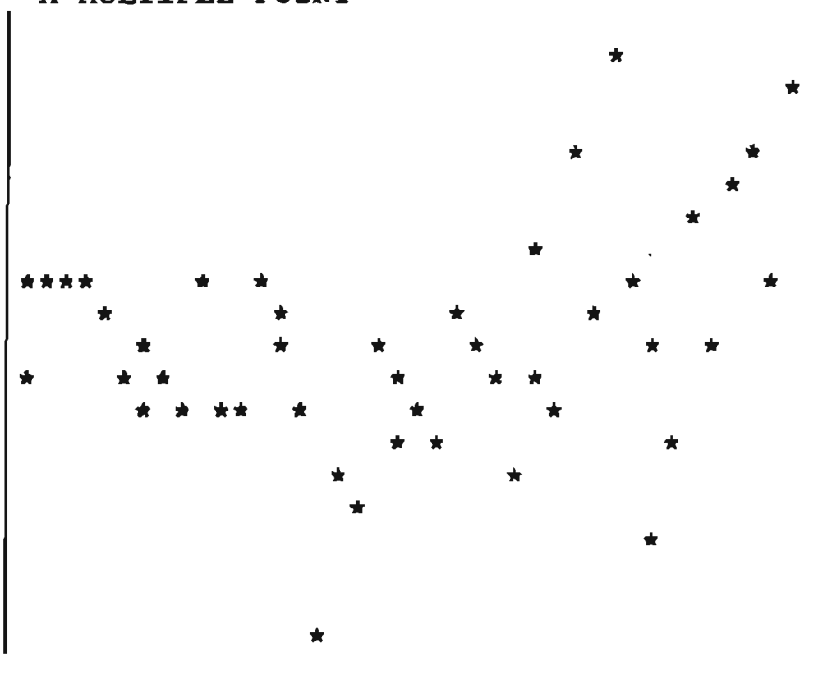
 |_PLOT IPMT YHAT1/TIME NOPRETTY

 REQUIRED MEMORY IS PAR=    7 CURRENT PAR=  500
 FOR MAXIMUM EFFICIENCY USE AT LEAST PAR=     8
        46 OBSERVATIONS
                    *=IPMT
                    +=YHAT1
                    M=MULTIPLE POINT
  0.12404E+06 |                                        *
  0.11699E+06 |                                        +
  0.10995E+06 |
  0.10291E+06 |
   95865.     |                                     *
   88822.     |                                              * *
   81780.     |                                   *
   74737.     |                                         * *
   67695.     |                                  *     *
   60652.     |                                  M +M+++++M+++*+
   53610.     |                        + + M++MM+++*+                +
   46567.     |                         + M**    *  *       *
   39525.     |                            * *    *
   32482.     |                  *  *    **                  *
   25440.     |                 +++++M+
   18397.     |               +M* **  *
   11355.     |               M        *
    4312.1    |              +
   -2730.4    |MA*****
   -9772.9    |+++++
              |_____________________________________________
                1.000     12.250     23.500     34.750     46.000

                                TIME
```

```
|_PLOT E1/TIME NOPRETTY

REQUIRED MEMORY IS PAR=     7 CURRENT PAR=  500
FOR MAXIMUM EFFICIENCY USE AT LEAST PAR=     7
       46 OBSERVATIONS
                    *=E1
                    M=MULTIPLE POINT
```




```
                1.000     12.250     23.500     34.750     46.000

                                    TIME
|_GENR YHAT12=YHAT1*YHAT1
|_******** SKEWNESS TESTS ********
|_GEN1 G11=.2248
|_GEN1 T=$N
..NOTE..CURRENT VALUE OF $N    =    46.000
|_** G11 has to be obtained from the OLS above
|_GEN1 SQRTB1= G11*((T-2)/SQRT(T*(T-1)))
|_GEN1 Y=SQRTB1*(((T+1)(T+3))/(6*(T-2)))**0.5
|_GEN1 B2SQRTB1=(3*(T**2+27*T-70)(T+1)(T+3))/((T-
2)(T+5)(T+7)(T+9))
|_GEN1 W2=-1+(2*(B2SQRTB1-1))**0.5
|_GEN1 SQRTW2=SQRT(W2)
|_GEN1 DELTA=1/SQRT(LOG(SQRTW2))
|_GEN1 ALPHA=(2/(W2-1))**0.5
|_GEN1 ZSQRTB1=DELTA*LOG((Y/ALPHA)+((Y/ALPHA)**2+1)**0.5)
|_PRINT ZSQRTB1
     ZSQRTB1
   0.6708540
|_******** KURTOSIS TEST ********
|_GENR G21=1.2574
|_** G21 has to be obtained from the OLS above
|_
```

```
 |_GEN1 B2=G21*((T-2)(T-3))/((T+1)(T-1))+(3*(T-1))/(T+1)
 |_GEN1 B2BAR=(3*(T-1))/(T+1)
 |_GEN1 VARB2=(24*T*(T-2)(T-3))/(((T+1)**2)(T+3)(T+5))
 |_GEN1 X=(B2-B2BAR)/SQRT(VARB2)
 |_GEN1 SQRTB1B2=((6*(T**2-
5*T+2))/((T+7)(T+9)))*SQRT((6*(T+3)(T+5))/(T*(T-2)(T-3)))
 |_GEN1
A=6+(8/(SQRTB1B2))*(2/(SQRTB1B2)+SQRT(1+4/(SQRTB1B2**2)))
 |_GEN1 ZB2=((1-2/(9*A))-((1-2/A)/(1+X*SQRT(2/(A-
4))))**(1/3))/SQRT(2/(9*A))
 |_PRINT  ZB2
     ZB2
    1.624648
 |_******** OMNIBUS TEST ********
 |_GEN1 K2=ZSQRTB1**2+ZB2**2
 |_PRINT K2
     K2
    3.089528
 |_**jOINT CONDITIONAL MEAN TEST
 |_GENR LAGE1=LAG(E1)
..NOTE.LAG VALUE IN UNDEFINED OBSERVATIONS SET TO ZERO
 |_SAMPLE 2 46

 |_OLS E1 T1 YHAT12 LAGE1

REQUIRED MEMORY IS PAR=   11 CURRENT PAR=  500
 OLS ESTIMATION
      45 OBSERVATIONS     DEPENDENT VARIABLE = E1
...NOTE..SAMPLE RANGE SET TO:     2,   46

 R-SQUARE =    0.1905     R-SQUARE ADJUSTED =    0.1313
VARIANCE OF THE ESTIMATE-SIGMA**2 =  0.18214E+09
STANDARD ERROR OF THE ESTIMATE-SIGMA =    13496.
SUM OF SQUARED ERRORS-SSE=  0.74679E+10
MEAN OF DEPENDENT VARIABLE =  -217.64
LOG OF THE LIKELIHOOD FUNCTION = -489.715

MODEL SELECTION TESTS - SEE JUDGE ET.AL.(1985, P.242)
 AKAIKE (1969) FINAL PREDICTION ERROR- FPE =    0.19833E+09
   (FPE ALSO KNOWN AS AMEMIYA PREDICTION CRITERION -PC)
 AKAIKE (1973) INFORMATION CRITERION- LOG AIC =    19.105
 SCHWARZ(1978) CRITERION-LOG SC =    19.266
MODEL SELECTION TESTS - SEE RAMANATHAN(1992,P.167)
 CRAVEN-WAHBA(1979) GENERALIZED CROSS VALIDATION(1979) -
GCV=  0.19991E+09
 HANNAN AND QUINN(1979) CRITERION -HQ=  0.21047E+09
 RICE (1984) CRITERION-RICE=  0.20184E+09
 SHIBATA (1981) CRITERION-SHIBATA=  0.19546E+09
 SCHWARTZ (1978) CRITERION-SC=  0.23278E+09
 AKAIKE (1974)INFORMATION CRITERION-AIC=  0.19824E+09

                    ANALYSIS OF VARIANCE - FROM MEAN
                     SS          DF              MS
F
```

```
 REGRESSION          0.17578E+10       3.          0.58592E+09
3.217
 ERROR               0.74679E+10      41.          0.18214E+09
 TOTAL               0.92257E+10      44.          0.20967E+09

                         ANALYSIS OF VARIANCE - FROM ZERO
                           SS             DF              MS
F
 REGRESSION          0.17599E+10       4.          0.43997E+09
2.416
 ERROR               0.74679E+10      41.          0.18214E+09
 TOTAL               0.92278E+10      45.          0.20506E+09


 VARIABLE    ESTIMATED  STANDARD    T-RATIO         PARTIAL
STANDARDIZED ELASTICITY
   NAME     COEFFICIENT   ERROR       41 DF    P-VALUE CORR.
COEFFICIENT  AT MEANS
 T1           427.59       220.1        1.943      0.059 0.290
0.3878    -47.1510
 YHAT12    -0.12590E-05 0.1151E-05   -1.094      0.280-0.168
-0.2152     15.0712
 LAGE1        0.29791      0.1515       1.966      0.056 0.294
0.2818      0.9842
 CONSTANT    -6985.4       4359.       -1.603      0.117-0.243
0.0000     32.0956
 |_TEST
 |_TEST T1=0
 |_TEST YHAT12=0
 |_TEST LAGE1=0
 |_END
 F STATISTIC =    3.2167899      WITH     3 AND    41 D.F.   P-
VALUE= 0.03252
 WALD CHI-SQUARE STATISTIC =    9.6503697      WITH     3 D.F.
P-VALUE= 0.02178
 UPPER BOUND ON P-VALUE BY CHEBYCHEV INEQUALITY = 0.31087
 |_**JOINT CONDITIONAL VARIANCE TEST
 |_GENR E12=E1*E1
 |_GENR LAGE12=LAG(E12)
 |_SAMPLE 2 46

 |_OLS E12 T1 YHAT12 LAGE12

 REQUIRED MEMORY IS PAR=    12 CURRENT PAR=  500
  OLS ESTIMATION
       45 OBSERVATIONS      DEPENDENT VARIABLE = E12
 ...NOTE..SAMPLE RANGE SET TO:     2,    46

  R-SQUARE =    0.1388      R-SQUARE ADJUSTED =    0.0757
 VARIANCE OF THE ESTIMATE-SIGMA**2 =  0.11873E+18
 STANDARD ERROR OF THE ESTIMATE-SIGMA =  0.34458E+09
 SUM OF SQUARED ERRORS-SSE=  0.48681E+19
 MEAN OF DEPENDENT VARIABLE =  0.20506E+09
 LOG OF THE LIKELIHOOD FUNCTION = -946.360
```

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 MODEL SELECTION TESTS - SEE JUDGE ET.AL.(1985, P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR- FPE =   0.12929E+18
    (FPE ALSO KNOWN AS AMEMIYA PREDICTION CRITERION -PC)
  AKAIKE (1973) INFORMATION CRITERION- LOG AIC =   39.400
  SCHWARZ(1978) CRITERION-LOG SC =   39.561
 MODEL SELECTION TESTS - SEE RAMANATHAN(1992,P.167)
  CRAVEN-WAHBA(1979) GENERALIZED CROSS VALIDATION(1979) -
GCV=  0.13032E+18
  HANNAN AND QUINN(1979) CRITERION -HQ=  0.13720E+18
  RICE (1984) CRITERION-RICE=  0.13157E+18
  SHIBATA (1981) CRITERION-SHIBATA=  0.12741E+18
  SCHWARTZ (1978) CRITERION-SC=  0.15174E+18
  AKAIKE (1974)INFORMATION CRITERION-AIC=  0.12923E+18

                    ANALYSIS OF VARIANCE - FROM MEAN
                     SS          DF              MS
F
 REGRESSION       0.78430E+18      3.       0.26143E+18
2.202
 ERROR            0.48681E+19     41.       0.11873E+18
 TOTAL            0.56524E+19     44.       0.12846E+18

                    ANALYSIS OF VARIANCE - FROM ZERO
                     SS          DF              MS
F
 REGRESSION       0.26766E+19      4.       0.66914E+18
5.636
 ERROR            0.48681E+19     41.       0.11873E+18
 TOTAL            0.75447E+19     45.       0.16766E+18


 VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL
STANDARDIZED ELASTICITY
   NAME    COEFFICIENT   ERROR      41 DF   P-VALUE CORR.
COEFFICIENT  AT MEANS
 T1         0.12634E+08 0.5690E+07   2.220     0.032 0.328
0.4630      1.4786
 YHAT12    -0.18117E-01 0.2935E-01 -0.6172     0.540-0.096
-0.1251     -0.2302
 LAGE12    -0.16089     0.1614     -0.9971     0.325-0.154
-0.1507     -0.1426
 CONSTANT -0.21698E+08 0.1091E+09 -0.1988     0.843-0.031
0.0000     -0.1058
  |_TEST
  |_TEST T1=0
  |_TEST YHAT12=0
  |_TEST LAGE12=0
  |_END
 F STATISTIC =   2.2018351     WITH    3 AND   41 D.F.  P-
VALUE= 0.10239
 WALD CHI-SQUARE STATISTIC =   6.6055053     WITH    3 D.F.
P-VALUE= 0.08559
 UPPER BOUND ON P-VALUE BY CHEBYCHEV INEQUALITY = 0.45417
```

```
|_SAMPLE 13 46

|_OLS IPMT RUV RGDP RFX DTF IAO RC TBT D1/ANOVA LM GF
RESID=E2 PREDICT=YHAT2 hetcov

 REQUIRED MEMORY IS PAR=   14 CURRENT PAR=  500
  OLS ESTIMATION
       34 OBSERVATIONS     DEPENDENT VARIABLE = IPMT
 ...NOTE..SAMPLE RANGE SET TO:   13,   46

 USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX

  R-SQUARE =    0.7614     R-SQUARE ADJUSTED =    0.6851
 VARIANCE OF THE ESTIMATE-SIGMA**2 =  0.20295E+09
 STANDARD ERROR OF THE ESTIMATE-SIGMA =    14246.
 SUM OF SQUARED ERRORS-SSE=  0.50738E+10
 MEAN OF DEPENDENT VARIABLE =    54997.
 LOG OF THE LIKELIHOOD FUNCTION = -368.201

 MODEL SELECTION TESTS - SEE JUDGE ET.AL.(1985, P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR- FPE =   0.25667E+09
    (FPE ALSO KNOWN AS AMEMIYA PREDICTION CRITERION -PC)
  AKAIKE (1973) INFORMATION CRITERION- LOG AIC =   19.350
  SCHWARZ(1978) CRITERION-LOG SC =   19.754
 MODEL SELECTION TESTS - SEE RAMANATHAN(1992,P.167)
  CRAVEN-WAHBA(1979) GENERALIZED CROSS VALIDATION(1979) -
GCV=  0.27601E+09
  HANNAN AND QUINN(1979) CRITERION -HQ=  0.29081E+09
  RICE (1984) CRITERION-RICE=  0.31711E+09
  SHIBATA (1981) CRITERION-SHIBATA=  0.22823E+09
  SCHWARTZ (1978) CRITERION-SC=  0.37953E+09
  AKAIKE (1974)INFORMATION CRITERION-AIC=  0.25338E+09

                    ANALYSIS OF VARIANCE - FROM MEAN
                     SS          DF              MS
F
 REGRESSION      0.16192E+11      8.       0.20240E+10
9.973
 ERROR           0.50738E+10     25.       0.20295E+09
 TOTAL           0.21265E+11     33.       0.64441E+09

                    ANALYSIS OF VARIANCE - FROM ZERO
                     SS          DF              MS
F
 REGRESSION      0.11903E+12      9.       0.13226E+11
65.167
 ERROR           0.50738E+10     25.       0.20295E+09
 TOTAL           0.12411E+12     34.       0.36502E+10


 VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL
STANDARDIZED ELASTICITY
   NAME    COEFFICIENT   ERROR      25 DF   P-VALUE CORR.
COEFFICIENT  AT MEANS
```

```
 RUV          65.475       43.05         1.521      0.141 0.291
0.1432      0.6735
 RGDP        -314.77       476.2        -0.6610     0.515-0.131
-0.0929     -0.5699
 RFX         -532.10       188.6         -2.821     0.009-0.491
-0.4615     -0.8062
 DTF          33947.       8737.          3.886     0.001 0.614
0.5175      0.5083
 IAO          411.26       372.1          1.105     0.280 0.216
0.1300      0.7632
 RC           379.66       438.6         0.8656     0.395 0.171
0.1097      0.7034
 TBT         -13917.       5122.         -2.717     0.012-0.477
-0.3002     -0.4172
 D1           50139.       4645.          10.79     0.000 0.907
0.3387      0.0268
 CONSTANT     6487.4     0.4906E+05      0.1322     0.896 0.026
0.0000      0.1180

 DURBIN-WATSON = 1.7426    VON NEUMANN RATIO = 1.7954    RHO
=  0.11071
 RESIDUAL SUM =  0.25102E-09  RESIDUAL VARIANCE =
0.20295E+09
 SUM OF ABSOLUTE ERRORS=  0.32461E+06
 R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.7614
 RUNS TEST:   16 RUNS,   16 POSITIVE,   18 NEGATIVE, NORMAL
STATISTIC = -0.6786
 COEFFICIENT OF SKEWNESS =  -0.2626 WITH STANDARD DEVIATION
OF 0.4031
 COEFFICIENT OF EXCESS KURTOSIS =   0.1116 WITH STANDARD
DEVIATION OF 0.7879

      GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 12
GROUPS
 OBSERVED  0.0  1.0  1.0  2.0  4.0 10.0  7.0  5.0  3.0  1.0
0.0  0.0
 EXPECTED  0.2  0.6  1.5  3.1  5.1  6.5  6.5  5.1  3.1  1.5
0.6  0.2
 CHI-SQUARE =    4.2035 WITH  1 DEGREES OF FREEDOM

 JARQUE-BERA ASYMPTOTIC LM NORMALITY TEST
 CHI-SQUARE =    0.3647 WITH  2 DEGREES OF FREEDOM
 |_DIAGNOS/ HET ACF RESET

 REQUIRED MEMORY IS PAR=   17 CURRENT PAR=  500
 DEPENDENT VARIABLE = IPMT             34 OBSERVATIONS
 REGRESSION COEFFICIENTS
    65.4751105969      -314.768063265      -532.102553076
33947.1349764
    411.263112825       379.658294444      -13916.8860693
50139.3779231
    6487.35201833

 HETEROSKEDASTICITY TESTS
```

```
   E**2 ON YHAT:          CHI-SQUARE =      0.011 WITH 1 D.F.
   E**2 ON YHAT**2:       CHI-SQUARE =      0.036 WITH 1 D.F.
   E**2 ON LOG(YHAT**2): CHI-SQUARE =      0.135 WITH 1 D.F.
   E**2 ON X (B-P-G) TEST:        CHI-SQUARE =      4.657
WITH   8 D.F.
   E**2 ON LAG(E**2)  ARCH TEST: CHI-SQUARE =      0.800
WITH    1 D.F.
   LOG(E**2) ON X (HARVEY) TEST: CHI-SQUARE =    900.532
WITH   8 D.F.
   ABS(E) ON X (GLEJSER) TEST:   CHI-SQUARE =      6.202
WITH   8 D.F.

 RAMSEY RESET SPECIFICATION TESTS USING POWERS OF YHAT
  RESET(2)=   5.4213      - F WITH DF1=   1 AND DF2=  24
  RESET(3)=   2.9658      - F WITH DF1=   2 AND DF2=  23
  RESET(4)=   1.9255      - F WITH DF1=   3 AND DF2=  22

 RESIDUAL CORRELOGRAM
  LM-TEST FOR HJ:RHO(J)=0, STATISTIC IS STANDARD NORMAL
  LAG      RHO        STD ERR      T-STAT      LM-STAT     DW-
TEST BOX-PIERCE-LJUNG
    1     0.1067      0.1715      0.6219      0.6908      1.7426
0.4220
    2     0.1104      0.1715      0.6435      0.6787      1.6958
0.8878
    3    -0.4692      0.1715     -2.7359      2.9637      2.8338
9.5801
    4    -0.1794      0.1715     -1.0458      1.1547      2.2111
10.8926
    5    -0.0173      0.1715     -0.1011      0.1128      1.8567
10.9053
    6     0.0284      0.1715      0.1657      0.1891      1.7642
10.9406
    7     0.0690      0.1715      0.4026      0.4784      1.4654
11.1567
    8    -0.0735      0.1715     -0.4283      0.5532      1.6038
11.4107
    9     0.0327      0.1715      0.1907      0.2376      1.3812
11.4630
   10     0.0743      0.1715      0.4330      0.5550      1.2382
11.7443
 LM CHI-SQUARE STATISTIC WITH  10  D.F. IS     9.987
 |_STAT IPMT RUV RGDP RFX DTF IAO RC TBT E2 YHAT2/ PCOR PCOV
 NAME         N   MEAN         ST. DEV      VARIANCE
MINIMUM      MAXIMUM
 IPMT         34   54997.       25385.      0.64441E+09
14638.      0.12404E+06
 RUV          34   565.73       55.528       3083.3
476.35       752.86
 RGDP         34   99.574       7.4921       56.132
86.500       113.50
 RFX          34   83.329       22.017       484.76
57.800       119.40
```

```
 DTF          34   0.82353       0.38695       0.14973
0.00000        1.0000
 IAO          34    102.07        8.0217        64.348
87.100         119.30
 RC           34    101.90        7.3365        53.824
87.800         115.90
 TBT          34    1.6485       0.54752       0.29978
0.53800        2.8100
 E2           34  0.73830E-11     12400.       0.15375E+09  -
28993.         24609.
 YHAT2        34    54997.        22151.       0.49066E+09
14853.        0.12404E+06
```

CORRELATION MATRIX OF VARIABLES - 34 OBSERVATIONS

```
 IPMT         1.0000
 RUV         0.17120        1.0000
 RGDP       -0.19962       -0.26839        1.0000
 RFX        -0.73392       -0.35451       0.30895        1.0000
 DTF         0.53444       -0.21804       0.63146E-01 -0.53717
1.0000
 IAO        -0.45822       -0.83608E-01   0.19127        0.68523
-0.64720
             1.0000
 RC         -0.13567       -0.18201       0.87459        0.25621
0.35037E-01
             0.14424         1.0000
 TBT        -0.49111E-01    0.15107      -0.84103E-01 -0.11689
0.46931
           -0.41191       -0.77336E-01    1.0000
 E2          0.48846        0.20002E-15 -0.88923E-16   0.24676E-
16 -0.30487E-17
            0.63554E-16 -0.84613E-16   0.12045E-15    1.0000
 YHAT2       0.87259        0.19620      -0.22877      -0.84109
0.61248
           -0.52513       -0.15548      -0.56282E-01 -0.12506E-
15    1.0000
                IPMT           RUV            RGDP           RFX
DTF
                IAO            RC             TBT            E2
YHAT2
```

COVARIANCE MATRIX OF VARIABLES - 34 OBSERVATIONS

```
 IPMT        0.64441E+09
 RUV         0.24132E+06    3083.3
 RGDP         -37966.       -111.66         56.132
 RFX        -0.41020E+06    -433.41         50.964         484.76
 DTF          5249.7        -4.6850        0.18307        -4.5765
0.14973
 IAO         -93309.        -37.241         11.495         121.02
-2.0089
```

```
             64.348
 RC         -25267.       -74.147        48.072        41.385
0.99465E-01
             8.4884        53.824
 TBT        -682.58        4.5929      -0.34500       -1.4091
0.99430E-01
            -1.8091      -0.31065       0.29978
 E2         0.15375E+09  0.13772E-09 -0.82608E-11  0.67368E-
11 -0.14628E-13
            0.63215E-11 -0.76972E-11  0.81776E-12
0.15375E+09
 YHAT2      0.49066E+09  0.24132E+06  -37966.      -
0.41020E+06   5249.7
            -93309.       -25267.       -682.58      -0.34349E-
07  0.49066E+09
               IPMT          RUV           RGDP          RFX
DTF
               IAO           RC            TBT           E2
YHAT2

 |_ols ruv rfx dtf iao m2 rc t1 d1

 REQUIRED MEMORY IS PAR=   14 CURRENT PAR=  500
  OLS ESTIMATION
       34 OBSERVATIONS     DEPENDENT VARIABLE = RUV
 ...NOTE..SAMPLE RANGE SET TO:   13,   46

  R-SQUARE =   0.5813     R-SQUARE ADJUSTED =   0.4686
 VARIANCE OF THE ESTIMATE-SIGMA**2 =   1638.5
 STANDARD ERROR OF THE ESTIMATE-SIGMA =   40.479
 SUM OF SQUARED ERRORS-SSE=   42602.
 MEAN OF DEPENDENT VARIABLE =   565.73
 LOG OF THE LIKELIHOOD FUNCTION = -169.510

 MODEL SELECTION TESTS - SEE JUDGE ET.AL.(1985, P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR- FPE =    2024.1
    (FPE ALSO KNOWN AS AMEMIYA PREDICTION CRITERION -PC)
  AKAIKE (1973) INFORMATION CRITERION- LOG AIC =   7.6039
  SCHWARZ(1978) CRITERION-LOG SC =   7.9630
 MODEL SELECTION TESTS - SEE RAMANATHAN(1992,P.167)
  CRAVEN-WAHBA(1979) GENERALIZED CROSS VALIDATION(1979) -
GCV=   2142.7
  HANNAN AND QUINN(1979) CRITERION -HQ=   2267.3
  RICE (1984) CRITERION-RICE=   2366.8
  SHIBATA (1981) CRITERION-SHIBATA=   1842.6
  SCHWARTZ (1978) CRITERION-SC=   2872.7
  AKAIKE (1974)INFORMATION CRITERION-AIC=   2006.0

                      ANALYSIS OF VARIANCE - FROM MEAN
                        SS          DF             MS
F
 REGRESSION        59148.           7.         8449.7
5.157
 ERROR             42602.          26.         1638.5
```

```
 TOTAL                0.10175E+06      33.          3083.3

                    ANALYSIS OF VARIANCE - FROM ZERO
                      SS             DF              MS
F
 REGRESSION          0.10941E+08       8.          0.13676E+07
834.644
 ERROR                42602.          26.           1638.5
 TOTAL               0.10983E+08      34.          0.32304E+06


 VARIABLE   ESTIMATED  STANDARD   T-RATIO         PARTIAL
STANDARDIZED ELASTICITY
   NAME     COEFFICIENT   ERROR      26 DF    P-VALUE CORR.
COEFFICIENT  AT MEANS
 RFX          0.30957      1.150      0.2692      0.790 0.053
0.1227      0.0456
 DTF          -163.34      36.22      -4.510      0.000-0.663
-1.1383     -0.2378
 IAO         -0.12775      1.357     -0.9415E-01 0.926-0.018
-0.0185     -0.0230
 M2           -1.4884      1.081      -1.377      0.180-0.261
-2.2512     -0.3981
 RC            1.3285      1.119       1.187      0.246 0.227
0.1755      0.2393
 T1            19.453      8.638       2.252      0.033 0.404
3.4887      1.0144
 D1            26.448      43.40      0.6094      0.548 0.119
0.0817      0.0014
 CONSTANT      202.70      221.8      0.9141      0.369 0.176
0.0000      0.3583

 |_ols rfx ruv dtf iao m2 rc t1 d1

 REQUIRED MEMORY IS PAR=   14 CURRENT PAR=  500
  OLS ESTIMATION
       34 OBSERVATIONS     DEPENDENT VARIABLE = RFX
 ...NOTE..SAMPLE RANGE SET TO:   13,   46

  R-SQUARE =    0.9228     R-SQUARE ADJUSTED =    0.9020
 VARIANCE OF THE ESTIMATE-SIGMA**2 =    47.524
 STANDARD ERROR OF THE ESTIMATE-SIGMA =    6.8938
 SUM OF SQUARED ERRORS-SSE=    1235.6
 MEAN OF DEPENDENT VARIABLE =    83.329
 LOG OF THE LIKELIHOOD FUNCTION = -109.324

 MODEL SELECTION TESTS - SEE JUDGE ET.AL.(1985, P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR- FPE =     58.706
    (FPE ALSO KNOWN AS AMEMIYA PREDICTION CRITERION -PC)
  AKAIKE (1973) INFORMATION CRITERION- LOG AIC =    4.0636
  SCHWARZ(1978) CRITERION-LOG SC =    4.4227
 MODEL SELECTION TESTS - SEE RAMANATHAN(1992,P.167)
  CRAVEN-WAHBA(1979) GENERALIZED CROSS VALIDATION(1979) -
GCV=    62.147
```

```
  HANNAN AND QUINN(1979) CRITERION -HQ=    65.762
  RICE (1984) CRITERION-RICE=    68.646
  SHIBATA (1981) CRITERION-SHIBATA=    53.444
  SCHWARTZ (1978) CRITERION-SC=    83.321
  AKAIKE (1974)INFORMATION CRITERION-AIC=    58.181

                        ANALYSIS OF VARIANCE - FROM MEAN
                          SS          DF              MS
F
 REGRESSION          14761.           7.          2108.8
44.373
 ERROR               1235.6          26.          47.524
 TOTAL               15997.          33.          484.76

                        ANALYSIS OF VARIANCE - FROM ZERO
                          SS          DF              MS
F
 REGRESSION        0.25085E+06        8.          31356.
659.797
 ERROR              1235.6          26.          47.524
 TOTAL             0.25209E+06      34.          7414.3


 VARIABLE   ESTIMATED  STANDARD   T-RATIO         PARTIAL
STANDARDIZED ELASTICITY
   NAME    COEFFICIENT   ERROR      26 DF   P-VALUE CORR.
COEFFICIENT  AT MEANS
 RUV        0.89789E-02 0.3335E-01  0.2692      0.790 0.053
0.0226      0.0610
 DTF        -1.8132       8.227     -0.2204      0.827-0.043
-0.0319     -0.0179
 IAO        0.22744      0.2268       1.003      0.325 0.193
0.0829      0.2786
 M2        -0.50939      0.1624      -3.137      0.004-0.524
-1.9430     -0.9250
 RC         0.10074      0.1947       0.5174     0.609 0.101
0.0336      0.1232
 T1          2.3868       1.539       1.551      0.133 0.291
1.0795      0.8450
 D1         -2.9341       7.422      -0.3953     0.696-0.077
-0.0229     -0.0010
 CONSTANT    53.018       36.93       1.436      0.163 0.271
0.0000      0.6362

 |_ols iao ruv rfx dtf m2 rc t1 d1

 REQUIRED MEMORY IS PAR=   14 CURRENT PAR=  500
  OLS ESTIMATION
       34 OBSERVATIONS     DEPENDENT VARIABLE = IAO
 ...NOTE..SAMPLE RANGE SET TO:   13,   46

  R-SQUARE =    0.5810     R-SQUARE ADJUSTED =    0.4682
 VARIANCE OF THE ESTIMATE-SIGMA**2 =    34.218
 STANDARD ERROR OF THE ESTIMATE-SIGMA =    5.8497
```

```
 SUM OF SQUARED ERRORS-SSE=    889.68
 MEAN OF DEPENDENT VARIABLE =    102.07
 LOG OF THE LIKELIHOOD FUNCTION = -103.740

 MODEL SELECTION TESTS - SEE JUDGE ET.AL.(1985, P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR- FPE =     42.270
    (FPE ALSO KNOWN AS AMEMIYA PREDICTION CRITERION -PC)
  AKAIKE (1973) INFORMATION CRITERION- LOG AIC =    3.7351
  SCHWARZ(1978) CRITERION-LOG SC =    4.0942
 MODEL SELECTION TESTS - SEE RAMANATHAN(1992,P.167)
  CRAVEN-WAHBA(1979) GENERALIZED CROSS VALIDATION(1979) -
GCV=    44.747
  HANNAN AND QUINN(1979) CRITERION -HQ=    47.350
  RICE (1984) CRITERION-RICE=    49.427
  SHIBATA (1981) CRITERION-SHIBATA=    38.481
  SCHWARTZ (1978) CRITERION-SC=    59.993
  AKAIKE (1974)INFORMATION CRITERION-AIC=    41.892

                      ANALYSIS OF VARIANCE - FROM MEAN
                        SS          DF              MS
F
 REGRESSION         1233.8           7.         176.26
5.151
 ERROR              889.68          26.         34.218
 TOTAL              2123.5          33.         64.348

                      ANALYSIS OF VARIANCE - FROM ZERO
                        SS          DF              MS
F
 REGRESSION       0.35544E+06       8.         44430.
1298.419
 ERROR             889.68          26.         34.218
 TOTAL            0.35633E+06      34.         10480.


 VARIABLE   ESTIMATED  STANDARD   T-RATIO         PARTIAL
STANDARDIZED ELASTICITY
   NAME    COEFFICIENT   ERROR      26 DF   P-VALUE CORR.
COEFFICIENT  AT MEANS
 RUV      -0.26679E-02 0.2834E-01 -0.9415E-01 0.926-0.018
-0.0185     -0.0148
 RFX       0.16376     0.1633       1.003     0.325 0.193
0.4495      0.1337
 DTF      -9.3041      6.745       -1.379     0.179-0.261
-0.4488     -0.0751
 M2       -0.23709E-01 0.1617      -0.1466    0.885-0.029
-0.2482     -0.0351
 RC        0.55528E-01 0.1657       0.3351    0.740 0.066
0.0508      0.0554
 T1        0.22610      1.364       0.1658    0.870 0.032
0.2807      0.0653
 D1       -0.37880E-01  6.317      -0.5997E-02 0.995-0.001
-0.0008      0.0000
```

```
 CONSTANT    88.853       27.50        3.231      0.003 0.535
0.0000      0.8705

 |_ols t1 ruv rfx dtf iao m2 rc d1

 REQUIRED MEMORY IS PAR=    14 CURRENT PAR=  500
  OLS ESTIMATION
       34 OBSERVATIONS     DEPENDENT VARIABLE = T1
 ...NOTE..SAMPLE RANGE SET TO:    13,    46

  R-SQUARE =    0.9944     R-SQUARE ADJUSTED =    0.9929
 VARIANCE OF THE ESTIMATE-SIGMA**2 =  0.70677
 STANDARD ERROR OF THE ESTIMATE-SIGMA =  0.84069
 SUM OF SQUARED ERRORS-SSE=    18.376
 MEAN OF DEPENDENT VARIABLE =    29.500
 LOG OF THE LIKELIHOOD FUNCTION = -37.7835

 MODEL SELECTION TESTS - SEE JUDGE ET.AL.(1985, P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR- FPE =    0.87306
    (FPE ALSO KNOWN AS AMEMIYA PREDICTION CRITERION -PC)
  AKAIKE (1973) INFORMATION CRITERION- LOG AIC = -0.14473
  SCHWARZ(1978) CRITERION-LOG SC =  0.21441
 MODEL SELECTION TESTS - SEE RAMANATHAN(1992,P.167)
  CRAVEN-WAHBA(1979) GENERALIZED CROSS VALIDATION(1979) -
GCV=  0.92423
  HANNAN AND QUINN(1979) CRITERION -HQ=  0.97799
  RICE (1984) CRITERION-RICE=    1.0209
  SHIBATA (1981) CRITERION-SHIBATA=  0.79481
  SCHWARTZ (1978) CRITERION-SC=    1.2391
  AKAIKE (1974)INFORMATION CRITERION-AIC=  0.86525

                      ANALYSIS OF VARIANCE - FROM MEAN
                       SS          DF             MS
F
 REGRESSION         3254.1           7.         464.87
657.750
 ERROR              18.376          26.        0.70677
 TOTAL              3272.5          33.         99.167

                         ANALYSIS OF VARIANCE - FROM ZERO
                          SS          DF             MS
F
 REGRESSION         32843.           8.         4105.3
5808.616
 ERROR              18.376          26.        0.70677
 TOTAL              32861.          34.         966.50


 VARIABLE    ESTIMATED  STANDARD    T-RATIO         PARTIAL
STANDARDIZED ELASTICITY
   NAME     COEFFICIENT   ERROR       26 DF    P-VALUE CORR.
COEFFICIENT  AT MEANS
 RUV        0.83908E-02 0.3726E-02    2.252      0.033 0.404
0.0468      0.1609
```

```
 RFX          0.35495E-01 0.2288E-01    1.551      0.133 0.291
0.0785       0.1003
 DTF           3.8006      0.6729       5.648      0.000 0.742
0.1477       0.1061
 IAO          0.46700E-02 0.2817E-01   0.1658      0.870 0.032
0.0038       0.0162
 M2           0.11332      0.6829E-02   16.59      0.000 0.956
0.9557       0.5812
 RC          -0.49963E-01 0.2176E-01   -2.296      0.030-0.411
-0.0368      -0.1726
 D1          -0.82444      0.8933      -0.9229      0.365-0.178
-0.0142      -0.0008
 CONSTANT     6.1578       4.521        1.362      0.185 0.258
0.0000       0.2087

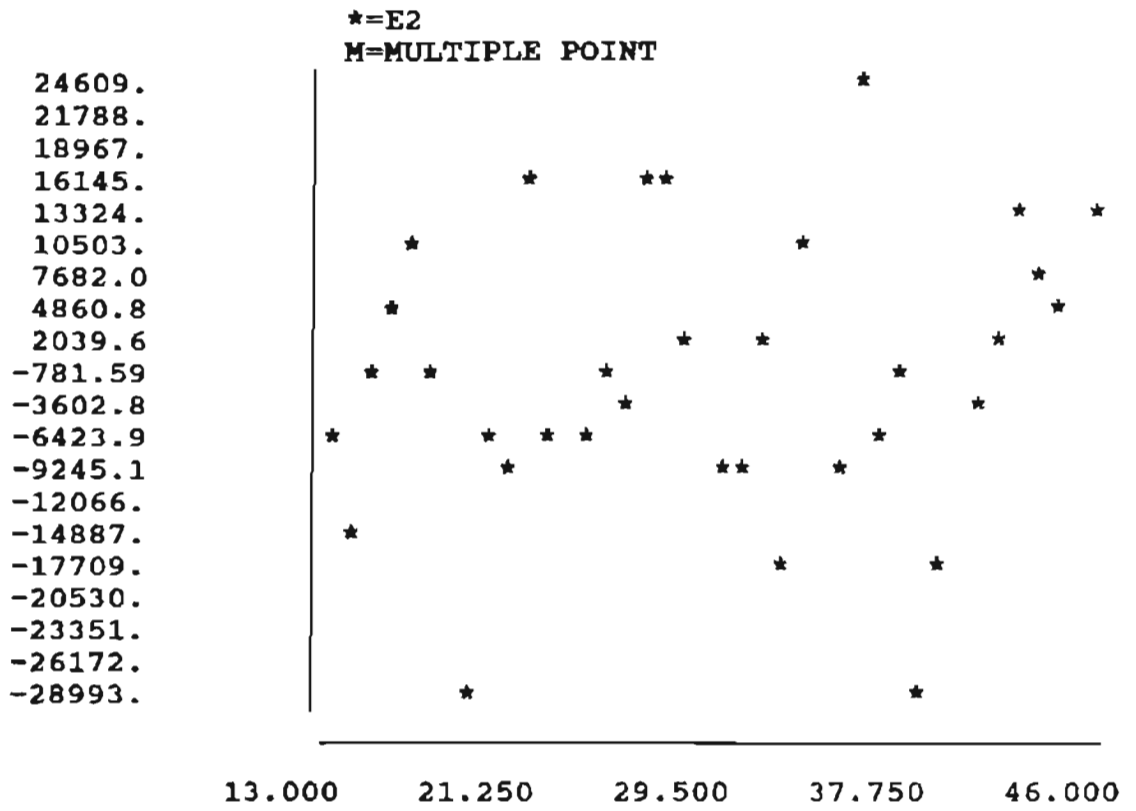
 |_PLOT IPMT YHAT2/TIME NOPRETTY

 REQUIRED MEMORY IS PAR=   10 CURRENT PAR=  500
 FOR MAXIMUM EFFICIENCY USE AT LEAST PAR=    11
        34 OBSERVATIONS
                    *=IPMT
                    +=YHAT2
                    M=MULTIPLE POINT
  0.12404E+06 |                                  M
  0.11828E+06 |
  0.11252E+06 |
  0.10676E+06 |
  0.10100E+06 |
   95246.     |                                *
   89489.     |                                          *   *
   83731.     |                             *
   77973.     |                                       M *+   +
   72215.     |                           *    +++
   66458.     |                           +++ * *              *
   60700.     |                          +           ++   *+ +
   54942.     |                    +   **    *                +
   49184.     |                 *   *     *     *          *
   43427.     |             +    +   MM   + +
   37669.     |              ++ *     ++   *            *
   31911.     |  +M*      ***+
   26153.     | +   +*
   20396.     | *     *
   14638.     |  *   ++ *
              ---------------------------------------------------
              13.000     21.250     29.500     37.750     46.000

                                  TIME

 |_PLOT E2/TIME NOPRETTY

 REQUIRED MEMORY IS PAR=   10 CURRENT PAR=  500
 FOR MAXIMUM EFFICIENCY USE AT LEAST PAR=    11
        34 OBSERVATIONS
```




```
_GENR YHAT22=YHAT2*YHAT2
_******** SKEWNESS TESTS ********
_GEN1 G12=-.2626
_** G12 has to be obtained from the OLS above
_GEN1 SQRTB21= G12*((T-2)/SQRT(T*(T-1)))
_GEN1 Y2=SQRTB21*(((T+1)(T+3))/(6*(T-2)))**0.5
_GEN1 B2SQRB21=(3*(T**2+27*T-70)(T+1)(T+3))/((T-
2)(T+5)(T+7)(T+9))
_GEN1 W22=-1+(2*(B2SQRB21-1))**0.5
_GEN1 SQRTW22=SQRT(W22)
_GEN1 DELTA2=1/SQRT(LOG(SQRTW22))
_GEN1 ALPHA2=(2/(W22-1))**0.5
_GEN1
ZSQRTB21=DELTA2*LOG((Y2/ALPHA2)+((Y2/ALPHA2)**2+1)**0.5)
_PRINT ZSQRTB21
   ZSQRTB21
-0.7815469
_******** KURTOSIS TEST ********
_GENR G22=.1116
_** G22 has to be obtained from the OLS above
_GEN1 B22=G22*((T-2)(T-3))/((T+1)(T-1))+(3*(T-1))/(T+1)
_GEN1 B22BAR=(3*(T-1))/(T+1)
_GEN1 VARB22=(24*T*(T-2)(T-3))/(((T+1)**2)(T+3)(T+5))
_GEN1 X2=(B22-B22BAR)/SQRT(VARB22)
_GEN1 SQRB1B22=((6*(T**2-
5*T+2))/((T+7)(T+9)))*SQRT((6*(T+3)(T+5))/(T*(T-2)(T-3)))
```

```
 |_GEN1
A2=6+(8/(SQRB1B22))*(2/(SQRB1B22)+SQRT(1+4/(SQRB1B22**2)))
 |_GEN1 ZB22=((1-2/(9*A2))-((1-2/A2)/(1+X*SQRT(2/(A2-
4))))**(1/3))/SQRT(2/(9*A2))
 |_PRINT  ZB22
     ZB22
    1.624648
 |_******** OMNIBUS TEST ********
 |_GEN1 K22=ZSQRTB21**2+ZB22**2
 |_PRINT K22
     K22
    3.250298
 |_**JOINT CONDITIONAL MEAN TEST
 |_GENR LAGE2=LAG(E2)
 |_SAMPLE 14 46

 |_OLS E2 T1 YHAT22 LAGE2

 REQUIRED MEMORY IS PAR=   14 CURRENT PAR=  500
  OLS ESTIMATION
       33 OBSERVATIONS     DEPENDENT VARIABLE = E2
 ...NOTE..SAMPLE RANGE SET TO:    14,    46

  R-SQUARE =    0.0351     R-SQUARE ADJUSTED =  -0.0647
 VARIANCE OF THE ESTIMATE-SIGMA**2 =  0.16751E+09
 STANDARD ERROR OF THE ESTIMATE-SIGMA =   12943.
 SUM OF SQUARED ERRORS-SSE=  0.48578E+10
 MEAN OF DEPENDENT VARIABLE =   186.63
 LOG OF THE LIKELIHOOD FUNCTION = -357.146

 MODEL SELECTION TESTS - SEE JUDGE ET.AL.(1985, P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR- FPE =   0.18782E+09
    (FPE ALSO KNOWN AS AMEMIYA PREDICTION CRITERION -PC)
  AKAIKE (1973) INFORMATION CRITERION- LOG AIC =   19.050
  SCHWARZ(1978) CRITERION-LOG SC =   19.231
 MODEL SELECTION TESTS - SEE RAMANATHAN(1992,P.167)
  CRAVEN-WAHBA(1979) GENERALIZED CROSS VALIDATION(1979) -
GCV=  0.19062E+09
  HANNAN AND QUINN(1979) CRITERION -HQ=  0.19940E+09
  RICE (1984) CRITERION-RICE=  0.19431E+09
  SHIBATA (1981) CRITERION-SHIBATA=  0.18289E+09
  SCHWARTZ (1978) CRITERION-SC=  0.22490E+09
  AKAIKE (1974)INFORMATION CRITERION-AIC=  0.18759E+09

                    ANALYSIS OF VARIANCE - FROM MEAN
                     SS          DF              MS
F
 REGRESSION      0.17685E+09      3.       0.58950E+08
0.352
 ERROR           0.48578E+10     29.       0.16751E+09
 TOTAL           0.50347E+10     32.       0.15733E+09

                    ANALYSIS OF VARIANCE - FROM ZERO
```

```
                        SS          DF            MS
F
 REGRESSION        0.17800E+09       4.        0.44500E+08
0.266
 ERROR             0.48578E+10      29.        0.16751E+09
 TOTAL             0.50358E+10      33.        0.15260E+09


 VARIABLE   ESTIMATED  STANDARD    T-RATIO         PARTIAL
STANDARDIZED ELASTICITY
   NAME    COEFFICIENT   ERROR      29 DF    P-VALUE CORR.
COEFFICIENT  AT MEANS
 T1          270.01       328.9      0.8208      0.418 0.151
0.2081     43.4034
 YHAT22    -0.51323E-06 0.1108E-05 -0.4631      0.647-0.086
-0.1169     -9.8539
 LAGE2      0.83267E-01 0.1889       0.4409      0.663 0.082
0.0820     -0.1842
 CONSTANT   -6040.3       8020.      -0.7532      0.457-0.139
0.0000    -32.3654
 |_TEST
 |_TEST T1=0
 |_TEST YHAT22=0
 |_TEST LAGE2=0
 |_END
 F STATISTIC =  0.35191577      WITH     3 AND    29 D.F.  P-
VALUE= 0.78805
 WALD CHI-SQUARE STATISTIC =    1.0557473      WITH     3 D.F.
P-VALUE= 0.78777
 UPPER BOUND ON P-VALUE BY CHEBYCHEV INEQUALITY = 1.00000
 |_**JOINT CONDITIONAL VARIANCE TEST
 |_GENR E22=E2*E2
 |_GENR LAGE22=LAG(E22)
 |_SAMPLE 14 46

 |_OLS E22 T1 YHAT22 LAGE22

 REQUIRED MEMORY IS PAR=   15 CURRENT PAR=  500
  OLS ESTIMATION
       33 OBSERVATIONS     DEPENDENT VARIABLE = E22
 ...NOTE..SAMPLE RANGE SET TO:    14,    46

  R-SQUARE =    0.0440     R-SQUARE ADJUSTED =  -0.0549
 VARIANCE OF THE ESTIMATE-SIGMA**2 =  0.47614E+17
 STANDARD ERROR OF THE ESTIMATE-SIGMA =  0.21821E+09
 SUM OF SQUARED ERRORS-SSE=  0.13808E+19
 MEAN OF DEPENDENT VARIABLE =  0.15260E+09
 LOG OF THE LIKELIHOOD FUNCTION = -678.324

 MODEL SELECTION TESTS - SEE JUDGE ET.AL.(1985, P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR- FPE =   0.53386E+17
    (FPE ALSO KNOWN AS AMEMIYA PREDICTION CRITERION -PC)
  AKAIKE (1973) INFORMATION CRITERION- LOG AIC =   38.515
  SCHWARZ(1978) CRITERION-LOG SC =   38.697
```

```
 MODEL SELECTION TESTS - SEE RAMANATHAN(1992,P.167)
  CRAVEN-WAHBA(1979) GENERALIZED CROSS VALIDATION(1979) -
GCV=  0.54182E+17
  HANNAN AND QUINN(1979) CRITERION -HQ=  0.56678E+17
  RICE (1984) CRITERION-RICE=  0.55233E+17
  SHIBATA (1981) CRITERION-SHIBATA=  0.51987E+17
  SCHWARTZ (1978) CRITERION-SC=  0.63927E+17
  AKAIKE (1974)INFORMATION CRITERION-AIC=  0.53322E+17

                        ANALYSIS OF VARIANCE - FROM MEAN
                         SS          DF              MS
F
 REGRESSION        0.63511E+17       3.       0.21170E+17
0.445
 ERROR             0.13808E+19      29.       0.47614E+17
 TOTAL             0.14443E+19      32.       0.45135E+17

                        ANALYSIS OF VARIANCE - FROM ZERO
                         SS          DF              MS
F
 REGRESSION        0.83199E+18       4.       0.20800E+18
4.368
 ERROR             0.13808E+19      29.       0.47614E+17
 TOTAL             0.22128E+19      33.       0.67055E+17


 VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL
STANDARDIZED ELASTICITY
   NAME     COEFFICIENT   ERROR      29 DF   P-VALUE CORR.
COEFFICIENT  AT MEANS
 T1         0.39767E+07 0.5477E+07  0.7261     0.474 0.134
0.1810      0.7818
 YHAT22    -0.12801E-01 0.1848E-01 -0.6928     0.494-0.128
-0.1722     -0.3006
 LAGE22    -0.16843     0.1813     -0.9291     0.361-0.170
-0.1697     -0.1622
 CONSTANT   0.10393E+09 0.1342E+09  0.7746     0.445 0.142
0.0000      0.6810
  |_TEST
  |_TEST T1=0
  |_TEST YHAT22=0
  |_TEST LAGE22=0
  |_END
 F STATISTIC =  0.44462113     WITH    3 AND   29 D.F.  P-
VALUE= 0.72293
 WALD CHI-SQUARE STATISTIC =   1.3338634     WITH    3 D.F.
P-VALUE= 0.72111
 UPPER BOUND ON P-VALUE BY CHEBYCHEV INEQUALITY = 1.00000
  |_SAMPLE 1 46
  |_GENR LNIPMT=LOG(IPMT)
  |_GENR LNRUV=LOG(RUV)
  |_GENR LNRFX=LOG(RFX)
  |_GENR LNIAO=LOG(IAO)
  |_GENR LNM2=LOG(M2)
  |_
```

```
  |_GENR LNRC=LOG(RC)
  |_GENR LNRGDP=LOG(RGDP)
  ...WARNING...ILLEGAL LOG  IN OBS.    1, VALUE REPLACED BY
ZERO     0.00000
  ...WARNING...ILLEGAL LOG  IN OBS.    2, VALUE REPLACED BY
ZERO     0.00000
  ...WARNING...ILLEGAL LOG  IN OBS.    3, VALUE REPLACED BY
ZERO     0.00000
  ...WARNING...ILLEGAL LOG  IN OBS.    4, VALUE REPLACED BY
ZERO     0.00000
  ...WARNING...ILLEGAL LOG  IN OBS.    5, VALUE REPLACED BY
ZERO     0.00000
  ...WARNING...ILLEGAL LOG  IN OBS.    6, VALUE REPLACED BY
ZERO     0.00000
  ...WARNING...ILLEGAL LOG  IN OBS.    7, VALUE REPLACED BY
ZERO     0.00000
  ...WARNING...ILLEGAL LOG  IN OBS.    8, VALUE REPLACED BY
ZERO     0.00000
  ...WARNING...ILLEGAL LOG  IN OBS.    9, VALUE REPLACED BY
ZERO     0.00000
  ...WARNING...ILLEGAL LOG  IN OBS.   10, VALUE REPLACED BY
ZERO     0.00000
  ...WARNING...ILLEGAL LOG  IN OBS.   11, VALUE REPLACED BY
ZERO     0.00000
  ...WARNING...ILLEGAL LOG  IN OBS.   12, VALUE REPLACED BY
ZERO     0.00000
  |_GENR LNTBT=LOG(TBT)
  ...WARNING...ILLEGAL LOG  IN OBS.    1, VALUE REPLACED BY
ZERO     0.00000
  ...WARNING...ILLEGAL LOG  IN OBS.    2, VALUE REPLACED BY
ZERO     0.00000
  ...WARNING...ILLEGAL LOG  IN OBS.    3, VALUE REPLACED BY
ZERO     0.00000
  ...WARNING...ILLEGAL LOG  IN OBS.    4, VALUE REPLACED BY
ZERO     0.00000
  ...WARNING...ILLEGAL LOG  IN OBS.    5, VALUE REPLACED BY
ZERO     0.00000
  ...WARNING...ILLEGAL LOG  IN OBS.    6, VALUE REPLACED BY
ZERO     0.00000
  ...WARNING...ILLEGAL LOG  IN OBS.    7, VALUE REPLACED BY
ZERO     0.00000
  ...WARNING...ILLEGAL LOG  IN OBS.    8, VALUE REPLACED BY
ZERO     0.00000
  ...WARNING...ILLEGAL LOG  IN OBS.    9, VALUE REPLACED BY
ZERO     0.00000
  ...WARNING...ILLEGAL LOG  IN OBS.   10, VALUE REPLACED BY
ZERO     0.00000
  ...WARNING...ILLEGAL LOG  IN OBS.   11, VALUE REPLACED BY
ZERO     0.00000
  ...WARNING...ILLEGAL LOG  IN OBS.   12, VALUE REPLACED BY
ZERO     0.00000

  |_OLS LNIPMT LNRUV LNRFX DTF LNIAO LNRC D1/ANOVA LM GF
RESID=E3 predict=yhat3 hetcov
```

```
 REQUIRED MEMORY IS PAR=   21 CURRENT PAR=  500
  OLS ESTIMATION
       46 OBSERVATIONS     DEPENDENT VARIABLE = LNIPMT
 ...NOTE..SAMPLE RANGE SET TO:     1,   46

 USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX

  R-SQUARE =    0.8554     R-SQUARE ADJUSTED =    0.8332
 VARIANCE OF THE ESTIMATE-SIGMA**2 =  0.75982
 STANDARD ERROR OF THE ESTIMATE-SIGMA =  0.87168
 SUM OF SQUARED ERRORS-SSE=   29.633
 MEAN OF DEPENDENT VARIABLE =   9.9150
 LOG OF THE LIKELIHOOD FUNCTION = -55.1568

 MODEL SELECTION TESTS - SEE JUDGE ET.AL.(1985, P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR- FPE =   0.87544
    (FPE ALSO KNOWN AS AMEMIYA PREDICTION CRITERION -PC)
  AKAIKE (1973) INFORMATION CRITERION- LOG AIC = -0.13541
  SCHWARZ(1978) CRITERION-LOG SC =  0.14287
 MODEL SELECTION TESTS - SEE RAMANATHAN(1992,P.167)
  CRAVEN-WAHBA(1979) GENERALIZED CROSS VALIDATION(1979) -
GCV=  0.89620
  HANNAN AND QUINN(1979) CRITERION -HQ=  0.96932
  RICE (1984) CRITERION-RICE=  0.92603
  SHIBATA (1981) CRITERION-SHIBATA=  0.84025
  SCHWARTZ (1978) CRITERION-SC=   1.1536
  AKAIKE (1974)INFORMATION CRITERION-AIC=  0.87336

                    ANALYSIS OF VARIANCE - FROM MEAN
                     SS          DF            MS
F
 REGRESSION        175.31          6.        29.218
38.453
 ERROR             29.633         39.       0.75982
 TOTAL             204.94         45.        4.5542

                    ANALYSIS OF VARIANCE - FROM ZERO
                     SS          DF            MS
F
 REGRESSION        4697.5          7.        671.07
883.192
 ERROR             29.633         39.       0.75982
 TOTAL             4727.1         46.        102.76


 VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL
STANDARDIZED ELASTICITY
   NAME    COEFFICIENT   ERROR      39 DF   P-VALUE CORR.
COEFFICIENT  AT MEANS
 LNRUV      -2.7044     0.3531     -7.660     0.000-0.775
-0.3631     -1.7280
 LNRFX      -3.9209     0.6020     -6.513     0.000-0.722
-0.9622     -1.8343
```

```
 DTF       -0.10347      0.2935      -0.3525      0.726-0.056
-0.0239     -0.0064
 LNIAO      3.0466       1.558        1.956       0.058 0.299
0.1603      1.4360
 LNRC       1.8780       1.787        1.051       0.300 0.166
0.0656      0.8731
 D1         0.26596      0.2321       1.146       0.259 0.181
0.0184      0.0006
 CONSTANT   22.397       9.958        2.249       0.030 0.339
0.0000      2.2589

 DURBIN-WATSON = 1.5793    VON NEUMANN RATIO = 1.6144    RHO
=  0.10362
 RESIDUAL SUM =  0.71054E-13  RESIDUAL VARIANCE =  0.75982
 SUM OF ABSOLUTE ERRORS=   26.176
 R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.8554
 RUNS TEST:   18 RUNS,   22 POSITIVE,   24 NEGATIVE, NORMAL
STATISTIC = -1.7798
 COEFFICIENT OF SKEWNESS =  -0.7609 WITH STANDARD DEVIATION
OF 0.3501
 COEFFICIENT OF EXCESS KURTOSIS =   3.6885 WITH STANDARD
DEVIATION OF 0.6876

      GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 10
GROUPS
 OBSERVED  2.0  0.0  0.0  4.0 18.0 12.0  9.0  0.0  0.0  1.0
 EXPECTED  0.4  1.3  3.6  7.3 10.4 10.4  7.3  3.6  1.3  0.4
 CHI-SQUARE =   25.5783 WITH  1 DEGREES OF FREEDOM

 JARQUE-BERA ASYMPTOTIC LM NORMALITY TEST
 CHI-SQUARE =   23.4360 WITH  2 DEGREES OF FREEDOM
 |_DIAGNOS/ HET ACF CHOWONE=7 RESET

 REQUIRED MEMORY IS PAR=   24 CURRENT PAR=  500
 DEPENDENT VARIABLE = LNIPMT          46 OBSERVATIONS
 REGRESSION COEFFICIENTS
   -2.70438993156      -3.92090162260     -0.103466859773
3.04659807596
    1.87799879123      0.265960589568       22.3974892404

 HETEROSKEDASTICITY TESTS
   E**2 ON YHAT:          CHI-SQUARE =     11.247 WITH 1 D.F.
   E**2 ON YHAT**2:       CHI-SQUARE =     12.152 WITH 1 D.F.
   E**2 ON LOG(YHAT**2): CHI-SQUARE =      6.832 WITH 1 D.F.
   E**2 ON X (B-P-G) TEST:       CHI-SQUARE =     15.955
WITH   6 D.F.
   E**2 ON LAG(E**2)  ARCH TEST: CHI-SQUARE =      4.573
WITH    1 D.F.
   LOG(E**2) ON X (HARVEY) TEST: CHI-SQUARE =    835.032
WITH   6 D.F.
   ABS(E) ON X (GLEJSER) TEST:   CHI-SQUARE =     19.995
WITH   6 D.F.

 RAMSEY RESET SPECIFICATION TESTS USING POWERS OF YHAT
```

```
 RESET(2)=   15.783      - F WITH DF1=   1 AND DF2=  38
 RESET(3)=   8.8290      - F WITH DF1=   2 AND DF2=  37
 RESET(4)=   5.9955      - F WITH DF1=   3 AND DF2=  36

 RESIDUAL CORRELOGRAM
  LM-TEST FOR HJ:RHO(J)=0, STATISTIC IS STANDARD NORMAL
  LAG      RHO        STD ERR      T-STAT       LM-STAT     DW-
TEST BOX-PIERCE-LJUNG
     1     0.1036     0.1474       0.7026       0.7519      1.5793
0.5266
     2     0.1314     0.1474       0.8910       0.9014      1.5042
1.3926
     3     0.1352     0.1474       0.9167       0.9282      1.4895
2.3306
     4    -0.0911     0.1474      -0.6175       0.6498      1.9374
2.7664
     5     0.3692     0.1474       2.5041       2.5572      0.8302
10.1078
     6     0.0044     0.1474       0.0297       0.0308      1.3330
10.1089
     7    -0.0005     0.1474      -0.0031       0.0034      1.3111
10.1089
     8     0.0229     0.1474       0.1554       0.1651      1.2353
10.1394
     9    -0.1203     0.1474      -0.8159       0.8680      1.5216
11.0030
    10    -0.0087     0.1474      -0.0590       0.0633      1.2784
11.0076
    11    -0.0700     0.1474      -0.4750       0.5092      1.3970
11.3170
    12    -0.0730     0.1474      -0.4951       0.5364      1.3844
11.6631
    13     0.0171     0.1474       0.1162       0.1259      1.1970
11.6827
    14    -0.1430     0.1474      -0.9700       1.0959      1.5070
13.0942
 LM CHI-SQUARE STATISTIC WITH  14  D.F. IS    10.899
 ...MATRIX IS NOT POSITIVE DEFINITE..FAILED IN ROW    3

 ...MATRIX IS NOT POSITIVE DEFINITE..FAILED IN ROW    3

 ...MATRIX IS NOT POSITIVE DEFINITE..FAILED IN ROW    3

 ...MATRIX IS NOT POSITIVE DEFINITE..FAILED IN ROW    3

 ...MATRIX IS NOT POSITIVE DEFINITE..FAILED IN ROW    3

 ...MATRIX IS NOT POSITIVE DEFINITE..FAILED IN ROW    3

 ...MATRIX IS NOT POSITIVE DEFINITE..FAILED IN ROW    3

 ...MATRIX IS NOT POSITIVE DEFINITE..FAILED IN ROW    3

 ...MATRIX IS NOT POSITIVE DEFINITE..FAILED IN ROW    3
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...MATRIX IS NOT POSITIVE DEFINITE..FAILED IN ROW     3
...MATRIX IS NOT POSITIVE DEFINITE..FAILED IN ROW     3
...MATRIX IS NOT POSITIVE DEFINITE..FAILED IN ROW     3
...MATRIX IS NOT POSITIVE DEFINITE..FAILED IN ROW     6
...MATRIX IS NOT POSITIVE DEFINITE..FAILED IN ROW     6
...MATRIX IS NOT POSITIVE DEFINITE..FAILED IN ROW     6
...MATRIX IS NOT POSITIVE DEFINITE..FAILED IN ROW     6
...MATRIX IS NOT POSITIVE DEFINITE..FAILED IN ROW     6
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...MATRIX IS NOT POSITIVE DEFINITE..FAILED IN ROW     7
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...MATRIX IS NOT POSITIVE DEFINITE..FAILED IN ROW     7
...MATRIX IS NOT POSITIVE DEFINITE..FAILED IN ROW     7
...MATRIX IS NOT POSITIVE DEFINITE..FAILED IN ROW     7


 SEQUENTIAL CHOW AND GOLDFELD-QUANDT TESTS
     N1    N2     SSE1          SSE2          CHOW          G-Q
DF1   DF2

            CHOW TEST - F DISTRIBUTION WITH DF1=   7 AND
DF2=  32
 |_Stat LNIPMT LNRUV LNRFX DTF LNIAO LNRC E3 YHAT3/ PCOR
PCOV
 NAME          N   MEAN         ST. DEV       VARIANCE
MINIMUM        MAXIMUM
 LNIPMT        46   9.9150        2.1341        4.5542
1.3863         11.728
 LNRUV         46   6.3353       0.28654       0.82108E-01
5.8641         7.9611
 LNRFX         46   4.6385       0.52371       0.27427
4.0570         5.7664
```

```
 DTF          46  0.60870       0.49344       0.24348
0.00000       1.0000
 LNIAO        46   4.6735       0.11229       0.12609E-01
4.4671        4.8881
 LNRC         46   4.6096       0.74510E-01   0.55517E-02
4.4751        4.7527
 E3           46  0.15447E-14   0.81149       0.65851      -
2.5666        2.3027
 YHAT3        46   9.9150        1.9737        3.8957
1.8669        11.894
```

CORRELATION MATRIX OF VARIABLES - 46 OBSERVATIONS

```
 LNIPMT     1.0000
 LNRUV     -0.41062       1.0000
 LNRFX     -0.84165       0.51405E-01   1.0000
 DTF        0.60782      -0.50656E-01  -0.75768       1.0000
 LNIAO     -0.69277       0.75188E-01   0.86285      -0.82444
1.0000
 LNRC       0.30034      -0.17950      -0.21676       0.21761
-0.19060
            1.0000
 E3         0.38026      -0.38902E-15  -0.64662E-15   0.14222E-
15 -0.31917E-15
           -0.90575E-16    1.0000
 YHAT3      0.92488      -0.44397      -0.91001       0.65719
-0.74903
            0.32473       0.52326E-15   1.0000
               LNIPMT        LNRUV         LNRFX         DTF
LNIAO
               LNRC          E3            YHAT3
```

COVARIANCE MATRIX OF VARIABLES - 46 OBSERVATIONS

```
 LNIPMT     4.5542
 LNRUV     -0.25110       0.82108E-01
 LNRFX     -0.94065       0.77141E-02   0.27427
 DTF        0.64005      -0.71623E-02  -0.19580       0.24348
 LNIAO     -0.16601       0.24192E-02   0.50741E-01  -0.45680E-
01   0.12609E-01
 LNRC       0.47756E-01  -0.38323E-02  -0.84583E-02   0.80005E-
02  -0.15947E-02
            0.55517E-02
 E3         0.65851      -0.90457E-16  -0.27480E-15   0.56946E-
16  -0.29083E-16
           -0.54765E-17    0.65851
 YHAT3      3.8957       -0.25110      -0.94065       0.64005
-0.16601
            0.47756E-01   0.83809E-15   3.8957
               LNIPMT        LNRUV         LNRFX         DTF
LNIAO
               LNRC          E3            YHAT3
```

```
|_ols lnruv lnrfx dtf lniao lnm2 lnrc t1 d1

 REQUIRED MEMORY IS PAR=   21 CURRENT PAR=  500
  OLS ESTIMATION
       46 OBSERVATIONS     DEPENDENT VARIABLE = LNRUV
 ...NOTE..SAMPLE RANGE SET TO:     1,   46

  R-SQUARE =    0.1268     R-SQUARE ADJUSTED =  -0.0340
 VARIANCE OF THE ESTIMATE-SIGMA**2 =  0.84902E-01
 STANDARD ERROR OF THE ESTIMATE-SIGMA =  0.29138
 SUM OF SQUARED ERRORS-SSE=    3.2263
 MEAN OF DEPENDENT VARIABLE =    6.3353
 LOG OF THE LIKELIHOOD FUNCTION = -4.15287

 MODEL SELECTION TESTS - SEE JUDGE ET.AL.(1985, P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR- FPE =   0.99667E-01
    (FPE ALSO KNOWN AS AMEMIYA PREDICTION CRITERION -PC)
  AKAIKE (1973) INFORMATION CRITERION- LOG AIC =  -2.3095
  SCHWARZ(1978) CRITERION-LOG SC =  -1.9915
 MODEL SELECTION TESTS - SEE RAMANATHAN(1992,P.167)
  CRAVEN-WAHBA(1979) GENERALIZED CROSS VALIDATION(1979) -
GCV=  0.10278
  HANNAN AND QUINN(1979) CRITERION -HQ=  0.11188
  RICE (1984) CRITERION-RICE=  0.10754
  SHIBATA (1981) CRITERION-SHIBATA=  0.94531E-01
  SCHWARTZ (1978) CRITERION-SC=  0.13650
  AKAIKE (1974)INFORMATION CRITERION-AIC=  0.99312E-01

                     ANALYSIS OF VARIANCE - FROM MEAN
                       SS          DF            MS
F
 REGRESSION        0.46859          7.       0.66942E-01
0.788
 ERROR              3.2263         38.       0.84902E-01
 TOTAL              3.6949         45.       0.82108E-01

                     ANALYSIS OF VARIANCE - FROM ZERO
                       SS          DF            MS
F
 REGRESSION         1846.7          8.        230.84
2718.916
 ERROR              3.2263         38.       0.84902E-01
 TOTAL              1849.9         46.        40.216


 VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL
STANDARDIZED ELASTICITY
   NAME     COEFFICIENT   ERROR      38 DF   P-VALUE CORR.
COEFFICIENT  AT MEANS
 LNRFX     -0.32303      0.4098     -0.7884     0.435-0.127
-0.5904     -0.2365
 DTF        0.14022      0.2346      0.5976     0.554 0.096
0.2415      0.0135
```

```
 LNIAO      0.22380      0.9246       0.2420      0.810 0.039
0.0877      0.1651
 LNM2      -0.62710      0.3961       -1.583      0.122-0.249
-2.4374     -0.4245
 LNRC      -0.22718      0.6695      -0.3393      0.736-0.055
-0.0591     -0.1653
 T1         0.37009E-01 0.1873E-01    1.976      0.055 0.305
1.7336      0.1373
 D1        -0.25446E-02 0.3065      -0.8302E-02 0.993-0.001
-0.0013      0.0000
 CONSTANT    9.5692       6.289        1.522      0.136 0.240
0.0000      1.5105

 |_ols lnrfx lnruv dtf lniao lnm2 lnrc t1 d1

 REQUIRED MEMORY IS PAR=   21 CURRENT PAR=  500
  OLS ESTIMATION
       46 OBSERVATIONS     DEPENDENT VARIABLE = LNRFX
 ...NOTE..SAMPLE RANGE SET TO:     1,   46

  R-SQUARE =    0.9597     R-SQUARE ADJUSTED =    0.9523
 VARIANCE OF THE ESTIMATE-SIGMA**2 =  0.13093E-01
 STANDARD ERROR OF THE ESTIMATE-SIGMA =  0.11442
 SUM OF SQUARED ERRORS-SSE=  0.49754
 MEAN OF DEPENDENT VARIABLE =   4.6385
 LOG OF THE LIKELIHOOD FUNCTION =  38.8436

 MODEL SELECTION TESTS - SEE JUDGE ET.AL.(1985, P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR- FPE =   0.15370E-01
    (FPE ALSO KNOWN AS AMEMIYA PREDICTION CRITERION -PC)
  AKAIKE (1973) INFORMATION CRITERION- LOG AIC =  -4.1789
  SCHWARZ(1978) CRITERION-LOG SC =  -3.8609
 MODEL SELECTION TESTS - SEE RAMANATHAN(1992,P.167)
  CRAVEN-WAHBA(1979) GENERALIZED CROSS VALIDATION(1979) -
GCV=  0.15849E-01
  HANNAN AND QUINN(1979) CRITERION -HQ=  0.17253E-01
  RICE (1984) CRITERION-RICE=  0.16585E-01
  SHIBATA (1981) CRITERION-SHIBATA=  0.14578E-01
  SCHWARTZ (1978) CRITERION-SC=  0.21049E-01
  AKAIKE (1974)INFORMATION CRITERION-AIC=  0.15315E-01

                    ANALYSIS OF VARIANCE - FROM MEAN
                     SS          DF             MS
F
 REGRESSION        11.845          7.        1.6921
129.236
 ERROR            0.49754         38.      0.13093E-01
 TOTAL             12.342         45.      0.27427

                    ANALYSIS OF VARIANCE - FROM ZERO
                     SS          DF             MS
F
 REGRESSION        1001.6          8.        125.20
9562.029
```

```
 ERROR              0.49754          38.        0.13093E-01
 TOTAL               1002.1          46.         21.784


 VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL
STANDARDIZED ELASTICITY
   NAME     COEFFICIENT   ERROR      38 DF   P-VALUE CORR.
COEFFICIENT  AT MEANS
 LNRUV     -0.49816E-01 0.6319E-01 -0.7884     0.435-0.127
-0.0273     -0.0680
 DTF        0.36196     0.7158E-01   5.057     0.000 0.634
0.3410      0.0475
 LNIAO      0.68250E-01 0.3632       0.1879    0.852 0.030
0.0146      0.0688
 LNM2      -0.77516     0.9987E-01  -7.762     0.000-0.783
-1.6485     -0.7166
 LNRC      -0.13177     0.2624      -0.5021    0.618-0.081
-0.0187     -0.1309
 T1         0.16234E-01 0.7259E-02   2.236     0.031 0.341
0.4161      0.0822
 D1        -0.58985E-01 0.1200      -0.4916    0.626-0.079
-0.0166     -0.0003
 CONSTANT   7.9662       2.191       3.636     0.001 0.508
0.0000      1.7174

 |_ols lniao lnruv lnrfx dtf lnm2 lnrc t1 d1

 REQUIRED MEMORY IS PAR=   21 CURRENT PAR=  500
  OLS ESTIMATION
       46 OBSERVATIONS     DEPENDENT VARIABLE = LNIAO
 ...NOTE..SAMPLE RANGE SET TO:     1,   46

  R-SQUARE =    0.8252     R-SQUARE ADJUSTED =    0.7931
 VARIANCE OF THE ESTIMATE-SIGMA**2 =  0.26092E-02
 STANDARD ERROR OF THE ESTIMATE-SIGMA =  0.51080E-01
 SUM OF SQUARED ERRORS-SSE=  0.99150E-01
 MEAN OF DEPENDENT VARIABLE =   4.6735
 LOG OF THE LIKELIHOOD FUNCTION =  75.9433

 MODEL SELECTION TESTS - SEE JUDGE ET.AL.(1985, P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR- FPE =   0.30630E-02
    (FPE ALSO KNOWN AS AMEMIYA PREDICTION CRITERION -PC)
  AKAIKE (1973) INFORMATION CRITERION- LOG AIC =  -5.7919
  SCHWARZ(1978) CRITERION-LOG SC =  -5.4739
 MODEL SELECTION TESTS - SEE RAMANATHAN(1992,P.167)
  CRAVEN-WAHBA(1979) GENERALIZED CROSS VALIDATION(1979) -
GCV=  0.31585E-02
  HANNAN AND QUINN(1979) CRITERION -HQ=  0.34382E-02
  RICE (1984) CRITERION-RICE=  0.33050E-02
  SHIBATA (1981) CRITERION-SHIBATA=  0.29052E-02
  SCHWARTZ (1978) CRITERION-SC=  0.41948E-02
  AKAIKE (1974)INFORMATION CRITERION-AIC=  0.30521E-02

                    ANALYSIS OF VARIANCE - FROM MEAN
```

```
                        SS          DF              MS
F
 REGRESSION        0.46823           7.        0.66890E-01
25.636
 ERROR             0.99150E-01      38.        0.26092E-02
 TOTAL             0.56738          45.        0.12609E-01

                    ANALYSIS OF VARIANCE - FROM ZERO
                        SS          DF              MS
F
 REGRESSION         1005.2           8.         125.65
48154.813
 ERROR             0.99150E-01      38.        0.26092E-02
 TOTAL              1005.3          46.         21.854


 VARIABLE   ESTIMATED  STANDARD   T-RATIO         PARTIAL
STANDARDIZED ELASTICITY
   NAME     COEFFICIENT   ERROR      38 DF    P-VALUE CORR.
COEFFICIENT  AT MEANS
 LNRUV      0.68778E-02 0.2842E-01  0.2420      0.810 0.039
0.0176      0.0093
 LNRFX      0.13601E-01 0.7238E-01  0.1879      0.852 0.030
0.0634      0.0135
 DTF       -0.40122E-01 0.4081E-01 -0.9831      0.332-0.157
-0.1763     -0.0052
 LNM2      -0.87849E-01 0.7025E-01  -1.250      0.219-0.199
-0.8713     -0.0806
 LNRC       0.19713E-01 0.1175       0.1678     0.868 0.027
0.0131      0.0194
 T1         0.15549E-02 0.3438E-02   0.4522     0.654 0.073
0.1859      0.0078
 D1        -0.84465E-02 0.5371E-01 -0.1573      0.876-0.026
-0.0111      0.0000
 CONSTANT   4.8407      0.8202        5.902     0.000 0.692
0.0000      1.0358

 |_ols t1 lnruv lnrfx dtf lniao lnm2 lnrc d1

 REQUIRED MEMORY IS PAR=   21 CURRENT PAR=  500
  OLS ESTIMATION
       46 OBSERVATIONS     DEPENDENT VARIABLE = T1
 ...NOTE..SAMPLE RANGE SET TO:     1,   46

  R-SQUARE =   0.9729     R-SQUARE ADJUSTED =   0.9679
 VARIANCE OF THE ESTIMATE-SIGMA**2 =   5.7777
 STANDARD ERROR OF THE ESTIMATE-SIGMA =   2.4037
 SUM OF SQUARED ERRORS-SSE=   219.55
 MEAN OF DEPENDENT VARIABLE =   23.500
 LOG OF THE LIKELIHOOD FUNCTION = -101.219

 MODEL SELECTION TESTS - SEE JUDGE ET.AL.(1985, P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR- FPE =    6.7825
    (FPE ALSO KNOWN AS AMEMIYA PREDICTION CRITERION -PC)
```

```
  AKAIKE (1973) INFORMATION CRITERION- LOG AIC =   1.9108
  SCHWARZ(1978) CRITERION-LOG SC =   2.2288
 MODEL SELECTION TESTS - SEE RAMANATHAN(1992,P.167)
  CRAVEN-WAHBA(1979) GENERALIZED CROSS VALIDATION(1979) -
GCV=   6.9941
  HANNAN AND QUINN(1979) CRITERION -HQ=   7.6134
  RICE (1984) CRITERION-RICE=   7.3185
  SHIBATA (1981) CRITERION-SHIBATA=   6.4330
  SCHWARTZ (1978) CRITERION-SC=   9.2888
  AKAIKE (1974)INFORMATION CRITERION-AIC=   6.7584

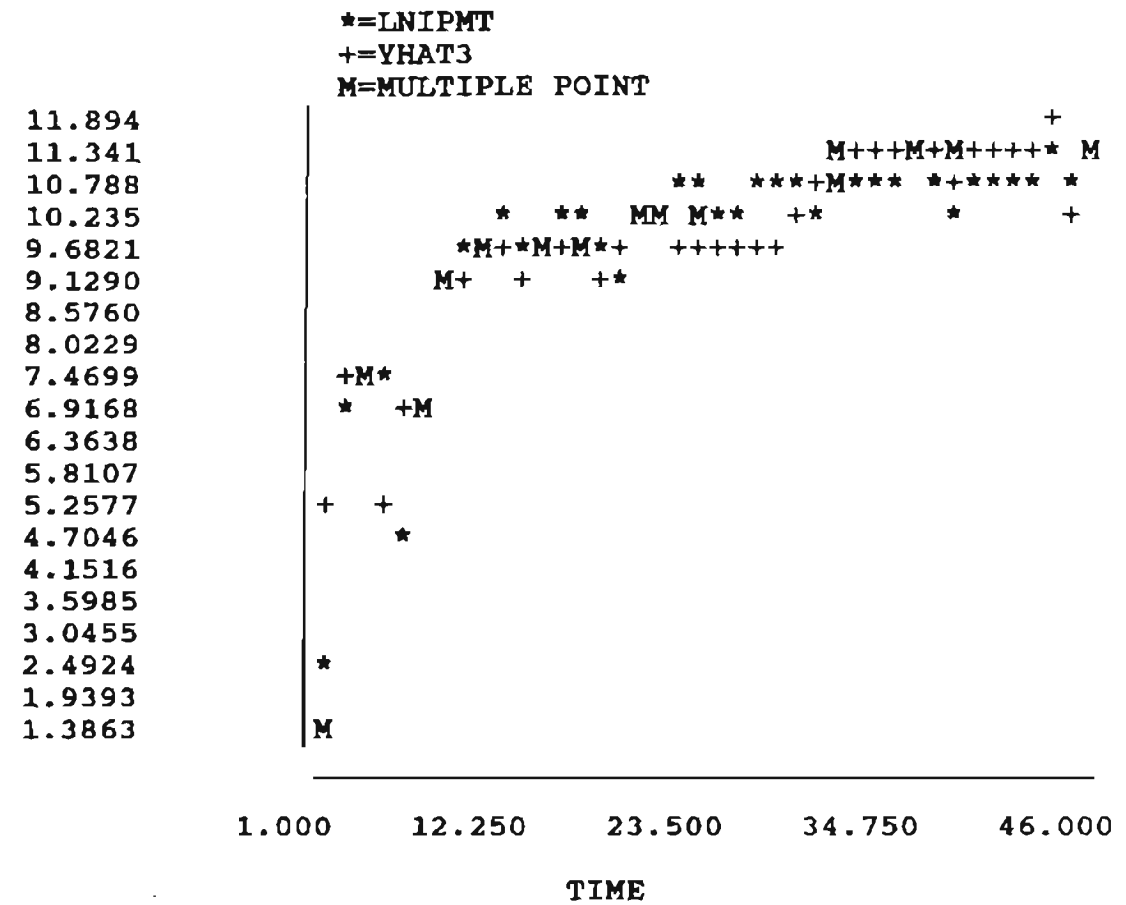
                    ANALYSIS OF VARIANCE - FROM MEAN
                     SS          DF              MS
F
 REGRESSION        7887.9          7.         1126.8
195.033
 ERROR             219.55         38.         5.7777
 TOTAL             8107.5         45.         180.17

                    ANALYSIS OF VARIANCE - FROM ZERO
                     SS          DF              MS
F
 REGRESSION        33291.          8.         4161.4
720.254
 ERROR             219.55         38.         5.7777
 TOTAL             33511.         46.         728.50


 VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL
STANDARDIZED ELASTICITY
   NAME    COEFFICIENT   ERROR      38 DF   P-VALUE CORR.
COEFFICIENT  AT MEANS
 LNRUV       2.5185      1.274       1.976     0.055 0.305
0.0538      0.6790
 LNRFX       7.1637      3.203       2.236     0.031 0.341
0.2795      1.4140
 DTF        -2.7289      1.894      -1.441     0.158-0.228
-0.1003     -0.0707
 LNIAO       3.4430      7.613      0.4522     0.654 0.073
0.0288      0.6847
 LNM2        16.592      2.033       8.161     0.000 0.798
1.3767      3.0278
 LNRC       -10.977      5.237      -2.096     0.043-0.322
-0.0609     -2.1532
 D1        -0.76219E-01  2.528    -0.3015E-01  0.976-0.005
-0.0008     -0.0001
 CONSTANT   -60.668      52.52       -1.155     0.255-0.184
0.0000     -2.5816

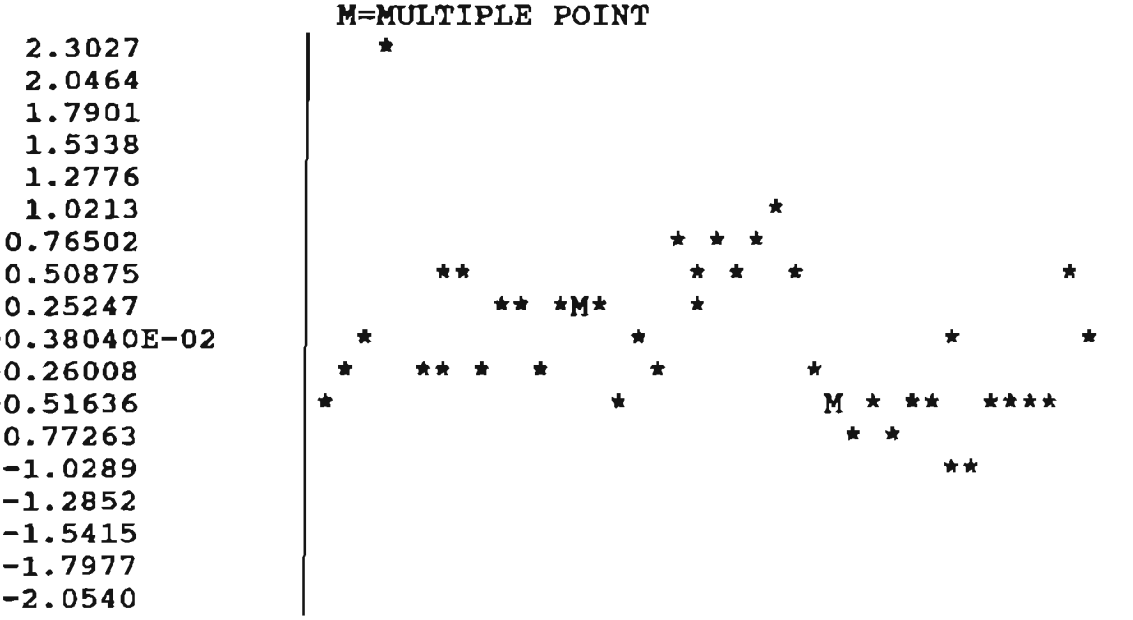
 |_PLOT LNIPMT yhat3 /TIME NOPRETTY

 REQUIRED MEMORY IS PAR=   17 CURRENT PAR=  500
 FOR MAXIMUM EFFICIENCY USE AT LEAST PAR=    18
        46 OBSERVATIONS
```




```
|_PLOT E3/TIME NOPRETTY

REQUIRED MEMORY IS PAR=   17 CURRENT PAR=  500
FOR MAXIMUM EFFICIENCY USE AT LEAST PAR=    17
       46 OBSERVATIONS
```



```
   -2.3103          |
   -2.5666          |*    *
                    |_____________________________________________

                  1.000     12.250     23.500     34.750     46.000

                                    TIME
  |_GENR YHAT32=YHAT3*YHAT3
  |_******** SKEWNESS TESTS ********
  |_GEN1 G13=-.7609
  |_** G13 has to be obtained from the OLS above
  |_GEN1 SQRTB31= G13*((T-2)/SQRT(T*(T-1)))
  |_GEN1 Y3=SQRTB31*(((T+1)(T+3))/(6*(T-2)))**0.5
  |_GEN1 B2SQRB31=(3*(T**2+27*T-70)(T+1)(T+3))/((T-
2)(T+5)(T+7)(T+9))
  |_GEN1 W23=-1+(2*(B2SQRB31-1))**0.5
  |_GEN1 SQRTW23=SQRT(W23)
  |_GEN1 DELTA3=1/SQRT(LOG(SQRTW23))
  |_GEN1 ALPHA3=(2/(W23-1))**0.5
  |_GEN1
ZSQRTB31=DELTA3*LOG((Y3/ALPHA3)+((Y3/ALPHA3)**2+1)**0.5)
  |_PRINT ZSQRTB31
      ZSQRTB31
    -2.123109
  |_******** KURTOSIS TEST ********
  |_GENR G23=3.6885
  |_** G23 has to be obtained from the OLS above
  |_GEN1 B23=G23*((T-2)(T-3))/((T+1)(T-1))+(3*(T-1))/(T+1)
  |_GEN1 B23BAR=(3*(T-1))/(T+1)
  |_GEN1 VARB23=(24*T*(T-2)(T-3))/(((T+1)**2)(T+3)(T+5))
  |_GEN1 X3=(B23-B23BAR)/SQRT(VARB23)
  |_GEN1 SQRB1B23=((6*(T**2-
5*T+2))/((T+7)(T+9)))*SQRT((6*(T+3)(T+5))/(T*(T-2)(T-3)))
  |_GEN1
A3=6+(8/(SQRB1B23))*(2/(SQRB1B23)+SQRT(1+4/(SQRB1B23**2)))
  |_GEN1 ZB23=((1-2/(9*A3))-((1-2/A3)/(1+X*SQRT(2/(A3-
4))))**(1/3))/SQRT(2/(9*A3))
  |_PRINT  ZB23
      ZB23
     1.624648
  |_******** OMNIBUS TEST ********
  |_GEN1 K23=ZSQRTB31**2+ZB23**2
  |_PRINT K23
      K23
     7.147073
  |_**jOINT CONDITIONAL MEAN TEST
  |_GENR LAGE3=LAG(E3)
 ..NOTE.LAG VALUE IN UNDEFINED OBSERVATIONS SET TO ZERO
  |_SAMPLE 2 46

  |_OLS E3 T1 YHAT32 LAGE3

 REQUIRED MEMORY IS PAR=   21 CURRENT PAR=  500
  OLS ESTIMATION
```

```
      45 OBSERVATIONS     DEPENDENT VARIABLE = E3
 ...NOTE..SAMPLE RANGE SET TO:     2,    46

  R-SQUARE =    0.0845     R-SQUARE ADJUSTED =    0.0175
 VARIANCE OF THE ESTIMATE-SIGMA**2 =  0.51742
 STANDARD ERROR OF THE ESTIMATE-SIGMA =  0.71932
 SUM OF SQUARED ERRORS-SSE=    21.214
 MEAN OF DEPENDENT VARIABLE =  0.55870E-01
 LOG OF THE LIKELIHOOD FUNCTION = -46.9324

 MODEL SELECTION TESTS - SEE JUDGE ET.AL.(1985, P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR- FPE =    0.56341
    (FPE ALSO KNOWN AS AMEMIYA PREDICTION CRITERION -PC)
  AKAIKE (1973) INFORMATION CRITERION- LOG AIC = -0.57422
  SCHWARZ(1978) CRITERION-LOG SC = -0.41362
 MODEL SELECTION TESTS - SEE RAMANATHAN(1992,P.167)
  CRAVEN-WAHBA(1979) GENERALIZED CROSS VALIDATION(1979) -
GCV=  0.56790
  HANNAN AND QUINN(1979) CRITERION -HQ=  0.59789
  RICE (1984) CRITERION-RICE=  0.57336
  SHIBATA (1981) CRITERION-SHIBATA=  0.55523
  SCHWARTZ (1978) CRITERION-SC=  0.66125
  AKAIKE (1974)INFORMATION CRITERION-AIC=  0.56315

                      ANALYSIS OF VARIANCE - FROM MEAN
                       SS          DF            MS
F
 REGRESSION        1.9575           3.       0.65250
1.261
 ERROR             21.214          41.       0.51742
 TOTAL             23.172          44.       0.52663

                      ANALYSIS OF VARIANCE - FROM ZERO
                       SS          DF            MS
F
 REGRESSION        2.0980           4.       0.52449
1.014
 ERROR             21.214          41.       0.51742
 TOTAL             23.312          45.       0.51805


 VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL
STANDARDIZED ELASTICITY
   NAME    COEFFICIENT   ERROR      41 DF   P-VALUE CORR.
COEFFICIENT  AT MEANS
 T1         0.61385E-02 0.1648E-01  0.3725     0.711 0.058
0.1111      2.6369
 YHAT32    -0.84522E-02 0.7069E-02  -1.196     0.239-0.184
-0.3563    -15.6884
 LAGE3      0.12464     0.1350      0.9230     0.361 0.143
0.1409     -0.0039
 CONSTANT   0.78527     0.4515       1.739     0.089 0.262
0.0000     14.0553
 |_TEST
```

```
 |_TEST T1=0
 |_TEST YHAT32=0
 |_TEST LAGE3=0
 |_END
  F STATISTIC =   1.2610660      WITH    3 AND   41 D.F.  P-
VALUE= 0.30034
  WALD CHI-SQUARE STATISTIC =   3.7831980      WITH    3 D.F.
P-VALUE= 0.28585
  UPPER BOUND ON P-VALUE BY CHEBYCHEV INEQUALITY = 0.79298
 |_**JOINT CONDITIONAL VARIANCE TEST
 |_GENR E32=E3*E3
 |_GENR LAGE32=LAG(E32)
 |_SAMPLE 2 46

 |_OLS E32 T1 YHAT32 LAGE32

  REQUIRED MEMORY IS PAR=   22 CURRENT PAR=  500
   OLS ESTIMATION
        45 OBSERVATIONS     DEPENDENT VARIABLE = E32
  ...NOTE..SAMPLE RANGE SET TO:     2,    46

   R-SQUARE =    0.2990     R-SQUARE ADJUSTED =    0.2477
  VARIANCE OF THE ESTIMATE-SIGMA**2 =    1.1249
  STANDARD ERROR OF THE ESTIMATE-SIGMA =    1.0606
  SUM OF SQUARED ERRORS-SSE=    46.121
  MEAN OF DEPENDENT VARIABLE =  0.51805
  LOG OF THE LIKELIHOOD FUNCTION = -64.4060

  MODEL SELECTION TESTS - SEE JUDGE ET.AL.(1985, P.242)
   AKAIKE (1969) FINAL PREDICTION ERROR- FPE =     1.2249
     (FPE ALSO KNOWN AS AMEMIYA PREDICTION CRITERION -PC)
   AKAIKE (1973) INFORMATION CRITERION- LOG AIC =  0.20239
   SCHWARZ(1978) CRITERION-LOG SC =  0.36298
  MODEL SELECTION TESTS - SEE RAMANATHAN(1992,P.167)
   CRAVEN-WAHBA(1979) GENERALIZED CROSS VALIDATION(1979) -
GCV=    1.2347
   HANNAN AND QUINN(1979) CRITERION -HQ=    1.2999
   RICE (1984) CRITERION-RICE=    1.2465
   SHIBATA (1981) CRITERION-SHIBATA=    1.2071
   SCHWARTZ (1978) CRITERION-SC=    1.4376
   AKAIKE (1974)INFORMATION CRITERION-AIC=    1.2243

                      ANALYSIS OF VARIANCE - FROM MEAN
                        SS          DF              MS
F
 REGRESSION         19.668           3.         6.5560
5.828
 ERROR              46.121          41.         1.1249
 TOTAL              65.789          44.         1.4952

                      ANALYSIS OF VARIANCE - FROM ZERO
                        SS          DF              MS
F
```

```
 REGRESSION          31.745            4.          7.9362
7.055
 ERROR               46.121           41.          1.1249
 TOTAL               77.866           45.          1.7304


 VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL
STANDARDIZED ELASTICITY
   NAME     COEFFICIENT   ERROR      41 DF   P-VALUE CORR.
COEFFICIENT  AT MEANS
 T1         0.32637E-01 0.2388E-01   1.367     0.179 0.209
0.3506      1.5120
 YHAT32    -0.25007E-01 0.1049E-01  -2.384     0.022-0.349
-0.6257     -5.0059
 LAGE32     0.30534      0.1376       2.218     0.032 0.327
0.3054      0.3053
 CONSTANT    2.1699      0.7124       3.046     0.004 0.430
0.0000      4.1886
  |_TEST
  |_TEST T1=0
  |_TEST YHAT32=0
  |_TEST LAGE32=0
  |_END
 F STATISTIC =   5.8280406      WITH     3 AND    41 D.F.  P-
VALUE= 0.00206
 WALD CHI-SQUARE STATISTIC =   17.484122      WITH     3 D.F.
P-VALUE= 0.00056
 UPPER BOUND ON P-VALUE BY CHEBYCHEV INEQUALITY = 0.17158
 |_SAMPLE 13 46

 |_OLS LNIPMT LNRUV LNRGDP LNRFX DTF LNIAO LNRC LNTBT
D1/ANOVA LM GF RESID=E4 PREDICT=YHAT4 hetcov

 REQUIRED MEMORY IS PAR=   24 CURRENT PAR=  500
  OLS ESTIMATION
       34 OBSERVATIONS     DEPENDENT VARIABLE = LNIPMT
 ...NOTE..SAMPLE RANGE SET TO:   13,   46

 USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX

  R-SQUARE =   0.6791     R-SQUARE ADJUSTED =   0.5764
 VARIANCE OF THE ESTIMATE-SIGMA**2 =  0.10604
 STANDARD ERROR OF THE ESTIMATE-SIGMA =  0.32564
 SUM OF SQUARED ERRORS-SSE=   2.6510
 MEAN OF DEPENDENT VARIABLE =   10.803
 LOG OF THE LIKELIHOOD FUNCTION = -4.86946

 MODEL SELECTION TESTS - SEE JUDGE ET.AL.(1985, P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR- FPE =   0.13411
    (FPE ALSO KNOWN AS AMEMIYA PREDICTION CRITERION -PC)
  AKAIKE (1973) INFORMATION CRITERION- LOG AIC =  -2.0220
  SCHWARZ(1978) CRITERION-LOG SC =  -1.6180
 MODEL SELECTION TESTS - SEE RAMANATHAN(1992,P.167)
```

CRAVEN-WAHBA(1979) GENERALIZED CROSS VALIDATION(1979) - GCV= 0.14421
HANNAN AND QUINN(1979) CRITERION -HQ= 0.15194
RICE (1984) CRITERION-RICE= 0.16569
SHIBATA (1981) CRITERION-SHIBATA= 0.11925
SCHWARTZ (1978) CRITERION-SC= 0.19830
AKAIKE (1974)INFORMATION CRITERION-AIC= 0.13239

ANALYSIS OF VARIANCE - FROM MEAN

	SS	DF	MS	F
REGRESSION	5.6103	8.	0.70129	6.614
ERROR	2.6510	25.	0.10604	
TOTAL	8.2613	33.	0.25034	

ANALYSIS OF VARIANCE - FROM ZERO

	SS	DF	MS	F
REGRESSION	3973.6	9.	441.51	4163.725
ERROR	2.6510	25.	0.10604	
TOTAL	3976.3	34.	116.95	

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	T-RATIO 25 DF	PARTIAL P-VALUE	CORR. COEFFICIENT	STANDARDIZED ELASTICITY AT MEANS
LNRUV	0.14025	0.5949	0.2358	0.816	0.047	0.0822
LNRGDP	-0.30245	1.063	-0.2845	0.778	-0.057	-0.1287
LNRFX	-0.97056	0.3639	-2.667	0.013	-0.471	-0.3942
DTF	0.67272	0.1938	3.472	0.002	0.570	0.0513
LNIAO	0.82765	0.6599	1.254	0.221	0.243	0.3542
LNRC	0.29054	1.075	0.2702	0.789	0.054	0.1243
LNTBT	-0.22902	0.1326	-1.727	0.097	-0.326	-0.0092
D1	0.54265	0.1092	4.972	0.000	0.705	0.0015
CONSTANT	9.9245	5.370	1.848	0.076	0.347	0.9187

DURBIN-WATSON = 1.5448 VON NEUMANN RATIO = 1.5916 RHO = 0.21170
RESIDUAL SUM = -0.22560E-12 RESIDUAL VARIANCE = 0.10604
SUM OF ABSOLUTE ERRORS= 6.8367
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.6791

```
 RUNS TEST:   12 RUNS,   19 POSITIVE,   15 NEGATIVE, NORMAL
STATISTIC = -2.0370
 COEFFICIENT OF SKEWNESS =  -1.5700 WITH STANDARD DEVIATION
OF 0.4031
 COEFFICIENT OF EXCESS KURTOSIS =   3.9362 WITH STANDARD
DEVIATION OF 0.7879

      GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 12
GROUPS
 OBSERVED  1.0  0.0  1.0  1.0  4.0  8.0  8.0  7.0  4.0  0.0
0.0  0.0
 EXPECTED  0.2  0.6  1.5  3.1  5.1  6.5  6.5  5.1  3.1  1.5
0.6  0.2
 CHI-SQUARE =    9.2741 WITH  1 DEGREES OF FREEDOM

 JARQUE-BERA ASYMPTOTIC LM NORMALITY TEST
 CHI-SQUARE =   27.3391 WITH  2 DEGREES OF FREEDOM
 |_DIAGNOS/ HET ACF RESET

 REQUIRED MEMORY IS PAR=   27 CURRENT PAR=  500
 DEPENDENT VARIABLE = LNIPMT          34 OBSERVATIONS
 REGRESSION COEFFICIENTS
   0.140253059273     -0.302449638981     -0.970558113036
0.672721534399
   0.827651189461      0.290543348822     -0.229017307842
0.542653285558
    9.92450341455

 HETEROSKEDASTICITY TESTS
   E**2 ON YHAT:          CHI-SQUARE =      0.406 WITH 1 D.F.
   E**2 ON YHAT**2:       CHI-SQUARE =      0.432 WITH 1 D.F.
   E**2 ON LOG(YHAT**2): CHI-SQUARE =      0.380 WITH 1 D.F.
   E**2 ON X (B-P-G) TEST:        CHI-SQUARE =      3.531
WITH   8 D.F.
   E**2 ON LAG(E**2)  ARCH TEST: CHI-SQUARE =      0.311
WITH    1 D.F.
   LOG(E**2) ON X (HARVEY) TEST: CHI-SQUARE =    749.968
WITH   8 D.F.
   ABS(E) ON X (GLEJSER) TEST:   CHI-SQUARE =      6.142
WITH   8 D.F.

 RAMSEY RESET SPECIFICATION TESTS USING POWERS OF YHAT
  RESET(2)=   1.6560     - F WITH DF1=   1 AND DF2=  24
  RESET(3)=  0.81754     - F WITH DF1=   2 AND DF2=  23
  RESET(4)=  0.53860     - F WITH DF1=   3 AND DF2=  22

 RESIDUAL CORRELOGRAM
  LM-TEST FOR HJ:RHO(J)=0, STATISTIC IS STANDARD NORMAL
  LAG      RHO        STD ERR      T-STAT      LM-STAT     DW-
TEST BOX-PIERCE-LJUNG
    1     0.2075      0.1715      1.2101      1.3244      1.5448
1.5975
    2     0.0315      0.1715      0.1839      0.1936      1.8260
1.6355
```

```
     3    -0.3988      0.1715     -2.3252      2.4759      2.6647
7.9142
     4    -0.2054      0.1715     -1.1979      1.2865      2.2379
9.6363
     5     0.0662      0.1715      0.3859      0.4263      1.6794
9.8212
     6     0.0499      0.1715      0.2912      0.3272      1.7116
9.9302
     7     0.0686      0.1715      0.4000      0.4449      1.2464
10.1435
     8    -0.1682      0.1715     -0.9806      1.2009      1.5951
11.4750
     9    -0.0498      0.1715     -0.2904      0.3449      1.3461
11.5965
    10    -0.0051      0.1715     -0.0298      0.0362      1.2056
11.5978
 LM CHI-SQUARE STATISTIC WITH  10  D.F. IS      9.780
 |_STAT LNIPMT LNRUV LNRGDP LNRFX DTF LNIAO LNRC LNTBT E4
YHAT4/ PCOR PCOV
 NAME          N    MEAN          ST. DEV       VARIANCE
MINIMUM        MAXIMUM
 LNIPMT        34    10.803       0.50034       0.25034
9.5914         11.728
 LNRUV         34    6.3338       0.93150E-01   0.86769E-02
6.1661         6.6239
 LNRGDP        34    4.5981       0.75298E-01   0.56699E-02
4.4601         4.7318
 LNRFX         34    4.3878       0.27026       0.73043E-01
4.0570         4.7825
 DTF           34   0.82353       0.38695       0.14973
0.00000         1.0000
 LNIAO         34    4.6227       0.78082E-01   0.60968E-02
4.4671         4.7816
 LNRC          34    4.6215       0.71534E-01   0.51170E-02
4.4751         4.7527
 LNTBT         34   0.43259       0.40011       0.16009      -
0.61990         1.0332
 E4            34 -0.66352E-14    0.28343       0.80332E-01   -
1.0167        0.36543
 YHAT4         34    10.803       0.41232       0.17001
10.001         11.728

  CORRELATION MATRIX OF VARIABLES -        34 OBSERVATIONS


 LNIPMT      1.0000
 LNRUV      0.10834       1.0000
 LNRGDP    -0.18558      -0.28432       1.0000
 LNRFX     -0.73003      -0.38098      0.31780        1.0000
 DTF        0.61618      -0.23479      0.48536E-01 -0.51912
1.0000
 LNIAO     -0.51581      -0.97552E-01  0.20735       0.69159
-0.63481
             1.0000
```

```
 LNRC      -0.12964      -0.18765       0.86988       0.23184
0.29454E-01
           0.14467       1.0000
 LNTBT      0.13234       0.30137E-01 -0.32953E-01 -0.15467
0.55762
          -0.43286      -0.33554E-01   1.0000
 E4         0.56647       0.48966E-15 -0.79371E-15 -0.11436E-
14 -0.12066E-14
           0.40718E-15   0.37506E-15 -0.11047E-14   1.0000
 YHAT4      0.82408       0.13147      -0.22520      -0.88587
0.74772
          -0.62592      -0.15732       0.16059       0.40639E-
15   1.0000
               LNIPMT        LNRUV         LNRGDP        LNRFX
DTF
               LNIAO         LNRC          LNTBT         E4
YHAT4

  COVARIANCE MATRIX OF VARIABLES -       34 OBSERVATIONS


 LNIPMT     0.25034
 LNRUV      0.50493E-02  0.86769E-02
 LNRGDP    -0.69918E-02 -0.19943E-02  0.56699E-02
 LNRFX     -0.98718E-01 -0.95911E-02  0.64675E-02  0.73043E-
01
 DTF        0.11930      -0.84630E-02  0.14142E-02 -0.54290E-
01   0.14973
 LNIAO     -0.20151E-01 -0.70953E-03  0.12191E-02  0.14595E-
01 -0.19180E-01
           0.60968E-02
 LNRC      -0.46400E-02 -0.12504E-02  0.46855E-02  0.44821E-
02   0.81530E-03
           0.80805E-03   0.51170E-02
 LNTBT      0.26493E-01   0.11232E-02 -0.99279E-03 -0.16726E-
01   0.86334E-01
          -0.13523E-01 -0.96038E-03   0.16009
 E4         0.80332E-01   0.12928E-16 -0.16939E-16 -0.87599E-
16 -0.13233E-15
           0.90112E-17   0.76042E-17 -0.12528E-15   0.80332E-
01
 YHAT4      0.17001       0.50493E-02 -0.69918E-02 -0.98718E-
01   0.11930
          -0.20151E-01 -0.46400E-02   0.26493E-01   0.47492E-
16   0.17001
               LNIPMT        LNRUV         LNRGDP        LNRFX
DTF
               LNIAO         LNRC          LNTBT         E4
YHAT4

 |_ols lnruv lnrfx dtf lniao lnm2 lnrc t1 d1

 REQUIRED MEMORY IS PAR=   24 CURRENT PAR=  500
  OLS ESTIMATION
```

```
       34 OBSERVATIONS     DEPENDENT VARIABLE = LNRUV
  ...NOTE..SAMPLE RANGE SET TO:    13,    46

   R-SQUARE =    0.5828      R-SQUARE ADJUSTED =    0.4704
  VARIANCE OF THE ESTIMATE-SIGMA**2 =  0.45948E-02
  STANDARD ERROR OF THE ESTIMATE-SIGMA =  0.67785E-01
  SUM OF SQUARED ERRORS-SSE=  0.11947
  MEAN OF DEPENDENT VARIABLE =    6.3338
  LOG OF THE LIKELIHOOD FUNCTION =  47.8245

  MODEL SELECTION TESTS - SEE JUDGE ET.AL.(1985, P.242)
   AKAIKE (1969) FINAL PREDICTION ERROR- FPE =    0.56760E-02
     (FPE ALSO KNOWN AS AMEMIYA PREDICTION CRITERION -PC)
   AKAIKE (1973) INFORMATION CRITERION- LOG AIC =  -5.1805
   SCHWARZ(1978) CRITERION-LOG SC =  -4.8214
  MODEL SELECTION TESTS - SEE RAMANATHAN(1992,P.167)
   CRAVEN-WAHBA(1979) GENERALIZED CROSS VALIDATION(1979) -
GCV=  0.60086E-02
   HANNAN AND QUINN(1979) CRITERION -HQ=  0.63582E-02
   RICE (1984) CRITERION-RICE=  0.66370E-02
   SHIBATA (1981) CRITERION-SHIBATA=  0.51672E-02
   SCHWARTZ (1978) CRITERION-SC=  0.80559E-02
   AKAIKE (1974)INFORMATION CRITERION-AIC=  0.56252E-02

                      ANALYSIS OF VARIANCE - FROM MEAN
                        SS          DF            MS
F
 REGRESSION        0.16687           7.       0.23839E-01
5.188
 ERROR             0.11947          26.       0.45948E-02
 TOTAL             0.28634          33.       0.86769E-02

                      ANALYSIS OF VARIANCE - FROM ZERO
                        SS          DF            MS
F
 REGRESSION         1364.1           8.        170.52
37110.231
 ERROR             0.11947          26.       0.45948E-02
 TOTAL              1364.2          34.        40.125


 VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL
STANDARDIZED ELASTICITY
   NAME    COEFFICIENT   ERROR      26 DF   P-VALUE CORR.
COEFFICIENT  AT MEANS
 LNRFX      0.11374      0.1638      0.6943      0.494 0.135
0.3300      0.0788
 DTF       -0.20509      0.7354E-01  -2.789      0.010-0.480
-0.8520     -0.0267
 LNIAO     -0.46178E-02 0.2349      -0.1966E-01 0.984-0.004
-0.0039     -0.0034
 LNM2      -0.75590E-01 0.1543      -0.4900      0.628-0.096
-0.5399     -0.0577
```

```
 LNRC        0.13391      0.1826       0.7332      0.470 0.142
0.1028       0.0977
 T1          0.16680E-01 0.7478E-02    2.231       0.035 0.401
1.7832       0.0777
 D1          0.40142E-01 0.7299E-01    0.5500      0.587 0.107
0.0739       0.0002
 CONSTANT     5.2780       1.787        2.954       0.007 0.501
0.0000       0.8333

 |_ols lnrfx lnruv dtf lniao lnm2 lnrc t1 d1

 REQUIRED MEMORY IS PAR=   24 CURRENT PAR=  500
  OLS ESTIMATION
       34 OBSERVATIONS     DEPENDENT VARIABLE = LNRFX
 ...NOTE..SAMPLE RANGE SET TO:    13,    46

  R-SQUARE =    0.9303     R-SQUARE ADJUSTED =    0.9115
 VARIANCE OF THE ESTIMATE-SIGMA**2 =  0.64659E-02
 STANDARD ERROR OF THE ESTIMATE-SIGMA =  0.80411E-01
 SUM OF SQUARED ERRORS-SSE=  0.16811
 MEAN OF DEPENDENT VARIABLE =   4.3878
 LOG OF THE LIKELIHOOD FUNCTION =  42.0172

 MODEL SELECTION TESTS - SEE JUDGE ET.AL.(1985, P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR- FPE =   0.79873E-02
    (FPE ALSO KNOWN AS AMEMIYA PREDICTION CRITERION -PC)
  AKAIKE (1973) INFORMATION CRITERION- LOG AIC =  -4.8389
  SCHWARZ(1978) CRITERION-LOG SC =  -4.4797
 MODEL SELECTION TESTS - SEE RAMANATHAN(1992,P.167)
  CRAVEN-WAHBA(1979) GENERALIZED CROSS VALIDATION(1979) -
GCV=  0.84554E-02
  HANNAN AND QUINN(1979) CRITERION -HQ=  0.89472E-02
  RICE (1984) CRITERION-RICE=  0.93396E-02
  SHIBATA (1981) CRITERION-SHIBATA=  0.72713E-02
  SCHWARTZ (1978) CRITERION-SC=  0.11336E-01
  AKAIKE (1974)INFORMATION CRITERION-AIC=  0.79158E-02

                    ANALYSIS OF VARIANCE - FROM MEAN
                      SS          DF            MS
F
 REGRESSION        2.2423          7.       0.32033
49.541
 ERROR            0.16811         26.       0.64659E-02
 TOTAL             2.4104         33.       0.73043E-01

                    ANALYSIS OF VARIANCE - FROM ZERO
                      SS          DF            MS
F
 REGRESSION        656.84          8.        82.105
12698.207
 ERROR            0.16811         26.       0.64659E-02
 TOTAL             657.01         34.        19.324
```

```
 VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL
STANDARDIZED ELASTICITY
   NAME     COEFFICIENT   ERROR      26 DF   P-VALUE CORR.
COEFFICIENT  AT MEANS
 LNRUV      0.16005      0.2305      0.6943     0.494 0.135
0.0552      0.2310
 DTF        0.32224      0.7677E-01   4.197     0.000 0.636
0.4614      0.0605
 LNIAO      0.23334      0.2749      0.8488     0.404 0.164
0.0674      0.2458
 LNM2      -0.51295      0.1539      -3.333     0.003-0.547
-1.2626     -0.5648
 LNRC      -0.17773      0.2161     -0.8225     0.418-0.159
-0.0470     -0.1872
 T1         0.76814E-03 0.9681E-02  0.7934E-01 0.937 0.016
0.0283      0.0052
 D1        -0.84891E-01 0.8548E-01 -0.9932     0.330-0.191
-0.0539     -0.0006
 CONSTANT    5.3095       2.217       2.395     0.024 0.425
0.0000      1.2101

 |_ols lniao lnruv lnrfx dtf lnm2 lnrc t1 d1

 REQUIRED MEMORY IS PAR=   24 CURRENT PAR=  500
  OLS ESTIMATION
       34 OBSERVATIONS     DEPENDENT VARIABLE = LNIAO
 ...NOTE..SAMPLE RANGE SET TO:   13,   46

  R-SQUARE =   0.5862     R-SQUARE ADJUSTED =   0.4748
 VARIANCE OF THE ESTIMATE-SIGMA**2 =  0.32019E-02
 STANDARD ERROR OF THE ESTIMATE-SIGMA =  0.56586E-01
 SUM OF SQUARED ERRORS-SSE=  0.83250E-01
 MEAN OF DEPENDENT VARIABLE =   4.6227
 LOG OF THE LIKELIHOOD FUNCTION =  53.9646

 MODEL SELECTION TESTS - SEE JUDGE ET.AL.(1985, P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR- FPE =   0.39553E-02
    (FPE ALSO KNOWN AS AMEMIYA PREDICTION CRITERION -PC)
  AKAIKE (1973) INFORMATION CRITERION- LOG AIC =  -5.5417
  SCHWARZ(1978) CRITERION-LOG SC =  -5.1825
 MODEL SELECTION TESTS - SEE RAMANATHAN(1992,P.167)
  CRAVEN-WAHBA(1979) GENERALIZED CROSS VALIDATION(1979) -
GCV=  0.41872E-02
  HANNAN AND QUINN(1979) CRITERION -HQ=  0.44307E-02
  RICE (1984) CRITERION-RICE=  0.46250E-02
  SHIBATA (1981) CRITERION-SHIBATA=  0.36008E-02
  SCHWARTZ (1978) CRITERION-SC=  0.56138E-02
  AKAIKE (1974)INFORMATION CRITERION-AIC=  0.39200E-02

                    ANALYSIS OF VARIANCE - FROM MEAN
                     SS          DF            MS
F
 REGRESSION       0.11794          7.       0.16849E-01
5.262
```

```
 ERROR              0.83250E-01      26.        0.32019E-02
 TOTAL              0.20120          33.        0.60968E-02

                        ANALYSIS OF VARIANCE - FROM ZERO
                          SS             DF              MS
F
 REGRESSION          726.67            8.          90.833
28368.177
 ERROR              0.83250E-01      26.        0.32019E-02
 TOTAL               726.75          34.         21.375


 VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL
STANDARDIZED ELASTICITY
   NAME     COEFFICIENT   ERROR      26 DF   P-VALUE CORR.
COEFFICIENT  AT MEANS
 LNRUV     -0.32179E-02 0.1637     -0.1966E-01 0.984-0.004
-0.0038     -0.0044
 LNRFX      0.11555     0.1361      0.8488      0.404 0.164
0.3999      0.1097
 DTF       -0.63273E-01 0.6886E-01 -0.9188      0.367-0.177
-0.3136     -0.0113
 LNM2      -0.44931E-01 0.1291     -0.3481      0.731-0.068
-0.3828     -0.0470
 LNRC       0.49228E-01 0.1537      0.3202      0.751 0.063
0.0451      0.0492
 T1         0.19939E-02 0.6802E-02  0.2931      0.772 0.057
0.2543      0.0127
 D1         0.26558E-02 0.6128E-01  0.4334E-01 0.966 0.008
0.0058      0.0000
 CONSTANT    4.1188      1.523       2.705      0.012 0.469
0.0000      0.8910

 |_ols t1 lnruv lnrfx dtf lniao lnm2 lnrc d1

 REQUIRED MEMORY IS PAR=   24 CURRENT PAR=  500
  OLS ESTIMATION
       34 OBSERVATIONS     DEPENDENT VARIABLE = T1
 ...NOTE..SAMPLE RANGE SET TO:   13,   46

  R-SQUARE =   0.9789     R-SQUARE ADJUSTED =   0.9733
 VARIANCE OF THE ESTIMATE-SIGMA**2 =   2.6526
 STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.6287
 SUM OF SQUARED ERRORS-SSE=   68.969
 MEAN OF DEPENDENT VARIABLE =   29.500
 LOG OF THE LIKELIHOOD FUNCTION = -60.2679

 MODEL SELECTION TESTS - SEE JUDGE ET.AL.(1985, P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR- FPE =    3.2768
    (FPE ALSO KNOWN AS AMEMIYA PREDICTION CRITERION -PC)
  AKAIKE (1973) INFORMATION CRITERION- LOG AIC =   1.1779
  SCHWARZ(1978) CRITERION-LOG SC =   1.5370
 MODEL SELECTION TESTS - SEE RAMANATHAN(1992,P.167)
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  CRAVEN-WAHBA(1979) GENERALIZED CROSS VALIDATION(1979) -
GCV=    3.4688
  HANNAN AND QUINN(1979) CRITERION -HQ=    3.6706
  RICE (1984) CRITERION-RICE=    3.8316
  SHIBATA (1981) CRITERION-SHIBATA=    2.9831
  SCHWARTZ (1978) CRITERION-SC=    4.6507
  AKAIKE (1974)INFORMATION CRITERION-AIC=    3.2475

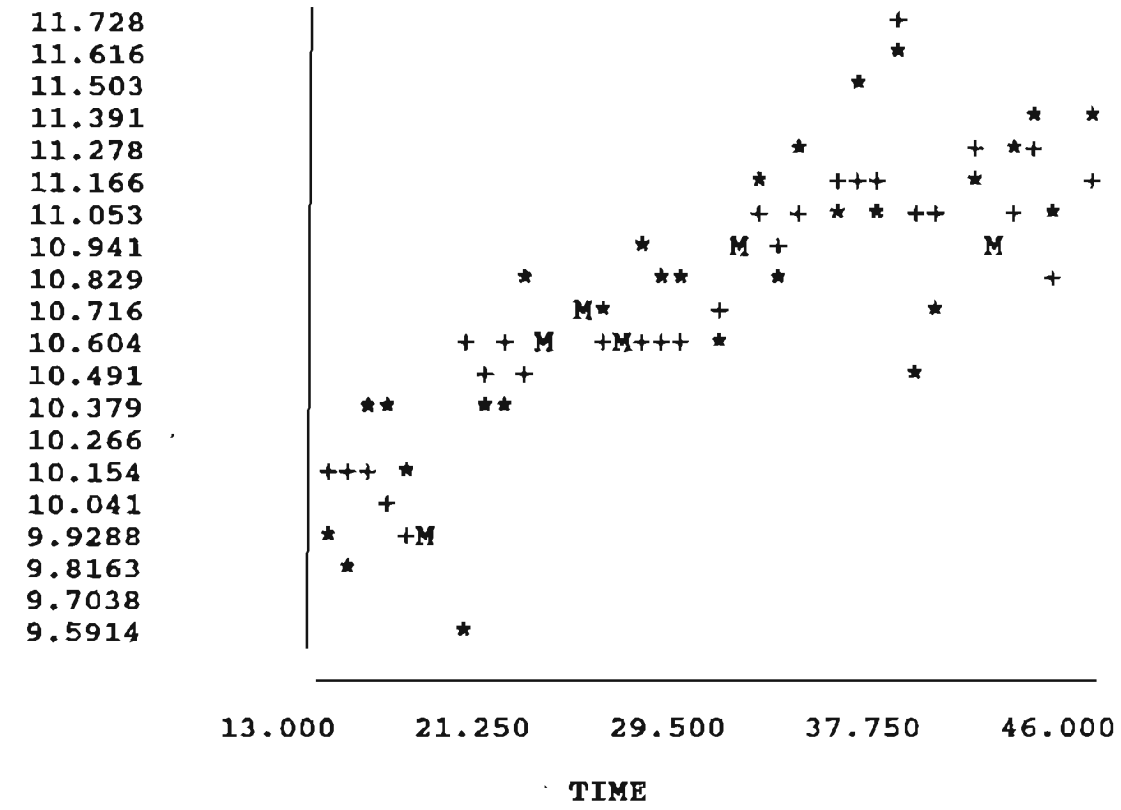
                        ANALYSIS OF VARIANCE - FROM MEAN
                          SS          DF              MS
F
 REGRESSION          3203.5           7.          457.65
172.525
 ERROR               68.969          26.         2.6526
 TOTAL               3272.5          33.         99.167

                        ANALYSIS OF VARIANCE - FROM ZERO
                          SS          DF              MS
F
 REGRESSION          32792.           8.          4099.0
1545.251
 ERROR               68.969          26.         2.6526
 TOTAL               32861.          34.         966.50


 VARIABLE    ESTIMATED  STANDARD    T-RATIO         PARTIAL
STANDARDIZED ELASTICITY
   NAME     COEFFICIENT   ERROR       26 DF    P-VALUE CORR.
COEFFICIENT  AT MEANS
 LNRUV        9.6297       4.317       2.231      0.035 0.401
0.0901      2.0675
 LNRFX       0.31513       3.972      0.7934E-01 0.937 0.016
0.0086      0.0469
 DTF         -1.5062       1.992      -0.7560     0.456-0.147
-0.0585     -0.0420
 LNIAO        1.6518       5.635       0.2931     0.772 0.057
0.0130      0.2588
 LNM2         15.220       2.227        6.835     0.000 0.802
1.0167      2.4925
 LNRC        -3.3646       4.384      -0.7675     0.450-0.149
-0.0242     -0.5271
 D1          -1.0618       1.751      -0.6062     0.550-0.118
-0.0183     -0.0011
 CONSTANT    -97.219       45.80       -2.123     0.043-0.384
0.0000     -3.2956

 |_PLOT LNIPMT YHAT4/TIME NOPRETTY

 REQUIRED MEMORY IS PAR=    20 CURRENT PAR=  500
 FOR MAXIMUM EFFICIENCY USE AT LEAST PAR=    21
        34 OBSERVATIONS
                    *=LNIPMT
                    +=YHAT4
                    M=MULTIPLE POINT
```




```
|_PLOT E4/TIME NOPRETTY

REQUIRED MEMORY IS PAR=   20 CURRENT PAR=  500
FOR MAXIMUM EFFICIENCY USE AT LEAST PAR=    21
       34 OBSERVATIONS
                  *=E4
                  M=MULTIPLE POINT
  0.36543
  0.29268
  0.21994
  0.14720
  0.74453E-01
  0.17088E-02
-0.71035E-01
-0.14378
-0.21652
-0.28927
-0.36201
-0.43475
-0.50750
-0.58024
-0.65299
-0.72573
-0.79847
-0.87122
-0.94396
 -1.0167
```

```
              13.000     21.250     29.500     37.750     46.000

                                    TIME
 |_GENR YHAT42=YHAT4*YHAT4
 |_******** SKEWNESS TESTS ********
 |_GEN1 G14=-1.57
 |_** G14 has to be obtained from the OLS above
 |_GEN1 SQRTB41= G14*((T-2)/SQRT(T*(T-1)))
 |_GEN1 Y4=SQRTB41*(((T+1)(T+3))/(6*(T-2)))**0.5
 |_GEN1 B2SQRB41=(3*(T**2+27*T-70)(T+1)(T+3))/((T-
2)(T+5)(T+7)(T+9))
 |_GEN1 W24=-1+(2*(B2SQRB41-1))**0.5
 |_GEN1 SQRTW24=SQRT(W24)
 |_GEN1 DELTA4=1/SQRT(LOG(SQRTW24))
 |_GEN1 ALPHA4=(2/(W24-1))**0.5
 |_GEN1
ZSQRTB41=DELTA4*LOG((Y4/ALPHA4)+((Y4/ALPHA4)**2+1)**0.5)
 |_PRINT ZSQRTB41
     ZSQRTB41
   -3.759844
 |_******** KURTOSIS TEST ********
 |_GENR G24=3.9362
 |_** G24 has to be obtained from the OLS above
 |_GEN1 B24=G24*((T-2)(T-3))/((T+1)(T-1))+(3*(T-1))/(T+1)
 |_GEN1 B24BAR=(3*(T-1))/(T+1)
 |_GEN1 VARB24=(24*T*(T-2)(T-3))/(((T+1)**2)(T+3)(T+5))
 |_GEN1 X4=(B24-B24BAR)/SQRT(VARB24)
 |_GEN1 SQRB1B24=((6*(T**2-
5*T+2))/((T+7)(T+9)))*SQRT((6*(T+3)(T+5))/(T*(T-2)(T-3)))
 |_GEN1
A4=6+(8/(SQRB1B24))*(2/(SQRB1B24)+SQRT(1+4/(SQRB1B24**2)))
 |_GEN1 ZB24=((1-2/(9*A4))-((1-2/A4)/(1+X*SQRT(2/(A4-
4))))**(1/3))/SQRT(2/(9*A4))
 |_PRINT  ZB24
     ZB24
    1.624648
 |_******** OMNIBUS TEST ********
 |_GEN1 K24=ZSQRTB41**2+ZB24**2
 |_PRINT K24
     K24
    16.77591
 |_**JOINT CONDITIONAL MEAN TEST
 |_GENR LAGE4=LAG(E4)
 |_SAMPLE 14 46

 |_OLS E4 T1 YHAT42 LAGE4

REQUIRED MEMORY IS PAR=   24 CURRENT PAR=  500
 OLS ESTIMATION
      33 OBSERVATIONS     DEPENDENT VARIABLE = E4
...NOTE..SAMPLE RANGE SET TO:   14,   46

 R-SQUARE =    0.1037     R-SQUARE ADJUSTED =    0.0109
```

```
 VARIANCE OF THE ESTIMATE-SIGMA**2 =  0.80210E-01
 STANDARD ERROR OF THE ESTIMATE-SIGMA =  0.28321
 SUM OF SQUARED ERRORS-SSE=    2.3261
 MEAN OF DEPENDENT VARIABLE =  0.70587E-02
 LOG OF THE LIKELIHOOD FUNCTION = -3.06162

 MODEL SELECTION TESTS - SEE JUDGE ET.AL.(1985, P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR- FPE =   0.89932E-01
    (FPE ALSO KNOWN AS AMEMIYA PREDICTION CRITERION -PC)
  AKAIKE (1973) INFORMATION CRITERION- LOG AIC =  -2.4099
  SCHWARZ(1978) CRITERION-LOG SC =  -2.2285
 MODEL SELECTION TESTS - SEE RAMANATHAN(1992,P.167)
  CRAVEN-WAHBA(1979) GENERALIZED CROSS VALIDATION(1979) -
GCV=  0.91273E-01
  HANNAN AND QUINN(1979) CRITERION -HQ=  0.95477E-01
  RICE (1984) CRITERION-RICE=  0.93043E-01
  SHIBATA (1981) CRITERION-SHIBATA=  0.87575E-01
  SCHWARTZ (1978) CRITERION-SC=  0.10769
  AKAIKE (1974)INFORMATION CRITERION-AIC=  0.89824E-01

                    ANALYSIS OF VARIANCE - FROM MEAN
                      SS          DF            MS
F
 REGRESSION       0.26898          3.       0.89660E-01
1.118
 ERROR             2.3261         29.       0.80210E-01
 TOTAL             2.5951         32.       0.81096E-01

                    ANALYSIS OF VARIANCE - FROM ZERO
                      SS          DF            MS
F
 REGRESSION       0.27062          4.       0.67656E-01
0.843
 ERROR             2.3261         29.       0.80210E-01
 TOTAL             2.5967         33.       0.78688E-01


 VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL
STANDARDIZED ELASTICITY
   NAME    COEFFICIENT   ERROR      29 DF   P-VALUE CORR.
COEFFICIENT  AT MEANS
 T1         0.14784E-01 0.1082E-01   1.366     0.182 0.246
0.5020     62.8322
 YHAT42    -0.15158E-01 0.1190E-01  -1.274     0.213-0.230
-0.4652   -251.7769
 LAGE4      0.13906     0.1837      0.7572     0.455 0.139
0.1391     -0.1364
 CONSTANT   1.3417       1.122       1.196     0.241 0.217
0.0000    190.0812
 _TEST
 _TEST T1=0
 _TEST YHAT42=0
 _TEST LAGE4=0
 _END
```

```
 F STATISTIC =   1.1178214      WITH     3 AND    29 D.F.  P-
VALUE= 0.35797
 WALD CHI-SQUARE STATISTIC =   3.3534641      WITH     3 D.F.
P-VALUE= 0.34027
 UPPER BOUND ON P-VALUE BY CHEBYCHEV INEQUALITY = 0.89460
  |_**JOINT CONDITIONAL VARIANCE TEST
  |_GENR E42=E4*E4
  |_GENR LAGE42=LAG(E42)
  |_SAMPLE 14 46

  |_OLS E42 T1 YHAT42 LAGE42

 REQUIRED MEMORY IS PAR=   25 CURRENT PAR=  500
  OLS ESTIMATION
       33 OBSERVATIONS      DEPENDENT VARIABLE = E42
 ...NOTE..SAMPLE RANGE SET TO:    14,    46

  R-SQUARE =    0.0680      R-SQUARE ADJUSTED =  -0.0285
 VARIANCE OF THE ESTIMATE-SIGMA**2 =  0.34587E-01
 STANDARD ERROR OF THE ESTIMATE-SIGMA =  0.18598
 SUM OF SQUARED ERRORS-SSE=    1.0030
 MEAN OF DEPENDENT VARIABLE =  0.78688E-01
 LOG OF THE LIKELIHOOD FUNCTION =  10.8177

 MODEL SELECTION TESTS - SEE JUDGE ET.AL.(1985, P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR- FPE =   0.38779E-01
    (FPE ALSO KNOWN AS AMEMIYA PREDICTION CRITERION -PC)
  AKAIKE (1973) INFORMATION CRITERION- LOG AIC =  -3.2511
  SCHWARZ(1978) CRITERION-LOG SC =  -3.0697
 MODEL SELECTION TESTS - SEE RAMANATHAN(1992,P.167)
  CRAVEN-WAHBA(1979) GENERALIZED CROSS VALIDATION(1979) -
GCV=  0.39357E-01
  HANNAN AND QUINN(1979) CRITERION -HQ=  0.41170E-01
  RICE (1984) CRITERION-RICE=  0.40121E-01
  SHIBATA (1981) CRITERION-SHIBATA=  0.37763E-01
  SCHWARTZ (1978) CRITERION-SC=  0.46436E-01
  AKAIKE (1974)INFORMATION CRITERION-AIC=  0.38733E-01

                    ANALYSIS OF VARIANCE - FROM MEAN
                      SS          DF            MS
F
 REGRESSION       0.73130E-01      3.       0.24377E-01
0.705
 ERROR             1.0030         29.       0.34587E-01
 TOTAL             1.0761         32.       0.33630E-01

                    ANALYSIS OF VARIANCE - FROM ZERO
                      SS          DF            MS
F
 REGRESSION       0.27746          4.       0.69365E-01
2.006
 ERROR             1.0030         29.       0.34587E-01
 TOTAL             1.2805         33.       0.38802E-01
```

```
 VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL
STANDARDIZED ELASTICITY
   NAME    COEFFICIENT   ERROR      29 DF   P-VALUE CORR.
COEFFICIENT  AT MEANS
 T1        -0.75922E-02 0.6854E-02  -1.108      0.277-0.201
-0.4003     -2.8946
 YHAT42     0.43467E-02 0.7534E-02  0.5770      0.568 0.107
0.2072      6.4766
 LAGE42    -0.14178      0.1815     -0.7810      0.441-0.144
-0.1421     -0.1389
 CONSTANT -0.19224      0.7137     -0.2694      0.790-0.050
0.0000     -2.4431
  |_TEST
  |_TEST T1=0
  |_TEST YHAT42=0
  |_TEST LAGE42=0
  |_END
 F STATISTIC =  0.70479413     WITH    3 AND   29 D.F.  P-
VALUE= 0.55692
 WALD CHI-SQUARE STATISTIC =   2.1143824     WITH    3 D.F.
P-VALUE= 0.54901
 UPPER BOUND ON P-VALUE BY CHEBYCHEV INEQUALITY = 1.00000
 |_STOP
```

VITA

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Master of Science

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