1994

Mothers' labour force participation decisions and child care provision in Australia

Gary Sherry
Edith Cowan University

Edith Cowan University

Copyright Warning

USE OF THESIS

The Use of Thesis statement is not included in this version of the thesis.

Mothers' Labour Force Participation Decisions And Child Care Provision In Australia

By

Gary Sherry, Bachelor Of Business

A Thesis Submitted in Partial Fulfilment of the Requirements for the Award of

Bachelor Of Business With Honours

at the Faculty of Business, Edith Cowan University

Date of Submission: 11 January 1994

ABSTRACT

Public subsidisation of child care has increased steadily over it's 20 year history, corresponding with increases in the rate of labour force participation of mothers. This research seeks to determine if labour force participation is driven by provision of child care or if the supply of child care is driven by demand of mothers participating in the labour force.

Much of the Australian research of mothers' labour force participation does not take account for the provision or use of child care, yet all find the presence of children in the family as having a major impact on the labour force decisions of mothers (Ross, 1986; Beggs & Chapman, 1988; Ross & Saunders, 1993). In her 1993 study Corbett found evidence supporting participation being driven by child care provision. This research is guided by Corbett's study, seeking to confirm her results and search for differences in this relationship between child care and full- and part-time participation. The labour force participation of mothers is analysed as part-time and full-time participation to differentiate between the characteristics of these two groups of mothers identified in previous studies (Ross, 1986; Beggs & Chapman, 1988; Ross & Saunders, 1993).

Time series analyses of labour market participation for mothers was conducted using child care supply as an explanatory variable and of child care demand using labour market participation as an explanatory variable. Results do not confirm Corbett's (1993) findings of a relationship favouring child care driving participation. This research finds equal evidence of support for both relationships, with mothers' part-time participation being a more significant variable than full-time participation in both relationships.

COPYRIGHT AND ACCESS DECLARATION

I certify that this thesis does not, to the best of my knowledge and belief:

(i) incorporate without acknowledgement any material previously submitted for a degree or diploma in any institution of higher education;

(ii) contain any material previously published or written by another person except where due reference is made in the text; or

(iii) contain any defamatory material.

Signed (signature not included in this version of the thesis)

Date…….

ACKNOWLEDGMENTS

The author wishes to acknowledge the assistance of the following for their advice, encouragement and support with respect to this research:

Supervisor: Margaret Giles, lecturer, Department of Economics, Edith Cowan University.

Members of the Economics Department, Edith Cowan University.

My family,

and

and Natalie

TABLE OF CONTENTS

List of Tables

List of Figures

1 INTRODUCTION

The last 50 years have seen remarkable changes in the economic status of the family resulting from the increased participation of married women in the labour force. Where once it was unusual even for a married woman without children to be working, now it is quite common for mothers with dependent children to be in the labour force.

This research seeks to examine determinants of mother's labour force participation in the period from 1979 to the present and identify the role in this increased participation of government subsidisation of child care services. In particular, the determinants of mothers' participation and the role of subsidised child care will be analysed in relation to differences between part-time and full-time labour force participation.

Section 2 outlines the background and effects of changes in labour force participation by mothers and funding by government of child care. Section 3 explains the planned methodology of this research, its design, data to be used and tools of analysis. The results of this research are presented in Section 4, and conclusions are drawn from this research in Section 5. References are listed in Section 6.

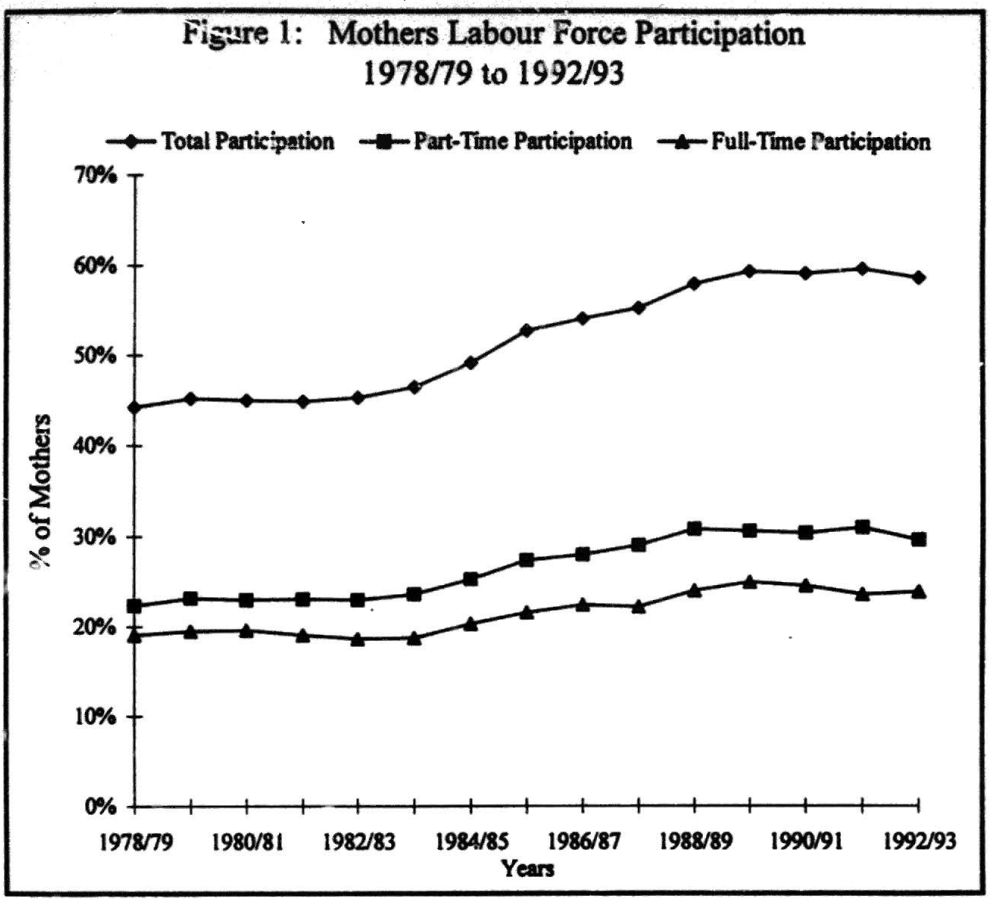
2 BACKGROUND

Labour Force Participation of Mothers

The rate of participation of women in the work force since the second world war has been dramatically increasing. In 1947 most married women stayed at home, but in 1994 the majority of women have at least some role in the workplace. In 1947 women composed only 22.4% of the work force with married women just 3.2% but by 1981 this had risen to 37.6% and 21.7% respectively (Lewis & Shorten, 1987). Changes in the participation of mothers in the labour force in the period from 1978/79 to 1992/93, represented in Figure 1, has seen the labour force participation rate of mothers with dependent children rise from 43.7% to 58.7% in that period (ABS, Cat. No. 6224, Table 2.12).

The most noticeable inducement for mothers to enter the paid work force is the economy moving to a knowledge, information and service skills base in which women and men are equally proficient and are paid similar wage rates, inducing female labour supply. Men no longer have a comparative advantage in the skills required in today's labour force. This has resulted in a shift in the structure of the family financial position with an increase in the costs and a fall in the benefits associated with a mother engaging in home work.

A major inducement for women to leave the paid labour force is to bear, raise and care for children. Neo-classical economics has always considered the family's expenditure on



Source: Generated from Australian Bureau of Statistics (ABS), Cat. No. 6224, in ABS Cat. No. 6101, Table 2.12.

children as consumption. However Burggraf (1993) sees the child's place in the economy as being the human capital of the future, with the family bearing the cost of investment in this human capital. The family's investment takes the form of producing healthy, disciplined, motivated and caring young adults to enter society. This investment by the family is now under threat from the increasing costs to the family of investing in children and the reduction of direct benefits received by the family.

Changes in the costs to families of their investment in children include;

- the rising opportunity cost of female time in the labour market. As mentioned, women can now directly compete with men in nearly all sections of the labour market on the basis of skills and receive equal wages. The foregone family income resulting from the loss of female earnings through the rearing of children has been estimated in Australia as $300,000 for the first child and a further $50,000 for the second (Beggs & Chapman, 1986).

- the present government policy of shifting towards personal wealth accumulation, in the form of superannuation, for retirement income has increased the opportunity cost of mothers' time in the labour market. Women are disadvantaged in access to worthwhile superannuation through their irregular participation in the labour force resulting in a smaller superannuation benefit combined with their greater life expectancy (Winocur & Rosenman, 1992).

- the years of schooling and university required before a child can become an independent unit in the economy, join the work force and gain financial

independence is increasing. Thus the time in which families must invest in children is also increasing.

In contrast to the increasing costs of working in the home, changes in the benefits to families from home work include;

- reduced opportunities for the family to contribute to the family's money income from working at home, for example through working in the family business.

- the social security system replacing the traditional obligation of children to provide for parents in their old age. The social security system itself represents the socialisation of one of the benefits of children, the earnings of the children are collected and distributed to people other than the children's parents.

To ensure that investment in children by families is continued in the face of the increased cost of such investment, Burggraf (1993) states that the system of allocating resources to the family should move to either socialise the cost of investment in children or privatise the benefits of this investment. The privatising of the benefits of investing in children, to counter the increased costs, would run counter to the social security system.

Child Care Funding

While the privatising of the benefits of investing in children may be possible, the trend of Australian governments has been to socialise some of the increased costs. Socialisation takes the form of contributing to the costs involved with children whose mothers choose to participate in the paid labour force and payments to reduce the opportunity cost of those

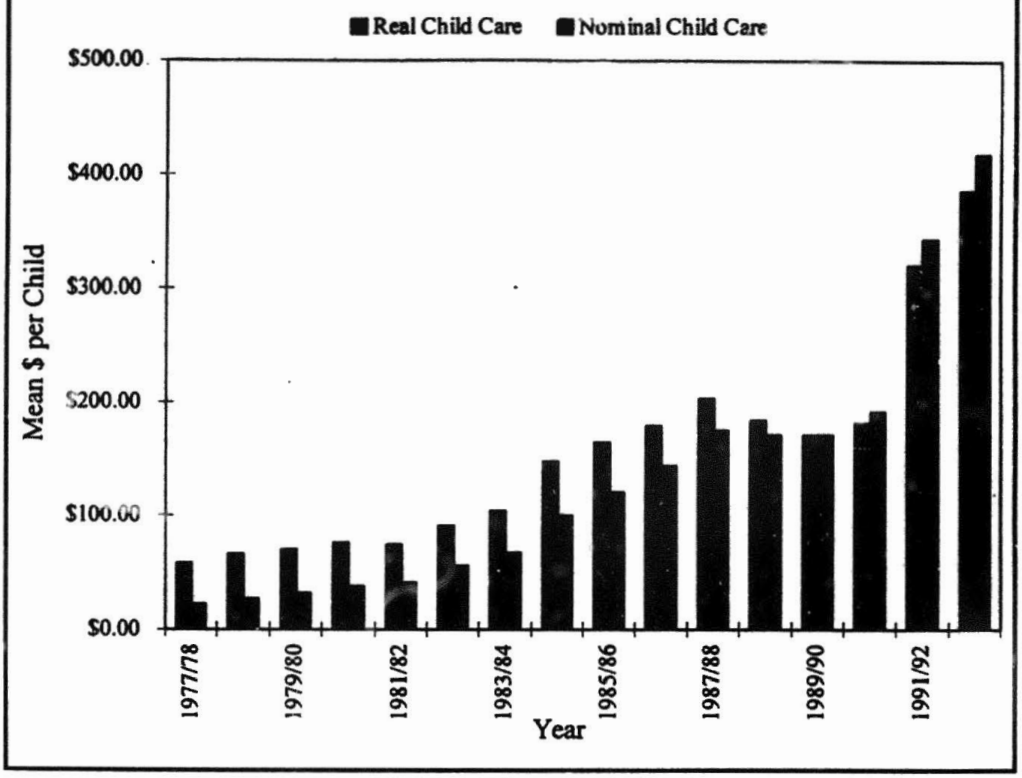
mothers who choose home production over labour force participation. Currently the federal government is adjusting payments to families, broadening their scope to include a payment for the home care of children by their mothers and increases to the subsidisation of child care with the introduction of a rebate for the cost of child care.

For mothers with pre-school age children arranging for suitable care for their children during work hours is a large burden. Government subsidies take the form of capital grants to non-profit child care centres to provide places for children, a means tested subsidy, known as Fee Relief, paid to registered child care facilities to reduce fees paid and a Cash Rebate paid to families on the basis of a percentage of out-of-pocket expenses for child care. Child care subsidies began in a limited way in 1974 and were increased in 1991 to include privately owned child care centres (Corbett, 1993). The Cash Rebate, which is not means tested, on child care costs commenced in July 1994 (Dawkins & Willis, 1993, 3.109). Changes to the total subsidy of child care, in both nominal and inflation adjusted, real terms, from 1978/79 to the 1992/93 can be seen in Figure 2.

Review of Literature

While the decision of a man to enter the work force is considered to be a trade off between paid work and leisure, the decision of a married woman is between paid work, home work and leisure (Norris, 1989, p. 18). Mincer's (cited in Norris, 1989, p. 18) original studies of married women's labour force participation involved the supply of

Figure 2: Federal Funding For Child Care 1977/78 to 1992/93



Source: Generated from; Funding Data from Annual Reports of Department of Social Security (1977/8-1984/5), Department of Community Services (1985/6-1988/9), Department of Community Services and Health (1988/89-1990/91), Department of Health, Housing and Community Services (1991/92) and Budget Paper No. 1 (1992/93). Population Data from ABS Cat. No. 3101, Table 13. Consumer Price Index Data from ABS Cat. No. 1350, Table 7.1.

labour being a trade off between the spouse's permanent income and the earnings of the woman from paid labour. Mincer's model for female labour force participation was;

$$M = b\,Y + a\,W$$

where M is the quantity of labour supplied by a woman, Y is the husband's permanent income, W the woman's wage rate and a and b are coefficients to be estimated (Norris, 1989, p. 18). Mincer's cross-sectional studies, published in 1962 suggested Y has a negative effect on M, while W has a positive effect (Norris, 1989, p. 18).

Much of the research in Australia on the labour force participation of women investigated the effects of the increase in female wage rates on their labour supply following the 1972 wage decision that increased female wage rates to those for males in equal jobs. Before 1972 women's wages had been set as 75% of the male wage (Gregory, McMahon & Whittingham, 1983, p. 20). Cross-sectional studies by Miller and Volker (1983) and Ross (1985) confirmed an Australian relationship between female labour force participation and spouse's income and the female wage rate, but also found relationships between women's labour force participation and the presence and age of the women's children, years of education and place of birth.

Gregory, McMahon and Whittingham's (1983, p. 42) time series analysis suggested demand for female labour was a prominent force in increasing participation, with growth in the economy being greater in those sectors in which female labour force participation was highest. This increased demand for female labour has coincided with increased demand for part-time labour, which accounts for 90% of the growth in female labour participation from

1966 to 1982 (Gregory et al., 1983, p. 4) and 79% from 1966 to 1986 (Department of Employment, Education and Training, 1990, p. 12).

Cross-sectional PROBIT (cumulative normal probability function) analysis of data from the 1986 Australian Bureau of Statistics income distribution survey (Ross & Saunders, 1993) confirms that the presence of children, especially between the ages of 0 to 4, and sources of income other than mothers' earnings, that is spouse's income and transfer payments, have a negative effect on mothers' labour force participation. However Ross and Saunders (1993) found differences in the effects of some independent variables on the types of participation undertaken by mothers. The variables of young children, family income and transfer payments that had significant negative effects for mothers' participation as a whole and for mothers undertaking part-time work were not significant for mothers working full-time. The significant variables for mothers working full-time were education and work experience. The presence of a working spouse had a negative effect for women working full-time but a positive effect for those working part-time. Ross and Saunders' (1993) analysis found that single mothers had little difference in labour participation behaviour to non-single mothers.

Corbett (1993), in analysing women's labour force participation since 1974, found a strong relationship with the level of government funding of child care. While Corbett's model includes the variables of fertility, women's wage earnings and a variable for economic performance, it does not include variables for family income other than the earnings of women, such as male wage earnings or other income. With the central focus on the government level of child care funding, which began in 1974, the analysis does not make use of more up to date labour force statistics available since 1979. These statistics allow

the use of mothers' participation, disaggregated into full-time, part-time and unemployed labour, as a dependent variable.

The variables identified as significant in the cross-sectional studies of the labour force participation of mothers appear to have different effects on the type of labour force participation. These differences evident in Ross and Saunders' (1993) study have not been effectively analysed in a time series analysis.

3 METHODOLOGY

Data

This research looks to examine the relationship between the type of labour force participation of mothers and child care funding in a time series analysis. This analysis uses data adjusted for changes in population, inflation and the cyclical state of the economy. The data used in creating these variables is listed in Appendix D. Accordingly the variables in this research are;

LFPM	Labour force participation rate of mothers.
MPTE	Mothers part-time labour force participation.
MFTE	Mothers full-time labour force participation.
CCARE	Government funding of child care
DUM1	Dummy variable for a change in the intercept resulting from the different method of government funding of child care.

DUM2	Dummy variable for a change in the slope of the analysis resulting from the different method of government funding of child care.
AWFE	The average weekly full-time earnings of women.
DSREB	The value of the tax rebate for a dependent spouse.
AWME:	Average weekly total male earnings.
FERT	The Australian Birth Rate.
UNE	The unemployment rate.
TIME	Time trend variable
β_i	Coefficients to be estimated.
υ	The estimated residual error term.

The dependent variable of the labour force participation rate of mothers is represented by the labour force participation of women with dependent children as measured by the ABS Labour Force and Family Characteristics Survey, ABS Catalogue No. 6224.0, Table 2.12, for the years 1979 to 1993. This survey calculates the participation rate as those mothers, aged 15 and over, with dependent children, undertaking, and seeking to undertake, paid employment, expressed as a percentage of the population of mothers with dependent children. A dependent child is classified as a family member aged 15 or less or one attending school or university if aged 24 or less. While the impact of children on a mothers' labour force participation decreases with the increase in age of the children (Ross & Saunders, 1993), this measurement is still preferable to one reflecting the labour force participation of all women.

The variables of mothers' full-time participation and mothers' part-time participation represent the percentage of the population of mothers with dependent children working full-

and part-time. These variables are calculated as the total of mothers working full- or part-time, expressed as a percentage of the population of mothers with dependent children. These two variables do not include unemployed mothers or mothers already employed, but seeking to participate in a different way.

For a mother with dependent children who are below school age the arrangement of suitable child care is perhaps the biggest obstacle to participating in the labour force. This care can take two forms, either informal or formal care. Informal care, care that is outside government regulation, may cost less or be more flexible than formal care, however the quality of such care may also be less (Teal, 1992). Formal child care is that which falls under government regulation and receives government funding in the forms of operational subsidies paid to the care centre or Fee Relief paid direct to the parents whose children receive care.

While a significant number of parents may use informal care, the government assistance to the child care centres represents a significant reduction in the cost of formal care for the children of working parents and is thus an incentive for mothers to undertake paid labour. Corbett (1993) found a positive relationship between government spending on child care and women's labour force participation.

The level of child care funding is collated from the annual reports of the relevant government departments, 1977/78 to 1983/84 Department of Social Security, 1984/85 to 1986/87 Department of Community Services, 1987/88 Department of Community Services and Health, 1988/89 to 1989/90 Department of Health, Housing and Community Services, and Budget Paper No. 1. As in Corbett's study (1993) the level of funding is converted to a

real figure using the consumer price index (ABS Cat. No. 1350, Table 7.1.) and divided by the population of children aged 0 to 4 years (ABS, Cat. No. 3101, Table 13), to produce a measure of the mean real funding per child.

Funding for child care was instituted in 1974, increased gradually to 1991 and then doubled in 1992 with the expansion of Fee Relief to parents whose children were cared for in privately owned, as well as non-profit, child care centres (Corbett, 1993). To correct this analysis for this one off decision dummy variables will be used. To detect changes in the intercept of the equations, the dummy variable DUM1 will have a value of zero for the years 1979 to 1991 and a value of one for the years 1992 and 1993. To detect for changes in the slope of the equation the dummy variable DUM2 will have the values of DUM1 multiplied by the variable for child care funding of that year. The value of DUM2 will thus be zero for the years 1979 to 1991 and the value of the child care funding variable for the years 1992 and 1993.

An increased number of children in a family would reduce the opportunity cost of working outside the home, as the costs of child care for a larger number of children would increase. A study of data from the United States of America by Fayiasa and Fessehatzion (1990) found an inverse relationship between the birth rate and female labour force participation, while the Australian study of Corbett (1993) found no such relationship. The fertility rate, shown in the ABS Catalogue No. 3301, Table 4, represents the number of births 1000 women would have if they had the birth rate of that year.

In terms of the models in this research, female earnings represent the opportunity cost of undertaking leisure or home labour while male earnings represent the present income of the

family. On the basis of Ross and Saunders' (1993) findings the value of the average weekly female income would be more to determine the full-time participation of mothers whilst part-time participation of mothers would be expected to correlate positively with male earnings. The earnings of females represented by the ABS survey of female full-time ordinary earnings. The earnings of males are represented as the average weekly total male earnings. The wage data is gathered from ABS, Catalogue No. 6302, Table 1 and a wage index from ABS, Catalogue No. 6312, Table 1, is used to convert the wage earnings to real data.

Ross and Saunders (1993) found that income other than earnings from labour has a negative relationship with a mother's choice to enter the labour force. One example of such income that can be modelled in a time series analysis is the effect of the family receiving the dependant spouse rebate. This rebate reduces a worker's tax liability if the worker's spouse earns less than a nominal amount. This represents an incentive for the mothers of children not to enter the work force. The amount of the dependent spouse rebate, as stated in the Australian Master Tax Guide (CCH Tax Editors, 1978 to 1993, 17.20), is deflated using the consumer price index, ABS Cat. No. 1350, Table 7.1.

To model the cyclical effects of the economy the unemployment rate of all Australians is used as a proxy. The cycle of the economy effects labour force participation decisions by effecting the unemployed's perception of obtaining employment. Thus in times of high unemployment the unemployed may leave the labour market based on their low expectation of obtaining a job. Demographic research of these discouraged unemployed, known as hidden unemployed, finds 80% to be female (Bureau of Labour Market Research, 1986, p. 13). In this light this variable seeks to detect changes in the labour force participation rate

of mothers that are a result of discouraged workers leaving the work force. This variable would be expected to have an inverse relationship with participation. The unemployment statistic is gathered from the ABS Catalogue No. 6204 in ABS Catalogue No. 6403, Table 67.

Other factors that may have an impact on mothers' labour force participation but are unable to be directly measured in time series analysis are attempted to be covered by using a time trend variable. This variable would look to screen for changes in independent variables including the education level of mothers and social attitudes. Ross and Saunders (1993) found a positive relationship between education and all types of mothers' labour force participation. The time trend variable is a simple arithmetic sequence.

As the labour force and child care funding statistics used in this research are reported as at June 30 each year, any reference to a year in this research refers to the financial year ending at June 30.

Research Design

This research uses multiple regression analysis to ascertain the presence of a relationship between the labour force decisions of mothers and child care funding.

Decisions of mothers to enter or re-enter the labour force will not be made and implemented in a short time period. The effect of the explanatory variables on mothers' decisions to enter the labour force will take a period of time in which a mother would evaluate the explanatory variables effecting the family, decide to enter the labour market and then

under ake the process of searching for a position in the labour market. To account for this gap between the explanatory variable effecting the family and the recording of the mothers involvement in the labour force, the dependent variables in models 1 and 2 will be lagged by one year. The use of lagged variables is signified by the addition of T-1 to the variable symbol.

In models 3, 4 and 5 the dependent variable of child care funding may be determined by the use of child care by families or by government as a fiscal policy reacting to independent variables in the present or immediately past time periods. This research follows Corbett's (1993) using of lagged variables to test which time period is most appropriate for each variable. Again the use of lagged variables is signified by the addition of T-1 to the variable symbol.

The models to be examined in this research and their respective hypothesises are:

Model 1

Participation is dependent on the explanatory variables with all the explanatory variables lagged one year.

model 1.1.

$$LFPM = \beta_0 + \beta_1(CCARET\text{-}1) + \beta_2(DUM1T\text{-}1) + \beta_3(DUM2T\text{-}1) + \beta_4(AWFET\text{-}1) + \beta_5(DSREBT\text{-}1) + \beta_6(AWMET\text{-}1) + \beta_7(FERTT\text{-}1) + \beta_8(UNET\text{-}1) + \beta_9(TIME) + \upsilon$$

H_o : $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = \beta_8 = \beta_9 = 0$

H_1 : At least one β_i does not equal 0

model 1.2.

$$MPTE = \beta_o + \beta_1(CCARET\text{-}1) + \beta_2(DUM1T\text{-}1) + \beta_3(DUM2T\text{-}1) + \beta_4(AWFET\text{-}1) + \beta_5(DSREBT\text{-}1) + \beta_6(AWMET\text{-}1) + \beta_7(FERTT\text{-}1) + \beta_8(UNET\text{-}1) + \beta_9(TIME) + \upsilon$$

H_o : $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = \beta_8 = \beta_9 = 0$

H_1 : At least one β_i does not equal 0

model 1.3.

$$MFTE = \beta_o + \beta_1(CCARET\text{-}1) + \beta_2(DUM1T\text{-}1) + \beta_3(DUM2T\text{-}1) + \beta_4(AWFET\text{-}1) + \beta_5(DSREBT\text{-}1) + \beta_6(AWMET\text{-}1) + \beta_7(FERTT\text{-}1) + \beta_8(UNET\text{-}1) + \beta_9(TIME) + \upsilon$$

H_o : $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = \beta_8 = \beta_9 = 0$

H_1 : At least one β_i does not equal 0

Model 2

Participation is dependent on the explanatory variables of child funding and time which are lagged one year.

model 2.1.

$$LFPM = \beta_o + \beta_1(CCARET\text{-}1) + \beta_2(DUM1T\text{-}1) + \beta_3(DUM2T\text{-}1) + \beta_4(TIME) + \upsilon$$

$H_o: \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$

$H_1:$ At least one β_i does not equal 0.

model 2.2.

$$MPTE = \beta_o + \beta_1(CCARET\text{-}1) + \beta_2(DUM1T\text{-}1) + \beta_3(DUM2T\text{-}1) + \beta_4(TIME) + \upsilon$$

$H_o: \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$

$H_1:$ At least one β_i does not equal 0

model 2.3.

$$MFTE = \beta_o + \beta_1(CCARET\text{-}1) + \beta_2(DUM1T\text{-}1) + \beta_3(DUM2T\text{-}1) + \beta_4(TIME) + \upsilon$$

$H_o: \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$

H_1 : At least one β_i does not equal 0

Model 3

Demand for child care is dependent on explanatory variables with only labour force participation lagged one year.

model 3.1.

$$CCARE = \beta_o + \beta_1(LFPMT\text{-}1) + \beta_2(DUM1) + \beta_3(DUM2) + \beta_4(AWFE) + \beta_5(DSREB) + \beta_6(AWME) + \beta_7(FERT) + \beta_8(UNE) + \beta_9(TIME) + \upsilon$$

H_o : $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = \beta_8 = \beta_9 = 0$

H_1 : At least one β_i does not equal 0

model 3.2.

$$CCARE = \beta_o + \beta_1(MPTET\text{-}1) + \beta_2(MFTET\text{-}1) + \beta_3(DUM1) + \beta_4(DUM2) + \beta_5(AWFE) + \beta_6(DSREB) + \beta_7(AWME) + \beta_8(FERT) + \beta_9(UNE) + \beta_{10}(TIME) + \upsilon$$

H_o : $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = \beta_8 = \beta_9 = \beta_{10} = 0$

H_1 : At least one β_i does not equal 0

Model 4

Child care demand is a function of explanatory variables, all explanatory variables lagged one year.

model 4.1.

$$CCARE = \beta_o + \beta_1(LFPMT\text{-}1) + \beta_2(DUM1) + \beta_3(DUM2) + \beta_4(AWFET\text{-}1) + \beta_5(DSREBT\text{-}1) + \beta_6(AWMET\text{-}1) + \beta_7(FERTT\text{-}1) + \beta_8(UNET\text{-}1) + \beta_9(TIME) + \upsilon$$

$H_o: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = \beta_8 = \beta_9 = 0$

$H_1:$ At least one β_i does not equal 0

model 4.2.

$$CCARE = \beta_o + \beta_1(MPTET\text{-}1) + \beta_2(MFTET\text{-}1) + \beta_3(DUM1) + \beta_4(DUM2) + \beta_5(AWFET\text{-}1) + \beta_6(DSREBT\text{-}1) + \beta_7(AWMET\text{-}1) + \beta_8(FERTT\text{-}1) + \beta_9(UNET\text{-}1) + \beta_{10}(TIME) + \upsilon$$

$H_o: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = \beta_8 = \beta_9 = \beta_{10} = 0$

$H_1:$ At least one β_i does not equal 0

Model 5

Child care demand is dependent on the explanatory variables of labour force participation lagged one year and time.

model 5.1.

$$CCARE = \beta_o + \beta_1(LFPMT\text{-}1) + \beta_2(DUM1) + \beta_3(DUM2) + \beta_4(TIME) + \upsilon$$

$H_o: \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$

$H_1:$ At least one β_i does not equal 0

model 5.2.

$$CCARE = \beta_o + \beta_1(MPTET\text{-}1) + \beta_2(MFTET\text{-}1) + \beta_3(DUM1) + \beta_4(DUM2) + \beta_5(TIME) + \upsilon$$

$H_o: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$

$H_1:$ At least one β_i does not equal 0

Data Analysis

The multiple regression analysis of data is conducted using the SPSS data analysis computer program. The backward elimination stepwise regression method is used where those variables proving to be insignificant are sequentially removed. The criteria for removal of a variable is a probability F distribution at the level of significance of 15% for each variable.

Common problems associated with regression analysis are multicollinearity, autocorrelation and heteroscedasticity. Multicollinearity is a serious problem when independent variables are linear correlated and the estimates of the significance of each independent variable become unreliable (Brown, 1991, p 112). While there is no conclusive test for a significant level of multicollinearity in a model (Ramanathan, 1989, p 234), the seriousness of the multicollinearity will be measured in the estimates of models having extremely high R^2 measurements and low t-statistics. The solution to this multicollinearity will depend on its seriousness. If the multicollinearity is so bad that no one variable is near significance, the variable with the highest standard error will be dropped from the model. The use of backward stepwise regression will help to reduce the effects of multicollinearity removing insignificant variables that may be adding to the multicollinearity. The extent of the linear correlation between the variables of each model can be seen in a matrix of correlation coefficients presented in appendix A.

Autocorrelation exists when error terms are serially correlated (Brown, 1991, p 164). The test for the presence of autocorrelation is the Lagrange Multiplier Test (Ramanathan, 1989, p 338). Any models exhibiting autocorrelation are estimated using the Cochrane-Orcutt Iterative procedure (Ramanathan, 1989, p 340). A list of the Lagrange Multiplier test results are presented in Appendix C.

Heteroscedasticity occurs when the residual terms of the models estimated are not constant (Ramanathan, 1989, p 450). Tests to determine heteroscedasticity begin with an examination of plots of the residual error term υ against the independent variables of the models (Brown, 1991, p. 194). The plots are listed in Appendix B.

4 RESULTS

The analysis of the joint significance of variables in each model using the F-Test saw all models being significant. Analysis for the significance of variables resulted in individual variables of each equation except for model 2.3 being significant. In all models serious multicollinearity was present with the adjusted R^2 of most models being extremely high, being greater than 0.96. However the strength of the relationships between variables was apparent with variables having t-statistics large enough to be statistically significant despite the presence of multicollinearity. In the estimation of the variants of model 2 and 5 autocorrelation was a significant problem. These models were estimated using the Cochrane-Orcutt procedure to eliminate the effects of autocorrelation.

In model 1.1 all the variables except DSREBT-1, FERTT-1 and UNET-1 were significant. The explanatory power of the variables of CCARET-1, TIME, AWFET-1 and AWMET-1 are large and of similar size. The dummy variable of DUM2T-1 being significant in all the variants of model 1 signifies a change in the slope of the linear relationship of CCARET-1 and labour force participation after the method of subsidisation of child care was changed. The variable DUM1T-1 was not significant in any of the variants of model 1. The significance of the variable CCARET-1 in models 1.1 and 1.2 is in keeping with the results

Table 1: Results for Model 1.1

Dependent Variable: LFPM

Adjusted R^2: 0.9958

F Statistic: 230.1684

Variable	Coefficient	Standard Coefficient	t-Statistic	Sig. of t-Stat.
CCARET-1	0.040	0.462	4.183	0.004
DUM2T-1	-0.026	-0.337	-6.532	0.000
TIME	0.947	0.674	4.112	0.004
AWFET-1	0.144	0.497	3.698	0.008
AWMET-1	-0.133	-0.529	-3.041	0.019
DSREBT-1	-0.003	-0.122	-2.185	0.065
UNET-1	-0.294	-0.091	-1.978	0.088
Constant	51.514	.	3.655	0.008

of previous research (Corbett, 1993). However the insignificance of CCARET-1 in model 1.3 may support a different type of relationship between child care funding and the different types of employment undertaken by mothers. The significant relationships found in this research between MPTE and AWFET-1 and MFTE and AWMET-1, UNET-1 and AWFET-1 conforms with results of research of Ross and Saunders (1993).

Table 2: Results for Model 1.2

Dependent Variable: MPTE

Adjusted R^2: 0.9895

F Statistic: 440.1604

Variable	Coefficient	Standard Coefficient	t-Statistic	Sig. of t-Stat.
CCARET-1	0.038	0.785	7.614	0.000
DUM2T-1	-0.021	-0.512	-10.607	0.000
AWFET-1	0.075	0.468	5.646	0.000
Constant	-3.209	.	-0.839	0.419

Table 3: Results for Model 1.3

Dependent Variable: MFTE

Adjusted R^2: 0.9662

F Statistic: 67.6630

Variable	Coefficient	Standard Coefficient	t-Statistic	Sig. of t-Stat.
CCARET-1	0.016	0.484	2.220	0.057
DUM2T-1	-0.009	-0.310	-3.039	0.016
TIME	0.477	0.920	2.870	0.021
AWFET-1	0.097	0.905	3.604	0.007
AWMET-1	-0.095	-1.023	-2.978	0.018
UNET-1	-0.436	-0.366	-4.177	0.003
Constant	24.762	.	2.638	0.030

Table 4: Results for Model 2.1

Dependent Variable: LFPM

Adjusted R^2: 0.9032

F Statistic: 44.1766

Variable	Coefficient	Standard Coefficient	t-Statistic	Sig. of t-Stat.
CCARET-1	0.052	0.937	3.339	0.008
DUM1T-1	-9.298	-0.966	-4.443	0.002
TIME	0.997	0.634	4.226	0.003
Constant	36.550	.	22.081	0.000

In model 1.2 the variable CCARET-1 has the largest impact on mother's part-time participation. The only other significant independent variable is that of AWFET-1. This differs significantly from Model 1.3 where the CCARET-1 variable becomes insignificant while the values of the coefficients of the TIME, AWFET-1 and AWMET-1 are strongly significant variables and have large explanatory power. The variable UNET-1 is only significant in model 1.3 and the variables DSREBT-1 and FERTT-1 are not significant in either model.

Results of the estimation of the variants of model 2 saw all models being significant at the 95% confidence level of the F-Test. The results of models 2.1 and 2.2 are largely in line with those of model 1. Significantly in model 2.2 the variable CCARET-1 is strongly

Table 5: Results for Model 2.2

Dependent Variable:	MPTE			
Adjusted R^2:	0.9047			
F Statistic:	42.4567			
Variable	Coefficient	Standard Coefficient	t-Statistic	Sig. of t-Stat.
CCARET-1	0.042	1.407	5.177	0.001
DUM1T-1	-7.424	-1.493	-6.841	0.000
TIME	0.391	0.433	3.104	0.013
Constant	18.606	.	41.699	0.000

Table 6: Results for Model 2.3

Dependent Variable:	MFTE			
Adjusted R^2:	0.6465			
F Statistic:	9.2587			
Variable	Coefficient	Standard Coefficient	t-Statistic	Sig. of t-Stat.
CCARET-1	0.026	0.978	1.723	0.119
DUM1T-1	-3.694	-0.756	-1.899	0.09
TIME	0.239	0.387	1.143	0.282
Constant	16.022	.	13.107	0.000

significant and has much more explanatory power than the TIME variable. In model 2.1 CCARET-1 is significant and more powerful than TIME, but not to the same extent as model 2.2. While the variables of model 2.3 are jointly significant, individual t-statistics of

the variables are not significant at the 95% confidence level. The dummy variable DUM1T-1 is significant in both models 2.1 and 2.2, indicating a continuation of the slope of the relationship between CCARET-1 and labour force participation but a shift in the point of intercept of the relationship after the change in the method of child care subsidisation.

Table 7: Results for Model 3.1

Dependent Variable: CCARE

Adjusted R^2: 0.9431

F Statistic: 50.7653

Variable	Coefficient	Standard Coefficient	t-Statistic	Sig. of t-Stat.
LFPMT-1	4.156	0.365	2.570	0.033
DUM2	0.243	0.309	3.184	0.013
FERT	-0757	-0.392	-2.614	0.031
UNE	10.345	0.294	2.542	0.035
Constant	1276.437	.	2.132	0.066

The variables of LFPMT-1, UNE and FERT are significant in model 3.1 and MPTET-1, UNE and FERT significant in model 3.2, with the participation variables in each equation being only slightly more significant than the other variables in each model. Importantly the variable of MFTET-1 is not significant in model 3.2 and the significant variable of UNE has a positive relationship with child care, demand for child care places increasing with unemployment. In model 3.1 the dummy variable DUM2 is a significant and in model 3.2 both dummy variables, DUM1 and DUM2, are significant.

Table 8: Results for Model 3.2

Dependent Variable: CCARE

Adjusted R^2: 0.9710

F Statistic: 88.0196

Variable	Coefficient	Standard Coefficient	t-Statistic	Sig. of t-Stat.
MPTET-1	8.235	0.302	2.925	0.019
DUM1	-431.447	-1.709	-3.299	0.011
DUM2	1.591	2.235	4.413	0.002
UNE	10.457	0.245	2.815	0.023
FERT	-0.679	-0.258	-2.407	0.043
Constant	1123.075	.	1.936	0.089

Table 9: Results for Model 4.1

Dependent Variable: CCARE

Adjusted R^2: 0.9614

F Statistic: 75.8182

Variable	Coefficient	Standard Coefficient	t-Statistic	Sig. of t-Stat.
LFPMT-1	13.591	1.193	5.736	0.000
FERTT-1	1.359	0.767	7.856	0.000
DSREBT-1	0.242	0.796	5.080	0.001
AWMET-1	3.155	1.037	4.342	0.003
Constant	-4742.365	.	9.025	0.000

In models 4.1 and 4.2 the explanatory participation variables of LFPMT-1 and MPTET-1 are both significant and have large explanatory power while MF1ET-1 is not significant in model 4.2. In model 4.1 the variables of FERTT-1, DSREBT-1 and AWMET-1 are significant, with AWMET-1 having large explanatory power. The coefficient estimate for the variable of FERTT-1 in model 4.1 has a negative relationship with CCARE, the reverse of that for FERT in model 3.1. MPTET-1 and the dummy variables are the only significant variables in model 4.2. The dummy variables are only significant in model 4.2.

Table 10: Results for Model 4.2

Dependent Variable: CCARE

Adjusted R^2: 0.9692

F Statistic: 82.8458

Variable	Coefficient	Standard Coefficient	t-Statistic	Sig. of t-Stat.
MPTET-1	25.822	0.947	5.662	0.005
DUM1	-500.599	-1.983	-3.097	0.015
DUM2	1.832	2.576	4.151	0.003
DSREBT-1	0.097	0.239	2.116	0.067
FERTT-1	0.537	0.230	1.999	0.081
Constant	-1700.816	.	-2.730	0.026

Table 11: Results for Model 5.1

Dependent Variable: CCARE

Adjusted R^2: 0.9767

F Statistic: 20.1539

Variable	Coefficient	Standard Coefficient	t-Statistic	Sig. of t-Stat.
LFPMT-1	4.647	0.230	0.802	0.449
DUM2	0.411	0.839	5.497	0.001
TIME	1.289	0.033	0.103	0.921
Constant	-101.228	.	-0.481	0.645

Table 12: Results for Model 5.2

Dependent Variable: CCARE

Adjusted R^2: 0.9071

F Statistic: 24.6449

Variable	Coefficient	Standard Coefficient	t-Statistic	Sig. of t-Stat.
MPTET-1	9.759	0.278	1.145	0.296
MFTET-1	-4.770	-0.102	-0.553	0.600
DUM1	-204.182	-0.997	-1.247	0.259
DUM2	1.018	1.730	1.941	0.100
TIME	5.442	0.175	0.470	0.655
Constant	-59.669	.	-0.273	0.793

The results of the variants of models 3 and 4 conflict with the research results of Corbett (1993). Corbett (1993) found no significant relationship between the independent variables of FERT, AWFE, labour force participation and the dependent variable of CCARE. This research finds statistically significant links between these variables.

The models 5.1 and 5.2 are statistically significant as a whole when tested by the F-Test, however the individual variables are largely insignificant. The only significant variable in either model was the dummy variable DUM2 in model 5.1.

5 CONCLUSIONS

This research finds equal evidence supporting the propositions that government subsidisation of child care drives labour force participation of mothers and that the demand for child care being influenced by mothers' labour force participation. In both of these explanations the part-time participation of mothers is more strongly driven by child care and a more powerful force on child care demand than full-time participation.

However, it must be noted that the number of observations, fifteen for models 1 and 2 and fourteen for models 3, 4 and 5, is extremely low and evidence from time lags is tenuous as a test of causality. The large number of variables combined with a low number of observations has reduced the degrees of freedom within the models, with no model having greater than 12 degrees of freedom and one having just 8. Such low degrees of freedom can lead to a decrease in the precision of estimates of individual coefficients and a decrease the power of tests of these coefficients (Ramanathan, 1989, p 165). This increases the probability of accepting false hypothesis.

The results of this research suggest the type of labour force participation of mothers to be explained by differing variables. Part-time participation is strongly explained by the government provision of subsidised child care while this variable is not as significant in explaining mothers full-time participation. The models of 1.2 and 1.3 find significant differences in the effects of government subsidised child care on the labour force participation of mothers, child care being a more significant factor in the decisions of mothers undertaking part-time work than those undertaking full-time work. This difference could result from the opportunity cost of home labour compared to undertaking part-time work being less than when compared to full-time labour and thus the cost of obtaining child care is a significant factor in increasing the value of home labour. In such a situation the government subsidisation of child care reduces the opportunity cost of not working part-time. In undertaking full-time labour force participation the opportunity cost is already large, due to the changes in female and male wages and changes in factors associated with the time trend variables, education, community attitudes, to the extent to which government subsidised child care becomes less significant in the decision process

The models of child care demand show labour force participation to be significant in explaining child care demand, with mothers part-time labour force participation having significantly more explanatory power than that of full-time participation on the demand for child care. However several of the results question the accuracy of the child care demand. The models found only family income variables, male earnings and the dependent spouse rebate, and not female earning to be significant. The variable for the Australian birth rate was found to have contrasting effects in two of the demand models.

The difference between estimated coefficients in the models for part-time and full-time participation may result from factors resulting in the specification of the variables for labour force participation. The variables for participation includes mothers of all dependent children, not just those aged 0-5 who are eligible for the child care subsidy. Ross and Saunders (1993) found that the significance of the presence of dependent children on the labour force decisions of mothers decreased with increased age of the dependent children. The presence of all dependent children, not just those eligible for the child care subsidy, may make the estimates of this research for full-time participation weaker if there is a pattern of participation where mothers' participation is largely part-time when their children are of child care age and then full-time when their children are older, but still dependent.

This study has identified a strong link between government subsidised child care and mother's part-time labour market participation. Cross-sectional studies of mother's labour force participation have yet to include any variable related to the availability of subsidised child care in their analysis of labour force participation. A cross-sectional study would improve on explaining this link by being able to identify the specific age of the dependent children and the use of subsidised child care by the mother. In this way the link between subsidised child care and full-time participation of mothers would be explained more clearly.

Mothers working full-time, by virtue of the larger amount of care required when compared to part-time, receive the greatest child care subsidy, yet this, according to this research plays little part in their decision to work. The receipt of the largest subsidy by those who earn the highest wage, the full-time work force, suggests that the distribution of the subsidy

may be skewed towards higher income earners. These questions would, again, be resolved by a cross-sectional analysis of labour force participation and child care.

6 REFERENCES

Brown, W. S. (1991). Introducing econometrics. St. Paul: West Publishing Company

Beggs, J. J., & Chapman, B. J. (1988). The foregone earnings from child rearing in Australia (Discussion Paper No. 190). Canberra: Centre for Economic Policy Research, Australian National University.

Bureau of Labour Market Research. (1986). Unemployment and the Labour Market: Anatomy of the Problem (Research Report No. 9). Canberra: Australian Government Publishing Service.

Burggraf, S. P. (1993, September/October). How should the costs of child rearing be distributed? Challenge, pp. 48-55.

CCH Tax Editors. (1993). Australian master tax guide. North Ryde: CCH Australia Limited.

Corbett, J. (1993). Child care provision and women's labour market participation in Australia (Discussion Paper No. 32). Canberra: Policy Project, Australian National University.

Department of Employment, Education and Training. (1990). Part-time work: trends and issues. Prepared for the Women's Research and Employment Initiatives Program. Canberra: Women's Bureau.

Dawkins, J., & Willis, R. (1993). Budget statements, 1993/94 (Budget Paper No. 1). Canberra: Australian Government Publishing Service.

Fayissa, B., & Fessehatzion, T. (1990). Child care services in the labourforce participation and income distribution of working mothers in the US. International Journal of Social Economics, 17(4), 49-56.

Gregory, R. G., McMahon, P. J., & Whittingham, B. (1983). Women in the labour force: Trends causes and consequences (Conference Paper No. 25). Canberra: Bureau of Labour Market Research.

Lewis, D. E., & Shorten, B. (1987). Female participation in the Australian labour force. Australian Bulletin of Labour, 13(4), 237-263.

Miller, P. W., & Volker P. (1983). A cross-sectional analysis of the labour force participation of married women in Australia. The Economic Record, 59(164), 28-42.

Norris, K. (1989). The economics of Australian labour markets (2nd ed.). Melbourne: Longman Cheshire.

Ramanathan, R. (1989). Introductory econometrics with applications. San Diego: Harcourt Brace Jovanovich.

Ross, R., & Saunders, P. (1993, June). The labour supply behaviour of sole mothers and married mothers in Australia: evidence from the 1986 income distribution survey. Australian Economic Papers, pp. 116-133.

Ross, R. T. (1986). Analysis of the 1980 Sydney survey of work patterns of married women: further results. The Economic Record, 62(178), 325-337.

Teal, F. (1992). The use and cost of child care in Australia. The Australian Economic Review, No. 97, 3-14.

Winocur, S., & Rosenman, L. (1992, July). Superannuation: some implications for women. Current Affairs Bulletin, pp. 28-29.

7 APPENDICES

Appendix A: Matrices of Correlation Coefficients.

model 1 correlation coefficients

	AWFET-1	AWMET-1	CCARET-1	DUM1T-1	DUM2T-1	DSREBT1
AWFET-1	1.0000					
AWMET-1	0.9668	1.0000				
CCARET-1	0.9080	0.8539	1.0000			
DUM1T-1	0.4461	0.3224	0.6948	1.0000		
DUM2T-1	0.4461	0.3224	0.6948	1.0000	1.0000	
DSREBT-1	-0.8664	-0.8684	-0.7234	-0.2335	-0.2335	1.0000
FERTT-1	-0.7719	-0.8275	-0.7235	-0.2476	-0.2476	0.5628
LFPM	0.9638	0.9614	0.8761	0.3031	0.3031	-0.8848
MFTE	0.9466	0.9272	0.8452	0.2888	0.2888	-0.8856
MPTE	0.9522	0.9574	0.8540	0.2422	0.2422	-0.8728
TIME	0.9476	0.9625	0.9078	0.4330	0.4330	-0.8176
UNET-1	0.3877	0.3365	0.5640	0.5724	0.5724	-0.1651

	FERTT-1	LFPM	MFTE	MPTE	TIME	UNET-1
LFPM	-0.7759	1.0000				
MFTE	-0.7825	0.9791	1.0000			
MPTE	-0.7846	0.9951	0.9741	1.0000		
TIME	-0.7837	0.9612	0.9057	0.9432	1.0000	
UNET-1	-0.1360	0.3647	0.2183	0.3326	0.5244	1.0000

model 2 correlation coefficients

	CCARET-1	DUM1T-1	DUM2T-1	LFPM	MFTE	MPTE
CCARET-1	1.00000					
DUM1T-1	0.6948	1.0000				
DUM2T-1	0.6948	1.0000	1.0000			
LFPM	0.8761	0.3031	0.3031	1.0000		
MFTE	0.8452	0.2888	0.2888	0.9791	1.0000	
MPTE	0.8540	0.2422	0.2422	0.9951	0.9741	1.0000
TIME	0.9078	0.4330	0.4330	0.9612	0.9057	0.9432

	TIME
TIME	1.0000

model 3 correlation coefficients

	AWFE	AWME	CCARE D	DUM1	DUM2	DSREB
AWFE	1.0000					
AWME	0.9686	1.0000				
CCARE	0.8751	0.7994	1.0000			
DUM1	0.5703	0.4376	0.8428	1.0000		
DUM2	0.5681	0.4371	0.8521	0.9950	1.0000	
DSREB	-0.8645	-0.9144	-0.6295	-0.2579	-0.2511	1.0000
FERT	-0.7292	-0.7656	-0.5407	-0.1935	-0.1727	0.6935
LFPMT-1	0.9781	0.9675	0.8613	0.3843	0.3843	-0.9493
MFTET-1	0.9263	0.9260	0.7446	0.5072	0.4970	-0.8848
MPTET-1	0.9617	0.9666	0.7702	0.4234	0.4137	-0.9472
TIME	0.9535	0.9517	0.8929	0.5901	0.5914	-0.8328
UNE	0.4596	0.3730	0.6606	0.6857	0.6814	-0.1935

	FERT	LFPMT-1	MFTET-1	MPTET-1	TIME	UNE
FERT	1.0000					
LFPMT-1	-0.7759	1.0000				
MFTET-1	-0.5792	0.9298	1.0000			
MPTET-1	-0.7707	0.9966	0.9192	1.0000		
TIME	-0.6670	0.9708	0.9046	0.9379	1.0000	
UNE	0.0317	0.2476	0.3668	0.2787	0.5893	1.0000

model 4 correlation coefficients

	AWFET-1	AWMET-1	CCARE	DUM1	DUM2	DSREBT-1
AWFET-1	1.0000					
AWMET-1	0.9668	1.0000				
CCARE	0.8721	0.8144	1.0000			
DUM1	0.6030	0.5192	0.8428	1.0000		
DUM2	0.6048	0.5124	0.8521	0.9950	1.0000	
DSREBT-1	-0.8664	-0.8684	-0.6634	-0.4061	-0.3982	1.0000
FERTT-1	-0.7719	-0.8275	-0.5480	-0.1646	-0.1822	0.5628
LFPMT-1	0.9678	0.9591	0.8613	0.3843	0.3843	-0.9046
MFTET-1	0.9523	0.9511	0.7446	0.5072	0.4970	-0.9209
MPTET-1	0.9460	0.9555	0.7702	0.4234	0.4137	-0.9007
TIME	0.9476	0.9625	0.8929	0.5900	0.5914	-0.8176
UNET-1	0.3877	0.3365	0.7172	0.6735	0.6856	-0.1651

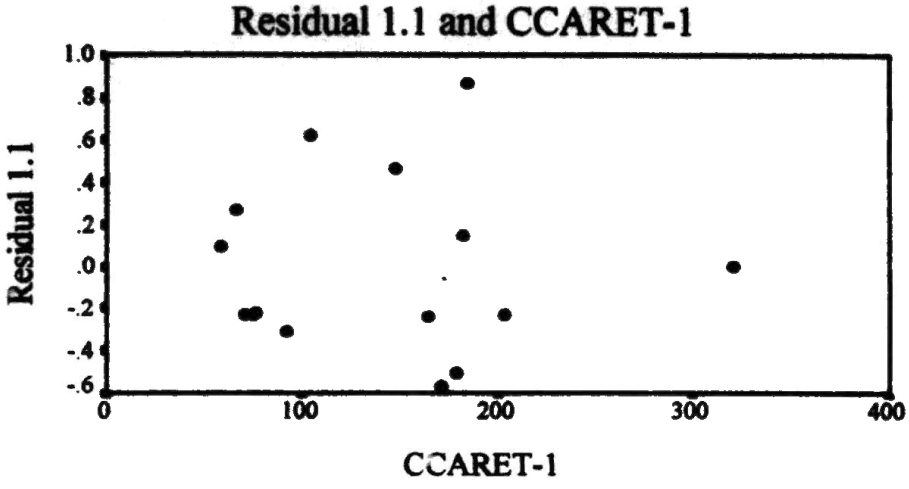
	FERTT-1	LFPMT-1	MFTET-1	MPTET-1	TIME	UNET-1
FERTT-1	1.0000					
LFPMT-1	-0.7907	1.0000				
MFTET-1	-0.7914	0.9298	1.0000			
MPTET-1	-0.8090	0.9966	0.9192	1.0000		
TIME	-0.7837	0.9708	0.9046	0.9379	1.0000	
UNET-1	-0.1360	0.1877	0.1604	0.2794	0.5244	1.0000

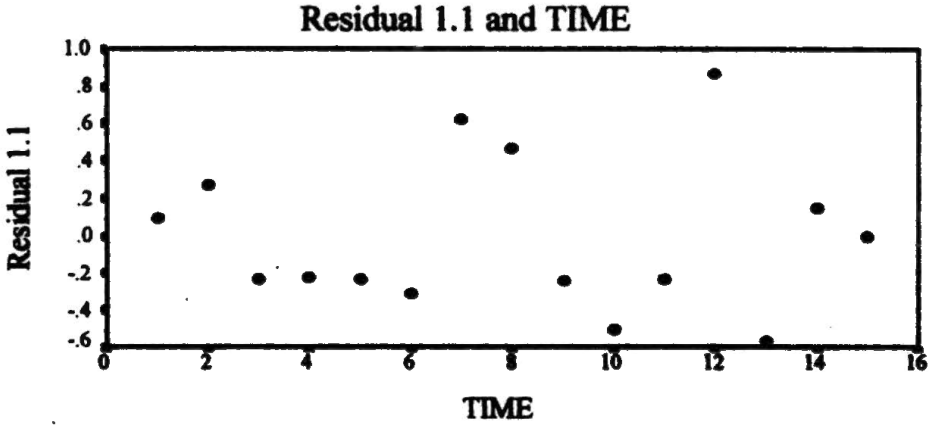
model 5 correlation coefficients

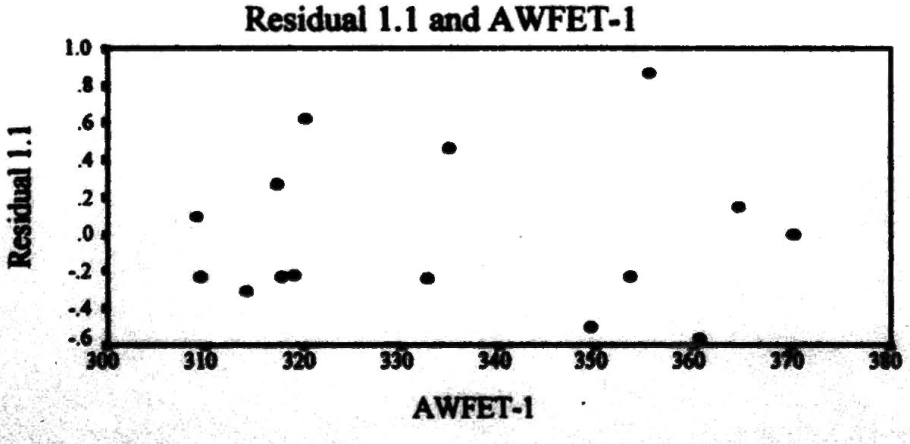
	CCARE	DUM1	DUM2	LFPMT-1	MFTET-1	MPTET-1
CCARE	1.0000					
DUM1	0.8428	1.0000				
DUM2	0.8521	0.9950	1.0000			
LFPMT-1	0.8613	0.3843	0.3843	1.0000		
MFTET-1	0.7446	0.5072	0.4970	0.9298	1.0000	
MPTET-1	0.7702	0.4234	0.4137	0.9966	0.9192	1.0000
TIME	0.8929	0.5901	0.5914	0.9708	0.9046	0.9379

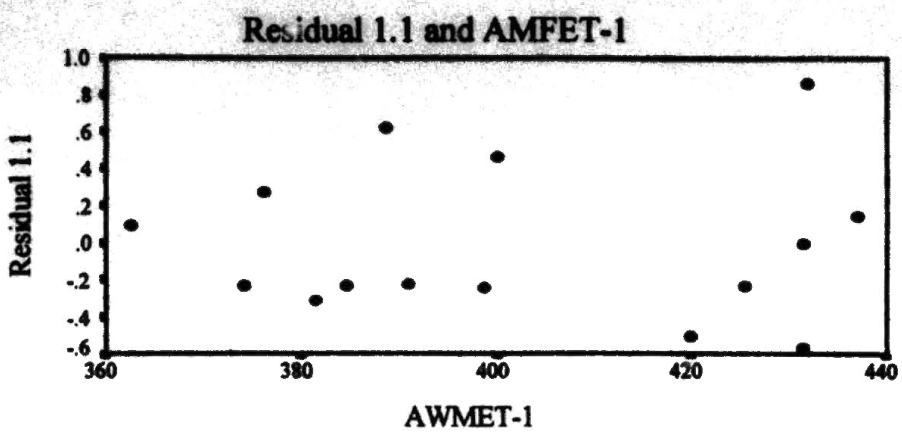
	TIME
TIME	1.0000

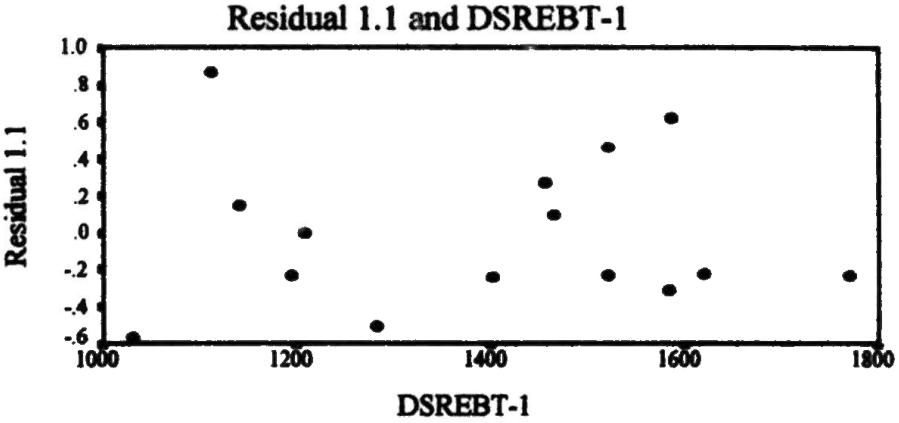
model 1.1.

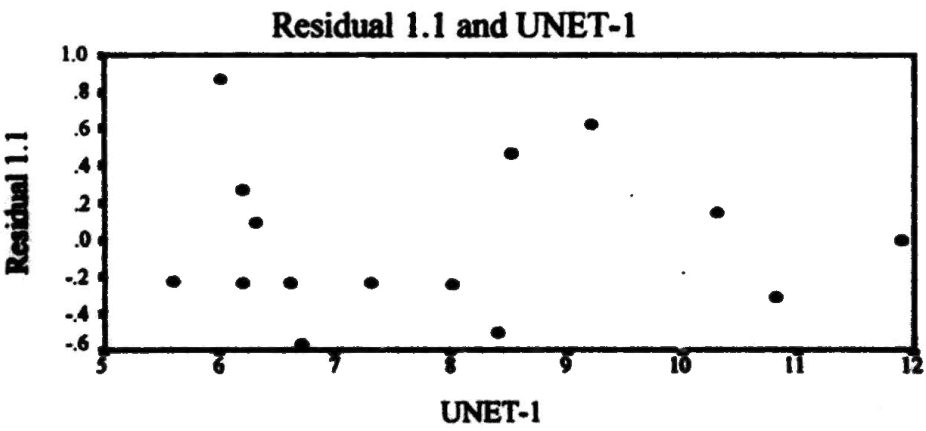

Residual 1.1 and CCARET-1
Residual 1.1
1.0
.8
.6
.4
.2
.0
-.2
-.4
-.6
0
100
200
300
400
CCARET-1


Residual 1.1 and TIME
Residual 1.1
1.0
.8
.6
.4
.2
.0
-.2
-.4
-.6
0
2
4
6
8
10
12
14
16
TIME

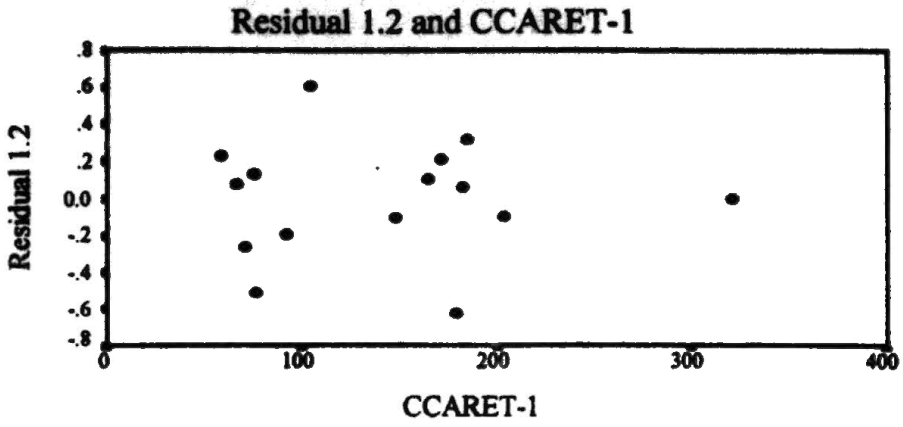

Residual 1.1 and AWFET-1
Residual 1.1
1.0
.8
.6
.4
.2
.0
-.2
-.4
-.6
300
310
320
330
340
350
360
370
380
AWFET-1

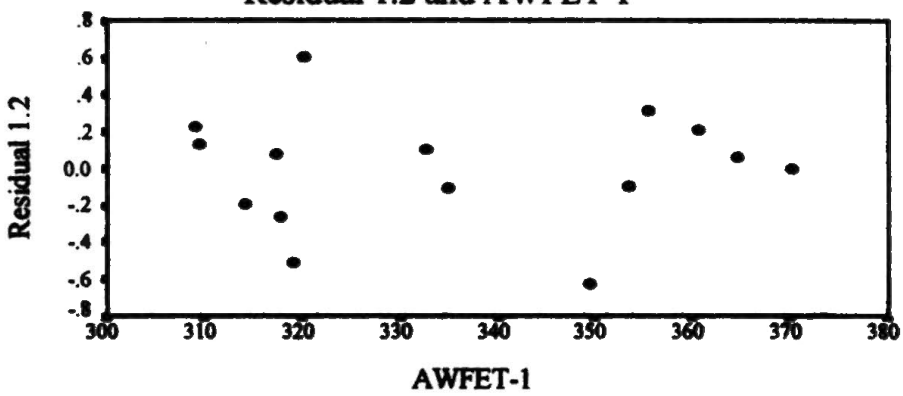

Residual 1.1 and AMFET-1
Residual 1.1
1.0
.8
.6
.4
.2
.0
-.2
-.4
-.6
360
380
400
420
440
AWMET-1


Residual 1.1 and DSREBT-1
Residual 1.1
1.0
.8
.6
.4
.2
.0
-.2
-.4
-.6
1000
1200
1400
1600
1800
DSREBT-1

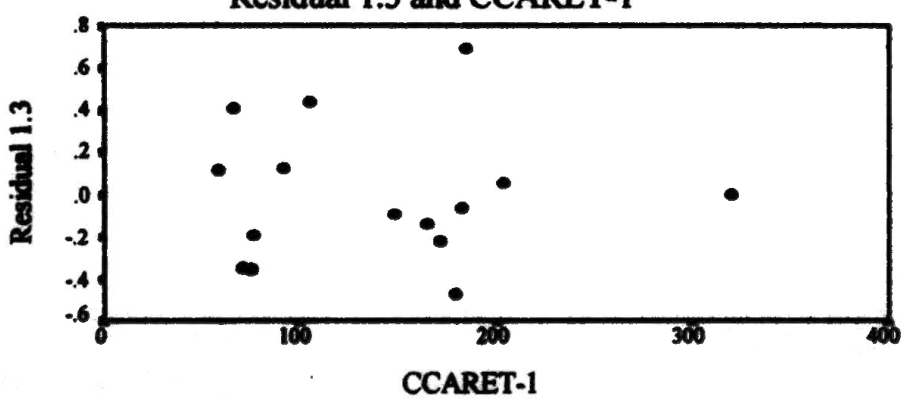

Residual 1.1 and UNET-1
Residual 1.1
1.0
.8
.6
.4
.2
.0
-.2
-.4
-.6
5
6
7
8
9
10
11
12
UNET-1

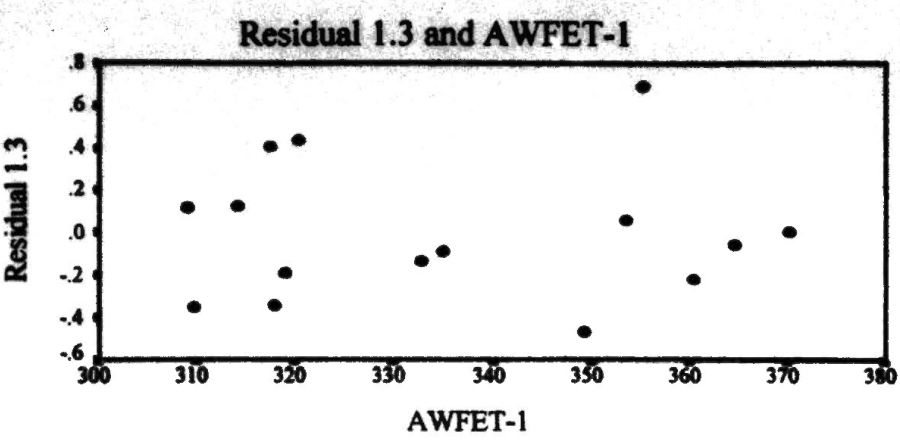
model 2.1.

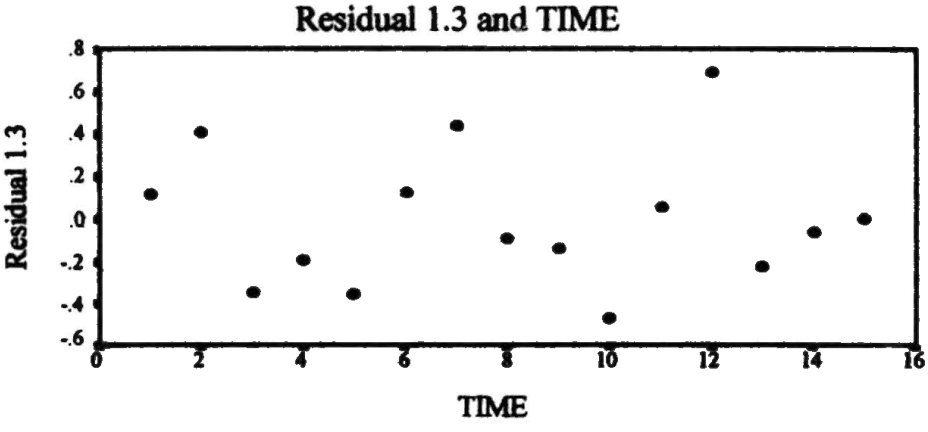


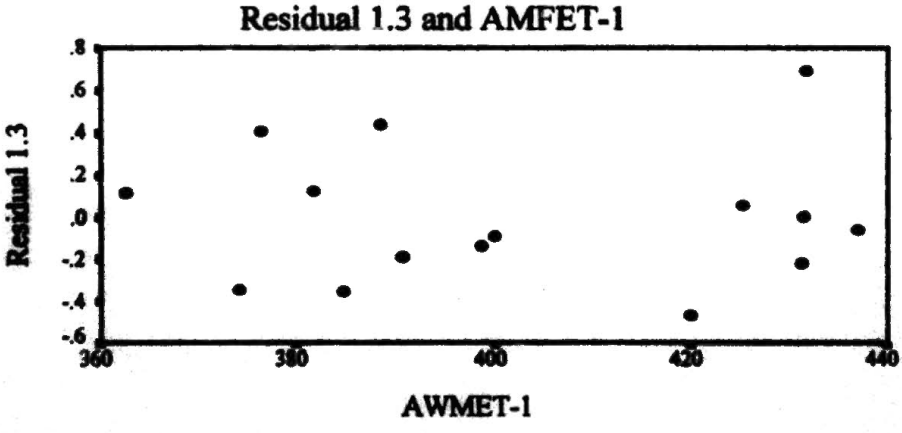


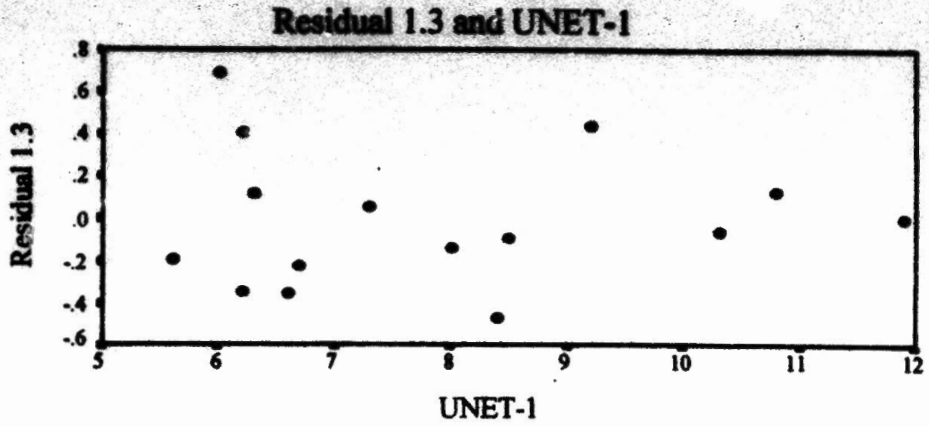
model 1.3.



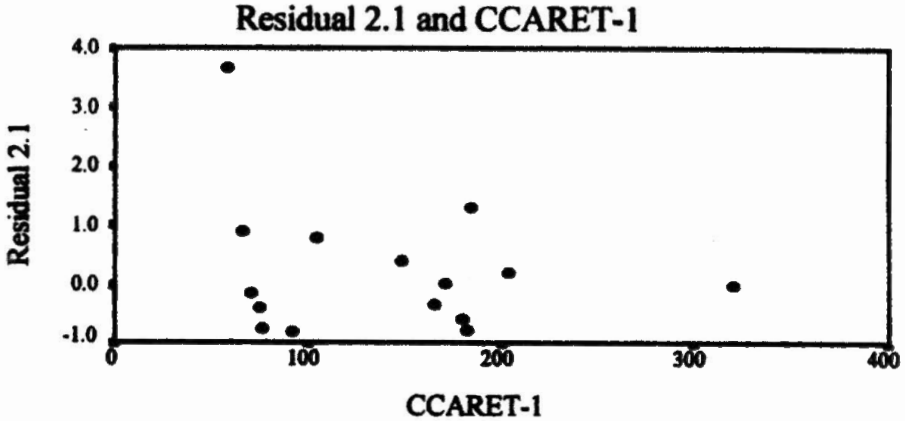

Residual 1.3 and AWFET-1
Residual 1.3
.8
.6
.4
.2
.0
-.2
-.4
-.6
300
310
320
330
340
350
360
370
380
AWFET-1

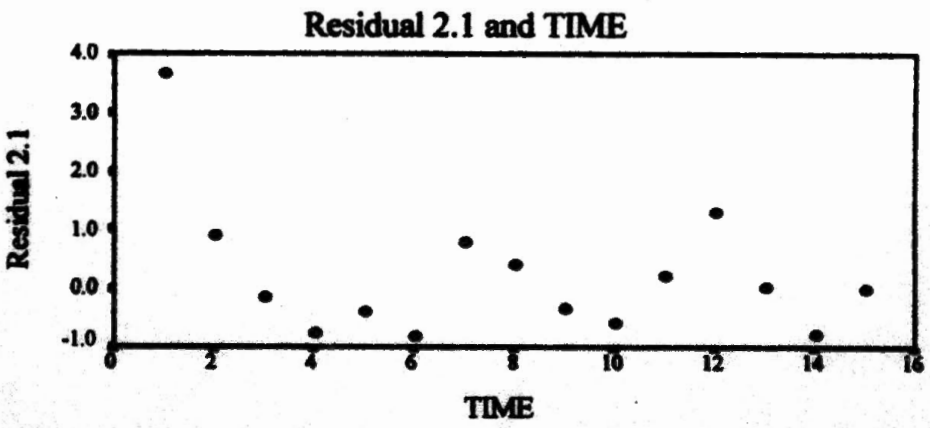

Residual 1.3 and TIME
Residual 1.3
.8
.6
.4
.2
.0
-.2
-.4
-.6
0
2
4
6
8
10
12
14
16
TIME


Residual 1.3 and AMFET-1
Residual 1.3
.8
.6
.4
.2
.0
-.2
-.4
-.6
360
380
400
420
440
AWMET-1

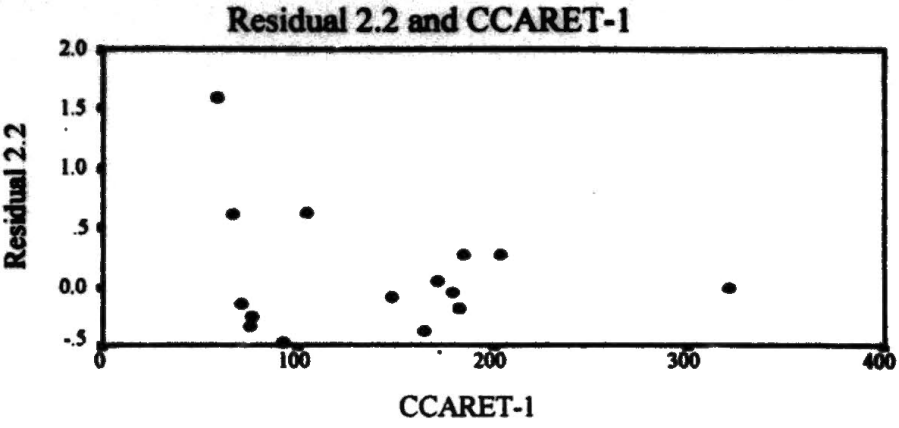

Residual 1.3 and UNET-1
Residual 1.3
.8
.6
.4
.2
.0
-.2
-.4
-.6
5
6
7
8
9
10
11
12
UNET-1

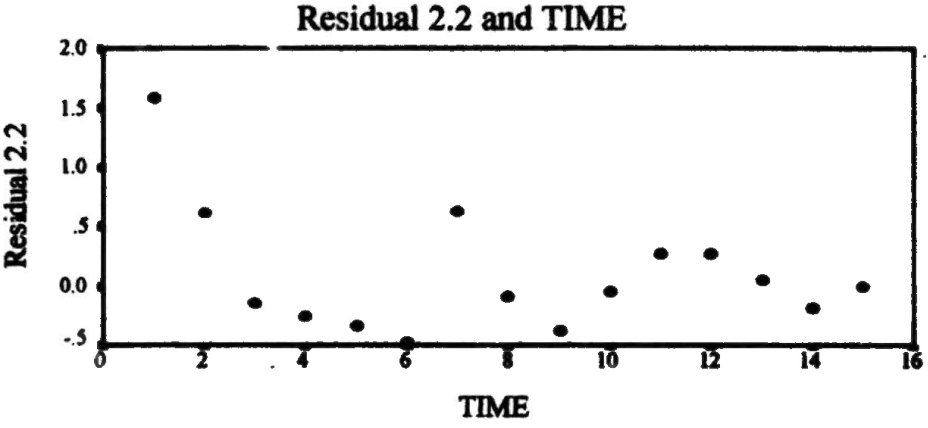
model 2.1.


Residual 2.1 and CCARET-1
Residual 2.1
4.0
3.0
2.0
1.0
0.0
-1.0
0
100
200
300
400
CCARET-1

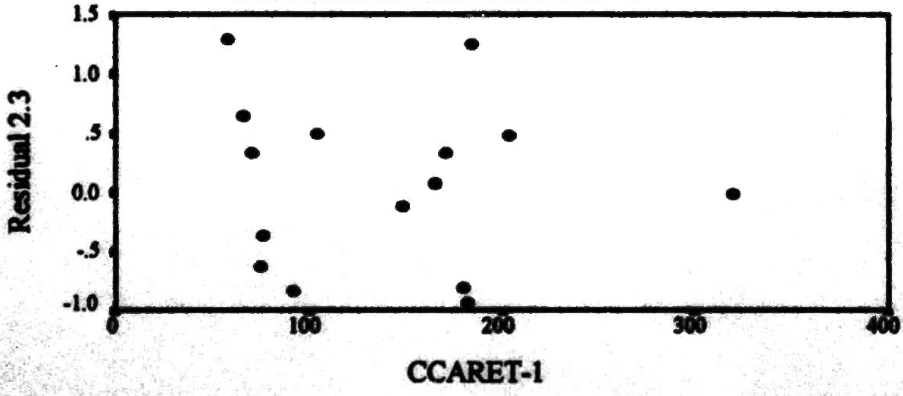

Residual 2.1 and TIME
Residual 2.1
4.0
3.0
2.0
1.0
0.0
-1.0
0
2
4
6
8
10
12
14
16
TIME

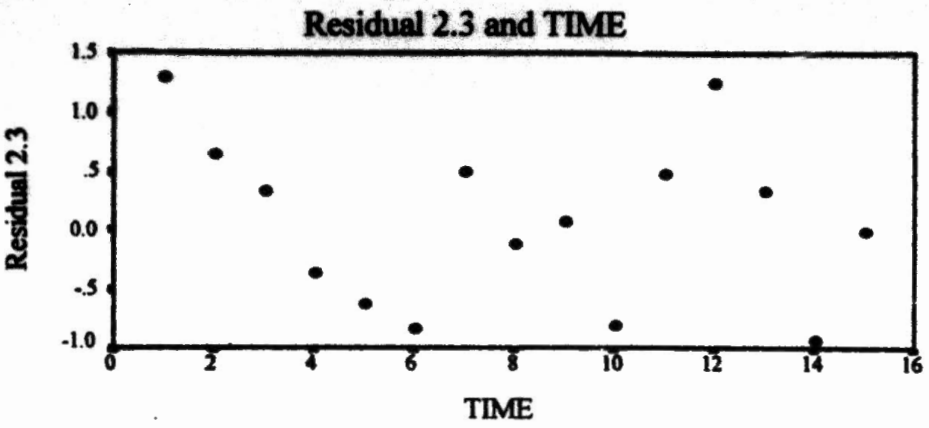
model 2.2.



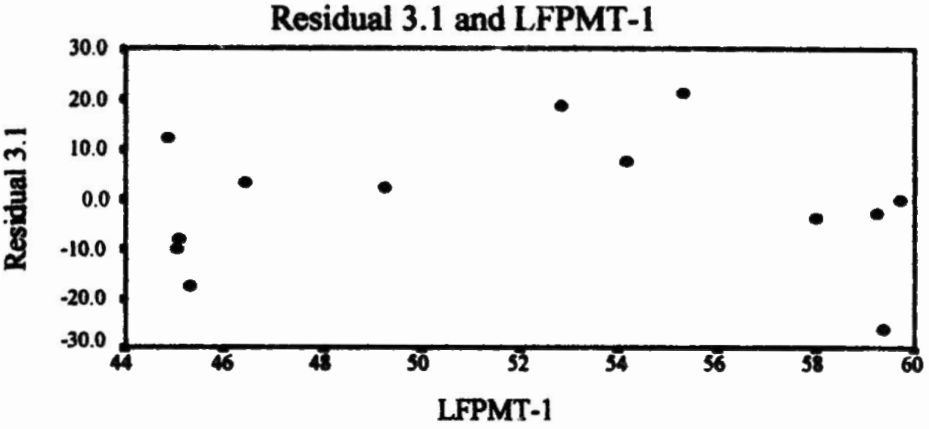


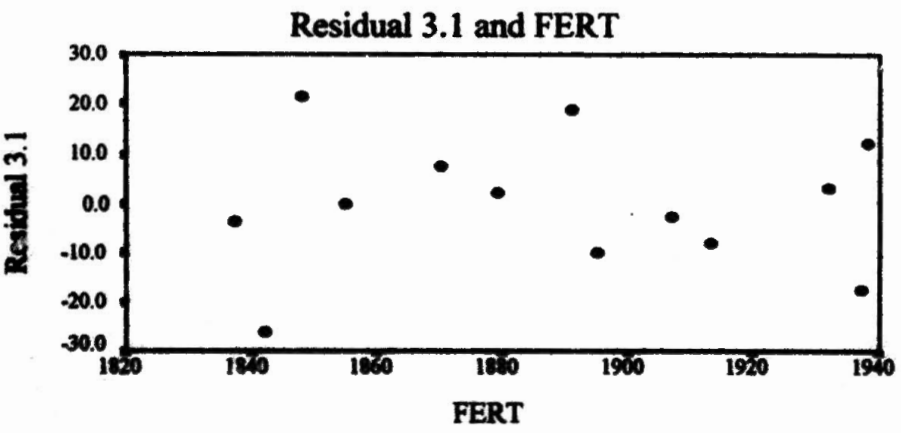
model 2.3.

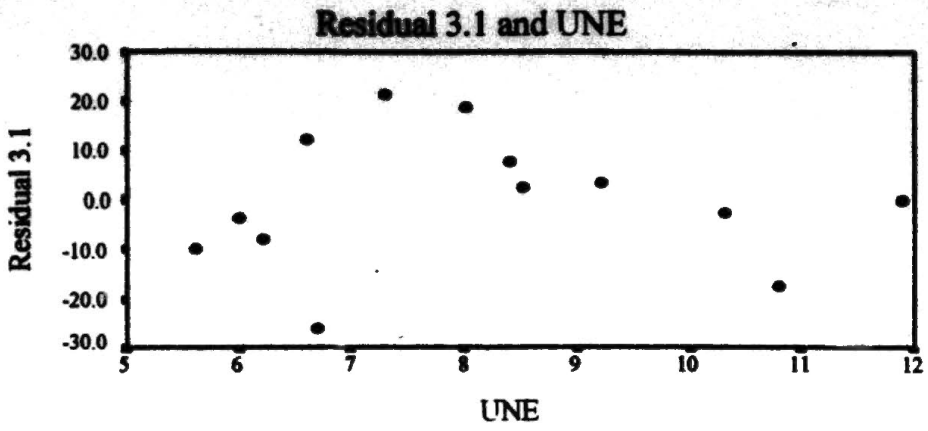



Residual 2.3 and TIME
Residual 2.3
1.5
1.0
.5
0.0
-.5
-1.0
0
2
4
6
8
10
12
14
16
TIME

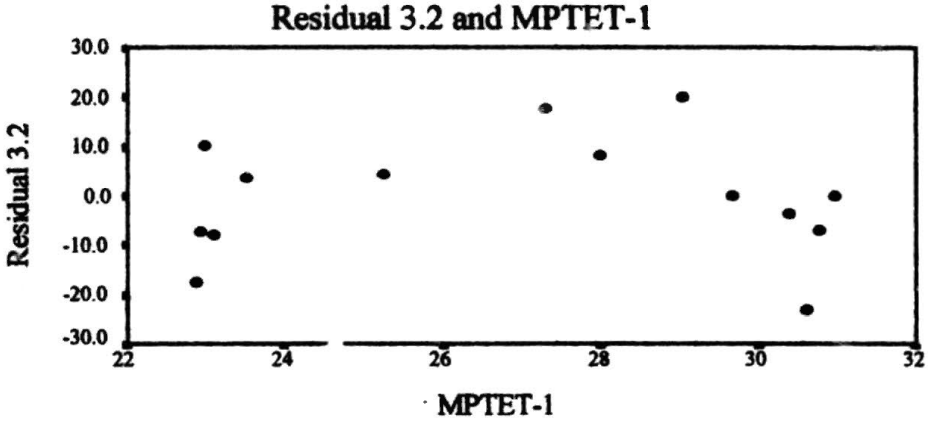
model 3.1.

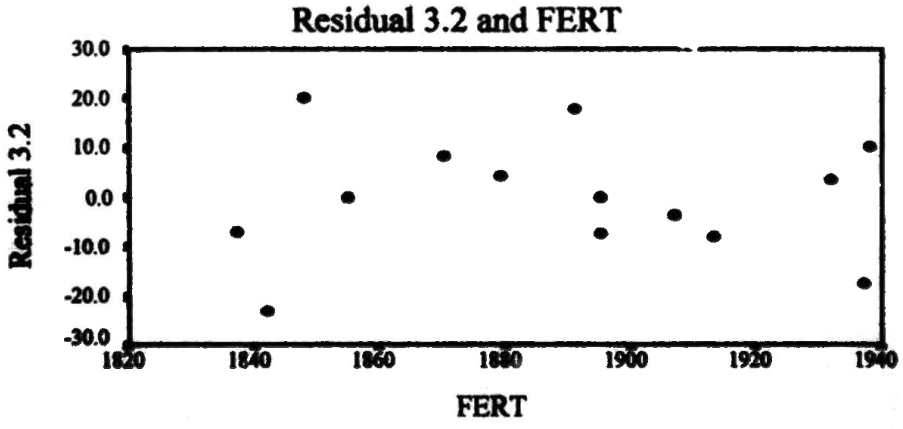

Residual 3.1 and LFPMT-1
Residual 3.1
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
44
46
48
50
52
54
56
58
60
LFPMT-1

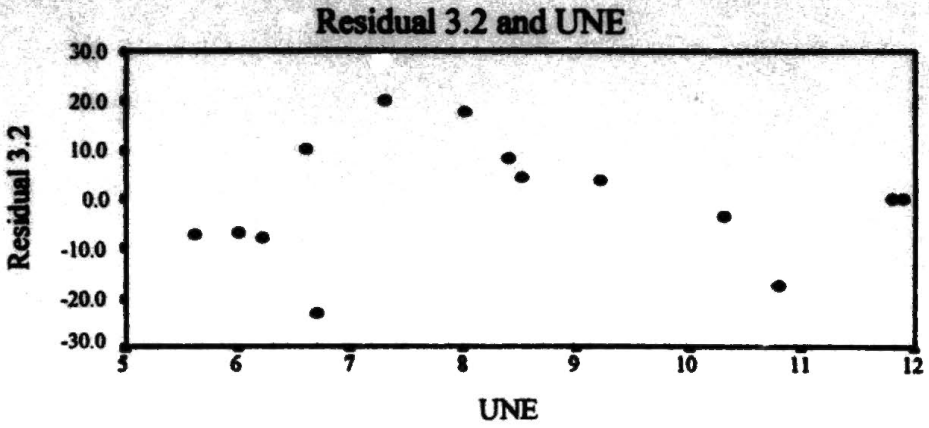

Residual 3.1 and FERT
Residual 3.1
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
1820
1840
1860
1880
1900
1920
1940
FERT


Residual 3.1 and UNE
Residual 3.1
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
5
6
7
8
9
10
11
12
UNE

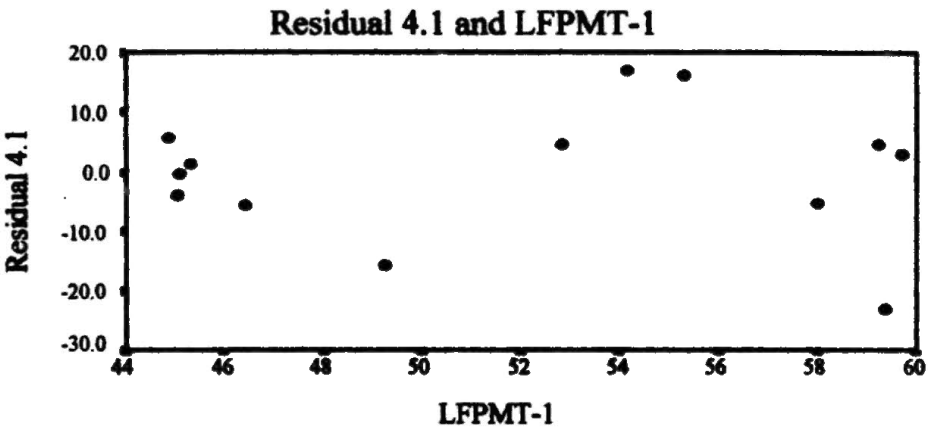
model 3.2.

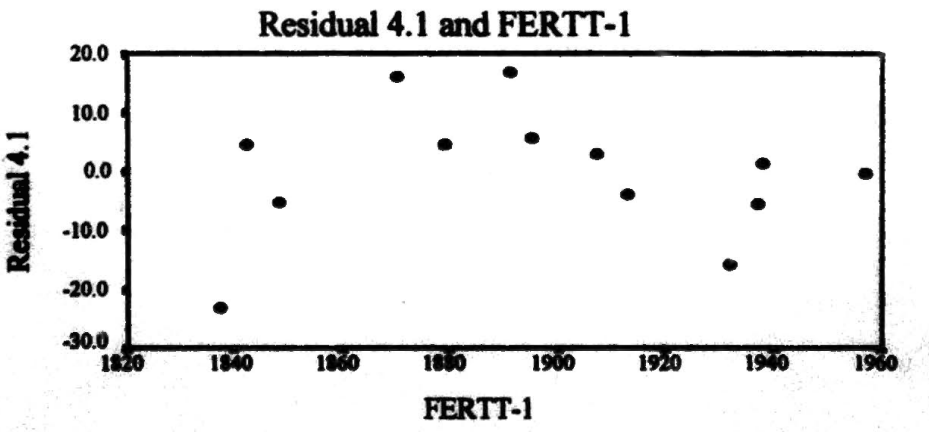

Residual 3.2 and MPTET-1
Residual 3.2
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
22
24
26
28
30
32
MPTET-1

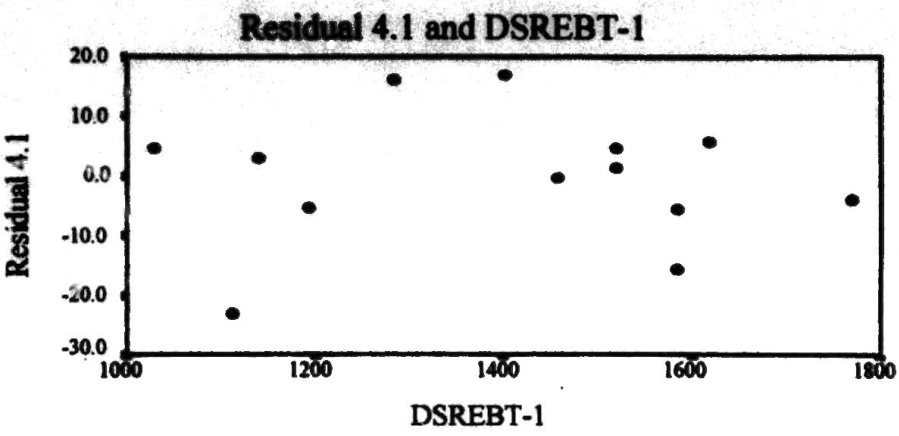

Residual 3.2 and FERT
Residual 3.2
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
1820
1840
1860
1880
1900
1920
1940
FERT

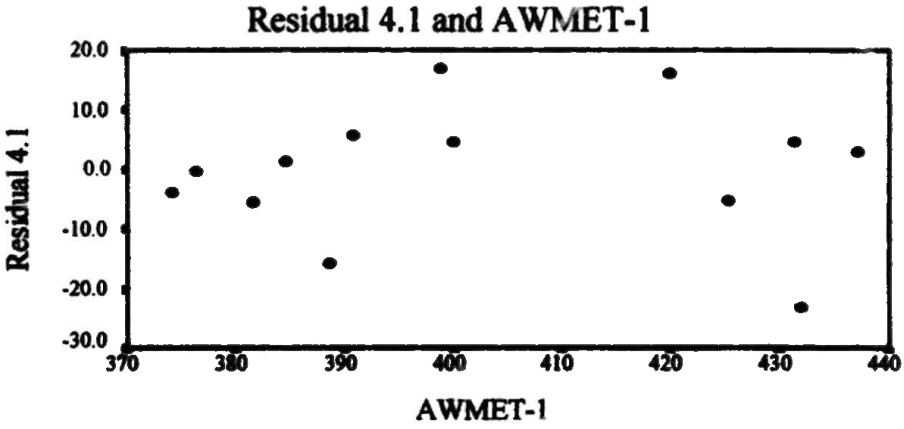

Residual 3.2 and UNE
Residual 3.2
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
5
6
7
8
9
10
11
12
UNE

model 4.1.

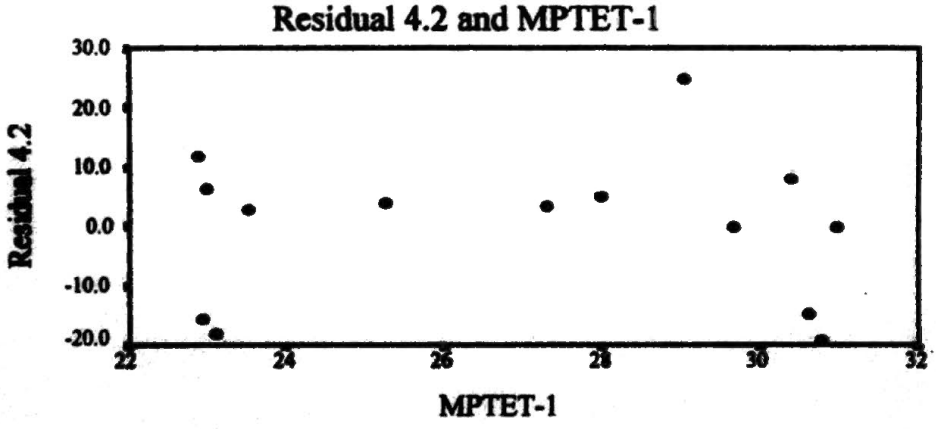

Residual 4.1 and LFPMT-1
Residual 4.1
20.0
10.0
0.0
-10.0
-20.0
-30.0
44
46
48
50
52
54
56
58
60
LFPMT-1

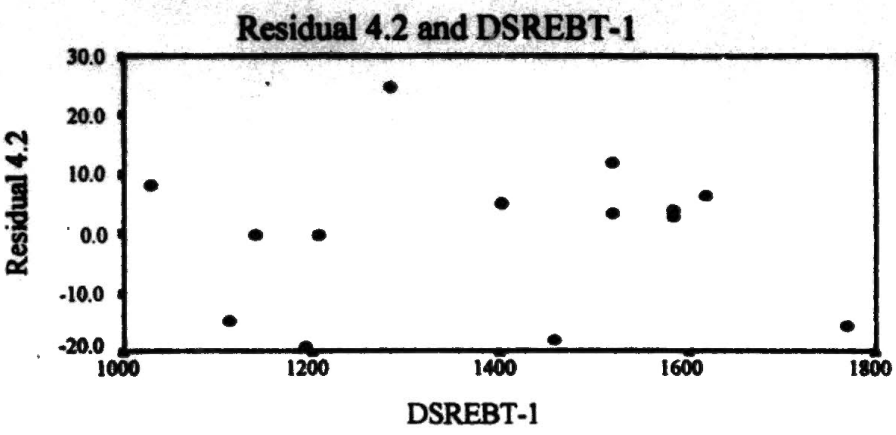

Residual 4.1 and FERTT-1
Residual 4.1
20.0
10.0
0.0
-10.0
-20.0
-30.0
1820
1840
1860
1880
1900
1920
1940
1960
FERTT-1

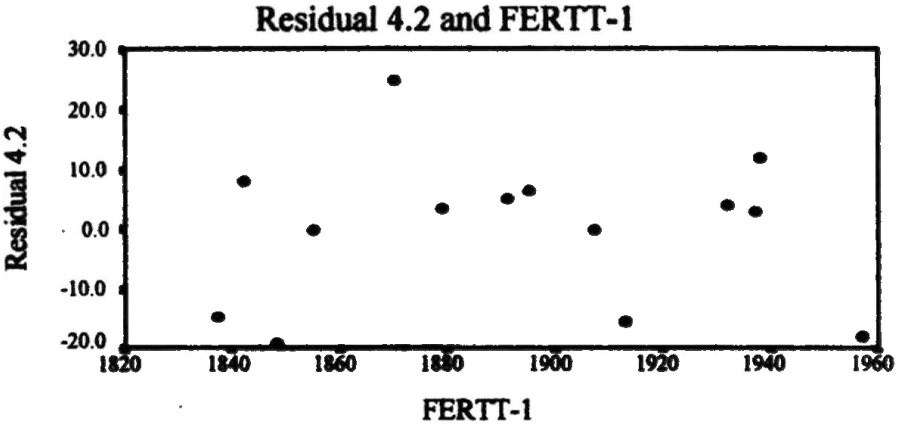

Residual 4.1 and DSREBT-1
Residual 4.1
20.0
10.0
0.0
-10.0
-20.0
-30.0
1000
1200
1400
1600
1800
DSREBT-1


Residual 4.1 and AWMET-1
Residual 4.1
20.0
10.0
0.0
-10.0
-20.0
-30.0
370
380
390
400
410
420
430
440
AWMET-1

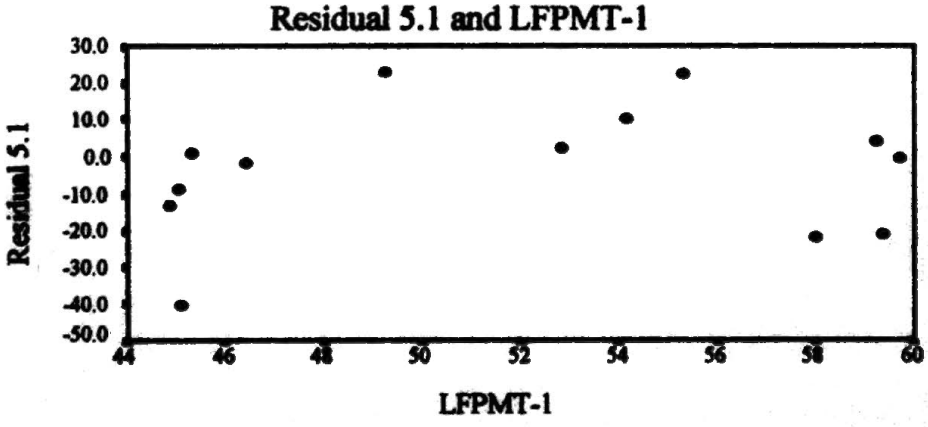
model 4.2.

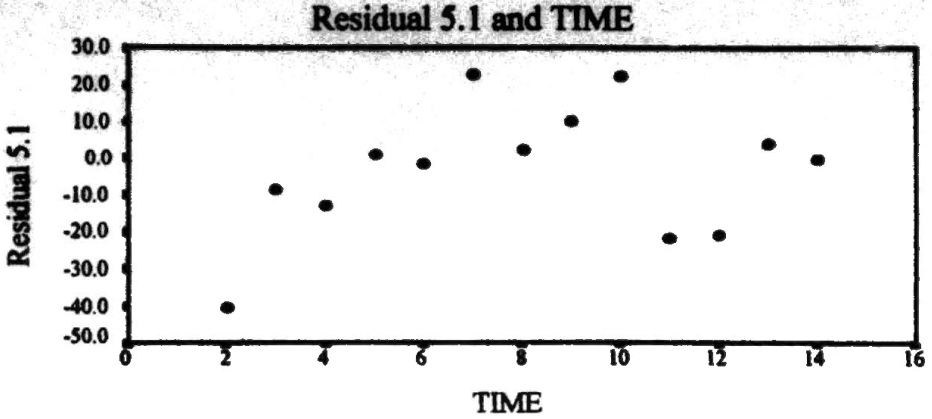

Residual 4.2 and MPTET-1
Residual 4.2
30.0
20.0
10.0
0.0
-10.0
-20.0
22
24
26
28
30
32
MPTET-1


Residual 4.2 and DSREBT-1
Residual 4.2
30.0
20.0
10.0
0.0
-10.0
-20.0
1000
1200
1400
1600
1800
DSREBT-1

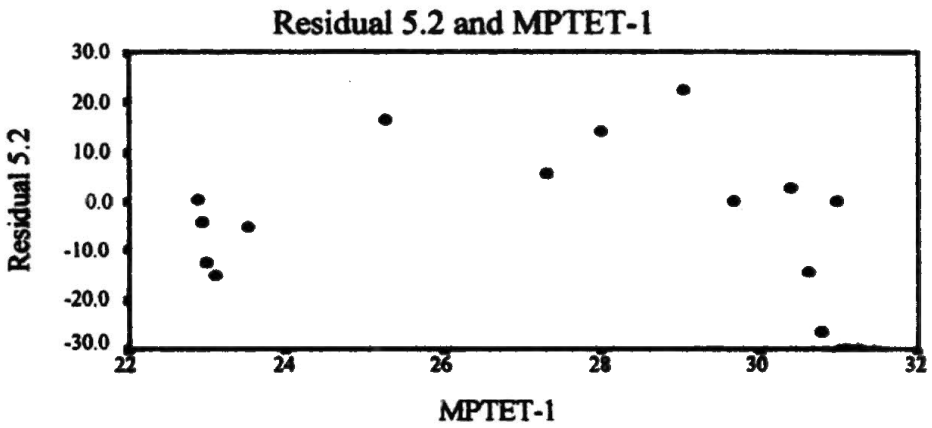

Residual 4.2 and FERTT-1
Residual 4.2
30.0
20.0
10.0
0.0
-10.0
-20.0
1820
1840
1860
1880
1900
1920
1940
1960
FERTT-1

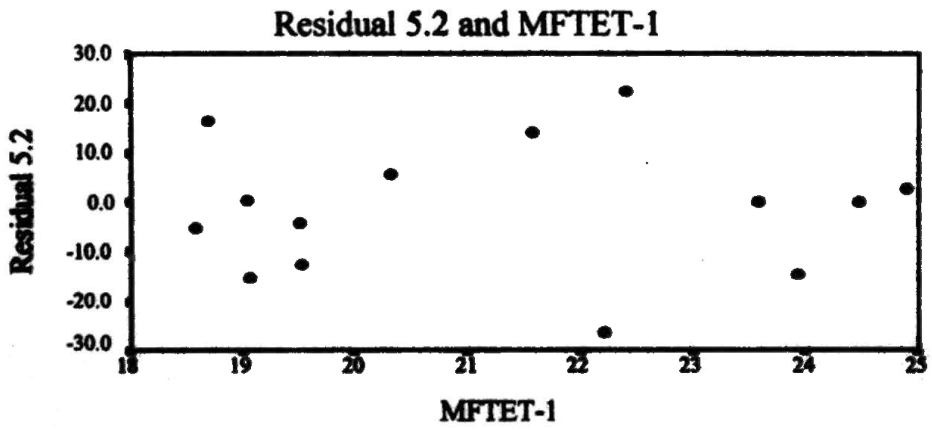
model 5.1.


Residual 5.1 and LFPMT-1
Residual 5.1
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
44
46
48
50
52
54
56
58
60
LFPMT-1


Residual 5.1 and TIME
Residual 5.1
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
0
2
4
6
8
10
12
14
16
TIME

model 5.2.


Residual 5.2 and MPTET-1
Residual 5.2
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
22
24
26
28
30
32
MPTET-1


Residual 5.2 and MFTET-1
Residual 5.2
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
18
19
20
21
22
23
24
25
MFTET-1

Appendix C: Lagrange Multiplier Tests for Autocorrelation

model 1.1.

R Square 0.04063

No. of Observations 14

Reject zero Autocorrelation if $(n-1).R^2 > \chi^2$. with 1d.f.(0.05)

χ^2 with 1d.f.(0.05) = 3.84146

$(n-1).R^2 = 13 \cdot 0.04063 = 0.5282$

$0.5282 < 3.84146$

model 1.2.

R Square 0.0071

No. of Observations 14

Reject zero Autocorrelation if $(n-1).R^2 > \chi^2$ with 1d.f.(0.05)

χ^2 with 1d.f.(0.05) = 3.84146

$(n-1).R^2 = 13 \cdot 0.0071 = 0.0923$

$0.0923 < 3.84146$

model 1.3.

R Square 0.0011

No. of Observations 14

Reject zero Autocorrelation if $(n-1).R^2 > \chi^2$ with 1d.f.(0.05)

χ^2 with 1d.f.(0.05) = 3.84146

$(n-1).R^2 = 13 \cdot 0.0011 = 0.0147$

$0.0147 < 3.84146$

model 2.1.

R Square	0.50294
No. of Observations	14

Reject zero Autocorrelation if $(n-1).R^2 > \chi^2$ with 1d.f.(0.05)

χ^2 with 1d.f..(0.05) = 3.84146

$(n-1).R^2 = 13 \cdot 50294 = 6.5382$

$6.5382 > 3.84146$

model 2.2.

R Square	0.4685
No. of Observations	14

Reject zero Autocorrelation if $(n-1).R^2 > \chi^2$ with 1d.f.(0.05)

χ^2 with 1d.f.(0.05) = 3.84146

$(n-1).R^2 = 13 \cdot 0.4685 = 6.0908$

$6.0908 > 3.84146$

model 2.3.

R Square 0.2654

No. of Observations 14

Reject zero Autocorrelation if $(n-1).R^2 > \chi^2$ with 1d.f.(0.05)

χ^2 with 1d.f.(0.05) = 3.84146

$(n-1).R^2 = 13 \cdot 0.2654 = 3.4503$

$3.4503 < 3.84146$

model 3.1.

R Square 0.00556

No. of Observations 13

Reject zero Autocorrelation if $(n-1).R^2 > \chi^2$ with 1d.f.(0.05)

χ^2 with 1d.f.(0.05) = 3.84146

$(n-1).R^2 = 12 \cdot 0.00556 = 0.06672$

$0.06672 < 3.84146$

model 3.2.

R Square 0.00556

No. of Observations 13

Reject zero Autocorrelation if $(n-1).R^2 > \chi^2$ with 1d.f.(0.05)

χ^2 with 1d.f.(0.05) = 3.84146

$(n-1).R^2 = 12 . 0. 00556 = 0.06672$

0. 06672 < 3.84146

model 4.1.

R Square 0.06313

No. of Observations 13

Reject zero Autocorrelation if $(n-1).R^2 > \chi^2$ with 1d.f.(0.05)

χ^2 with 1d.f.(0.05) = 3.84146

$(n-1).R^2 = 12 . 0. 06313 = 0.75756$

0. 75756 < 3.84146

model 4.2.

R Square 0.00811

No. of Observations 13

Reject zero Autocorrelation if $(n-1).R^2 > \chi^2$ with 1d.f.(0.05)

χ^2 with 1d.f.(0.05) = 3.84146

$(n-1).R^2 = 12 . 00811 = 0.09732$

0. 09732 < 3.84146

model 5.1.

R Square 0.33726

No. of Observations 13

Reject zero Autocorrelation if $(n-1).R^2 > \chi^2$ with 1d.f.(0.05)

χ^2 with 1d.f.(0.05) = 3.84146

$(n-1).R^2 = 12 . 0. 33726 = 4.04712$

4. 04712 > 3.84146

model 5.2.

R Square 0.34026

No. of Observations 13

Reject zero Autocorrelation if $(n-1).R^2 > \chi^2$ with 1d.f.(0.05)

χ^2 with 1d.f.(0.05) = 3.84146

$(n-1).R^2 = 12 . 0. 34026 = 4.08312$

4.08312 > 3.84146

YEAR	LABOUR FORCE			POPN.	PARTICIPATION RATE			CHILD CARE	YEAR
	Part-Time 000'S	Full Time 000'S	Total 000'S	000'S	Total	Part-Time	Full-Time	Nominal 000'S	
1978								$25,203.00	1978
1979	459.6	392.6	912.8	2060.7	44.296%	22.303%	19.052%	$31,086.00	1979
1980	479.4	404.9	938.4	2077.3	45.174%	23.078%	19.492%	$36,136.00	1980
1981	476.0	405.2	934.8	2075.8	45.033%	22.931%	19.520%	$42,851.00	1981
1982	478.0	396.1	933.5	2080.5	44.869%	22.975%	19.039%	$47,355.00	1982
1983	479.6	389.4	949.5	2096.8	45.283%	22.873%	18.571%	$64,954.00	1983
1984	496.6	394.7	980.6	2112.7	46.415%	23.505%	18.682%	$80,125.00	1984
1985	533.6	429.1	1040.3	2112.9	49.236%	25.254%	20.309%	$119,731.00	1985
1986	581.3	459.6	1125.3	2131.0	52.806%	27.278%	21.567%	$146,424.00	1986
1987	609.3	487.8	1179.6	2178.5	54.147%	27.969%	22.392%	$175,222.00	1987
1988	640.3	489.7	1220.2	2206.0	55.313%	29.025%	22.199%	$215,219.00	1988
1989	678.6	527.7	1278.9	2204.6	58.011%	30.781%	23.936%	$212,527.00	1989
1990	700.2	569.4	1357.9	2286.9	59.377%	30.618%	24.898%	$215,036.00	1990
1991	692.0	557.6	1349.0	2278.2	59.213%	30.375%	24.475%	$243,638.00	1991
1992	720.6	548.8	1390.0	2327.9	59.710%	30.955%	23.575%	$439,800.00	1992
1993	694.5	558.6	1374.8	2341.2	58.722%	29.664%	23.860%	$538,179.00	1993

YEAR	CPI	CHILD CARE Real 000'S	POPN. 0-4	CCARE Nominal	CCARE Real	AWFE Nominal	WAGE INDEX 1	WAGE INDEX 2	YEAR
1978	37.9	$66,498.68	1136.90	$22.17	$58.49	$169.60	697.4	114.9	1978
1979	41.0	$75,819.51	1142.36	$27.21	$66.37	$179.80	719.9	118.6	1979
1980	45.2	$79,946.90	1130.87	$31.95	$70.70	$195.50		128.8	1980
1981	49.4	$86,742.91	1139.62	$37.60	$76.12	$221.40		145.3	1981
1982	54.6	$86,730.77	1154.73	$41.01	$75.11	$239.10		161.7	1982
1983	60.8	$106,832.24	1168.98	$55.56	$91.39	$276.70		184.4	1983
1984	65.0	$123,269.23	1181.17	$67.84	$104.36	$297.40		194.4	1984
1985	67.8	$176,594.40	1194.69	$100.22	$147.82	$325.50		203.5	1985
1986	73.5	$199,216.33	1208.49	$121.16	$164.85	$345.30		217.0	1986
1987	80.3	$218,209.22	1216.64	$144.02	$179.35	$372.70		224.4	1987
1988	86.3	$249,384.70	1225.81	$175.57	$203.45	$392.00		231.4	1988
1989	92.6	$229,510.80	1243.85	$170.86	$184.52	$426.80			1989
1990	100.0	$215,036.00	1258.15	$170.91	$170.91	$454.50			1990
1991	105.3	$231,375.12	1271.70	$191.58	$181.94	$488.90			1991
1992	107.3	$409,878.84	1281.02	$343.32	$319.96	$514.80			1992
1993	108.4	$496,475.09	1287.27	$418.08	$385.68	$520.70			1993

YEAR	WAGE INDEX 3	AWFE Real	DSREB Nominal	DSREB Real	AWME Nominal	WAGE INDEX 1	WAGE INDEX 2	AWME Real	YEAR
1978	54.9	$309.02	$555.00	$1,464.38	$198.00	115.3	54.6	$362.52	1978
1979	56.7	$317.36	$597.00	$1,456.10	$212.70	119.3	56.5	$376.25	1979
1980	61.5	$317.75	$800.00	$1,769.91	$231.90	130.8	62.0	$374.15	1980
1981	69.4	$318.98	$800.00	$1,619.43	$270.00	145.8	69.1	$390.80	1981
1982	77.2	$309.54	$830.00	$1,520.15	$296.00	162.4	77.0	$384.64	1982
1983	88.1	$314.12	$963.00	$1,583.88	$337.60	186.7	88.5	$381.60	1983
1984	92.9	$320.25	$1,030.00	$1,584.62	$362.00	196.6	93.2	$388.58	1984
1985	97.2	$334.84	$1,030.00	$1,519.17	$389.50	205.5	97.4	$399.99	1985
1986	103.8	$332.66	$1,030.00	$1,401.36	$413.90	218.9	103.8	$398.75	1986
1987	106.7	$349.30	$1,030.00	$1,282.69	$446.30	224.0	106.3	$419.85	1987
1988	110.9	$353.47	$1,030.00	$1,193.51	$470.00	233.7	110.5	$425.34	1988
1989	120.1	$355.37	$1,030.00	$1,112.31	$505.20		117.0	$431.79	1989
1990	126.1	$360.43	$1,030.00	$1,030.00	$540.00		125.2	$431.31	1990
1991	134.1	$364.58	$1,200.00	$1,139.60	$578.20		132.3	$437.04	1991
1992	139.1	$370.09	$1,296.00	$1,207.83	$589.70		136.7	$431.38	1992
1993	140.4	$370.87	$1,379.00	$1,272.14	$599.50		138.3	$433.48	1993

YEAR	FERT	UNE	TIME	YEAR
1978	2037	6.3	0	1978
1979	1957	6.2	1	1979
1980	1913	6.2	2	1980
1981	1895	5.6	3	1981
1982	1938	6.6	4	1982
1983	1937	10.8	5	1983
1984	1932	9.2	6	1984
1985	1879	8.5	7	1985
1986	1891	8.0	8	1986
1987	1870	8.4	9	1987
1988	1848	7.3	10	1988
1989	1837	6.0	11	1989
1990	1842	6.7	12	1990
1991	1907	10.3	13	1991
1992	1855	11.9	14	1992
1993	1895	11.8	15	1993