

198505  
2579

**EARNINGS - TENURE PROFILES IN THE U.K. PUBLIC AND  
PRIVATE SECTORS**

by

**James S. Coleman**

Thesis submitted in fulfilment of requirements for the degree of Doctor of Philosophy  
in Economics.

University of Stirling

September 1994

## ABSTRACT

The thesis examines the effect of tenure on earnings in the British public and private sectors. The characteristic differences between the labour markets associated with the two sectors are examined. Several theories underlying the earnings-tenure effect are then assessed for their suitability in explaining earnings patterns in each of the sectors under analysis. Cross sectional estimation is carried out using one year of the New Earnings Survey Panel. The results show a higher return to tenure in central and local government than in the private sector or public corporations. There also appears to be a higher return to tenure for females in all sectors than for males. Explanations are offered for these observations, based on the labour market characteristics of the sectors noted earlier. An attempt is then made to correct for estimation biases associated with job match heterogeneity, which are purported to overstate return to tenure. The correction is based on techniques adopted in the recent American literature using instrumental variables. Despite the use of this process, the expected decrease in return to tenure is not observed unless certain key variables are omitted from the estimating equation.

## ACKNOWLEDGEMENTS

I would like to thank the following with whom I corresponded, for helpful suggestions: Robert Topel, Alan Krueger, Daniel Hamermesh, Ron Ehrenberg, John Raisian, Richard Disney, Neil Millward, Robin Naylor, Derek Robinson and Chris Trinder. I would also like to thank Bob Elliott and Steve Woodbury for helpful comments during the developmental stage of the thesis, as well as seminar participants at Manchester University Economics Department. I am grateful to the Department of Employment for use of the data, thanks especially to Robert Jukes. The views expressed however are not necessarily those of the Department of Employment. Sincere thanks goes to Elizabeth Roberts and Felix Ritchie for invaluable computing help regarding the empirical sections. Thanks also to my family, and to staff in the Economics Departments of Stirling and Durham Universities for support over the last four years. I retain my most grateful thanks however for my supervisors - Bob Hart and David Bell - without whose advice and patience it would not have been possible. The usual disclaimer applies.

# CONTENTS

<b>INTRODUCTION.....</b>	<b>1</b>
<b>CHAPTER 1</b>	
<b>Distinguishing Characteristics of the Public and Private sectors.</b>	
<b>1.1 Introduction.....</b>	<b>6</b>
<b>1.2 The Nature of the Public Sector Enterprise.....</b>	<b>8</b>
<b>1.3 Other Characteristic Differences in Public and Private sector Labour Markets.....</b>	<b>9</b>
<b>Chapter 1 Endnotes.....</b>	<b>13</b>
<b>CHAPTER 2</b>	
<b>Why do Earnings Increase with Tenure? A Theoretical Investigation in the Context of the Public and Private Sectors.</b>	
<b>2.1 Introduction.....</b>	<b>18</b>
<b>2.2 Human Capital Theory.....</b>	<b>19</b>
<b>2.2.1 Specific Human Capital and Transactions Costs.....</b>	<b>22</b>
<b>2.2.2 Transaction Costs in the Public and Private Sectors.....</b>	<b>24</b>
<b>2.2.3 Collective Bargaining and Unionisation.....</b>	<b>28</b>
<b>2.3 The Agency Hypothesis.....</b>	<b>32</b>
<b>2.3.1 Deferred Compensation and Public/Private Earnings Profiles.....</b>	<b>35</b>
<b>2.4 Screening and Turnover.....</b>	<b>38</b>
<b>2.4.1 Screening, Turnover and Public/Private Earnings Profiles.....</b>	<b>40</b>
<b>2.5 Length of Tenure in the Public and Private Sectors.....</b>	<b>42</b>



<b>2.6 Firm Size: Does the Public Sector Firm Act like a Large Private Sector Firm...</b>	<b>44</b>
<b>2.7 Summary of Theoretical Conclusions.....</b>	<b>47</b>
<b>Chapter 2 Endnotes.....</b>	<b>49</b>

## **CHAPTER 3**

### **Overview of Existing Empirical Work and Econometric Techniques**

<b>3.1 The Basic Earnings Function.....</b>	<b>50</b>
<b>3.2 Cross Sectional Estimation.....</b>	<b>54</b>
<b>3.3 Problems Associated with Cross Sectional Estimation.....</b>	<b>57</b>
<b>3.3.1 Self Selection Bias.....</b>	<b>57</b>
<b>3.3.2 Heterogeneity Bias.....</b>	<b>59</b>
<b>3.4 Early Longitudinal Analysis.....</b>	<b>61</b>
<b>3.5 Recent Panel Data Estimation.....</b>	<b>64</b>
<b>3.6 Implications of Previous Research.....</b>	<b>71</b>
<b>Chapter 3 Endnotes.....</b>	<b>74</b>

## **CHAPTER 4**

### **Data Description and Data Problems**

<b>4.1 The New Earnings Survey Panel Dataset.....</b>	<b>75</b>
<b>4.1.1 The New Earnings Survey.....</b>	<b>75</b>
<b>4.1.2 Problems of Identification.....</b>	<b>76</b>
<b>4.1.3 Collecting the Survey.....</b>	<b>77</b>
<b>4.2 Construction of the Panel Dataset.....</b>	<b>78</b>
<b>4.2.1 Numbers in the Panel.....</b>	<b>78</b>
<b>4.2.2 Length of Time in the Panel.....</b>	<b>81</b>

4.3 Problems with the Dataset.....	82
4.3.1 Attrition.....	82
4.3.2 Non-Response.....	83
4.3.3 Measurement Error.....	84
4.3.4 Other Data Problems.....	85
Chapter 4 Endnotes.....	87

## **CHAPTER 5**

### **Cross Section Estimation: Salient Features**

5.1 Introduction.....	88
5.2 Tenure Coefficient Profiles.....	89
5.3 Age Coefficient Profiles.....	95
5.4 Occupation Coefficients.....	96
5.5 Area Coefficients.....	97
5.6 Firm Size Coefficients.....	98
5.7 Collective Agreement Coefficients.....	99
5.8 Comparison of Growth Rates with Existing Literature.....	101
Chapter 5 Endnotes.....	103

## **CHAPTER 6**

### **Cross Sectional Results: Theoretical Appraisal**

6.1 Earnings-Tenure Profiles in the Public and Private Sectors: Resumé.....	114
6.2 Tenure Coefficients.....	116
6.3 Age Coefficients.....	130
6.4 Kos Coefficients.....	132

6.5 Area Coefficients.....	135
6.6 Firm Size Coefficients.....	136
Chapter 6 Endnotes.....	138

## **CHAPTER 7**

### **Instrumental Variable Estimation: Results and Interpretation**

7.1 Introduction: Econometric Problems.....	148
7.2 Estimation Results.....	152
7.2.1 Estimation of the Original Equation.....	152
7.2.2 Use of a Tenure Instrument in the Equation.....	154
7.2.3 Use of the Hours Variable in the Equation.....	163
Chapter 7 Endnotes.....	166

<b>CONCLUSIONS.....</b>	<b>176</b>
-------------------------	------------

<b>REFERENCES.....</b>	<b>183</b>
------------------------	------------

<b>APPENDIX 1.....</b>	<b>189</b>
------------------------	------------

<b>APPENDIX 2.....</b>	<b>190</b>
------------------------	------------

<b>APPENDIX 3.....</b>	<b>193</b>
------------------------	------------

<b>APPENDIX 4.....</b>	<b>195</b>
------------------------	------------

## LIST OF FIGURES

<b>Fig. 1.1 % Agreement Coverage by Occupation, Male.....Pg. 14</b>	
<b>1.2 % in each Firm Size category(CSZE79), Males.....15</b>	
<b>1.3 % in each Occupation by Firm Size(03), Males.....16</b>	
<b>1.4 % in each Occupation by Firm Size(09), Males.....17</b>	
<b>5.1 Tenure Coefficient Profiles, Males.....104</b>	
<b>5.2 Tenure Coefficient Profiles, Females.....105</b>	
<b>5.3 Age Coefficients, Males.....106</b>	
<b>5.4 Age Coefficients, Females.....107</b>	
<b>5.5 Occupation Coefficients, Males.....108</b>	
<b>5.6 Occupation Coefficients, Females.....109</b>	
<b>5.7 Area Coefficients, Males.....110</b>	
<b>5.8 Area Coefficients, Females.....111</b>	
<b>5.9 CSZE Coefficients, Males.....112</b>	
<b>5.10 CSZE Coefficients, Females.....113</b>	
<b>6.1 % in each Occupation, Males.....139</b>	
<b>6.2 % in each Occupation, Females.....140</b>	
<b>6.3 % in each NYRS(Age 46), Males.....141</b>	
<b>6.4 % in each NYRS(Age 46), Females.....142</b>	
<b>6.5 % in each Occupation(20 Years Tenure), Males.....143</b>	
<b>6.6 % in each Occupation(20 Years tenure), Females.....144</b>	
<b>6.7 Age Profile Kos 122, Males.....145</b>	
<b>6.8 Age Profile Kos 122, Females.....146</b>	
<b>6.9 Mean Tenure by Occupation, Males.....147</b>	



<b>7.1 OLS Tenure Coefficient Profiles, Males.....</b>	<b>167</b>
<b>7.2 OLS Tenure Coefficient Profiles, Females.....</b>	<b>168</b>
<b>7.3 OLS Tenure Coefficient Profiles, Males.....</b>	<b>169</b>
<b>7.4 OLS Tenure Coefficient Profiles, Females.....</b>	<b>170</b>
<b>7.5 OLS tenure Coefficient Profiles, Females, CENG.....</b>	<b>171</b>
<b>7.6 OLS Tenure Coefficient Profiles, Males.....</b>	<b>172</b>
<b>7.7 OLS Tenure Coefficient Profiles, Females.....</b>	<b>173</b>
<b>7.8 IV Tenure Coefficient Profiles, Males.....</b>	<b>174</b>
<b>7.9 IV Tenure Coefficient Profiles, Females.....</b>	<b>175</b>



## LIST OF TABLES

<b>Table 1.1 Average Tenure 1979.....</b>	<b>Pg. 12</b>
<b>4.1 Numbers in NES Panel 1975-84.....</b>	<b>79</b>
<b>4.2 Total Numbers in Sample 1979.....</b>	<b>80</b>
<b>5.1 Growth Rates by Tenure, Males.....</b>	<b>92-93</b>
<b>5.2 Growth Rates by Tenure, Females.....</b>	<b>93-94</b>
<b>5.3 Collective Agreement Coefficients.....</b>	<b>100</b>
<b>6.1 % &gt;16 Years Tenure(Age 46).....</b>	<b>121</b>
<b>6.2 Top Ten Occupations by Employment, PRIV Males.....</b>	<b>123</b>
<b>6.3 Top Ten Occupations by Employment, PUBC Males.....</b>	<b>123</b>
<b>6.4 Top Ten Occupations by Employment, CENG Males.....</b>	<b>124</b>
<b>6.5 Top Ten Occupations by Employment, LOCG Males.....</b>	<b>124</b>
<b>6.6 Top Ten Occupations by Employment, PRIV Females.....</b>	<b>125</b>
<b>6.7 Top Ten Occupations by Employment, PUBC Females.....</b>	<b>125</b>
<b>6.8 Top Ten Occupations by Employment, CENG Females.....</b>	<b>126</b>
<b>6.9 Top Ten Occupations by Employment, LOCG Females.....</b>	<b>126</b>
<b>6.10 % in 20 Years Tenure Category, Males.....</b>	<b>128</b>
<b>6.11 % in 20 Years Tenure Category, Females.....</b>	<b>128</b>
<b>7.1 Males Estimated Coefficients.....</b>	<b>154</b>
<b>7.2 Females Estimated Coefficients.....</b>	<b>155</b>
<b>7.3 PRIV Males estimated Coefficients.....</b>	<b>158</b>
<b>7.4 PUBC Males estimated Coefficients.....</b>	<b>158</b>
<b>7.5 CENG Males estimated Coefficients.....</b>	<b>159</b>
<b>7.6 LOCG Males estimated Coefficients.....</b>	<b>159</b>

<b>7.7 PRIV Females Estimated Coefficients.....</b>	<b>160</b>
<b>7.8 PUBC Females Estimated Coefficients.....</b>	<b>160</b>
<b>7.9 CENG Females estimated Coefficients.....</b>	<b>161</b>
<b>7.10 LOCG Females Estimated Coefficients.....</b>	<b>161</b>

## INTRODUCTION

The broad objectives of this thesis are twofold. Firstly, it extends the study of wage-tenure profiles within a UK setting. Secondly, it seeks to add to the growing literature on the characteristic differences which exist between public and private sector labour markets. In this latter respect, earnings profiles give us potentially richer insights into public/private sector pay than are available from simple analyses of earnings differentials.

One of the key strengths of this particular study is that it makes use of the New Earnings Survey(NES) panel dataset. The NES is a very rich source of information providing a large number of control variables and a much larger number of observations than have been used in similar studies. The survey is conducted annually and attempts to cover the same individuals each year, thus allowing the construction of a panel. The annual NES aims to consist of 1% of employees in the UK, making it the richest source of labour market data in Europe. It also has the advantage of incorporating very specific occupational and industrial codings, as well as detailed information on company and establishment sizes. In addition, it contains an informative separation of the public sector into public corporations, central government and local government.

The study of the earnings-tenure relationship is an important aspect of labour economics. Individuals entering the labour market or selecting into particular occupations are interested in what will happen to their earnings over time if they stay in a job, rather than the spot differential relative to other jobs at the point of



entry. Yet, analysis of comparative earnings in the UK to date has tended to be undertaken mainly in the context of simple wage differentials or wage relativities.

Simple cross sectional wage differentials take no account of what will happen over the worker's time in a job. It is somewhat surprising, therefore, that a great deal of negotiation between employers and bodies representing the interests of employees is based on spot differentials. Arguably, a more realistic approach to negotiation is to take into account the expected progression of earnings growth as the length of the job spell increases. The results presented in the thesis regarding the wage-tenure effect, give a new perspective on the characteristic differences which exist between the public and private sectors. A study such as this has never been undertaken previously.

Evidence on earnings differentials has often formed the basis for government policies aimed at controlling public sector pay. Even as this is written, the government has announced a further freeze on the salaries of public servants. Unfortunately, such policies fail to take account of lifetime movements in earnings. This is especially important given that average tenure in the public sector as a whole tends to be longer than in the private sector. The impact of a policy influencing the current wage paid to an average public sector employee will occur over a longer time period than that of a private sector employee. This may allow the possibility of smoothing the impact of the policy in the public sector.

An analysis of the effect of tenure on earnings in the public and private sectors is also helpful in interpreting the success of incomes policies, whether these consist of explicit intervention as in the 1970's, or are of a more implicit nature such as those imposed under Mrs Thatcher's protracted public spending freeze. It is often

argued that incomes policies have been unduly harsh on the public sector, given the relative ease with which the government can impose wage restraint on this sector relative to the private sector (e.g. Dean 1981, Elliott and Fallick 1981). Again such assessments are often made in terms of movements in differentials and relativities over time. If it is the case that the return to tenure is higher in the public sector, the impact of discriminatory control may not have been as negative as it first appears. The object of this thesis is not primarily to investigate the effectiveness of pay policies, but rather to cast empirical light on the relative earnings-tenure effect itself.

Another strength of this particular study is that it provides a detailed comparison of earnings profiles for males and females. Given that females tend to be concentrated into a much narrower range of jobs than their male counterparts, it will be interesting to see if this has a bearing on the effect of tenure on their earnings. Previous work has tended not to adopt this type of approach, relying once again on differentials as the basis for comparison. This analysis therefore offers some interesting insights into the female labour market.

An attempt is also made to incorporate into the empirical sections recent developments in the econometric methodology associated with earnings profiles. Analysts in the US have suggested the use of alternative estimation procedures to correct for potential biases purported to exist in the data, particularly those stemming from job match effects. An attempt is made to incorporate one of these particular approaches, based on the use of instrumental variables, into the subsequent investigation. The results obtained provide an interesting insight into recent American work.

The structure of the thesis proceeds as follows. In Chapter 1, the analysis



begins by setting the scene with a discussion of the main characteristic differences between the labour markets associated with the public and private sectors. Chapter 2 investigates the theories which attempt to explain the shape of the earnings profile. This is done in the context of the public/private split and attempts to say something about why we might expect a difference between the sectors in terms of the earnings-tenure effect. Chapter 3 examines the econometric methodology which lies behind estimation of the return to tenure, and examines previous attempts to estimate this effect. Of particular interest are the more recent American studies in this field which extend the econometric analysis by attempting to correct for estimation biases. An attempt will be made to incorporate some of these techniques into the subsequent empirical work.

In Chapter 4, there is a description of the data to be used in the analysis, outlining its strengths and weaknesses. In Chapter 5, the first of the empirical chapters, some basic results are presented, and in Chapter 6 these will be interpreted in the light of the evidence regarding the structure of the public and private labour markets. The final chapter attempts a more sophisticated empirical analysis whereby some of the techniques developed in the US are tried out here and the results compared with those of earlier studies.

The main findings of the thesis can be summarised briefly as follows:

- Observed return to tenure is higher in central and local government than in the private sector and public corporations.
- Return to tenure is higher for females than for males in all the sectors under analysis.
- The use of instrumental variable procedures to control for job match

heterogeneity has no effect on estimated return to tenure unless certain key variables are omitted from the estimating equation.

## **CHAPTER 1**

### **DISTINGUISHING CHARACTERISTICS OF THE PUBLIC AND PRIVATE SECTORS**

#### **1.1. Introduction.**

As an introduction to the analysis which follows, it will be instructive to examine characteristic differences that exist between the labour markets associated with the public and private sectors. Any strong differences which emerge, may well have a bearing on the opportunities for such things as investment in human capital or the initiation of detailed monitoring arrangements, both of which, as we shall see later, may affect the earnings -tenure relationship. As discussed here, the two sectors are quite distinct in terms of the nature and measurement of production and in wage bargaining arrangements. In the following chapter, the major theories explaining why observed earnings increase with tenure will be re-evaluated for their applicability to the public and private sectors in the light of any revealed differences.

Throughout the analysis, estimation makes use of data from the New Earnings Survey Panel data set for 1979. The choice of dataset and specific year will be discussed in much greater detail in subsequent chapters. Data from 1979 is used, as this wave contains certain key variables essential to the analysis, which are not available in other years<sup>1</sup>.

Also for the purposes of analysis, the public sector has been split into its three main constituent parts - Public Corporations(PUBC), Central Government(CENG), and Local Government(LOCG). This is an informative split, as the sectors embrace different types of occupations and therefore different types of skills, training, and monitoring systems, all of which, as we shall see subsequently can have a bearing on the shape of the earnings profile.

The Public Corporations(PUBC) sector consists mainly of public utilities such as gas, electricity and water, as well as heavy manufacturing/extraction eg. coal and steel. Most of this sector has been transferred to the private sector since 1979. The choice of this year therefore allows an analysis of these industries in a public sector context. This sector also tends to be characterised by heavy industry requiring large investments in plant and machinery, and will therefore probably have more in common with the private sector than with the remainder of the public sector.

The Central Government(CENG) sector contains those sections of the public sector controlled and financed centrally. This includes such things as the civil service and the NHS. The bulk of this sector consists of service and administrative occupations. The same types of occupations can also be observed in the Local Government(LOCG) sector, which in this case is organised by local authorities. This sector includes amongst other things, protective services such as the police, and educational services. Again, the bulk of this sector contains service type occupations.



## **1.2 The Nature of the Public Sector Enterprise.**

According to conventional industrial economic theory, the most obvious factor which distinguishes an organisation in the private sector from its public sector counterpart is the fact that the former takes profit maximisation as its key economic objective, whereas the latter may not. As Freeman(1987) points out, the public sector firm is not subject to the controls of the competitive market, but is instead ultimately controlled by government and the financial or budgetary limits the government imposes upon the enterprise.

There may be any number of goals imposed upon the public sector firm; and only one of these need be economic efficiency. Both Rees(1984) and Levy(1987) have suggested that the public sector firm may seek to maximise some form of utility function based, for example, on size or output. Such a utility function would presumably be constructed with reference to the objectives the government has in mind for the particular organisation. As we shall see later however, the goals of government with regard to the public sector are frequently ambiguous and very often lack clear definition.

A point related to the ultimate goal of the public sector enterprise concerns ownership. Public sector ownership is not transferable but remains wholly with either the government or some agency acting on the government's behalf. Further, there is no buying or selling of shares which, in a private sector firm, would help to guard against excessive managerial inefficiency. In the private firm, the efficiency of any party involved is measured by his or her marginal contribution to total net profit. In the public sector however, measures of productivity will again be made in accordance with the goals of government, and will relate to the specific nature of each individual enterprise.



This process may well result in differing and not necessarily compatible means of productivity evaluation across different parts of the public sector. As a consequence of this, there is unlikely to be any uniform method of evaluating productivity throughout the whole of the public sector.

### **1.3 Other Characteristic Differences in Public and Private Sector Labour Markets.**

There are several important factors that distinguish the specific labour markets associated with the public and private sectors. One obvious factor relates to the extent of unionisation in each sector. Union membership is much greater in the public sector; approximately 81% of employees in the public sector are union members, compared to approximately 38% in the private sector (Beaumont 1989, Parry and Schmidt 1987). It would also appear that the decline in union membership in the 1980's was relatively more significant in the private sector. For example, in both private construction and private manufacturing, actual union membership declined by approximately 41% between 1980 and 1987, whereas, total membership declined by only 5.0% in the public sector as a whole. (Waddington 1992).

Figure 1.1 shows, for each sector, the percentage of male employees by occupation<sup>2</sup>, who are covered by some form of collective bargaining agreement. The last three sectors together represent the public sector sample. As can be seen from the figure, agreement coverage is generally much more widespread in the public sector. In all occupations, the private sector has the lowest percentage coverage. For clerical staff(222), coverage is as follows - private 23.43%; public corporations 81.45%; central

government 94.48%; local government 89.45%. This gives a public sector average of 88.46% coverage.

Two other factors of note are firm size and fringe benefits. Firms or organisations in the public sector are generally thought to be larger in terms of total workforce than those in the private sector. Figure 1.2 shows how males in each sector are distributed across company size(CSZE) categories<sup>3</sup>. As the diagram shows, public sector males are heavily concentrated into the largest firm size category(>5000), whereas private sector males are more evenly distributed among size categories.

In figure 1.3, we can observe distribution of individuals who work in firms relating to size 03(50-99 employees) category, which can be compared with figure 1.4 - numbers working in size 09 category(>5000). As can be seen, the private sector tends to dominate in the smaller size category, whereas the public sector is much more strongly represented in the larger size category.

Evidence on fringe benefits for both the UK and the US(Elliott and Murphy 1987, Ippolito 1987, Lovejoy 1988, Wiatrowski 1988), suggests that the most important of these benefits - earnings related pensions - are much more commonly observed and generally of greater value in the public sector. According to the Megaw Report on Civil Service Pay(1982), the value of civil service pension arrangements relative to private sector arrangements added 2% to the real income of civil servants between 1975 and 1980.

A further factor of note in distinguishing between public and private sectors, concerns hours worked. There is some evidence that public employees work fewer hours annually, and have a greater amount of paid leave than their private sector counterparts(Elliott and Murphy 1987). Also, public sector workers tend to receive more

paid leave at fewer years of service(Wiatrowski 1988).

Another difference between the sectors relates to the male/female distribution. Statistics show that the public sector has a higher female to total employees ratio than the private sector(Trinder 1981), and that this ratio has been increasing over time(Parry and Schmidt 1987). According to Fleming(1988), females accounted for approximately 58% of employees in the central government sector(the main public sector employer of women), but only 43.5% of full time employees generally. This central government figure is mainly accounted for by women working in education and the health service. Such a situation suggests that even within the public sector itself, female employees are concentrated into specific types of employment. This issue will be addressed in greater depth later in the thesis<sup>4</sup>.

Also worth noting is that employees in the public sector tend on average to be more highly qualified than employees in the private sector in that they are more likely to possess some form of educational or professional qualification. According to Parry and Schmidt(1987), in 1981, 55% of individuals with post school qualifications worked in the public sector. The number of individuals holding some form of qualification in the public sector as a whole increased from 18% to 23% from 1971-81, compared to an increase of only 6% to 8% in the private sector for the same period.

Finally, it will be worth examining average length of tenure in each of the sectors. Table 1.1 gives this average for males and females.



**Table 1.1**

<b>Average Tenure 1979 (Years)</b>		
<b>Sector</b>	<b>Males</b>	<b>Females</b>
PRIV	8.357	5.414
PUBC	13.311	7.561
CENG	10.484	5.459
LOCG	7.982	5.749

The table shows that although male average tenure length is similar for both private sector and local government, it is considerably longer for the two other sectors, especially public corporations. For females, is very similar in three of the sectors, but as for males, public corporations has the longest average overall.

The above are the main characteristic differences in the labour markets associated with the public and private sectors. It is possible that some of these characteristics may affect the shape of the earnings-tenure profile. In the following chapter I will investigate the main hypotheses which seek to explain why an individual's earnings should increase with tenure, i.e. why the earnings profile will be positively sloped. The evidence associated with public and private sector labour markets presented above will be referred to in an attempt to establish which theory is the more appropriate in explaining the pattern of earnings in each sector. These characteristic differences will also be referred to in Chapters 6 and 7 in order to aid the interpretation of the empirical results presented there.

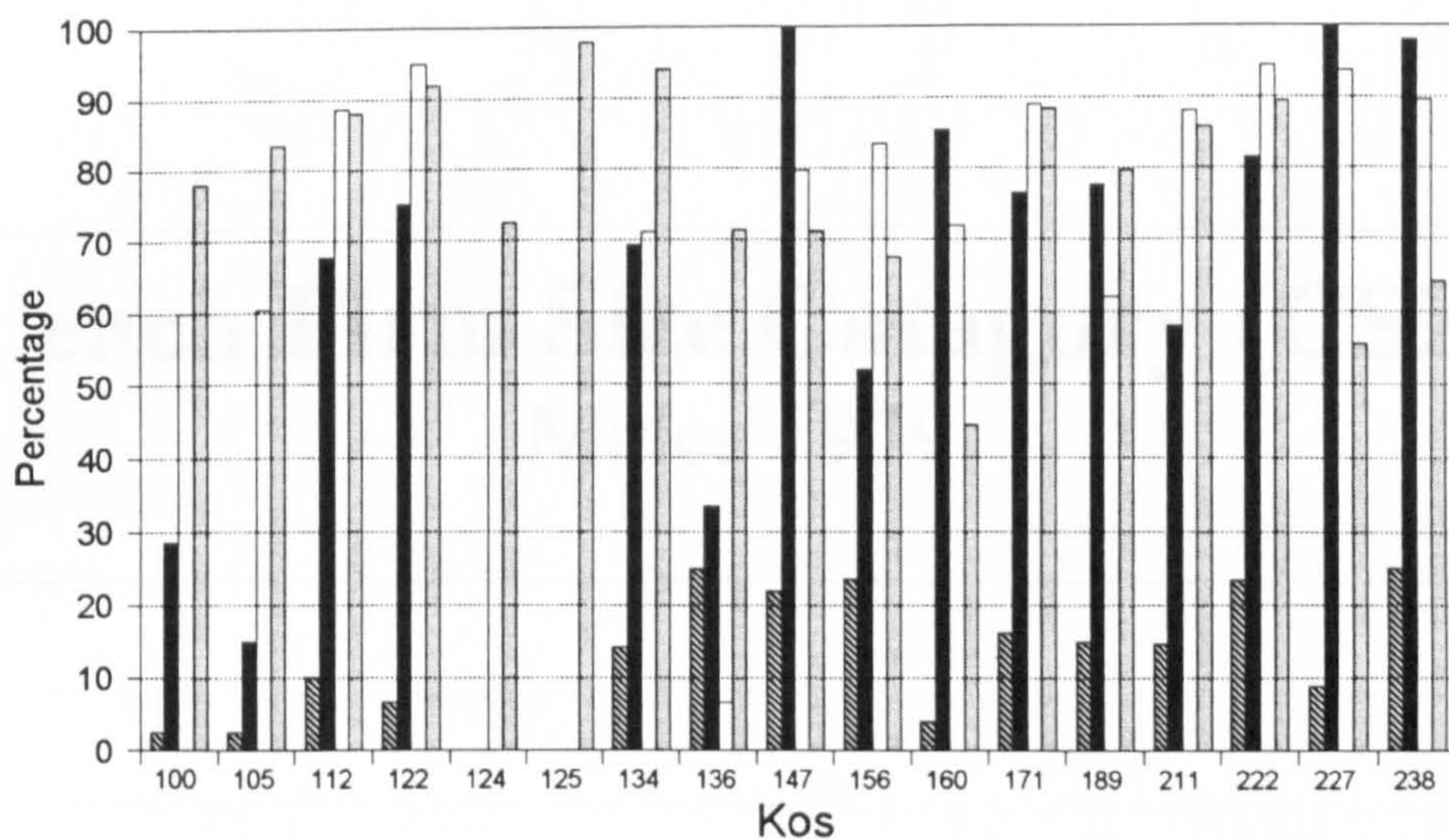
**CHAPTER 1 ENDNOTES**

1. Chapter 4 discusses characteristics of the NES panel, whereas Chapter 5 outlines the main reasons for using 1979 as the year of analysis.
2. See Appendix 3 for a list of occupation(KOS) codes.
3. See Appendix 2 for a list of CSZE categories.
4. See Chapter 4 for a breakdown of the male/female ratios in the sample used for estimation.



# % Agreement Coverage by Occupation

(100-238) Males 1979



## (246-540) Males 1979

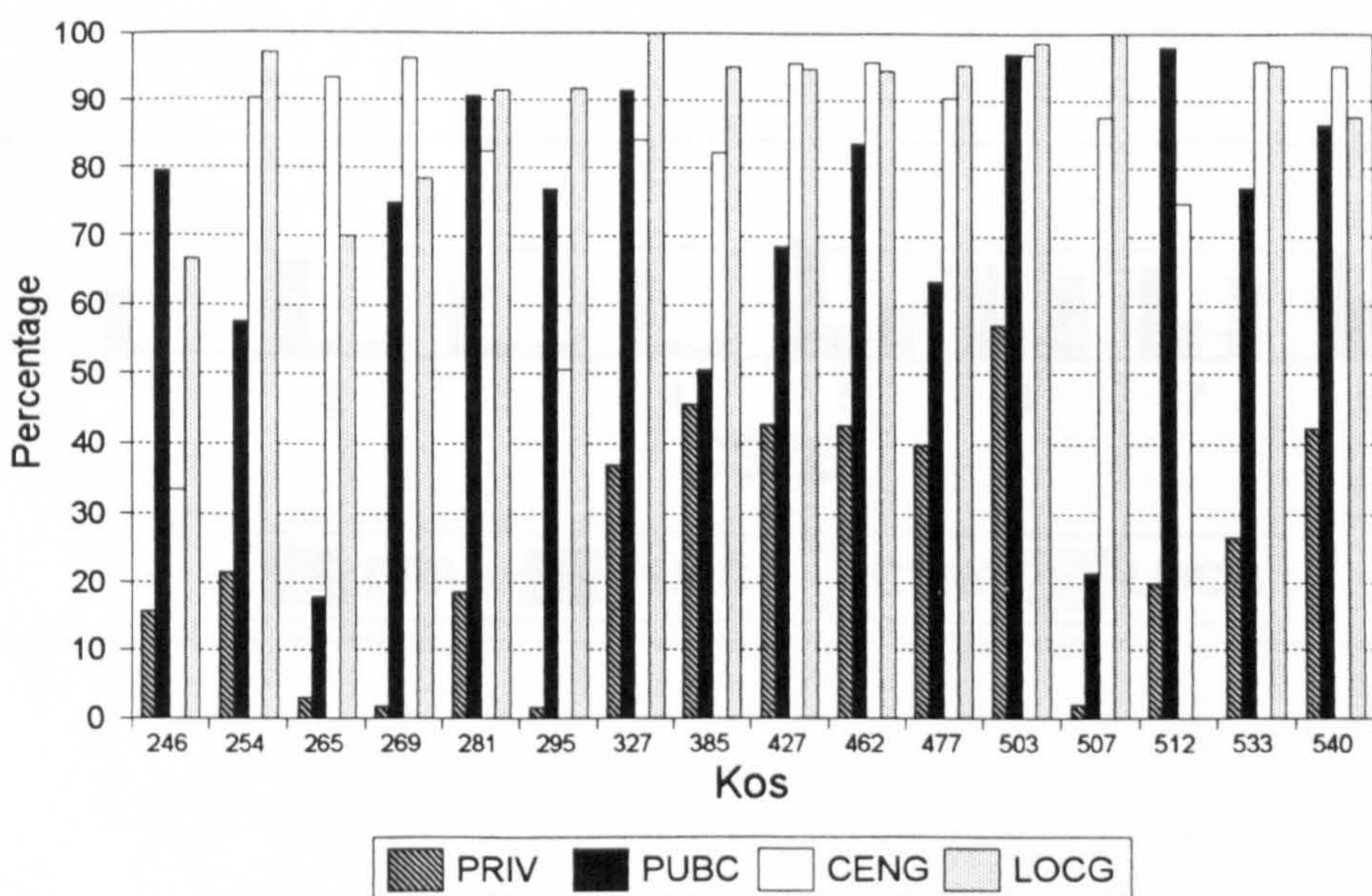


Figure 1.1



## % in each Firm Size Category (CSZE79) Males 1979

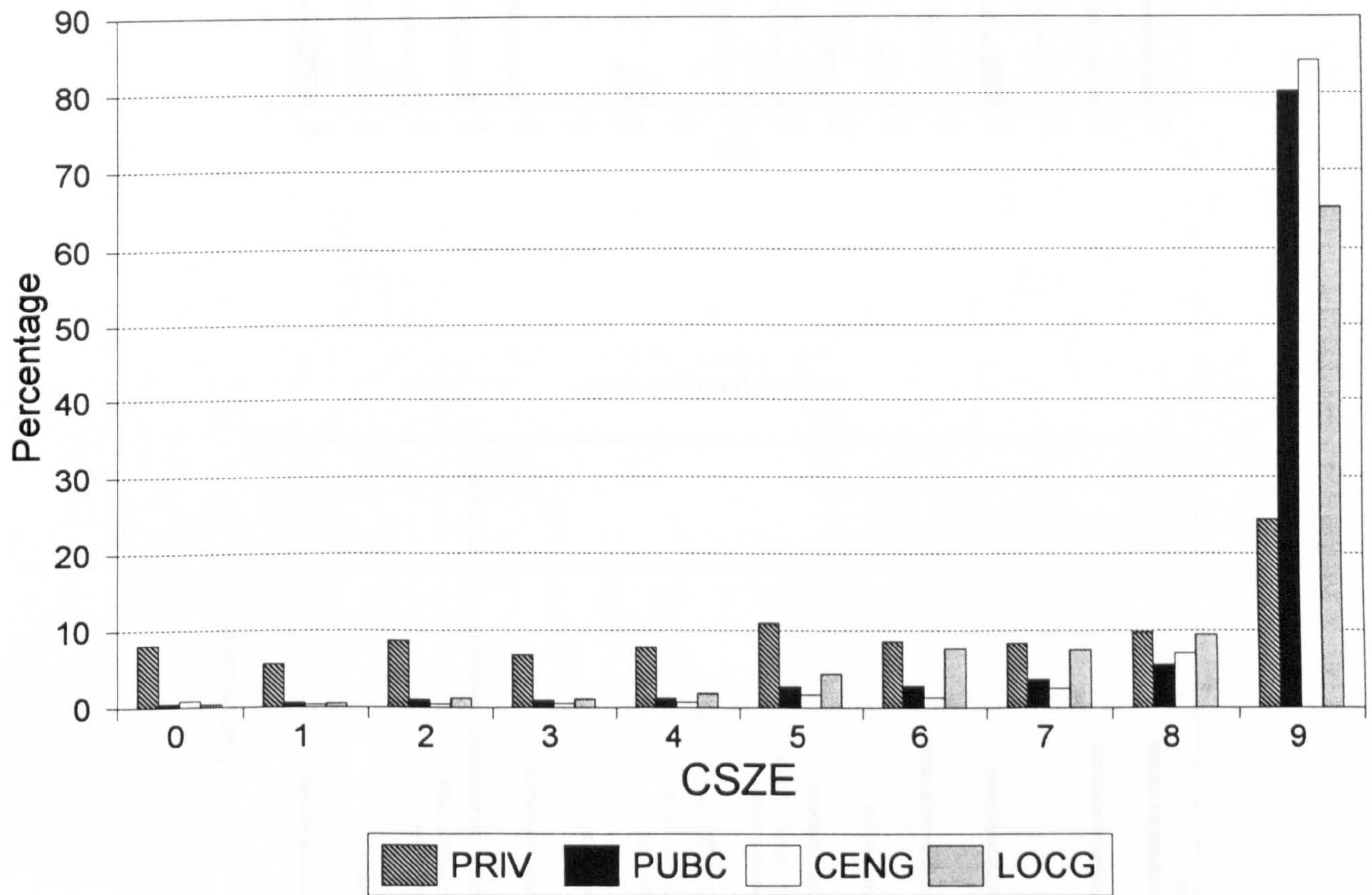
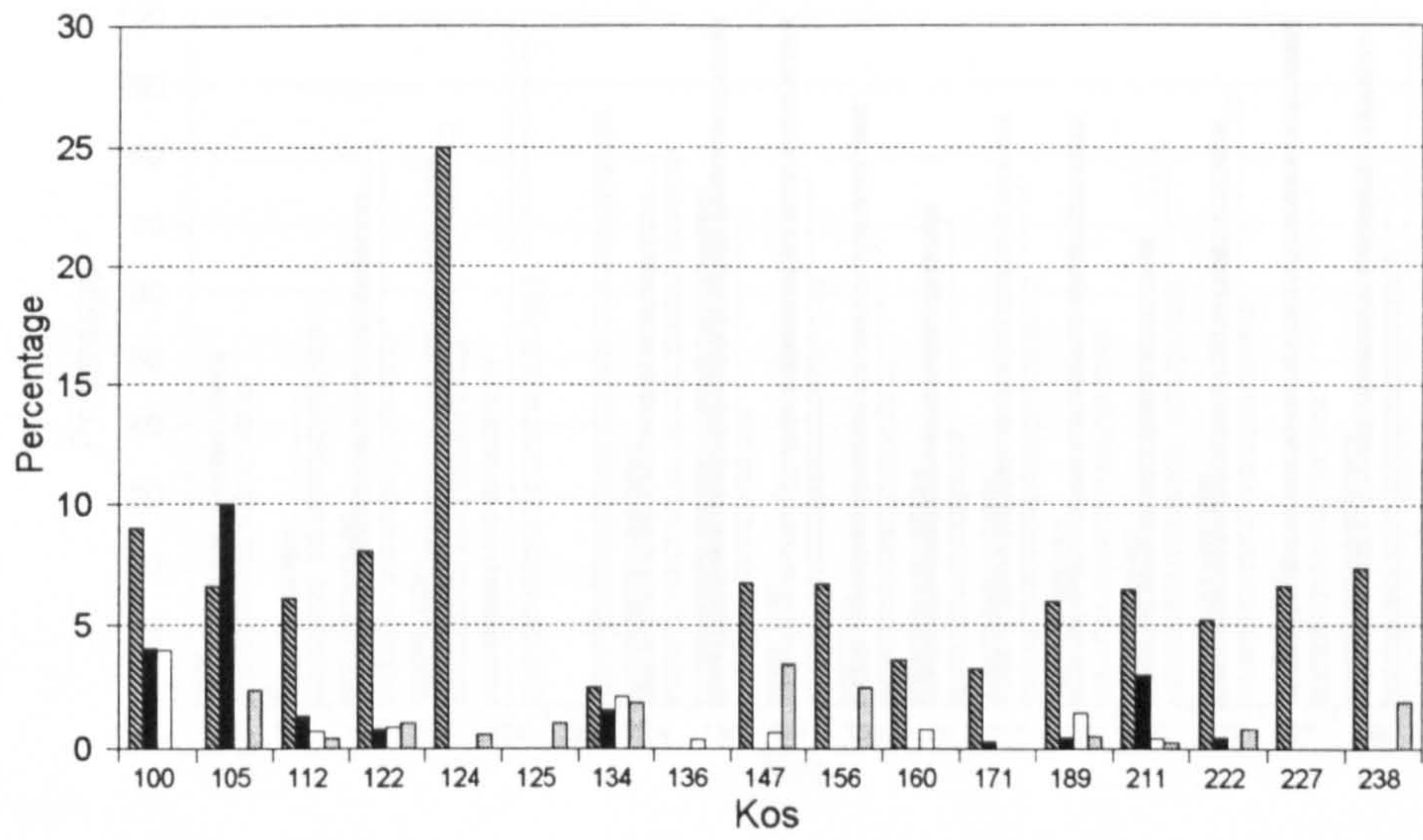


Figure 1.2

### % in each Occupation by Firm Size(03)

(100-238)Males 1979



(246-540)Males 1979

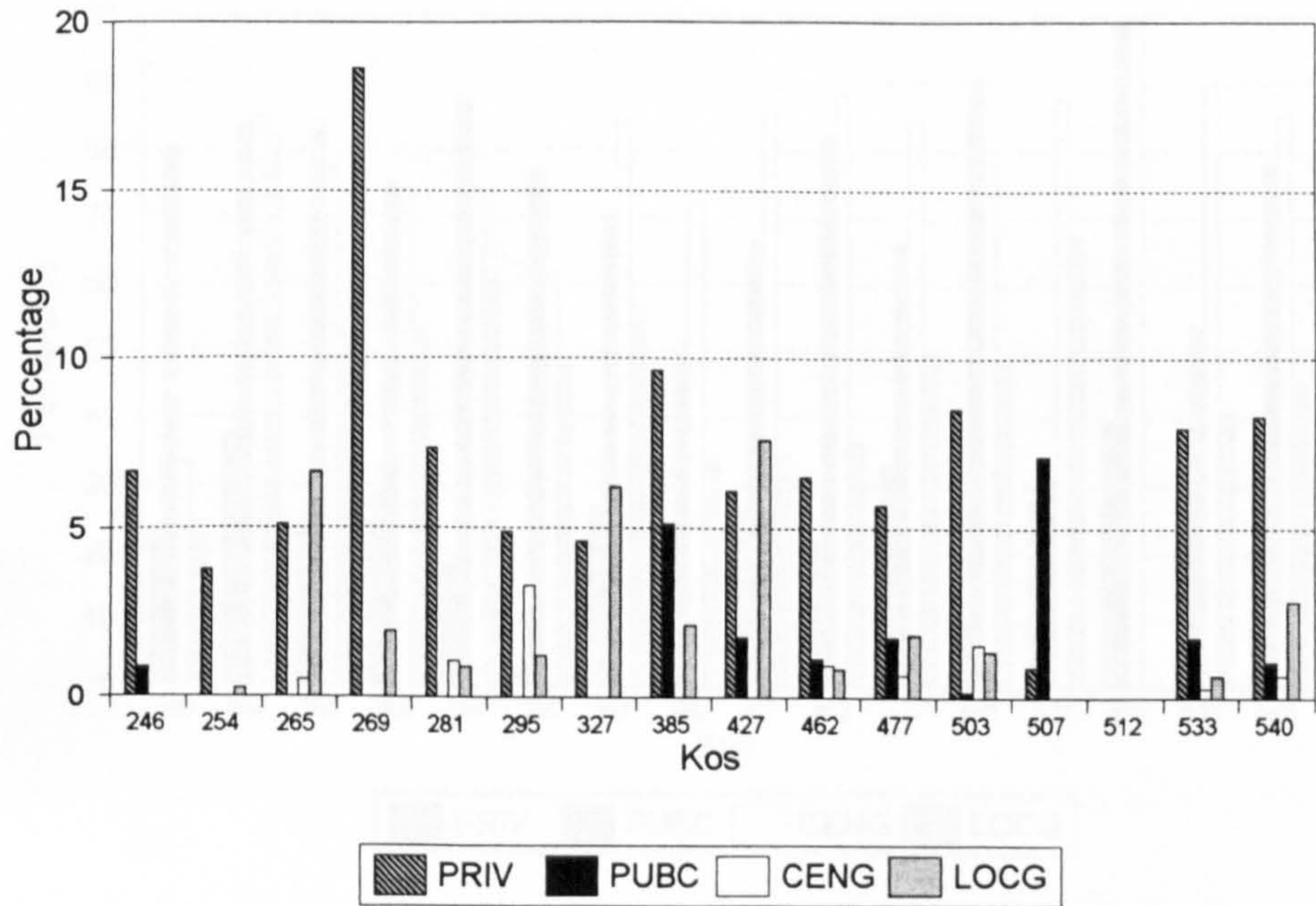
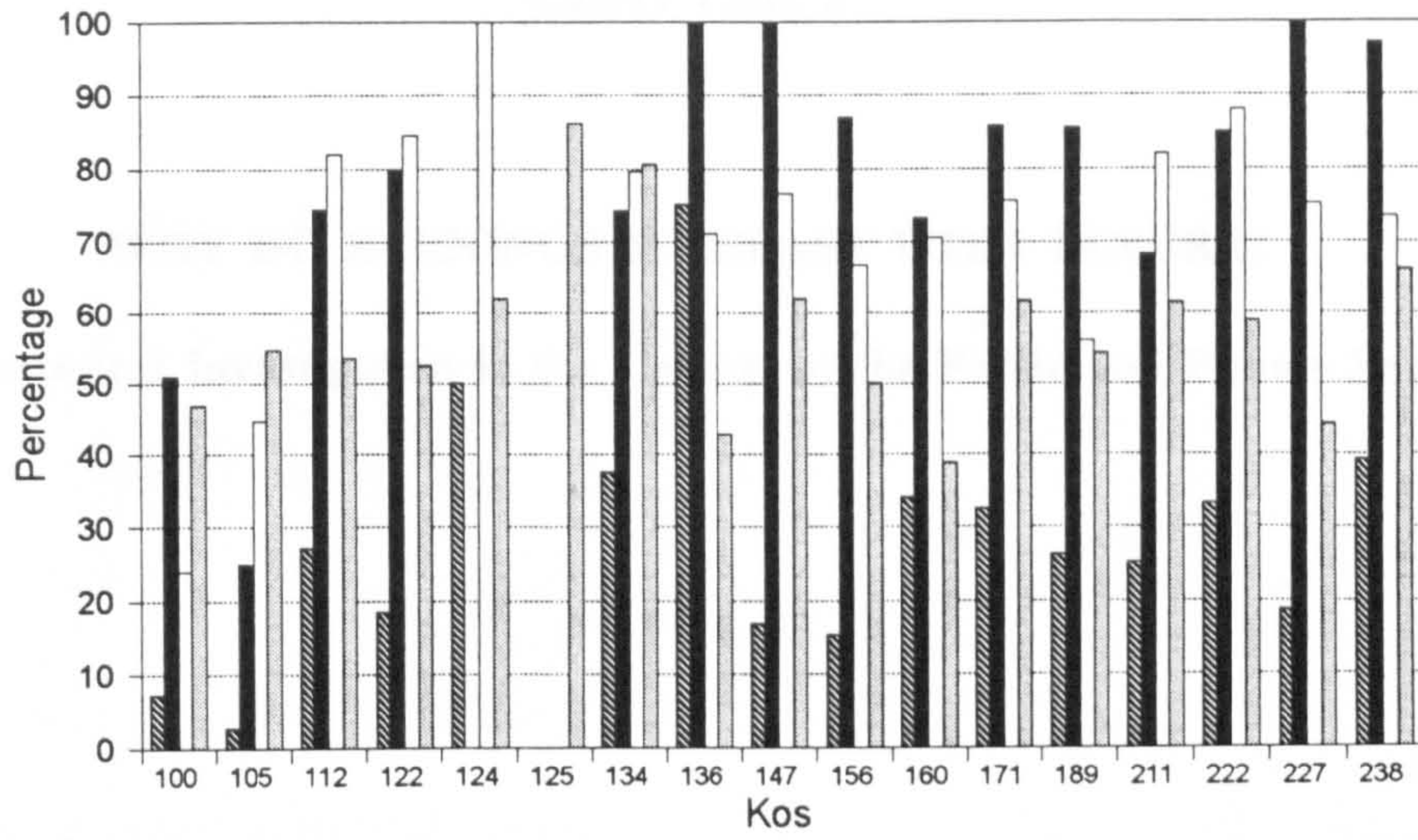


Figure 1.3



# % in each Occupation by Firm Size(09)

(100-238)Males 1979



(246-540)Males 1979

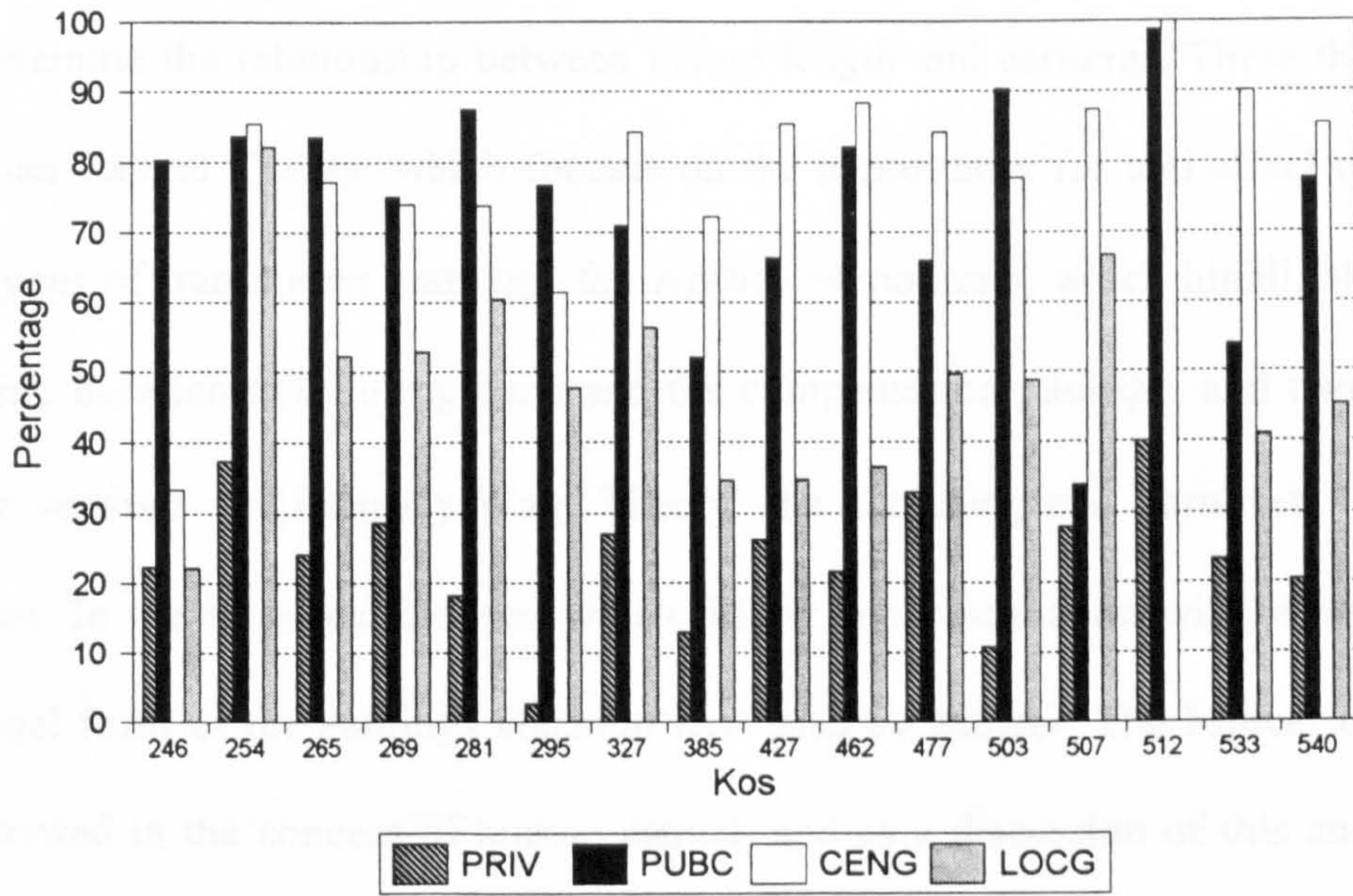


Figure 1.4



## CHAPTER 2

### WHY DO EARNINGS INCREASE WITH TENURE?

#### A Theoretical Investigation in the Context of the Public and Private Sectors

##### 2.1. Introduction.

Having identified the main characteristic differences between public and private sector labour markets, I shall now examine three established theories which seek to examine the relationship between tenure length and earnings. These theories are: Human Capital Theory, which focuses on the opportunity for and effect of various types of training on earnings; the Agency Hypothesis, which highlights the relationship between monitoring costs and the compensation package; and two particular versions of Efficiency Wage Theory -the Screening and Turnover hypotheses. In the empirical sections which follow later, estimation will be based on a functional form of the earnings equation first used by Mincer. The Mincer equation is itself rooted in the concept of human capital, and so a discussion of this and related theories will be of use in interpreting the results obtained from the estimation.

After discussing each theory in turn, an analysis will be undertaken with regard to the applicability of each in describing any public/private earnings dichotomy which might exist. This analysis will take place in the light of the

previous chapter's discussion of differences in the labour markets associated with the two sectors.

## **2.2. Human Capital Theory.**

Mincer(1958,1962,1974), Becker(1975), and Oi(1962), have been particularly responsible for highlighting the effect of two types of human capital investment - general training and firm specific training - on workers' wages over tenure. General training is easily transferable and will increase workers' marginal product in all firms, whereas specific training increases marginal product in the current firm only(i.e. the firm where the training has taken place). Both types of training will cause earnings to increase over tenure, due to associated productivity increases.

General training requires that the worker pay all the costs of training, and in return receive all the rewards; it is not in the firm's interests to pay for human capital investment which can be utilised in other firms. At the beginning of their tenure with the firm, workers pay for general training by receiving a wage which is less than the value of their marginal product(this difference will equal the total cost of training over time). As tenure increases and general training is completed, workers will receive a wage equal to the new higher value of marginal product(VMP). The overall result is a wage which will increase in value as tenure increases, i.e. an upward sloping wage-tenure profile.

As far as specific i.e. non transferable training is concerned, the worker and the employer will share both the investments and the returns involved. In this case,

the worker is unwilling to undertake the total cost of investment. As the training is specific, the worker will suffer a capital loss if after having undertaken all training costs, he/she is prematurely laid off by the firm. On the other hand, the firm is also unwilling to undertake the total costs of investment, as it too will suffer a loss in the event of premature quits. This problem is resolved by the worker and the firm agreeing to share both the costs and the returns associated with the specific investment (Hashimoto 1979). In the early years of tenure when the specific training is undertaken, workers earn a wage which is higher than VMP. As tenure accrues, and specific investment increases the worker's marginal product, workers' earn a wage which is above the original VMP, but below the new higher VMP - in this way, both the costs and the returns to the investment are shared between worker and firm. Again, the overall result is a wage which increases as tenure increases, i.e. the wage-tenure profile is upward sloping<sup>1</sup>. The greater is the investment in specific human capital, the greater is the sharing of costs and rewards and the steeper therefore is the earnings profile.

Holtman and Idson (1991) have extended this type of analysis by suggesting that worker and firm may share the costs of training, even where training is general. This occurs if training is poorly signalled in the market, and would have the effect of raising productivity more with the current employer than with an alternative one. This latter effect is due to the current employer having an advantage in assessing the productivity enhancing results of the training and the quality of the job match.

In a recent article on private sector training, Lynch (1992) finds that formal training and tenure are uncorrelated. She does find however that even after controlling for industry and occupation, training still has a significant impact on



wages. In addition to this, spells of on the job training acquired before the current job, have no impact on current wages, suggesting that on the job training for the private sector at least, tends towards the highly specific.

The above discussion suggests that where human capital investment in the form of general and specific training is present, the wage will be an increasing function of tenure, and the earnings-tenure profile will be upward sloping. As greater diversification and specialisation develops within the firm's production process, the extent to which human capital investment is specific to a single firm is also likely to increase. In any situation where specific human capital investment has taken place, wage will increase over tenure, and an upward sloping earnings-tenure profile will result. The greater is the investment in such human capital, the greater are the costs and returns involved for worker and firm and the steeper therefore is the earnings profile.

In this thesis, my main concern lies with a comparison of the relative steepnesses of the earnings profiles associated with the public and private sectors. The specific human capital hypothesis is only one possible explanation for the positive relationship between earnings and tenure within a firm. The alternatives will be examined in due course. It will be helpful firstly to examine human capital theory in more detail, specifically with regard to the concept of transaction costs. Such an analysis will allow a better understanding of the effect of tenure on earnings in the two sectors.



### **2.2.1. Specific Human Capital and Transaction Costs.**

Hashimoto(1979,1981,1990) has extended the basic human capital hypothesis by introducing the concept of transaction costs. Although this approach was first developed by theorists such as Coase and Williamson, the original notion of transaction costs has been applied directly by Hashimoto to the relationship between employer and employee within the firm. Hashimoto's notion of such costs relates specifically to exchanges which take place between different hierarchical levels of the firm.

According to Hashimoto, transaction costs are costs associated with communicating information both between employer and employees, and among employees, as well as convincing all parties of such information's validity and believability. The lower are transaction costs, the more readily believable is the information exchanged between parties.

If specific human capital investment occurs in a situation where the costs of transacting information are low, employer and employee will more readily reach agreement on the costs and returns involved in such investment. Such a situation Hashimoto suggests, will effectively reduce the marginal cost of investment in firm specific skills, implying that a higher degree of investment will take place. It can therefore be hypothesised that the lower are transaction costs, the higher will be the degree of investment in firm specific human capital.

Also important is the fact that where transaction costs are low and valid information is efficiently exchanged between parties, contracts will be much more flexible, and will respond much more readily to changing circumstances. This effect

will reduce the probability of sub-optimal separations<sup>2</sup> occurring, and so lengthen average tenure within the firm. The mobility propensity of workers will be reduced, thereby encouraging yet further investment in firm specific skills.

In the previous section it was suggested that where investments in firm specific training are high, earnings will increase more rapidly over tenure i.e. the earnings-tenure profile will be more steeply sloped. In examining such profiles in the public and private sectors, the sector displaying a more favourable transaction cost environment will arguably have a higher degree of firm specific human capital investment, implying in turn a more steeply sloped earnings-tenure profile.

The Hashimoto(1979) model begins from the premise that workers receive some form of specific training in a two period setting. At the beginning of the first period, employer and employee agree on the costs of and returns to training. At the beginning of the second period all relevant information becomes available, and worker and employer decide whether to stay together or separate.

Where transaction costs are zero and all information is verifiable, sub-optimal separations will not occur - the firm will decide on dismissal and the worker will decide on quit simultaneously - contracts will therefore be fully contingent. It is more likely to be the case however that only some information is verifiable, and that a random element is involved in the transacting of information. In this case optimal separations will occur only on the average. Where a sub-optimal separation does occur, there will be a partial dissipation of the return to the investment. The parties will therefore choose an optimal sharing ratio(i.e. sharing of the return) which reduces the likelihood of a sub-optimal separation, and minimises the dissipation of the return. Hashimoto(1990), argues that low transaction costs will result in longer



employer-employee attachment, and a variation in compensation and hours worked in response to demand shifts, rather than a change in numbers employed. This Hashimoto suggests, explains the common Japanese use of bonus payments as a means of varying compensation rather than employment variation through redundancy in the face of changing demand<sup>3</sup>.

The main conclusion to be drawn from Hashimoto's work is that where transaction costs are low, investment in firm specific human capital will be higher, leading to a more steeply sloped earnings profile. It now remains to be seen whether existing evidence can suggest anything about the relative significance of transaction costs in the UK public and private sectors. This may in turn allow us to make some predictions regarding the tenure-earnings effect in each sector.

### **2.2.2. Transaction Costs in the Public and Private Sectors.**

In this section, I will extend the human capital analysis by examining evidence which may suggest differences in transaction costs across the sectors in question. Arguably the most important factor here relates to the nature of collective bargaining and the extent of trade union membership. As considerable research has been done into this area, this topic will be dealt with in a separate section.

It will perhaps be instructive to look again at the nature of the single public sector organisation. As mentioned in Chapter 1, in many instances the goals of government with regard to the public sector enterprise tend to lack clear definition. By contrast, the private sector firm generally has one key objective, that being the

maximisation of profit. It is certainly possible that a private sector firm may also have several objectives, however profit maximisation is of such central importance, that simplifying in such a way as to assume a single objective does not detract too greatly from reality.

According to Millward and Parker(1983), in a private sector firm which is characterised by a divorce of ownership from control, managers acting on behalf of the shareholders may be able to alter the objectives of the firm from profit maximisation to some other goal such as sales growth. There are however certain elements which can help counteract such a degree of managerial discretion. Firstly there exists a market for shares, where shareholders who are unhappy with the motives of the managerial team and the resulting effects on their own income can sell their holdings in the company. Secondly, competition exists for key positions within the firm's internal labour market, whereby those managers who are unwilling to attach the required degree of importance to profit maximisation can be easily replaced by qualified candidates from below. Such curbs as these on the freedom of managers in the private firm, will help retain the relative primacy of profit maximisation as a key objective in the private sector.

The multi-goal problem of the public enterprise has been encapsulated by Jones(1982) thus:

"One of the most common topics in the public enterprise literature is the problem of multiple objectives. Public enterprises are called upon to pursue a mix of commercial and non commercial objectives, which can include such diverse goals as earning profits, redistributing income, subsidizing particular regions and sectors, earning foreign



exchange, generating employment, and increasing the probability that the party in power will be re-elected. Having such a plethora of objectives can be equivalent to having no objective, and management is all too often left free to pursue its own interests or a constantly shifting incoherent mix."(Jones 1982, pp.4-5).

In a situation where the actual objective of the public sector firm is ambiguous, there are likely to be additional costs associated with the transfer of information between the parties involved. Jones and Cockerill(1984), have pointed out that public enterprises have statutory duties and imposed obligations, which may conflict with the strict interpretation by managers of their commercial interests.

It is also important to note that the market does not act as a disciplining device in the public sector in the same way as in the private sector. As Lindsay(1976) points out, the discipline imposed upon a private sector firm by the discerning customer will reduce the degree to which owners are required to monitor internal resource use or engage in quality control of the firm's products. In the public sector firm however, an efficient internal monitoring system must be formulated, based not on marginal effect on profit, but on the prescribed objectives of the enterprise, objectives which can often be extremely ill-defined. Such a situation increases the scope for inefficient transactions of information between the various levels of the public sector enterprise. The problem lies with the fact that the public organisation, unlike the private firm, does not have a single overbearing absolute - profitability - by which to measure efficiency. As Millward and Parker(1983) point out, there are bound to be problems in establishing detailed employment contracts where difficulties exist in identifying the productivity of individuals within a firm,

and hence in relating monetary rewards to productivity.

The transacting of information among the various levels of the public sector firm is therefore likely to be more complicated where both the objectives of the firm and the means by which the fulfilment of these objectives is assessed are both numerous and not clearly defined. Sikorsky(1986) claims that any incentive which exists for devising and monitoring reward systems will be automatically reduced in the public sector firm due to the ownership situation, i.e. the fact that government, a non profit making organisation, is in overall control.

The above discussion suggests that the costs of transacting information between the relevant parties in the public sector firm may be greater than in a private sector firm, suggesting in turn, that transaction costs as defined by Hashimoto, will also be higher. Following Hashimoto's line of argument, this situation implies a lower degree of firm specific human capital investment in the public sector, due to the resulting higher marginal cost of such investment. As a consequence of the ownership situation, it may be suggested that the wage will increase more rapidly over tenure in the private sector firm, and the earnings profile will therefore have a steeper slope.

A further factor which is likely to have a bearing on the levels of transaction costs and specific training in public and private sector firms is firm or organisation size. As firm size and hence the number of employees in the firm increases, the costs of communicating information both between employer and employees, and among employees, will also increase. This implies a positive correlation between firm size and transaction costs. Firm size is generally thought of as being larger in the public sector, thus increasing the number of channels through which information

must be transacted. From the previous discussion, information transfer in the public sector is arguably by its nature more costly than in the private sector. Allied to the fact that firm size is usually larger in the public sector, this suggests higher transaction costs and lower investment in firm specific human capital in this sector.

Also worth considering in this context is male/female distribution. As stated in Chapter 1, the public sector has a higher female to total employee ratio. Female employees on average tend to have a shorter total attachment to the labour market than males. This lower average labour market duration will reduce the incentive for investment in firm specific human capital on both the part of the employee and the firm. The total period over which the costs of investment can be recouped is reduced. This will again reduce the scope for investment in specific skills in the public sector, and will tend to flatten the earnings profile.

In examining the importance of transaction costs in the decision to invest in skills in the public and private sectors, it is essential to analyze the effect of unionisation and collective bargaining. This will be done in the following section.

### **2.2.3. Collective Bargaining and Unionisation.**

A great deal of research into the relationship between transaction costs and the incentives for investment in specific human capital has been done with particular reference to the Japanese labour market. This research has brought together elements of training, transaction costs and union/bargaining structure, and has produced major



empirical results regarding the relationship between them. A discussion of this existing work will perhaps be helpful in looking at human capital in the context of a public/private dichotomy.

Hashimoto, in his work on transaction costs and firm specific human capital, has highlighted the importance of the Japanese phenomenon of "enterprise unionism". In this situation, the union is specific to the firm, and is respondent to the particular characteristics and needs of the employer. According to Chalmers(1989), over 90% of union members in Japan belong to some form of enterprise union.

Most firm have their own specific enterprise union, of which all employees irrespective of status are members, and although most unions belong to national level federations, basic issues such as wages and working conditions are negotiated at the firm level. It is a common practice in Japanese industrial relations, that the maximum possible effort is directed to settling disputes informally within the firm, before recourse is made to conciliation or arbitration services.

Another significant role of the enterprise union is the control of workers' shirking or malfeasance, as well as monitoring the employer for morally hazardous behaviour(Hashimoto 1990). Decentralised union activity of this type confers significant economies of scale on the gathering and transacting of information, reducing the possibility of sub-optimal separations, and increasing the amount of firm specific human capital investment. Another notable advantage of the enterprise union is the fact that it will allow contracts to be more flexible, enabling the bargaining parties to respond more easily to changing circumstances.

Kawanishi(1992) adds, that as the enterprise union includes all workers irrespective of actual occupation, it will be free from problems associated with



demarcation. As a result, the union may facilitate the introduction of new technologies, and may also accommodate well to change in industrial structure. This further suggests that in a situation where bargaining is of a more decentralised variety, there may be a higher incidence of specific human capital investment, especially of an innovative variety.

Kawanishi also suggests however that the practice of enterprise unionism should not be separated from the commonly observed phenomenon of lifetime employment. The introduction of seniority based personnel systems in Japan was seen to result in employees identifying more closely with their firm, again resulting in a favourable transaction costs environment. Evidence on average tenure length in Chapter 1 showed average tenure in public corporations to be significantly longer than in other sectors. This sector may possibly be perceived as offering something akin to lifetime employment, and we may therefore as a result, expect a high degree of specific investment in this sector.

As far as the U.K public sector is concerned, Beaumont(1989), claims that the collective bargaining system is biased towards the establishment and maintenance of national level agreements and procedures, as opposed to those at firm level. Individual bargaining autonomy is minimal in the public sector, with the extent of well developed shop steward arrangements at individual establishments being more widespread in the private sector. According to Elliott and Murphy(1990), although national level agreements are widespread in both sectors, it is more likely that the public sector national agreement will actually specify the particular wage received by a worker. In the private sector, national level bargaining is likely to stipulate the minimum wage to be paid, and this will often be augmented by further establishment

level negotiations. Evidence suggests that it is the private sector which is more decentralised generally in terms of bargaining decisions. An illustrative example relating to manning levels, suggests approximately 32% of public sector establishments negotiated this issue at establishment level, compared to approximately 59% of private sector establishments(Public Money June 1984).

Similarly, Daniel and Millward(1984) have observed that where bargaining decisions are taken at an establishment level, this is more likely to be in a private sector firm. They also add, that manual shop stewards are more likely to have received some form of trade union training in private sector firms, and that this training is more likely to have been initiated by management.

The above evidence suggests that efficiencies in negotiation comparable to those which would occur in the presence of an enterprise union are more applicable to the private sector organisation than to its public sector counterpart. Although UK private sector unions tend not to be enterprise specific, the fact that bargaining tends to be relatively more decentralised, should in theory provide a lower transaction cost environment. Again the evidence seems to suggest relatively higher costs of transacting information between employer and employees in the public sector. Unions in this sector are involved in national and formal bargaining arrangements, whereas private sector negotiation(to the extent that it occurs at all) is more likely to take place in an informal context at the enterprise level.

Where industrial disruption does occur in the public sector, it is often more likely to involve formal arbitration procedures, whereas, in the private sector, informal establishment level negotiation tends to be the norm. Higher transaction costs in the public sector would suggest less investment in firm specific skills,

resulting in a relatively flatter earnings profile. Earnings in the private sector will rise at a higher rate as tenure increases than in the public sector.

In conclusion therefore, the specific human capital hypothesis seems to be a more appropriate explanation of increasing earnings with tenure in the private sector. If this indeed is the prevailing explanation as to why wage-tenure profiles are upward sloping, then the slope of the private sector profile is likely to be steeper than that of the public sector profile.

Although evidence based on characteristics of the two sectors suggests that human capital may provide a more effective explanation of private earnings patterns, this does not exclude the possibility that it also has some degree of relevance for the public sector. There is however an alternative explanation - the agency hypothesis - which may be a better explanation as to the pattern of earnings in the public sector.

### **2.3. The Agency Hypothesis.**

The agency hypothesis is an alternative to human capital in explaining why earnings increase over tenure. The Lazear(1979) version of agency theory begins from the premise that monitoring worker performance is costly, and in order to prevent workers shirking, the firm will defer payment to the latter part of the worker's tenure with the firm rather than pay a wage equal to marginal product throughout. This is a principal-agent relationship whereby the employer constructs a



compensation scheme which encourages the worker to behave in an optimal manner.

The employer wishes to ensure that workers provide the desired amount of effort throughout the whole of their tenure with the firm. The measurement of this effort however, is often impractical due to the costs involved in monitoring individual worker productivity. The employer solves this problem by offering a wage below value of marginal product(VMP) at the beginning of tenure, and a wage greater than VMP in the later years of tenure. There is a certain probability that the worker will be detected performing sub-optimally. If so, the future wage premium will be forfeited. It is the possibility of this series of events occurring that suppresses worker cheating. The overall outcome, is that the worker will earn a wage which increases as tenure lengthens i.e. the earnings profile will be positively sloped. In such a set-up, the firm and the worker have entered into a long term implicit contract, the success of which depends on the honesty of both parties in adhering to their side of the bargain. If the firm decides to dismiss workers without due reason to avoid paying the future premium, it may encounter future difficulty in attracting suitably qualified workers. In such contractual situations, potential loss of reputation acts as a means of mitigating against opportunistic behaviour by the firm.

This alternative explanation as to why tenure will have a positive effect on earnings does not make use of the notion of human capital investment. This theory can be seen to act completely independently of human capital theory, although it could also be argued that some combination of the two theories is at work in explaining the upward sloping earnings profile. For the moment I shall treat the two theories as completely separate explanations<sup>4</sup>.

The deferred compensation model has three important implications. Firstly it



will result in longer lengths of tenure than would otherwise be the case. Secondly it will reduce worker turnover and its associated costs. Thirdly, workers will wish to continue working beyond the efficient retirement date, defined as that point where the value of the worker's marginal product is just equal to the reservation wage. It is for this particular reason, that firms find it necessary to initiate mandatory retirement practices. An additional problem arises however. If a worker in the final years of tenure is aware that his/her employment will be terminated in the near future, he/she faces no incentive to provide the desired amount of effort. The firm can circumvent this problem by offering the worker some form of pension payment upon retirement, this pension being part of the total deferred compensation package received by the worker. Any worker caught cheating, forfeits both future wages and pension, thus encouraging non shirking even in the final stages of tenure. The greater is the value of an occupational pension offered by an employer, the greater also, it can be argued, is the extent to which deferred compensation is employed as an incentive system. In their recent work, Clark and Ogawa(1992a,b) find that if the age of mandatory retirement is increased, the earnings profile will become flatter. This phenomenon they argue occurs due to an increase in the period over which deferred compensation can be paid, leading to a smoother compensation pattern.

In examining the extent to which the agency hypothesis explains the positive slope of the earnings profile in the public and private sectors, it will be important to analyze firstly the reasons why monitoring worker performance may be costly in either sector, and secondly the extent to which compensation is deferred and pension schemes employed in each sector. This analysis is undertaken in the following section.

### **2.3.1. Deferred Compensation and Public/Private Sector Earnings**

#### **Profiles.**

Lazear has suggested that the higher are the costs of monitoring the individual employee's productivity, the greater will be the degree to which compensation is deferred as a means of mitigating against shirking. Following this line of argument, certain factors suggest that the public sector will encounter higher costs of monitoring than those in the private sector.

Firstly, there is the role of firm or organisation size, which is generally thought of as being greater in the public sector. It would seem reasonable to postulate that there is a positive correlation between the number of employees in an organisation, and the total costs of monitoring performance. This immediately suggests higher costs of monitoring in the public sector. The issue of firm size will be examined in more depth in a later section.

Secondly, it should be remembered that marginal addition to profit or residual is not used in the public sector as a means of evaluating worker performance. The vast majority of employees within the private sector enterprise are evaluated by use of a common marginal profit valuation. In the public sector enterprise, specific means of evaluating performance must be created for different groups of employees, dictated both by their particular function within the organisation, and by the designated objectives of the enterprise itself. Such a plethora of evaluation procedures will have a tendency to increase the monitoring costs of the public sector organisation.

The third reason why monitoring costs may be higher in the public firm,



relates to the fact that the scope for managerial discretion is greater in this type of enterprise than in the private sector equivalent. In the private sector firm, managerial discretion can be limited through voting by shareholders at an annual general meeting. A management team which has not performed according to share holders wishes can be replaced easily through an efficient internal management network. A second means by which managerial discretion is limited is through the market for shares. Such means of control, available to the principals of the private sector enterprise, are not available within the public sector firm. As a result, more expense must necessarily be incurred in monitoring the performance of public sector managers in order to ensure that their actions are in accordance with the objectives set out for the enterprise.

These factors would seem to suggest that monitoring of employees will be more costly in the public sector firm, and so following Lazear(1979), the extent to which compensation is deferred must be greater, to provide an effective incentive device. Whether this is in fact the case can be evaluated by comparing the size and incidence of occupational pensions(an important part of the deferred payment package) in each sector.

As previously mentioned, earnings related pensions are much more commonly observed and generally of greater value in the public sector. In the United States the common use of the "Terminal Earnings" method of calculating public employee pensions, greatly increases their value relative to the average private sector pension. As a share of compensation, government pensions are on average three times larger than those in the private sector (Ippolito 1987). Moreover, the pension penalty imposed on public sector workers who quit is almost four times larger in relation to



cash wage than pension penalties found in the private sector. It should also be noted that length of tenure is generally longer in the public sector and turnover is less cyclically sensitive (Utgoff 1983, Ippolito 1987). This suggests that in the U.S. at least, the extent to which compensation is deferred in the public sector is much greater than in the private sector, suggesting that the public firm under the agency hypothesis will exhibit a steeper earnings profile. As mentioned earlier with regard to the U.K. civil service, the Megaw Committee Report (1982) found that the value of civil service pension arrangements relative to private sector arrangements increased between 1975-80, adding 2% to the real income of civil servants.

Although I have suggested that high pension payments may be indicative of a steeply sloped earnings profile since they might represent a significant degree of deferred compensation, a counter argument to this has been provided by Ippolito (1991). Ippolito has separated the effects of, and motives for, the use of a pension as opposed to "wage tilt", to discourage workers from either shirking or quitting. He suggests that by offering a significant pension on termination of employment, there is no need to have an earnings profile which is steeply sloped during tenure. If the promised pension payment is of sufficient value, it will reduce both shirking and quit propensities during tenure. In this instance, the decision to offer a pension rather than increasing earnings will be viewed as favourable by the employee, due to the resulting tax consequences.

Only if the pension is treated as a deferred payment received upon retirement will the earnings profile have a particularly steep slope. This suggests that although the agency rather than the human capital hypothesis is a more credible explanation of wage patterns over tenure in the public sector, the result may not necessarily be a

more steeply sloped profile.

Contrary to the argument outlined above, Oi(1983) has suggested that an increase in the extent to which compensation is deferred, may instead be indicative of a high degree of firm specific human capital investment. This implies that there may be some combination of both agency and specific human capital explaining the slope of the wage-tenure profile in either sector. The above discussion seems to suggest however, that the agency hypothesis is a more appropriate explanation than human capital as to why earnings should increase with tenure in the public sector. If a combination of specific human capital and agency is at work in both sectors, the mix may possibly be biased towards specific human capital in the private sector, and agency in the public sector.

#### **2.4. Screening and Turnover.**

One final set of explanations which might be relevant to the discussion relates to various efficiency wage hypotheses, the most relevant of which are the screening and turnover theories. Although of less significance in this particular analysis, these hypotheses are also worth outlining for completeness.

According to efficiency wage arguments, it is in the interests of a firm to attract employees who are both suitably qualified, and who have a low propensity to quit. The screening hypothesis suggests that workers are heterogeneous in their productivity, their trainability, and their quit propensities (Salop and Salop 1976). As turnover involves the firm in hiring and training costs, reducing turnover by



attracting employees with low quit probabilities will lead to higher profits.

According to Katz(1986), if workers are heterogeneous in ability, and if ability and reservation wages are positively correlated, firms that offer higher wages will attract higher quality applicants. The firm must now ensure that suitably qualified employees will not quit, i.e. it must make use of some form of selection procedure which encourages only low quit probability applicants to select employment with the firm. This can be achieved by offering a wage which increases over tenure. In the early years of tenure, wages are low, and the worker is in effect paying an entrance fee or bond. As tenure lengthens, wage paid increases, so that in the latter part of tenure, the worker effectively receives the bond repayment i.e. the promised high wage which encouraged the worker to select employment with the firm in the first place. The willingness of the worker to pay the bond, signals his or her willingness to stay with the firm for a significant period. If the worker quits prematurely, he/she will forgo the future wage premium. In this situation, an upward sloping earnings profile enables the firm to attract applicants who are both highly qualified, and who have low quit propensities.

The bonding argument suggests that in effect, employees are paying the costs of their own hiring or training. This is contrary to the specific human capital argument, which suggests that worker and firm will share the costs of training. Katz(1986) has argued that full bonding is impractical due to imperfections in capital markets i.e. risk averse workers are likely to be unwilling to post bonds and bear the risk of being unsuited to a job. In this case, firms must bear some part of the turnover costs.



#### **2.4.1. Screening, Turnover and Public/Private Earnings Profiles.**

The screening and turnover models are likely to apply in both public and private sector labour markets, as firms attempt to attract high quality labour and reduce the costs associated with turnover. It appears likely that firms in both sectors will gain from initiating an upward sloping earnings profile of an efficiency wage type. As far as screening is concerned however, this may be a relatively more important issue in the public sector.

As argued earlier, it may be more costly to evaluate the performance of an employee in the public sector due to the exclusion of a profit related evaluation measure. This situation may well prompt the public sector enterprise to initiate a more effective screening procedure so as to attract only the most productive and lowest quit propensity employees, reducing to some extent future monitoring costs. This line of argument implies that a wage profile dictated by the screening/turnover hypotheses is possibly more likely to be employed in the public sector firm. One manner in which this might be analyzed, is by examining the qualifications possessed by persons employed in each sector, and by looking at the effect on applications of changes in wage payments.

U.K. evidence for the 1980's seems to suggest that the public sector is successfully attracting more highly qualified applicants. According to Parry and Schmidt(1987), in 1981, 23.1% of the public sector workforce had some form of post-school qualification, compared to only 8.2% of the private sector workforce. This resulted in 55% of the post-school qualified workforce being located in the public sector. Such evidence may suggest that it is the public sector in the U.K.

which is offering a screening/turnover type efficiency wage. There is also evidence that the same thing is happening in the US. Empirical results by Blank(1985), indicate that workers with lower educational attainment tend to select private sector employment, while those with either higher education, or more experience, seem to prefer the public sector. Belman and Heywood(1989) are in agreement with this finding, as they observe higher levels of education associated with greater probability of government employment. Again this may imply that the public sector wage is conforming to a screening/turnover efficiency wage hypothesis.

In contrast to the above, Katz and Krueger(1991) have suggested their findings for the US indicate the opposite is true, and that it may be the private sector which is attracting more qualified individuals. They observe greater returns to higher education(e.g. college degree) in the private sector, whereas returns to high school education only, are greater in the public sector. This, they claim, has resulted in public sector organisations experiencing difficulty in attracting suitably qualified applicants for posts requiring some form of higher education, while at the same time experiencing queues for jobs which require only high school qualifications. They also suggest that in the U.S. in the 1980's, there has been a tendency for turnover of highly trained workers to increase in the public sector. This evidence implies that the private sector is increasingly capturing a greater share of the highly qualified workers in the market. It may be doing this by offering an efficiency wage which conforms to the screening hypothesis. Krueger(1988a,b), has also found that by increasing wages in the public sector, firms in this sector will be able to increase both the number and the average quality of potential employees applying to the sector.



In the above discussion, it was argued that the firm wishes to attract suitably qualified applicants, and prevent them from quitting. The firm can do this by offering a high wage (essentially an efficiency wage), which will be paid after some period of tenure has elapsed, thus incorporating a bonding mechanism. As with the agency hypothesis, the firm again defers compensation in such a way as to compel the worker to behave in a desired manner. With regard to the different sectors, in order to judge the extent to which the screening/turnover efficiency wage is utilized in either sector, the extent to which compensation is deferred must again be examined. As was argued in the section dealing with the agency hypothesis, compensation appears to be deferred to a greater extent in the public sector.

### **2.5. Length of Tenure in the Public and Private Sectors.**

How long will the average job last in either the public or private sectors, and how many jobs can an average worker expect to hold in each sector? What does the evidence suggest? Ippolito(1987) and Utgoff(1983) have examined US data, which show that Federal workers do not often quit their jobs, and that government quit rates are much lower than those of the private sector. Also, turnover appears to be less cyclically sensitive in the public sector. This evidence has led some to argue that federal workers are overpaid. Ippolito and Utgoff however suggest that this situation exists primarily due to the loss of future compensation - mainly in terms of pension payments -which would result from premature quitting. This implies that job



tenures tend to be longer in the public sector, and that the average public sector worker can expect to hold fewer jobs than his or her private sector counterpart.

According to Krueger(1988a), for the average US federal sector post, more applications are received than for the average private sector post. The Federal sector attracts more job applicants generally, resulting in queues for government jobs.

Krueger also finds that there is a positive wage differential paid by the government sector. Such a differential then, is unlikely to be compensating for undesirable work in the government sector, but may be a screening/turnover type efficiency wage. This suggests that two forces are at work in the public sector, firstly the extent to which compensation is deferred is significantly greater than in the private sector, and secondly the government may be paying high efficiency type wages. The overall result would be that the earnings profile is steeper in the public sector increasing both the demand for public sector employment, and the length of tenure of the average public employee.

Table 1.1 in Chapter 1 displayed average length of tenure for both males and females in the sectors under analysis. Tenure length in the public sector as a whole seems to be longer than in the private sector, which suggests that the findings for the US might also apply for the UK. There would appear to be less mobility generally in the public than in the private sector.

## **2.6. Firm Size: Does the Public Sector Firm Act Like a Large Private Sector**

### **Firm?**

There has been some discussion in the literature as to the similarities between public and private sector firms in terms of behaviour. In the past, a positive correlation was shown to exist between both firm size and earnings (Hashimoto 1979), and firm size and tenure (Hashimoto and Raisian 1985). Recently, Schmidt and Zimmerman (1991) have found that even after controlling for variables which may explain why large firms have high wages, a positive relationship between firm size and earnings is still observed.

The larger is the size of organisation, the higher is the average wage paid, and the longer is a worker's average length of tenure. Such phenomena may be explained by an increased opportunity within a large organisation for inter-firm promotion or transfer, or the reduced risk associated with a large firm equipping its workforce with firm specific skills. These relationships appear to exist in a similar manner in both public and private sectors.

Belman and Heywood (1990), have estimated U.S. public/private wage differentials, taking into account firm size. They begin from the premise that public sector compensation is generally higher than that of the private sector, and that this is commonly seen by critics as evidence of over payment of public employees. They find after controlling for firm size that both male and female differentials are reduced, suggesting that public sector workers receive differentials for working in larger establishments. It would appear therefore, that the public sector organisation is mimicking the behaviour of its large private sector counterpart by paying a high

wage. This suggests a positive differential can be earned by working in the public sector, once firm size is controlled for however, this differential is substantially reduced. In addition to this, Hundley(1991) finds that public wages for occupations that are unique to the public sector are higher than public wages for occupations that are also traded in the private sector.

An associated point raised by Utgoff(1983) and Belman and Heywood(1990), concerns the fact that a public sector enterprise will be encouraged to act as if it were a private sector firm, paying a high wage in order to compete with the private sector for qualified labour. Such a finding is in keeping with the screening hypothesis explained earlier. Utgoff goes on to say that by paying high wages, the public sector will seek to imitate the induced efficiencies of the private sector.

So far, it appears that the public sector firm does not behave in a manner which is significantly different from its large private sector counterpart. Differences begin to appear however once collective bargaining arrangements are taken into account. In large private sector firms, earlier evidence suggested that the scope for establishment level negotiation over a variety of issues was much greater. In the public sector firm however, bargaining is more likely to take place at a national level. This is more akin to bargaining in the small firm private sector, where industry wide agreements are the norm, and the scope for plant level negotiation is more limited.

According to Sanjines and Thomson(1990), large firms can also be characterised by a greater degree of managerial specialisation in the area of industrial relations. An example of this refers back to the discussion on shop steward training, which is more prevalent in the private sector, and indeed often initiated there at



management level. The large private sector firm appears to be characterised by plant level negotiation, and in-house informal bargaining facilities, as opposed to national level negotiation and reliance on formal outside negotiating bodies prevalent in the public sector.

Returning to the earlier discussion on specific human capital investment, Oi(1983) has claimed that such investment is only observed in that sector of the economy consisting of very large firms. Large firms which incur high monitoring costs will demand more productive workers who in turn will command higher wages. Such workers will however require less monitoring, and will undergo a higher degree of firm specific human capital investment than less productive workers. This line of argument suggests that specific human capital is more likely to be observed in the public sector which consists of relatively larger organisations. The conclusion reached previously however, was that specific human capital investment will be more common in the private sector due to the more favourable transaction cost environment in this sector. This conflict may be resolved by considering just how specific human capital investment in each sector actually is.

According to Oi, only the largest firms will have specific investment, as these firms will specialise in the production of certain key goods or services. Smaller firms must necessarily be more adaptable, and as a result the nature of their human capital investment must be broader and less firm specific. The public sector tends to be characterised by many occupations which are not necessarily firm specific. The large private sector firm on the other hand, may well produce goods or services which are unique, and hence may utilize a very specific production process requiring a skill mix which is also unique to the firm. In this case, it could be argued that human

capital investment tends to be much more specific to individual enterprises in the private sector, so giving some solution to the above conflict.

## **2.7 Summary of Theoretical Conclusions.**

Having earlier outlined the main characteristic differences between the public and private sectors, this chapter has drawn on these factors in attempting to anticipate the effect of tenure on earnings. The main conclusion is that different theories may be appropriate in explaining the effects of tenure in different sectors.

The analysis began by examining human capital theory, with specific reference to the prevailing transaction costs environment in each sector. Where such costs are lower, we can, according to the theory, expect a higher degree of human capital investment especially of a specific kind, and hence, a steeper earnings profile. Transaction costs are arguably lower in the private sector due to a variety of factors. Firstly, there is the nature of the private organisation itself. Profit maximisation is the primary goal in this sector, and lends itself to a more efficient evaluation of worker performance than do the numerous goals laid down by government for the public organisation.

Secondly, there is the issue of unionisation and collective bargaining procedures. Collective bargaining is undertaken at a much more decentralised level in the private sector, again suggesting a more complimentary environment for investment in human capital. The experience of the enterprise union practice in Japan was drawn upon in order to illustrate the relationship between bargaining

practices and the level of specific investment.

Firm or organisation size is a further factor which should be brought to bear in this discussion. As organisations tend to be larger in the public sector, thus increasing the number of channels through which information must flow, we might again expect a lower investment in human capital in this sector. Also of note is the question of male/female ratios in employment. Female employees make up a greater proportion of the total workforce in the public sector. As female workers statistically tend to have lower total employment duration, it would be reasonable to expect less opportunity, and to a certain extent less willingness for investment in specific human capital.

Human capital theory seems to suggest that the tenure effect on earnings will be greater in the private sector. Human capital however is not the sole explanation as to why the earnings profile will be upward sloping. An alternative explanation which is independent of human capital is the agency hypothesis. Evidence seems to suggest that this may instead be the prevailing explanation of the tenure earnings relationship in the public sector. This hypothesis is mainly concerned with monitoring which, due to the size and nature of the public organisation, will be more difficult in this sector.

In the following chapters, estimation will be undertaken which attempts firstly to measure the tenure effect, and subsequently, to differentiate between the competing explanations. In the next chapter, a review is undertaken of previous attempts to actually estimate the effect of tenure on earnings.



**CHAPTER 2 ENDNOTES**

1. Hutchens(1989) gives an in-depth theoretical discussion of general and specific training investments.
2. Hashimoto defines sub-optimal separations as the failure of quit and dismissal decisions to be taken simultaneously.
3. Transaction costs are thought to be relatively lower in Japan, than in other similarly advanced economies.
4. This is the typical approach adopted in the literature.

## CHAPTER 3

### OVERVIEW OF EXISTING EMPIRICAL WORK AND ECONOMETRIC TECHNIQUES

#### 3.1. The Basic Earnings Function

The basic prototype-earnings tenure relationship which is usually tested in this type of analysis can be given by:

$$W_{ijt} = X_{ijt}\beta_1 + T_{ijt}\beta_2 + Z'\alpha + \epsilon_{ijt} \quad (3.1),$$

where,  $W_{ijt}$  is (log)wage for individual  $i$  in job  $j$  at time  $t$ ;  $X_{ijt}$  is total labour market experience;  $T_{ijt}$  is tenure with the current firm<sup>1</sup>, and  $Z$  is a vector of control variables eg. industry, firm size and the presence of a collective bargaining agreement. Such a standard equation is derived from previous work by Mincer(1974), who suggested that earnings for the typical worker will increase over tenure due to both general experience in the market place, and specific experience with the current firm In equation (3.1), the parameter  $\beta_1$  measures return to total labour market experience, whereas  $\beta_2$  measures returns to specific tenure with the current firm.

It is usual also to include in this type of equation, higher order terms in  $X$  and  $T$ . Following Borjas(1981), we can see why this is the case. Assume that the relationship between an individual's earning capacity and stock of human wealth can be

written as:

$$W_t = E_s + r \sum_{i=0}^T k_i \quad (3.2),$$

where  $W_t$  is earnings capacity at time  $t$ ;  $r$  is rate of return to human capital investment;  $E_s$  is earnings capacity after completion of  $s$  years of schooling, and  $k_i$  is the ratio of investment costs ( $C_i$ ) to earnings capacity ( $W_i$ ).

The human capital model predicts that the investment ratio i.e. the proportion of time spent in undertaking human capital investment, will decline linearly as tenure increases. There are two reasons for this, firstly, investments undertaken at an earlier stage of tenure have a longer amortization or payback period, and secondly, the costs of investment in terms of forgone earnings increase as tenure increases.

A functional form describing the path of investment over the working life would be:

$$k_t = k_0 - \beta t \quad (3.3),$$

where  $k_0$  is the initial level of the investment ratio (i.e. the proportion of time allocated to on the job training upon entering the labour force); and  $\beta$  is the rate of decline of human capital investment. Rewriting the first equation in continuous terms, substituting the second equation, and integrating, yields a simple form of the earnings function:

$$W_t = E_s + r k_0 T - \frac{r \beta}{2} T^2 \quad (3.4),$$

For estimation purposes, such an equation can be written as:



$$W_t = \alpha + \beta_1 T + \beta_2 T^2 + \epsilon \quad (3.5),$$

where:

$$\alpha = E_s, \quad \beta = rk_0, \quad \beta_2 = -\frac{rk_0}{2}.$$

Such a specification suggests that the earnings profile is of a concave shape, and that earnings increase at a decreasing rate over tenure.

Of particular interest in this thesis, is the effect of tenure on earnings in the public and private sectors. The equation which will be estimated is:

$$\ln W_i = \beta_1 AGT_i + \beta_2 WBC_i + \alpha'_K KOS_i + \alpha'_A AREA_i + \alpha'_S SIC_i + \alpha'_F FPTIME_i + \alpha'_G AGE_i \\ + \alpha'_N NYRS79_i + \alpha'_C CSZE79_i + \alpha'_E ESZE79_i + \epsilon_i \quad (3.6)$$

AGT signifies the type of collective bargaining agreement if any, governing an employees pay and conditions. Agreements which are clearly structured and regularly updated are likely to have a positive and significant effect on earnings, and should therefore be controlled for in this type of analysis. The WBC variable represents the existence of a wages board or council, and performs much the same role as the AGT variable. KOS is a dummy variable representing occupation. Use of this variable will control for the presence of high paying occupations, a phenomenon common to all sectors. SIC is a dummy for industry, and operates in much the same way as KOS, taking into account differences in earnings and pay structures among industries. AREA is a dummy variable signifying the UK region in which the worker is employed. There are 11 areas used in the analysis: Greater London, South East, South West, West Midlands, East Midlands, Yorkshire and Humberside, North West, North, Wales and Scotland. This dummy will take into account the fact that wages and earnings patterns

will differ across the country. Earnings will generally be higher in London and the South East for example than for occupations located in the North. This phenomenon is again likely to apply to all sectors. FPTIME refers to whether the employee works full or part time. Obviously, those who work full time will immediately have earnings greater than those of part timers.

The AGE variable is a dummy which indicates the employee's age. This variable will to a certain extent be a measure of general human capital. In this type of analysis, a general human capital variable is usually constructed using the number of years of education an employee has undertaken. In the NES dataset however an education variable has not been included, and so some other means of measuring general experience must be utilised.

In this particular analysis, it is assumed that age and occupation together will capture the effects of general human capital investment. Occupation in most instances will be a function of education received. The total number of years of education influences the particular type of occupation an individual is eligible for.

Returning to equation (3.1), the principle focus of this thesis will be the relative differences in the values of a parameter such as  $\beta_2$  in equations relating to the public and private sectors. Such differences will reflect the ways in which earnings increase over tenure in the separate sectors, and will determine the slopes of their respective earnings profiles. In other words, the main objective is to determine whether the returns to tenure can be said to be greater in either one of the sectors.

The following sections will examine previous attempts to estimate the earnings profile using various types of data. This will illustrate the way in which estimation has developed in order to deal with any econometric problems which have been

encountered.

### 3.2. Cross Sectional Estimation.

The first major attempt at cross sectional estimation of the earnings profile can be found in Mincer(1974). In this seminal work, Mincer develops and estimates both a "Schooling Model" and a "Human Capital Model" of earnings growth. In these models, earnings are primarily a function of the general human capital involved in schooling investment. The costs of such investment can be calculated as the postponement of current earnings over the period where schooling investment is undertaken.

The formula for the Schooling Model earnings equation is given as:

$$\ln Y_s = \ln Y_0 + rs \quad (3.7),$$

where  $Y_s$  is annual earnings of an individual with  $s$  years of schooling;  $Y_0$  is original earning capacity;  $s$  is years of schooling, and  $r$  is average rate of return to schooling.

In his empirical analysis, Mincer firstly estimates using cross sectional data, the effect of schooling on earnings for 3 sub-sets of the general sample, these sub-sets representing individuals who have 8, 6-10, and 7-9 years of labour market experience. An equation such as (3.7) is estimated, followed by one which also includes a variable for weeks worked. The data used is 1/1000 sample of the US census for 1960.

The findings indicate a positive relationship between earnings and years of schooling. In this model, schooling is used as proxy for general human capital



investment. It is also found that the expanded regression which includes number of weeks worked, shows partial coefficients of schooling to be several percentage points lower than in the simpler equations.

Mincer's next step is to develop a human capital earnings function. He develops a parabolic and a Gompertz earnings function, which are specified to a quadratic approximation in a Taylor expansion. The parabolic earnings function is given by the following:

$$\ln Y_t = a + b_1 s + b_2 t + b_3 t^2 + v \quad (3.8),$$

where:

$$a = \ln E_0 - k_0 \left( 1 + \frac{k_0}{2} \right),$$

$$b_1 = r_s,$$

$$b_2 = r_s k_0 + \frac{k_0}{T} (1 + k_0),$$

$$b_3 = - \left( \frac{r_s k_0}{2T} + \frac{(k_0)^2}{2T^2} \right),$$

$Y_t$  represents earnings at time  $t$ ;  $s$  is years of schooling;  $t$  is years of experience (current age minus years of schooling minus age at start of schooling);  $v$  is the random error component;  $E_0$  is initial earning capacity;  $k_0$  is the initial post school investment ratio;  $r_s$  is the rate of return to post school investment; and  $T$  is the total period of total net investment.

The Gompertz earnings function is given by:

$$\ln Y_t = a + b_1 s + b_2 x_t + b_3 x_t^2 + v \quad (3.9),$$

where:

$$a = \ln E_0 + \frac{r k_0}{\beta}, \quad b_1 = r_s$$

$$b_2 = -\frac{r k_0}{\beta} - k_0, \quad b_3 = -\frac{k_0^2}{2}$$

$$X_t = e^{-\beta t}.$$

In the subsequent regressions, all estimated coefficients are found to be highly significant.

Mincer concludes that the completion of schooling is not necessarily the completion of investment in human capital, as variation of earnings associated with age is not captured by the simple schooling model. Investment in human capital continues throughout working life, but at a diminishing rate due to the increasing opportunity costs of investment, and the shortening of the payback period. Earnings i.e. the return to the net investment, will also follow this same pattern of increasing at a diminishing rate over time. The general result of this will be an earnings profile which is concave in shape.

An important series of studies which also utilized cross sectional data, were those of Abraham and Medoff(1980,1981), which sought to examine whether the slopes of experience-earnings profiles could be matched with the slopes of experience-

productivity profiles for the same groups of workers. In other words, they sought to determine whether those paid more were really more productive.

The data used for these studies were extracted from the personnel files of several large US companies taken at a specific date. These files gave information on grade level performance, as well as earnings. The function estimated in Abraham and Medoff(1981), is a simple one given by:

$$\ln Y = \beta_1 X + \beta_2 P + \eta \quad (3.10),$$

where Y is earnings; X is experience, and P is within grade level performance of the individual. The results of the estimation show a substantial positive within-grade level return to both experience and company service(also included as a variable in the regression equation).

### **3.3. Problems Associated with Cross Sectional Estimation.**

#### **3.3.1. Self Selection Bias.**

The type of cross sectional estimation undertaken by Mincer and others is subject to two important econometric problems - self selection bias and heterogeneity bias(which will be dealt with in the next sub section). Self selection bias is especially important when dealing with a comparison of earnings associated with more than one distinct type of employment or sector, or more generally, where a choice has been made by individuals in a sample between different sources of employment. The problem here, is that there may exist certain characteristics associated with individuals in the sample



which determine their choice of employment, these characteristics not having been picked up by the data. This problem is one primarily of omitted variable bias. All wage observations in the data will have come from individuals who chose to work in a particular sector. Such a choice may have a direct effect on the return to any vector of personal characteristics included in the estimated earnings function.

Borrowing from Sumner(1981), assume a sectoral choice wage function can be given by:

$$\ln W_i = X_i \theta + X_i D_i \gamma + u_i \quad (3.11),$$

where  $W_i$  is wage;  $X_i$  is a vector of individuals' personal attributes;  $D_i=1$  if individuals choose to work in sector 1;  $D_i=0$  if individuals choose to work in sector 2;  $u_i$  is the disturbance term.

For workers in sector 2, the vector of compensations is  $\theta$ , whereas for workers in sector 1, the vector of compensations is  $(\theta+\gamma)$ . Assume also, that the disturbance term  $u_i$  is a function of sectoral choice:

$$u_i = \alpha_i + \rho_i D_i \quad (3.12).$$

In this case, covariance between  $X_i D_i$  and the disturbance term will produce inconsistent estimates of  $\theta$  and  $\gamma$ . This bias is a result of the effect of individuals exercising choice as to the sector they wish to work in.

The solution to this particular problem is proposed in Heckman(1979). It is suggested that a two step estimation procedure is employed, using probit analysis to show the effects of human capital variables on the choice as to work in a particular

sector. The Heckman two-step procedure allows the use of simple regression methods to estimate behavioural functions by least squares methods.

### **3.3.2. Heterogeneity Bias**

Estimation of earnings profiles using cross sectional data, such as Mincer(1974), consistently reveals a positive relationship between wage and length of tenure. Such a finding can be explained by traditional human capital theory, which suggests that as tenure increases, workers undergo both general and specific training, which increases productivity within the firm. Sharing in the returns to this productivity gain is the main reason under this hypothesis why earnings increase as tenure increases. There exists however another explanation - the job matching hypothesis - which seeks to explain why the analysis of cross sectional data should find a positively sloped earnings profile.

The job matching theory of Jovanovic(1979a,b), suggests that tenure will be long and wages high, where a good match has been struck between employer and employee. The quality of any match will only become known after a certain length of tenure has elapsed. Where job match quality is high, it will be in the interests of both parties to maintain the employment contract, as productivity is greater in this case than for an alternative match. In order to maintain the contract, the firm must pay the worker a wage which will reduce his probability of quitting. In this situation, high quality job matches exhibit both a relatively high wage and long tenure.

In estimating earnings profiles using cross sectional data, only one point of observation in each match length is made. As a result, the analyst may face a sample

which displays increasing wage with increasing tenure. The data however contains no information about the quality of the job match. For example, good matches may be associated throughout the sample with high wage and long tenure, whereas poor matches will be associated with shorter tenure and a lower wage. Cross sectional data, referring as it does to only one point in time, may then suggest a positive correlation between wage and length of tenure. The job-match hypothesis suggests however that the slope of the earnings profile may be flatter than cross sectional estimation seems to indicate. The inability of such data to take account of the job match effect will bias the estimates of return to tenure. It is this inability to model the quality of the job match which underlies the heterogeneity bias problem in cross sectional estimation.

Following Topel(1991), the heterogeneity bias problem can be modelled as follows. A prototype model of earnings can be given by:

$$y_{ijt} = X_{ijt}\beta_1 + T_{ijt}\beta_2 + \varepsilon_{ijt} \quad (3.13),$$

where  $y_{ijt}$  is log wage for individual  $i$  on job  $j$  at time  $t$ ;  $X_{ijt}$  is total labour market experience;  $T_{ijt}$  is current job tenure; and  $\varepsilon_{ijt}$  is the random error.  $\beta_1$  gives the average return to an additional year of experience, and  $\beta_2$  gives the average return to an additional year of tenure.

In this example, assume the error can be decomposed into:

$$\varepsilon_{ijt} = \phi_{ijt} + \mu_i + v_{ijt} \quad (3.14),$$

where  $\phi_{ijt}$  is a stochastic component of wages specific to a worker-firm pair(i.e. a measure of job match quality);  $\mu_i$  is a person-specific effect which measures unobserved



differences in earning capacity among individuals; and  $v_{ijt}$  is a completely random component. The fact that the error can be decomposed into job match and individual ability components, demonstrates that any attempt to estimate the regression equation by OLS with cross sectional data, will result in biased estimates of  $\beta_1$  and  $\beta_2$  due to covariance between the regressors and the unobservable components of  $\varepsilon_{ijt}$ .

Heterogeneity in the sample i.e. differences in job match quality, will lead to biased estimates of the returns to experience and tenure. Such biases can be avoided by the use of longitudinal or panel data sets, which allow the analysis of the earnings of each individual over time. An overview of the use of longitudinal data in the estimation of earnings profiles will be examined in the following sections.

### **3.4. Early Longitudinal Analysis.**

One of the first studies to estimate earnings profiles using longitudinal data(i.e. data wherein individuals in the sample are followed over time), was that of Mincer and Jovanovic(1981). This study is concerned with the effects of individual differences on both the relationship between earnings and tenure, and on mobility propensity. Mincer and Jovanovic suggest that the slope of the earnings profile will be steeper for those individuals of greater ability who acquire a high degree of firm specific human capital investment i.e. individuals in a good job match. They suggest that as individual differences affect mobility propensity, the earnings function should be reformulated to include both experience and tenure variables, the former capturing general or transferable human capital investments, and the latter specific or non-transferable

investments. This is an advance on the original earnings type equation, which simply regressed earnings on total labour market experience or age. The empirical analysis in this particular study showed that inclusion of a tenure variable, reduces the value of the estimated coefficient on experience.

Another set of studies using longitudinal data were undertaken by Bartel and Borjas<sup>3</sup>. These studies are concerned with earnings growth on the job, compared with earnings growth as a result of moving between jobs. The comparison here is between the way in which labour turnover affects the wage profile across jobs, and the way in which turnover affects wage within a job. The use of a longitudinal data set (National Longitudinal Surveys of Young and Mature Men), allows the analysis of average changes in wages for the sample over a certain number of years as a result of job change.

In examining the effect on wage growth of job mobility, Bartel and Borjas (1981) use percentage wage growth over a two year period as the dependent variable. This is regressed against a set of standardizing variables which are held constant. The next step is to compare an individual's earnings growth due to switching jobs, with that growth which would have been experienced had the individual not changed jobs. The longitudinal data can be used to approximate unobservable wage growth which would have been experienced had the worker remained in his previous job. For this purpose the sample is split into those workers who did not change jobs between 1967-1973, or who changed only between 1969-1971. The basic difference between these two groups lies in their 1969-71 separation propensities. A wage growth equation is estimated for each sub-period - 1967-69, 1969-71, 1971-73 - as a function of the 1969-71 separation



probabilities. The coefficients on these dummies can then be analyzed to determine how the movers' wages were growing before, during, and after the job change.

By examining the behaviour of the separation dummies over the six year period, it can be determined whether a mover did in fact gain from the move. The next part of the Bartel and Borjas study utilizes longitudinal data to examine how labour turnover affects the earnings profile within the job. Two separate equations are estimated, using as the dependent variables, absolute income growth(1967-69), and percentage income growth(1967-69), which are regressed against previous experience, current job tenure, time remaining on the job as of 1967, and a set of standardizing variables. From these regressions, the authors are able to obtain a figure for the annual increase in earnings for an individual remaining in his present employment for an additional twenty years.

These estimations do not permit a test of whether turnover leads to smaller or larger lifetime wage growth. The use of longitudinal data does however avoid biases arising due to individuals selecting into certain jobs based on their separation propensity or job match qualities. For estimation purposes, the following estimation equation is used:

$$Y_t - Y_0 = \beta_1 t + \beta_2 t^2 + \beta_3 e + \beta_4 e^2 \quad (3.15),$$

where  $Y_t$  is current earnings;  $Y_0$  is earnings in the first year of the life cycle;  $t$  is current tenure, and  $e$  is total labour market experience.

By looking at wage growth, it is possible to net out any individual differences that are unobserved, but which affect the individual's earnings throughout working life. The coefficients  $\beta_i (i=1..4)$ , can be interpreted as the effects of experience and job tenure on total life cycle wage progress. The final results show that while mobility that



takes place early in the life cycle may have a positive effect on earnings, individuals who settle with a firm and remain there for the remainder of their time in the labour market, experience larger lifetime growth than individuals who are still changing jobs<sup>4</sup>.

### **3.5. Recent Panel Data Estimation.**

The availability of several large panel data sets in the United States, has allowed analysts to more accurately observe the effect of tenure on earnings. Recent important studies include those of Altonji and Shakotko(1987), Abraham and Farber (1987), Marshall and Zarkin(1987), Brown(1989) and Ruhm(1990). These studies seek to challenge the previous empirical findings of a significant positive relationship between tenure and earnings. The studies mentioned above attempt to take account of heterogeneity bias which results from the sorting process, whereby high ability individuals end up in high quality matches with long tenure and high wage throughout.

Although there are several accepted theories as to why earnings will increase with tenure, it is argued that unobserved heterogeneity across individuals and across job matches may produce inconsistent estimates of the effect of tenure on wages and turnover. It is suggested that taking into account heterogeneity among individuals, will reduce the effects of tenure on wage, and may even indicate a reversal of the direction of causality from the previously accepted high tenure leading to high wage(as suggested by the human capital or agency hypotheses), to high wage leading to greater tenure length(as suggested by the job matching hypothesis).

In the Altonji and Shakotko model, an instrumental variable approach is adopted in estimating the wage-tenure profile. The data used in this case is a sample of male heads of households from the US Panel Study of Income Dynamics. It is assumed that the wage of individual  $i$  in job  $j$  at time  $t$  is given by:

$$W_{ijt} = \beta_0 X_{ijt} + \beta_1 T_{ijt} + \beta_2 T_{ijt}^2 + \beta_3 OLDJOB_{ijt} + \varepsilon_{ijt} \quad (3.16),$$

where  $W_{ijt}$  is log of real wage;  $X_{ijt}$  is a vector of characteristics of person and job, including labour market experience;  $T_{ijt}$  is the number of years of tenure of individual  $i$  in job  $j$  at time  $t$ , and  $OLDJOB_{ijt} = 1$  if  $T_{ijt} > 1$ , and 0 if otherwise. This latter variable is included in order that the wage response to the first year of tenure is not restricted by the quadratic specification of the tenure profile. It is assumed that the error term  $\varepsilon_{ijt}$  can be decomposed into the following components:

$$\varepsilon_{ijt} = \varepsilon_i + \varepsilon_{ij} + \eta_{ijt} \quad (3.17),$$

where  $\varepsilon_i$  is a fixed individual effect (capturing differences in ability);  $\varepsilon_{ij}$  is a fixed job match effect, and  $\eta_{ijt}$  is a transitory component.

It is likely that there will be a positive correlation between tenure and the individual effect  $\varepsilon_i$ . The reason is that individuals who are of high ability, are less likely to have a history of quits or layoffs, and this subsequently will have a positive effect on their tenure with the current firm. It is also expected that there will be some degree of correlation between tenure and the job match effect  $\varepsilon_{ij}$ , as workers in a good job match and who have a high  $\varepsilon_{ij}$ , will be receiving high wages, which will in turn reduce their propensity to quit. Alternatively, where  $\varepsilon_{ij}$  is high, workers will only quit where

a wage offer is high enough to compensate for mobility costs. This creates a negative relationship in a cross section between tenure and wage. Altonji and Shakotko assume however that the net effect of  $\varepsilon_{ij}$  will be to induce an additional upward bias in OLS estimates of the wage-tenure profile.

In order to remove the potential bias induced by population heterogeneity, an instrumental variable approach is adopted. The instrumental variables used for  $T_{ijt}$ ,  $T^2_{ijt}$ , and  $OLDJOB_{ijt}$ , are deviations of these variables around their means for the sample observations on a given job match:

$$\tilde{T}_{ijt} = T_{ijt} - \bar{T}_{ij}$$

$$\left(\tilde{T}_{ijt}\right)^2 = T^2_{ijt} - (\bar{T}_{ij})^2,$$

$$\tilde{OLDJOB}_{ijt} = OLDJOB_{ijt} - \overline{OLDJOB}_{ij}$$

where  $\bar{T}$  is the mean tenure length for individual  $i$  in job  $j$ . Instrumental variables such as those above are expected to be uncorrelated with the individual specific error component  $\varepsilon_i$ , and the permanent job match component  $\varepsilon_{ij}$ , but highly correlated with those variables they are instruments for. The instrumental variable procedure adopted is a 2SLS estimator.

The data used in the Altonji and Shakotko study is based upon the 1968-81 waves of the Panel Study of Income Dynamics. OLS estimates are first obtained then compared with those of the instrumental variable (IV) estimates, to determine whether bias is present in the estimation of the earnings profile. The OLS estimates obtained are



similar to those of Mincer and Jovanovic(1981), and suggest a substantial increase in earnings as tenure increases. In contrast, the IV approach indicates substantially smaller earnings growth in the first year of tenure, and a virtually flat profile thereafter. The main conclusion reached by the authors, is that any significant positive correlation observed between tenure and earnings in previous studies is due primarily to heterogeneity bias, and the slope of the earnings profile will as a result be much flatter than was previously believed.

An alternative study undertaken along the same lines as Altonji and Shakotko(1987), is that of Abraham and Farber(1987). In this case, it is suggested that the error term associated with the earnings-tenure function is correlated with pre-job experience. The explanation offered, is that workers with more experience will typically end up in higher quality job matches which pay higher wages, thus inducing a positive correlation between the two variables. Such a correlation will therefore lead to a biased estimator of the return to seniority(tenure) in the earnings equation.

In order to correct for potential bias, Abraham and Farber, in a similar vein to Altonji and Shakotko, adopt an instrumental variable approach. In this case, the instrument adopted for the seniority variable is:

$$\xi_{ijt} = S_{ijt} - \left( \frac{1}{2} D_{ij} \right) \quad (3.18),$$

where  $S_{ijt}$  is seniority for individual  $i$  in job  $j$  at time  $t$ , and  $D_{ij}$  is completed length of current job. This latter variable is given by:

$$D_{ij} = \gamma \mu_{ij} + \epsilon_{ij} \quad (3.19),$$

where  $\mu_{ij}$  is the error component of the earnings function, and  $\gamma$  is a parameter which summarizes the relationship between  $D$  and  $\mu$ . Such a relationship is assumed to be positive, as workers in good matches - as measured by one of the components of  $\mu_{ij}$  - tend to have longer completed durations of job tenure.

In order to proceed with this IV estimation, Abraham and Farber outline a procedure for estimating completed job duration. Once this has been estimated, estimation of the earnings-tenure equation can then be obtained using the following function:

$$\ln(W_{ijt}) = \theta_0 + \theta_1 S_{ijt} + \theta_2 E_{ijt} + \theta_3 E_{ijt}^2 + X_{ijt} \Omega + \epsilon_{ijt} \quad (3.20),$$

where  $\ln(W_{ijt})$  is log of real average hourly earnings;  $S_{ijt}$  is seniority;  $E_{ijt}$  is total experience, and  $X_{ijt}$  is a vector of other individual characteristics.

The data used in this estimation is again taken from the Panel Study of Income Dynamics. As with Altonji and Shakotko, a comparison is made between standard OLS estimates and the IV estimates. The OLS estimates suggest sizeable returns to both general labour market experience and seniority. The IV estimates, although showing little effect on the estimated return to experience, do however show a substantial fall in the return to seniority. Abraham and Farber conclude that most of the cross sectional correlation between earnings and seniority, controlling for experience, reflects the influence of heterogeneity bias due to omitted variables.

Other studies in a similar vein which have reached much the same conclusions are those of Marshall and Zarkin(1987), Brown(1989), and Ruhm(1990).

One paper which seeks to challenge these recent findings is that of Topel(1991). Again an earnings function is developed which has a decomposition of the error term into a job match component, an individual ability component, and a stochastic component. The earnings function is given by:

$$y_{ijt} = X_{ijt}\beta_1 + T_{ijt}\beta_2 + \epsilon_{ijt} \quad (3.21),$$

where:

$$\epsilon_{ijt} = \phi_{ijt} + \mu_i + v_{ijt} \quad (3.22).$$

In this case,  $y_{ijt}$  is log wage;  $X_{ijt}$  is total labour market experience;  $T_{ijt}$  is current job tenure;  $\phi_{ijt}$  represents the worker-firm job match effect;  $\mu_i$  represents an individual ability effect, and  $v_{ijt}$  is a stochastic component.

Again a correlation is purported to exist between the decomposed error term and the experience and tenure variables. An auxiliary regression of  $\phi$  on the observables is given by:

$$\phi_{ijt} = X_{ijt}b_1 + T_{ijt}b_2 + u_{ijt} \quad (3.23).$$

Topel disregards the common assumption of a positive relationship between the job match component  $\phi_{ijt}$  and tenure, and instead suggests that as persons who change job normally gain from the move, they will be included in the data at low job tenure levels, thus inducing a negative relationship between job match quality and tenure, and hence wage and tenure. As a result, comparing wages for workers with different job tenures will understate the returns to seniority.

Topel suggests a two-step estimation procedure in order to deal with any



potential bias. In the first step, a first difference of the original earnings equation is made:

$$y_{ijt} - y_{ijt-1} = \beta_1 + \beta_2 + \epsilon_{ijt} - \epsilon_{ijt-1} \quad (3.24)$$

as  $\Delta X = \Delta T = 1$ . Since  $X = X_0 + T$ , where  $X_0$  is initial experience on the job, the earnings equation can be written as:

$$y = X_0 \beta_1 + TB + \epsilon \quad (3.25)$$

where  $B = \beta_1 + \beta_2$ . The two step model is given by the equation representing differences in within job wage growth, and:

$$y - T\hat{B} = X_0 \beta_1 + e \quad (3.26)$$

where  $\hat{B} = (\hat{\beta}_1 + \hat{\beta}_2)$  and  $e = \epsilon + T(B - \hat{B})$ .  $\hat{B}$  is a consistent first step estimator of the sum of the returns to experience and tenure.

Such a two step model will yield unbiased estimators of  $\beta_1$  and  $\beta_2$ , only if  $EX'_0 \epsilon = 0$ . This condition will not hold however if job matching is important. Despite this however, Topel shows that the two step model establishes a lower bound on the average return to seniority. Specifically, he finds that returns to seniority are large, 10 years of job seniority increase the wage of the typical worker by 28% relative to alternatives. He also reports estimates of the wage profile generated by ordinary least squares applied to his prototype equation(3.20). The returns to seniority are higher than in the two step estimation, "though not dramatically so". Topel therefore concludes that as the two step procedure produces a lower bound, OLS estimates may in fact be quite accurate.

In discussing the results of Altonji and Shakotko, Topel suggests that the particular instrumental variable procedure used in their analysis produces a greater upward bias in the returns to experience and so a greater downward bias in the returns to tenure, than would be found in his own estimation procedure. This partly explains the small tenure effects estimated by Altonji and Shakotko<sup>5</sup>.

The data used in the estimation of the two step model are again taken from the Panel Study of Income Dynamics(in particular the first 16 waves 1968-83). Contradictory to the results of Altonji and Shakotko(1987), Abraham and Farber (1987) et al, Topel finds that the returns to seniority are significant, and that in fact the earnings profile has a substantial positive slope. Such findings are also obtained in a study by Hersch and Reagan(1990).

### **3.6. Implications of Previous Research.**

The review of previous attempts to estimate the tenure-earnings relationship, suggests there are several important implications which must be taken into account before attempting a similar analysis of the public and private sectors. Section 3.3.1 highlighted the problem of self-selection bias in the population under analysis. This problem is one of particular relevance to a situation where individuals are making a choice between employment in the private rather than public sector and vice versa. If it is possible empirically to take into account this choice factor, a more accurate picture of public sector earnings profiles will emerge.

The second major estimation problem was that of heterogeneity bias outlined in

section 3.3.2. In this case the so called "job match" effect will cause a bias in the estimation of tenure effects. Again, with reference to public and private sector comparisons, some attempt should be made to include the quality of job match in order to obtain accurate estimates. Before comparing returns to tenure in each sector, it must be established whether in fact a tenure effect exists in the first place. The discussion in section 3.5 on recent panel data estimation highlighted this very debate, with authors disagreeing not only on the magnitude of the effect, but whether the effect is in fact significant.

Also of interest in relation to heterogeneity, is the precise interpretation of the relationship between quality of job match and tenure. Altonji and Shakotko argue that there will be a positive correlation between tenure and job match - workers in a good job match will receive a high wage which will in turn reduce their propensity to quit. Topel on the other hand suggests that workers who change job tend to gain from the move and will be recorded in the data at low tenure levels, inducing a negative relationship between job match quality and tenure. The Altonji and Shakotko interpretation suggests an upward bias in the returns to seniority, whereas the Topel interpretation implies that returns to tenure will be understated. Not surprisingly, the results in both cases tend to bear out the original assumptions of the authors, however, this argument serves to highlight the importance of accurately identifying and interpreting unobservable characteristics in the employer-employee relationship.

In the analysis which follows, comparing the effects of tenure on earnings in the public and private sectors, an attempt will be made to take into account both quality of job match and self selection effects. This will be done using a simple instrumental variable procedure based on that outlined in the time series work above. The resulting



coefficients will then be compared with those received from the original OLS estimation. Although a tenure series is not available for the estimation which will be attempted here, previous longitudinal evidence will be drawn upon to offer a comparison with the results which follow. Before moving on to estimation, the next chapter gives a detailed description of the data used in the analysis.

**CHAPTER 3 ENDNOTES**

1. Tenure is also referred to in the literature as seniority.
2. Latterly Medoff and Abraham attempt a longitudinal analysis of the regression equation. The implications of such an approach will be dealt with in subsequent sections.
3. Bartel 1980, Borjas 1981, Bartel and Borjas 1981.
4. Longitudinal data has also been used in the examination of the effects of migration on earnings(see for example Farber 1983, and Hunt and Kau 1985), and in the analysis of womens' earnings (see for example Corcoran et al 1983,and Cox 1984).
5. Topel also offers measurement error in recorded job tenure as an explanation for the failure to find a significant correlation between seniority and earnings. In comparing his results to those of Abraham and Farber(1987), who also find no significant relationship between tenure and earnings, Topel attributes this disparity solely to differences in methodology.

## CHAPTER 4

### DATA DESCRIPTION AND DATA PROBLEMS

#### 4.1 The New Earnings Survey Panel Dataset

The New Earnings Survey Panel Dataset is constructed from the annual New Earnings Survey (NES), which was first conducted in 1968 and then annually from 1970. The construction of the panel is made possible due to the particular sample used. Individuals with the same certain two digits in their National Insurance (NI) numbers appear annually in the survey (Micklewright and Trinder 1981). As a result, over the years 1975-90, information on earnings and labour market characteristics of around 375,000 individuals has been collected. According to Adams and Owen (1989), some 20,000 of these individuals are present in a sample for the 12 year period 1975-86. As the panel dataset is derived from the annual NES, it would be appropriate to begin with a description of the annual survey.

##### 4.1.1 The New Earnings Survey.

The NES, which is collected by the Department of Employment, attempts to



estimate gross weekly earnings of all civilian employees in the UK in a single week of each year. The survey was first carried out in 1968, and since 1970 has been conducted every April. The sampling frame is derived from employees NI numbers, and since 1970, the survey has aimed to consist of 1% of all employees in the UK, typically 170,000 individuals annually. The panel dataset covers only 1975 onwards, due to a change in the sample selection method in this particular year. All information is collected by the employer, who is obliged to comply with the Department of Employment under the 1947 Statistics of Trade Act.

The NES sampling frame consists of all employees' NI numbers in the UK PAYE scheme. The sample itself consists of all those employees whose NI numbers end specifically in the digits "14". This same pair of digits has been used every year since 1975.

#### **4.1.2 Problems of Identification.**

One problem with the NES annual sample relates to the fact that it uses NI numbers assigned by the Inland Revenue, and will therefore only be as accurate as the Inland Revenue's PAYE records. Such records will exclude any individual whose earnings are below PAYE deduction level, and the survey may therefore exclude a significant number of low income earners. Part of the sample is also chosen from employer rolls(still using the same NI number method). Where this method of sampling is used, individuals whose earnings are below PAYE deduction level are more likely to be included, than in the situation where the IR selects the sample. According to

Adams and Owen, any bias resulting from this particular identification problem will not be evenly distributed, but will be most severe in sectors where few employers select the sample.

Another aspect of this identification bias, is that many employees who are below PAYE deduction level are likely to be in part time work, a high proportion of whom are likely to be women. Excluding such a group may cause estimates of earnings using NES to be biased upwards. This particular aspect may be of greater relevance for the public sector which employs a greater proportion of female part-timers. As a result, estimates of earnings in the public sector may be biased upwards relative to the private sector.

A second problem of identification concerns the fact that the sample is drawn in February, some time before the actual survey date (in April). As a result, individuals who are unemployed at the time of sample selection but who are working again by the April survey week will be excluded from the survey. An associated problem in this area, is that persons may not be registered in the local tax office records of his/her employer's PAYE scheme at the survey date.

#### **4.1.3 Collecting the Survey.**

Each year, approximately 200,000 survey forms are sent out to be completed by employers. Forms are immediately sorted according to whether individuals have been employed in the same job for more or less than 12 months. The data then undergoes a series of checks, to ensure that the information has been processed correctly. There is

a statutory obligation for an employer to comply with the NES, although employers of certain occupational groups are exempt(see Appendix 1). A list of data collected, and the variables of particular interest for the remainder of the analysis is given in Appendix 2.

## **4.2 Construction of the Panel Dataset.**

Each annual NES gives a detailed cross sectional picture of earnings in the UK. As the same two NI number digits are used to identify the sample each year, the survey collects a series of information on the same individuals over time. Consequently, the Department of Employment has been able to link data on individuals across years on the basis of their NI number, thereby constructing a panel dataset. The panel currently runs from 1975-90. The starting year of 1975, chosen due to a change in sample selection method in this year, resulted in a maximum sample overlap of only 25% between 1970 and 1975(Endean and Smith 1990).

### **4.2.1 Numbers in the Panel.**

Table 4.1 gives numbers in the panel for 1975-84, classified by age and sex. Age inconsistencies can arise due to the procedure whereby year of birth is estimated by the employer, if the correct year of birth is unknown<sup>1</sup>.



**Table 4.1****NUMBERS IN NES PANEL 1975-84**

Year	<b>Males</b>			
	<u>Consistent</u>		<u>Age Inconsistent</u>	
	Number	Part-Time (%)	Number	Part-Time (%)
1975	89,601	2.6	9,163	4.3
1976	95,880	2.8	8,769	4.8
1977	95,797	2.4	9,323	5.2
1978	95,847	2.4	9,234	5.0
1979	94,542	2.5	9,743	5.7
1980	93,460	2.4	10,257	4.6
1981	93,865	2.6	9,792	5.1
1982	90,382	2.5	9,466	5.0
1983	87,575	2.7	8,793	5.1
1984	86,386	3.1	8,517	4.9

Year	<b>Females</b>			
	<u>Consistent</u>		<u>Age Inconsistent</u>	
	Number	Part-Time (%)	Number	Part-Time (%)
1975	50,035	31.1	5,679	40.1
1976	56,691	32.9	5,600	42.9
1977	58,312	33.1	6,113	43.8
1978	59,090	33.4	6,131	43.8
1979	59,808	33.8	6,659	45.7
1980	60,216	33.6	6,941	46.4
1981	61,306	33.9	6,752	47.1
1982	60,375	33.8	6,539	47.0
1983	60,157	34.0	5,949	46.5
1984	59,946	34.5	5,778	47.4

(Source: Endean and Smith 1990)

Three distinct trends can be identified in the data. Firstly, the proportion of both male and female part-timers in the panel increases over time. Secondly, the proportion of the panel (males and females), present in any particular year is noticeably low for 1975, possibly reflecting a higher rate of non-response in the first year of the new

sampling method. For males, the proportion in the sample remains steady until 1982 and then declines, probably due to the rise both in unemployment and self-employment resulting from the recession of the early 1980's. The third identifiable trend concerns the observation that records with at least one inconsistent observation are more likely to be associated with part-time individuals (Endean and Smith 1990; Adams and Owen 1989).

Numbers present in the public and private sectors are available for 1979<sup>2</sup> (full-time individuals only), and are presented in Table 2<sup>3</sup>.

**Table 4.2**

<b>Total Numbers in Sample 1979</b>			
	<b>Total</b>	<b>Males</b>	<b>Females</b>
<b>Priv Sec</b>	104,692 (62.4)	68,020 (65.0)	36,672 (35.0)
<b>Pub Sec</b>	63,133 (37.6)	34,609 (54.82)	28,524 (45.18)
<b>PUBC</b>	18,931	16,188 (85.5)	2,743 (14.49)
<b>CENG</b>	17,079	6,359 (37.23)	10,720 (62.8)
<b>LOCG</b>	27,123	12,062 (44.47)	15,061 (55.53)

PUBC: public corporations

CENG: central government

LOCG: local government

As can be seen from the table, the female to male employees ratio is higher in the public sector. The Central and Local government sectors are both mostly made up of female employees, with Central Government being especially female dominated.

#### **4.2.2 Length of Time in the Panel.**

One particular point worth noting is the large proportion of individuals who spend only one year in the panel. Endean and Smith suggest that this is 23% of age consistent males, and 26% of age consistent females. Adams and Owen claim that this high proportion may be a result of errors in recording NI numbers. There is also a smaller proportion of females who spend all their time in the survey than males. In addition, Endean and Smith have observed that for those spending close to the maximum number of years in the survey, the spell is more likely to be broken than complete. Males aged between 25-50 years remain for much longer periods in the panel - 16% stay on average for the whole ten years from 1975-84, compared to 10% of those in the panel as a whole.

The proportion of the individuals leaving the panel increases with age, but the overall proportion leaving declines after 1979. The number of individuals joining in 1976 is higher than in any of the other years, however this may be due to the low response in the starting year 1975. Endean and Smith suggest that below the age of 40, a much higher proportion of females join and leave the panel in any particular year than males, confirming that they are more likely to take breaks from employment at this age than their male counterparts.



### **4.3 Problems with the Dataset.**

One particular problem common to the use of panel data, is loss of individuals over time. Of the 170,000 individuals who appear in at least one year, only 20,000 appear consistently in the 12 years 1975-86. This loss of individuals can be categorised in either of two ways - attrition or non-response. Each of these topics will be dealt with in turn.

#### **4.3.1 Attrition.**

Attrition is a process whereby individuals leave the population covered by the NES over time. The main reasons for leaving can be categorised as follows:

- (a) leaving the labour force due to unemployment or some other reason,
- (b) becoming self-employed, or
- (c) moving into employment in one of the sectors not covered by the NES (see Appendix 1).

In the analysis of earnings in the public and private sectors, if attrition is thought more likely to occur in one of the sectors, this will lead to a bias in the estimation. It could possibly be argued that as length of tenure tends to be longer in the public sector (especially in public corporations), there is likely to be less movement from this sector into sectors not covered by the NES. Further analysis is required however, before any firm conclusions can be reached regarding this point.

### **4.3.2 Non-Response**

This phenomenon occurs where an individual is employed in a covered sector, but is not included in the analysis. Non-response can occur for several reasons. Firstly, individuals may not be included in a particular year because their earnings have fallen below the NI limit. This effect is unlikely to be completely random, but will tend to be most common among part-timers. In 1980, the Department of Employment estimated that around a third of part-time workers do not enter the NES due to exclusion from PAYE schemes.

A second reason for non-response is non compliance on the part of the employer. Non compliance may arise for one of two reasons. There may firstly be an inability to identify the correct employer, caused by administrative errors in sample selection. Alternatively, a potential member of the sample may have changed jobs or started work after a period of unemployment and the local tax office records of his/her employers PAYE scheme may not yet have recognised this. This second phenomenon is likely to vary in regularity, and will depend primarily on the state of the labour market. This type of non-response is also unlikely to be completely random, and will be greater where the costs of compliance are highest. Such costs will tend to be higher in smaller firms the majority of which, the data suggests, are to be found in the private sector. It should also be noted that response to a government survey is likely to be highest in those cases where the government is also the employer of the individuals concerned i.e. the public sector.

### 4.3.3 Measurement Error

A further problem common to panel datasets is measurement error. Such error can occur at any stage of the survey process, and if non-random, will again bias any analysis making use of the data. Measurement error can be demonstrated most clearly with sex and age inconsistencies. The explanation for the latter may well be the procedure whereby employers are asked to estimate the employee's year of birth if the actual year is unknown. Age inconsistencies may also occur due to employees giving inaccurate information about their age. Adams and Owen suggest that here, the observed value will be close to the actual value, though potentially not distributed around it. Sex inconsistencies will probably be completely random, although no analysis has actually been undertaken on this particular problem.

There may also be measurement error due to inaccurate completion of questionnaires. Gregory et al(1990), expect this type of error to be largely random, although possibly more prevalent for newer employees where information is less securely established. They suggest further that errors in coding and transcription are also largely random, introducing variability and inaccuracy into the figures, but not systematic bias.



#### 4.3.4 Other Data Problems.

Another problem with the NES Panel, particularly with reference to its application to earnings-tenure analysis, is the fact that it does not contain a variable measuring general human capital or experience. Such a variable is usually constructed using number of years of education. General human capital is usually given by the formula:

$$\text{Experience}=(\text{age}-\text{schooling}-5),$$

where it is assumed schooling commences at age 5. Such an approach is not possible using the NES panel due to the absence of an education variable, and so some other means of measuring experience must be established.

For the purposes of this particular analysis, it will be hypothesised that there exists a direct relationship between age and occupation combined, and educational attainment:

$$\text{Experience}=f(\text{age},\text{occupation}).$$

In many occupations, a certain stage of education or qualification must be attained before entry into that particular career can be considered (e.g. teaching). At the other end of the spectrum, there are many jobs where it can be realistically assumed that only the basic compulsory educational attainment has been achieved in order to enter such occupations.

An additional problem with the NES panel for the specific analysis of earnings-tenure profiles, is the fact that the tenure variable is available for only 3 years of the panel (1975, 1976, and 1979). Although cross sectional estimation is possible for each

of these three years, time series analysis - the major strength of the panel dataset - is precluded. Fortunately, a variable - "J12M" - exists, whereby individuals (or more correctly their employers), are asked whether they have worked for the current firm for greater or less than 12 months. The following response values are allowed:

1: >12 months,

2: <12 months.

As a result, given the length of tenure in any one of the years - 1975, 1976 or 1979 - it might be possible to construct a tenure series based on the individual's response to the J12M question. This will depend on the extent to which such a question has been answered correctly. The problems of inconsistency due to measurement error will apply here as in all questions however. If there is any pattern to this inconsistency, any analysis based on the constructed tenure series will give biased results.

Such a procedure where a tenure series has been constructed given only limited information, has been employed in previous analyses of the relationship between tenure and earnings. Topel(1991), which has already been examined in depth, has employed the same technique, whereby a tenure series was constructed, given responses to a question not asked in consecutive years.

**CHAPTER 4 ENDNOTES**

1. Age inconsistency is a form of measurement error. Such errors will be discussed in more detail in section 4.3.3.
2. 1979 is chosen due to the inclusion of several variables essential for an analysis of earnings in the public and private sectors. See section 5.1 for more details.
3. Each figure as percentage of the total is given underneath in brackets.



## CHAPTER 5

### CROSS SECTION ESTIMATION:

#### Salient Features

##### 5.1 Introduction.

Estimation was carried out using one particular wave of the NES panel. The year chosen for analysis is 1979, the latest year for which information on certain key variables is available. In this year, a number of specific questions were asked concerning company size, establishment size and most importantly number of years of tenure, which had not been asked in previous years (with the exception of tenure, which was asked in 1975 and 1976). In order to utilise a combination of these and other variables, 1979 was considered to be the most appropriate year for cross section estimation purposes.

The particular equation estimated is one which features the tenure variable (NYRS79) as a dummy, rather than the more common tenure and tenure squared approach of the traditional Mincer equation<sup>1</sup>. The equation is of the form:

$$\ln W_i = \beta_1 AGT_i + \beta_2 WBC_i + \alpha'_K KOS_i + \alpha'_A AREA_i + \alpha'_S SIC_i + \alpha'_F FPTIME_i + \alpha'_G AGE_i + \alpha'_N NYRS79_i + \alpha'_C CSZE79_i + \alpha'_E ESZE79_i + \epsilon_i \quad (5.1),$$

where  $W$  is wage,  $AGT$  is agreement,  $WBC$  is wages board or council,  $KOS$  is an occupation dummy,  $SIC$  is an industry dummy,  $FPTIME$  is a dummy indicating whether the individual worked full or part time,  $NYRS79$  is the tenure dummy,  $CSZE79$  is the company size dummy, and  $ESZE79$  is the establishment size dummy.

The adoption of a dummy variable structure for the tenure variable was decided upon after examining the results of a similar approach with the  $AGE$  variable. Such a structure yielded age coefficients which when plotted, gave rise to a profile of the shape typically suggested by human capital theory: upward sloping, reaching a peak or plateau as human capital accumulation achieves a maximum, and then declining.<sup>2</sup> As this profile was obtained without the necessity of imposing a strict quadratic form upon the equation, it was decided to proceed in the same manner with the  $NYRS79$  variable. This process manages to draw out from the data a typical human capital relationship, without having to impose a specific form on the estimating equation.

The remainder of this chapter will highlight the main features of the cross sectional results. A discussion of the theoretical explanations underpinning these results will follow in Chapter 6.

## **5.2 Tenure Coefficient Profiles**

Tenure( $NYRS$ ) coefficients obtained from estimating the cross section earnings equation are plotted in figures 5.1 and 5.2. The figures display coefficient values, which although of interest in quantifying the return to tenure, are also useful in observing the

percentage increase in earnings from the base or starting value, as tenure increases. Log earnings associated with two separate tenure lengths can be given by:

$$\ln W_2 = a_0 + b_1 D_2 \quad (5.2),$$

$$\ln W_4 = a_0 + b_2 D_4 \quad (5.3).$$

In both equations,  $D_2$  and  $D_4$  represent the appropriate tenure dummies, which will take the value 1 in each case. The intercept  $a_0$  will measure all other effects in both cases.

The difference in log wages can be written as:

$$\ln W_2 - \ln W_4 = b_1 - b_2 \quad (5.4).$$

The difference between  $W_2$  and base wage  $W_0$  can be written as:

$$\ln W_2 - \ln W_0 = b^* \quad (5.5),$$

where  $b^*$  measures the difference in the effect of tenure on earnings between the two tenure lengths. Equation (5.5) can be rewritten as:

$$\ln \frac{W_2}{W_0} = b^* \quad (5.6),$$

which can in turn be written as:

$$\frac{W_2}{W_0} = \exp(b^*) \quad (5.7).$$

As  $b^*$  is a small number, the expression  $\exp(b^*)$  can be thought of as approximating a



percentage value. It is therefore possible to view each coefficient plotted as a percentage increase in earnings from the base or starting earnings.

The results for males, displayed in figure 5.1, show tenure profiles which are of a more linear shape than human capital theory would suggest. The most notable point concerning the pattern which emerges, is the apparent distinction between private sector and public corporations on the one hand, and central and local government on the other.

The central and local government profiles move very closely together, and are noticeably steeper than those of the private sector and public corporations. Although these latter two profiles do not overlap to the same extent, they do still appear to move together. Of the four male profiles, only the private sector seems to flatten out, while the others continue to rise in an approximately linear fashion. There is however, more variability in the slope of the public corporations profile.

Tenure coefficients for females are displayed in figure 5.2. The effects described above for males, are even more pronounced for females. Again we see a separation between the steeper central and local government profiles, and the relatively flatter private sector and public corporations profiles. It can also be seen that although the central and local government profiles are linear and continue to increase even at the highest tenure category, those of the private sector and public corporations appear to flatten out (and even begin to turn down in the case of the private sector).

Comparison of male and female profiles shows that although starting from similar points, female tenure returns appear to overtake those of males as the latter years of tenure (16 years and over) are reached. This rather surprising phenomenon can be analyzed in more detail by examining the growth rates of earnings associated with each sector. These growth rates are presented in Tables 5.1 and 5.2.

These tables show the wage(W) received in each tenure category for an individual who stays with the firm for the whole of the tenure period. The tables also show percentage cumulative growth of earnings(CG) as tenure increases, and average annualized growth rate(G<sup>\*</sup>).

Table 5.1

<b>Growth Rates by Tenure - Males I</b>					
<b>Tenure</b>	<b>0-2</b>	<b>2-4</b>	<b>4-6</b>	<b>6-8</b>	<b>8-12</b>
<b>PRIV W</b>	79.77	82.77	82.69	82.71	84.63
<b>CG</b>	--	3.76	3.66	3.68	6.09
<b>PUBC W</b>	84.67	90.08	91.60	89.02	92.66
<b>CG</b>	--	6.39	8.18	5.14	9.44
<b>CENG W</b>	73.05	78.73	81.85	83.46	86.74
<b>CG</b>	--	7.78	12.05	14.25	18.74
<b>LOCG W</b>	77.38	80.00	83.60	84.56	87.02
<b>CG</b>	--	3.38	8.04	9.28	12.46

Table 5.1(Contd.)

Growth Rates by Tenure - Males II					
Tenure	12-16	16-20	20-24	>24	G*
<b>PRIV W</b>	84.69	85.49	88.30	88.31	0.33
CG	6.16	7.17	10.69	10.72	
<b>PUBC W</b>	92.44	93.99	93.46	96.02	0.48
CG	9.18	11.00	10.38	13.40	
<b>CENG W</b>	87.37	88.90	91.18	94.95	0.87
CG	19.60	21.70	24.82	29.98	
<b>LOCG W</b>	88.71	89.45	93.09	94.40	0.61
CG	14.64	15.60	20.30	22.00	

Table 5.2

Growth Rates by Tenure - Females I					
Tenure	0-2	2-4	4-6	6-8	8-12
<b>PRIV W</b>	39.24	41.26	41.61	42.47	43.15
CG	--	5.15	6.04	8.23	9.96
<b>PUBC W</b>	51.64	55.64	56.11	57.90	58.58
CG	--	7.74	8.66	12.12	13.44
<b>CENG W</b>	44.6	47.6	50.19	52.76	53.93
CG	--	6.73	12.53	18.30	20.92
<b>LOCG W</b>	35.83	37.80	39.59	40.68	41.69
CG	--	5.50	10.49	13.54	16.35



Table 5.2(Contd.)

Growth Rates by Tenure - Females II					
Tenure	12-16	16-20	20-24	>24	G*
<b>PRIV W</b>	43.58	43.90	44.92	44.12	0.35
CG	11.06	11.88	14.48	12.44	
<b>PUBC W</b>	58.44	59.32	62.47	62.23	0.58
CG	13.17	14.87	20.97	20.50	
<b>CENG W</b>	56.89	57.58	58.94	61.42	1.01
CG	27.56	29.10	32.15	37.71	
<b>LOCG W</b>	44.43	45.64	46.85	48.34	0.93
CG	24.00	27.38	30.76	34.91	

The above tables show that the previous finding of a steeper slope for the female tenure profiles is indeed borne out by the associated growth rates. For all sectors, the average annualized growth rate for females is higher than the corresponding rate for males, suggesting higher average growth of female earnings. Also, the cumulative growth taken from starting wage, is higher at the final tenure category for females in every sector.

The observation of steeper profiles and higher growth rates for females may be explained by the tendency for females to have lower absolute starting wages. This particular point will be dealt with in much more detail in Chapter 6. The final section of this chapter will feature a comparison of the growth rates presented above with some of those in the existing literature.

### **5.3 Age Coefficient Profiles.**

Figures 5.3 and 5.4 display profiles based on age coefficients for males and females. The male age profiles (figure 5.3), are of the typical shape suggested by human capital theory - upward sloping, reaching a plateau, and then declining gradually. The profiles for each sector also closely overlap with each other. A reference age group of 41 years was chosen, as this is likely to be close to the point where the effect of age on earnings is greatest in all sectors. As a result, there is likely to be less variability in earnings at different ages with reference to the earnings of an average 41 year old, both within and between sectors, than had an alternative such as age 16 been used as the reference. This will therefore enable a more realistic comparison of the effect of age on earnings in each sector.

As can be seen, the central government profile both begins and ends at a position which is higher than that of the other profiles. In comparison, the private sector profile begins and ends at a position below the other sectors, suggesting greater variation in the effect of age in this sector.

Figure 5.4 shows the same profiles for the female sample. Again, as with the males, the approximately quadratic shape suggested by human capital theory is observed. In this case however, the profiles are more closely overlapping, and appear to be flatter, especially over the mid-range ages (31-46 years). The female public corporations profile begins from a lower position than the other profiles, but ends at a position above the others, it also declines at a slower rate than the other three profiles.

Another interesting point with regard to the male/female comparison, is the fact that all of the female profiles begin from a position of higher returns to age than their

male counterparts. This phenomenon is especially apparent in the private sector.

#### **5.4 Occupation Coefficients.**

Coefficients obtained from occupation(KOS) dummies are graphed in figures 5.5 and 5.6.<sup>3</sup> The reference occupation used is general management, which explains the preponderance of negative coefficients. Female occupation coefficients are given in figure 5.6. The most relevant comment concerning these female coefficients is that occupations in the public corporations appear to earn a premium compared to similar occupations in other sectors. These female public corporation returns are particularly high for professional type occupations, such as accountancy, systems analysts and managerial occupations.

Figure 5.5 displays occupation coefficients for males. In this case, occupations in central government tend generally to have higher returns than similar occupations in other sectors. This effect is especially pronounced in medical and legal type occupations. In stating this however, it appears that there is a large positive premium to be earned in medical occupations in the private sector. For the male sample, occupations in local government and public corporations tend to give the lowest returns.

In comparing the size of returns to occupation for males and females, it is interesting to note that female returns tend to be greater than those of males. It should also be noted however, that there are certain occupations in which very few females will be present, and that numbers will also differ in the same occupations between different sectors. It is possible for example, that there may be a high concentration of central government females in professional and welfare related occupations. This discussion



will be elaborated upon in the analysis which follows in Chapter 6.

As pointed out in Chapter 4, in the empirical work undertaken in this study, occupation in combination with age has been used as a proxy for education. As a consequence, it will be difficult to infer from the results any direct effect of occupation alone on earnings, and these particular estimates may therefore have to be treated with some degree of scepticism.

### **5.5 Area Coefficients.**

Area coefficients are graphed in figures 5.7 and 5.8.<sup>4</sup> The reference area used is London, which again explains a negative sign on the coefficients. Figure 5.8 displays area coefficients for the female sample. For females in all areas, central government gives a higher return than in all other sectors, there is also little variation in the size of this return across areas (with the exception of Wales). If central government is excluded, there is also little variation in the size of public and private sector return both within and across areas.

Male area coefficients are shown in figure 5.7. These coefficients show no distinct pattern either within or across regions, and there is much more general variability than with the female coefficients. Some areas display similar returns for all sectors (e.g. Yorkshire and Humberside), whereas others display wide divergence in returns between sectors (e.g. East Anglia and East Midlands). Returns to working in the public sector as a whole for males appear to differ widely across the country. Overall

however, the return to area appears to be higher for males than for females in all sectors and in all regions.

### **5.6 Firm Size Coefficients.**

Coefficients from firm size(CSZE) dummies are given in figures 5.9 and 5.10.<sup>5</sup> Male coefficients are shown in figure 5.9. For this sample, the effects of firm size tend generally to increase in all sectors until the highest size categories are reached(categories 07,08,09), after which, the effects become fairly stable. Private sector firm size returns tend to be higher than in other sectors for all size categories. This effect is even more pronounced at the largest firm sizes where the coefficients are considerably greater for private sector than for other sectors. Also in this sector, firm size effects tend to increase as size increases, and then remain fairly stable at the largest size categories.

In general, public sector firm size returns tend to increase steadily, then tail off significantly as the largest size categories are reached. There appear to be negative returns to working in the smallest firm size categories in the public corporations. This effect may be due to the fact that public corporations will tend only to be located in the largest size categories. Another point worth noting, is that returns to the 06 category(500-999 employees), for central government are greater than for all other sectors in this category.

Figure 5.10 displays female firm size coefficients. Again, as for males, private sector size effects increase with firm size, becoming steady at the largest sizes, although the effect is not quite so pronounced as for males. There is very wide variation in the size effects for public corporations, a phenomenon which may be explained by there being both very few females working in this sector, and very few firms located in the smallest categories. There are also similar returns to size for private sector and central government at the highest firm sizes. Again it is worth noting that in the 06 size category, the central government coefficient is the highest.

In comparing male and female size effects, female returns appear generally lower than male returns. There is also more general variability in the strength of the effect for females, especially with regard to public corporations and local government.

### **5.7 Collective Agreement Coefficients.**

Collective agreement coefficients are displayed below in Table 5.3, with t-statistics given in brackets.



Table 5.3

<b>Collective Agreement Coefficients</b>		
	<b>MALE</b>	<b>FEMALE</b>
<b>PRIV</b>	-0.007 (-2.0517)	0.0107 (2.10202)
<b>PUBC</b>	-0.046 (-4.4962)	-0.0042 (-0.2422)
<b>CENG</b>	-0.0108 (-0.6759)	0.0556 (4.8272)
<b>LOCG</b>	0.01 (0.7895)	0.0213 (1.3045)

For males, having some form of collective agreement has a negative effect on earnings in the private sector, as might be expected given the resistance many private employers display towards union activity. Surprisingly however, there is also a negative return to collective agreement in public corporations and central government. Local government is the only sector which gives a positive return to collective agreement for the male sample. This set of results is especially surprising bearing in mind that the year chosen for analysis is 1979, a year widely acknowledged as the high point of union power in the UK, especially in the public sector.

Turning to the results for females, there is in contrast to the male sample a positive return to collective agreement in the private sector. For the public corporations, there is a negative relationship between agreement and earnings. It should be borne in mind again that there is likely to be a small number of females in this sector, and they may well be concentrated into occupations which are not covered by agreements relating to their male counterparts. As would be expected, there is a positive return to collective agreement for females working in both central and local government. These

are sectors which are characterised by high proportions of female employees, and we would expect collective agreements here to be reasonably sympathetic to the circumstances faced by female employees.

### **5.8 Comparison of Growth Rates with Existing Literature**

In this section, I shall compare the effect of tenure on actual growth rate of earnings obtained above, with rates obtained in the recent literature in this area.

Hashimoto and Raisian's 1985 study compares earnings profiles for the United States and Japan. Their findings suggest that earnings profiles are steeper in Japan, tenure in a particular job is longer and that workers will indeed have fewer jobs over their lifetime than in the US. Hashimoto and Raisian's U.S. results refer to private sector males in non agricultural industries. For medium sized firms, they find that after 15 years with the same employer, there is a 4.1% growth in wages attributable to tenure, which increases to 18.7% after 25 years. This figure can be compared to the 6.16% cumulative growth after 16 years tenure, and 10.69% after 24 years obtained for private sector males in the above estimation. The growth rates found for the Japanese sample in Hashimoto and Raisian are even greater than those found for the U.S. sample.

Altonji and Shakotko(1987), estimate the effect of tenure on earnings using ordinary least squares and instrumental variable procedures, the latter being employed in an attempt to correct for heterogeneity bias.<sup>6</sup> The OLS results suggest that the first 10 years of tenure will result in a 30% growth in earnings for private sector(non government employed) males. This figure falls substantially to 2.7% when the IV

estimator is used. When the authors employ a GLS estimator, a figure of 13.1% for the effect of 10 years of tenure on earnings growth is obtained. These results compare to a figure of 6.09%, which is the cumulative growth observed after 12 years of tenure in the preceding estimation.

Abraham and Farber(1987), also employ both OLS and IV methods of estimation, and again the analysis is restricted to private sector males. From their OLS estimation they obtain a net return to seniority(or tenure) of 1 to 1.5% per year. This compares with their instrumental variable results of a 0.6% estimated net return to seniority for the white collar sample, and a 0.3% return for the blue collar sample. This can be compared with an average annualized growth rate of 0.33 obtained from the private sector male sample in my own estimation.

In the paper by Brown(1989), use is made of a fixed effects model which includes an early tenure dummy. The results from this estimation indicate 8% growth over the first four years of tenure. This can be compared with my own figure of 3.76%. Brown's main concern however is with the effect of training on tenure, and his findings suggest that 3 years of training will generate a 27% increase in earnings.

In the following chapter, the results of the empirical analysis above will be discussed in a theoretical context.



**CHAPTER 5 ENDNOTES**

1. Refer to Chapter 3 for a discussion of previous approaches to estimating the effect of tenure on earnings.
2. The shape of the typical earnings profile is explained in Chapter 3.
3. A list of Kos codes used is given in Appendix 3.
4. A list of areas chosen for the analysis is given in Appendix 2
5. Actual firm sizes associated with each CSZE category, are available in Appendix 2.
6. Refer to Chapter 3 for a discussion of the effects of heterogeneity bias in the estimation of earnings tenure profiles, and the econometric methods employed to correct for it.

# Tenure Coefficient Profiles

## Males All Sectors 1979

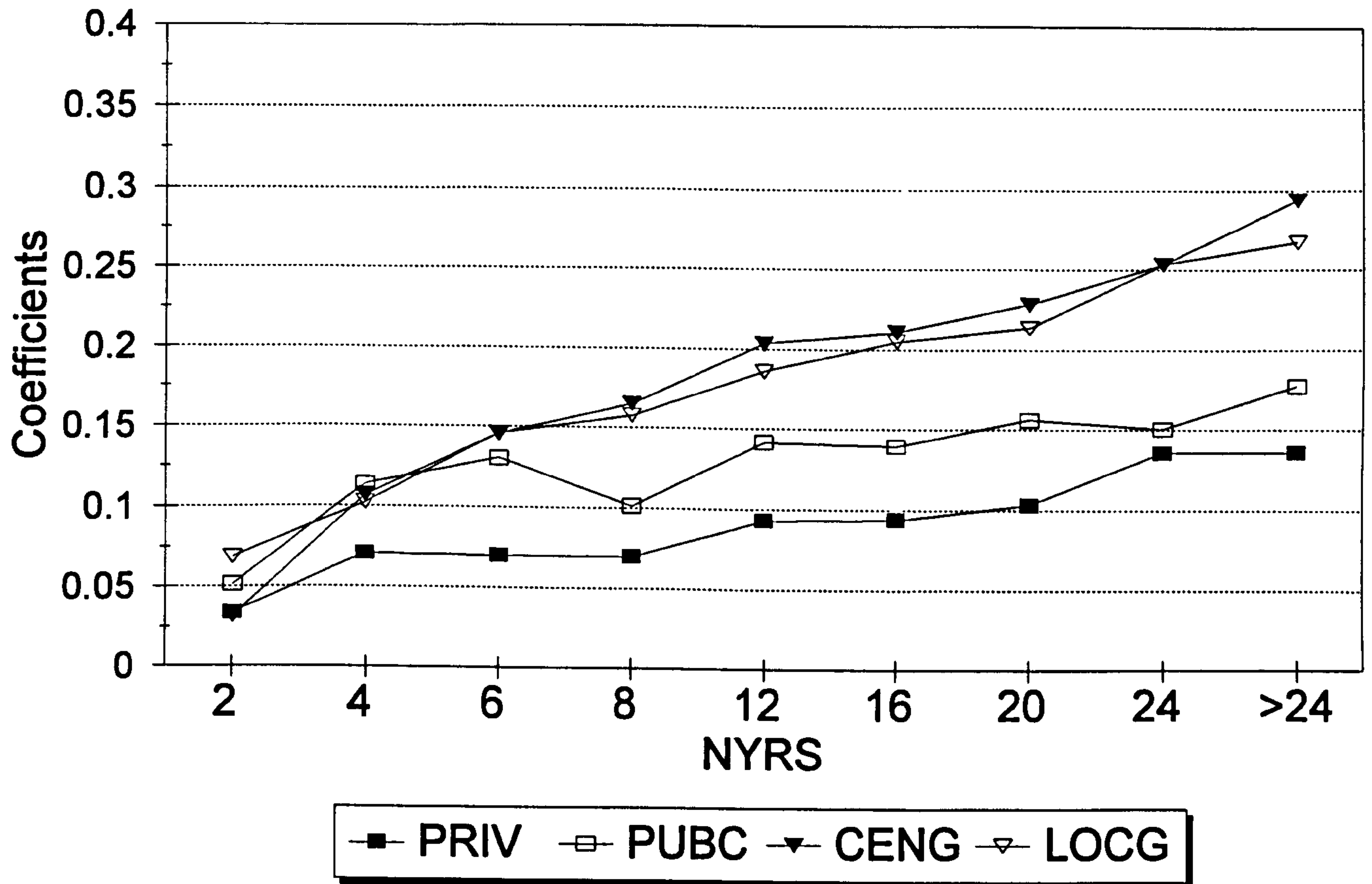


Figure 5.1

# Tenure Coefficient Profiles

Females All Sectors 1979

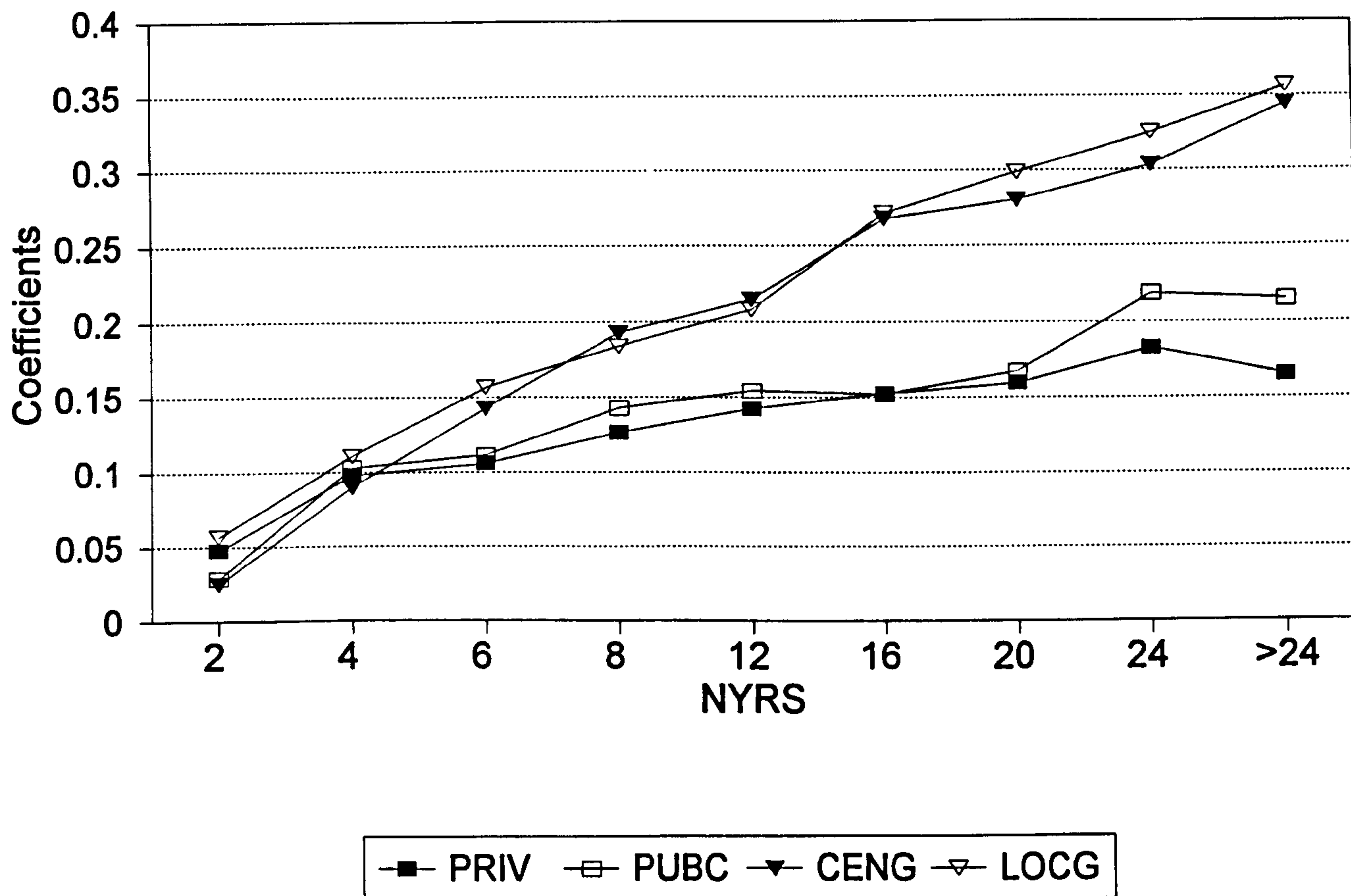


Figure 5.2



# Age Coefficients

Males All Sectors 1979

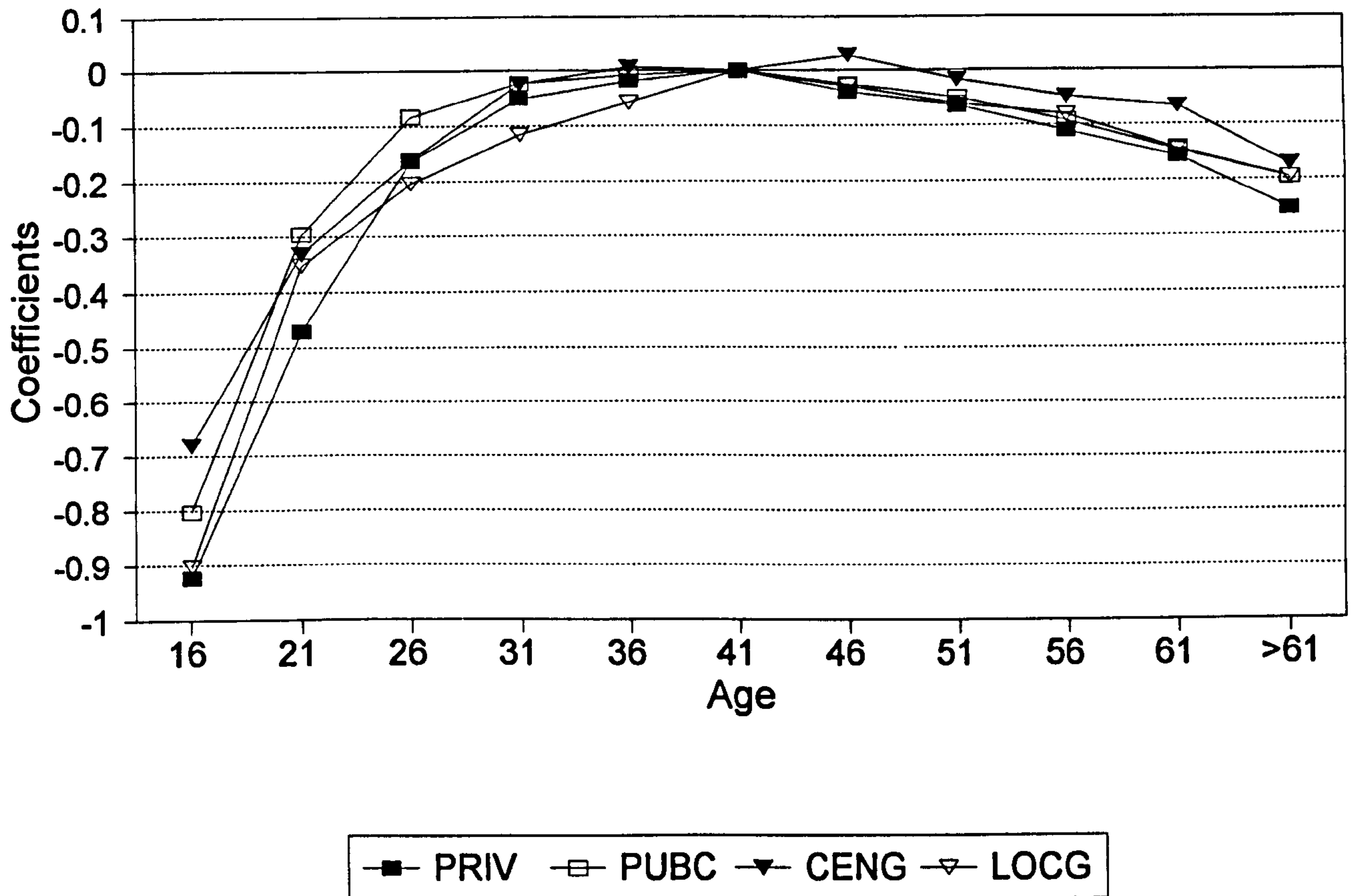


Figure 5.3

# Age Coefficients

Females All Sectors 1979

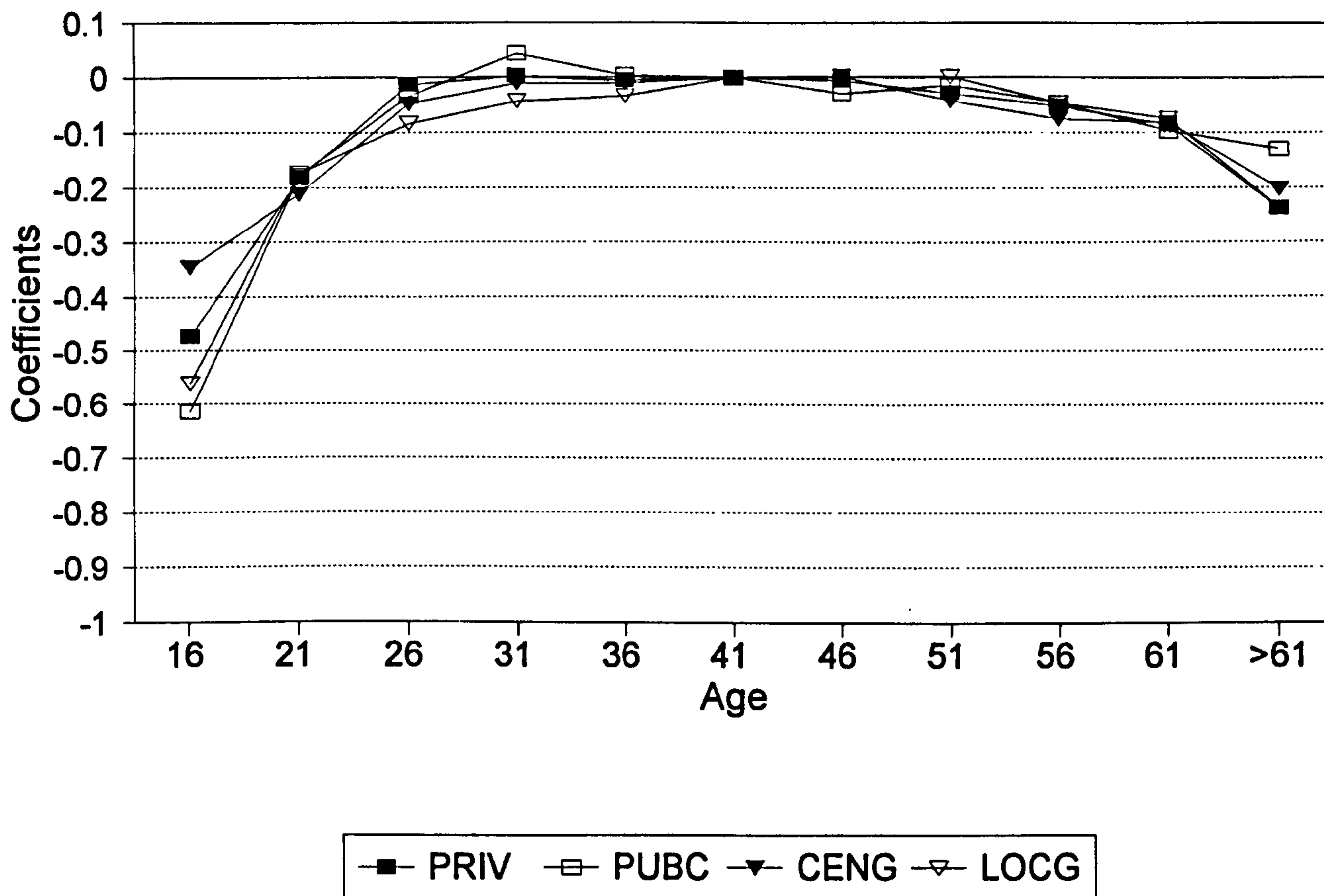
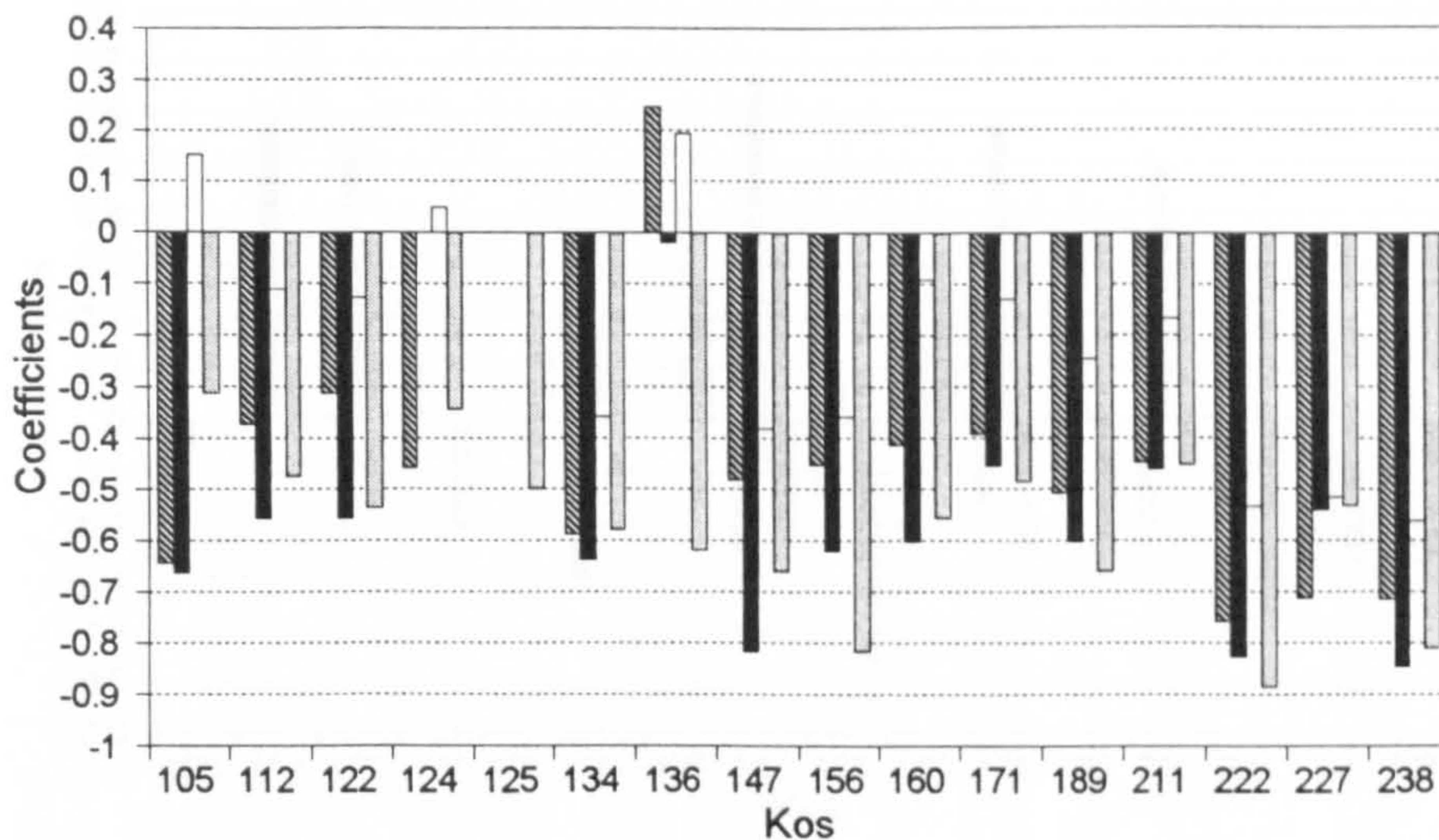


Figure 5.4



# Occupation Coefficients

(105-238) Males 1979



(246-540) Males 1979

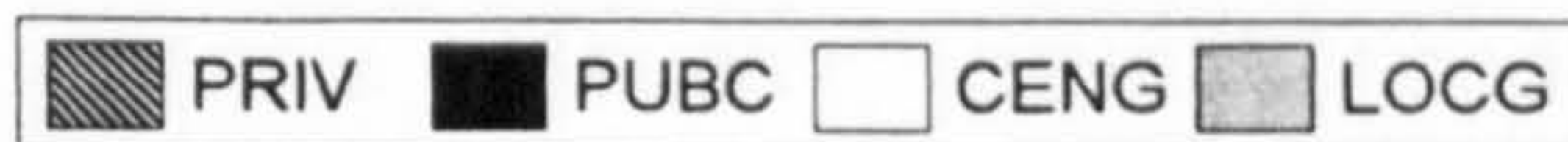
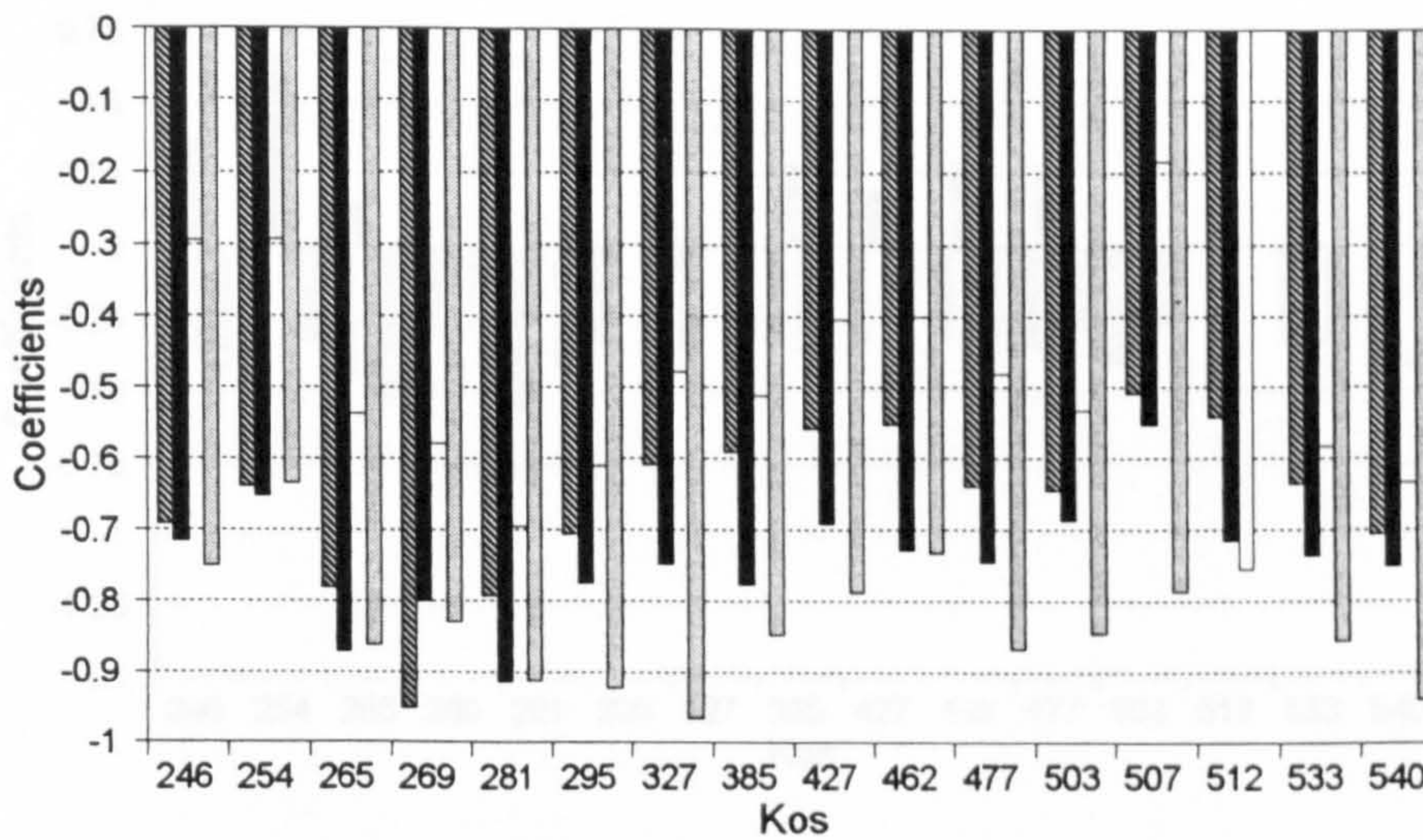
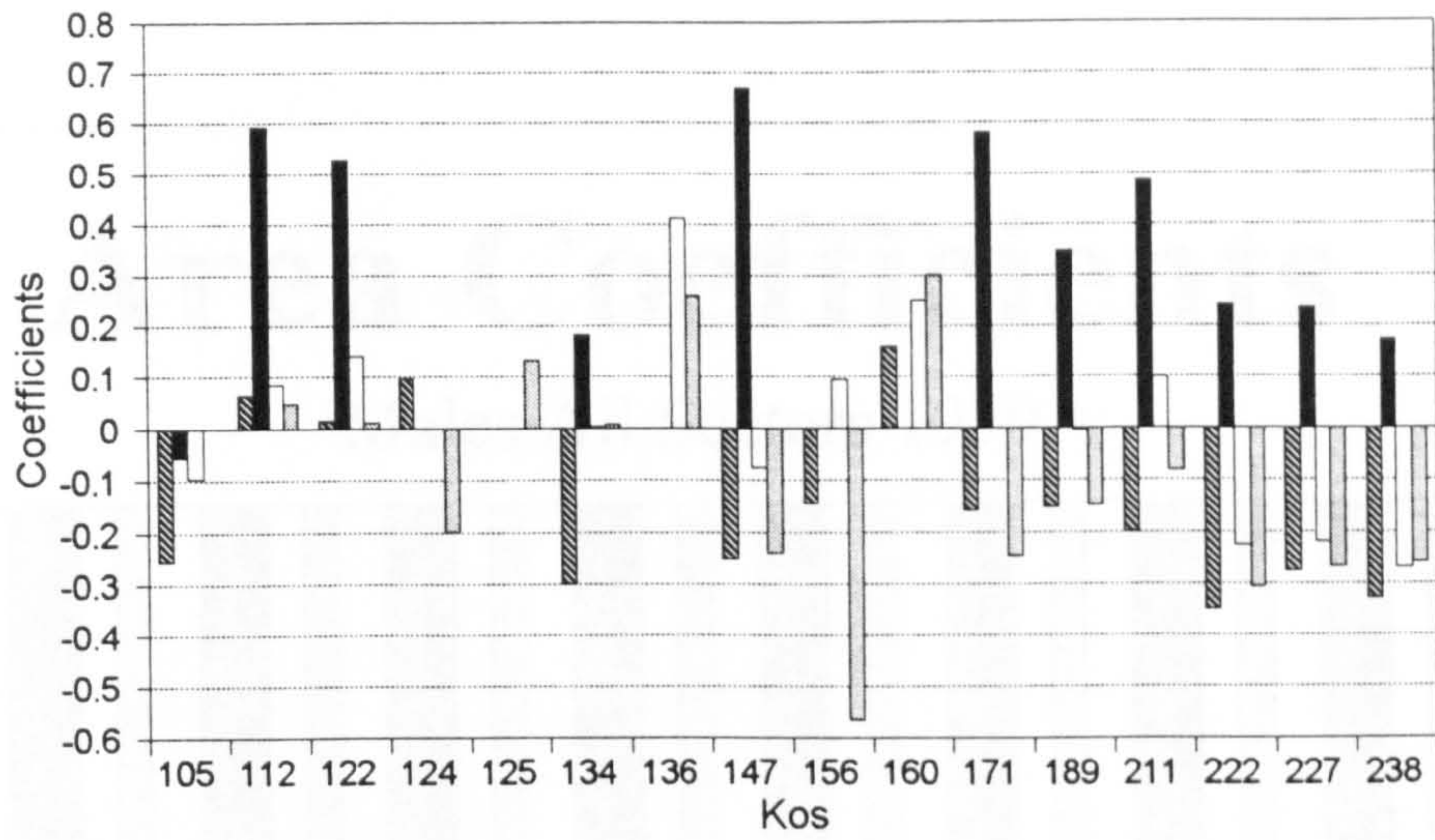


Figure 5.5

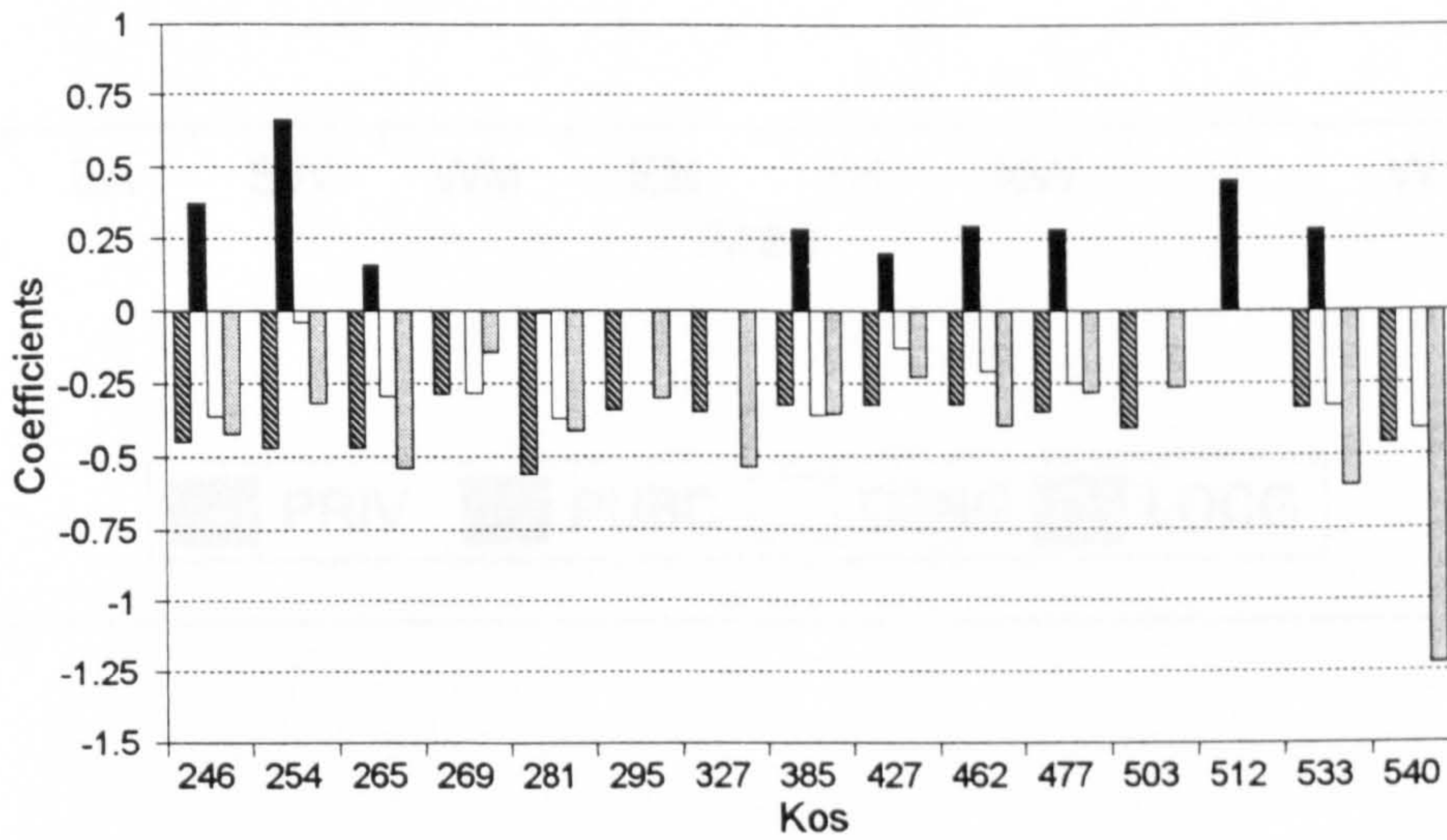


# Occupation Coefficients

(105-238) Females 1979



(246-540) Females 1979



PRIV PUBC CENG LOCG

Figure 5.6



# Area Coefficients

Males All Sectors 1979

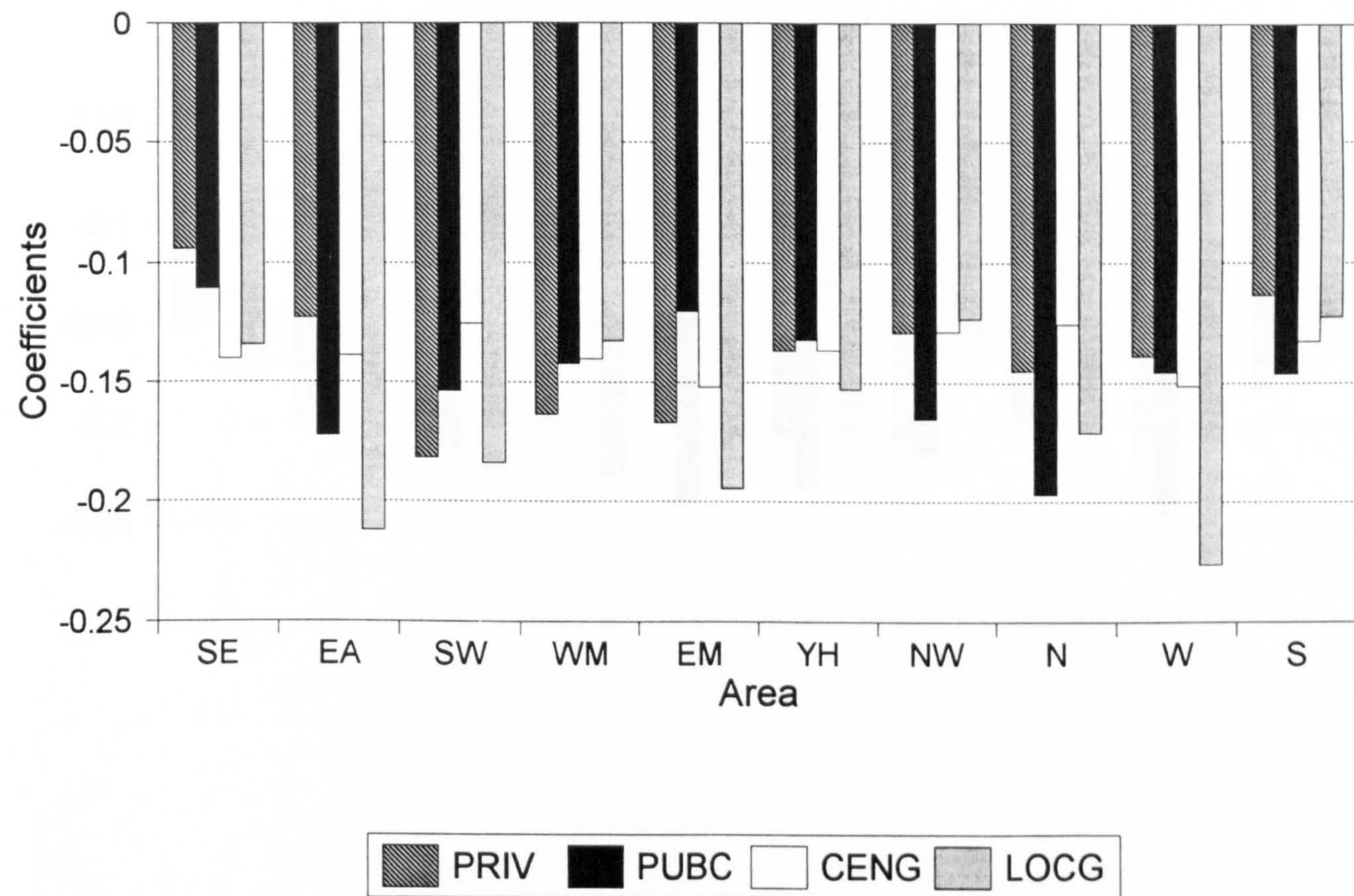


Figure 5.7



# Area Coefficients

Females All Sectors 1979

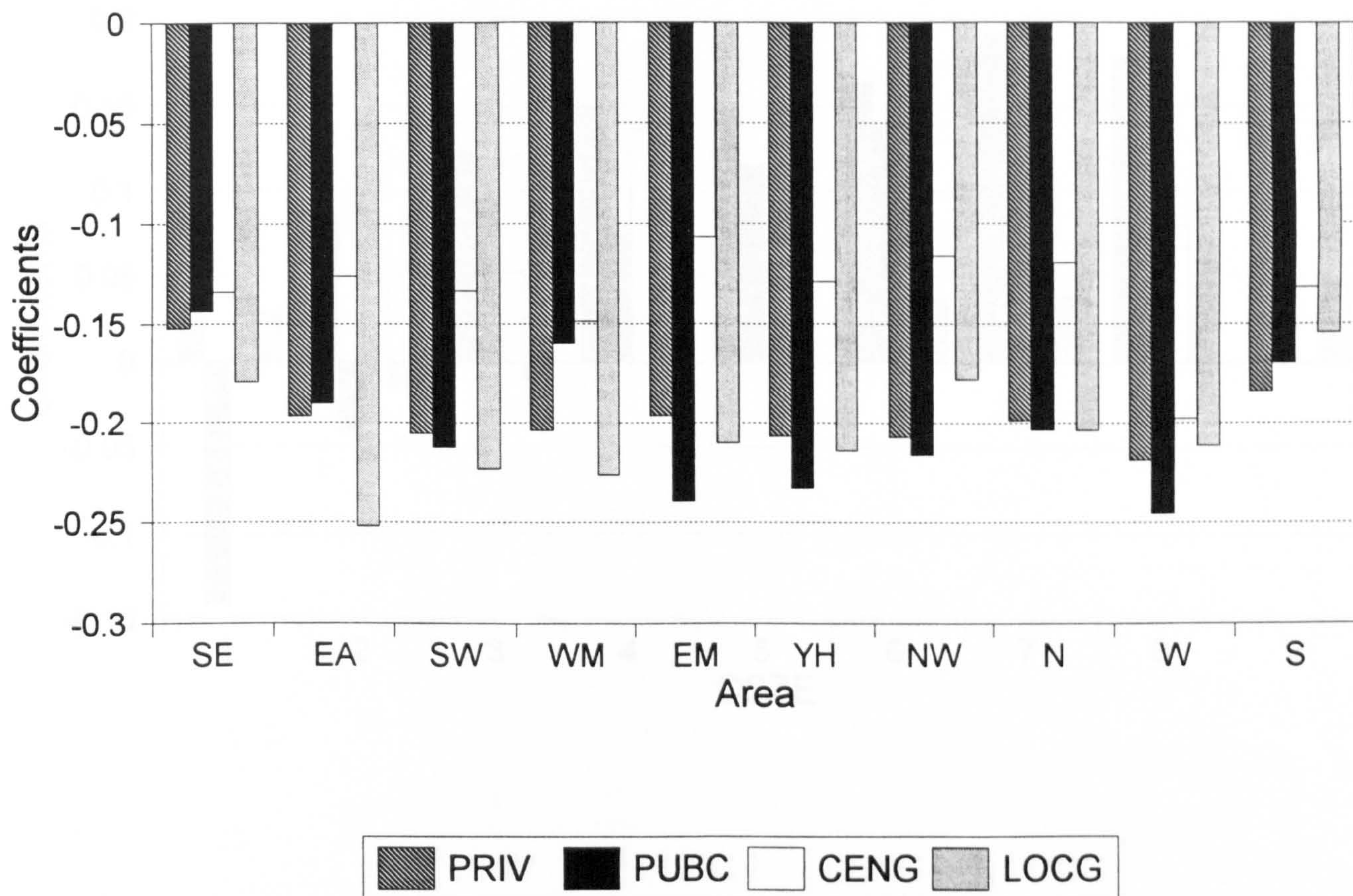


Figure 5.8



# CSZE Coefficients

Males All Sectors 1979

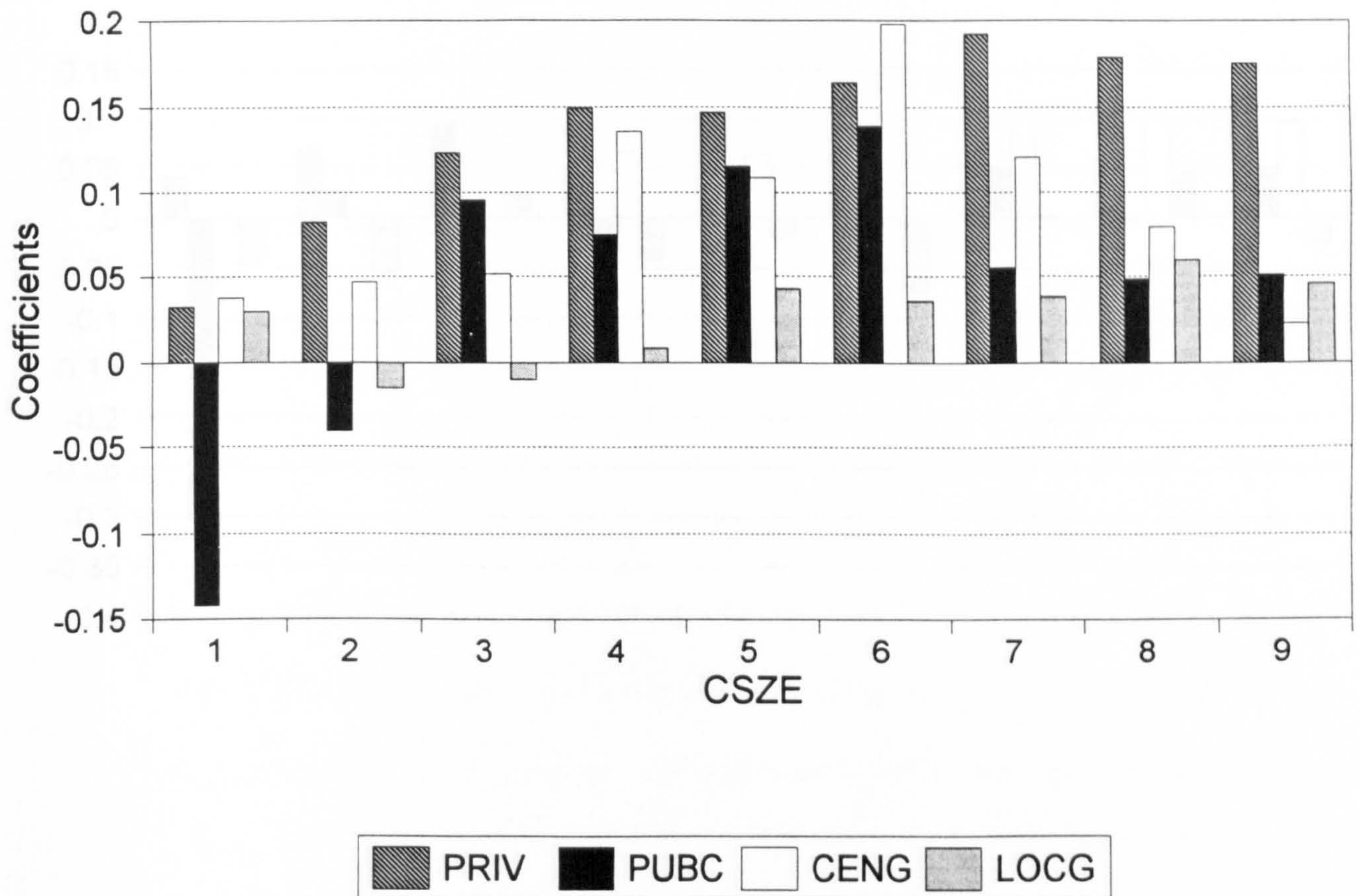


Figure 5.9



# CSZE Coefficients

Females All Sectors 1979

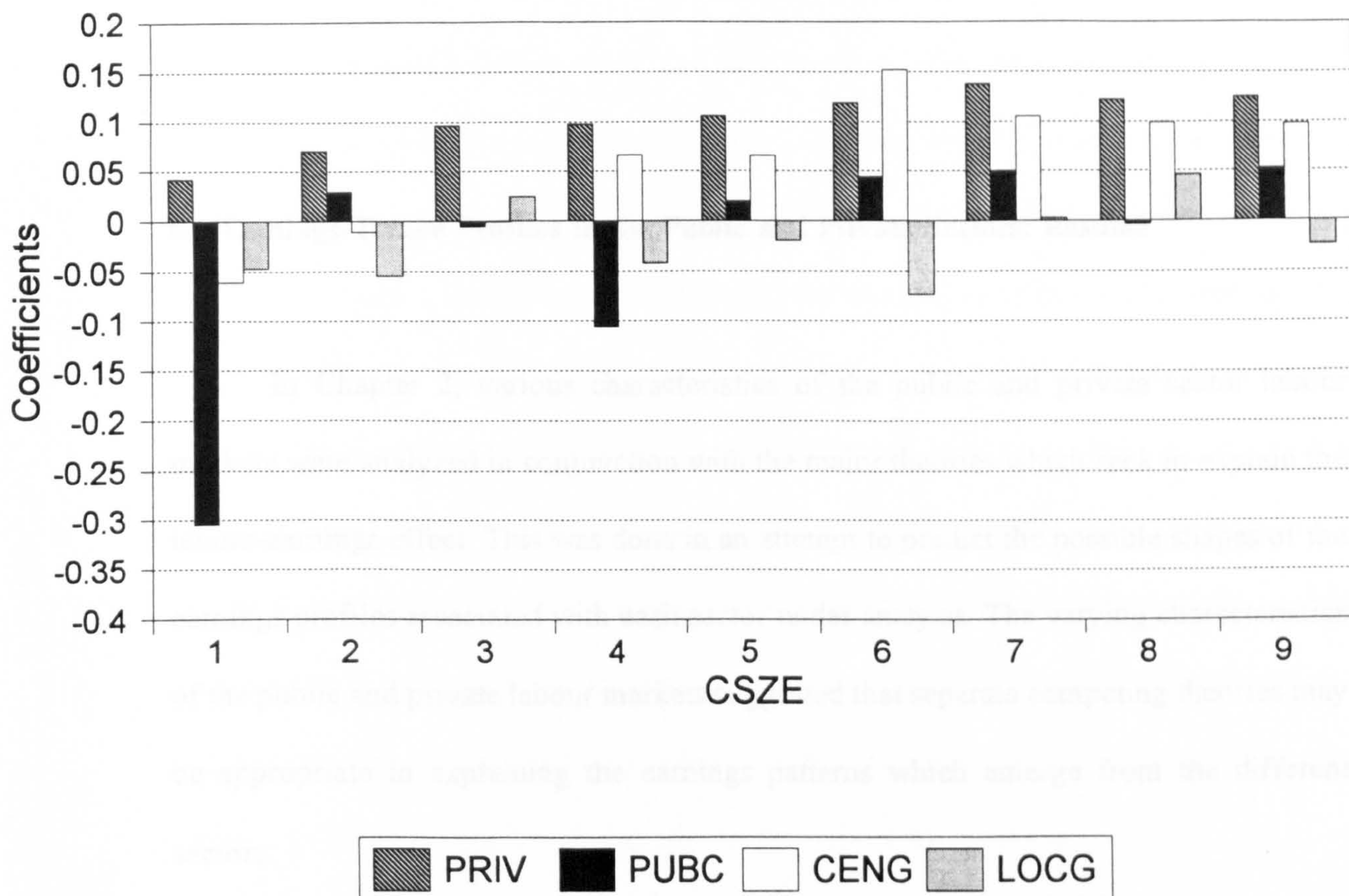


Figure 5.10

## **CHAPTER 6**

### **CROSS SECTIONAL RESULTS:**

#### **Theoretical Appraisal**

##### **6.1 Earnings-Tenure Profiles in the Public and Private Sectors: Resumé**

In Chapter 2, various characteristics of the public and private sector labour markets were analyzed in conjunction with the major theories which seek to explain the tenure-earnings effect. This was done in an attempt to predict the possible shapes of the earnings profiles associated with each sector under analysis. The varying characteristics of the public and private labour markets suggested that separate competing theories may be appropriate in explaining the earnings patterns which emerge from the different sectors.

It was suggested earlier that transaction costs, that is the costs of transferring information between employer and employee, may be relatively less significant in the private sector. Such a situation would lead to a relatively lower marginal cost of investing in human capital in the private sector. The human capital hypothesis suggests that the earnings profile will be upward sloping in the early years of tenure, reach a peak and then decline as human capital depreciates in later years. Such a shape reflects the fact that investments in human capital in the form of training will be concentrated in the early years of tenure. There are two reasons why this is the case. Firstly, as



tenure increases, the payback period over which the rewards from training investment can be recouped declines. Secondly, the cost of training investments in the form of forgone earnings will increase as tenure increases.

In the latter years of tenure, as the marginal product of the employee declines, earnings will tend to decline accordingly, in other words, rents associated with earlier training investment begin to erode. As time goes on, and the actual accumulation of human capital in the form of training becomes more distant, it can be expected that each additional year of tenure will have an increasingly less significant effect on earnings. In such a situation there may well be a dissipation of the total human capital accumulated over the worklife. This process of accumulation of human capital is reflected in the shape of the earnings profile, which will be upward sloping in the period where human capital accumulation is positive, will reach a plateau as accumulation achieves its peak, and then decline as the marginal product of the worker declines in later years. In terms of empirics, such a pattern of human capital accumulation is reflected in the earnings function by using tenure and tenure squared variables, that is by imposing a quadratic form on the estimating equation.

For public sector earnings, it was suggested that an agency explanation may be more appropriate. In this scenario, earnings are deferred until a later period, in order that employees behave in a manner deemed acceptable by the employer. In the early years of tenure when earnings are lower, if workers are found to be performing below standard, they will be fired by the employer, and will forfeit their right to future higher earnings. A principal-agent relationship of this type could well be initiated at a variety of hierarchical levels within the firm. This deferred compensation mechanism acts as a deterrent against worker malfeasance. The result of this will be a profile which tends

to be more linear in shape and which lacks the declining curve of the human capital situation. In the discussion which follows, the empirical results of Chapter 5 will be analyzed in the context of the theoretical approach adopted previously.

## **6.2 Tenure Coefficients**

The most notable findings to emerge from the analysis of the tenure coefficients (figures 5.1 and 5.2), concern the separation of the associated profiles into two distinct groups. On the one hand, there are the steeper central and local government profiles, and on the other, the flatter and less linearly shaped private sector and public corporations profiles. This distinct pattern, common to both males and females, may suggest two competing explanations as to why earnings increase with tenure in each of the sectors. The linear central and local government profiles may well be explained by a greater degree of deferred compensation i.e. an agency explanation, whereas, the flatter profiles of the private sector and public corporations might be better explained by an accumulation of human capital.

The human capital approach suggests an approximately quadratic relationship between tenure and earnings, implying a decrease in the rate of increase in earnings as tenure rises. The agency hypothesis suggests alternatively, that earnings are deferred from the early years of tenure to the later years. By what is effectively the payment of an implicit bond, problems such as shirking and excessive turnover can be reduced. The deferred compensation received in the latter stage of tenure will usually consist firstly



of significantly higher earnings compared to starting wage, and secondly, an occupational pension normally received upon the initiation of a mandatory retirement period. The existence of a significant occupational pension, more often observed in central and local government than in the private sector or public corporations, would further suggest an agency explanation for these two sectors. This type of deferred compensation structure will result in the earnings profile being of a more linear shape, reflecting the fact that individuals are systematically receiving payment deferred from an earlier period. According to the agency argument, such constantly increasing earnings explains the need for the utilisation of mandatory retirement, further explaining the necessity for an occupational pension<sup>1</sup>.

The difference both in the shapes of the profiles and their associated interpretations, is most probably related to the types of occupations and skills characteristic to each sector. An agency explanation is likely to be more appropriate where the monitoring of employee output is either more costly, or more difficult to achieve effectively. This situation will tend to arise where worker output cannot be measured in terms of number of units produced. Employee performance evaluation will be more effectively achieved in manufacturing industries which are heavily concentrated in private sector and public corporations, than in administrative and service type occupations, which make up a large part of the central and local government sectors.

Referring to figures 6.1 and 6.2, we can see the distribution of employees across occupations for different sectors<sup>2</sup>. These figures show the number of employees in each occupation, as a percentage of total sector. The data displayed suggest a higher number of central and local government employees in non-manufacturing occupations.

Looking at certain occupations in detail, we can observe that for clerical



occupations(222), 17.08% of central government males are employed in this category, compared to only 6.04% of males in the private sector and 6.99% in the public corporations. For some non-manufacturing occupations, there appears to be only one sector, usually either central or local government, which is the major employer. This is the case with Teaching(124,125,134), where local government is the major employer, and Welfare and Medicine(136,147), where central government is the main employer. At the other end of the spectrum, for example in Processing, Making and Repairing (427,462), 27.01% of male employees in the public corporations, and 22.37% in the private sector, work in this category, compared to only 10.41% in central government, and 4.22% in local government. The profusion of non manufacturing occupations in central and local government, an agency explanation regarding tenure and earnings is more likely to be appropriate here, than in the other two sectors.

The actual profiles obtained by the estimation, and the evidence regarding the distribution of occupations within each sector, suggest two competing explanations are at work concerning earnings in the public and private sectors. These competing explanations in turn suggest that there may be dissimilar quantities of human capital investment present in the two pairs of sectors, with private sector and public corporations having a relatively greater quantity.

These findings tie in with the theoretical argument presented in Chapter 2, which also suggested that investment in human capital, especially that of a firm specific variety, will be relatively higher in the private sector, possibly due to a more favourable transaction cost environment. This argument rests on the notion that where transaction costs(i.e. the costs of exchanging information between employer and employee) are lower, the parties involved will more easily reach agreement over the costs and returns

involved in human capital investment. Transaction costs can be lowered for example, by having a highly decentralised bargaining structure. Evidence from Chapter Two suggests that bargaining is of a relatively more decentralised nature in the private sector. It is also probable that the public corporations profile behaves in a similar manner to that of the private sector, due to these two sectors sharing many similar occupations, especially with regard to manufacturing, engineering and technology, and thus involving many of the same types of training investments.

The more linearly shaped central and local government profiles suggest the possibility of a relatively higher degree of deferred compensation in these sectors, and this argument is similarly backed up by evidence in Chapter Two. As suggested there, pension payments in these two sectors are likely to be of a greater value than in other sectors. A high degree of deferred compensation in the form of substantial pension payments is generally indicative of a high degree of deferred compensation throughout tenure. According to the Megaw Report on Civil Service Pay(1982), the value of civil service pay arrangements relative to private sector arrangements, added 2% to real income in the civil service, a significant central government employer. Also, the transaction cost environment in the central and local government sectors(and the public sector generally) may be less favourable. This would primarily be due to the more bureaucratic nature of these sectors, necessitating the emergence of a principal-agent arrangement demonstrated be a greater emphasis on deferred compensation.

An alternative explanation may possibly involve both the rate at which human capital investment is undertaken during tenure, and the way in which this training is utilised. It may be the case that in the private sector and public corporations training investments are highly concentrated at the beginning of tenure. An example may be



initial apprenticeships or training programmes which can then be utilised throughout the remainder of the job with only minor and occasional updating. In the central and local government sectors however, training may be of a more continuous character, with a requirement for individuals to adapt training for different responsibilities or departments as they proceed along career or promotion paths. In this type of situation we may well observe a much more linear profile.

Of additional interest is a comparison of the profiles for the male and female samples. It would appear that the female profiles in all sectors are steeper than those for the males, with returns to tenure for females being particularly high in the latter years of tenure. This pattern is most pronounced for the central and local government profiles. It is generally thought that due to female employees having on average shorter employment durations, they will have accumulated a lower total level of human capital. Following orthodox theory, this would suggest a less steep earnings profile relative to males. The above result is therefore rather surprising.

At different age ranges (but especially the latter age ranges) female employees will tend on average to have a lower length of tenure at each age than their male counterparts, and this will have some bearing on the slope of the earnings profile. This effect can be analyzed for the 46 year old age group by referring to figures 6.3 and 6.4 (note different y-axis scales in each figure). These figures show the way in which individuals in the age 46 category are distributed according to tenure category (where tenure refers to time spent with the current firm). In figure 6.3, it can be seen that for 46 year old males, it is the ">24 years" category which contains the most significant number of individuals, whereas for females, it is the "12 years" category. Females are also distributed more evenly across tenure categories.



Table 6.1 shows as a percentage of each sector, those individuals who have tenure of 16 years and over. From this table we observe that for a given age(46 years), the number of females with over 16 years of tenure is lower than for males in all sectors.

**Table 6.1**

% >16 Years Tenure(Age 46)		
	MALES	FEMALES
PRIV	50.77	30.86
PUBC	74.07	45.46
CENG	53.65	33.03
LOCG	38.69	27.84

These shorter average lengths of tenure possessed by females reduce the opportunity for investment in human capital. It would be reasonable therefore to expect a lower total accumulation of human capital, and that the female profiles would have a relatively flatter slope.

Returning once again to the growth rates presented in Chapter 5, it can be observed that the average annualized growth rate of earnings ( $G^*$ ) is higher for females in all sectors than for males, implying that growth of earnings is more pronounced for the female sample. This again is a rather unexpected result. It can also be noted that the highest growth rates are those for central and local government, and that the greatest divergence in male and female rates occur in these sectors. This result is in keeping with the shapes of the profiles observed above.

In discussing the relationship between male and female earnings, it may be informative to recall historical trends in the UK labour market. For reasons outlined earlier, estimation makes use of data taken from 1979. This particular year is associated

with a period of rapid expansion in the participation rate of females in the labour market. As the number of women active in the labour market increased, upward pressure on earnings of an institutional nature was also observed. Those women who have accumulated at least 16 years of tenure by 1979 would have experienced this type of upward pressure on their earnings. These institutional forces resulted in legislation such as the Equal Pay Act of 1970 and the Sex Discrimination Act of 1975. It would therefore not be entirely surprising to see rapid growth rates in the earnings of women who have accumulated significant tenure by 1979.

From an arithmetic point of view therefore, the observation that female profiles are steeper and growth rates higher is probably related to the fact that starting salaries will have been generally lower than those for males, although some attempt to catch up may have been made. Female growth rates having been calculated from a lower absolute starting point, will be of a higher value.

The fact that females tend to have lower absolute starting wages, may also be related to the fact that they are concentrated into a different range of occupations than their male counterparts. Many of these occupations, especially in the public sector, will however be characterised by rigid earnings structures, and reasonable tenure length, despite any temporary absences. The ten biggest employers in each sector in terms of occupation, are presented in tables 6.2-6.9, these tables show the percentage in each sector employed in the ten largest occupation categories, and the total percentage of each sector that this top ten constitutes.

**Table 6.2**

<b>Top Ten Occupations by Employment-PRIV Males</b>		
1.	Processing,Making,Repairing and Related	22.37%
2.	Road Transport,Materials Moving	10.86%
3.	Managerial(Excluding General Management)	7.30%
4.	Making and Repairing(Excl Metal and Electrical)	6.83%
5.	Painting,Repetitive Assembling,Product Inspect- ion,Packaging and Related.	6.30%
6.	Clerical	6.04%
7.	Selling	5.62%
8.	Materials Processing(Excl Metals)	5.47%
9.	Construction,Mining and Related	3.98%
10.	Other Professional and Related in Science, Engineering,Technology	3.40%
<b>Total</b>		<b>78.17%</b>

**Table 6.3**

<b>Top Ten Occupations by Employment-PUBC Males</b>		
1.	Processing,Making,Repairing and Related	27.01%
2.	Road Transport,Materials Moving	14.82%
3.	Construction,Mining and Related	9.93%
4.	Machine/Telephone Operators	8.31%
5.	Clerical	6.99%
6.	Other Professional and Related in Science, Engineering,Technology	5.59%
7.	Engineers	4.26%
8.	Railway Transport	4.10%
9.	Miscellaneous	3.42%
10.	Cleaning,Hairdressing,Personal Services	2.66%
<b>Total</b>		<b>87.09%</b>



**Table 6.4**

<b>Top Ten Occupations by Employment-CENG Males</b>		
1.	Clerical	17.08%
2.	Processing,Making,Repairing and Related	10.41%
3.	Other Professional and Related in Education, Welfare and Health	7.55
4.	Ambulancemen,Hospital/Hotel Porters	6.17%
5.	Other Professional and Related Supporting Management	5.46%
6.	Road Transport,Materials Moving	5.33%
7.	Other Professional and Related in Science, Engineering,Technology	5.27%
8.	Medical/Dental Practitioners	4.72%
9.	Accountants,Economists,Systems Analysts,P.R. Officers	4.70%
10.	Managerial (Excl General Management)	3.98%
<b>Total</b>		<b>70.67%</b>

**Table 6.5**

<b>Top Ten Occupations by Employment-LOCG Males</b>		
1.	Security and Protective Services	12.43%
2.	Teachers(Secondary)	11.91%
3.	Teachers(Primary),Social/Welfare Workers	8.92%
4.	Teachers(Further/Higher Education),University Academics	8.61%
5.	Cleaning,Hairdressing,Personal Services	7.07%
6.	Construction,Mining and Related	6.67%
7.	Road Transport,Materials Moving	6.04%
8.	Other Professional and Related in Science, Engineering,Technology	5.54%
9.	Farming,Fishing and Related	4.62%
10.	Processing,Making,Repairing and Related	4.22%
<b>Total</b>		<b>76.03%</b>

**Table 6.6**

<b>Top Ten Occupations by Employment-PRIV Females</b>		
1.	Clerical	24.64%
2.	Selling	14.46%
3.	Painting, Repetitive Assembling, Product Inspection, Packaging and Related	11.91%
4.	Secretarial/Receptionist	11.33%
5.	Making and repairing (Excl Metal and electrical)	7.99%
6.	Catering/Housekeeping	6.15%
7.	Cleaning, Hairdressing, Personal Services	5.20%
8.	Machine/Telephone Operators	3.51%
9.	Materials Processing (Excl Metals)	3.38%
10.	Processing, Making, Repairing and Related	2.93%
<b>Total</b>		<b>91.50%</b>

**Table 6.7**

<b>Top Ten Occupations by Employment-PUBC Females</b>		
1.	Clerical	41.81%
2.	Machine/telephone Operators	17.54%
3.	Secretarial/Receptionists	9.39%
4.	Catering/Housekeeping	8.88%
5.	Cleaning, Hairdressing, Personal Services	8.44%
6.	Road Transport, Materials Moving	2.70%
7.	Selling	2.63%
8.	Other Professional and Related supporting Management	1.75%
9.	Processing, Making, Repairing and Related	1.54%
10.	Other Professional and Related in Science, Engineering, Technology	1.43%
<b>Total</b>		<b>96.11%</b>

**Table 6.8**

<b>Top Ten Occupations by Employment-CENG Females</b>		
1.	Other Professional and Related in Education, Welfare and Health	41.26%
2.	Clerical	23.41%
3.	Catering/Housekeeping	11.24%
4.	Secretarial/Receptionist	8.42%
5.	Cleaning,Hairdressing,Personal Services	4.62%
6.	Machine/Telephone Operators	2.40%
7.	Ambulancemen,Hospital/Hotel Porters	1.61%
8.	Other Professional and Related in Science, Engineering,Technology	1.05%
9.	Medical/Dental Practitioners	0.98%
10.	Other Professional and Related supporting Management	0.67%
<b>Total</b>		<b>95.66%</b>

**Table 6.9**

<b>Top Ten Occupations by Employment-LOCG Females</b>		
1.	Catering/Housekeeping	30.46%
2.	Teachers(Primary),Social/Welfare Workers	19.27%
3.	Cleaning,Hairdressing,Personal Services	12.97%
4.	Clerical	11.40%
5.	Teachers(Secondary)	9.24%
6.	Secretarial/Receptionist	4.14%
7.	Teachers(Further/Higher Education),University Lecturers	3.38%
8.	Ambulancemen,Hospital/Hotel Porters	2.03%
9.	Security and Protective Services	1.35%
10.	Other Professional and Related in Science, Engineering,Technology	1.08%
<b>Total</b>		<b>95.32%</b>



One striking difference between males and females concerns the private sector and public corporations. In these two sectors, males appear to be much more heavily concentrated into manufacturing occupations, and females into non manufacturing occupations. In central and local government, there is a tendency for females to be concentrated into professional type jobs. It is also important to note that females in each sector generally, are concentrated into a narrower band of occupations than males. For females, the ten largest occupations account for over 90% of employees in all sectors, for males, this figure ranges from 70.67% in central government, to 80.09% in public corporations. This line of argument can be extended by analyzing the distribution across occupation of females with significant lengths of tenure, and the bearing this may have on earnings profiles.

Overall, there will be fewer women who have held the same job for a significant length of tenure than men. Also, significant lengths of tenure for females will be more easily achieved in some occupations rather than others. An indication of the distribution of tenured males and females across occupations for a given tenure of 20 years can be drawn from figures 6.5 and 6.6. These figures show in percentage terms how individuals with 20 years of tenure are distributed across occupations. The data displayed in figures 6.5 and 6.6, show that females with 20 years tenure are concentrated into a much narrower band of occupations than their male counterparts. It is also worthwhile noting, that this narrower band again comprises mainly non-manual service type occupations which, as pointed out earlier, are occupations which will have higher monitoring costs, and may lead to the formation of a more linear earnings profile. Tables 6.10 and 6.11 give precise figures for the percentage of individuals in the 20 year category in various occupations by sector.

The occupations which appear in tables 6.10 and 6.11 are those which contain the largest numbers of female employees, a comparison can therefore be made as to the differences in the relative concentrations of males and females into jobs which the data suggests are highly female intensive. The most startling

Table 6.10

<b>% in 20 years Tenure Category(MALES)</b>							
<b>KOS</b>	<b>125</b>	<b>134</b>	<b>147</b>	<b>222</b>	<b>227</b>	<b>238</b>	<b>265</b>
PRIV	0	0.51	0.2	5.21	0.08	0.51	0.51
PUBC	0	0.5	0.08	7.26	0.08	9.76	0.08
CENG	0	2.12	3.7	12.7	0	2.65	2.65
LOCG	11.13	4.97	0.68	2.05	0.17	0	0.17

Table 6.11

<b>% in 20 years Tenure Category(FEMALES)</b>							
<b>KOS</b>	<b>125</b>	<b>134</b>	<b>147</b>	<b>222</b>	<b>227</b>	<b>238</b>	<b>265</b>
PRIV	0	0.6	0.5	21.58	11.79	1.9	4.5
PUBC	0	0	0	39.45	13.76	23.85	0
CENG	0	0	31.58	22.93	12.41	3.38	11.28
LOCG	9.6	21.07	0.27	9.07	3.2	0	34.67

differences relate to Clerical(222), and secretarial(227), occupations, especially in the private sector, public corporations, and central government, where there is a wide divergence in the numbers of 20 year tenured males and females working in these occupations. There are also significant differences in occupations such as Primary Teaching and Welfare(134), at local government level, and, Professional and related in Education Welfare and Health(147), at central government level. This latter grouping

includes such occupations as nursing administrators, pharmacists, and medical technicians.

The results from both figures 6.5 and 6.6, and tables 6.10 and 6.11, suggest that significantly tenured women in each sector will be concentrated into a much narrower range of jobs than men. Many of these jobs, for example Teaching, Welfare and Medicine, will be of a professional, skilled variety, and there will therefore be a higher proportion of the female sample who are tenured professionals than of the male sample in each sector. Significantly tenured males tend to appear in a much broader distribution of occupations. The steeper profile for women may therefore be due to the greater concentration of females with significant tenure into certain key occupations, occupations which will tend to be of a more professional and therefore high paying nature, will tend also to be located in the public sector, and have more rigid earnings structures.

Another possible explanation for the observed high tenure returns for females might relate specifically to breaks in the job spell. Women who take time out of the labour market may well return eventually to the same or similar job, a situation probably more common to the public sector. Their earnings upon returning may then be on a par with their last wage, however they will be recorded in the data as having low tenure. Alternatively earnings upon returning to work may catch up very quickly with pre absence earnings. There may therefore be some females in the sample who appear to have high earnings associated with low tenure. This is a phenomenon observed also by Topel(1991), who suggests that individuals who change jobs will gain from the move and will be recorded as having both low tenure and high wage.



### **6.3 Age Coefficients.**

The most notable factor concerning the age coefficient profiles (figures 5.3 and 5.4), is the fact that they are of the traditional shape suggested by human capital theory i.e the profiles are positively sloped, reach a peak and then decline slightly. This in turn suggests that observed returns to age can be explained by an accumulation of human capital. Bearing in mind that a dummy version of the age variable was used.

In this analysis, age, in combination with occupation is used as a proxy for general human capital. The age profiles suggest that investments in general or transferable skills are concentrated in the early years of experience. The more linear tenure profiles already examined, suggest that specific human capital investment (for which tenure is a proxy), may be more evenly spread throughout time on the job. This concentration of general training at the early years of experience will lead to sharply increasing returns to age as age increases, with an eventual flattening out of the return and a decrease in the later years of tenure.

In examining the profiles for males, it can be seen that there is least variation in the central government profile, and most variation in the private sector profile, suggesting a higher degree of general training in the private sector. Such an observation may reflect differences in employees educational attainment upon entering the labour market. The proportion of individuals entering the central government sector with some form of post schooling qualification, e.g. a college or university degree, is higher than the proportion entering the private sector (Parry and Schmidt 1987). In some instances, this may require less human capital investment on the part of the public sector

employer. The greater variation in the slope of the private sector age profile in the early years of tenure, may reflect the greater amount of training investment undertaken by employees with no post school qualifications. This initial training period may be the approximate equivalent of time spent in post school educational investment experienced by individuals who may then enter the central government sector. The result of this may well be a higher degree of general transferable training undertaken in the private sector and may explain why this profile has the steeper slope.

A second factor of note concerns a comparison of male and female age profiles. The female sample seem to produce flatter profiles than their male counterparts, suggesting less variation in returns to age for females. This may be due to the fact that females will tend on average to have less total experience in the labour market than males, and are more likely to have broken spells in their employment durations. Females who temporarily leave the labour market and resume work several years later, will to a certain extent have forfeited the earnings increases associated with these missing years. Female employees may find that after having taken time off work, they are effectively taking up from where they left off. The effect of this experience break, which causes a significant number of females to have missed out on several years of earnings increments, will be to flatten out the age-earnings profile for this group.

One final point concerning the age coefficient profiles for both males and females, is that although there are significant differences in the profiles at earlier ages, the profiles are surprisingly similar after age 41. This may again be due to the broken spells of employment experienced by females, which will tend to be concentrated at earlier ages. Males on the other hand will on average have more continuous employment durations at earlier ages, and hence opportunity for a greater volume of

training experience. At older ages however, both the male and female sample will tend to have equally continuous employment, implying the same kind of experience effects at these ages, and hence similar profile shapes.

Some indication as to the differences in rates of continuous employment duration can be obtained by examining figures 6.7 and 6.8. These figures give age profiles i.e. how employees can be divided up according to age grouping, for a particular occupation. The occupation chosen is Professional and Related supporting Management(122), a category which includes such jobs as marketing/advertising executives, purchasing managers, and general administrators. In the male sample, figure 6.7, for age categories 22 to 46, there is little variation in the percentages of individuals present in each of these categories. For the female sample however, there is a decline in the number of employees in this occupation in the mid range ages, with the two outside categories of age 20 and age 41 having the higher numbers of employees. Such a pattern suggests that females are experiencing breaks in their employment spells at these mid range ages, but returning to work at later ages, possibly explaining the age coefficients which emerge.

#### **6.4 Kos Coefficients.**

In this particular estimation, occupation has been used to proxy education, due to the belief that occupation is very strongly correlated with previous education undertaken. The education variable, not present in the NES dataset, is normally used to



construct a measure of general human capital. Bearing this in mind therefore, little can be said about the effect of occupation on earnings per se, although some interesting areas can be addressed.

The most notable point concerning the male and female Kos coefficients (figures 5.5 and 5.6) involves public corporation occupations. It would appear that females may earn premiums for working in occupations in the public corporations compared to working in the same occupations in other sectors. This may be explained by the fact that such occupations tend to be highly male dominated, with very few females working in the public corporations as a whole. As a result, we may be observing females being paid according to male earnings structures. There may be insufficient numbers of females present in this sector, to have enabled the emergence of predominantly female pay structures. As time goes on, it may be the case that a growing number of females are now entering what were once considered to be "male" occupations, but with no consequential restructuring of earnings. Returning to figures 6.1 and 6.2 however, it appears that females in this sector are still concentrated into occupations such as Clerical and Secretarial (222,227), machine/telephone operators(238), catering(265), and cleaning(281).

In sectors with higher numbers of female employees there are likely to be many more occupations which are considered traditionally "female", and thus will have associated historical earnings structures. Even in occupations which contain large numbers of both males and females, there is still likely to be a divergence in pay structures, emanating from original differences in post and pre legislation earnings patterns, based for example on the higher probability of females having broken spells of employment. An additional explanation for the public corporation premiums, may be

related to the fact that there are likely to be fewer part time or unskilled jobs in the public corporations than in other sectors, with these jobs having been predominantly performed by females in other sectors.

Another factor worth noting in this context concerns the nature of collective bargaining. In the public corporations as in most of the public sector, bargaining tends to be of a highly centralised, nationally based nature. In this type of situation, agreements may well cover a much wider variety of occupations than in the private sector, and it will therefore be more difficult to differentiate in bargaining terms between alternative occupations within the firm or within the sector as a whole. As a result, there may be an overlap in the pay structures for males and females in public corporation occupations.

Another point of note with respect to Kos coefficients, is the fact that for males, central government occupations tend to give a greater return than similar occupations in other sectors. This may be due to central government having more highly structured earnings and promotion ladders. In combination with the findings that there is less variation with returns to age than in other sectors, and greater variation in returns to tenure, such evidence may suggest that there is possibly an efficiency wage type explanation for central government earnings. The male returns to age at higher age ranges are also greater for central government than for other sectors, which may imply a higher degree of payment is deferred to a later age in this sector. This evidence may be indicative of the implicit bonding procedure associated with efficiency wages.

## **6.5 Area Coefficients.**

The first thing to note about male area coefficients (figures 5.7 and 5.8), is the fact that there is least variability in return to area in central government. The fact that returns to area tend not to differ between areas in this sector, is indicative of a highly centralised bargaining structure, which to a great extent will fail to take account of local economic conditions. It should be remembered that individuals will receive a return to working in a specific area for a specific occupation, and that the total return will therefore consist of an area and occupation return, with the elasticity of demand for labour among different occupations in different areas having a bearing on the overall result.

As far as area coefficients in the female sample are concerned, it can be observed that returns to area are greater for central government employees in all areas. This suggests uniformity of approach to pay in all areas for central government in relation to other sectors. This may in turn reflect the fact that females may be concentrated into certain types of occupations in central government, for example, medical and administrative occupations. There is also however, more variability in female central government returns than in male returns for the same sector, which may suggest more decentralised bargaining for females within this particular sector than for males, which again may be related to the types of occupations into which female employees are concentrated.



## **6.6 Firm Size Coefficients.**

The coefficient results for firm size (figures 5.9 and 5.10) suggest that there are greater returns to firm size in the private sector than in the public sector. There appears therefore to be a more pronounced relationship between firm size and earnings in the private sector. Returning to the argument outlined in Chapter Two concerning Oi's firm size discussion, the greater firm size effect for the private sector may suggest a higher degree of firm specific human capital investment in this sector, as larger firms tend to have more specialised and capital intensive production processes.

As stated in Chapter Two, it is generally thought that firms in the public sector are of a larger average size than those of the private sector. If the Oi argument is followed, we would expect that there would be a greater degree of firm specific human capital in this sector. The firm size effect however is greater in the private sector, suggesting a higher degree of firm specific investment in this sector, as a result possibly, of a more favourable transaction cost environment. It could also be suggested, that individuals in the public sector are not being paid compensating differentials to work in large firms. This may be due to the greater number of large sized firms in this sector, with public sector workers having little alternative but to work in large firms.

This evidence may also suggest that there is little competition for employees both between sectors, and within the public sector itself. Public sector employers appear not to offer differentials to attract workers, suggesting in turn that skills are possibly highly sector specific, and are not easily transferable. This situation may be especially so in the public sector with less competition within this sector as a whole for employees, than in the private sector, which is likely to possess a higher degree of skill

mix.

This firm size effect may also be related to tenure. Examining figure 6.9, which gives mean tenure by occupation for males, it can be seen that employees in public corporations and central government tend to have longer mean tenure than their counterparts in other sectors. This tendency for longer tenure may well be indicative of non transferability of skills, or alternatively of a self selection effect on behalf of workers themselves. Such a situation will therefore reduce the likelihood of the public sector paying employees compensating differentials to work in large firms.

Another point to note is that the returns to size for females are lower in all sectors than for males. This may again be linked to the Oi argument, in suggesting that female employees are less likely to possess the same degree of skill specificity as their male counterparts, possibly due again to the greater likelihood of females having breaks in their employment durations.

The purpose of this chapter has been to analyze the previous chapter's empirical results in a theoretical context. These results have been obtained using a very simple OLS procedure. Despite this however, the analysis has brought to light some very interesting and original points relating to differences in the earnings-tenure relationship across the public and private sectors. In the following chapter, empirical analysis will again be undertaken. The estimation procedures will this time be rather more sophisticated, in an attempt to overcome the econometric biases purported to exist in cross sectional estimation of the earnings effect.

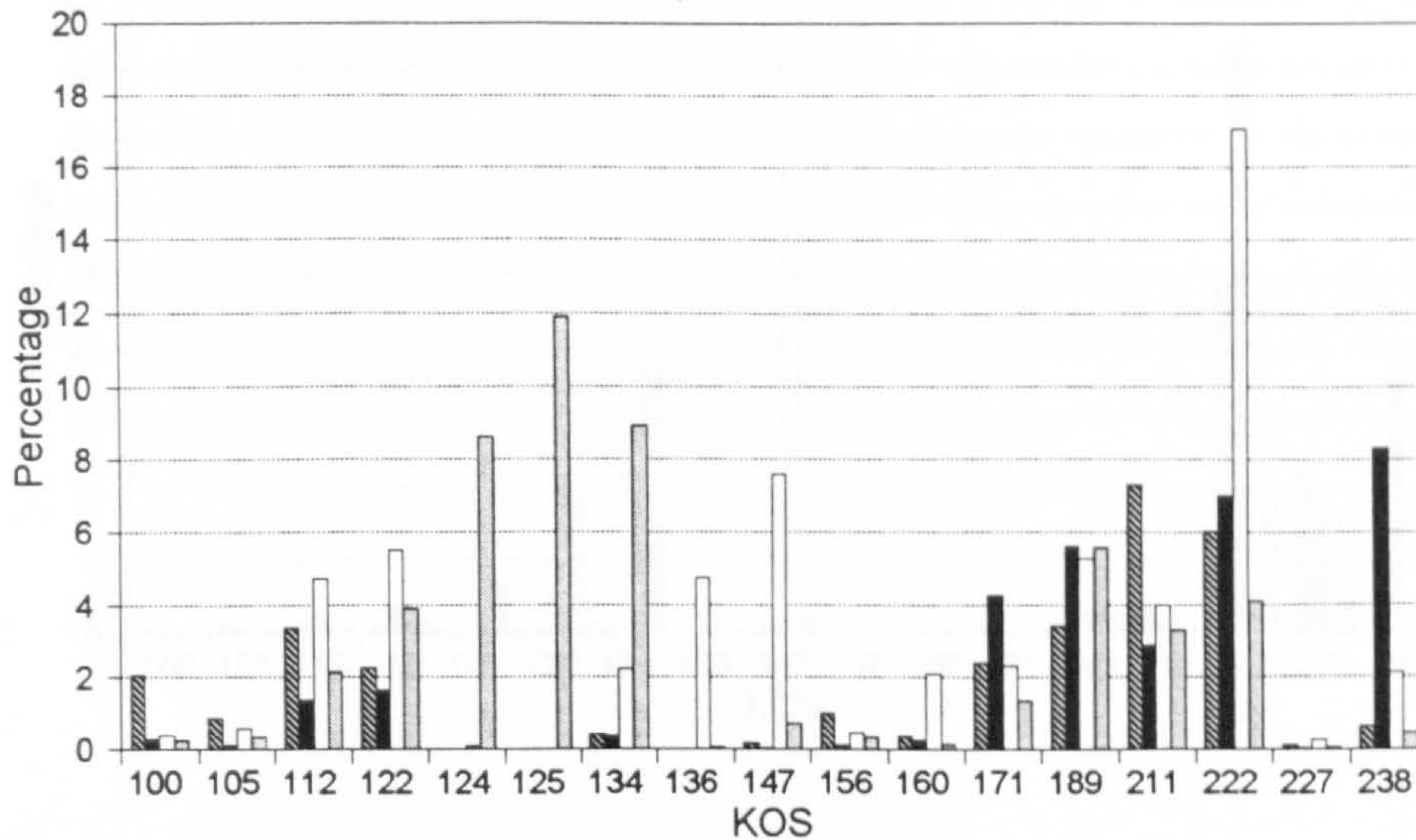
**CHAPTER 6 ENDNOTES**

1. Lazear pursues this argument in much greater detail, outlining the requirement for mandatory retirement in an environment where human capital accumulation takes place.
2. Refer to Appendix 3, for a list of Kos codes and the associated occupation categories.



# % in each Occupation

(100-238) Males 1979



(246-540) Males 1979

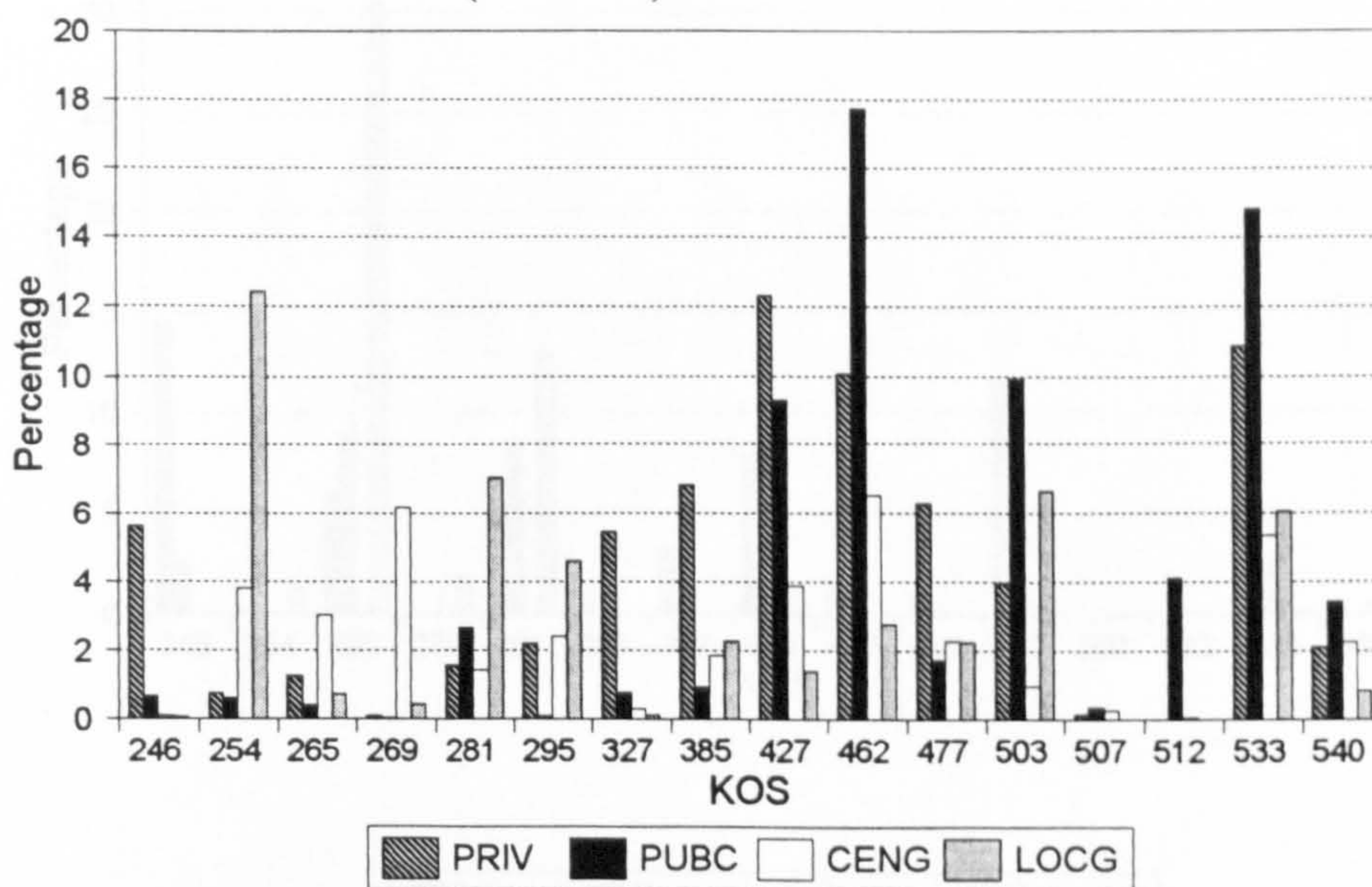
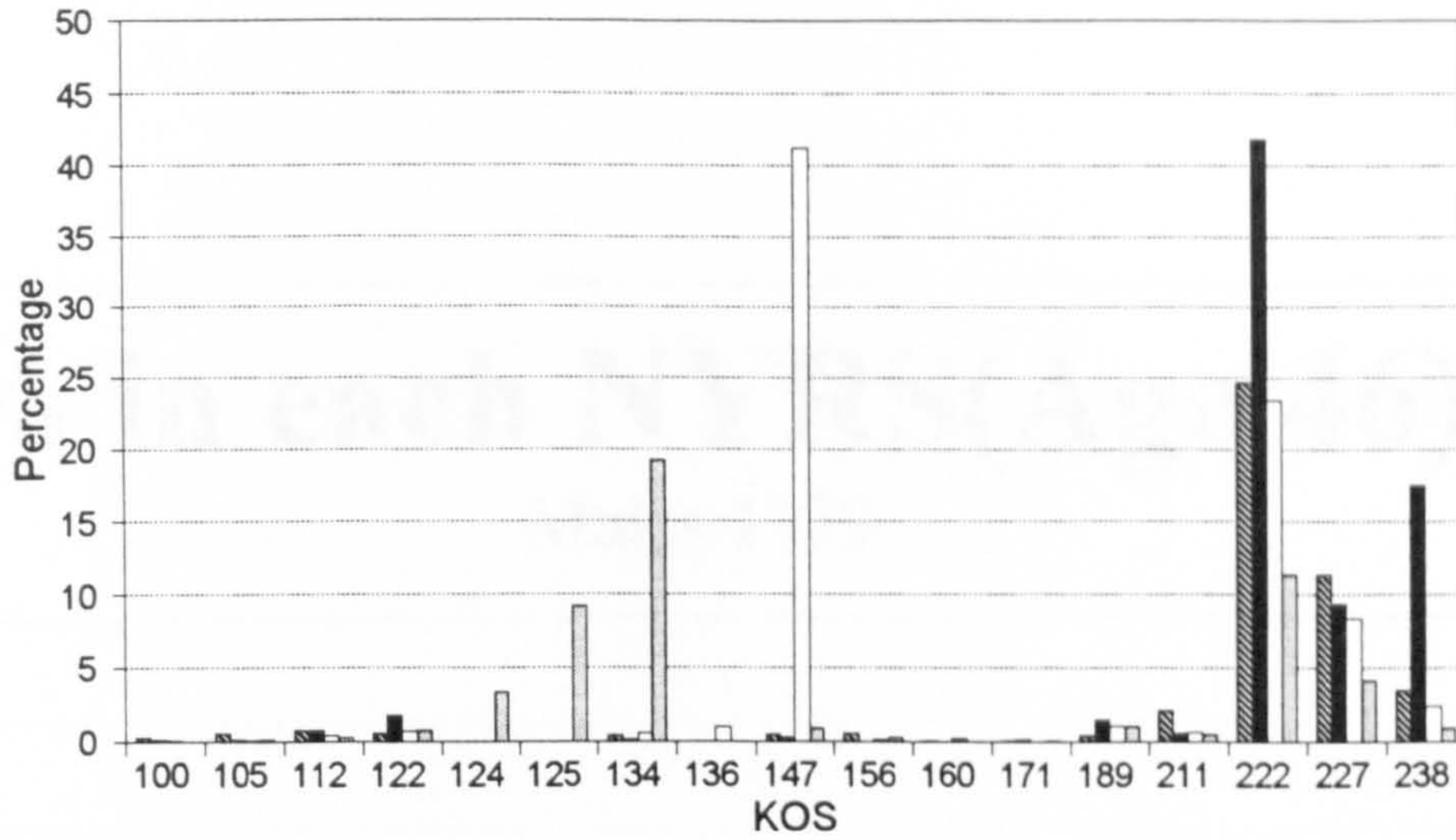


Figure 6.1



# % in each Occupation

(100-238) Females 1979



(246-540) Females 1979

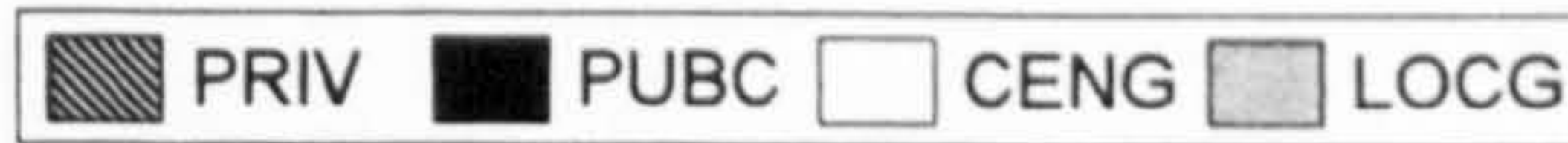
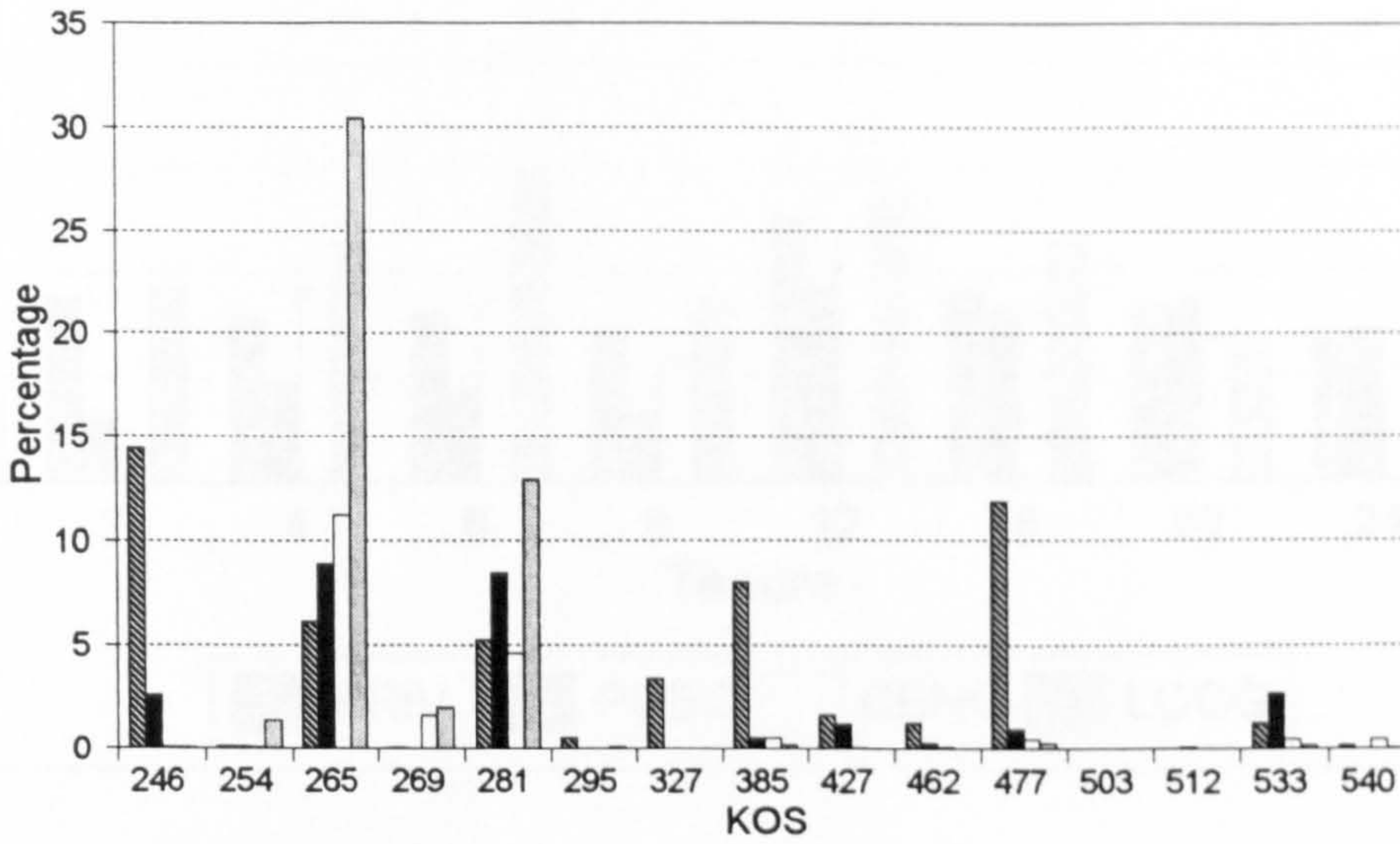


Figure 6.2



# % in each NYRS(Age 46)

Males 1979

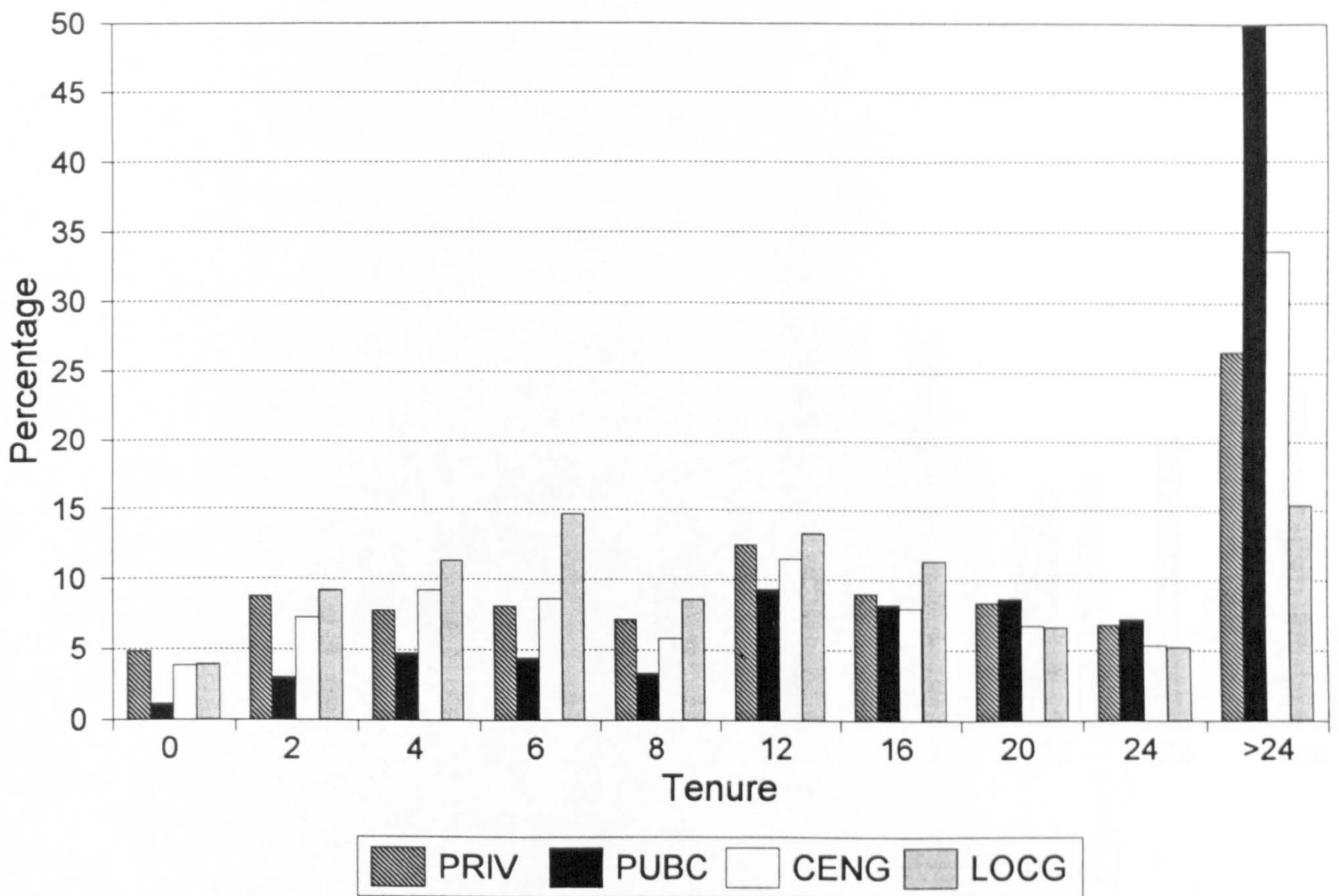


Figure 6.3



# % in each NYRS(Age 46)

Females 1979

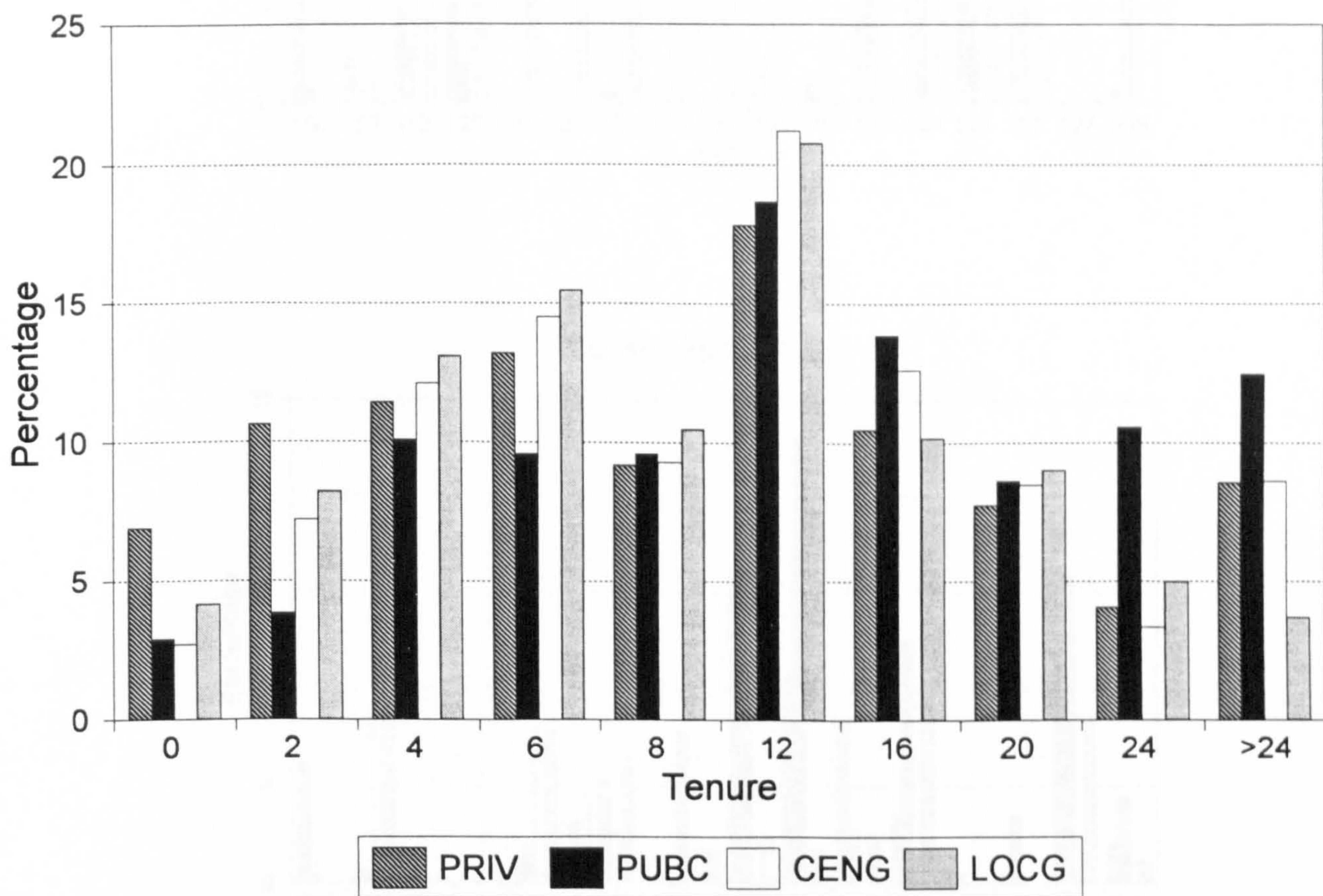
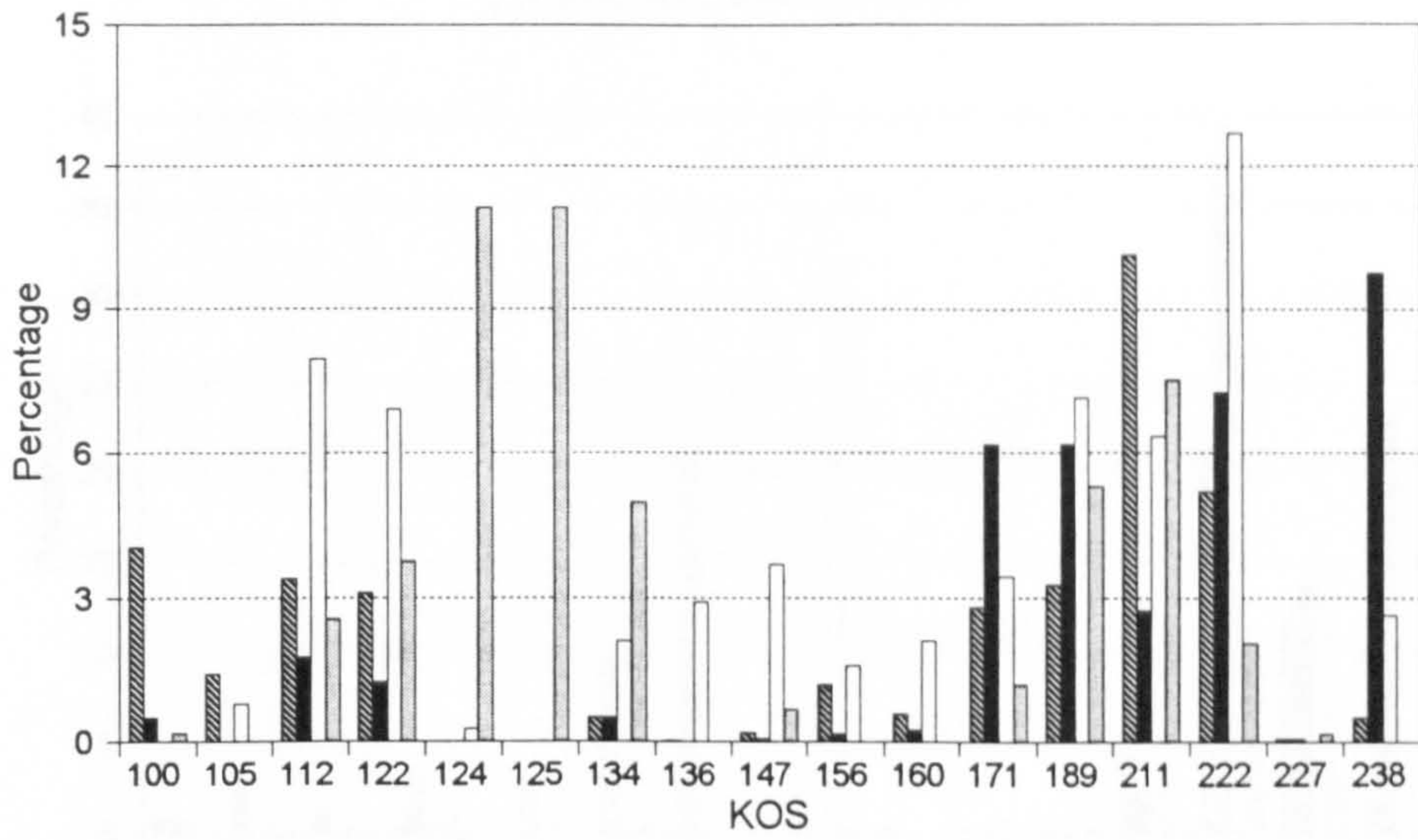


Figure 6.4

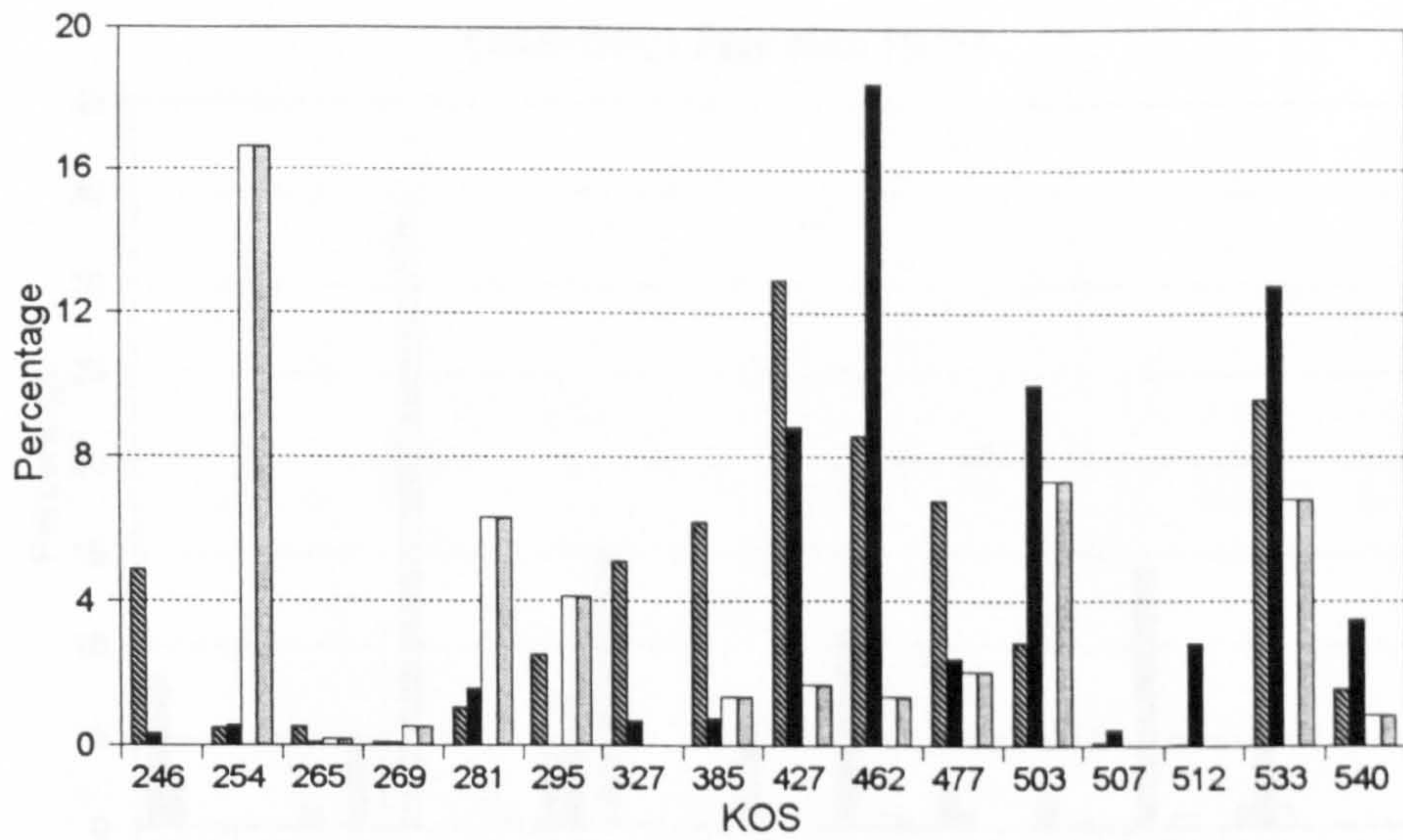


# % in each Occupation (20 Years Tenure)

(100-238) Males 1979



(246-540) Males 1979



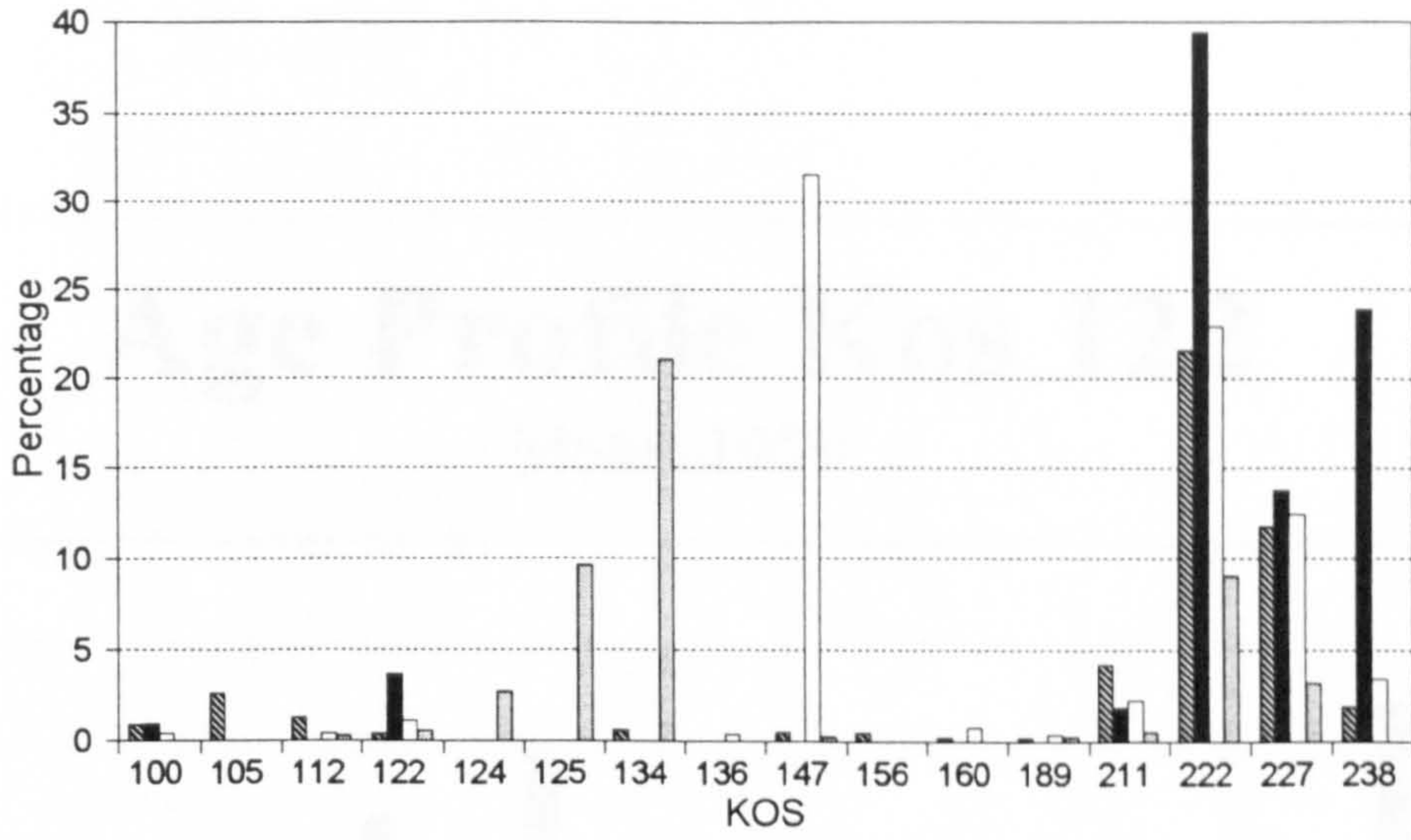
PRIV PUBC CENG LOCG

Figure 6.5



### % in each Occupation (20 Years Tenure)

(100-238) Females 1979



(246-540) Females 1979

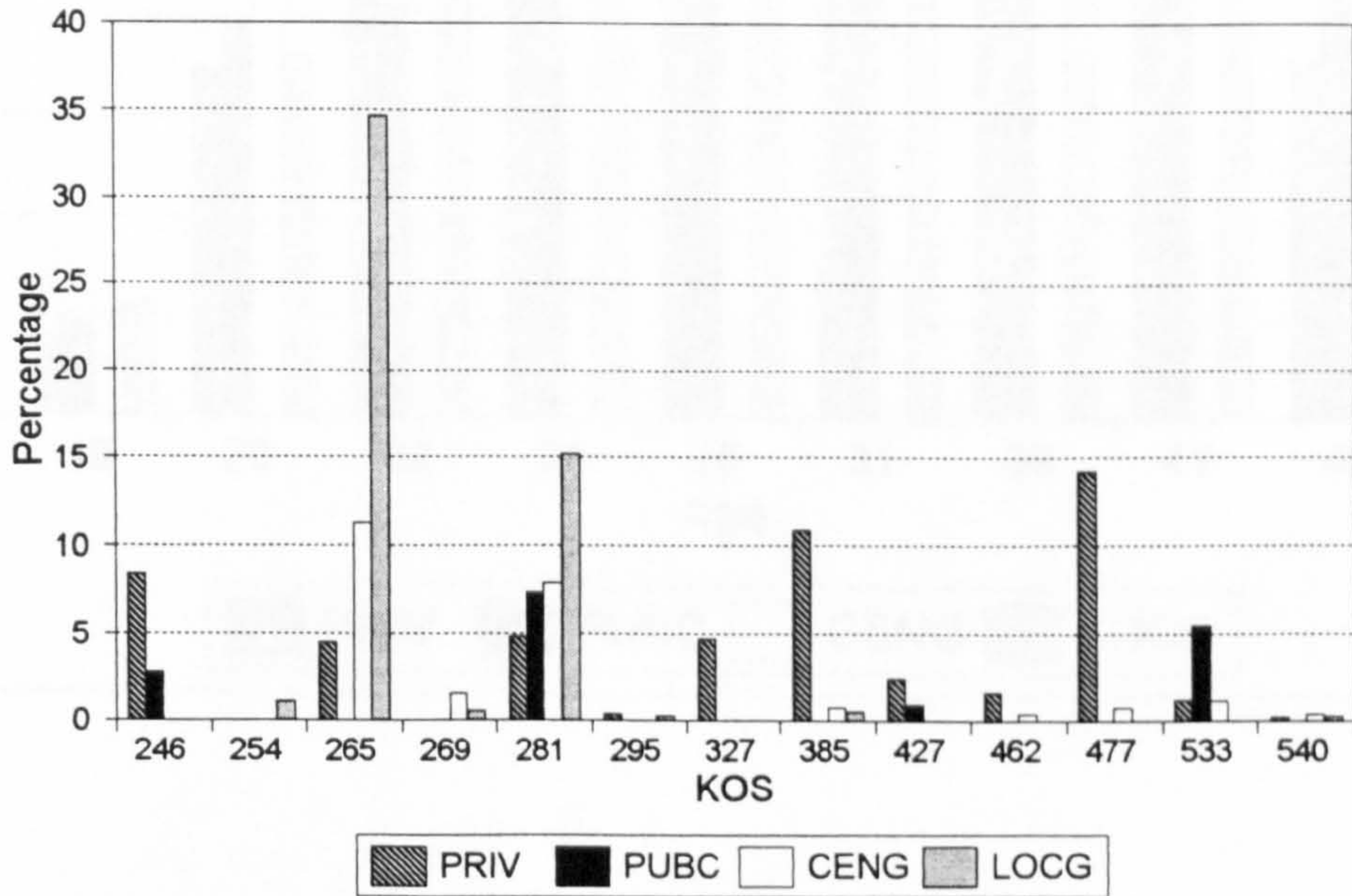


Figure 6.6



# Age Profile Kos 122

Males 1979

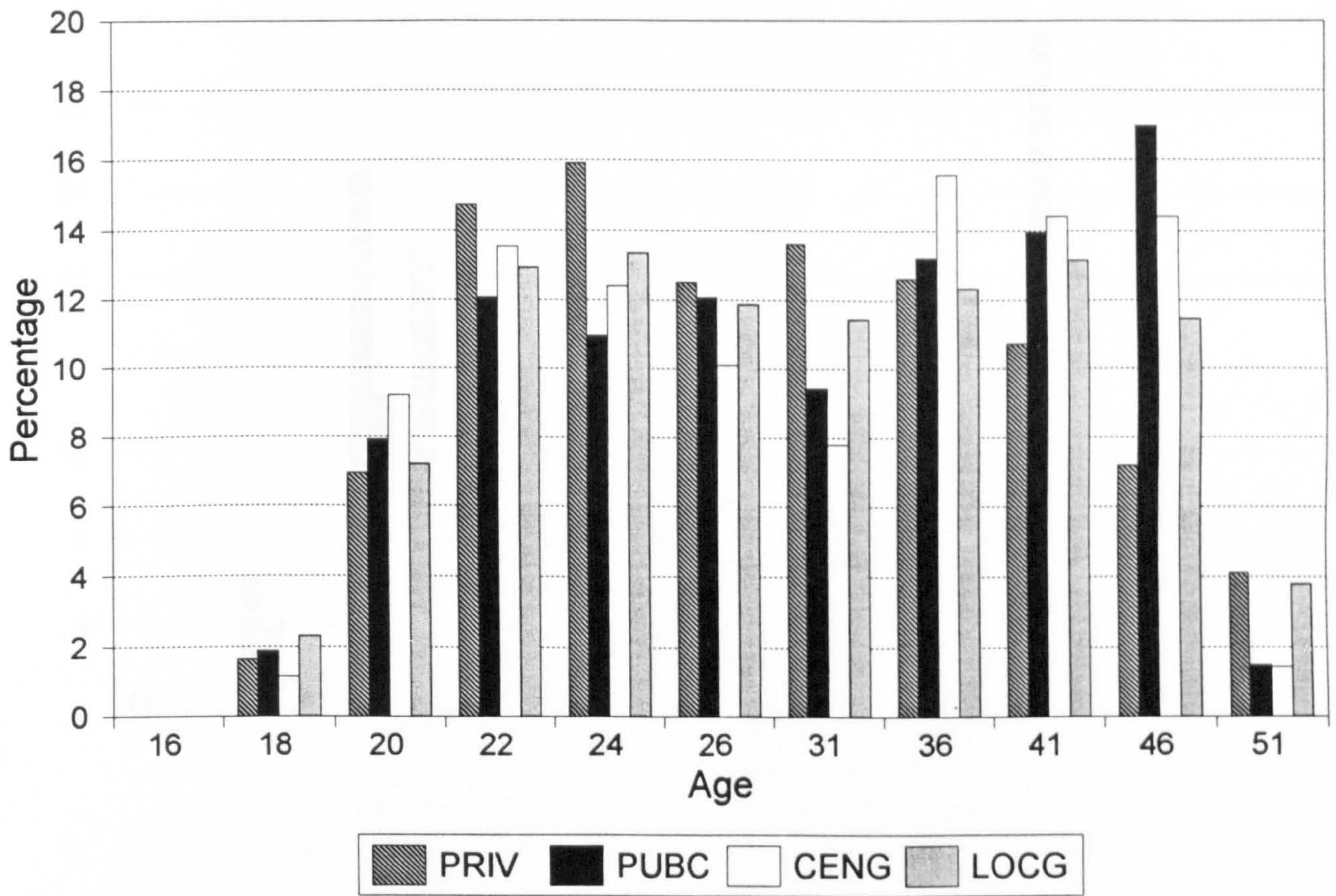


Figure 6.7



# Age Profile Kos 122

Females 1979

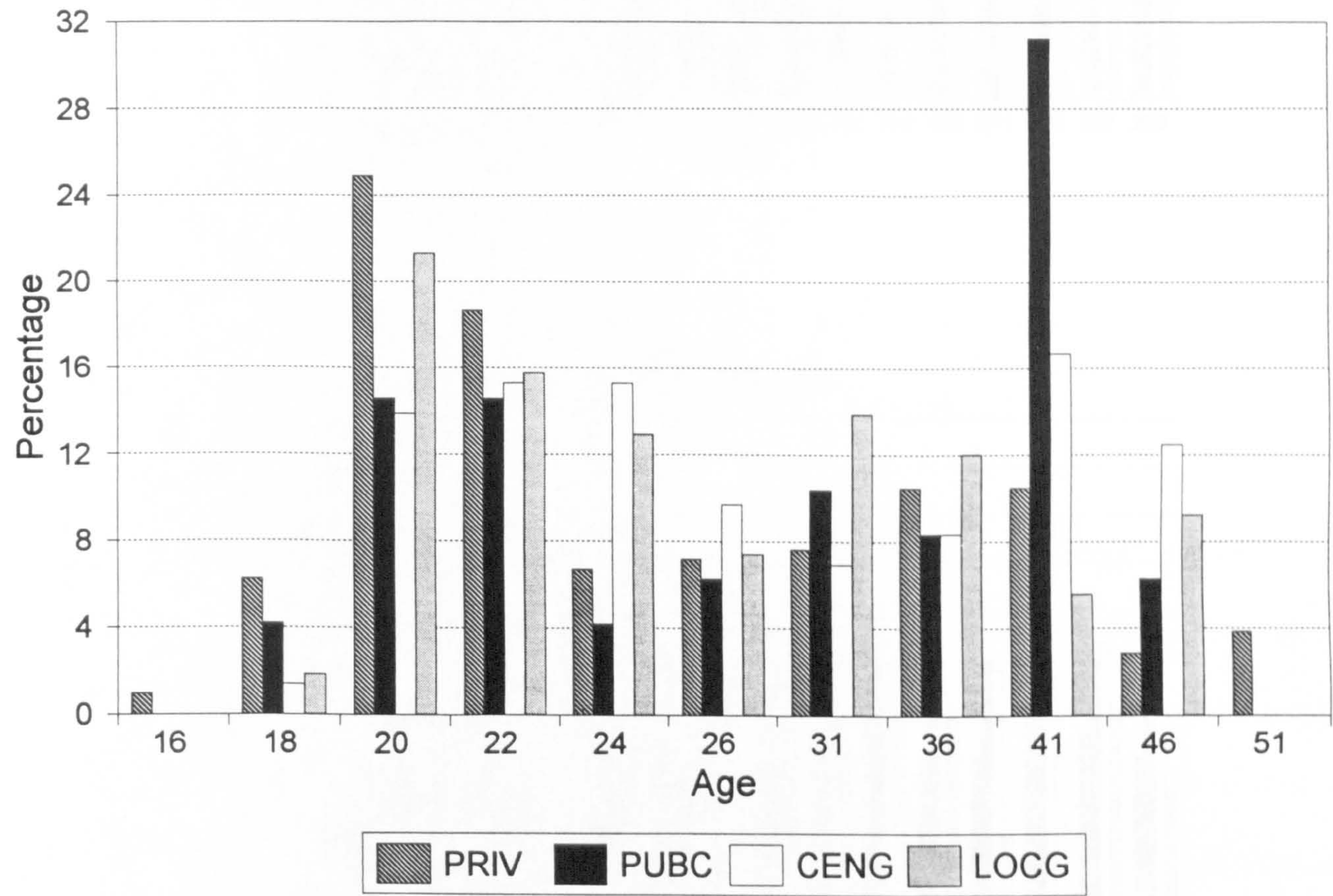
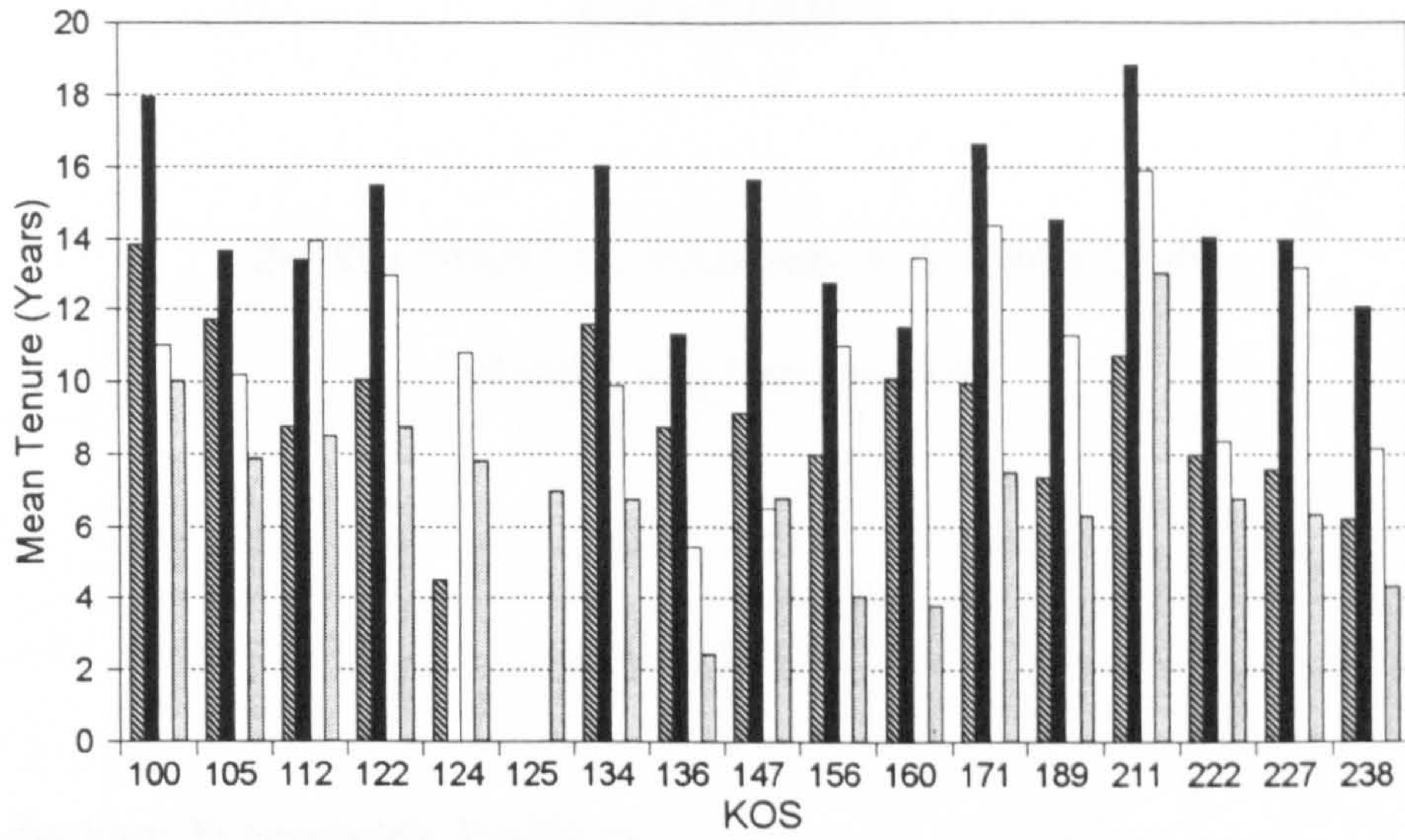


Figure 6.8

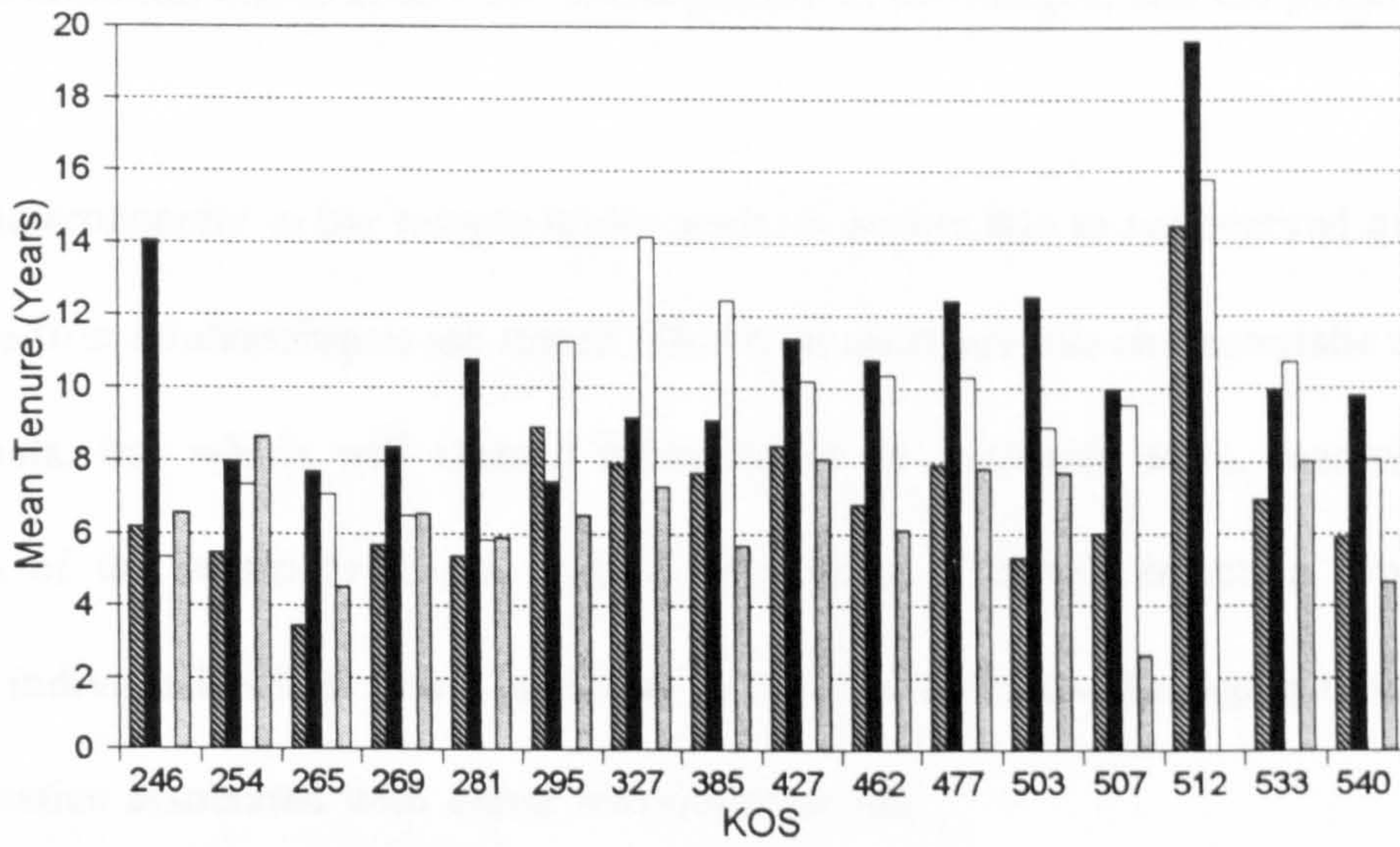


# Mean Tenure by Occupation

(100-238) Males 1979



(246-540) Males 1979



PRIV PUBC CENG LOCG

Figure 6.9



**CHAPTER 7****INSTRUMENTAL VARIABLE ESTIMATION:****Results and Interpretation****7.1 Introduction: Econometric Problems**

As outlined earlier in Chapter 3, certain econometric problems must be addressed in order to obtain an accurate estimate of the effect of tenure on earnings. The two most relevant estimation biases arise from heterogeneity in the sample, and the possibility of self selection.

Heterogeneity in the sample under analysis occurs due to unobserved quality of the employee-firm relationship or job match. This is an unobservable characteristic not captured by the data, but which will instead be captured by the error term, leading to biased estimates of the return to tenure in OLS estimation. The self selection process is one whereby individuals select into a particular occupation or sector due again to unobservable characteristics associated with either individual or job.

The heterogeneity problem can be demonstrated as follows.

Following Topel(1991), a prototype earnings function can be written as:

$$y_{ij} = X_{ij}\beta_1 + T_{ij}\beta_2 + \epsilon_{ij} \quad (7.1)$$

where  $y_{ij}$  is log earnings,  $X_{ij}$  is total labour market experience,  $T_{ij}$  is tenure, and  $\epsilon_{ij}$  is the

error term. Where heterogeneity is present, the error term itself can be decomposed into:

$$\epsilon_{ij} = \phi_{ij} + \mu_i + v_{ij} \quad (7.2),$$

where  $\phi_{ij}$  is a stochastic component of wages specific to a worker-firm pair i.e. the job match component,  $\mu_i$  is a person specific effect measuring unobservable differences among individuals with regard to earning capacity, and  $v_{ij}$  is a completely random component. In this situation, there exists covariance between tenure and the unobservables in the error term. OLS estimation would therefore produce a biased estimate of the return to tenure in the estimating equation. Many analysts have suggested overcoming this problem by use of an instrumental variable (IV) related to tenure, but which is uncorrelated with the unobservable characteristics<sup>1</sup>.

The particular instrument used in the analysis which follows is individual tenure minus mean tenure for that individual's occupation across all sectors. This will be expected to be highly correlated with tenure, but uncorrelated with unobserved job match quality. The instrument is based on that used by Altonji and Shakotko in their 1987 article, and is orthogonal by construction to fixed individual effects and fixed job match effects in the error term. In order to perform the estimation a traditional Mincer type earnings equation is used, i.e. one in which log wage is regressed on tenure and tenure squared<sup>2</sup>.

The OLS estimating equation is given by:

$$\ln W_i = \beta_1 NYRS79_i + \beta_2 (NYRS79_i)^2 + \alpha'_N X'_N + \epsilon_i \quad (7.3)$$

where  $X'_N$  is a vector of all other explanatory variables. For instrumental variable estimation the following equation is used:

$$\ln W_i = \beta_1 \tilde{NYRS79}_i + \beta_2 (\tilde{NYRS79}_i)^2 + \alpha'_N X'_N + \epsilon_i \quad (7.4)$$

where:

$$\tilde{NYRS79}_i = NYRS79_i - \overline{NYRS79K_j}$$

and,

$$(\tilde{NYRS79}_i)^2 = (NYRS79_i)^2 - (\overline{NYRS79K_j})^2$$

$\overline{NYRS79K_j}$  is the mean tenure for occupation  $K_j$  across all sectors.

The approach adopted in this case is of the usual Mincer type, involving the use of tenure and tenure squared variables, rather than the dummy variable technique adopted previously. The reason for this is the difficulty experienced in attempting to instrument for a series of dummy variables. The results do however form a useful and interesting comparison with those obtained earlier.

The second econometric problem which must be addressed in attempting an unbiased estimate of the tenure effect, is that of self selection. This problem is especially relevant when analysing sectoral choice with regard to public and private sector employment. Individuals may possess unobservable characteristics which affect their productivity in various sectors, and which therefore influences their initial choice of sector. There are numerous characteristics possessed by different sectors or by individuals themselves which may influence sectoral choice. One approach to solving this problem is to identify a decision variable which operates as a proxy for this sectoral choice.

It could be argued that flexibility in terms of hours worked per week is an important



influence an individual's choice to work in a particular sector. Hours of work may therefore be seen as a decision variable affecting the self selection process, and acting as a proxy for sectoral choice. This problem is very similar to the heterogeneous job match problem discussed earlier, in that there are certain characteristics of both individual and job which make a particular job a good one for that individual.

This problem of self selection or endogeneity has been addressed by Vella and Verbeek(1993a,b) in their analysis of endogenous choice of union jobs . This approach can be generalised to include a number of endogenous choice scenarios. Assume the earnings function can be given by the following expression:

$$\ln W_{it} = \beta' X_{it} + \delta H_{it} + e_{it} \quad (7.5)$$

where  $H_{it}$  is total weekly hours, which acts as a decision variable influencing sectoral choice. The error term in this case can be decomposed into the following:

$$e_{it} = \rho_i + v_{it} \quad (7.6)$$

where  $\rho_i$  is an individual specific fixed effect which captures the individuals decision to select into a particular sector, and  $v_{it}$  is a completely random effect. Hours worked in this model are a determinant of earnings, however this variable is also related to the individual fixed effect and thus sectoral choice. Covariance exists therefore between the hours variable and the unobserved fixed effect present in the error term.

This self selection bias is similar to that associated with job match heterogeneity. The individual's productivity in the job is again influenced by factors which are not picked up by the data. As with the heterogeneity problem, Vella and Verbeek suggest that this bias

can be removed by use of an instrumental variable, although their preferred approach is to use a control function procedure. They do show however that the control function and IV procedures have identical properties (Vella and Verbeek 1993b). In the analysis which follows, an IV process based on hours worked is employed. This is equivalent to a two stage Heckman type process which has previously been used in this type of analysis<sup>3</sup>.

The instrument required is one which is correlated with hours, but which is uncorrelated with the individual fixed effect. A similar instrument is adopted as for the tenure variable earlier:

$$\tilde{H}_{it} = H_{it} - \bar{H}_j$$

where  $\bar{H}$  is mean hours for individual  $i$ 's occupation across all sectors. Using both the instruments for tenure and hours, the biases involved in estimating the effect of tenure on earnings will be reduced.

## 7.2 Estimation Results

### 7.2.1 Estimation of the Original Equation

The analysis began by estimating an equation identical to that used for the empirical work in Chapter 5, the only difference being the use of tenure and tenure squared variables rather than the tenure dummy used earlier. The controls used in the equation are the following: agreement/wages board coverage; part-time work control; occupation dummies;

area dummies; industry dummies; age dummies; company(i.e. firm size) dummies, and establishment size dummies<sup>4</sup>. In the empirical analysis so far, the coefficients have proved to be very stable. The analysis has been characterised by the use of large samples for each sector and the availability of a large number of explanatory variables. Equations were estimated using firstly the normal non instrumented hours and tenure variables. The results were then compared with those obtained following the inclusion of the instruments.

Tenure profiles based on the estimated coefficients obtained are reproduced in figure 7.1 for males, and figure 7.2 for females. These figures display profiles using the non instrumented tenure and tenure squared estimates(not including hours). As can be seen, these profiles are of a pattern similar to that suggested by human capital theory, upward sloping then eventually flattening. As with the profiles in Chapter 5, we again observe a distinct separation between the private sector and public corporation profiles on the one hand, and those of central and local governments on the other. Also in keeping with the previous results, the returns to tenure for females are higher than those for males. The smooth nature of these profiles can be explained by the use of yearly tenure intervals for plotting purposes. Previously in Chapter 5 the estimation proceeded using a tenure dummy.

Figures 7.3 and 7.4, reproduce the new results using identical intervals to those in Chapter 5, and it would appear that the tenure returns and profile shapes are very similar to those obtained there. Figure 7.5 superimposes the tenure profile obtained here for one of the sectors - central government females - upon that obtained in Chapter 5 for the same sector. CENGT indicates the profile which makes use of tenure and tenure squared variables, whereas CENGD is the profile resulting from the tenure dummy. This suggests



that both approaches, a traditional Mincer specification of the tenure variable and the dummy approach, are capturing a similar return to tenure, although arguably the dummy returns are more accurate as they do not involve the imposition of a specific form on the estimating equation.

### 7.2.2 Use of a Tenure Instrument in the Equation

The estimation proceeded by including the tenure instruments described earlier in the original equation, again making use of all available explanatory variables. As a result, there appeared to be no change whatsoever in the size of the estimated return to tenure, although there was a very small change in the t-statistics. Surprisingly, the tenure coefficients remained exactly the same irrespective of whether instruments were used or not. Tables 7.1 and 7.2 give estimated coefficients for the non instrumented variables.

**Table 7.1**

<b>MALES Estimated Coefficients</b>				
	<b>PRIV</b>	<b>PUBC</b>	<b>CENG</b>	<b>LOGG</b>
<b>NYRS</b>	0.0058 (13.1973)	0.0064 (8.5253)	0.0163 (11.3377)	0.0126 (11.1843)
<b>NYRS<sup>2</sup></b>	-0.0001 (-6.7664)	-0.0001 (-4.8941)	-0.0003 (-6.4925)	-0.0002 (-5.1340)

Table 7.2

<b>FEMALES Estimated Coefficients</b>				
	<b>PRIV</b>	<b>PUBC</b>	<b>CENG</b>	<b>LOCG</b>
<b>NYRS</b>	0.0139 (19.2527)	0.0142 (6.9277)	0.0249 (17.7620)	0.0205 (11.8486)
<b>NYRS<sup>2</sup></b>	-0.0003 (-12.7929)	-0.0003 (-4.4451)	-0.0005 (-9.7628)	-0.0004 (-6.0192)

The coefficients displayed above remained exactly the same despite the inclusion of the tenure instruments.

This is a rather interesting result given the apparent effectiveness with which tenure instruments have previously been used to detect and control for job match effects. Previous analyses have employed a much more limited set of control variables. The dataset used in this particular analysis, the New Earnings Survey panel, is characterised by large samples for each sector and a large number of control variables, many of which are in dummy form. One advantage of the large sample size is the fact that if for some reason the instruments are not controlling for biases, the estimated coefficients are less likely to be influenced by other spurious effects.

It is important to bear in mind that the tenure instrument employed above is only one of a large number of variables used in the estimation, and it is this fact which may have a bearing on its inability to perform as expected. The instrumenting of tenure constitutes a relatively small change to one of the 70 variables which are used in the regression. The instrumenting process is more likely to have an effect as the number of regressors used is reduced. For Altonji and Shakotko who employ a very similar technique, their instrument may have an effect on the return to tenure given that they

use many fewer variables in their equation<sup>5</sup>.

Given the source of the instrument, it would be a useful exercise to compare the results obtained from the specification used above with one which is more in keeping with the equation Altonji and Shakotko actually estimate. Obviously two different datasets are used in these analyses, so direct comparison is not possible.

The Altonji and Shakotko equation, in addition to tenure and tenure squared, includes education, experience, an interaction term involving the two, and higher order forms of experience. They also control for marital status, union membership, health status, city size, and region. One important variable which is not used by Altonji and Shakotko, but which is present in the equation 7.3, is occupation. Of all the variables available, it is occupation which is most likely to have a bearing on the possibility of job match effects being significant. Occupation is a key determinant of earnings, and also a key influence on the quality of an individual's job-match. The omission of occupation from the estimating equation may well cause the tenure instrument to have an effect on the estimated coefficient. As will be seen later, the omission of this variable does indeed have important implications for the observed return to tenure once a tenure instrument is included.

Some of the variables used by Altonji and Shakotko are not included in the NES dataset, but a close approximation to their equation can be given by:

$$\ln W_i = \beta_1 NYRS79_i + \beta_2 (NYRS79_i)^2 + \beta_3 AGT + \beta_4 WBC + \alpha'_G AGE + \alpha'_A AREA + \epsilon_i \quad (7.7)$$

where AGT is agreement coverage, WBC refers to wages board or council coverage, AGE is an age dummy and AREA is an area dummy. The purpose here is to estimate a



more restricted form of equation 7.4. The object is not to replicate any of the previous studies, this is impossible given differences in the datasets and specific techniques applied. Our interest is simply in whether different specifications of the estimating equation will influence the effectiveness of the instruments in altering return to tenure.

Equation 7.7 was estimated using both the normal and instrumented versions of the tenure variable. In this case, the use of the tenure instrument did indeed cause the decrease in the estimated coefficient demonstrated by others. Tenure profiles obtained using the normal tenure variable in this new specification are given in figures 7.6 and 7.7, and those obtained using the tenure instrument are given in figures 7.8 and 7.9. As can be seen from these figures, when the tenure instrument is included, there is indeed a flattening of the profile. This effect is apparent for males in all sectors, and for females in the private sector and public corporations.

The actual estimated coefficients obtained are given in tables 7.3-7.6 for males and 7.7-7.10 for females. These tables include results for the hours variable which was subsequently added to the equation, and which will be discussed later.

Table 7.3

PRIV Males Estimated Coefficients				
	1	2	3	4
NYRS	0.0139 (28.3833)		0.0148 (31.9666)	
NYRS <sup>2</sup>	-0.0002 (-12.5649)		-0.0002 (-13.8589)	
Hours			0.0123 (82.3053)	
NYRS(IV)		0.0090 (18.1929)		0.0095 (20.2697)
NYRS <sup>2</sup> (IV)		-0.0001 (-7.2058)		-0.0001 (-8.1349)
Hours(IV)				0.0148 (93.5476)

Table 7.4

PUBC Males Estimated Coefficients				
	1	2	3	4
NYRS	0.0107 (13.4481)		0.0128 (17.3113)	
NYRS <sup>2</sup>	-0.0001 (-6.3863)		-0.0002 (-8.3777)	
Hours			0.0117 (46.1108)	
NYRS(IV)		0.0083 (10.1953)		0.0091 (12.0884)
NYRS <sup>2</sup> (IV)		-0.0001 (-5.1842)		-0.0001 (-6.1638)
Hours(IV)				0.0138 (50.7162)

Table 7.5

<b>CENG Males Estimated Coefficients</b>				
	1	2	3	4
NYRS	0.0248 (14.0317)		0.0264 (15.8706)	
NYRS <sup>2</sup>	-0.0003 (-6.9809)		-0.0004 (-8.0034)	
Hours			0.0147 (25.9283)	
NYRS(IV)		0.0178 (9.8302)		0.0185 (10.6664)
NYRS <sup>2</sup> (IV)		-0.0002 (-4.9105)		-0.0003 (-5.6870)
Hours(IV)				0.0211 (33.7128)

Table 7.6

<b>LOCG Males Estimated Coefficients</b>				
	1	2	3	4
NYRS	0.0232 (17.2158)		0.0222 (16.8787)	
NYRS <sup>2</sup>	-0.0003 (-6.7888)		-0.0003 (-6.5049)	
Hours			0.0083 (21.9094)	
NYRS(IV)		0.0178 (12.9932)		0.0123 (7.3112)
NYRS <sup>2</sup> (IV)		-0.0002 (-4.5411)		-0.0001 (-1.0215)
Hours(IV)				0.0364 (25.4854)



Table 7.7

PRIV Females Estimated Coefficients				
	1	2	3	4
NYRS	0.0330 (33.9135)		0.0177 (29.3353)	
NYRS <sup>2</sup>	-0.0005 (-17.5955)		-0.0003 (-17.4505)	
Hours			0.0434 (222.3487)	
NYRS(IV)		0.0279 (28.4249)		0.0171 (27.9756)
NYRS <sup>2</sup> (IV)		-0.0005 (-15.0511)		-0.0003 (-17.1115)
Hours(IV)				0.0405 (192.9952)

Table 7.8

PUBC Females Estimated Coefficients				
	1	2	3	4
NYRS	0.0286 (9.8767)		0.0200 (10.8147)	
NYRS <sup>2</sup>	-0.0004 (-4.7073)		-0.0003 (-5.9003)	
Hours			0.0368 (59.2797)	
NYRS(IV)		0.0283 (9.6268)		0.0210 (11.1160)
NYRS <sup>2</sup> (IV)		-0.0005 (-5.2552)		-0.0004 (-6.7082)
Hours(IV)				0.0329 (48.5196)

Table 7.9

CENG Females Estimated Coefficients				
	1	2	3	4
NYRS	0.0425 (22.1644)		0.0263 (20.9943)	
NYRS <sup>2</sup>	-0.0006 (-9.6106)		-0.0004 (-8.9191)	
Hours			0.0381 (113.2648)	
NYRS(IV)		0.0440 (22.7788)		0.0292 (22.9676)
NYRS <sup>2</sup> (IV)		-0.0007 (-11.2447)		-0.0005 (-11.4051)
Hours(IV)				0.0344 (95.5875)

Table 7.10

LOCG Females Estimated Coefficients				
	1	2	3	4
NYRS	0.0445 (16.6293)		0.0214 (11.6580)	
NYRS <sup>2</sup>	-0.0005 (-5.0785)		-0.0002 (-2.9621)	
Hours			0.0513 (115.3156)	
NYRS(IV)		0.0557 (20.6075)		0.0269 (14.5016)
NYRS <sup>2</sup> (IV)		-0.0010 (-9.4612)		-0.0004 (-6.4552)
Hours(IV)				0.0500 (104.0262)

The above tables show that there has been a decrease in the return to tenure for males in all sectors, and for females in the private sector and public corporations. These findings are more in keeping with those of Altonji and Shakotko. One rather surprising point to note is that the use of the tenure instrument for females in central and local government actually causes the tenure coefficient to increase.

Altonji and Shakotko find in their paper that use of instrumental variables not only causes a reduction in the tenure coefficient, but also that it becomes insignificant. The above results using NES data also show a decrease in the return to tenure, however in this case the variable remains significant. It is difficult to say whether this decrease in the tenure coefficient is related to unobserved job match effects, as the inclusion of additional explanatory variables will remove the depression caused by using the instrumental variable. Given sufficient explanatory variables, it has been shown that the tenure coefficients do not vary at all, suggesting that the decrease is more likely to be caused by the omission of certain key variables from the equation.

From the results above, it can be observed that using an equation with a limited number of controls leads to a decrease in the return to tenure given the inclusion of a tenure instrument. Further testing of various specifications of the equation led to the discovery that of all the controls available, occupation when excluded, led to the largest decrease in the return to tenure, again given the inclusion of a tenure instrument. When occupation is added to the equation, there appears to be very little in the way of what has previously been identified as a job match effect.

As discussed earlier in Chapter 3, a debate is currently underway in the US



concerning the exact significance of tenure as a determinant of earnings. Analysts such as Altonji and Shakotko as well as others such as Abraham and Farber, suggest that tenure is in fact insignificant, and that it is experience and job-matches which are the main determinants of earnings. Recently, Topel(1991) has provided evidence which fails to support these findings, and shows that tenure remains significant in the earnings equation. Those who claim an insignificant tenure effect tend to make use of IV procedures to take account of possible job match effects, whereas Topel uses a more sophisticated two stage procedure<sup>6</sup>. It may perhaps be the case that the job-match effect detected previously is simply the result of estimation procedures which include too few explanatory variables. Given the finding that it is the exclusion of occupation primarily, which causes the instrument to reduce tenure returns, the job-match effect observed by others may possibly be a simple occupation effect.

### **7.2.3 Use of the Hours Variable in the Equation**

As mentioned earlier in the chapter, hours of work can be seen as a decision variable which influences choice of job or sector. This is akin to having an unobservable fixed effect captured by the error term, which encapsulates the situation whereby some individuals are naturally more productive in certain occupations, and make a sectoral selection on this basis. As argued earlier the use of an instrument based on the decision variable should remove this self selection effect, in the same way that

the tenure instrument seeks to remove the fixed job-match effect.

The analysis began with reference again to the original estimating equation from Chapter 5. Similar to the tenure instrument, there was no noticeable difference in the return to hours when the hours instrument was included. It was decided again to estimate equation 7.7, this time including hours. The hours variable was included separately in its normal and instrumented forms, and the results are included in tables 7.3-7.10 above.

Due to the use of gross pay per week as the actual earnings variable in the empirical work, the analysis of the hours coefficients in themselves are of no great interest, we would expect this variable to be a large and significant determinant of earnings. However, some interesting points do emerge with the inclusion of the simple non instrumented hours variable. Hours worked seem to be a much more significant determinant of earnings for women than for men. This result may well be a function of the types of occupations into which women are concentrated, a point discussed in detail in the previous chapter. When hours of work are included in the male equation, the return to tenure increases for all sectors except local government. For women however, the inclusion of hours reduces the return to tenure, suggesting that these two variables act quite separately for women, whereas it may be a combination of the two which influences male earnings. On the whole though it would appear that women are paid according to the amount of work they actually do, whereas men are more likely to be paid for being in a particular job. This is not an altogether surprising result. As we saw earlier, females do tend on average to have a shorter total attachment to the labour

market than their male counterparts. As a result, female earnings are more likely to be related to the work done during periods of attachment, as there may be a degree of uncertainty associated with estimating the end point of the current job spell. This uncertainty is likely to be lower for males, whose average length of tenure in any job is longer than for females, again as shown earlier.

Turning now to the use of the hours instrument, it can be seen from the tables above, that the inclusion of the instrument causes an increase in the return to hours for males, and a decrease in the return to hours for females. As with the use of the tenure instrument, if the IV process is indeed controlling for some kind of fixed effect, we would expect the return to the variable in question to decrease. This is indeed true for the female sample, suggesting that self selection is present for females in all sectors. Again this result is not entirely unexpected, as we know that females enter a more restricted range of occupations than males, and experience less flexibility in the number of hours they can work.

There is again a problem however in interpreting the usefulness of the hours instrument, as the inclusion of additional explanatory variables reduces the power of the instrument to alter the hours coefficient. If the original equation from Chapter 5 is estimated with hours added, there is no change whatsoever to the size of the hours coefficient once the instrument is included.



**CHAPTER 7 ENDNOTES**

- 1. See Chapter 3 for a discussion of previous attempts to use instrumental variables in this type of analysis, and also alternative approaches used by analysts such as Topel, who claims that due to the way in which tenure data is recorded, instrumenting out tenure will not control for job heterogeneity.**
- 2. See Chapter 3 for both an in depth analysis of the heterogeneity bias problem and the traditional Mincer approach to estimating the effect of tenure on earnings.**
- 3. Again see Chapter 3 for a discussion of the use of the Heckman two stage correction for self selection. The Heckman process uses a probit estimator which proved difficult to construct using the dataset. It was decided that for this analysis, IV estimation would make a suitable alternative.**
- 4. See Chapter 5 for the complete list of variables in the estimating equation.**
- 5. When the hours instrument was added to the estimating equation, again there was no change to the size of the estimated coefficient for this variable. The hours coefficients will be discussed later in this chapter.**
- 6. See Chapter 3 for more information on the specific procedures involved.**

# OLS Tenure Coefficient Profiles

## Males All Sectors

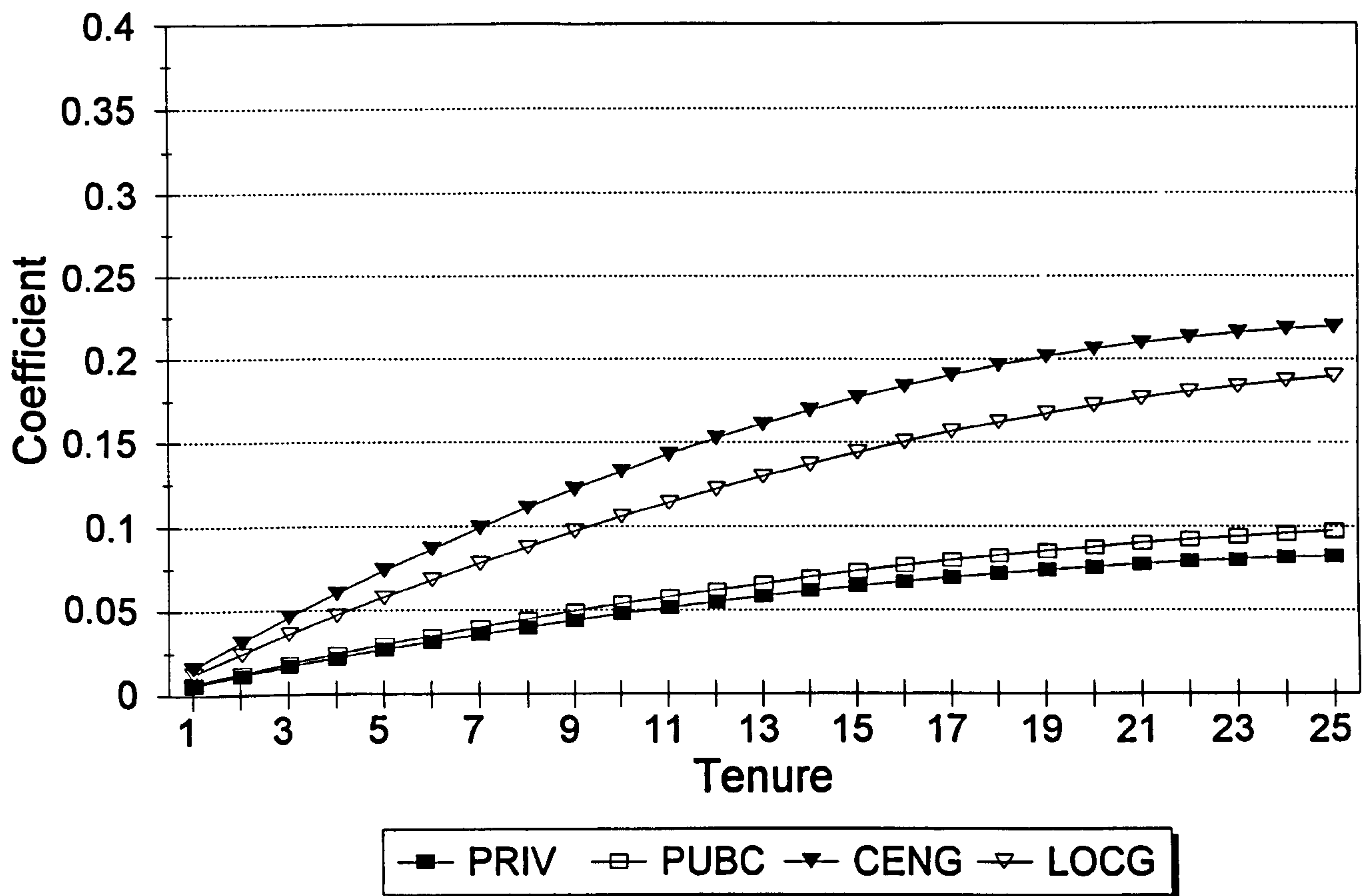


Figure 7.1

# OLS Tenure Coefficient Profiles

## Females All Sectors

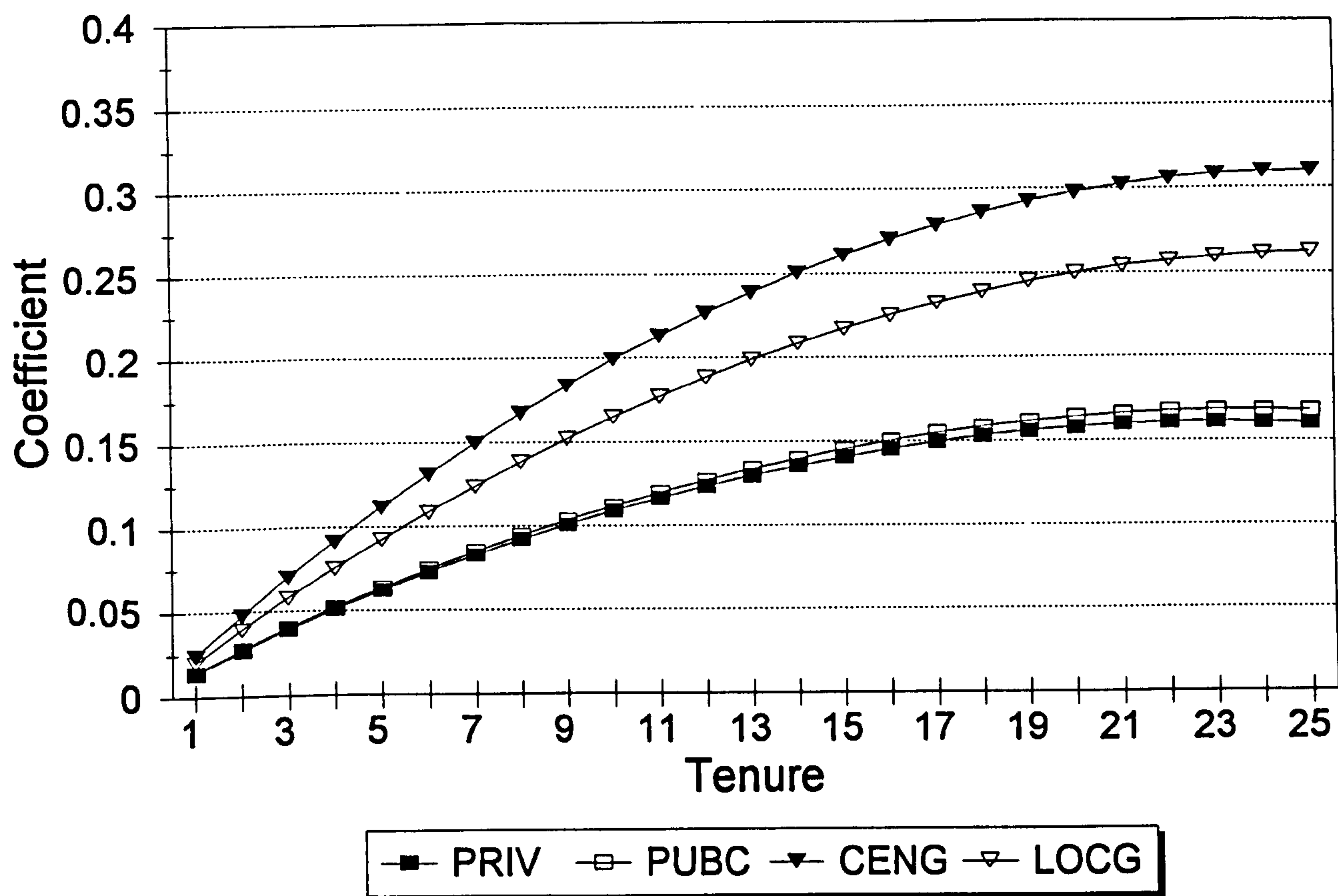


Figure 7.2



# OLS Tenure Coefficient Profiles

## Males All Sectors

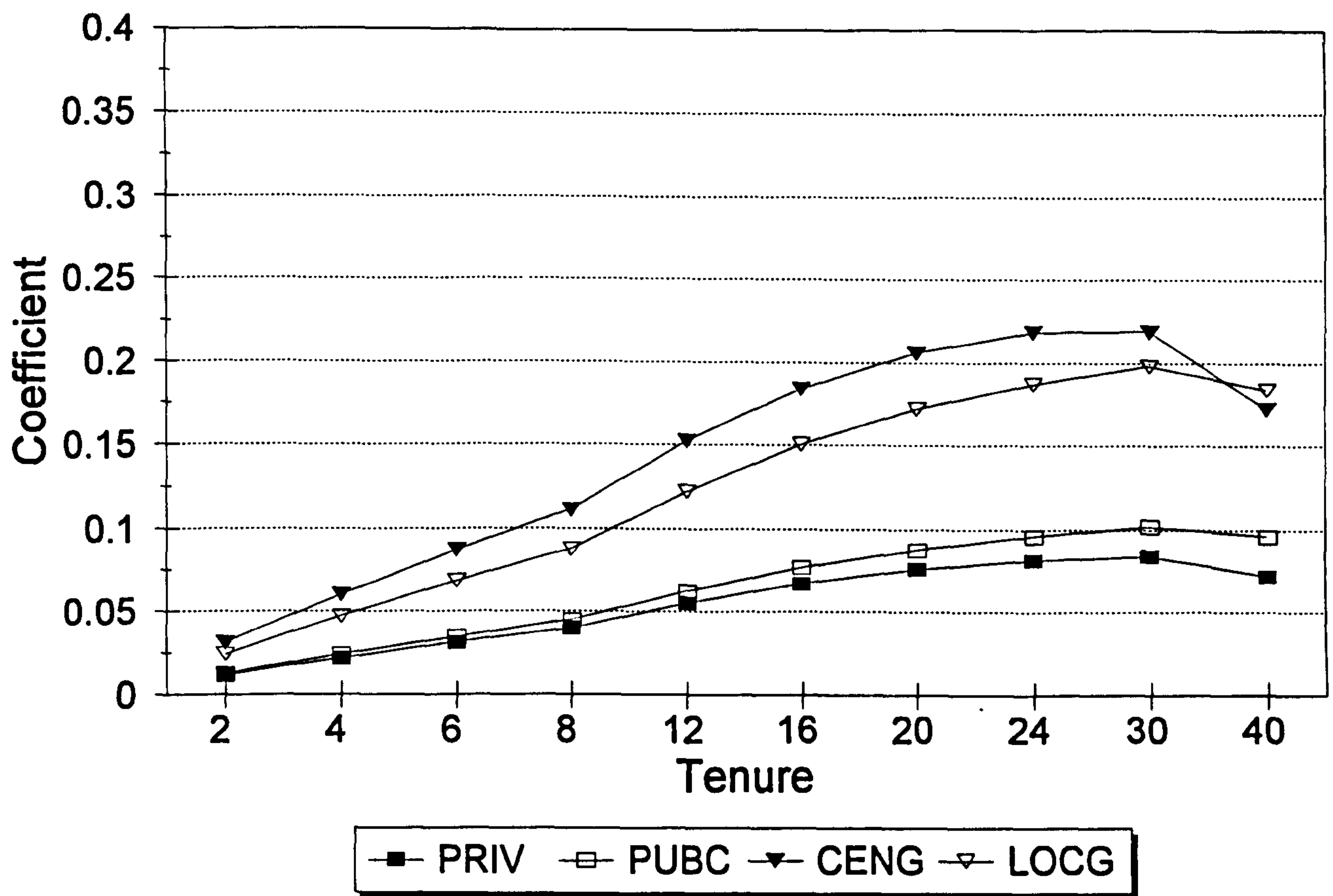


Figure 7.3

# OLS Tenure Coefficient Profiles

## Females All Sectors

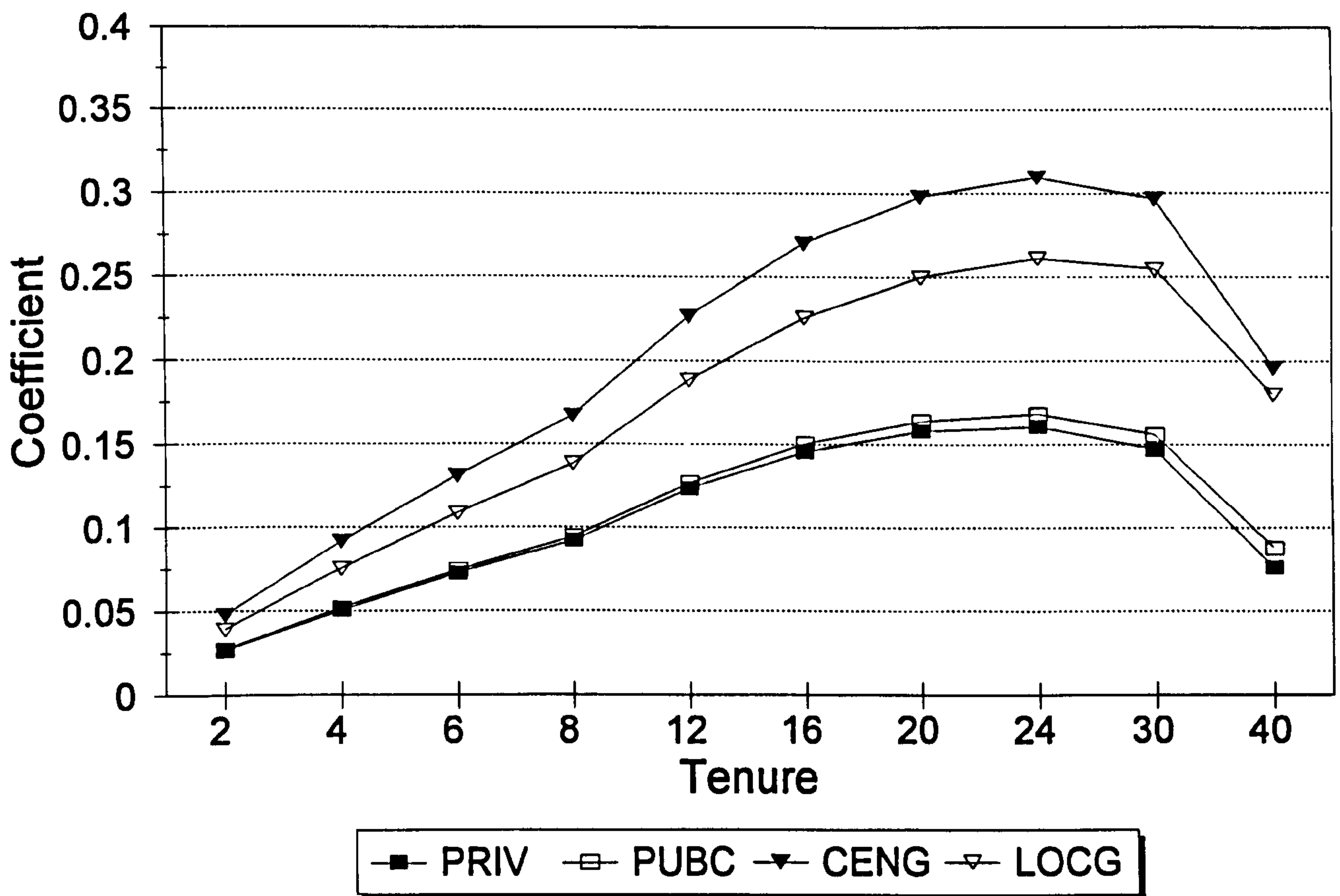


Figure 7.4

# OLS Tenure Coefficient Profiles

## Females CENG

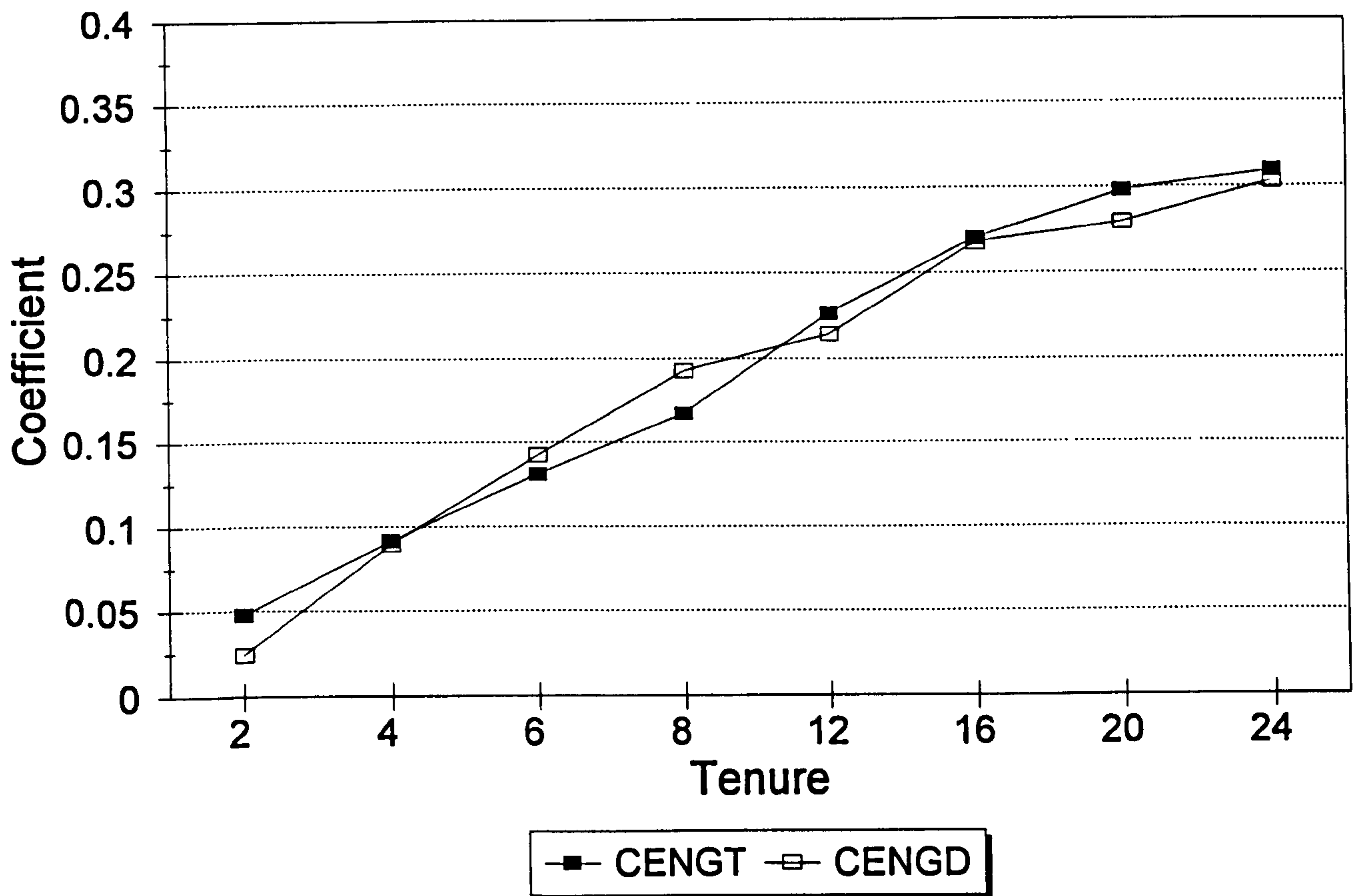


Figure 7.5



# OLS Tenure Coefficient Profiles

## Males (Alternative Specification)

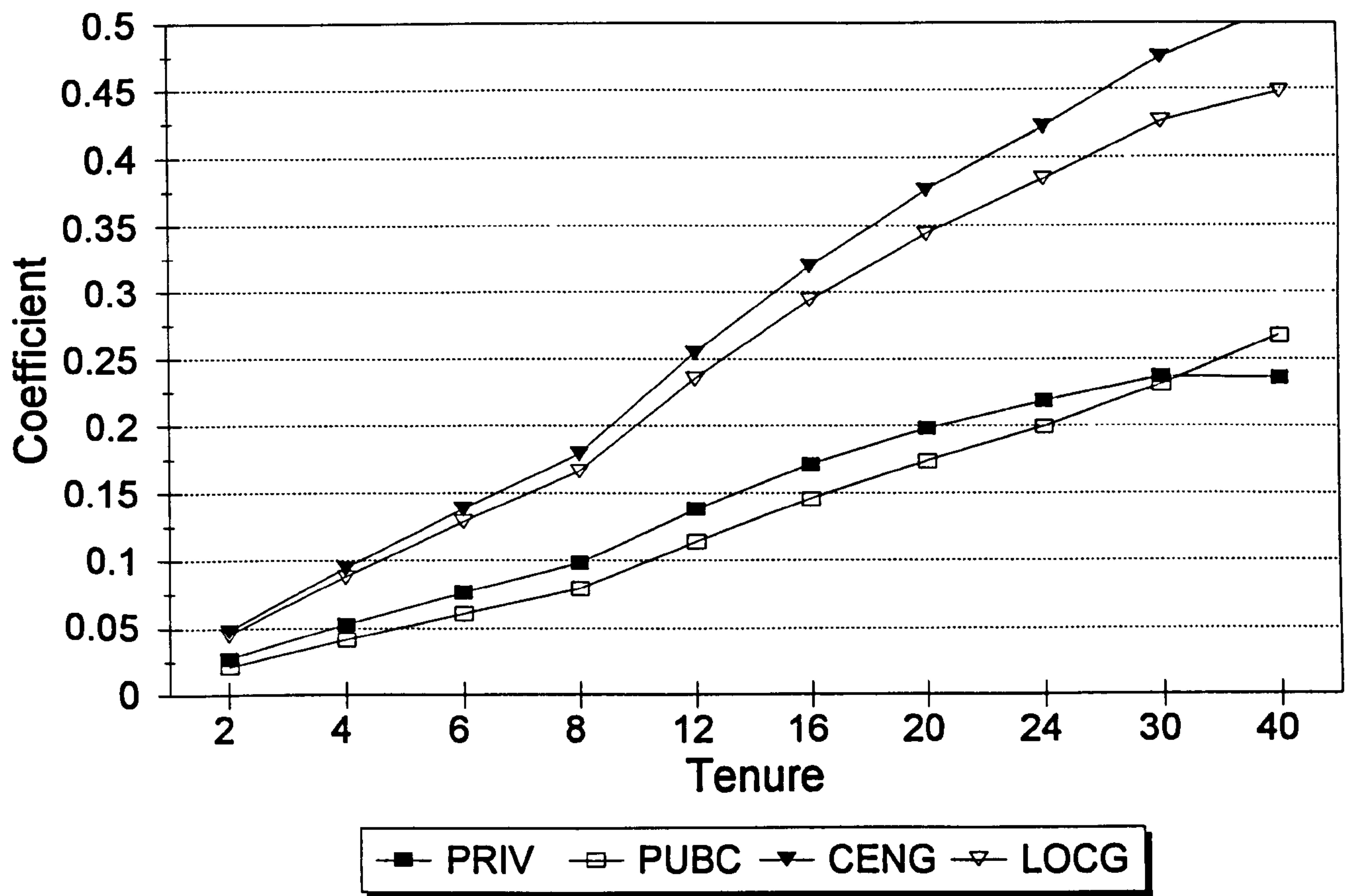


Figure 7.6

# OLS Tenure Coefficient Profiles

## Females (Alternative Specification)

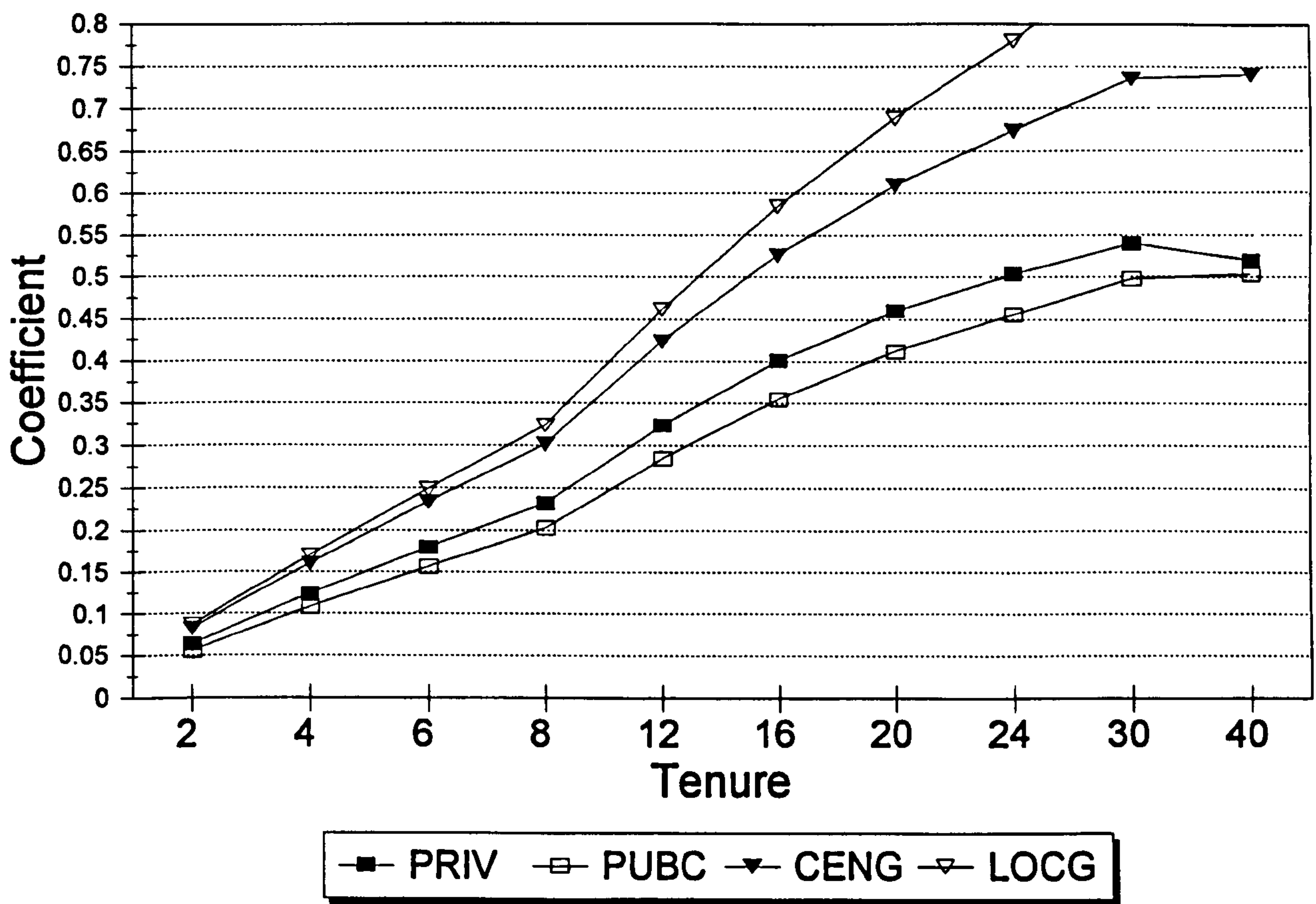


Figure 7.7

# IV Tenure Coefficient Profiles

## Males (Alternative Specification)

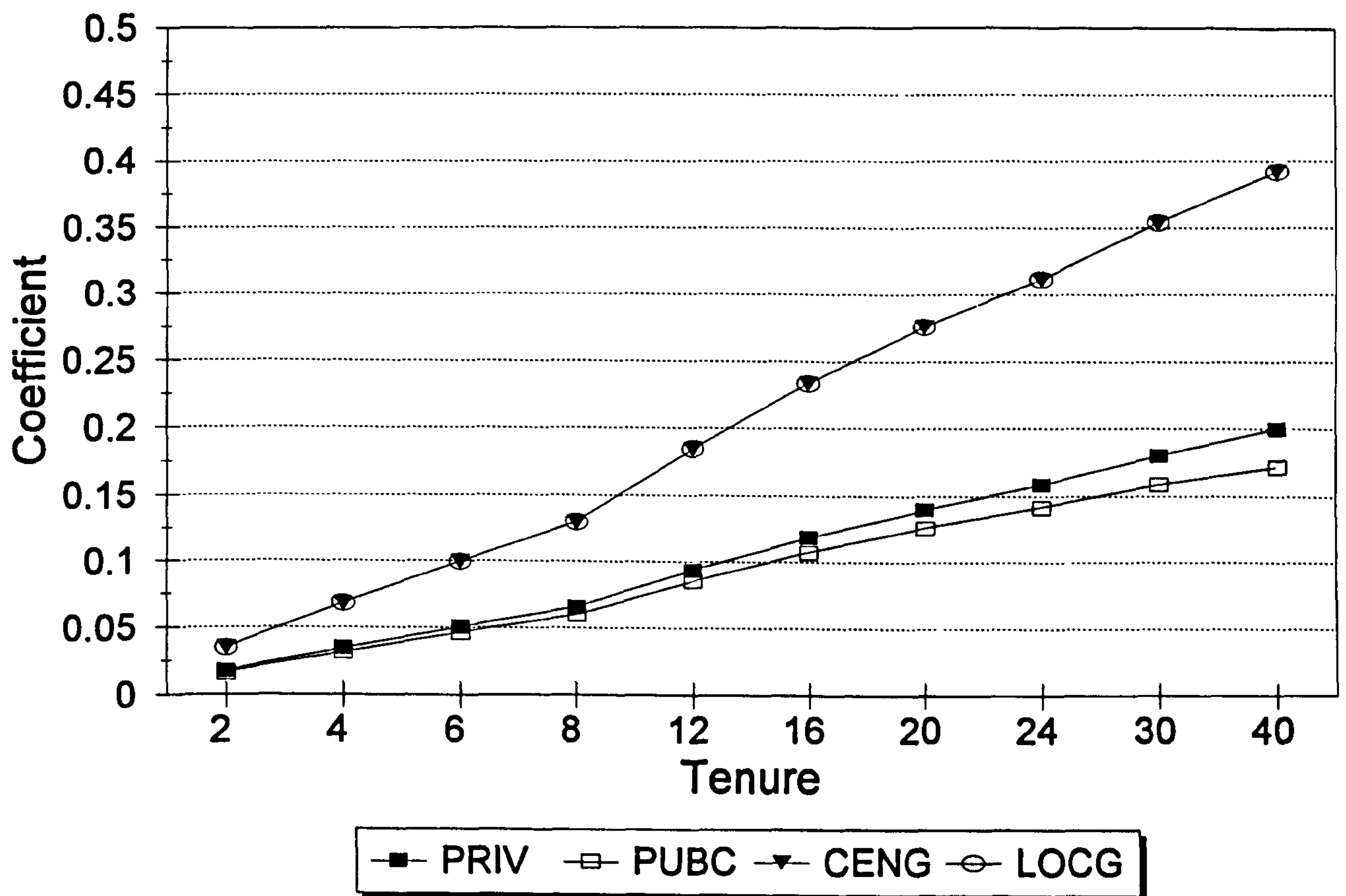


Figure 7.8



# IV Tenure Coefficient Profiles

## Females (Alternative Specification)

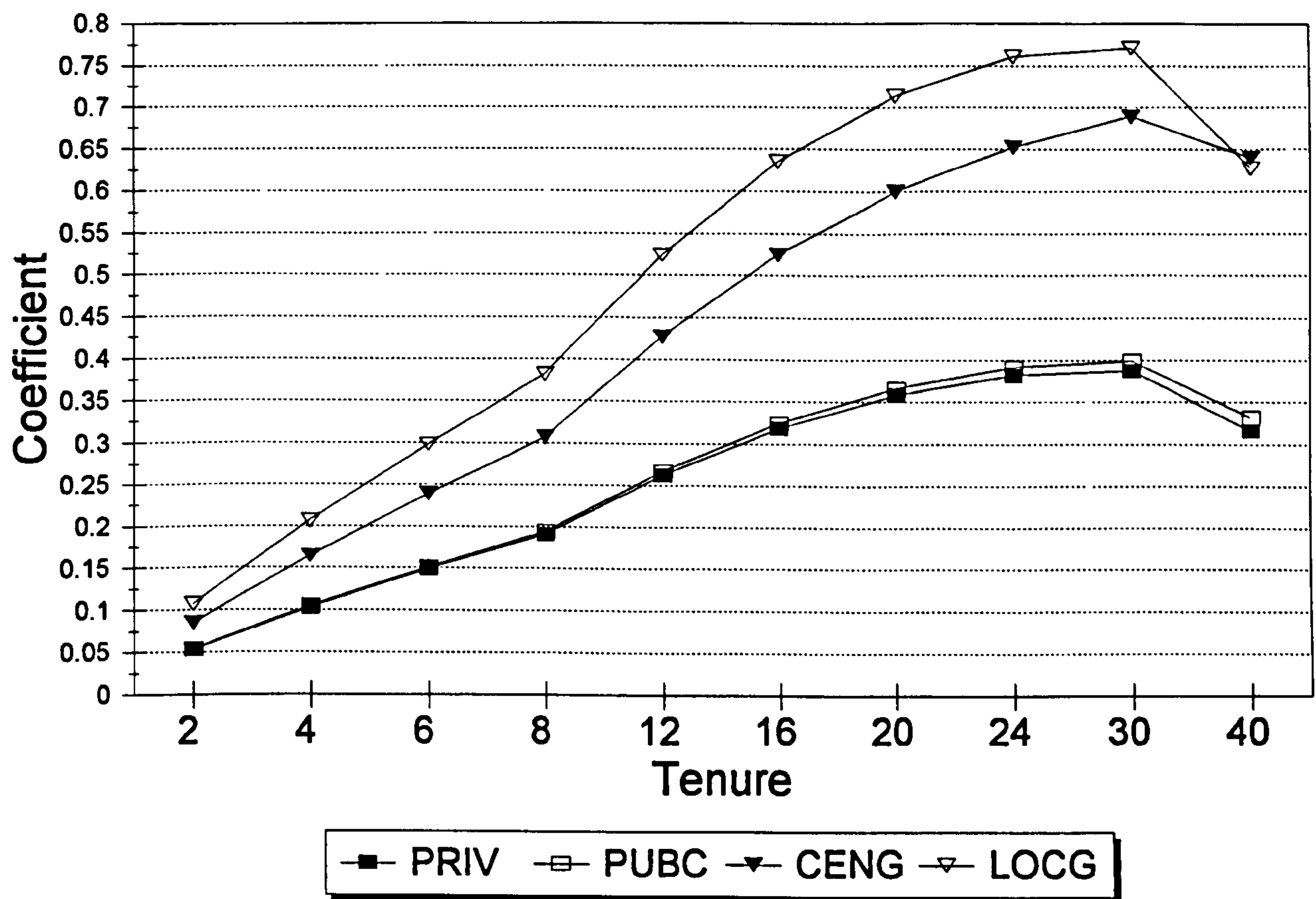


Figure 7.9

## CONCLUSIONS

In chapter 2, an attempt was made to investigate the two main theories underlying the earnings-tenure effect - human capital and agency - in the context of the UK public and private sectors. This was undertaken in order to try and suggest whether the characteristic labour market differences associated with the two sectors could enable us to infer anything about the likely shapes of their respective earnings profiles.

For the private sector, it was suggested that the shape of the earnings-tenure relationship was most probably influenced by investments in human capital, as discussed in the traditional literature. There are two main reasons for this. Firstly, relative to the public sector, private sector organisations are more likely to be characterised by the manufacture of a physical end product. In this case, it will be a more straightforward process to link the remuneration of the employee to productivity increases which result from investments in human capital. Secondly, it may be the case that there exists a lower transaction cost environment in the private sector relative to the public sector. The concept of transaction costs as interpreted by Hashimoto was applied to the UK public and private sectors, and it was suggested there that certain factors may point to lower transaction costs and therefore a higher degree of investment in human capital in the private sector.

As far as the public sector is concerned, the discussion in Chapter 2 indicated that an agency rather than human capital explanation might underlie the effect of tenure on earnings. In the public organisation (with the exception of the public

corporations), there is very often no obvious physical end product. In this situation, tenure is likely to play a more important role in determining remuneration across an individual's lifetime in a particular job. Also, the more bureaucratic nature of the public organisation, with its relatively greater emphasis on centralised control and bargaining, may lead to a higher transaction cost environment, possibly leading to a lesser degree of human capital investment than in the private sector. This is not to say that these are the only explanations for possible differences in rates of human capital investment between the sectors. Differing occupational structures may also have a bearing on the opportunities for and incidence of investments in human capital. Much of the training done in private sector industries is bound to be quite inappropriate for public organisations.

The OLS results presented in Chapter 5 seem to bear out these a priori expectations. The estimated wage-tenure profiles for the private sector and for public corporations seem more in keeping with the predictions of human capital than do those of central and local government. The private and public corporations profiles seem to flatten out, suggesting a tailing off of return to human capital, whereas those of central and local government continue upwards in an almost linear fashion.

The earnings growth rates presented in Chapter 5 show that although individuals entering the private sector may expect to earn a higher starting wage than their counterparts in the public sector, the subsequent rate of earnings growth will not be as high. Return to tenure was found to be higher in central and local government, indicating that tenure is indeed of relatively greater importance as a determinant of earnings in these sectors. This may well be due to the fact that these sectors consist of predominantly administrative and service type occupations. In this



situation it is difficult to relate remuneration to increases in productivity, given the complexity inherent in defining productivity gains in public organisations. It is more likely to be the case that public workers are rewarded for maintaining their attachment to their employer, as suggested by agency theory.

A second interesting finding concerned a comparison of the return to tenure for males and females across sectors. It would appear that females in general experience a higher return to tenure than males. This may at first appear a surprising result. However, it could be the case that tenure, or rather actual time spent in a job, is a more significant determinant of earnings for females, since they tend on average to have a relatively shorter attachment to the labour market than their male counterparts. Men, having longer average lengths of tenure, may be in a better position to develop higher quality job matches which will reduce the importance of tenure on their earnings, and therefore increase the influence of other variables such as occupation.

Another factor which might possibly underlie the finding of a relatively higher return to tenure for females, is the fact that they tend to be concentrated into a much narrower range of occupations than males. As shown in Chapter 6, women who have accumulated a significant length of tenure with the same employer are likely to be found in a few key occupations, whereas the equivalent male grouping are spread across the full spectrum of jobs. Such occupations for long tenured women are often in the public sector and are in many cases characterised as being highly professional. It may not be surprising therefore to see tenured women with higher returns to tenure than males.

A further factor explaining this higher return to tenure for females, might

relate specifically to absences from the labour market. Many women who take time out of the labour market, especially those in the public sector, will return eventually to the same job. Their earnings may as a result be at a similar level to when they left. However, their relatively high pay at re-entry will be correlated with low tenure. Alternatively, their current earnings may catch up with their pre-leaving earnings very quickly.

It is possible that the simple OLS procedure used in Chapter 5 suffers from estimation biases that serve to affect the observed return to tenure. Of particular note, are biases arising from the existence of job match and self selection effects which are not picked up by the data. These issues have come under scrutiny in the recent American literature. This concentrates on examining the significance of tenure, once job-match heterogeneity has supposedly been removed. It is possible that the tenure variable is capturing unobserved effects present in the error term, and some form of correction is therefore necessary in order to accurately estimate the tenure effect.

Many analysts have advocated the use of instrumental variable techniques in order to correct for the heterogeneity bias. In this case, an instrument is constructed that is highly correlated with tenure, but which is uncorrelated with the unobservable characteristics of the error term. This approach was incorporated into the analysis in Chapter 7. An equation equivalent to that of Chapter 5 was estimated, the only difference being the use of tenure and tenure squared variables, instead of the previous tenure dummy approach. Results obtained by using the normal tenure variable were then compared with those obtained using the instrument.

The results of this estimation surprisingly showed no change in the size of



the estimated tenure return. This is a notable result given that previous studies have found a significant decrease in the return to tenure once the instrument is included in the regression. The instrument used was based upon that developed by Altonji and Shakotko(1987), and so an informative way to proceed was to recreate, as far as possible, the equation which they themselves estimate.

In this case, running a much more restricted form of the equation and excluding some key explanatory variables, there was indeed an observed decrease in the return to tenure. However, this effect appeared to be more a result of the omission of certain variables than due to any unobserved job match heterogeneity. Of all the explanatory variables excluded, further testing revealed that occupation had the most significant effect on whether the use of an instrument would make a difference to the estimated tenure return. It may well be the case therefore, that the job-match effect detected by others may actually represent a simple occupation effect. If analysts who have previously attempted this particular form of estimation, had available to them a dataset similar to the NES in terms of number of observations and control variables, they may perhaps have obtained radically different results.

Also in Chapter 7, an attempt was made to correct for self-selection effects. This is a particularly significant bias when analysing choice of work in different sectors of the economy. Again, an instrumental variable was used to correct for this bias, this time based on previous work by Vella and Verbeek(1993a,b). The results here showed that there is indeed a self-selection effect for females in all sectors, but not for males. In this case, an instrumental variable was used based on hours worked, as this is considered an important factor determining choice of occupation



or sector for females. As already suggested, females tend to enter a more restricted range of occupations than their male counterparts, and this may well be influenced by flexibility in terms of the amount of hours they can work.

As has been demonstrated, earnings profiles can provide us with a great deal of information about earnings patterns across the labour market. The above results form the most comprehensive study in this subject area for the UK labour market. This analysis in particular has attempted to use estimation of the earnings-tenure effect to extend the knowledge available regarding the differing characteristics which exist between the public and private sectors in the UK. As has been shown above, there are indeed stark differences across sectors. Primarily, the return to tenure is higher for both males and females in the central and local government sectors than for private and public corporations employees. In some ways this can be seen almost as a straightforward public/private separation. The public corporations, though similar in many ways to the private sector, are now a much less significant component of the UK economy than they were previously. The vast majority of individuals who work in the public sector are now to be found in the central and local government sectors.

As mentioned previously, studies of comparative earnings in the UK have tended to focus on differentials and relativities across and between occupations or sectors. Such studies offer less information than does the study of earnings-tenure effects. This thesis has attempted to show that there are significant differences regarding the way in which earnings will vary over an individual's time with a particular employer. This is especially important for public sector employees, as their average tenure is generally long. Any government policy which seeks to influence

the relationship between earnings in the public and private sectors might arguably be more effective if these differences are taken into account.

## REFERENCES

- Abraham, K.G. and Farber, H.S. (1987); "Job Duration, Seniority and Earnings", American Economic Review, Vol 77, No 3, pp.278-297.
- Abraham, K.G. and Meddoff, J.L. (1980); "Experience, Performance and Earnings", Quarterly Journal of Economics, Vol 95, No 4, pp.703-736.
- Abraham, K.G. and Medoff, J.L. (1981); "Are Those Paid More Really More Productive? The Case of Experience", Journal of Human Resources, Vol 16, No 2, pp.186-216.
- Adams, M. and Owen, J. (1989); The New Earnings Survey Panel Data Set, New Earnings Survey Panel Project Working Paper No.1 (Employment Market Research Unit)
- Altonji, J.G. and Shakotko, R.A. (1987); "Do Wages Rise With Job Seniority?", Review of Economic Studies, Vol 54, No 3, pp.437-459.
- Bartel, A.P. (1980); "Earnings Growth on the Job and Between Jobs", Economic Inquiry, Vol 18, No 1, pp.123-137.
- Bartel, A.P. and Borjas, G.J.(1981); "Wage Growth and Job Turnover: An Empirical Analysis", in S.Rosen (Ed.), Studies in Labor Markets, University of Chicago Press.
- Beaumont, P.B. (1989); "Industrial Relations in the Public Sector", in B.Towers (Ed.) "A Handbook of Industrial Relations Practice", Kogan Page, London.
- Becker, G.S. (1975); Human Capital:a theoretical and empirical analysis with special reference to education, 2nd Edition, NBER, Columbia University Press.
- Belman, D. and Heywood J.S. (1989); "Government Wage Differentials: a Sample Selection Approach", Applied Economics, Vol 21, pp.427-438.
- Belman, D. and Heywood J.S. (1990); "The Effect of Establishment and Firm Size on Public Wage Differentials", Public Finance Quarterly, Vol 18, No 2, pp.221-235.
- Blank, R.M. (1985); "An Analysis of Workers Choice Between Employment in the Public and Private Sectors", Industrial and Labor Relations Review, Vol 38, No 2, pp.211-224.
- Borjas, G.J. (1981); "Job Mobility and Earnings Over the Life Cycle", Industrial and Labor Relations Review, Vol 34, No 3, pp.365-376.



- Brown, J.N. (1989); "Why do Wages Increase with Tenure? On the Job Training and Lifecycle Wage Growth Observed Within Firms", American Economic Review, Vol 79, No 5, pp.971-991.
- Chalmers, N.J. (1989); Industrial Relations in Japan, Routledge, London.
- Clark, R.L. and Ogawa, N. (1992a); "The Effects of Mandatory Retirement on Earnings Profiles in Japan", Industrial and Labor Relations Review, Vol 45, No 2, pp.258-266.
- Clark, R.L. and Ogawa, N. (1992b); "Employment Tenure and Earnings Profiles in Japan and the United States", American Economic Review, Vol 82, No 1, pp.336-345.
- Cockerill, T.A.J. and Jones, T.T. (1984); "Public Enterprise Management", in J.F. Pickering; T.A.J.Cockerill (Eds.), The Economic Management of the Firm, Philip Allan, Oxford.
- Corcoran, M, Duncan, G.J. and Ponza, M. (1983); "A Longitudinal Analysis of White Womens' Wages", Journal of Human Resources, Vol 18, No 4, pp.497-520.
- Cox, D. (1984); "Panel Estimates of the Effects of Career Interruptions on the Earnings of Women", Economic Inquiry, Vol 22, No 3, pp.386-403.
- Daniel, W.W. and Millward, N. (1984); "Trade Union Recognition and Associated Issues", in Daniel, W.W. and Millward, N. Workplace Industrial Relations in Britain, Heinemann Educational Books, London.
- Dean, A. (1981); "Public and Private Sector Pay and the Economy", in Elliott, R.F. and Fallick, J.L. Incomes Policies, Inflation and relative Pay, Allan and Unwin, London.
- Elliott, R.F. and Fallick, J.L. (1981); "Incomes Policy and the Public Sector", in Elliott, R.F. and Fallick, J.L. Incomes Policies, inflation and relative Pay, Allan and Unwin, London.
- Elliott, R.F. and Murphy, P.D. (1987); "The Relative Pay of Public and Private Sector Employees 1970-1984.", Cambridge Journal of Economics, Vol 11, pp.107-132.
- Elliott, R.F. and Murphy, P.D. (1990); "National Wage Agreements", in M.B. Gregory and A.W.J.Thomson, A Portrait of Pay 1970-1982, Clarendon Press, Oxford.
- Endean, R. and Smith, W. (1990); "The New Earnings Survey Panel", in Gregory, M.B. and Thomson, A.W.J. (Ed.s), A Portrait of Pay 1970-82, Clarendon Press, Oxford.
- Farber, S.C. (1983); "Post Migration Earnings Profiles: An Application of Human Capital and Job Search Models", Southern Economic Journal, Vol 49, No 3,

pp.693-705.

- Fleming, A. (1988); "Employment in the Public and Private Sectors 1982-1988", Economic Trends, No 422, December 1988, pp.119-129.
- Freeman, R.B. (1987); "How do Public Sector Wages and Employment Respond to Economic Conditions", in D.A. Wise (Ed.), Public Sector Payrolls, NBER, University of Chicago Press.
- Gregory, M.B. et al (1990); "The New Earnings Survey", in Gregory, M.B. and Thomson, A.W.J. (Ed.s), A Portrait of Pay 1970-1982, Clarendon Press, Oxford.
- Hashimoto, M. (1979); "Bonus Payments, On-the-Job Training and Lifetime Employment in Japan", Journal of Political Economy, Vol 87, No 5, Pt 1, pp.1086-1104.
- Hashimoto, M. (1981); "Firm Specific Human Capital as a Shared Investment", American Economic Review, Vol 71, No 3, pp.475-482.
- Hashimoto, M. (1990); The Japanese Labor Market in a Comparative Perspective with the US, W.E.Upjohn Institute, Kalamazoo, Michigan.
- Hashimoto, M. and Raisian, J. (1985); "Employment Tenure and Earnings Profiles in Japan and the United States", American Economic Review, Vol 75, No 4, pp.721-735.
- Heckman, J.L. (1979); "Sample Selection Bias as a Specification Error", Econometrica, Vol 47, No 1, pp.153-161.
- Hersch, J. and Reagan, P. (1990); "Job Match, Tenure and Wages Paid by Firms", Economic Inquiry, Vol 28, No 3, pp.488-507.
- Holtman, A.G. and Idson, T.L. (1991); "Employer Size and On-the-Job Training Decisions", Southern Economic Journal, Vol 58, No 2, pp.339-355.
- Hundley, G. (1991); "Public and Private Sector Occupational Pay Structures", Industrial Relations, Vol 30, No 3, pp.417-434.
- Hunt, J.C. and Kau, J.B. (1985); "Migration and Wage Growth: A Human Capital Approach", Southern Economic Journal, Vol 51, No 3, pp.697-710.
- Hutchens, R.M. (1989); "Seniority, Wages and Productivity: a Turbulent Decade", Journal of Economic Perspectives, Vol 3, No 4, pp.49-64.
- Ippolito, R.A. (1987); "Why Federal Workers Don't Quit", Journal of Human Resources, Vol 22, No 2, pp.281-299.
- Ippolito, R.A. (1991); "Encouraging Long Term Tenure: Wage Tilt or Pensions?", Industrial and Labor relations Review, Vol 44, No 3, pp.520-535.



- Jones, L.P. (1982); "Introduction", in L.P. Jones (Ed.) Public Enterprise in Less Developed Countries, Cambridge University Press.
- Jovanovic, B. (1979,a); "Job Matching and the Theory of Turnover", Journal of Political Economy, vol 87, no.5, pp.972-990.
- Jovanovic, B. (1979,b); "Firm Specific Capital and Turnover", Journal of Political Economy, Vol 87, No 6, pp.1246-1260.
- Jovanovic, B. and Mincer, J. (1981), "Labor Mobility and Wages", in S.Rosen (Ed.), Studies in Labor Markets, University of Chicago Press.
- Katz, L.F.(1986); "Efficiency Wage Theories: a Partial Evaluation", NBER Macroeconomics Annual (Edited by S.Fischer), MIT Press, pp.235-276.
- Katz, L.F. and Krueger, A.B. (1991); Changes in the Structure of Wages in the Public and Private Sectors, mimeo, Princeton University.
- Kawanishi, H. (1992); Enterprise Unionism in Japan, Kegan Paul International, London.
- Krueger, A.B. (1988a); "The Determinants of Queues for Federal Jobs", Industrial and Labor Relations Review, Vol 41, No 4, pp.567-581.
- Krueger, A.B. (1988b); "Are Public Sector Workers Paid More than their Alternative Wage?: Evidence from Longitudinal Data and Job Queues", in R.B.Freeman and C.Ichniowski, When Public Sector Workers Unionise, NBER, University of Chicago Press.
- Lazear, E.P. (1979); "Why is there Mandatory Retirement?", Journal of Political Economy, Vol 87, No 6, pp.1261-1284.
- Levy, B. (1987); "A Theory of Public Enterprise Behaviour", Journal of Economic Behaviour and Organisation, Vol 8, pp.75-96.
- Lindsay, C.M. (1976); "A Theory of Government Enterprise", Journal of Political Economy, Vol.84, No.5, pp.1061-1077.
- Lovejoy, L.M. (1988); "The Comparative Value of Pensions in the Public and Private Sectors", Monthly Labor Review, December, pp.18-26.
- Lynch, L.M. (1992); "Private Sector Training and the Earnings of Young Workers", American Economic Review, Vol 82, No 1, pp.229-312.
- Marshall, R.C. and Zarkin, G.A. (1987); "The Effect of Job Tenure on Wage Offers", Journal of Labor Economics, Vol 5, No 3, pp.301-324.
- Megaw, J. (1982); Inquiry into Civil Service Pay Vol 2: Research Studies, HMSO Command Paper 8590/2 July 1982.



- Micklewright, J. and Trinder, C. (1981); New Earnings Surveys 1968-80: Sampling Methods and Non-Response, Social Science Research Council Programme: Taxation Incentives and the Distribution of Income. Discussion Paper No.31.
- Millward, R and Parker, D.M. (1983); "Public and Private Enterprise: Comparative Behaviour and Relative Efficiency", in R.Millward, D.Parker, L.Rosenthal, M.T.Sumner and N.Topham, Public Sector Economics, Longman, London.
- Mincer, J. (1958); "Investment in Human Capital and Personal Income Distribution", Journal of Political Economy, Vol 66, No 4, pp.281-302.
- Mincer, J. (1962); "On - the - job Training: Costs, Returns and Some Implications", Journal of Political Economy, Vol.70 (Supplement), pp.S50-S79.
- Mincer, J. (1974); Schooling, Experience and Earnings, NBER, Columbia University Press.
- Oi, W.Y. (1962); "Labor as a Quasi-Fixed Factor", Journal of Political Economy, Vol 70, pp.538-555.
- Oi, W.Y. (1983); "The Fixed Employment Costs of Specialized Labor", in J.E. Triplett (Ed.) Measurement of Labor Cost, NBER, University of Chicago Press, London.
- Parry R. and Schmidt K-D. (1987); Public Employment in Britain and Germany, Studies in Public Policy No 157, University of Strathclyde.
- Public Money (1984); "Public Sector as Employer: How Industrial Relations Compare With the Private Sector - 2", Public Money, June 1984, pp.60-66.
- Rees, R. (1984); "A Positive Theory of the Public Enterprise", in M. Marchand, P. Pestieau, H. Tulken, The Performance of Public Enterprises, Elsevier Science Publishers BV (North-Holland).
- Ruhm, C.J. (1990); "Do Earnings Increase With Job Seniority?", Review of Economics and Statistics, Vol 72, No 1, pp.143-147.
- Salop, J. and Salop, S. (1976); "Self-Selection and Turnover in the Labour Market", Quarterly Journal of Economics, Vol 90, Nov, pp.619-627.
- Sanjines, C. and Thomson, A. (1990); "Earnings by Size of Company and Establishment", in M.B. Gregory and A.W.J. Thomson (Eds.), A Portrait of Pay 1970-82, Clarendon Press, Oxford, 1990.
- Schmidt, C.M. and Zimmerman, K.F. (1991); "Work Characteristics, Firm Size and Wages", Review of Economics and Statistics, Vol 73, No 4, pp.705-709.
- Sikorsky, D. (1986); "Public Enterprise: How is it Different from the Private Sector", Annals of Public and Cooperative Economy, Vol.57, Part 4, pp.477-511.

- Sumner, D.A. (1981), "Wage Functions and Occupational Selection in a Rural Less Developed Country", Review of Economics and Statistics, Vol 63, No 4, pp.513-519.
- Topel, R. (1991), "Specific Capital, Mobility and Wages: Wages Rise With Job Seniority", Journal of Political Economy, Vol 99, No 1, pp.145-176.
- Trinder, C. (1981); "Pay of Employees in the Public and Private Sector", National Institute Economic Review, 1981(3), pp.48-56.
- Utgoff, K.C. (1983); "Compensation Levels and Quit Rates in the Public Sector", Journal of Human Resources, Vol 18, No 3, pp.394-406.
- Vella, F. and Verbeek, M. (1993a); Estimating the Impact of Endogenous Union Choice on Wages Using Panel Data, Tilburg University, mimeo, May 1993.
- Vella, F. and Verbeek, M.(1993b); Estimating and Interpreting Models with Endogenous Treatment Effects: The Relationship Between Competing Estimates of the Union Impact on wages, mimeo, July 1993.
- Waddington, J. (1992); "Trade Union Membership in Britain 1980-1987: Unemployment and Restructuring", British journal of Industrial Relations, Vol 30, No 2, pp.287-325.
- Wiatrowski, W.J. (1988); "Comparing Employee Benefits in the Public and Private Sectors", Monthly Labor Review, December, pp.3-8.

**APPENDIX 1**

**OCCUPATIONS EXEMPTED FROM THE NEW EARNINGS SURVEY**

- (A) Domestic servants in private employment(since 1970).
- (B) Former employees now retired and receiving an occupational pension.
- (C) Wives working for/with their husbands or vice versa.
- (D) Those employed outside Great Britain.
- (E) Those who left the employer before 1st March.
- (F) Company directors receiving no salary.
- (G) Clergymen holding pastoral appointments.



**APPENDIX 2****DATA COLLECTED BY THE NEW EARNINGS SURVEY**

The following are those particular variables collected by the NES and of interest in the econometric analysis of earnings profiles.

**NINO:** Reference number which is mapped from the NI number, but in fact bears no relationship to the NI number.

**SEX:** Sex variable (Takes values - female/male/missing)

**AGE:** Age variable (Takes values 0-98 if present, 99 if missing)

The following variables relate to special questions asked in specific years only.

**CTRG(1984):** Training variable, categorised as:

- 1: YTS apprentice
- 2: Non YTS apprentice
- 3: YTS other training
- 4: Non YTS other training
- 5: Not currently receiving vocational training.

**NYRS(1975,76,79):** Number of years the employee has been in the company/business/organisation. The variable takes the value of the number of years, 0 if less than 12 months, and 99 if missing.

**TAGT(1978,85):** Type of agreement. Takes values:

- 1: National and supplementary company/district/local

2: National only

3: Company/district/local

4: No agreement

**CSZE(1979):** Size of company/business/organisation. Takes values:

00 <10  
 01 10-19  
 02 20-49  
 03 50-99  
 04 100-199  
 05 200-499  
 06 500-999  
 07 1000-1999  
 08 2000-4999  
 09 >5000  
 99 missing

**ESZE(1979):** Size of establishment. Takes values as for CSZE(1979).

The following variables relate to questions which were asked yearly.

**KOS:** Occupation variable. There are over 445 occupations used in the survey. (See

Appendix 3, for a list of the relevant KOS codes)

**AGT:** Collective agreement.

**WBC:** Wages board or council that the employee worked under.

**J12M:** Length of time the employee has spent in the same job with the same employer.

Takes values:

0: no response

1: >12 months

2: <12 months

9: missing

**AREA:** Area. Takes values:

- 00 Greater London(GL)
- 01 South East(excluding Greater London)(SE)
- 02 East Anglia(EA)
- 03 South West(SW)
- 04 West Midlands(WM)
- 05 East Midlands(EM)
- 06 Yorkshire and Humberside(YH)
- 07 North West(NW)
- 08 North(N)
- 09 Wales(W)
- 10 Scotland(S)
- 99 Missing

**SIC:** Industry variable, grouped into 27 categories (see Appendix 4 for a listing of SIC codes)

**TPUB4:** Variable relating to which sector the employee works in. The public sector is divided into 3 categories. Takes values:

- 0: Private sector
- 1: Public Sector(Public Corporations)
- 2: Public Sector(Central Government)
- 3: Public Sector(Local Government)
- 9: Missing

**GPAY:** Gross weekly pay



**APPENDIX 3****OCCUPATION (KOS) CODES**

- 100 General Management.
- 105 Barristers; Solicitors; Clerks to Local Authorities; Secretaries to Professional Bodies.
- 112 Accountants; Economists; Systems Analysts; P.R. Officers.
- 122 Other Professional and Related Supporting Management.
- 124 Teachers(Further/Higher Education); University Academics.
- 125 Teachers(Secondary).
- 134 Teachers(Primary); Social/Welfare workers.
- 136 Medical/Dental Practitioners.
- 147 Other Professional and Related in Education, Welfare and  
Health.
- 156 Literary, Artistic and Sport.
- 160 Scientists
- 171 Engineers.
- 189 Other Professional and Related in Science, Engineering,  
Technology and Similar Fields.
- 211 Managerial(Excluding General Management).
- 222 Clerical.
- 227 Secretarial/Receptionists.
- 238 Machine/Telephone Operators.
- 246 Selling.

- 254 Security and Protective Services.
- 265 Catering/Housekeeping.
- 269 Ambulancemen; Hospital/Hotel Porters.
- 281 Cleaning; Hairdressing; Personal Services.
- 295 Farming, Fishing and Related.
- 327 Materials Processing(Excluding Metals).
- 385 Making and Repairing(Excluding Metal and Electrical).
- 427 } Processing, Making, Repairing and Related.
- 462 }
- 477 Painting, Repetitive Assembling, Product Inspection, Packaging and Related.
- 503 Construction Mining and related.
- 507 Shipping.
- 512 Railway Transport.
- 533 Road Transport; Materials Moving.
- 540 Miscellaneous.

**APPENDIX 4****INDUSTRY (SIC) CODES**

- 1 Agriculture, Forestry and Fishing.
- 2 Mining and Quarrying.
- 3 Food, Drink and Tobacco.
- 4 Coal and Petroleum Products.
- 5 Chemical and Allied Products.
- 6 Metal Manufacture.
- 7 Mechanical Engineering.
- 8 Instrument Engineering.
- 9 Electrical Engineering.
- 10 Shipbuilding and Marine Engineering.
- 11 Vehicles.
- 12 Other Metal Goods.
- 13 Textiles.
- 14 Leather, Leather Goods and Fur.
- 15 Clothing and Footwear.
- 16 Bricks, Glass, Pottery and Cement.
- 17 Timber, Furniture etc.
- 18 Paper, Printing, Publishing.
- 19 Other Manufacturing Industry.
- 20 Construction.



21 Gas, Electricity, Water.

22 Transport and Communications.

23 Distributive Trades.

24 Insurance, Banking, Finance.

25 Professional and Scientific Services.

26 Miscellaneous Services.

27 Public Administration.