# Real Wages and the Demand for Labour in Ghana's Manufacturing Sector

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**WPS/95-7**

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March 1995

**Abstract:** Real wages in Ghana have fallen substantially over the last twenty years. The question posed by this paper is whether this evidence for wage flexibility implies a competitive market clearing labour market. It is argued that it does not. There is sufficient flexibility in the production structure to ensure that a rapid growth of labour demand can be absorbed at declining average real wages while maintaining a substantial differential across workers based on firm characteristics. Indeed it is possible the differential has been increasing in the recent past. Declining real wages are not indicative of a competitive labour market, or of market clearing, in the sense that a uniform wage exists for the same quality of labour. Falling real wages are indicative of a labour market in which social security provisions are absent and investment is insufficient to raise labour demand faster than supply. A decline in wages is associated with a fall in productivity. It is possible that output is rising.

The data used in this paper were collected by a team from the Centre for the Study of African Economies, University of Oxford and the University of Ghana, Legon as part of the Regional Program on Enterprise Development (RPED) organised by the World Bank. The questionnaire was designed by a team from the World Bank. The Ghana part of the study is funded by the Overseas Development Administration (ODA). Ursula Kretzer assisted both in collecting and cleaning the data. Andrew Oswald has offered much useful advice and assistance. All errors are mine.

## 1 Introduction

Two clearly contrasted views of the labour market in developing countries can be identified. One view observes a competitive labour market in which wages are flexible, markets clear and similar labour is equally priced, Rosenzweig (1988). There is evidence from rural labour markets that family workers earn the same wages as hired labour, and that both rural and urban labour markets are highly integrated, Benjamin (1992). The second view observes the converse; labour markets are fragmented in many areas and segmented in others, resulting in a wide dispersion of wage rates. Bevan, Collier and Gunning (1989) argue that in African rural labour market wage differentials are large. In urban areas, the evidence, frequently of an informal nature, of extensive underemployment combined with wage rates in large firms substantially greater than ones in smaller firms, is viewed as confirming the rejection of the competitive market clearing model (Little, Mazumdar and Page (1987) provide a comprehensive survey of the evidence on wage size differentials for developing countries.)

Both views are consistent with dualism in the manufacturing sector. The competitive view would interpret wage differentials across firms of different size as implying that large firms have better qualified and more skilled staff than smaller firms. Part of the differential may be due to differences in the supply price of younger and older workers, an argument advanced by Mazumdar (1983) in his analysis of the Bombay labour market. The second view must implicitly argue that these differentials cannot be explained by human capital related premia for working in larger enterprises. In particular it must be the case that skill differentials do not explain the earning differentials. The observation that larger firms, which are more capital intensive, more dependent on imports, and compete more closely with importable traded goods, co-exist with smaller firms is thus subject to two radically different interpretations.

In addition to cross-section evidence, the first view of African labour markets would point to the substantial falls in real wages over the past twenty year as being wholly inconsistent with any assumption of rigid real wages set by institutional or other factors. The causes of this fall in real wages are contentious. Jamal and Weeks (1993) implicitly view these falls as an indictment of structural adjustment policies. The fact of the fall is however not is dispute. If the second view of labour markets is to be substantiated it must show how the hypothesised rigidity can co-exist with substantial flexibility in real wages over time.

The two views of African labour markets continue to co-exist partly due to conflicts between cross-section and time series data and partly to the inability of most data sets to discriminate between competing hypotheses. To establish the role of institutional factors and rent sharing in the determination of earnings requires individual based information on the skill categories of the individuals and firm level information on profits, size and unionisation.[1] To identify a labour demand curve requires information on labour and capital inputs and factor prices at the level of the firm. If both individual and firm level information is available then it should be possible to show how an earnings function transforms into a labour demand function. It is one of the most widely attested facts in the earnings function literature that the size of a firm, measured by employment, enters positively into the determination of earnings, for example, Brown and Medoff (1989). The competitive view can interpret this result either as a reflection of preferences, individuals prefer small to large firms and must therefore be compensated for working in large firms; or as indicative of firm specific effects such that unobservable characteristics of the individuals are correlated with the size

[1] Oswald (1995) provides a comprehensive review of the comparative evidence for rent sharing as an explanation for observed earnings differentials based on earnings functions in which a profit term appears. Oswald argues that there is evidence for rent sharing being a very important determinant of earnings differentials. One study using developing country data which argues otherwise is Morrison (1994) who tests for institutional and rent sharing effects by assessing whether institutional or rent sharing variables can explain inter-industry wage differentials. He finds that `there is little support for a rent-sharing explanation of interindustry wage differentials in Ecuador', (p.363).

of firms. However the competitive view would argue that the profit rate belongs in the demand for labour function, where it enters with a positive sign. In particular this view would argue that the profit rate should not enter the earnings function and if it were found to be significant this would result from either, or both, of specification error due to the mixing of an earnings function with a labour demand function, or due to the correlation between earnings and firm fixed effects.

In this paper we exploit the existence of a data set that possesses both firm and individual data that enables us to estimate an earning function, a production function and labour demand functions on a similar basis. The data set is a three year panel survey of firms so we can test for the existence of firm fixed effects in each of the functions we consider. The data set has also recall data on earnings so we can examine in more detail than is usually possible for African labour markets the pattern of real wage changes over time. We begin in the next section by setting out the evidence for changes in real wages in Ghana over the period since the 1970s. In section 3 we turn to the relationship between wages and profit rates in both the earnings function and the labour demand function. The evidence on market clearing is considered in section 4. A final section concludes the paper.

## 2. Real Wages in Ghana

While there is no doubt that real wages in Ghana have fallen, both the extent of the fall, and its pattern over time, is uncertain. If the index of the official minimum wages is used, then calculations presented by Adelman (1991, p.76) show that real wages in 1985 were at 28% of their 1975 value, an annualized rate of fall of 12.6% per annum. There are two problems with using minimum wage rates to infer changes in actual wages. The first is that there is much evidence that minimum wages are not paid in the small scale sector and that, in the large firm sector, actual wages are well above minimum wage rates. The second problem with using minimum wage rates is that they do not include allowances which are an important source of wages both at the bottom and the top of the wages scale. Our data allow us to address both these issues more directly than is possible with official statistics.

The results of the RPED survey give three years of data on the wages and allowances of workers in all size of firms. Further, as part of the survey, workers were asked their pay when starting work at their current firm. While this data is problematic, given the very high rates of inflation in Ghana, it nevertheless presents a picture of starting wages for those employees who answered this question. In the following tables we will present the wage data from the RPED surveys for the whole range of workers and apprentices and compare these wages with the official minimum wage data. A comparison of minimum wages rates with starting wages for production workers over the period 1969 to 1994 is presented in table 1. The actual wages data referred to in the table is the recalled starting wages of workers when first employed in their current firm. The data compares recalled starting wages with minimum wage rates for a labourer in the public sector. The two sets of numbers are, therefore, on as comparable a basis as is possible. From 1969 to 1992 actual wages were substantially higher than the official minimum wage confirming the dangers of using the minimum wage rates to infer actual wages. It is striking that, since 1988, minimum wages have risen far faster than these recalled wages such that by 1993 minimum and recalled actual wages were virtually the same. It appears from this data that, far from minimum wages setting a minimum below which the private sector does not fall, higher wages in the private sector have provided a target for the public sector to meet.

Considering the recall data for starting real wages several points emerge from table 1. The first is that the fall in real wages over the period 1969-1985 is much less than is implied by the use of minimum wage rates. Second, there is some evidence of recovery over the period when the

structural adjustment program was begun in 1983. It is probable that the substantial rise shown between 1980 and 1985 is misleading, very few employees started work in this period and the magnitude of the inflation makes assessing real changes hazardous. We are on stronger grounds in the period 1987-1989 when real wages appear to be about the same as in 1980. The data presented in table 1 implies that, while real wages did not rise in the 1980s, the precipitous fall which had occurred in the 1970s did not continue. Third, real starting wages recommenced their fall in the early 1990s such that they were about half the level of the mid 1970s.

The evidence from table 1 does not imply that real wages for all workers fell. By construction the wage index in table 1 is of workers beginning their jobs which means that they are younger than the average of those in employment. In table 2 we look at the wages of all male workers and we also present a decomposition between production workers on the one hand, and managerial and technical workers on the other, over the three waves of the survey. The decomposition we present shows that, while real wages fell on average, they actually increased for the higher paid workers. This suggests that higher paid workers in formal employment were better able to protect their real wage position than both those entering the labour force, and the production workers within the sector.

We can investigate the possibility of a widening gap between lower and higher paid workers further by looking at the data for apprentices' wages. Apprentices are employees working in small firms who are taken on by a master as trainees. Many are not paid and those that are paid receive substantially lower wages that those in larger firms. In table 3 we present the data for the three waves of the survey for male apprentices. Over the three waves of the survey the percentage being paid fell from 91.1% to 89.3% while nominal wages, for those paid, fell. Inflation averaged about 17% over this period (table 1) so real wages for apprentices halved over the two years of the survey.

One way to investigate the causes of this wide, and widening, dispersion of wage rates is to combine an earnings function with a labour demand equation. In order to do this it is necessary to reconcile the individual based data with the firm level information on labour costs.[2] In table 4 we compare the two sources of information. Column [1] of table 4 presents the results of combining workers and apprentices from tables 2 and 3 to give an average wage for all workers in the firms.[3] This data is restricted to male full time employees but, with that qualification, should be the same variable as taking total labour costs of the firm and dividing by the number of employees. This second measure of the average wage by firm is shown in column [2] of table 4. The firm level estimate is substantially below the same variable as measured by looking at individual earnings. There are two possible reasons for this discrepancy. Our decision to restrict the individual level data to full time males, and the exclusion of apprentices who are not paid, means that the individual based data overstates average wage. Such a restriction is necessary as we wish to avoid the problems posed by modelling zero wage apprentices. The advantage, which is essential for the experiment we wish to carry out, is that the individual based data enables us to control for the human capital characteristics of the firms. In Appendix 1 we report earnings functions, in which we compare the earnings variables from the individual based data with that available from the firm level data. It is apparent that the firm level variable is subject to far more serious measurement error than the individual based data. For the remainder of this paper we use the individual based data as our measure of the firm wage rate.

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[2] In the survey workers in the firm were asked their wages, this is what the text refers to as individual based information. Firms were also asked their labour costs and total numbers employed; this is the firm level information.

[3] This average wage combines basic wages with allowances. Allowances are an important source of earnings for both apprentices and those working in larger firms. The relative importance of basic wages and allowances is discussed in Teal (1994).

The second piece of information in table 4 is the profit rate As a prelude to introducing both an earnings function and a labour demand equation we report in the lower part of Table 4 the relationship in the crude data between wages and profit rates. Table 4 equation [1] reports a pooled regression from all three waves of the relationship between wage rates and profits; it is significantly negative. Such an equation would, in terms of the competitive model, describe the factor price frontier for a simple two-factor model. If wages are higher for larger firms, which face lower capital costs, then the positive relationship between wages and size and the negative relationship between size and profit rates will generate the negative relationship we observe in the data. That this is the case is confirmed by equation [2] in table 4 where the inclusion of the size variable removes the significant negative relationship between wage and profit rates. Such a finding leaves open the importance of the profit rate variable once we allow for the differing skill compositions of the firms and for unobservable firm fixed effects. To consider those factors is the object in the next section.

## 3. Earnings Functions, the Demand for Labour and the Rate of profits

The evidence of falling real wages and of a wide dispersion of wages presented above leaves open the fundamental question as to how far the competitive model can explain the dispersion. In this section we establish the relationship between the wage rate and the price of capital measured as the ratio of profits to the value of capital. In table 5 we present an earning equation of the form:

(1) $\text{Ln } w = \alpha_0 + \alpha_1 \text{Education} + \alpha_2 \text{Age} + \alpha_3 \text{Tenure} + \alpha_4 \text{Ln } L + \alpha_5 \text{Ln } r + \alpha_6 \text{Union} + \alpha_7 \text{Ownership} + \text{Sector Dummies} + \text{Location Dummies} + \text{Occupational Dummies}$

The competitive interpretation of this equation is that the wage differentials we observe can be explained by the skill differentials of individuals and compensating differentials. In order to enable us to contrast the competitive with the rent sharing model we include in this equation variables which could be given an interpretation, either in terms of institutional features of the labour market, or rent sharing. In particular we include the price of capital in this equation.[4] The problems of interpretation presented by such an equation are most clearly seem if we write two forms of the labour demand function:

(2) $\text{Ln } L = \beta_0 - \beta_1 \text{Ln } w + \beta_2 \text{Ln } r + \beta_3 \text{Ln } Y$

(3) $\text{Ln } L = \theta_0 - \theta_1 \text{Ln } w + \theta_2 \text{Ln } r + \theta_3 \text{Ln } K$

Equations (2) and (3) are alternative specifications of the labour demand function, equation (2) being the derivative of the cost function and equation (3) the derivative of the restricted profit function.[5] Equation (1) is actually an amalgam of equations (2) and (3) if the competitive model is correct. Our data set enables us to obtain another view of the labour demand functions as we have information

[4]The profit term in the equations surveyed by Oswald (1995) is profits per employee. In this paper we use the natural logarithm of the profit rate in order to establish a parallel between the demand for labour and the earnings function. In order to allow comparison with the equations surveyed by Oswald Appendix 2 reports the results of table 5 using a profits per employee variable.

[5]Equation (2) is open to two interpretations. The one we adopt is that of a demand for labour with both factor prices entering the equation. If competitive factor markets are assumed then the coefficient on the real wage in a regression of value-added per employee against the real wages is an estimate of the elasticity of substitution. As we do not wish to assume the competitiveness of the factor market we do not adopt this approach which has been widely used to estimate the elasticity of substitution, see Hamermesh (1993, pp.29-30).

on labour and capital inputs as well as value-added output so we can estimate a production function. The parameters of equations (2) and (3) depend on the technology of the production function.

$$(4) \qquad \text{Ln } Y = \mu_0 + \mu_1 \text{ Ln } L + \mu_2 \text{ Ln } K + \mu_3 \text{ Ln } L^2 + \mu_4 \text{ Ln } K^2 + \mu_5 \text{ Ln } L * \text{Ln } K$$

Equation (4) presents a translog production function which is used as a basis for the derivation of a production function. These four equations can provide an internally consistent interpretation of the causes of the dispersion of wages and how the demand for labour is changing over time.

Table 5 presents the results of estimating the earnings function. The dependent variable in the regression is the log of wages. In table 5 equations [1] and [2] we use the individual based data, in equations [3] and [4] we move to a firm level of aggregation. We have 1400 individual observations from all three waves. We have included all male workers and apprentices who earn, who work full time. In the table we present the parameter estimates for variables predicted by the competitive human capital model and the rent sharing model. Individual experience is modelled by age and age squared [Age and Age$^2$]. Human capital is measured by Education in years. Firm specific training is captured by a Tenure variable which is the number of years the employee has been working for their present firm. The variable Ln (size), which is a measure of the size of the firm in terms of numbers of employee, has different interpretations depending on the underlying model. The remaining variables, which we would ague all have an interpretation in terms of non-competitive factors in the determination of wages, are whether or not the firm is unionised [Union], the age of the firm [Firm Age], the log of the profit rate [Ln (Profit Rate)] and the presence of foreign [Foreign Ownership] or state ownership [State Ownership]. The regressions reported in table 5 equation [1] also control for location and occupational effects. The only difference between equations [1] and [2] in the table is that equation [2] drops the controls for occupation. This is necessary to ensure that the individual based regression is as comparable as possible with the firm based regression where it is possible to control for all variables except occupation. As a comparison of equations [1] and [2] shows the only effect of dropping the occupational variables is to raise (nearly double) the coefficients on the age variables. All other coefficients are unchanged. If age is picking up the experience acquired with working, of a general rather than specific form, then this finding is wholly consistent with the competitive human capital model. If, on the other hand, jobs in the high paying sector are rationed by queuing then age is picking up another aspect of rent sharing, in that length of time spent waiting is an important determinant of earnings. The F test reported for both equations [1] and [2] shows that the pooling of the data over all three years of the survey is rejected, quite decisively. There are reasons for this, some of which are discussed in Teal (1994). The specification of a labour demand function has to be at the level of the firm so we move from the individuals based data of equations [1] and [2] to a firm level specification in equations [3] and [4]. In equation [3] we report the result of a firm based earning regression using the same variables as for the individual regression. We continue to control for location but not for occupation. Equations [2] and [3] are directly comparable. The effect of moving from individual based to firm level data is to increase still further the coefficient on age. The effects on other coefficients is small, although at a firm level the data cannot distinguish as clearly between size and union effects as appeared to be the case with individual based data.

Finally we turn to a consideration of firm fixed effects. Table 5 equation [4] reports the results of pooling the two years of first differences possible from this three year panel data set. Such a regression is a powerful test of the importance of the profit variables as a genuine explanator of wages. Across the three waves of the survey unionisation, ownership and, by definition, firm fixed effects, do not change. The differenced regression contains the human capital and rent sharing variables. The coefficients on age and education are similar to equation [2]. There is also no change on the coefficient on the profit rate which enters with a positive sign in the determination of wages.

It appears that the rent sharing effect through the profit rate is well defined, highly significant and robust to the move from individual to firm based regressions.

We now need to consider if the profit rate enters the demand for labour as it needs to do if we are to identify a demand for labour function. In the demand for labour employment should be positively related to the profit rate and negatively related to the real wage. In Figure 1 we present the results of a simple regression of the natural log of the wage-rental rate (where the rental rate is the profit rate defined as in the regressions reported in Table 5) on the natural log of the labour-capital ratio. The relationship, which is from the pooling of the three waves of the panel, shows a marked and, as we show below, highly significant negative relationship. Figure 1 could be interpreted as an estimate of the labour demand function (3) above in which a coefficient of unity is imposed on the capital variable. One of the concerns of the investigations that follow is to see how robust is the relationship presented in figure 1. It is clear from table 5 that the profit rate determines the wage rate. Such a relationship implies that any attempt to estimate a demand function for labour in which both wages and profit rates appear will be subject to problems of simultaneity bias. The existence of such bias implies that figure 1 as it stands cannot be used to infer the existence of a labour demand function.

In order to investigate the issue we begin with a consideration of the production function and the degree of substitutability between labour and capital which characterises the Ghanaian manufacturing sector. Table 6 reports the results of estimating equation (4). Equations [1] and [2] use levels data, equations [3] and [4] test for the importance of firm fixed effects by differencing the data. If Cobb-Douglas is supported by the data this implies for (2) that $\beta_1 = \beta_2 = \mu_2$ where $\mu_2$ is the share of capital and for (3) that $\theta_1 = \theta_2 = 1.0$. Table 6 equation [1] is the most general form we estimated. We test for both pooling and the restriction to a Cobb-Douglas form. The data pools and the restrictions to move of a Cobb-Douglas form are rejected by the levels specification in equation [1] but accepted in the differenced specification of equation [3]. Equation [3] shows that the consequence of allowing for firm fixed effects in the regressions is to eliminate the significance of the capital term leaving the coefficient on labour of 0.6. It appears that there is a strong correlation between firm fixed effects and the capital term. It is, of course, possible that both capital and firm fixed effects are important. One way to investigate this is to move to the direct estimation of labour demand functions.

The first estimates of the two forms of the labour demand function considered in this paper, equations (2) and (3) above, are reported in table 7. Equations [1] and [2] report labour demand modelled as a function of factor prices and capital and output respectively. Equations [3] and [4] report the pooled differenced form of these equations. If the underlying technology is Cobb-Douglas then the coefficient on the wage rates should be -1.0 in equation [1] and -0.3 in equation [2]. In fact the wage term is incorrectly signed in equation [1] and the profit term is incorrectly signed in equation [2]. Once again the importance of the firm level fixed effects is apparent. In equation [3] and [4] wages and profits are correctly signed but both the capital stock variables and output are close to zero in value and insignificant. The results of table 7 imply that we cannot estimate a demand for labour function by using OLS. This, indeed, is what is implied by the finding in table 5 that profits are a significant determinant of wages. The effect from profits onto wages ensures that the separate effects of the profit and wage rate on labour, conditioned on the capital stock, cannot be estimated in equation [1]; while the highly significant negative coefficient on the profit rate in equation [2] could be the result of increased wages leading to an increase in productivity which is a decrease in the labour output ratio.

The results of table 7 show that endogeneity prevents us being able to estimate a demand for labour from the data using OLS. One way to proceed is to accept the evidence from the production function for constant returns to scale and attempt a direct estimation of the elasticity of substitution by regressing the log of the labour capital ratio against the log of the wage-rental ratio;

this approach we adopt in Table 8 (a). We could also allow for the endogeneity of output by regressing the log of the labour-output ratio on the relative factor prices; this approach we adopt in Table 8 (b). In both these regressions it will be necessary to instrument the factor price term. In Table 8 for both these regressions we present the levels and differenced regressions, with and without instruments. For the labour-capital ratio instrumenting the level equations produces a coefficient on the relative price term of -1.1 which is not significantly different from unity. Allowing for fixed effects by differencing reduces this coefficient to -0.86, which remains not significantly different from unity. The importance of both instruments and firm level fixed affects is also apparent in the second regression. Once the relative price term is instrumented the coefficient becomes highly significant and negative. However this is not true of the instrumented equation [4].

It might well be argued that the success of the labour capital ratio in Table 8 (a) arises from the failure to allow for the role of human capital variables in the regression. In Tables 9 and 10 we test for the importance of the human capital variables in both the regressions. The striking result in Table 9 is that for the differenced instrumented equation [4] the human capital variables have no affect at all on our estimate of the elasticity of substitution. For the labour-output equation shown in Table 10 the inclusion of the human capital terms and instrumenting the factor price term produces a coefficient of -0.3 on the factor price term which is identical to the share of capital implied by a Cobb-Douglas interpretation of the production function of Table 6. However this result does not survive the differencing reported in Table 10 equation [4]. It is true that, for this specification of the labour demand function, we are unable to obtain significant estimates of the factor price and fixed effects; possibly because the endogeneity in this form of the labour demand function is more serious than for the labour-capital specification.

We would argue, after this very extensive series of tests, that the scatter of points we presented in figure 1 does represent a labour demand function and shows clearly an inverse relationship between the wage rate and employment which is wholly consistent with the positive relationship of wage rates and employment from the earnings function of Table 5. It is also the case that there is strong evidence that the underlying elasticity of substitution is unity. This parameter is of great importance in the context of how far real wages need to fall if markets are to clear. To that question we now turn.

## 4. Labour Market Clearing

The evidence of the previous sections shows both considerable flexibility in wages, in that real wages have fallen very substantially over relatively short periods, and very large differentials based on firm characteristics. Thus we can either speak of a very flexible labour market (by which we would mean real wages can easily fall) or we can speak of a highly rigid labour market (by which we would mean that relative wages depend on institutional factors and rent sharing). Both views, on the evidence presented above, are correct. In this section we briefly review two related pieces of evidence as to the nature of labour market flexibility and the cause of the real wage decline. The first of these is the measured unemployment rate. The second is the level of investment over the period that has seen such a substantial fall in real wages.

During the period under consideration the amount of measured unemployment has scarcely changed. The 1960 census defined an unemployed person as `a person who did not work at any time during the reference month and has no fixed job...and who was looking actively for work by visiting employment agencies, writing applications etc,' Killick (1966). The 1960 census found a male unemployment rate of 6.5%. In the 1984 Census the unemployed `comprised all persons who did not work and had no fixed jobs during the seven days preceding Census Night but were actively looking for work (e.g. by visiting employment agencies, writing applications, seeing relatives to help

secure a job, etc.). Also included in the `Unemployed' category was any person who was not looking for work because he believed that no work was available for him', (p.xx) Ghana (1987). It is arguable that the 1984 census definition of the unemployed is rather wider than that of 1960. The 1984 census gave a figure for unemployment of 6.6%, the same as that of 1960. A survey carried out in 1980 and reported in Ghana (1981) found a slightly lower figures of 4.1% of the total labour force (as distinct from the male labour force). In an economy without a social security system the amount of unemployment, in the sense that the census defined the term, must be limited. Over this period the population, and that is for practical purposes the labour supply, has grown by some 2.5% per annum.

The data from table 1 suggest that real wages over the period 1969/70 to 1989/90 have halved which implies a long run average fall of about 3.5% per annum. The lower is the elasticity of substitution the higher must be the fall in real wages if the labour market is to clear. There is no evidence that the growth of labour to the manufacturing sector has been less that the population growth rate. There is also evidence that real incomes in urban areas remain substantially above rural incomes, Boateng et al (1992).[6] The extent of the fall in real wages necessary to clear the labour market depends on the extent of investment, to that question we now turn.

There are no time series on private manufacturing sector investment. However the RPED survey asked question regarding past investments undertaken by the firms. In the first wave of the survey the investment question was not asked directly, but indirectly, in terms of the major investments undertaken over the last ten years. In the second and third waves the questions was posed directly, as to the amount of investment undertaken in the last year. In the top half of table 11 we present the value of major investment undertaken by the firms in 1990 to 1992 relative to their capital value in 1991. We also present the percentage of firms which undertook any major investment at all. These percentages are presented by size of enterprise. The Table shows that firms reported negligible amounts of major investments over the period 1990-92, but substantial amounts of investment in both 1992 and 1993. Our interpretation of these figures is that most investment is - and continues to be - of a replacement form. The reason for the negligible amounts of major investments reported is that firms failed to see their regular expenditure on replacement equipment as part of any major expansion of capacity. The evidence from Wave 1 of the survey, that very small amounts of major investment had occurred in the Ghanaian manufacturing sector, is consistent with numerous, industry based, studies carried out over this period, which reported on the poor state of the capital stock, and by evidence that shortage of spare parts during the period of quantitative controls on imports prevented any substantial new investment. The very age of the capital stock by the end of the 1980s will imply substantial investment to maintain its fabric.

All this evidence suggests that negligible levels of investment have occurred in Ghana's manufacturing sector over the last ten years. If that is so then the output growth that has occurred will be the result of applying more labour to a given capital stock. If the labour market is to clear then real wages will need to fall. This fall will be associated with falls in productivity as output expands without any commensurate growth of the capital stock. If the elasticity of substitution is unity then a substantial rise in labour demand is possible with a decline in real wages of 3.5% per annum.

## 5. Summary and Conclusions

The size of the fall in real wages in the Ghana economy over the last twenty years has been very substantial. The question posed by this paper has been whether we should interpret such falls as evidence for wage flexibility in the context of broadly competitive labour markets. The potential importance of different labour market institutions in explaining the differential performance of economies has been argued by Fields and Wan (1989). Evidence has been presented that the price of capital enters the earnings function with a positive sign, suggesting that rent sharing is an important determinant of earning differentials. We have also used both

[6] The conclusion by Jamal and Weeks (1993, pp. 102-103) that urban wages fell depends on the use of minimum wage rates. They state, but provide no evidence for the statement, that this fall in real wages eliminated any rural-urban wage gap.

wages and the price of capital to estimate a labour demand function which is consistent with an underlying Cobb-Douglas technology. The survey from which this data is drawn also suggest that negligible amounts of investment have occurred in Ghana's manufacturing sector over the period when real wages have halved. The conclusion to be drawn on the basis of this evidence is that rent sharing explains much of the differentials in the cross-section regressions while the lack of investment explains the movement down a labour demand function. Wages can be described as `rigid' or as `flexible' depending on whether it is the earnings, or the labour demand, function which is the focus of attention.

**Table 1: Minimum Wage Rates and Starting Wages for Production Workers in Ghana: 1969-1994**

| | CPI 1977 = 100 | Minimum Wages (a) Cedis per Month | Actual Wages (b) Cedis per month | Real Minimum Wages 1977 Cedis per month | Real Actual Wages |
|---|---|---|---|---|---|
| 1969 | 13.4 | | 30 | | 224 |
| 1970 | 13.8 | | 35 | | 254 |
| 1973 | 19.6 | | 32 | | 163 |
| 1975 | 29.6 | 54 | 61 | 182 | 206 |
| 1979 | 270.4 | | 475 | | 176 |
| 1980 | 407.5 | 135 | 530 | 33 | 130 |
| 1985 | 3,647.2 | 1890 | 7,390 | 52 | 203 |
| 1987 | 6,352.0 | 3,038 | 9,016 | 48 | 142 |
| 1988 | 8,343.9 | 3,949 | 9,619 | 47 | 115 |
| 1989 | 10,449.3 | 4,944 | 13,568 | 47 | 130 |
| 1990 | 14,341.5 | 6,599 | 15,726 | 46 | 110 |
| 1991 | 16,932.5 | 12,472 | 19,574 | 74 | 116 |
| 1992 | 18,629.7 | 13,719 | 19,916 | 74 | 107 |
| 1993 | 23,279.7 | 21,950 | 20,309 | 94 | 86 |
| 1994 (c) | 28,320.4 | 26,341 | na | 93 | na |

(a) The figures for 1975 and 1980 are adapted from Alderman (1991, p.76) who gives a daily rate. This is converted to a monthly rate by assuming 27 working days per month. The figures from 1985 to 1993 refer to the minimum rate of pay for a labourer in the civil service.

(b) Actual wages are the reported wages of production workers in the RPED survey for their pay when they started work in their current firm. These figures thus refer to the starting pay of workers in the formal, ie wage paying, sector.

(c) The CPI for 1994 is based on year to year movements from June 1994 to June 1993

**Table 2: Nominal and Real Wages for Male Workers in Ghana: Evidence from the RPED Surveys 1992-1994 in Cedis per month (a)**

| | | Production Workers | | Managerial and technical Workers | | All Workers (b) | |
|---|---|---|---|---|---|---|---|
| | | Nominal | Real | Nominal | Real | Nominal | Real |
| 1992 | Mean | 27,139 | 146 | 48,805 | 262 | 33,993 | 183 |
| | Std | 12,188 | | 33,758 | | 22,748 | |
| | N | 225 | | 118 | | 440 | |
| 1993 | Mean | 31,173 | 134 | 67,434 | 290 | 45,884 | 197 |
| | Std | 15,822 | | 52,727 | | 37,094 | |
| | N | 242 | | 142 | | 511 | |
| 1994 | Mean | 34,415 | 122 | 80,017 | 283 | 48,961 | 173 |
| | Std | 14,073 | | 62,911 | | 40,428 | |
| | N | 329 | | 155 | | 772 | |

Mean is the mean of the sample, Std is the standard deviation and N is the number of observations.
(a) Nominal wages are in cedis per month. Real wages are in 1977 cedis per month.
(b) All workers includes production, managerial, technical and all other categories of workers surveyed.

**Table 3: Real Wages for Male Apprentices in Ghana: Evidence from the RPED Surveys 1992-1994 in Cedis per month (a)**

| | | Percentage being paid | Nominal Average Wages | Nominal Wages if paid | Real Wages if paid |
|---|---|---|---|---|---|
| 1992 | Mean | 91.1 | 8,221 | 9,020 | 48.4 |
| | Std | 28.5 | 7,455 | 7,332 | |
| | N | 158 | 158 | 144 | |
| 1993 | Mean | 89.4 | 7,523 | 8,408 | 36.1 |
| | Std | 30.8 | 6,930 | 6,799 | |
| | N | 152 | 152 | 136 | |
| 1994 | Mean | 89.3 | 6,194 | 6,940 | 24.5 |
| | Std | 31.0 | 6,337 | 6,310 | |
| | N | 243 | 242 | 216 | |

Mean is the mean of the sample, Std is the standard deviation and N is the number of observations.
(a) Nominal wages are in cedis per month. Real wages are in 1977 cedis per month.

**Table 4: Real Wages for Workers and Apprentices and Profit Rates in Ghana: Evidence from the RPED Surveys 1992-1994**

| | | Male Workers and Apprentices who are paid Individual Level Data [1] | All Employees Firm level Data [2] | Profit Rate [3] |
|---|---|---|---|---|
| 1992 | Mean | 25,979 | 15,797 | 2.34 |
| | Std | 17,625 | 14,093 | 5.53 |
| | N | 135 | 108 | 92 |
| 1993 | Mean | 33,384 | 23,954 | 4.08 |
| | Std | 22,408 | 20,475 | 20.1 |
| | N | 137 | 123 | 107 |
| 1994 | Mean | 37,044 | 30,255 | 1.47 |
| | Std | 24,746 | 27,174 | 4.51 |
| | N | 146 | 119 | 111 |

**A Regression of Wage Rate on the profit Rate: Dependent Variable: Ln (Wage Rate)**

| | Equation [1] | Equation [2] |
|---|---|---|
| Constant | 9.71 | 8.38 |
| | [97.8] | [59.1] |
| Ln (Profit Rate) | -0.08 | -0.004 |
| | [3.3] | [0.21] |
| Ln (Size) | | 0.42 |
| | | [11.4] |
| Wave 2 | 0.28 | 0.36 |
| | [2.1] | [3.3] |
| Wave 3 | 0.34 | 0.40 |
| | [2.5] | [3.6] |
| Adjusted $R^2$ | 0.06 | 0.36 |
| F [DF] (a) | 0.51 [2,275] | 0.23 [4,269] |
| $\chi^2$ (White test) [DF] (b) | 10.8 [6] | 15.7 [11] |
| Number of Obs. | 281 | 278 |

(a) The F statistic is a test for pooling of all three waves of the data. All the regressions accept pooling at the 1% significance level.
(b) The White test accepts the null of homoscedastic errors for both the regressions.
The absolute value of t statistics are in [ ] parentheses.

**Table 5 Earnings Equation for All workers and Apprentices who earn: Full Time and Male Dependent Variable**

| **Ln (Wage Rate)** | Individual Based Data (a) Equation [1] | Equation [2] | Firm Averaged Data Levels Equation [3] | Differenced Equation [4] |
|---|---|---|---|---|
| Constant | 6.47 | 5.49 | 4.99 | 0.18 |
| | [29.2] | [22.4] | [9.7] | [2.1] |
| Age | 0.09 | 0.17 | 0.21 | 0.16 |
| | [9.1] | [15.8] | [6.7] | [2.9] |
| $Age^2$ | -0.001 | -0.002 | -0.002 | -0.002 |
| | [7.2] | [12.6] | [5.2] | [2.3] |
| Education | 0.03 | 0.035 | 0.037 | 0.045 |
| (in years) | [5.7] | [6.2] | [2.4] | [1.9] |
| Tenure | 0.014 | 0.016 | 0.016 | -0.01 |
| | [4.0] | [4.3] | [1.4] | [0.4] |
| Ln (Size) | 0.09 | 0.09 | 0.11 | -0.002 |
| | [4.3] | [3.9] | [2.5] | [0.02] |
| Union | 0.33 | 0.37 | 0.17 | |
| | [6.3] | [6.1] | [1.5] | |
| Firm | -0.01 | -0.01 | -0.007 | |
| Age | [5.4] | [4.2] | [1.8] | |
| Ln (Profit | 0.05 | 0.06 | 0.04 | 0.06 |
| Rate) | [6.0] | [5.9] | [2.3] | [2.2] |
| Foreign | 0.22 | 0.20 | 0.17 | |
| Ownership | [4.3] | [3.6] | [1.7] | |
| State | 0.29 | 0.31 | 0.09 | |
| Ownership | [3.6] | [3.3] | [0.5] | |
| Wave2 | 0.27 | 0.27 | 0.25 | |
| | [6.0] | [5.5] | [2.9] | |
| Wave3 | 0.46 | 0.38 | 0.44 | 0.07 |
| | [10.6] | [7.9] | [5.1] | [0.6] |
| Adjusted $R^2$ | 0.68 | 0.58 | 0.63 | 0.14 |
| F [DF] (b) | 5.34 [54,1317]* | 3.6 [40,1338] * | 0.93 [37,217] | 0.87 [6,103] |
| $\chi^2$ (White test) [DF] | 462 [361] | 330 [211] | 192.8 [187] | 29.3 [34] |
| Number of Obs. | 1400 | 1399 | 277 | 117 |

(a) Equation [1] and [2] both control for sector and location effects. Equation [1] also controls for occupation while equation [2] does not. (b) The F test is a test for the validity of pooling the regression, * indicates pooling is rejected at the 1% significance level. The absolute value of t statistics are in [ ] parentheses.

**Table 6 Production Functions Dependent Variable Ln (Value-added)**

| | Level Equations | | Differenced Equations | |
|---|---|---|---|---|
| | Equation [1] | Equation [2] | Equation [3] | Equation [4] |
| Intercept | 6.19<br>[2.9] | 8.21<br>[21.7] | 0.15<br>[1.2] | 0.15<br>[1.2] |
| Ln (Labour) | -0.44<br>[0.9] | 0.73<br>[9.6] | 0.96<br>[1.0] | 0.6<br>[3.2] |
| Ln (Capital) | 0.80<br>[2.5] | 0.33<br>[10.1] | 0.39<br>[0.9] | -0.01<br>[0.11] |
| Ln (Labour)$^2$ | 0.03<br>[0.51] | | 0.02<br>[0.1] | |
| Ln (Capital)$^2$ | -0.02<br>[1.5] | | -0.01<br>[0.5] | |
| Ln (Labour)*<br>Ln (Capital) | 0.06<br>[1.1] | | 0.01<br>[0.1] | |
| Year Dummy<br>1992 | 0.17<br>[1.1] | 0.14<br>[0.9] | | |
| Year Dummy<br>1993 | 0.12<br>[0.8] | 0.08<br>[0.5] | 0.14<br>[0.8] | 0.13<br>[0.8] |
| Adjusted $R^2$ | 0.69 | 0.68 | 0.03 | 0.036 |
| F [ DF](a) | 0.63 [10,412] | 0.15 [4,421] | 0.87 [5,191] | 0.16 [2,214] |
| F [DF] (b) | 4.4 [3,422] | | 0.66 [3,213] | |
| White $\chi^2$ [DF] (c) | 31.2 [26] | 7.8 [11] | 28.1 [26] | 7.7 [8] |
| Number of Obs. | 430 | 430 | 220 | 220 |

(a) This F statistic is a test for pooling. All the regressions accept pooling at the 1% significance level.
(b) This F statistic is a test for restricting the trans-log specification to the Cobb-Douglas form. Equation [1] rejects and equation [3] accepts the restrictions at the 1% significance level.
(c) The White test accepts the null of homoscedastic errors for all the regressions.
The absolute value of t statistics are in [ ] parentheses.

The regressions reported in this table use the maximum possible sample from the three waves of the data. The sample is not restricted to those firms for which individual based data is available.

**Table 7 Demand for labour Dependent Variable Ln (Labour)**

| | Level Equations | | Differenced Equations (a) | |
|---|---|---|---|---|
| | Equation [1] | Equation [2] | Equation [3] | Equation [4] |
| Intercept | -3.7<br>[7.8] | -4.08<br>[9.9] | 0.11<br>[1.79] | 0.09<br>[1.5] |
| Ln (Wage Rate) 0.05 | -0.11<br>[0.8] | -0.007<br>[1.9] | -0.02<br>[0.10] | <br>[0.32] |
| Ln (Profit Rate) 0.17 | -0.15<br>[6.6] | 0.06<br>[-8.5] | 0.04<br>[2.2] | <br>[1.23] |
| Ln (Capital) | 0.41<br>[20.8] | | 0.002<br>[0.05] | |
| Ln (Value-added) | | 0.52<br>[20.8] | | 0.06<br>[1.12] |
| Year Dummy 1992 | -0.29<br>[2.8] | -0.24<br>[2.6] | | |
| Year Dummy 1993 | -0.36<br>[3.3] | -0.31<br>[3.3] | -0.10<br>[1.1] | -0.09<br>[1.08] |
| Adjusted $R^2$ | 0.69 | 0.76 | 0.05 | 0.06 |
| F [DF] (b) | 0.34 [6,266] | 0.20 [6,266] | 1.1 [3,109] | 0.99 [3,109] |
| White $\chi^2$ [DF] (c) | 15.3 [17] | 19.1[17] | 13.7 [13] | 11.9 [13] |
| Number of Obs. | 278 | 278 | 117 | 117 |

All equations are estimated by OLS.
(a) These differenced equations are the result of pooling the two first differences available from the three waves of the survey.
(b) This F statistic is a test for pooling. All the regressions accept pooling at the 1% significance level.
(c) The White test accepts the null of homoscedastic errors for all the regressions.
The absolute value of t statistics are in [ ] parentheses.

**Table 8 Direct Estimates of the Elasticity of Substitution**:

| **(a) Dependent Variable** | **Ln (Labour/Capital)** | | | |
|---|---|---|---|---|
| | Level Equations | | Differenced Equations | |
| | Equation [1] | Equation [2] | Equation [3] | Equation [4] |
| Intercept | -5.65 | -0.50 | -0.31 | 0.08 |
| | [15.5] | [0.22] | [2.45] | [0.3] |
| Ln (WageRate/ | -0.69 | -1.13 | -0.43 | -0.86 |
| Profit Rate) | [21.5] | [5.6] | [9.5] | [3.34] |
| Year Dummy | -0.22 | -0.47 | | |
| 1992 | [1.1] | [1.8] | | |
| Year Dummy | -0.39 | -0.96 | 0.13 | -0.13 |
| 1993 | [1.9] | [3.7] | [0.71] | [0.5] |
| Adjusted $R^2$ | 0.64 | 0.14 | 0.43 | 0.07 |
| F [DF] (a) | 0.76 [2,272] | | 1.31 [1,113] | |
| White $\chi^2$ [DF] (b) | 5.95 [6] | 5.6 [4] | | |
| Number of Obs. | 277 | 277 | 117 | 116 |
| Method (c) | OLS | IV | OLS | IV |

| **(b) Dependent Variable** | **Ln(Labour/Value-added)** | | | |
|---|---|---|---|---|
| | Level Equations | | Differenced Equations | |
| | Equation [1] | Equation [2] | Equation [3] | Equation [4] |
| Intercept | -12.5 | -5.72 | -0.31 | -0.24 |
| | [-34.1] | [-2.24] | [-2.6] | [-1.3] |
| Ln (WageRate/ | -0.03 | -0.64 | 0.30 | 0.12 |
| Profit Rate) | [1.1] | [2.8] | [7.1] | [0.6] |
| Year Dummy | -0.35 | -0.41 | | |
| 1992 | [1.8] | [1.4] | | |
| Year Dummy | -0.46 | -0.45 | -015 | -0.06 |
| 1993 | [2.4] | [1.5] | [0.8] | [0.31] |
| Adjusted $R^2$ | 0.02 | 0.03 | 0.29 | -0.01 |
| F [DF](a) | 0.76 | [2,272] | 1.51 | [1,113] |
| White $\chi^2$ [DF] (b) | 15.5[6] | 3.3 [4] | | |
| Number of Obs. | 278 | 277 | 117 | 116 |
| Method (c) | OLS | IV | OLS | IV |

(a) The F statistic is a test for pooling the three waves of the data. Both the OLS regressions accept pooling at the 1% significance level.
(b) The White test accepts the null of homoscedastic errors for all the regressions.

(c) The instruments used were the amounts of formal and informal borrowing and the size of the overdraft. All deflated by the number of employees.
The absolute value of t statistics are in [ ] parentheses.

**Table 9 The Demand for Labour Allowing for Human Capital Effects**
**Dependent Variable Ln(Labour/Capital)**

| | Level Equations | | Differenced Equations | |
|---|---|---|---|---|
| | Equation [1] | Equation [2] | Equation [3] | Equation [4] |
| Constant | -2.49<br>[2.9] | 1.80<br>[0.97] | -0.30<br>[2.2] | 0.04<br>[0.17] |
| Ln (Wage Rate/ Profit Rate) | -0.54<br>[14.9] | -0.47<br>[2.9] | -0.43<br>[9.4] | -0.87<br>[3.2] |
| Education | -0.12<br>[3.9] | -0.17<br>[4.9] | -0.04<br>[1.1] | -0.08<br>[1.6] |
| Age | -017<br>[3.2] | -0.38<br>[6.2] | 0.10<br>[1.2] | 0.002<br>[0.02] |
| $Age^2$ | 0.002<br>[2.2] | -.004<br>[4.1] | -0.001<br>[1.1] | -0.0001<br>[0.05] |
| Wave 2 | -0.18<br>[1.0] | -0.27<br>[1.4] | | |
| Wave 3 | -0.53<br>[2.9] | -0.98<br>[4.8] | 0.10<br>[0.51] | -0.05<br>[0.17] |
| Adjusted $R^2$ | 0.70 | 0.54 | 0.43 | 0.07 |
| F [DF](a) | 1.52 [8,263] | | 0.73 [4,107] | |
| White $\chi^2$ [DF] (b) | 19.9 [24] | | 15.3 [19] | |
| Number of Obs. | 278 | 277 | 117 | 116 |
| Method (c) | OLS | IV | OLS | IV |

(a) The F statistic is a test for pooling the two sets of differences made possible by the three waves of the data.
(b) The White test accepts the null of homoscedastic errors for both the regressions.
(c) The instruments used were the amounts of formal and informal borrowing and the size of the overdraft. All deflated by the number of employees.
The absolute value of t statistics are in [ ] parentheses.

**Table 10 The Demand for Labour Allowing for Human Capital Effects**
**Dependent Variable Ln(Labour/Value-added)**

| | Level Equations | | Differenced Equations | |
|---|---|---|---|---|
| | Equation [1] | Equation [2] | Equation [3] | Equation [4] |
| Constant | -7.31<br>[10.0] | -4.0<br>[1.9] | -0.31<br>[2.4] | -0.19<br>[0.98] |
| Ln (Wage Rate/ Profit Rate) | 0.19<br>[6.3] | -0.3<br>[1.76] | 0.31<br>[7.0] | 0.09<br>[0.45] |
| Education | -0.09<br>[3.3] | -0.06<br>[1.62] | -0.023<br>[0.64] | 0.002<br>[0.07] |
| Age | -0.34<br>[7.1] | -0.24<br>[3.44] | -0.04<br>[0.45] | 0.009<br>[0.095] |
| $Age^2$ | 0.004<br>[5.2] | 0.002<br>[2.6] | 0.0003<br>[0.24] | -0.0003<br>[0.27] |
| Wave 2 | -0.29<br>[1.9] | -0.31<br>[1.4] | | |
| Wave 3 | -0.67<br>[4.2] | -0.47<br>[2.1] | -0.12<br>[0.61] | -0.08<br>[0.42] |
| Adjusted $R^2$ | 0.38 | 0.17 | 0.28 | -0.03 |
| F [DF](a) | 0.80 [8,263] | | 1.87 [4,107] | |
| White $\chi^2$ [DF] (b) | 22.9 [24] | | 9.8 [19] | |
| Number of Obs. | 278 | 277 | 118 | 116 |
| Method | OLS | IV | OLS | IV |

(a) The F statistic is a test for pooling the two sets of differences made possible by the three waves of the data
(b) The White test accepts the null of homoscedastic errors for both the regressions.
(c) The instruments used were the amounts of formal and informal borrowing and the size of the overdraft. All deflated by the number of employees.
The absolute value of t statistics are in [ ] parentheses.

**Table 11 Investment in Ghana by Firm Size**

| Firm Size | | Major Investments in 1990-92 to 1991 Capital Value (Percent) | Percentage of Firms with any major investment in 1990-92 |
|---|---|---|---|
| Large | Mean | 3.3 | 50 |
| | Std | 6.3 | 51.1 |
| | N | 18 | 22 |
| Medium | Mean | 1.7 | 59.2 |
| | Std | 3.1 | 50.1 |
| | N | 16 | 27 |
| Small | Mean | 2.5 | 50.0 |
| | Std | 5.3 | 50.3 |
| | N | 70 | 78 |
| Micro | Mean | 2.5 | 23.5 |
| | Std | 6.1 | 43.1 |
| | N | 31 | 34 |
| Total | Mean | 2.5 | 45.9 |
| | Std | 5.4 | 50.0 |
| | N | 135 | 161 |

| Firm Size | | Investment to Capital Value | | Percentage of Firms Investing | |
|---|---|---|---|---|---|
| | | 1992 (Percent) | 1993 (Percent) | 1992 | 1993 |
| Large | Mean | 11.3 | 6.5 | 72.7 | 72.7 |
| | Std | 16.9 | 9.2 | 45.6 | 45.6 |
| | N | 17 | 20 | 22 | 22 |
| Medium | Mean | 28.9 | 13.0 | 56.1 | 70.6 |
| | Std | 64.9 | 20.6 | 50.2 | 46.2 |
| | N | 32 | 29 | 41 | 34 |
| Small | Mean | 11.3 | 10.8 | 55.4 | 44.4 |
| | Std | 28.6 | 34.2 | 50.0 | 50.0 |
| | N | 72 | 76 | 83 | 81 |
| Micro | Mean | 8.2 | 5.9 | 36.0 | 44.4 |
| | Std | 26.6 | 13.7 | 49.0 | 50.6 |
| | N | 21 | 24 | 25 | 27 |
| Total | Mean | 14.8 | 9.9 | 54.9 | 53.7 |
| | Std | 39.1 | 26.8 | 49.9 | 50.0 |
| | N | 142 | 149 | 171 | 164 |

Mean is the mean, Std is the standard deviation and N is the number of observations.

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**Appendix 1 Earnings Equation for All workers and Apprentices who earn: Full Time and Male**
**Dependent Variable Ln (Wages)**

| | Individual Based Data | Firm Based Data |
|---|---|---|
| Constant | 4.99 | 7.84 |
| | [9.7] | [9.5] |
| Age | 0.21 | 0.16 |
| | [6.7] | [3.2] |
| $Age^2$ | -0.002 | -0.002 |
| | [5.2] | [2.2] |
| Education | 0.037 | 0.02 |
| (in years) | [2.4] | [0.8] |
| Tenure | 0.015 | -0.002 |
| | [1.4] | [0.15] |
| Ln (Size) | 0.11 | -0.003 |
| | [2.5] | [0.1] |
| Union | 0.17 | 0.37 |
| | [1.5] | [1.99] |
| Firm | -0.007 | 0.005 |
| Age | [1.8] | [0.8] |
| Ln (Profit | 0.04 | 0.07 |
| Rate) | [2.3] | [2.5] |
| Foreign | 0.17 | 0.31 |
| Ownership | [1.7] | [1.9] |
| State | 0.09 | 0.27 |
| Ownership | [0.5] | [0.9] |
| Wave2 | 0.24 | 0.28 |
| | [2.9] | [2.0] |
| Wave3 | 0.44 | 0.54 |
| | [5.1] | [3.9] |
| Adjusted $R^2$ | 0.63 | 0.39 |
| F [DF] (a) | 0.93 [37,217] | 0.89 [38,210] |
| $\chi^2$ (White test) [DF] | 192.8 [187] | 173.6 [187] |
| Number of Obs. | 277 | 270 |

(a) The F test is a test for the validity of pooling the regression. both regressions accept pooling at the 1% significance level.
The absolute value of t statistics are in [ ] parentheses.

**Appendix 2 Earnings Equation for All workers and Apprentices who earn: Full Time and Male**

| **Dependent Variable** | Individual Based Data | | Firm Averaged Data | |
|---|---|---|---|---|
| **Ln (Wage Rate)** | (a) | | Levels | Differenced |
| | Equation [1] | Equation [2] | Equation [3] | Equation [4] |
| Constant | 6.49 | 5.49 | 4.99 | 0.14 |
| | [36.4] | [28.2] | [11.2] | [2.0] |
| Age | 0.09 | 0.16 | 0.21 | 0.17 |
| | [10.9] | [17.8] | [7.9] | [3.6] |
| $Age^2$ | -0.001 | -0.002 | -0.002 | -0.002 |
| | [8.9] | [14.3] | [6.45] | [3.1] |
| Education | 0.026 | 0.035 | 0.035 | 0.027 |
| (in years) | [5.7] | [7.2] | [2.6] | [1.51] |
| Tenure | 0.006 | 0.012 | 0.008 | 0.01 |
| | [2.4] | [3.5] | [0.9] | [0.7] |
| Ln (Size) | 0.07 | 0.09 | 0.13 | -0.003 |
| | [4.3] | [4.5] | [3.6] | [0.032] |
| Union | 0.28 | 0.29 | 0.12 | |
| | [6.1] | [5.6] | [1.2] | |
| Firm | -0.007 | -0.007 | -0.007 | |
| Age | [4.8] | [4.3] | [2.1] | |
| Profit per | 0.039 | 0.036 | 0.023 | 0.068 |
| Employee | [3.5] | [2.8] | [0.96] | [1.6] |
| Foreign 0.15 | | 0.15 | 0.13 | |
| Ownership | [3.5] | [3.1] | [1.4] | |
| State | 0.08 | 0.05 | -0.06 | |
| Ownership | [1.3] | [0.7] | [-0.4] | |
| Wave2 | 0.22 | 0.24 | 0.25 | |
| | [5.8] | [5.5] | [3.4] | |
| Wave3 | 0.39 | 0.31 | 0.42 | 0.11 |
| | [10.8] | [7.6] | [5.7] | [1.1] |
| Adjusted $R^2$ | 0.66 | 0.56 | 0.62 | 0.14 |
| F [DF] (b) | 3.23 [54,1726]* | | 1.1 [42,213] | 0.77 [6,159] |
| $\chi^2$ (White test) [DF] | 613 [368] | 403 [216] | 207.9[199] | |
| Number of Obs. | 1810 | 1810 | 347 | 173 |

(a) Equation [1] and [2] both control for sector and location effects. Equation [1] also controls for occupation while equation [2] does not. (b) The F test is a test for the validity of pooling the regression, * indicates pooling is rejected at the 1% significance level. The absolute value of t statistics are in [ ] parentheses.