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What Constrains the Demand for Labour in Firms in Sub-Saharan Africa?

Some Evidence from Ghana

Francis Teal (University of Oxford and IZA)

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ABSTRACT

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Employment in Ghana's manufacturing sector remained constant as a share of total employment from 1962 to 2014 at just over 10 per cent. However the share of employment in small scale enterprises, those employing less than 10, doubled in urban areas from 33 to 64 percent of the total. Such enterprises have much lower levels of labour productivity than larger ones. In this paper the possible reasons for this pattern of job expansion in the lower productivity sector are examined by combining census and survey data. It is shown that large firms use a much more capital intensive technology than smaller ones, face lower capital costs and pay higher wages. Possible reasons for these patterns of factor demand and factor prices are examined. Hypotheses that explain higher wages in larger firms include efficiency wages, rent capture, market frictions in search models and a rising labour supply function. Hypotheses that explain lower capital cost include differential access to financial markets and growth for more efficient firms. Matched panel data for workers and firms is available so the role of unobservables can be investigated. Evidence is presented that, conditioning on their efficiency, older firms are not larger. Larger firms face rising labour costs due to a rising supply curve for labour. Such rising costs may well reflect the high returns to physical capital in smaller enterprises.

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Ghana, manufacturing firms, labour demand, wages

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Outline of paper

1 Introduction

In this paper we document that the pattern of firm formation and growth in Ghana's manufacturing sector since independence has resulted in employment being increasingly concentrated in small firms which have low productivity and pay low wages relative to larger firms. The question which we propose to answer is: what explains this outcome? In addressing that question we use both census data for the manufacturing sector which covers the years from 1962 to 2014 and a panel survey of firms which covers the period from 1991 to 2003. The census data enables us to show the scale of this increase in small scale employment which was not only in firms but in enterprises classified as self-employed ones with employees. We need to explain not simply small firm growth but how wage employment in firms links to self-employment opportunities.

Teal (2016) uses the census for 1987 and 2003 to address the question, which has been prominent in discussions of firm growth in Africa, as to the existence of a 'missing middle' where it is argued small firms are limited in their ability to grow while larger firms benefit from privileged access to capital markets. While the existence of a 'missing-middle' depends in part on how that is defined and in part on whether the self-employed enterprises with employees are included in the definition of firm what was clear was the dominance of larger firms in the share of value-added. Using a wider definition of a firm, which includes self-employed with employees enterprises, in 2003 the top 1 per cent of firms produced 63 per cent of value-added. If the narrow definition of firm used in the manufacturing census is applied than the top 1 per cent of firms in 2003 were producing 72 per cent of value-added. Such findings, which result from the far higher productivity of larger firms, deepen the puzzle as to the extent of small firms in the distribution. It may well be that small firms are limited in their ability to expand but why do these larger, far more productive firms, not expand employment far more?

The use of firm panel data allows us to address that question directly by estimating both production and earnings function to assess the constraints on the growth of large firms. Firms may choose to pay efficiency wages thus creating a pool of workers willing to work at the going firm wage but whom the firm has no incentive to employ. This can be tested with a production function in which the average earnings of workers in the firm is added as a potential reason for higher productivity. In contrast higher earnings in larger firms may reflect their greater profitability and the ability of workers to capture these rents. This hypothesis can be tested with the earnings function with rents as a regressor.

The efficiency wage and rent sharing model have in common that they are non-competitive theories of the labour market. The evidence they seek to explain are the very large differences in wages and incomes observed across sectors. The most influential model of the links between sectors in developing countries is that due to Lewis (1954), a model which recently celebrated its sixtieth birthday Gollin (2014). While the mechanisms differ all these non-competitive theories have the prediction that workers willing to work for the going rate of wages in firms are rationed out of the firm labour market. This view that labour markets are segmented has been very influential in the modelling of such markets.

In contrast are models based on sorting across occupations and types of employment and search based on market frictions. A paper arguing that the rural urban income gap can be explained by sorting, not any form of segmentation, is Young (2013). In the analysis of developed country labour markets search models as set out in Mortensen (2003) have hypothesised that market frictions may set up heterogeneity in wage outcomes that need neither efficiency wages, nor rent sharing, nor sorting to explain. What both sorting and search models have in common is their focus on the importance of unobservables in the outcomes we observe in the labour market. Given our panel data we can obtain estimates of the unobserved factors determining both production and earnings. If sorting is an important feature we should expect to see a correlation between these unobserved aspect of workers and firms in contrast to search models which predict their absence. Further in contrast to the infinitely elastic labour supply of workers to firms predicted by the segmented view of the labour market we would expect an upward sloping supply curve of labour to firms. Increased supply requires a compensation for the opportunity costs of moving from the self-employed to the firm sector.

In the next section the firm census data is presented showing the changing patterns of job growth in Ghana's manufacturing sector over the period from 1962 to 2014. The issues that arise in modelling the demand for labour in Africa economies are briefly discussed in section 3. Section 4 outlines a framework for efficiency wages, rent sharing and sorting models of the labour market. The data are presented in section 5. Sections 6 and 7 present the earnings and production functions respectively. The determinants of firm size are analysed in section 8. Whether segmentation, searching or sorting explain what we observe in the labour market is considered in section 9. A final section concludes.

2 Manufacturing firms and employment in Ghana 1962 -2014

In this section the pattern of manufacturing employment growth in Ghana is examined for the years 1962, 1987, 2003 and 2014, four years in which Ghana undertook a census of its manufacturing firms. These censuses enable us to understand changes in employment across the size distribution of firms. Such changes are important, in part, because of the view that there is a 'missing-middle' of firms which arises due to the constraints on firm growth and, in part, due to the very different wages paid across the size distribution.

For Ghana's manufacturing sector the 1962 census recorded 95,158 enterprises with an average size of 3 employees and total employment of 254,247, the 1987 census recorded 8,349 enterprises with an average size of 19 and total employment 157,084, the 2003 census recorded 26,088 enterprises with an average size of 9 and total employment of 243,516 and the 2014 census recorded 99,437 enterprises with an average size of 4 and total employment of 437,316, Ghana Central Bureau of Statistics (1965), GSS (Ghana Statistical Service) (1989, 2006, 2015). Teal (2016) argues that to understand the reasons for this pattern of falling and then rising number of firms two aspects of how these censuses were conducted need to be considered. The first is that the 1962 census included enterprises run by the self-employed, these were it appears excluded from the later censuses. The second difference is in coverage. The 1962 and 2014 censuses included both urban and rural areas, the 1987 and 2003 censuses were confined to urban areas.

In Table 1 the data for the four censuses is presented on as consistent a basis as possible. The coverage is confined to urban areas and an estimate has been made of the number of self-employed enterprises with employees so that the pattern of growth of both firms, widely defined, and employment since 1962 can be seen. Figure 1 summarise how firms, using this broad definition, have evolved over the period from 1962 to 2014.

Table 1 shows the dangers of generalising even within a single country as to the patterns of firm and employment growth over time as these patterns are very different over the sub-periods for which we have data. In the first sub-period, 1962 to 1987, large firms, those employing more than 100, grew far more rapidly than medium and small ones. In the second sub-period, 1987 to 2003 this pattern was completely reversed with an explosion in the growth of the number of small firms, those employing fewer than 10. In the most recent sub-period, from 2003 to 2014, while small firm growth slowed it continued at a much higher rate than for larger firms. This pattern of firm growth has meant that while large firms have increased in number by 2.5 times from 1962 to 2014, the increase for small ones was 5 times. Small firms which employed 32 per cent of the manufacturing workforce in 1962, employed 64 per cent by 2014.

Figure 1 shows in graphical form this pattern of firm and employment growth over this period where in the left hand panel large firms are scarcely visible, while their much greater importance in numbers of employed is shown in the right hand panel. Another ddistinctive feature of the pattern of firm size changes shown in the Figure is the growth in the number of self-employed enterprises with employees. Their number more than tripled between 1987 and 2003 a faster growth rate than that of firms recorded in the manufacturing census. Their growth slowed from 2003 to 2014 but there are still twice as many of them as there are small firms. Teal (2016) shows that the tiny number of large firms dominate value-added given their much greater productivity. We show below that they are also by far the highest paying

part of the firm size distribution. Our objective is to explain why there has been this substantial switch into employment in low productivity, low wage enterprises.

Table 1 Manufacturing Firms and Self-employment Establishments with Employees (SEEE) by Size: An Urban Based Estimate

	Number of Firms and SEEE				Employment in Firms and SEEE			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
No. of Employees	1962 (a)	1987 (b)	2003 (b)	2014(e)	1962 (c)	1987 (d)	2003 (d)	2014(e)
Firms 1-4		2,919	14,067	30,000		7,283	29,296	59,857
SEEE 1-4		16,250	52,438	75,800		40,625	131,095	189,500
Total 1-4	19,900	19,169	66,505	105,800	21,227	47,908	160,391	249,357
5-9	1,561	3,391	8,036	14,202	8,586	21,214	57,237	87,477
Small	21,461	22,560	74,541	120,002	29,813	69,122	217,628	336,834
10-19	765	775	2,160	2,935	8,415	10,474	35,092	36,297
20-29	246	243	559	588	5,909	5,891	12,314	13,465
30-49	132	166	425	394	4,921	6,354	7,858	14,391
50-99	105	161	276	237	7,212	11,455	7,709	15,566
Medium	1,248	1,345	3,420	4,154	26,457	34,174	62,973	79,719
100-199	58	83	121	128	7,840	12,269	9,548	17,588
200-499	38	57	90		11,000	17,671	19,010	
500+	14	49	44	140	14,045	44,661	30,226	88,719
Large	110	189	255	268	32,885	74,601	58,784	106,307
Total	22,819	24,094	78,216	124,424	89,155	177,897	339,385	522,860
Total (excluding SEEE)	NA	7,844	25,778	48,624	NA	137,272	208,290	333,360

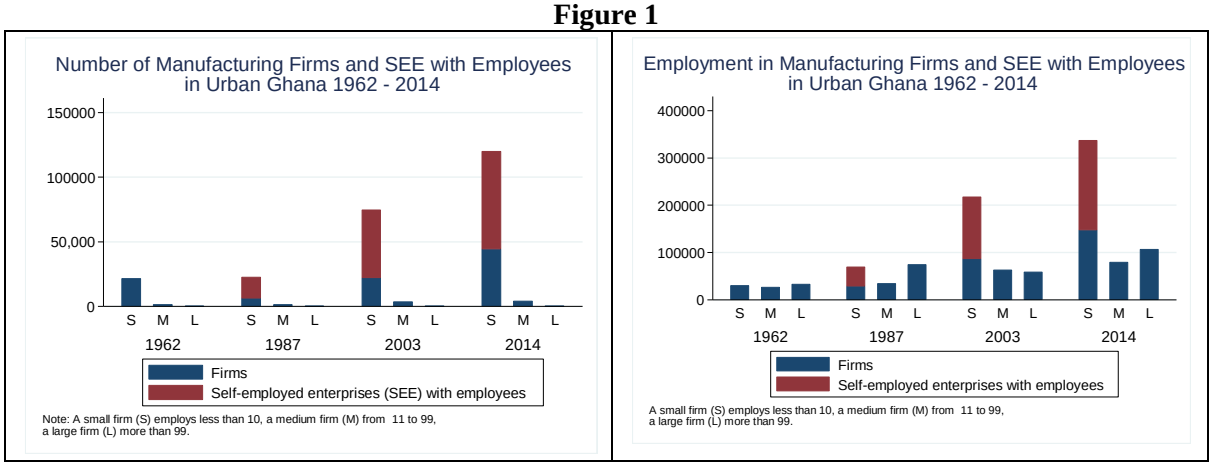
(a) The 1962 data is from Ghana Central Bureau of Statistics (1965). The 1962 Industrial Census recorded a total of 95,167 establishments which included enterprises run by the self-employed within households of which 72,348 were located in rural areas. As the 1987 and 2003 Industrial censuses did not cover the rural areas these have been excluded to ensure as much comparability across the censuses as possible.
(b) The number of Self-Employment Enterprises with Employees (SEEE) is taken from the population census data in Appendix Table 1 where it has been assume that 76.4 per cent of these enterprise were located in urban areas.
(c) A total employment figures of 89,155 for urban areas is available from Ghana Central Bureau of Statistics (1965). The figure for small firms is then a residual where it has been assumed all firms with more than 20 employees are located in urban areas.
(d) To establish the employment patterns in the classification which includes the self-employed enterprise with employees it is necessary to know how many employees such enterprise have. In 2004 the CSAE carried out a labour market survey in urban Ghana which recorded the number of workers engaged as self-employed and asked them if they did employ workers. The results are as follows:

Percentage of Self-employed who employed workers	16	
Conditional on employment how many workers did you employ?	Mean	2.5
	Median	2
	Minimum	1
	Maximum	10
	Standard Deviation	1.72

The proportion of the self-employed who hired workers at 16 per cent in the CSAE survey is higher than the 12 per cent recorded in the population census for 2000 across both rural and urban areas. However as the CSAE survey was confined to urban area the implication of the data in Appendix Table 1 is that 18 per cent of the self-employed had employees in urban areas slightly higher than the number reported above from the CSAE survey. Using the average number of employees of 2.5 based in the CSAE survey we have imputed employment in the Table.

(e) The data for 2014 is taken from GSS (2015) which covered both urban and rural areas so imputations are necessary to prove data on a consistent basis with 1987 and 2003. The imputations for 2014 are based on the following assumptions. The number of SEEE is inferred from the population census for 2010 which showed 75,800 self-employed with employees in urban areas (see Appendix Table 1: 78.7 per cent of 96,280). Employment in these firms is assumed to be 189,500 using the same scaling factor of 2.5 as used for 2003. The total number of employees in firms is assumed to be 333,360 (which is 76 per cent of the number in the report of 437,316) to impute a number for urban areas. All firms employing more than 5 are assumed to be urban. Given the total of 333,360 the number of employees in firms employing between 1 and 4 is derived as a residual as 59,857. The number of firms is then inferred assuming average employment of 2 as 30,000.

Figure 1



3 Modelling firm size and the demand for labour in African economies

The characteristics which are highlighted by the Ghanaian data of the last section are the growing importance of small scale enterprises and the fact, which may be much less common in other sub-Saharan African countries, of the domination within that small scale sector of household based self-employed, with employees, enterprises. This structure of the market ensures that an appropriate model must explain not only the demand for labour by firms but the links between wage and self-employment.

The basis of the choice between wage and self-employment is the focus of a model by Lucas (1978) where managerial ability, broadly conceived, limits the sale at which an enterprise can be operated. Lucas provides a model based on Gibrat's law and assumptions as to how wages will change with growth that predicts a falling share of self-employment with rising wages. The model assumes a limited range of 'talent' for managing but also assumes homogeneity of both capital and labour. Thus the return from the 'talent' is a residual from the revenues of the firm once labour and capital costs have been met. The Lucas model can be seen as an early example of applying the Roy (1951) model of sorting across occupations to the choice between wage and self-employment.

As will be shown in the analysis below two features of the data are the very large range of capital labour ratios seen across the firm population and the very small amounts of capital used by small firms. Given the very small amounts of capital necessary to start a self-employed enterprise it can be assumed that the owner possesses not simply a 'talent' for manging but also owns the capital stock of the firm. Thus the decision as to whether to be a wage employee or run an enterprise will depend not simply on any 'talent' for managing the individual possesses but on access to the capital to form an enterprise and the return from that capital.

The demand for labour by firms depends on the technology available to firms and the implication of differing capital labour ratios, shown below, is that this technology choice differs across firms of differing size. In the simplest competitive model of the firm neither wages nor the price of capital vary across firms which are modelled as price takers. The micro evidence across both developed and developing countries has shown the enormous variation in wages across firms of differing size, ownership and location. The possible reasons for such a correlation are surveyed in Oi and Idson (1999).

Establishing the reasons for the correlation between firm size and earnings is complex given the very large number of factors which distinguish small from large firms. The most immediate is that larger firms hire more skilled workers only some aspects of which may be observable. As we will show below large firms are much more profitable so it is possible that any firm size earnings effect is actually rent capture. An efficiency wage explanation would point to the possibility that larger firms pay more as such higher wages increase productivity and thus the ability of the firms to grow. In parallel with this concern as to how non-competitive features of the labour market can arise has been the development of search models which, even within a competitive framework, will generate a wage distribution which depends on the characteristics of firms. In these search models there is no simple labour demand function but a matching process by which workers and firms seek the best available match between the worker and the firm. Such search models have in common with the sorting models their focus on the role of unobservables but their predictions are quite different. Sorting implies that high productivity firms will match with high productive workers, search implies workers will be a random draw from the population.

The key common point of both search and sorting models is that you do not need to postulate any non-competition in the labour market to generate a relationship between wages and firm characteristics. Further for search models it is not necessary to assume that there is unobserved worker level heterogeneity underlying the differences in wages across those with similar human capital. Search plus firm differences in productivity will produce a wage dispersion. Extensions of these search models will also produce a dispersion of capital per employee across firm size as firms respond to draws in the labour market where they end up paying higher wages. The logic of such models is to invert the causation assumed in bargaining models where it is either worker bargaining or firms pursuit of an efficiency wage structure that lead to higher wages.

The focus of these models is on outcomes in the labour market. Equally important for our purposes are outcomes in the capital market. Typically in models focusing on labour outcomes the capital market is modelled as one where firms face a single interest rate. While such a simplifying assumption may be justified in developed country markets in poor countries the capital market is highly differentiated and, as will be shown, rates of return differ radically across firms in our sample. As with wages the direction of causation is unclear. The cross section data is consistent with models in which large firms have privileged access to the capital market. The data are also consistent with more productive firms growing and thus lowering the costs of capital they face as scale lowers the cost of supplying capital.

Once firms face differing capital cost the search model becomes more complex. In the models surveyed in Mortensen (2003) firms are concerned with the marginal productivity of the potential worker and compare that with their wage. However if firm growth leads to lower costs of capital firms will have an incentive to bid for more workers and potentially be willing to pay more than their current marginal product. In contrast if capital costs differ by firm size, due possibly to a fragmented capital market, and are unrelated to firm growth a different problem is posed. Why faced with lower capital costs do not such firms expand driving the smaller, high capital cost firms, from the market? The logic here must be that workers can capture some of the rents due to lower capital costs and we return, full circle, to the models where rent sharing drives the wages. To distinguish between these alternative explanations the role of unobservables both for firms and their workers is clearly crucial.

4 A general empirical framework for bargaining, efficiency wage and sorting models

In seeking to test between the alternative theories of labour demand and wage determination briefly reviewed in the last section we need data of the outcomes for firm and the wages of their workers. We will summarise our data in the next section, here we set out a framework within which these alternative hypotheses can be tested. We begin with how efficiency wage and rent sharing models explain the links between earnings, firm size and their profitability.

We use the framework of Blanchflower, Oswald and Sanfey (1996) who provide an early test for rent sharing. Define net profits as:

(1)

$$\pi = AF(K, eL) - wL - rK$$

where *A* is total factor productivity, *F* is the production function, *K* is physical capital, *e* is labour effort, *L* is labour, *w* is the unit price of labour and *r* is the unit price of capital.

The firm and the employees bargain over *w* and *L* such that the solution is obtained by maximising omega:

(2)

$$\Omega = \underset{L,K,w}{max} \phi log L(w - \overline{w}) + (1 - \phi) log \pi$$

where ϕ is the relative bargaining power of the employees. Provided that workers have some bargaining power, i.e. $\phi > 0$, the first order condition with respect to *w* can be written

(3)

$$w = \overline{w} + \frac{\phi}{1 - \phi} \cdot \frac{\pi^G - rK}{-\pi_w}$$

where $\pi^G = AF(K, eL) - wL$ is gross profit, and π_w is the partial derivative of π with respect to *w*.

If the employees have no bargaining power, so that $\phi = 0$, then the optimal wage will satisfy $w = \overline{w}$. In other words the wage will be the outside option. This may of course vary depending on the skills of the individual and the attributes of the firm but - and this is the key part as far as this non-competitive theory of wage determination is concerned - it should not be a function of the firm's profitability.

If we abstract from any efficiency wage considerations then $\pi_w = -L$ so our equation (3) simplifies to:

(4)

$$w = \overline{w} + \frac{\phi}{1 - \phi} \cdot \frac{\pi^G - rK}{L}$$

Wages will be a function of the outside options and the profits per employee. It is equations of this form that that have provided the basis for theories by which bargaining leads to the sharing of the rents of the firm. In testing for rent sharing a range of controls need to be included in the equation as clearly the rents of the firm may be proxying many other aspects of the firm. The extent of possible controls depends on the data available and as for this data we have firm data matched with their workers we can control for a wide range of firm effects. These include firm size and age and the human capital stock of the firm, all of which may affect firm profitability.

Let us turn to a form of the efficiency wage model which can be tested on production data. Efficiency wages implies that *w* will impact positively on labour effort, hence:

(5)

$$-\pi_w = L - AF_{eL} L e_w \equiv L(1 - g) \; w\square ere \; g = AF_{eL} e_w$$

If we have no bargaining then $\pi_w = 0$ and we get the result that
(6)

$$AF_{eL}e_w \equiv 1$$

If we now consider the problem of choosing the labour input we will have:
(7)

$$\pi_L = AF_{eL}e - w = 0$$

Combining (6) and (7) we have
(8)

$$we_w/e = 1$$

This result is originally due to Solow and shows that the wage elasticity with respect to effort is unity in this model. While very simple this equation is the basis for some of the initial tests of the efficiency wage model (see Levine (1992). If we assume a Cobb-Douglas form for the production function we have:

$$Y = AF(K, eL)$$

$$Y = (eL)^b K^{(1-b)}$$

which gives:

$$LnY = bLne + bLnL + (1-b)LnK$$

$$dLnY = bdLne + bdLnL + (1-b)dLnK$$

From (8)

$$we_w/e = 1$$

We can write this as:

$$wde/dw = e$$

$$dLn(e) = de/e = dw/w = dLn(w)$$

(9)

$$dLnY = bdLnw + bdLnL + (1-b)dLnK$$

In this early test for the efficiency wage hypothesis the prediction was that the parameter on the log of wages would be the same as that on labour. In other words 'wage increases would pay for themselves'. Another version of the efficiency wage theory, which is testable with earnings data, is that wages will be a function of the degree of monitoring carried out in the firm, Akerlof and Yellen (1986) provide a review of alternative versions of the efficiency wage hypothesis. To distinguish the monitoring version of efficiency wages and rent capture through profits we control for the proportion of supervisors and managers in the firm. We expect wages to be lower the higher their proportions. A countervailing view would be that they proxy other aspects of the human capital of the firm and will enter with a positive effect.

In our estimation of the earnings function we will control not only for the human capital characteristics of the worker but also of the firm by using firm level averages of the human capital stock modelled as firm-level averages of education and age. In the cross section we also control for time invariant characteristics of the firm which include, sector, location, ownership and unionisation.

While this range of controls is comprehensive by usual standards there remains the possibility that time invariant unobservables matter and are driving any correlation between firm size, profitability and earnings. For the period 1997 to 2003 we have a panel of workers in the firms so we can control not

only for firm fixed effects but also individual fixed effect. In the specification below we seek to identify those fixed effects. Our estimating equation for the earnings function in its full form is as follows:

(10)

$$\begin{aligned} Ln\,(Real\ Monthly\ Earnings)_{ijt} &= \alpha_0 + \alpha_1 Male_i + \alpha_2 Age_{it} + \alpha_3 Age_{it}^2 + \alpha_4 Education_i + \alpha_5 Education_i^2 \\ &+ \alpha_6 Tenure_{ijt} + \alpha_7 Ln(Employment)_{ijt} + \alpha_8 (Real\ Profits\ per\ employee)_{ijt} \\ &+ \alpha_9 (Firm\ Level\ Human\ Capital)_{jt} + \alpha_{10} (Proportion\ of\ Managers)_{jt} \\ &+ \alpha_{11} (Proportion\ of\ Supervisors)_{jt} + \alpha_{12} FirmAge_{jt} + \alpha_{13} Union_j \\ &+ \alpha_{14} (Sector\ Dummies)_i + \alpha_{15} (Location\ Dummies) \\ &+ \alpha_{16} (Ownership\ Dummies) + \alpha_{16} Time\_Dummies + \mu_i + \omega_j + \varepsilon_{ijt} \end{aligned}$$

To test the form of the efficiency wage hypothesis that 'wages can pay for themselves' we need a production function. In the exposition above we use a value-added specification but for reasons set out by Harris and Moffat (2016) we propose to use a gross output specification as intermediate inputs and costs are part of the dataset. The gross output production function is of the following form:

(11)

$$\begin{aligned} Ln\,(Output)_{jt} &= \beta_0 + \beta_1\, Ln(Capital)_{jt} + \beta_2\, Ln(Employment)_{jt} + \beta_3 Ln(Material\ Inputs)_{jt} \\ &+ \beta_4 (Other\ costs)_{jt} + \beta_5 Ln\,(Real\ Monthly\ Earnings)_{jt} \\ &+ \beta_6 (Firm\ Level\ Human\ Capital)_{jt} + \beta_7 (Proportion\ of\ Managers)_{jt} \\ &+ \beta_8 (Proportion\ of\ Supervisors)_{jt} + \beta_9 (FirmAge)_{jt} + \beta_{10} Union_j \\ &+ \beta_{11} (Sector\ Dummies)_j + \beta_{12} (Location\ Dummies)_j \\ &+ \beta_{13} (Ownership\ Dummies) + \beta_{14} (Time\ Dummies)_t + \theta_j + v_{jt} \end{aligned}$$

Both sorting and matching models imply that unobservable aspects of both firms and workers are crucial for understanding labour market outcomes. We can obtain estimates of such effects from our earnings and production functions as we have panel data. Such estimates provide us with a way of testing how firm size is related to the determinants of the efficiency of both firms and their workers. We can ask if older firms are larger, more productive and face a lower cost of capital. If older firms are larger then the inference would be that the lower capital costs observed with larger older firms was a result of their growth and that a market is operating by which relatively efficient firms grow. In contrast if we find that older firms are not larger, when we control for their productivity, it could imply that more productive firms do not grow and the mass of small firms we see forming in the census data are due to 'blockages' on the expansion of larger ones.

We propose to model the size of the firm with the following specification:

(12)

$$\begin{aligned} Ln(Employment)_{it} &= \delta_0 + \delta_1 Ln\,(Real\ Monthly\ Earnings)_{jt} + \delta_2 (FirmAge)_{jt} + \delta_3 (Firm_{FE})_j \\ &+ \delta_4 (Earn_{FE})_j + \delta_5 (Sector\ Dummies)_i + \delta_6 (Location\ Dummies) \\ &+ \delta_7 (Ownership\ Dummies) + \varepsilon_{it} \end{aligned}$$

The role of underlying efficiency in determining the size of firms will be assessed by using the fixed effects from the earnings function ($Earn_{FE}$) and the fixed effects from the production function ($Firm_{FE}$).

5 The data for production and earnings

To model these aspects of firm performance we propose to use a panel data set of firm and workers collected by the CSAE covering the period from 1991 to 2003. The key to being able to test some of

the hypotheses set out in the previous section is that panel firm level data can be matched with panel worker data. A panel data set was collected for Ghanaian manufacturing firms over the period 1991 to 2003. While workers matched with the firm were collected from 1991 it is only from 1997 that this was made into a panel. In Table 2 we report the summary statistics for the firm level data. Output, capital and inputs are measured in real terms in 1991 cedi prices. A price index for both output and raw material input casts was created when the surveys were carried out so, as far as possible, the possibility that productivity differences reflect market power can be ruled out. The worker level data, described below, was used to create a firm level earnings measure by weighting the earnings of the workers by the proportions of workers in each occupation within the firm. Table 3 below also shows this variable in US$ terms where the exchange rate in 1991 has been used to convert the 1991 cedis price to US$. This is more informative as to the average level of earnings in the firm than the cedi number although it is the constant price series that is used in all the estimations. In addition to creating a firm level earnings variable the data on the human capital characteristics of the workers was used, again weighted by occupation, to create a firm level variables for average education, age and tenure within the firm. The firm fixed effects are obtained from the panel over the period 1991 to 2003.

Table 2 Summary statistics for the production function

Variables	Median	Mean	Standard Deviation	Max	Min
Ln (Output/Worker in 1991 cedis)	14.13	14.11	1.20	17.81	8.58
Ln(Capital/Worker in 1991 cedis)	13.24	13.06	2.02	18.67	7.03
Ln (Raw Materials/Worker in 1991 cedis)	13.32	13.29	1.37	17.42	5.35
Ln (Other Costs/Worker in 1991 cedis)	11.55	11.48	1.71	15.96	5.44
Ln(Employment)	3.09	3.25	1.38	7.50	0.69
Ln (Earnings in 1991 cedis)_Weighted	10.04	9.85	0.89	12.16	5.20
Age_Weighted	31.89	31.88	8.01	61.65	15.00
Tenure_Weighted	5.58	6.64	4.74	30.00	0.00
Education_Weighted	10.09	9.89	2.60	21.10	0.00
Firm Age	17.00	18.50	12.18	73.00	0.00
Unionised (Dummy=1 if firm unionised)	0.00	0.30	0.46	1.00	0.00
Number of observations 1707					

Central to being able to understand the changes in the distribution of firms by size and employment in them shown in Figure 1 is the relationship between productivity and firm size. In the left hand part of Figure 2 the data from Table 2 is used to show the relationship between labour productivity measured as the log of real output per worker and the size of the firm measured by the log of employment. While there is enormous heterogeneity across firms of any given size there is, in the data, a clear positive relationship between labour productivity and firm size. Such a link implies that the increasing importance of small firms in the firm size distribution will imply a fall in the average productivity of firms in the sector.

The right hand part of Figure 2 shows an equally clear downward relationship between the profit rate, defined as profits to the value of the capital stock, and firm size. Such a relationship may have, at least, two possible explanations. One is that larger firms face lower capital costs as a result of their privileged access to the formal capital market. However within the sorting interpretation of what we are observing there is a quite different interpretation which is that more efficient firms grow and that growth lowers the cost of capital to them.

In Figure 3 we show the results of asking if older firms are both larger and have higher levels of productivity, which would be implied by the sorting view of what we are observing in the market. While

there is a pattern by which older firms are both larger and more productive the relationship is less clear-cut in the data than the link from productivity and the profit rate to firm size shown in Figure 2.

Figure 2

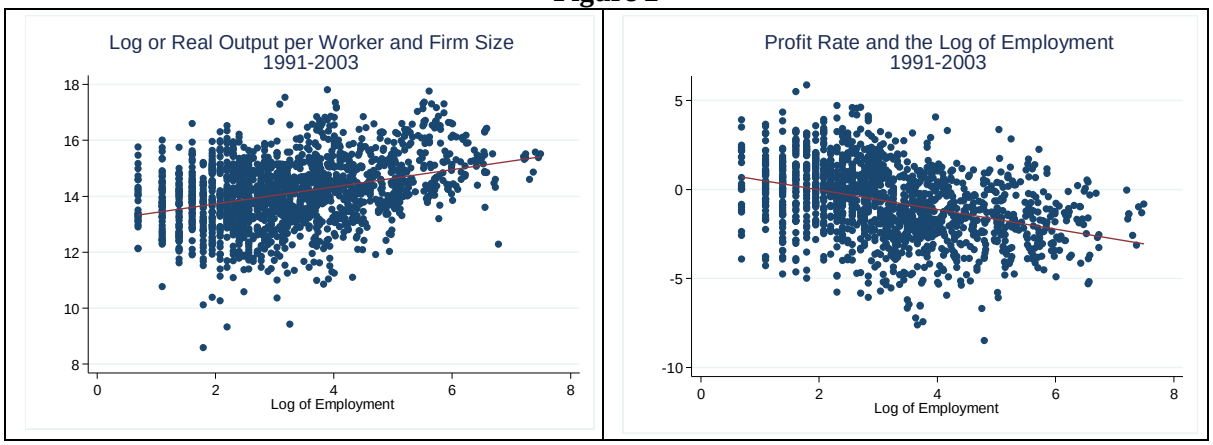


Figure 3

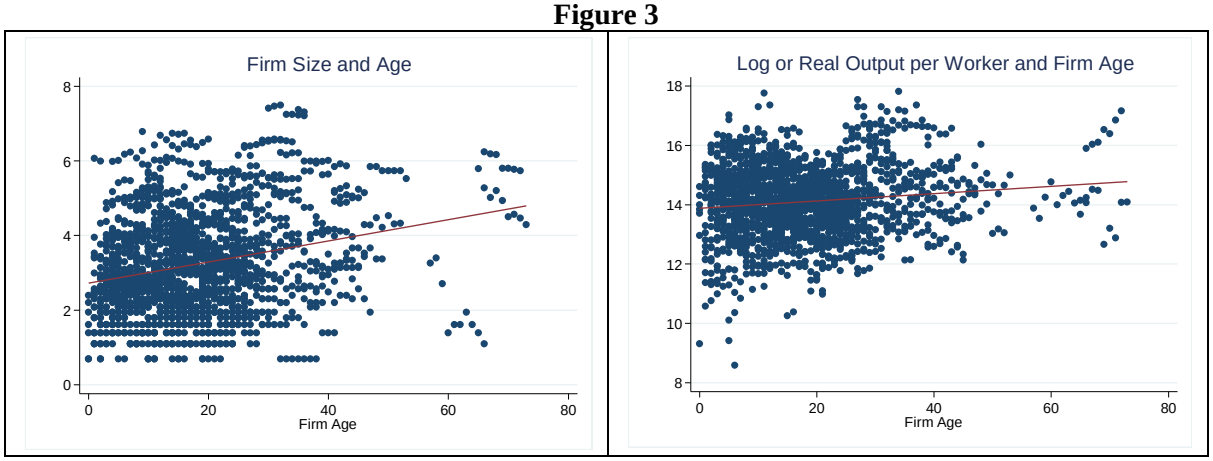


Table 3 provides the summary statistics used for the earnings function which is from the individual worker surveys. We confine the sample for the period over which we have a panel of the workers in the firms which is from 1996 so the panel dimension of the workers data is less than that for the firms at eight waves. When estimating the earnings function we will include the firm level dimensions of human capital to control for the possibility that larger firms pay more as the skills of the workforce are not fully captured by the education of the worker. As we have discussed above one version of the efficiency wage model sees the proportion of managers and supervisors as being an important determinants of earnings and we will include that too in our individual based earnings function.

In Figure 4 we show the relationship between the size of the firm and earnings (left hand panel) and real profits per employee (right hand panel). For both there is in the data a clear positive relationship and we wish to establish in the estimations of the models set out above which we report in the next section what underlies these relationships.

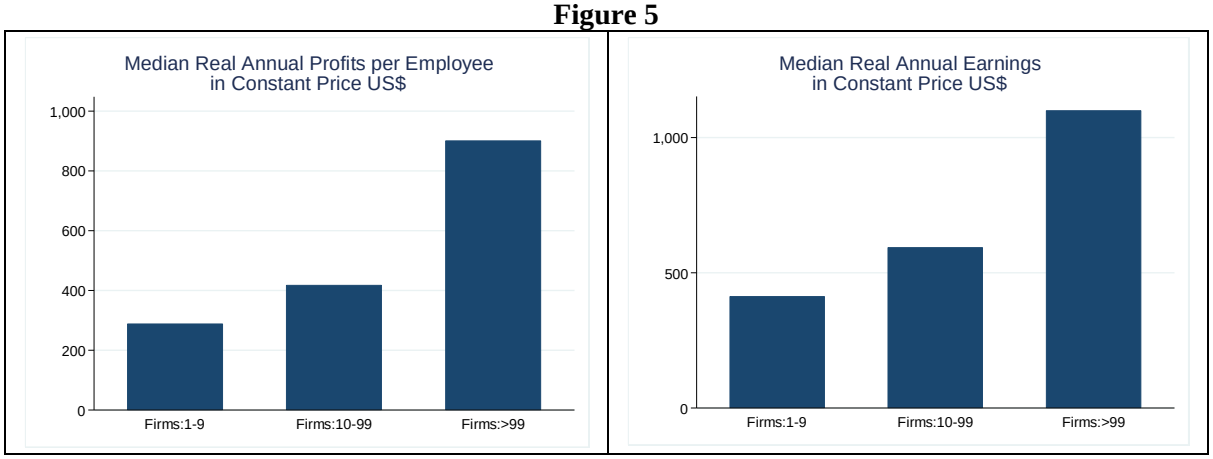
We showed in Figure 2 that the profit rate was far higher in small than larger. That leaves open the question as to whether the profit per employee will be higher in small firms which will be the opportunity cost of taking a wage job for those running a small scale enterprise. In the left hand panel of Figure 5 median real profits per employee is shown by the size of firm where we use the same categorization as in Table 1 and Figure1.The data is in constant price US$ to aid interpretation. The right hand panel of Figure 5 presents the data for earnings on the same basis as the left hand panel.

Table 3 Summary statistics for the earning function

Variable	Median	Mean	Standard Deviation	Max	Min
Ln (Real Monthly Earnings in 1991 Cedis))	10.12	10.17	0.83	13.49	6.58
Real Monthly Earnings (in Constant US$)	57.27	87.74	105.16	1970.99	1.26
Male	1.00	0.82	0.38	1.00	0.00
Age	35.00	36.88	11.28	82.00	15.00
Education (in years)	10.00	11.10	4.43	26.29	0.00
Tenure	6.00	8.49	7.83	98.00	0.00
Employment	50.00	120.94	202.74	1800.00	2.00
Ln(Employment)	3.91	3.98	1.25	7.50	0.69
Real Profits per Employee (Millions of 1991 Cedis)	0.22	0.49	0.90	5.84	-2.36
Real Profits per Employee (in Constant US$)	507.66	1130.57	2055.83	13362.22	-5409.43
Education Weighted	10.66	10.36	2.48	21.10	0.00
Age Weighted	35.51	35.30	7.27	61.65	15.00
Percentage of Managers	2.00	3.30	4.39	50.00	0.00
Percentage of Supervisors	3.23	4.68	6.28	73.53	0.00
Number of observations 6356					

Figure 4

Figure 5



While the profit rate for small firms is higher than for large firms profits per employee in small firms are about one third of the level of large firms. The right hand panel of Figure 5 shows in US$ terms the differences across small and larger firms of the cross tab using real cedi prices in the left hand panel of Figure 4. Figure 5 also show that the relationship between real earnings and real profits per employee shown in the right hand panel of Figure 4 may well be a result of firm size driving both variables.

6 An earnings function

Tables 4 and 5 report our estimates of Equation (10) a standard earnings function which is augmented to include both the log of employment and real profits per employee. The data is the individual level earnings of workers in the firms used to estimate the production function to be presented in the next section. We have panel data for the years 1997 to 2003 so the sample is confined to those years. In addition to the log of employment and real profits per employee the specification also includes the firm controls discussed above.

Table 4 Column (1) shows that in the cross section there is a clear and highly significant positive relationship between earnings and the size of the firm as measured by employment and also profits per employee. This holds with controls for the human capital within the firm and the degree of supervision of the workers. While this is a pooled cross section and thus has no controls for unobservables it needs to be noted that the range of controls are relatively comprehensive. The firm size and profit effect on earnings is not due to sector, ownership or unionisation. The advantage of the cross section is that within it there is, as we have shown, a lot of variation in both firm size and profits per employee. The disadvantage clearly is that unobservables may be driving the result. Given our data we can control for both firm and individual fixed effects which we do in Table 4, Columns (2) and (3).

In Table 4 Column (2) we control simply for firm fixed effects. The results are striking. While the human capital measures are little affected the firm size effect on earnings is greatly attenuated while the firm profit effect disappears. It appears from these results that the correlation between real profit per employee and earnings is entirely due to the firm fixed effect. One interpretation would be that more efficient firms generate more profits per employee and pay more. However there is no causation running from the profit term to earnings. Table 4 Column (3) extends the tests by controlling for individual fixed effects. The result here is that the firm size effect now disappears. Again this may suggest that there is no casual effect from size but more able individuals sort into larger firms. Both sets of results confirm the potential importance of unobservables, a key assumption of both search and sorting models of labour market outcomes.

However it is possible that the use of fixed effects has limited our ability to identify the effects of interest. The limited variation in the data over time combined with measurement error may make it hard to identify the time varying effects. It is also the case that while the fixed effects control for time invariant unobservables time varying unobservables may also be important. In Table 5 we investigate both issues by using the system GMM estimator as developed by Blundell and Bond (1998, 2000) and implemented in Stata by Roodman (2009). Controls are at the level of individual effects. The results are rather striking. Once endogeneity for both the firm size and profit effect is allowed for in Table 5 Column (1) the firm size effect is highly significant and the point estimate at 0.29 is substantially higher than that in Table 4 Column (1). However the standard error is also higher and we cannot reject the hypothesis that the OLS point estimate is correct. The profit effect remains insignificant in Table 5 Column (1) although given the increase in the standard error from the OLS results we again cannot reject the hypothesis that the OLS coefficient is correct.

In Table 5 Columns (2) and (3) we test if our inability to identify both a firm size and a profit effect is due to their correlation. Table 5 Column (2) drops the firm size variable while Table 5 Column (3) drops the profit variable. There is from these regressions no evidence that the inability to identify a significant profit effect is due to any such correlation. However as Table 5 Column (3) shows the firm size effect

Table 4
Dependent Variable: Ln of Real Monthly Earnings before Tax in 1991 Cedis

	(1)	(2)	(3)
	Pooled OLS	Firm Fixed Effects	Individual Fixed Effects
Male	0.144***	0.075*	
	(0.035)	(0.040)	
Age	0.050***	0.048***	0.027
	(0.007)	(0.008)	(0.018)
Age_squared	-0.000***	-0.000***	-0.000**
	(0.000)	(0.000)	(0.000)
Education (in years)	-0.017**	-0.012	
	(0.008)	(0.009)	
Education_squared	0.004***	0.003***	
	(0.000)	(0.000)	
Tenure	0.005***	0.007***	-0.006
	(0.002)	(0.003)	(0.005)
Ln (Employment)	0.195***	0.046	0.002
	(0.015)	(0.050)	(0.044)
Real Profits per Worker	0.063***	-0.006	0.000
	(0.013)	(0.016)	(0.014)
Education_weighted	0.004	-0.015	-0.006
	(0.006)	(0.009)	(0.008)
Age_weighted	-0.011***	-0.010**	-0.009***
	(0.002)	(0.004)	(0.003)
Percentage of Managers	0.006**	-0.002	-0.005
	(0.003)	(0.005)	(0.004)
Percentage of Supervisors	-0.003	-0.002	-0.002
	(0.002)	(0.002)	(0.002)
Constant	7.901***	8.332***	9.993***
	(0.147)	(0.234)	(0.458)
Observations	6,356	6,356	6,356
R-squared	0.459	0.583	0.099
Number of individuals			2,279
Number of firms		181	
Other controls			
Time dummies	Yes		
Sector Dummies	Yes		
Ownership dummies	Yes		
Unionisation	Yes		
Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1			

is now three times the OLS result from Table 4. For completeness Appendix Table 2 shows the same specifications as Table 5 but using the difference GMM estimator due to Arellano and Bond (1991). The results are very imprecise as would be expected given that the differences are being instrumented by levels. However the specification with only the firm size variable produces an even higher estimate than that reported in Table 5. We appear to have very clear evidence that OLS is underestimating the effect of firm size on wages and only very weak evidence for any effect from profits onto earnings. Teal (1996) found stronger rent sharing effects with an earlier version of this data but the panel was much shorter and there was at that time no panel component for the workers.

Table 5
Dependent Variable: Ln of Real Monthly Earnings before Tax in 1991 Cedis

	(1)	(2)	(3)
	Both profits and employment endogenous	Real profits per employee endogenous	Employment endogenous
Male	0.101*	0.143**	0.128**
	(0.055)	(0.071)	(0.056)
Age	0.065***	0.072***	0.031
	(0.021)	(0.022)	(0.035)
Age_squared	-0.000**	-0.001***	-0.000
	(0.000)	(0.000)	(0.000)
Education (in years)	-0.008	-0.011	-0.015
	(0.012)	(0.012)	(0.012)
Education_squared	0.003***	0.004***	0.003***
	(0.001)	(0.001)	(0.001)
Tenure	-0.029	-0.016	0.008
	(0.026)	(0.036)	(0.040)
Ln (Employment)	0.292**		0.592**
	(0.123)		(0.262)
Real Profits per Worker	0.019	0.014	
	(0.040)	(0.054)	
Education_weighted	-0.007	0.003	-0.007
	(0.008)	(0.010)	(0.008)
Age_weighted	-0.009*	-0.006	-0.017**
	(0.005)	(0.005)	(0.008)
Percentage of Managers	0.009	-0.003	0.020*
	(0.006)	(0.003)	(0.011)
Percentage of Supervisors	-0.002	-0.002	-0.003
	(0.002)	(0.002)	(0.003)
Constant	7.545***	7.873***	7.705***
	(0.271)	(0.411)	(0.290)
Observations	6,356	6,356	6,356
Number of individuals	2,279	2,279	2,279
Arellano-Bond AR(1)	Pr > z = 0.000	Pr > z = 0.000	Pr > z = 0.000
Arellano-Bond AR (2)	Pr > z = 0.870	Pr > z = 0.843	Pr > z = 0.807
Sargan Test	chi2(31) Prob > chi2 = 0.000	chi2(15) Prob > chi2 = 0.000	chi2(15) Prob > chi2 = 0.237
Hansen Test	chi2(31) Prob > chi2 = 0.590	chi2(15) Prob > chi2 = 0.377	chi2(15) Prob > chi2 = 0.622
Instruments used	Lags 3 to 4	Lags 3 to 4	Lags 3 to 4
All equations in this Table are estimated by system GMM. Except for employment and profits all variables are treated as exogenous. All equations have controls for time, sector, ownership and unionisation.			
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1			

7 A production function

In Table 6 we present our estimate of the production function, equation (11) above where we have imposed constant returns to scale. The more general function where this is not imposed but tested for is

Table 6
Gross Output Production Function: Dependent Variable Ln (Real Output/Worker)

	(1)	(2)	(3)	(4)
	Pooled OLS	Firm Fixed Effects	Diff GMM	Sys GMM
Ln (Capital/ Worker)	0.032***	0.052*	0.076	0.068**
	(0.010)	(0.029)	(0.063)	(0.032)
Ln (Raw Materials/Worker)	0.657***	0.623***	0.711***	0.701***
	(0.026)	(0.032)	(0.086)	(0.055)
Ln (Other Costs/Worker)	0.172***	0.140***	0.100	0.131***
	(0.022)	(0.020)	(0.065)	(0.047)
Ln (Real Earnings)_Weighted	0.078***	0.063***	0.051	0.057
	(0.023)	(0.021)	(0.083)	(0.056)
Age_Weighted	-0.007**	-0.007***	-0.004	-0.006
	(0.003)	(0.003)	(0.004)	(0.004)
Tenure_Weighted	0.003	0.005	0.004	0.006
	(0.004)	(0.005)	(0.007)	(0.004)
Education_Weighted	-0.000	-0.004	0.003	-0.002
	(0.006)	(0.007)	(0.007)	(0.007)
Percentage of Managers	0.001	-0.003	-0.000	0.000
	(0.002)	(0.003)	(0.004)	(0.003)
Percentage of Supervisors	0.003	0.005*	0.007*	0.004
	(0.003)	(0.002)	(0.004)	(0.003)
Firm Age	0.003*	-0.001		0.003
	(0.001)	(0.006)		(0.002)
Unionised	0.114**			0.055
	(0.056)			(0.094)
Constant	2.205***	3.137***		1.719*
	(0.296)	(0.424)		(0.933)
Observations	1,707	1,707	1,426	1,707
R-squared	0.908	0.755		
Number of firms		236	216	236
Implied labour coefficient	0.138 (0.018)***	0.185 (0.028)***	0.114 (0.095)	0.100 (0.056)*
Arellano-Bond AR(1)			Pr > z = 0.000	Pr > z = 0.000
Arellano-Bond AR (2)			Pr > z = 0.000	Pr > z = 0.000
Sargan Test			chi2(64)= 62.55 P>chi2= 0.528	chi2(100) = 114 P > chi2 = 0.160
Hansen Test			chi2(64) = 67.08 P > chi2 = 0.372	chi2(100)= 102 P > chi2 = 0.425
Endogenous variables			Ln (Capital/ Worker) Ln (Raw Materials/Worker) Ln (Other Costs/Worker) Ln (Earnings)	
Instruments used			Lags 3 to 4	Lags 3 to 4

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. All equations have controls for time. Columns (1) and (4) have controls for sector and ownership.

Table 3 in the appendix. Söderbom and Teal (2004) provide test for functional form using an earlier version of this dataset. As the test results in Appendix Table 3 show there is little evidence that constant returns is not accepted by the data. The test rejects at the 5 per cent significance level only for the difference GMM specification in which the point estimates for both capital and labour are negative and insignificant.

Table 6 Column (1) presents the pooled OLS estimate, column (2) uses firm fixed effects, column (3) uses the differenced GMM estimator and column (4) the system GMM estimator. The equations also controls for the human capital of the firm by a weighted average of the education, age and tenure of the workers. Of these in the pooled OLS estimation of Column (1) only the age variable is significant, and negative.

The first variable of interest for testing for efficiency wages in this specification is the wage variable which is a weighted average of the earnings of workers in the firm. In a simple efficiency wage model the parameter estimate on this variable should be the same as on the labour variable. It will be noted that in Columns (1) and (2) this variable is highly significant but the point estimate is clearly below that implied by the efficiency wage model. Column (2) controls for firm fixed effect and with such controls the point estimate on the wage term only declines marginally and not significantly. In Columns (3) and (4) we seek to control in additional for time varying unobservables by means of the differenced and system GMM estimators. The point estimate differs little in the difference and system GMM results from the fixed effects results in Column (2). Indeed the point estimates in Columns (2) and (4) are virtually identical.

The second version of the efficiency wage hypothesis that can be tested with the data is that the level of supervision reduces earnings. There is very little evidence for any such effect across the four specification shown in Table 6. At the 10 percent significance level there is an effect from the proportion of supervisors but the effect is positive suggesting a human capital rather than efficiency wage interpretation of the effect.

The implication of the results in Table 6 is that while there is some evidence that time invariant unobservables are positively correlated with the wage variable there is none that time varying unobservables are a significant factor. Equally important is to note that the cross section figures used in the previous section are replicated in the econometric analysis. The production function can with only small amounts of bias be estimated from the cross section. One possible interpretation of this result is that factor prices are exogenous to the firm and the higher capital labour ratios observed at higher level of employment reflect the variation over the size distribution of those factor prices.

8 The determinants of firm size

We are now is a position to use our measures of the unobserved determinants of firm level efficiency and the earnings of workers to address the possible reasons for changes in firm size. The data presented in Table 1 and Figure 1 showed the increasing domination of the firm size distribution by smaller firms and as shown in Figure 3 such firms are young ones. There are two possible interpretations of this pattern. One is that the small young firms are the seed bed for the next generation of large firms, the other is that they are the result of the failure of large firms to expand in number and size in line with the growth of population. Our measures of the unobserved element in the efficiency of firms and the skills of the workers enables us to ask if these measures are determinants of firm size. As we followed the firms over a 12 year period we can ask how their size changed over that period, conditioned on their efficiency. If such firms grow over their lifetime it suggests a selection process by which the efficient younger firms survive and grow. If we find no effect from the age of the firm it suggest that while large firms may be more efficient that is not the result of a development pattern of the smaller younger firms growing. In this latter case we would then need to address the question as to what was the origin of larger firms.

Table 7 Firm Size: Ln(Employment)

	(1)	(2)	(3)	(4)
	Pooled OLS	Pooled OLS	Pooled OLS	Firm Fixed Effects
Ln (Real Earnings)_Weighted	0.420***	0.171***	0.072	0.009
	(0.073)	(0.060)	(0.057)	(0.018)
Firm Age	0.018***	0.005	-0.020**	-0.004
	(0.006)	(0.005)	(0.010)	(0.004)
Age_Weighted			0.020***	-0.006**
			(0.007)	(0.002)
Tenure_Weighted			-0.017	-0.006
			(0.011)	(0.004)
Education_Weighted			0.002	0.002
			(0.014)	(0.005)
Percentage of Managers			-0.027***	-0.007***
			(0.006)	(0.002)
Percentage of Supervisors			0.011*	0.001
			(0.006)	(0.002)
Firm_Fixed Effects			1.009***	
			(0.241)	
Earnings_Fixed Effects			0.218***	
			(0.069)	
Unionised		1.533***	0.991***	
		(0.183)	(0.187)	
Constant	-2.264***	0.371	1.613***	3.518***
	(0.695)	(0.590)	(0.575)	(0.173)
Observations	1,564	1,564	1,564	1,564
R-squared	0.427	0.614	0.678	0.031
Number of firms				181
Controls				
Time dummies	No	No	No	No
Sector Dummies	Yes	Yes	Yes	Yes
Firm level human capital	No	Yes	Yes	Yes
Firm level supervision	No	Yes	Yes	Yes
Ownership dummies	No	Yes	Yes	Yes
Unionisation	No	Yes	Yes	Yes
Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1				

We are looking to investigate if older firms are more productive and larger. In Table 7, Column (1) we control only for time and sectors. It is clear that older firms are larger. Indeed this simply confirms the data shown in Figure 3 above. The firm size earnings effect has already been extensively investigated with it being assumed that causation is running from size to earnings. In Column (2) we introduce a range of controls for the human capital in the firm, supervision, ownership and unionisation. The firm age size effect now disappears. In Column (3) we continue with this set of controls but now ask if more productive firms, as modelled by firm fixed effect, and those with more skilled workers, as modelled by earnings fixed effects, are larger. We see now that not only are these factors highly significant determinants of earnings but the firm age effect is now significant and negative. These estimates of the fixed effects will be inconsistent as the length of the panel is relatively short. To test if the firm age effect in Columns (2) and (3) is due to the absent of controls for all time invariants aspect of firm size determination in Column (4) we run a fixed effects estimation when, of course we cannot identify the firm and earning fixed effects used in Column (3). The point estimate on firm age remains negative but is wholly insignificant. On the basis of the results in Table 7 we have no evidence that more productive firms have grown. Indeed we

have evidence that once we control for factors to do with the ownership of the firms that there is no relationship between the size of the firms and its age.

It is important to recall that large firms in our data are those with more than 100 employees, not large by standards other than African ones. The great mass of firms, more than 95 per cent, have less than 10 employees (Table 1). It is possible to use our data to assess if small firms do become large by asking how many large firms when they were first observed in 1991 had started out small. This is possible as firms were asked their start-up size. At the time of the first survey for the year 1991 the average age of the firms was 12 years (the medina was 11 and the range from zero to forty one). In Table 8 we present the data showing the pattern of growth from start-up to the year they were first observed.

Table 8

		Size in 1991		
Size at Start-up				Total
	Large (>99)	Medium (10-99)	Small (<10)	
Large (>99)	4	3	1	8
Medium (10-99)	9	47	7	63
Small (<10)	2	41	52	95
Total	15	91	60	166

It will be noted that only just 2 per cent of firms small when started were large when first observed in 1991. In contrast there is substantial churning between the small and medium categories. Indeed 10 per cent of firms of medium size at start-up become small. These results are clearly conditioned on firm survival. However the evidence from both Ghana and other sub-Saharan Africa countries is that larger firms are much more likely to survive than smaller one, so the data in Table 8 may well be exaggerating the extent of growth of smaller firms, Söderbom, Teal and Harding (2006).

That many firms large by African standards start out large, ie with far more than the 10 employees which dominate the firm size distribution, is confirmed by qualitative work on Ghana presented in Sutton and Kpentey (2012) who provide profiles of 50 leading companies in Ghana' manufacturing sector. They find that 'of the 50 firms profiled below, just over half had their origin in the domestic private sector. (Some 23 were set up by foreign firms and/or the government of Ghana.) Of the 27 domestic private-sector firms, only 15 began life as start-ups in manufacturing or construction. Just under half of the 27 were offshoots of local trading companies that had been in operation for many years before venturing into manufacturing'.

In summary we have presented evidence that once conditioned on observable factors of sector, ownership and firm level human capital the age effect on size disappears and when conditioned on unobservable aspects of productivity becomes negative. This is open to the interpretation, given the panel, that firms did not, on average, grow in size over this period. If that is correct then it implies some barrier to expansion of relatively larger firms. While the literature in this area has been dominated by a concern as to whether small firms grow, our analysis suggests the problem is very different. It is larger firms that face constraints on their ability to grow.

9 Segmentation, searching or sorting

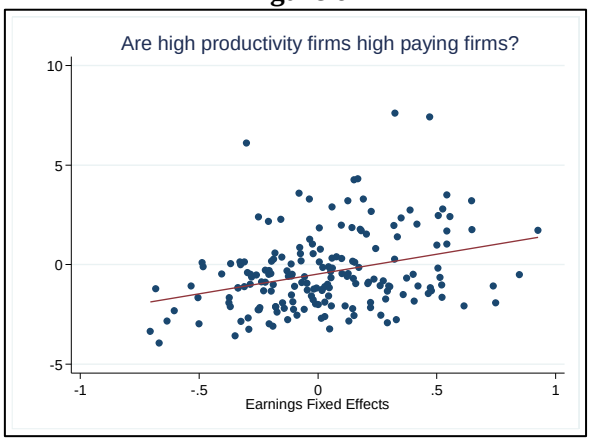
We turn now to the role of the labour market in constraints on the growth of large firms. Our data has shown a clear relationship between the wages paid by a firm and its size. Such a relationship is one found in almost all labour force datasets. Segmentation searching and sorting are all theories which will produce large differences in wages across the size distribution. As our data is panel we have been able to control for many of the factors that may be causing this wage size effect.

The segmentation view of labour markets has at its core that some barrier prevents market clearing. Efficiency wages and rent sharing are only two of the possible mechanisms but they are the ones we have tested for in this paper. We have found little, if any, evidence for either.

Search models in their simplest form predict that market frictions will generate difference linked to firm characteristics but that unobservable aspect of the workers will not be correlated with those of the firm and indeed in developed countries have found some evidence for that result. In Figure 6 we report the cross tab of the firm fixed effects obtained from the production function and the earnings fixed effects from the earnings function. The latter are the firm level average of the individual fixed effects from the panel of workers.

The Figure shows a clear positive relationship between the two measures, contrary to what would be predicted by a simple search model of the labour market. The implication is that some part of the higher earnings in higher productivity firms is due to their unobserved skills being productive and that firms do seek out relatively skilled individuals.

Figure 6



Our results presented above find that once instrumented the size effect is larger than in the cross section. This result is open to the interpretation that we have identified a labour supply function in which large firms face higher wage demands. Again such a finding is quite different from the normal assumption that work in larger firms is rationed and firms face an infinitely elastic supply curve at below the going wage in the firm. What could explain this disjunction between the usual assumptions and the empirical findings in this paper?

As we noted in the introduction a prominent feature of the changes in firm distribution over the period from 1987 to 2003 was the growth of enterprises run by the self-employed. Such enterprises, like those of small firms, are almost all owned by the person managing and running the enterprise. Such owners will capture the income from the ownership of capital. On the basis of the data in Table 1 the average number of employees in small firms (those employing form 1-9 employees) in 2003 was 3. Thus on the basis of the data shown in Figure 5 above for the small firm category the returns to the capital of the owner would be of the order of US$900 per year. This compares with the median earnings in firms of that size of less than US$500 shown in the right hand panel of Figure 5. These numbers also show why small firm formation is such a profitable operation relative to working in all but the largest firms.

It needs to be stressed that the evidence presented in this paper is not of rent seeking by which wage earnings capture some of the rents made by the firm although it is possible that is the case. The data presented in Figure5 shows one possible reason why the supply curve facing larger firms will be upward sloping.

Evidence that wage employment is not necessarily the preferred outcome in the context of sub-Saharan labour markets is found by Blattman and Dercon (2016) who conducted a RCT of employment

outcomes in Ethiopian firms. They conclude that 'overall, when the barriers to self-employment were relieved, applicants appear to have preferred entrepreneurial to industrial labor'. In the case of the Ghanaian data used in this paper the constraint would clearly be access to capital.

10 An overview

We began with a question: What accounts for the pattern of firm formation in Ghana's manufacturing sector by which growth in employment has come to be increasingly concentrated in the low productivity, low wage sector? We have investigated whether this is the result of new firms forming as a basis for a major expansion of the manufacturing sector or is the result of larger firms failing to grow and provide increased employment within larger firms. We have used panel data for firms and workers in those firms over the period from 1991 to 2003 which closely matches two censuses for 1987 and 2003 which showed the nature of firm expansion but cannot inform us as to whether small firms did grow to become large ones over that period.

We have argued that the evidence points to small firm formation being directly linked to the lack of expansion of employment in larger ones. However the link is not primarily through either efficiency wages or rent capture by workers in larger firms raising wage above the outside wage option although there may be some elements of both. The primary link is through the returns on physical capital in smaller firms raising the opportunity cost of labour to larger firms. Firms face an upwards sloping supply curve of labour quite contrary to standard models of how these labour markets work.

Clearly the existence of this mechanism depends on the highly fragmented capital market implied by the data. Capitals cost are far higher for smaller firms rates reflecting their limited access to capital markets. Any changes to these capital markets or the underlying efficiency of larger firms would disrupt this mechanism by which workers prefer self-employment to the firm wage options currently available. However given the present structure of capital markets and the levels of efficiency there is no reason to think firm wage employment is the preferred outcome for most workers.

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Appendix Tables

Appendix Table 1
Manufacturing Employment in Ghana's Population Census (Note both rural and urban)
Employed persons aged 15 years and over

	1984		2000			2010		
	Employment	Share	Employment	Share	Proportion urban	Employment	Share	Proportion urban
Wage employees								
Public	27,172	4.6	34,275	4.3		10,540	1.0	
Private	65,931	11.2	100,174	12.7		147,140	12.6	
Apprentices	25,332	4.3	78,834	10.0		96,960	8.3	
Other (a)	18,684	3.2	15,873	2.0		107,530	9.2	
Total Employed	137,119	23.3	229,156	29.1		362,170	31.0	
Self-Employed								
Without employees	430,029	73.1	490,276	62.2	58.3	708,060	60.7	57.6
With employees	21,270	3.6	68,636	8.7	76.4	96,280	8.3	78.7
Total Self-Employed	451,299	76.7	558,912	70.9	60.5	804,340	69.0	60.1
Percentage of self-employed who employ workers	4.7		1.2			12.0		
Total employment in Manufacturing	588,418	100.0	788,068	100.0		1,166,510	100.0	
Total employment	5,422,480		7,428,374			11,179,850		
Manufacturing employment as percentage of total	10.9		10.6			10.4		
Employment as reported in Manufacturing Censuses	1987 157,084		2003 243,516			2014 437,316		

Sources for population census data: Author's calculations based on published statistics from population census reports (Ghana Statistical Service, 1984, 2005). The 2010 data is taken from the 10 per cent sample of the population census on the GSO web site.

(a) The other category in 2000 and 2010 consists of casual workers, contributing family workers, household help and a very small residual category. The substantial rise in the 'other' category between 2000 and 2010 is from the contributing family worker category.

Appendix Table 2
Dependent Variable: Ln of Real Monthly Earnings before Tax in 1991 Cedis

	(1)	(2)	(3)
	Both profits and employment endogenous	Real profits per employee endogenous	Employment endogenous
Male	0.075	0.351	0.140
	(0.072)	(0.299)	(0.234)
Age	-0.001	-0.003	-0.001
	(0.001)	(0.002)	(0.002)
Age_squared	-0.081	-0.680	-0.218
	(0.130)	(0.644)	(0.513)
Ln (Employment)	-0.022		1.488*
	(0.620)		(0.824)
Real Profits per Worker	0.008	0.003	
	(0.047)	(0.049)	
Education_weighted	-0.013	-0.060	-0.003
	(0.016)	(0.055)	(0.047)
Age_weighted	-0.009	-0.033	-0.015
	(0.007)	(0.026)	(0.021)
Percentage of Managers	0.002	0.045	0.027
	(0.012)	(0.051)	(0.038)
Percentage of Supervisors	0.001	0.010	0.007
	(0.003)	(0.010)	(0.009)
Observations	4014	4014	4014
Number of individuals	2037	2037	2037
Arellano-Bond AR(1)	Pr > z = 0.000	Pr > z = 0.000	Pr > z = 0.000
Arellano-Bond AR (2)	Pr > z = 0.907	Pr > z = 0.433	Pr > z = 0.294
Sargan Test	chi2(19) = 46.52 Prob > chi2 = 0.000	chi2(9) = 15.88 Prob > chi2 = 0.069	chi2(9) = 9.62 Prob > chi2 = 0.382
Hansen Test	chi2(19) = 24.72 Prob > chi2 = 0.170	chi2(9) = 15.88 Prob > chi2 = 0.069	chi2(9) = 6.05 Prob > chi2 = 0.735
Instruments used	Lags 3 to 4	Lags 3 to 4	Lags 3 to 4
All equations in this Table are estimated by difference GMM. Except for employment and profits all variables are treated as exogenous.			
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1 All equations have controls for time, sector, ownership and unionisation.			

Appendix Table 3
Gross Output Production Function: Dependent Variable Ln (Real Output)

	(1)	(2)	(3)	(4)
	Pooled OLS	Firm Fixed Effects	Diff GMM	Sys GMM
Ln (Capital)	0.030***	0.015	-0.117	0.062**
	(0.007)	(0.038)	(0.129)	(0.026)
Ln (Raw Materials)	0.659***	0.623***	0.678***	0.723***
	(0.009)	(0.032)	(0.093)	(0.049)
Ln (Other Costs)	0.170***	0.138***	0.097	0.122***
	(0.009)	(0.020)	(0.063)	(0.041)
Ln (Employment)	0.158***	0.160***	-0.058	0.110*
	(0.017)	(0.031)	(0.124)	(0.066)
Ln (Earnings)_Weighted	0.076***	0.064***	0.047	0.032
	(0.015)	(0.021)	(0.067)	(0.044)
Age_weighted	-0.008***	-0.007***	-0.007**	-0.007*
	(0.002)	(0.003)	(0.004)	(0.004)
Tenure_Weighted	0.003	0.005	0.006	0.007
	(0.003)	(0.005)	(0.008)	(0.004)
Educated_Weighted	-0.001	-0.004	0.003	0.002
	(0.004)	(0.007)	(0.008)	(0.007)
pcman	0.001	-0.003	-0.001	0.001
	(0.002)	(0.003)	(0.004)	(0.003)
pcsuperv	0.003*	0.005*	0.006*	0.004
	(0.002)	(0.002)	(0.004)	(0.003)
Firm_Age	0.003***	0.000		0.003
	(0.001)	(0.006)		(0.002)
Unionised	0.079**			0.032
	(0.035)			(0.101)
Constant	2.176***	3.815***		1.722***
	(0.197)	(0.617)		(0.653)
Observations	1,707	1,707	1,426	1,707
R-squared	0.971	0.781		
Number of firms		236	216	236
Test for constant returns to scale	F(1,1669) = 2.39 Prob > F = 0.1226	F(1, 235) = 2.28 Prob > F = 0.1322	chi2(1) = 4.92 P > chi2 = 0.027	chi2(1) = 0.15 P > chi2 = 0.70
Arellano-Bond AR(1)			Pr > z = 0.000	Pr > z = 0.000
Arellano-Bond AR (2)			Pr > z = 0.000	Pr > z = 0.001
Sargan Test			chi2(80) = 63.18 Pr > chi2 = 0.92	chi2(125) = 145 Pr >chi2 = 0.10
Hansen Test			chi2(80) = 78.92 Pr > chi2 = 0.51	chi2(125) = 136 Pr > chi2 =0.24
Endogenous variables			Ln (Capital), Ln (Raw Materials), Ln (Other Costs), Ln (Employment), Ln (Earnings)	
Instruments used			Lags 3 to 4	Lags 3 to 4
Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1. All equations have controls for time. Columns (1) and (4) have controls for sector and ownership.				