Labour Demand Elasticities in Manufacturing Sector in Kenya

Anthony Wambugu
University of Nairobi
School of Economics
P .O.Box 30197-00100
Nairobi, Kenya

Abstract

Job creation and reduction of poverty are often goals of policy reforms that involve removal of input price distortions and acceleration ofoutput growth. Whether such reforms create jobs depends on the degree of responsiveness of labour demand to changes in wages and output. This study estimates labour demand functions using panel data for Kenya manufacturing firms. The estimated elasticities revealed, as expected, that higher wages reduce employment and higher value-added increases employment. The estimate of own-wage elasticity is around -0.20 and the output elasticity is around 0.10.The estimates of elasticities are robust to the inclusion of firm-characteristics and firm fixed effects in the labour demand equation. The estimates imply that a 10% increase in wages reduces employment by 2%, while an increase of a similar magnitude in value added increases employment by 1%. Kenyan policy makers can use these results when considering policies that increase manufacturing industry labor costs and value-added.

Keywords: Labour demand, wage elasticity, output elasticity, manufacturing, Kenya

1. Introduction

Job creation and poverty reduction remain at the heart of debate in Kenya among policy makers and the general public. This is because of the potential adverse social consequences of widespread unemployment and poverty. A possible explanation for the failure of the Kenyan economy to create adequate jobs is the level of real wages of formal sector workers. Efficiency wage considerations in a firm's wage policy and institutional forces (unions, minimum wage laws) in wage determination could result in formal sector real wage at a level above market-clearing wage. Another possible explanation for poor job creation is low rates of output growth.

After several years of low output growth, the Kenya government launched the Economic Recovery Strategy for Wealth and Employment Creation in 2003 to jumpstart the economy (GoK, 2003).It was hoped that economic recovery would be accompanied by job creation. Implicit in this view, is a positive relationship between output and employment. But the magnitude of the response is also important. In addition, if firms are faced with high wage costs, it may lead to significant reduction in employment-a negative relationship between wages and employment.

In 2007 the Government published the Vision 2030, a development blue-print that identifies the manufacturing industry as a key industry to achieve the Vision's economic growth and job creation goals (GoK, 2007). Whether this is realized or not depends on the responsiveness of employment to changes in economic variables. However, there is relatively little empirical evidence available about how manufacturing employers in Kenya adjust employment in response to changes in labor costs and output. This paper seeks to contribute to the current policy debate in Kenya over employment creation by investigating the role played by wage costs and value-added in the employment decisions of Kenyan manufacturers. By employment, we mean the number of workers in a firm. The main question is: how elastic is employment to changes in wage costs and output at firm-level in Kenya's manufacturing industry? Kenya provides suitable context to study the effect of wage costs and output on labor demand. After a long period of import substitution policies, the government began to undertake measures to liberalize the economy in 1993. Consequently, many manufacturers began to face competition from imported substitutes. However, labor market regulations on wages and employment remained in place until mid 1994 when some measures to liberalize the labor market began to be implemented.

There is empirical evidence (e.g. Bigsten et. al, 2000 and Wambugu, 2003) that manufacturing real wages rose during the 1990s. But little evidence is available on how employment responded in Kenya. Firm-level studies of labour demand are also scarce for developing countries (see Roberts and Skoufias, 1997; Teal, 2000).

Understanding the responsiveness of manufacturing employment to changes in wages and output is important for two reasons. First, the manufacturing sector in many African countries including Kenya is a major contributor to modern sector employment. Second, public policies such as those related to social security contributions, minimum wages, and redundancy payments change the cost of labour and thus manufacturing employment. If the own-wage elasticity of labour demand is large, policies that increase wages costs are likely to hurt employment substantially. But if labour demand is inelastic; policies that raise wage costs are unlikely to hurt employment substantially. Similarly, policies that expand output may either result in substantial job creation or jobless growth depending on the elasticity of employment with respect to output growth.

This paper used the only available firm-level panel data for the manufacturing industry in Kenya to estimate firm-level employment equations to identify the determinants of employment and examine labour demand elasticities. We also analyze the sensitivity of parameter estimates on wages and output to estimation procedures. The data used have several advantages. First, the data permit us to overcome the aggregation problem faced by studies that use aggregate macro-level or industry-level data. Second, the data contain a rich set of control variables. Third, the panel nature of the data allows control for impact of unobserved firm-specific factors on labor demand. The articleis organized as follows. Section 2describes the methodology of the study, encompassing the analytical framework, definition and measurement of variables, description of data and estimation issues. The estimation results are presented in Section 3. Section 4 summarizes and concludes the paper.

2. Methodology

2.1Analytical Framework

The starting point is the static profit maximization model of employer behaviour (Hammermesh, 1993). Following Milner and Wright (1998), this study adoptsCobb-Douglas production function.

$$Y_i = A^{\gamma} K_i^{\alpha} E_i^{\beta} \quad (1)$$

Where Y is real output, E represents units of labour, K is physical capital stock, and α and βdenote the factor share coefficients. The parameter γ permits factors that change productive efficiency, *A*. A profit maximizing employer hires labour and capital until the marginal revenue product of labour is equal to the wage (*w*) and marginal productivity of capital is equal to the user cost of capital (*r*). Solving the system of marginal productivity relations to eliminate capital from the output equation yields the following:

$$Y_i = A^{\gamma}\left(\frac{\alpha E_i}{\beta}.\frac{w}{r}\right)^{\alpha} E_i^{\beta} \quad (2)$$

Taking logarithms of (2) and rearranging allows the derivation of the firm's demand for labour as:

$$\ln E_i = \psi_0 + \psi_1 \ln\left(\frac{w}{r}\right) + \psi_2 \ln Y_i \quad (3)$$

where

$$\psi_0 = -\left(\frac{(\gamma \ln A + \alpha \ln \alpha - \alpha \ln \beta)}{\alpha + \beta}\right);\ \psi_1 = -\frac{\alpha}{(\alpha+\beta)};\ \psi_2 = \frac{1}{(\alpha+\beta)}$$

The responsiveness of manufacturing employment to changes in wages and output was examined using a panel data model. The empirical counterpart of equation (3) can be expressed as

$$\ln E_{it} = \phi_i + \delta_t + \psi_1 \ln w_{it} + \psi_2 \ln Y_{it} + \gamma X_{it} + \nu_{it} \quad (4)$$

where

E_{it} = total number of workers in firm *i* in time *t*

w_{it} = average real wage in firm *i* in time *t*

Y_{it} = real output in firm *i* in time *t*

X_{it} = vector of control variables

ϕ_i = firm specific effect

δ_t = time specific effect

The error term has three components, that is $v_{it} = \phi_i + \delta_t + u_{it}$. First, there are factors that are specific to the firm, and likely to affect labour demand, but are not explicitly included in the estimating equation. The presence of such factors introduces unobserved heterogeneity among firms and not controlling for the heterogeneity injects omitted variable bias. Including the firm-specific error component, ϕ_i reduces omitted variable bias from this source. Although the firm-specific error component might be unknown to the researcher, it may be known to firm managers, such that their employment, wage, and output decisions are a function of the firm-specific effect. This may lead to simultaneity bias. However, if labour supply to a given firm is perfectly elastic, wages can be treated as exogenous. Given that the manufacturing sector employs only a small proportion of the labour force in Kenya, the assumption is plausible. Second, manufacturing labour demand may fluctuate with changes in the economy over time. The component δ_t represents a time-specific effect, to account for business cycle effects on employment that are common to all firms. The third component u_{it} represents random factors and is assumed to be uncorrelated with explanatory variables.

In addition to the basic variables in the employment equation, we include a number of firm characteristics in the model as control variables. Firm age is included to account for productivity and efficiency in line with the model by Jovanovich (1982) that predicts positive correlation between firm age and productive efficiency. Firm-level human capital characteristics are also included to control for labour quality, since firms that pay high average wage per employee may be employing higher quality labour. Consequently, observable inter-firm differences in education, worker experience, and tenure of the work force are included in the equation to reduce the likelihood that our measure of real wage indicates quality of labor. The equation also controls for sector heterogeneity by including dummy variables for sectors, Dummy variables for union status and foreign ownership status are included also. Firm location dummies are included to accommodate the possibility of systematic variation in labour demand across urban centers. Although prices for other factors, such as capital are not available, some of the variables included (e.g. dummies for sectors and time period) may represent this omitted effect.

2.2 Data and measurement of variables

The study used data from surveys of about 200 Kenyan manufacturing firms conducted in 1993-1995 under the World Bank's Regional Program for Enterprise Development (RPED) by the University of Nairobi and the University of Gothenburg. A follow-up survey was conducted by the Center for the Study of African Economies and the United Nations Industrial Development (UNIDO) in 2000. New firms were therefore introduced to replace those that could not be traced.

Survey firms were selected randomly in four sub-sectors of manufacturing activity: food processing and bakeries, wood and furniture, textile and garment, and metal and machinery. A detailed exposition of survey design and a number of studies based on the RPED data for Kenya is provided in Bigsten and Kimuyu (2002) while Söderbom (2001) provides a report on the UNIDO survey. The survey team held interviews with firm managers and asked questions on firm history, entrepreneur characteristics, finance, investment, output, sales, costs of production, and employment, and investor confidence.

Employment is measured as the total number of workers in the firm at the end of year. Human capital variables include education, age, and tenure. These are weighted averages derived by combining firm-level information on the occupational distribution of workers and individual-level information on education, age, and tenure. The weight used is the proportion of workers in a given occupation in total work force. Value-added is measured as the value of sales less costs of raw materials and indirect costs. The sector dummies are defined such that dummy variable= 1 if firm is in the particular sector and zero otherwise. Location dummies are defined such that the dummy variable = 1 if firm located in the particular city and zero otherwise.

Foreign ownership status is indicated by a dummy variable = 1 if firm had any foreign owners and zero otherwise. Union status is indicated by a dummy variable = 1 if firm had any unionized workers and zero otherwise.

3. Empirical Results

3.1 Descriptive statistics

The summary statistics (mean, standard deviation, minimum, maximum, median, and the 25% and 75% percentiles) for employment, output and wages for the sample are presented in Appendix Table 1.Over half of the survey firms were located in Nairobi, Kenya's capital city, 20% are in Mombasa, Kenya's main seaport and the others are in two urban centers (Nakuru and Eldoret) in the interior. The size distribution of manufacturers is fairly wide: the smallest firm has one worker while the largest has 4000 workers. The median manufacturer has 31 workers. Over the survey period, the median number of workers rose from 29 to 35 but the mean declined. Overall median real value added is Kshs. 22, 106. It rose by 16% from Kshs. 20, 374 in wave 1. The mean real value added shows a decline of 37%. The overall median wage per worker is Kshs. 11, 789. It rose by 62% over the survey period.

3.2 Estimates of Employment equations

The use of panel data methods allows a richer analysis than would be possible with cross-section data. The paper used standard panel data methods (Baltagi, 2008) to estimate the employment equation. In the pooled OLS, firm fixed effects are ignored, while in the Fixed Effects model, firm specific effects are treated as constant across space and time. The model can be estimated by including a dummy for each firm. This is the least square dummy variable (LSDV) model. The disadvantage is that too many degrees of freedom are lost. Alternatively, the data can be transformed into deviations from mean before estimation. The important point is that in the fixed effects model, the firm effects only affect the intercepts. In the Random Effects model, firm specific effects are treated as random draws from an underlying population, and hence require distributional assumptions just like the stochastic error term.

The baseline employment equations are reported in Table 2, column 1 for least squares and column 2 for fixed effects model. The baseline employment equation includes log wage, log value added and allow for time effects as explanatory variables. Both wage costs and output have coefficients with the expected signs; positive and negative respectively. The coefficients are statistically significant at 1% level. Increases in real average wage reduce manufacturers' demand for labor, whereas increases in output increase labour demand.

Table 2: Baseline Employment Equations for Kenyan Manufacturing Sector

	Ordinary Least Squares (OLS)	Fixed Effects (FE estimator)
Ln(real wage/employee)	-0.2958	-0.1709
	(6.12)***	(5.88)***
Ln(real value added)	0.6200	0.1184
	(32.16)***	(5.96)***
Constant	0.0164	3.7623
	(0.04)	(12.31)***
Number of Observations	641	641
R-squared	0.74	0.63
Number of firms	319	319

Note. Robust t statistics in parentheses . * significant at 10%; ** significant at 5%; *** significant at 1%

The Hausman specification test rejects the random effects model (χ^2 = 1064.78; p-value = 0.00), and therefore the fixed effects model is preferred. This means that firm fixed effects only shift the intercept and are fixed over time and space. In the pooled OLS the estimated own-wage elasticity is -0.30; similar to the average own-wage elasticity reported by Hamermesh (1993) for studies of industrialized countries. The output elasticity is 0.62. With firm fixed effects (column 2), the own-wage elasticity is -0.20 and the output elasticity to 0.20. This suggests that ignoring firm fixed effects would overstate labour demand elasticities.

Although the coefficients on wages and value added in Table 2 have the apriori expected signs, this may be reflecting the impact of some firm characteristics. Therefore the baseline labour demand equation was augmented with a set of firm-characteristics. The results are presented in Table 3.The pooled OLS estimates indicate that the own-wage elasticity is -0.32 and the output elasticity is 0.45. The addition of firm characteristics reduced the output elasticity. The impact is more dramatic when we control for firm fixed effects. While own wage-elasticity is similar to that in the baseline equation (Table 3) the output elasticity falls to 0.10. The results also show that firms that have relatively more skilled workforce in terms of education and experience, have higher employment. Further, the effect of wages and output on employment does not seem to reflect a positive correlation between wages and the aspects of skill we control for.

Table 3: Employment Equations for Kenyan Manufacturing (With additional firm characteristics)

	Ordinary Least Squares	Fixed Effects (within)
Ln(wage/employee)	-0.3282	-0.1714
	(7.28)***	(5.92)***
Ln(value added)	0.4581	0.1012
	(17.87)***	(5.20)***
Age of firm	-0.0012	-0.0185
	(0.46)	(1.79)*
Average education	0.1360	0.0742
	(7.08)***	(4.72)***
Average age	0.0371	0.0250
	(4.90)***	(4.37)***
Average tenure	-0.0049	-0.0143
	(0.46)	(1.63)
Constant	-0.6472	3.0045
	(1.68)*	(8.94)***
Number of Observations	641	641
R-squared	0.81	0.68
Number of firms	319	319

Note. Robust t statistics in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1% The equations include controls for sector, location, union status, foreign ownership status, and survey wave.

The results (not shown) in Table 3 indicate that the additive sectoral effects on employment are statistically insignificant. However, the degree of responsiveness of employment to changes in wages and output might vary across sectors. This possibility was explored by adding interaction terms in the employment equation to allow employment elasticities to vary across sectors. The results are reported in Appendix Table 2.The results reveal that none of the coefficients on the interaction terms are significant, which suggests that there are no intersectoral differences in the employment effect of wages or output. The estimates of own-wage elasticity and output elasticity do not differ markedly from those in Table 3.

Because macroeconomic environment can lead to differences in employment responses to wages and output, the employment equation (4) was extended to include interactions terms to allow employment responses to vary across time periods. The results are presented in Appendix Table 3.The results show that the own wage elasticity in wave 2 was significantly different from that in the reference survey wave (wave 1). But the coefficients on interaction terms for waves 3 and 4 are not significantly different from zero. There is some evidence that the output elasticity was lower in wave 2 than in wave 1; a finding robust to the addition of firm fixed effects. On the other hand, the OLS estimates show that output elasticity in wave 4 was significantly greater than in wave 1. But this result is not robust to the inclusion of firm fixed effects.

4. Summary and Conclusion

The manufacturing industry in Kenya, like in other African countries, is a source of modern sector employment and output for domestic and export markets. If poverty is going to be reduced, better paying jobs must be created.

The manufacturing sector is one of the sectors earmarked to drive Vision 2030, Kenya's development blue-print. High wages, labour market regulations and slow output growth are often blamed for reducing formal employment. In theory, the employment consequences of changes in wages and output depend on the extent to which employment responds to such changes. However, partly due to lack of suitable data firm-level studies of how wages and output changes would influence job creation efforts in Kenya are lacking.

This study used firm-level panel data and panel data estimators to obtain wage and output elasticities of employment in Kenya's manufacturing industry. Estimates controlling for unobserved firm heterogeneity suggest that a 10% increase in the average wage reduces employment by about 2%, and a 10% increase in value-added increases employment by 1%.These results suggest that wage related policies (e.g. increases in social security and health insurance contributions by employers) that raise wage costs could be expected to have adverse and significant effect on employment creation in Kenya manufacturing industry. On the other hand policies that increase manufacturing value-added could be expected to contribute to job creation.

References

Baltagi, H.B.(2008), Econometric Analysis of panel data, John Wiley & Sons

Bigsten, A. and Kimuyu, P. (eds), (2002). *Structure and performance of manufacturing in Kenya*, Palgrave Publishers Limited, Houndmills, Basingstoke, Hampshire, New York.

Bigsten, A., P.Collier, S.Dercon, B. Gauthier, M. Fafchamps, J.W.Gunning, A.Issacksson,A.Oduro, R.Oostendorp, C. Pattillo, M. Soderbom, F.Teal, A.Zeufack, and S.Appleton (2000). Rates of return to human and physical capital in Africa's manufacturing sectors, *Economic Development and Cultural Change*: 48(4):801-827.

Government of Kenya (2003). *Economic Recovery Strategy for Wealth and Employment Creation 2003-2007*, Nairobi: Government Printer.

Government of Kenya (2007). *Kenya Vision 2030*. Nairobi: Government Printer.

Hamermesh, D., (1993). *Labor demand*, Princeton, New Jersey: Princeton University press

Jovanovich, B., (1982). Selection and evolution of industry, *Econometrica*, 50(3):649-670. Republic of Kenya, Economic surveys-various issues

Milner, C. and P. Wright (1998).Modelling labour market adjustment to trade liberalization in an industrializing economy, *The Economic Journal*, 108(447): 509–528.

Roberts, M. and Skoufias, E. (1997). The long-run demand for skilled and unskilled labor in Colombian manufacturing plants. *The Review of Economics and Statistics*, 79(2): 330-334.

Soderbom, M. (2001), Constraints and Opportunities in Kenyan Manufacturing: Report on the Kenyan Manufacturing Enterprise Survey 2000,United Nations Industrial DevelopmentOrganization

Teal, F., (2000). Real wages and the demand for skilled and unskilled male labour in Ghana's manufacturing sector: 1991-1995. *Journal of Development Economics*, 61(2): 447-461

Wambugu, A. (2003). *Essays on earnings and human capital in Kenya*, Economic studies, no. 124, Department of Economics, Göteborg University

Appendix

Table1: Descriptive statistics of key variables

	Employment	Real value added	Real wage per worker
Wave 1 (1993)			
Mean	131	189605	12838
Standard deviation	415	638372	11156
Minimum	1	11	589
25th percentile	6	2520	6366
Median	29	20374	10231
75th percentile	72	91601	15789
Maximum	4000	7185059	68208
Number of observations	183	183	183
Wave 2 (1994)			
Mean	74	198542	13318
Standard deviation	146	571017	13724
Minimum	1	5	617
25th percentile	7	2891	6560
Median	27	20395	10838
75th percentile	80	87803	15309
Maximum	1303	4625531	102810
Number of observations	148	148	148
Wave 3 (1995)			
Mean	105	204359	21151
Standard deviation	271	548217	30897
Minimum	1	17	874
25th percentile	7	3900	7019
Median	30	25678	12726
75th percentile	88	124945	22351
Maximum	2397	4125051	294684
Number of observations	160	160	160
Wave 4 (1999)			
Mean	118	118202	27740
Standard deviation	237	263510	58849
Minimum	2	150	1348
25th percentile	8	2769	9360
Median	35	23682	16549
75th percentile	110	88527	27524
Maximum	1600	2222641	625522
Number of observations	150	150	150
All (1993-1999)			
Mean	108	178642	18511
Standard deviation	292	531751	34048
Minimum	1	5	589
25th percentile	7	3006	6969
Median	31	22106	11789
75th percentile	80	101830	19583
Maximum	4000	7185059	625522
Number of observations	641	641	641

Table 2: Employment Equations for Kenyan Manufacturing Sector (with sector interaction terms)

	Ordinary Least Squares (OLS)	Fixed Effects (within)
Ln(wage/employee)	-0.3076	-0.1706
	(3.64)***	(3.05)***
Wage*wood and furniture	-0.0182	-0.0488
	(0.15)	(0.65)
Wage*textile and garments	0.0460	0.0003
	(0.45)	(0.00)
Wage*metal and machinery	-0.0540	0.0756
	(0.42)	(0.91)
Ln(value added)	0.4715	0.1409
	(12.27)***	(3.15)***
Value added*wood and furniture	-0.0347	-0.0463
	(0.63)	(0.84)
Value-added*textile and garments	0.0742	-0.0353
	(1.47)	(0.57)
Value-added*metal and machinery	-0.0592	-0.0646
	(1.16)	(1.13)
Age of firm	-0.0004	-0.0170
	(0.15)	(1.64)
Average education	0.1397	0.0728
	(7.19)***	(4.59)***
Average age	0.0376	0.0245
	(5.26)***	(4.20)***
Average tenure	-0.0061	-0.0142
	(0.59)	(1.56)
Constant	-0.9942	2.9160
	(1.47)	(8.46)***
Observations	641	641
R-squared	0.82	0.72
Number of firms	319	319

Note. Robust t statistics in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. The equations include controls for sector, location, union status, foreign ownership status, and survey wave.

Table 3: Employment Equation for Kenya Manufacturing Sector (With sector & time interactions)

	Ordinary Least Squares (OLS)	Fixed Effects (within)
Ln(wage/worker)	-0.4038	-0.2519
	(5.03)***	(5.43)***
Wage*wave 2	0.2666	0.1639
	(2.08)**	(2.52)**
Wage* wave 3	0.0304	0.0744
	(0.28)	(1.28)
Wage* wave 4	-0.0882	0.0042
	(0.75)	(0.05)
Ln(value added)	0.4668	0.1356
	(12.64)***	(5.93)***
Value-added*wave 2	-0.1340	-0.0733
	(2.98)***	(3.71)***
Value-added*wave 3	-0.0042	-0.0132
	(0.10)	(0.65)
Value-added*wave 4	0.1650	0.0225
	(3.29)***	(0.63)
Age of firm	-0.0017	-0.0496
	(0.69)	(0.47)
Average education	0.1435	0.0744
	(7.67)***	(4.79)***
Average age	0.0428	0.0242
	(5.88)***	(4.11)***
Average tenure	-0.0091	-0.0141
	(0.93)	(1.60)
Constant	-0.2133	4.0004
	(0.33)	(1.89)*
Observations	641	641
R-squared	0.83	0.74
Number of firms		319

Robust t statistics in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. The equations include controls for sector, location, union status, foreign ownership status, and survey wave.