Determinants of Wage Structure and Returns to Education in a Developing Country: Evidence from Linked Employer-Employee Manufacturing Survey Data of Ethiopia

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This study estimates the returns to education for workers in the Ethiopian manufacturing sector, and investigates additional determinants of hourly wages other than education. It starts the analysis using the standard framework of a Mincerian earnings function focusing on individual level characteristics as determinants of wages. The standard framework (basic Human Capital Model) is then augmented by controlling for firm level characteristics that are believed to play important roles in wage determination. In the basic model, the returns to one year of schooling for an Ethiopian manufacturing worker is around 10% for both men and women in the basic model - which is relatively small compared with estimates for other developing countries. When additional variables including firm level characteristics are controlled for, the returns to education go further down to about 8% for men and 9% for women. Conditional on schooling, the basic model estimates show that each additional year of labor market experience increases hourly wages by 6.0% for men and by 7.8% for women.

Keywords: Wage determinants, Labor market, Returns to education, Economic models, Ethiopia

JEL Classification: J16, J30, J31, J41, J71

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I. Introduction

This study applies the common framework of a Mincerian earnings function to investigate the determinants of hourly wages in the Ethiopian urban industry using a rich linked employer-employee sample of manufacturing survey data. In doing so, it estimates the returns to various levels of education for industrial workers in various occupational categories. The peculiarity of the study is that it augments the standard Mincerian earnings function (Human Capital Model) that uses individual level (workers') characteristics with additional establishment level characteristics that seem to play important roles in the wage setting process. Based on a Firm Analysis and Competitiveness Survey (FACS) data of manufacturing firms from about 11 selected Ethiopian cities in six regions, the paper presents yet an additional evidence that education and experience are important determinants of workers' productivity and hence their wages. However, the paper also highlights the importance of firm level characteristics such as ownership structure, firm size and sector of employment.

The paper has some important aspects: It investigates data from the Ethiopian manufacturing sector, a sector which is expected to be playing an increasingly important role in the country's future long term development. Moreover, even though Sub Saharan Africa (SSA) is a region which currently is engulfed with the most pressing challenges to the development community, there has not been much recent research work done on its urban labor market issues. In fact, not much recent information exists on the estimates of the returns to education in Africa's urban labor market. One of the major sources of international comparative data for the returns to education is Psacharopoulos (1993), but it has estimates for only a few African countries (such as Botswana and Cote d'Ivoire). Even these estimates are relatively old - Botswana's estimate for example is for 1975 and that of Cote d'Ivoire is for 1984. This paper therefore adds to the stock of limited information about the returns to education in urban Africa.

The total labor force in Ethiopia is estimated at around 27.5 million in 2000. Out of this, around 11.3 million (or about 41%) is the female labor force (World Development Indicators, 2002). Labor force participation in general in Ethiopia, as in other African countries, is high: - about 85% for men and 58% for women (ILO 2002). The

non-agricultural labor force participation for women, particularly that of manufacturing, however, is very small.

School enrollment ratios at all levels, except primary level, have not shown significant improvements in Ethiopia during the last two decades. Only primary enrollment rate increased from 26% in 1985 to around 70% in 2000 (World Development Indicators, 2002). Total public spending on education as a percentage of GDP has not also improved much: It increased from 3% in 1985 to close to 4% in 1995, which is comparable to the average for Sub Saharan Africa. Given the fluctuations in GDP performance and an ever growing demand for the provision of education in the country, however, this may not be considered as sufficient.

Industry as a whole contributes about 11% of the Ethiopian GDP; of which about 5 to 7% belongs to manufacturing alone. In addition to its smaller share of GDP, the average annual growth rate of manufacturing in Ethiopia has also been relatively disappointing. The average annual growth rate of manufacturing was 4.8% for the period between 1991 to 2000. In 1998, it was negative at -1.04%, but jumped to 14.8% in 1999. Agriculture and services are, therefore, still the dominant sectors in terms of their contribution to GDP in Ethiopia.

The remaining part of the paper is outlined as follows: Section II briefly discusses structure of the Ethiopian economy and recent developments. Section III discusses the data and background information about preliminary results from the survey. Section IV develops the basic Mincerian wage function and extends the framework to include linked establishment level variables. Results of the various specifications of the model will also be discussed; and the question of which important factors determine hourly wages will be addressed. Section V discusses the summary of the results and concludes.

II. The Ethiopian Economy

Ethiopia is one of the least developed countries in the world with an annual *per capita* income of about $110 (compared with the average for Sub-Saharan Africa which is close to $500). Ethiopians are therefore poor even by African standards. The country has experienced very low economic growth rates for the last several decades; and its economy, mainly because of its dependence on

TABLE 1

ETHIOPIA: SELECTED ECONOMIC INDICATORS

	1990	1995	1999	2000
GDP *per capita* (Constant 1995 US$)	100.32	102.24	112.56	115.88
GDP *per capita* Growth (Annual %)	-1.24	3.05	3.75	2.95
General Government Final Consumption Expenditure (% of GDP)	18.53	11.84	18.37	23.30
Illiteracy Rate, Adult Total (% of people ages 15 and above)	71.30	66.36	62.02	60.89
Illiteracy Rate, Adult Female (% of females ages 15 and above)	80.16	75.07	70.30	69.06
Total Debt Service (% of exports of goods and services)	34.89	19.08	16.44	13.94
Consumer Price Index (1995=100)	54.39	100.00	105.55	105.50
Current Account Balance (% of GDP)	-3.56	-1.56	-10.93	-5.24
Domestic Credit Provided by Banking Sector (% of GDP)	66.96	45.10	57.46	61.75
Domestic Credit to Private Sector (% of GDP)	19.54	13.01	29.03	28.97
Foreign Direct Investment, Net Inflows (% of GDP)	0.18	0.24	1.39	0.78
Population Growth (Annual %)	3.67	2.94	2.44	2.39
Population, Female (% of total)	50.45	50.40	50.33	50.31

Source: World Bank, World Development Indicators, 2002

agriculture, has been extremely vulnerable to external shocks such as weather changes, and a fall in international primary commodity prices, notably that of coffee. The 1970s and 1980s are mainly known to have been periods of high turmoil and economic stagnation in Ethiopia.

The pervasive poverty situation in Ethiopia is manifested in, among others, low access to health services (46%), low school enrollment ratios at all levels (70%, 5%, and 1% respectively for gross primary, secondary, and tertiary levels in 1999), and high level of illiteracy.

The Ethiopian economy is heavily dependent on agriculture which accounts for about 50% of the GDP, 90% of export earnings and 85% of total employment. Within agriculture, the major contribution to export earnings is derived from a single commodity - coffee which contributes about 60% of national export earnings. In general, the

TABLE 2
COMPARATIVE EDUCATIONAL OUTCOMES AND LABOR FORCE PARTICIPATION

Country / Region	Adult Illiteracy (%)				Youth Illiteracy (%)				Labor Force Participation: Ratio of Female to Male	
	1990		1999		1990		1999		1970	1998
	M	F	M	F	M	F	M	F		
Ethiopia	62	80	54	70	48	66	40	53	0.7	0.7
Mozambique	51	82	41	72	34	68	26	55	1.0	0.9
Nigeria	41	62	29	46	19	34	11	18	0.6	0.6
Kenya	19	39	12	25	7	13	4	6	0.8	0.9
Zimbabwe	13	25	8	16	3	9	2	5	0.8	0.8
East Asia & Pacific	13	29	8	22	3	8	2	4	0.7	0.8
Middle East & N. Africa	33	59	25	47	18	37	13	24	0.3	0.4
South Asia	41	66	34	58	29	50	23	41	0.5	0.5
Sub Sagaran Africa	40	60	31	47	25	40	18	27	0.7	0.7

Source: World Bank, World Development Indicators, 2002

country's growth performance at any time is correlated to, among other things, the growth in agricultural output. When the weather conditions improved, and the agriculture sector recovered, growth of the economy also rebounded. During the period of economic turn around of early 1990s, for example, agriculture also grew at an impressive rate (more than 5% during 1992/93 to 1996/97). However, as agriculture is mainly rain-fed, and based on small land holdings, its productivity is low. Moreover, frequent drought and falling terms of trade have hampered the sector's ability to sustainably support the country's development objectives.

The services sector is the other dominant sector in the Ethiopian economy. In the year 2000, it accounted for another 41% of the GDP. During the same period, the industrial sector accounted for only about 11% of the GDP while manufacturing accounted for only 5% to 7% of GDP.

III. The Ethiopian FACS Survey Data

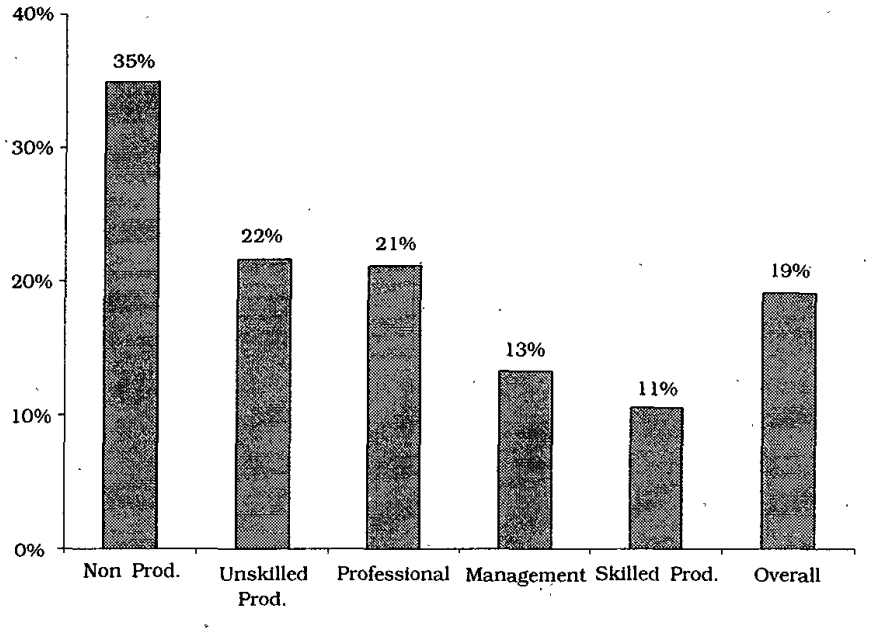
The data used for this analysis is drawn from a first round FACS carried out in Ethiopia by the Investment Climate Unit of the World Bank in collaboration with the Ethiopian Development Research

Institute (EDRI). The survey was carried out during the period of July to October, 2002, and covered a total of 427 manufacturing firms sampled from six (6) major industrial regions of the Ethiopian Federal Administration;[1] and seven (7) major sub-sectors (groups) of the manufacturing sector.[2] The data collected covers detailed firm level information such as investment decision of entrepreneurs, sources of investment financing, establishment level exports and imports, output, capacity utilization, capital stock, sales, regulations, as well as workers' training. In addition to the firm level questions directed to the management, up to 10 randomly selected workers were also interviewed from each firm in the sample. Data collected from these randomly selected workers includes information on wages (including allowances), tenure, number of hours worked per week, occupational category, educational level attained, experience both inside and outside the current company, age and gender. Using the available information about the wage level and frequency of payments (*i.e.* unit of time when the payment is made such as whether salary is reported as annual, monthly, weekly, and hourly) as well as the number of hours worked in a week, we computed the corresponding equivalent hourly wages for each worker in the sample. We then matched all the individual worker level (employee) variables with firm level (employer) data collected by interviewing the management of each firm. Our final sample consisted of about 2538 workers from various occupational categories. Of these workers, 575 (22.7%) are women.

In order to see the representativeness of the gender distribution of sampled workers to that of the actual, we looked at the information collected from the firm managers about their labor force at the firm level. Accordingly, as shown in Figure 1, we found that close to 20% of total workers in the sampled firms are women, which is quite similar to the gender distribution of the sampled workers themselves. Both the firm level and worker level information also reveal that quite a few women work at the management and skilled level occupational categories; while there is a larger proportion of them in the non-production category. Even when we look at the temporary

[1] The locations covered by the survey are Addis Ababa, Amhara region, Eastern region, Oromia region, Southern region, and Tigray region. Except Addis Ababa, in all the above regions two cities were covered by the survey.

[2] These sub-sectors are Food, Beverages, Textiles, Garments, Leather and Leather Products, Wood, Furniture and Metal work.



Source: Computed by the author using data from Ethiopian FACS, 2002.

FIGURE 1
SHARE OF WOMEN IN SAMPLED ENTERPRISES
BY OCCUPATIONAL CATEGORY

workers separately, the same holds true: A great majority of women who are temporary workers work in the non-production and unskilled occupational categories.

Firm level information collected by interviewing managers also reveal that few firms in the Ethiopian manufacturing sector provide in-house formal training programs - just around 11% of them. Moreover, in these programs, the majority of the trainees are production workers (both skilled and unskilled). An average of 20 and 14 skilled and unskilled production workers in each firm respectively participated in in-house training programs at their place of work during the year prior to the interview. Firms that provide outside training opportunities to their workers are also still few (15%). As expected, participants in these outside training opportunities are small in number from each firm, and mainly these opportunities target the professional and skilled worker categories (an average of 3 workers each from professional and skilled categories compared with

a single worker from the unskilled category). Surprisingly, firms also reported that few of their workers who participated in trainings have been promoted and/or got a pay raise (close to 4%). Despite this, however, workers do not seem to be moving out after completing the trainings. This most probably may be because of firm specific trainings that can not be transferred to other firms or activities; but it may also equally be because of a perceived lack of other employment opportunities in other manufacturing establishments.

There are some evidences of a relative shortage of skilled manpower in the Ethiopian manufacturing sector. While very few firms in general reported to have spent money to pay their workers for overtime work, relatively more firms have done so for their skilled workers. For example, the reported share of overtime payments out of the total cost of wages and salaries at a firm level in general is negligible (just close to 2%); while for skilled workers alone, this figure stands at 4% of the total cost of their wages and salaries. Another potential indicator of skill constraint is the time it takes to fill a vacancy for a skilled worker as opposed to a non skilled one: Our data reveals that it takes more time (7 weeks) to fill a vacancy for a skilled worker than that for unskilled one (which is just about 3 weeks).

A typical worker in the Ethiopian manufacturing sector, according to our data, effectively works for about 7 hours out of an 8-hour shift. This shows that, once at work, labor is effectively utilized. There is not also serious problem of over-manning at the firm level. Firms reported that on average they still would like to keep more than 90% of their current work force to produce their current level of output. As expected, however, over-manning is higher in the public enterprises (13% compared to close to 7% for private enterprises). Most of those firms who reported to have excess labor (about 55% of them) also reported that they keep the excess work force (however small it may be) mainly because they anticipate an increase in sales/production in the foreseeable future. According to about 25% of the firms, another reason for keeping the excess labor employed is due to laws and regulations regarding firing of workers. Some 20% reported 'pressure from unions';[3] while only 3% reported pressure from political groups

[3] Only close to 20% of firms in our sample answered positively to the question of whether any of their employees are members of a trade union. The average of reported level of unionization for those who responded

TABLE 3

AVERAGE HUMAN CAPITAL CHARACTERISTICS OF SAMPLED WORKERS

	% in Whole Sample	Average Years of Education	Average Age	% of Who Completed		% with University Degree	% Union Members
				Primary	Secondary		
Men	77.3	10.0	33.4	87.4	51.4	4.9	21.7
Women	22.7	11.1	31.2	90.4	70.3	3.3	31.9
Total	100.0	10.3	32.9	88.1	55.7	4.5	24.0

Source: Calculated by the author from FACS, 2002.

as a reason behind keeping excess labor force in their firms. Most of the firms in our sample (about 80%) reported that they work in a single shift basis; while another 11% and 9% respectively work double and triple shifts. Firms also report that they are using less than 60% of their full capacity for a variety of reasons such as insufficient demand, lack of raw materials and working capital. This means there is a room for increased output if remaining labor market and other constraints are sorted out; and if the economy and hence demand for their products picks up.

A preliminary investigation of the worker level FACS data shows that women on average have higher years of schooling (with 11.1 years of education compared with 10.0 for men). They are also younger with an average age of 31 years compared with 33 years for men. The percentage of women who have completed primary or secondary school is higher than that of men;[4] while the percentage of women who have completed university level schooling is less (3.3% compared to 5% for men). Women with union membership are also proportionately more than men (32% compared with 22% for men). The data also shows that women are on average paid less than men. Their average hourly wage is about 4.0 Ethiopian Birr (the local currency, ETB from now on) compared with close to 6 ETB for men (see Table 4). This, it should be noted, is in spite of the higher level of average years of education attained by women in the sample. Most probably, this may mean that women face more constraints to get

positively is around 77%.

[4] About 90% and 70% of women in our sample have completed respectively primary and secondary schooling compared with 87% and 51% for men.

TABLE 4

AVERAGE HOURLY PAY, HOURS WORKED PER WEEK, AND PERCENT WHO RECEIVED TRAINING IN CURRENT PLACE OF WORK (2002) - IN ETB

Sample	Hourly Wages (ETB)	Hours per Week	Receive Training (%)
Men	5.68	46.3	19.6
Women	4.12	45.1	22.4
Total	5.32	46.0	20.3

Source: Calculated by the author using Ethiopian FACS data.

access to jobs in the formal manufacturing sector unless they attain a relatively higher level of education than men: and once they land on the job, they get compensated at a lower rate than their men counterparts in the same job cell.

In terms of access to training opportunities provided by the companies they work for, women are equally likely to receive training as men once they join their current establishment of work.

IV. The Basic Mincerian Model: Returns to Years of Schooling

We start from the standard specification of a Mincerian earnings function which is commonly used to estimate the returns to education. This specification can be obtained from a standard human capital theory, the dominant economic theory of wage determination in the literature. The earnings function model is one of the successful specifications in empirical econometrics. In general it specifies the relationship between an individual worker's characteristics and his/her earnings per unit of time. This may also be viewed as a proxy to the intertemporal wealth maximization of an individual worker where education and on-the-job training can be regarded as investments on human capital (Willis 1986; Mincer 1974). It is also assumed that forgone earnings are a proxy for the cost of schooling; and that each individual worker enters the labor force right after completing his/her schooling. Each worker's working life is also assumed to be independent of his/her years of schooling and that the earnings grow at a constant rate over time due to various factors. In

a standard Human Capital Model specification, log of earnings are assumed to depend on education and experience. The specification of this model is of the following form:

$$\ln(w_i) = \alpha + \beta S_i + \gamma_1 EXPR_i + \gamma_2 (EXPR_i)^2 + \varepsilon_i \quad (1)$$

where $\ln(w_i)$ is the natural logarithm of earnings or wages per unit of time, S_i is Years of Education (Schooling), *EXPR* is a proxy for experience,[5] and ε is the error term. The subscript 'i' refers to each individual employee (*i.e.* $i = 1, \cdots, N$). The coefficients β and γ_1 represent the returns respectively to schooling and on-the-job training (experience). The basic model is based on the assumption that individual workers over time accumulate their human capital both at school; and in the labor marker once they join the work force (see Willis (1986)). Note that the function is concave in on-the-job training (experience) because of diminishing marginal returns to accumulated on-the-job training. As a result, the coefficient γ_2 is negative. The error term (ε) is well behaved and it captures other unobserved factors that contribute to worker's earnings.

For a wealth maximizing individual worker, the coefficient for the years of education (β) measures the internal rate of return to an additional year of schooling; and the coefficient for the years of labor market experience (γ_1) measures the rate of return to additional labor market experience. Note also that the effect of experience on earnings peaks when total experience reaches at $-\gamma_1/2\gamma_2$ where γ_2 is coefficient of the squared value of lab market experience.[6]

As is a tradition for a well-established literature, we estimate the standard Human Capital Model (and any of its variants) using Ordinary Least Squares (OLS). The OLS estimates of the basic earnings function using the Ethiopian manufacturing sector data are presented below. For the various extended specifications, see appendix tables.

As we see from the results in Table 5, the returns to education reported by the basic model are similar for both men and women. This is contrary to the findings in most other studies where women's

[5] Experience is computed as the survey year (2002) - the year in which the worker left school. When this variable is missing, potential experience computed as Age - Total years of education - 6 is substituted.

[6] See Willis (1986), pp. 529-32 for the derivation.

TABLE 5

OLS ESTIMATES OF RETURNS TO EDUCATION (TOTAL YEARS OF SCHOOLING) (ETHIOPIA, 2002)

	All Sample		Men	Women
	(1)	(2)	(3)	(4)
female	-0.132			
	(3.45)**			
educyrs	0.102	0.100	0.102	0.100
	(22.97)**	(22.63)**	(20.35)**	(11.62)**
expr	0.064	0.064	0.06	0.078
	(19.09)**	(19.19)**	(15.84)**	(12.49)**
exprsq	-0.001	-0.001	-0.001	-0.001
	(12.07)**	(12.10)**	(10.30)**	(8.75)**
Constant	-0.843	-0.859	-0.815	-1.084
	(15.47)**	(15.80)**	(13.21)**	(10.25)**
Observations	2235	2236	1742	493
R-squared	0.31	0.31	0.31	0.33

Robust *t*-statistics in parentheses

* Significant at 5% level, ** Significant at 1% level

Dependent Variable=Log of hourly wages

returns to years of education are larger than that of men.

Based on the estimates in Table 5, the marginal return to one full year of education for both males and females is around 10 percent after controlling for experience. These estimates actually are relatively smaller than the estimates found for other developing countries (See, for example, Psacharopoulos (1993); Psacharopoulos (1994); Psacharopoulos and Tzannatos (1991); Moock, Patrinos, and Venkataraman (1998); Van der Gaag and Vijverberg (1989)).[7] Psacharopoulos

[7] In fact, these estimates are lower even compared to other estimates for Ethiopia using different survey datasets. For example, in their quantile regression estimates, Girma and Kedir (2002) found around 15% returns to education. The differing results might have come from differences in the types and coverage of the data sets used. They used household survey data. Also the sampled workers in our dataset are only manufacturing sector employees in the regions covered by our survey. It is also quite possible that since the removal of an automatic placement of college and university graduates and narrowing employment opportunities for less educated (primary and high school graduates), employers have increased bargaining

(1993) estimated the returns to education for Botswana, for the year 1975, at 16.4% for men and 18.2% for women. Psacharopoulos also estimated the returns to education for Cote d'Ivoire (for the year 1984) at 11.1% and 22.6% respectively for men and women. Temesgen (2001) estimated the returns to education for manufacturing sector workers in Nigeria respectively for men and women at 12% and 19%. Other estimates for the returns to education in Africa include that of Ghana (for the year 1992) by the World Bank (1996). These estimates are 9.3% and 10.6% respectively for men and women.[8]

Our estimates in Table 5 also show that, conditional on schooling, each additional year of total labor market experience increases hourly wages by 6.0 percent for male workers, and by about 7.8 percent for females. The positive effect of experience on hourly wages peaks at 30 years (of total experience) for men and at 39 years for women. When we use dummies for education levels completed, we also find that returns to completed secondary education are higher for female workers than for male workers while for primary and university levels of education, the returns for men are much higher (See Appendix Table 3 and 4). Completed primary, completed secondary, and completed university education raise hourly earnings respectively by 27%, 95% and 232% compared with those without any completed level (*i.e.* less than six years of education).[9] Looking at the marginal returns to a year of education in a completed level (primary, secondary or tertiary) for the whole sample, we see that completing primary education has a 4.4% return for each year compared with no completed primary education; while completing high school has a 7.1% return compared with that in a completed primary level. Completed university education has a 13% return for each year than one in a completed secondary level.[10] The corresponding returns for

power.

[8] For a survey of detailed empirical studies on wage determination, see Berndt (1991).

[9] When a certain characteristics of a worker is represented by a dummy variable (with a value of '1' and estimated coefficient of λ_i), then that worker has earnings of e^{λ_i} times the earnings of a worker without that characteristics (dummy variable equals zero).

[10] In the extended (dummy) specification, rates of returns to a higher level of education are calculated as a ratio of differences between the coefficients and the number of years of schooling between the two successive levels. *e.g.*, In our case, for the first specification in the whole sample, the returns to a year in a completed university education controlling for union

each year of a completed primary, secondary, and university level education for women alone are 2.8%, 9.4%, and 3.2%, respectively.[11] Being female, in the Ethiopian manufacturing sector, after controlling for the basic human capital characteristics of experience and education reduces the returns to a hourly work by at least 13%;[12] but when other variables are also controlled for, the reduction in returns goes as high as 20%.[13] The returns to completed levels of education compared with non-completed education also increase with the number of years of schooling (and levels) for both sexes (see Appendix Table 4).

Such continuously increasing returns to education with increasing levels of education means that sticking to the school system and

membership, sector, size, experience, and ownership is: (1.199-0.670)/4= 13.2%. Similarly, for completed secondary education, over primary, the return is calculated as: (0.670-0.239)/6= 7.1%. For methodological issues on estimation of returns to education, see Psacharopoulos (1994).

[11] A joint *F*-test was done in order to investigate whether men and women face different labor market structure. The joint *F*-test considers a null hypothesis that the earnings regressions that were run independently for each gender group are identical. If, say, βi and $\propto$i are the two coefficients respectively from the regressions for men and women workers, we test the null hypothesis that, βi= $\propto$i jointly which is equivalent to testing whether the labor market structures faced by both men and women are the same. The relevant joint *F*-test is therefore expressed as:

$$F_{K,\,N+M\;\;2k} = \frac{(EES_R - EES_{UR})/K}{EES_{UR}/(N+M-2k)}$$

Where K is the degrees of freedom, N and M are the number of male and female workers respectively, EES_R is the error sum of squares in the restricted model (where the regression for the whole sample is run without the gender dummy - *i.e.* the coefficient for the gender dummy set to zero); and EES_{UR} stands for the error sum of squares in the unrestricted model. The null hypothesis was rejected.

[12] Most people take the coefficients of a dummy variable and multiply it by 100 to get the corresponding percentage changes. However, in order to calculate a precise percentage change (δ1) on the dependent variable due to a dummy variable, it is necessary first to calculate the anti-log of a regression coefficient (β1) and then subtract one from the result; *i.e.* (β1)= ln(1+ δ1). See Havorsen and Palmquist (1980) for interpretation of dummy variables in Semilogarithmic equations.

[13] This is similar to the estimate by Girma and Kedir (2002) who found a negative coefficient of about 0.21 for the gender (female) dummy.

completing as high level of education as possible is an investment with a high return in the future. This is so because such results probably suggest that additional investment in education that does not lead to the completion of a level (or rather to the award of a degree or certificate) might not necessarily grant the workers additional labor market returns.

Krishan *et al.* (1998), in their analysis of the urban labor market during structural adjustment in Ethiopia (covering 1990 to 1997), estimated returns to education increase for higher levels of schooling, where they found that these returns to education increase for higher levels of schooling, though they have remained largely unaffected during the period considered. Accordingly, for men 15-64 years of age, the returns to schooling for primary, secondary and tertiary levels in the public sector respectively were 0.31, 1.08, and 2.34 in 1997; while for the private sector the returns were reported as 0.04, 0.71, and 2.15. For women, most of the coefficients were not found to be significant in the public sector; but the returns for the private sector that are significant also show a similar trend: *i.e.*, coefficients of 0.71 for secondary and 2.15 for tertiary levels. There are also other African countries where the same trend has been observed. For example, in a gender discrimination study using manufacturing survey data sets from four African countries, Temesgen and Zeufack (2002) report that for Ghana the returns to completed primary, secondary and university levels respectively are 0.127, 0.165 and 0.213; while for the other three countries, the returns for completed secondary level are higher than that of both primary and university levels.

Wahba (2002) also report that one of the main findings of her paper is that "the estimated rates of return to education [in Egypt] increase with rising education levels" and agrees that "this is different to the common pattern found in most developing countries." In her study, controlling for regional dummies, the estimated coefficients for education dummy variables of Read, Primary, Preparatory, Secondary, and 'university and higher' levels respectively were 0.09, 0.12, 0.53, 0.68, and 1.14. She also found that this pattern remained consistent even when the estimation is done for each region as well as for urban-rural classification. There are studies that found such a pattern in developed economies as well. For example, Brunello *et al.* (2000) estimated the returns to high school, short term tertiary and tertiary levels of education for Italy respectively at 0.23, 0.35, and

0.50.

Now going back to our basic specification with years of schooling, we expect that individual workers with higher levels of education invest relatively more on their human capital; or rather they get better opportunities for company sponsored or funded trainings after they entered the labor market. They also embark on a carrier with a better opportunity for growth and increases in their wages. Such potential complementarities between the accumulation of human capital through schooling and labor market can be captured by adding an interaction term consisting of the schooling variable (S_i) and the experience ($EXPR_i$) on to equation (1) above. The earnings function specified above can therefore generally be re-written as:

$$\ln(w_i) = \alpha + \beta S_i + \gamma_1 EXPR_i + \gamma_2 (EXPR_i)^2 + \gamma_s (S_i EXPR_i) + \varepsilon_i \quad (2)$$

The results obtained by re-running the regression including the interaction term are reported in Table 6 below. The table shows that the coefficients for the interaction term are not only very small, but are also statistically insignificant; but the new coefficients for the returns to education for women are now slightly higher than the previous estimates and compared with that of men as well. However, the new results do not very much change the overall interpretation of the returns to education.

Once we estimated the returns to education using (1) above, we extended the basic model to include the other worker level variables such as gender and union membership. Due to the unique characteristics of our data set (*i.e.* linked employer-employee information), we are able to extend the model further to include firm level characteristics such as size, sector, and ownership. Generally, the extended earnings function can be specified as follows:

$$\ln(w_i) = \alpha + \beta X_i + \phi Y_i + \varepsilon_i \quad (3)$$

where X_i is a vector of individual level characteristics such as years of schooling and experience, Y_i is a vector representing the various firm level characteristics of the establishment where each worker is employed. As mentioned above, the subscript 'i' and $\ln(w_i)$ respectively refer to the individual employee and the log of hourly wages received by that employee; while β and ϕ are vectors of the

TABLE 6

OLS ESTIMATES OF RETURNS TO EDUCATION - WITH INTERACTION TERM (ETHIOPIA, 2002)

	All Sample		Men	Women
	(1)	(2)	(3)	(4)
female	-0.131			
	(3.43)**			
educyrs	0.100	0.097	0.099	0.121
	(13.09)**	(12.72)**	(11.36)**	(7.05)**
expr	0.063	0.063	0.059	0.096
	(12.98)**	(12.92)**	(11.09)**	(8.48)**
exprsq	-0.001	-0.001	-0.001	-0.001
	(12.06)**	(12.08)**	(10.26)**	(7.84)**
expr*edu*100	0.008	0.016	0.023	-0.144
	(0.21)	(0.43)	(0.54)	(1.75)
Constant	-0.831	-0.834	-0.781	-1.325
	(10.30)**	(10.34)**	(8.71)**	(7.01)**
Observations	2235	2236	1742	493
R-squared	0.31	0.31	0.31	0.34

Robust *t*-statistics in parentheses

* Significant at 5% level, ** Significant at 1% level

Dependent Variable = Log of hourly wages

coefficients to be estimated.

We run various specifications of this extended model and got some what consistent results. More than ten (10) variants of the extended model were run. First, we added three (3) sectoral dummies (food and beverages, leather and leather products, and wood/metal furniture) to capture differences that may arise due to sectoral variations. The excluded category was the textile and garments sector. The next set of variables included were a dummy for union membership of the worker and ownership status of the establishment. We then added size dummies (with the 'Large' size group being the excluded category).[14] The last variant of the specification added 'regional' dummies for the five (5) regions with Addis Ababa being the excluded category. The regressions were run using both 'years of schooling' and

[14] The dummies for size here were arbitrarily defined as follows: Small (< = 10 workers), Medium (11 - 100 workers), and large (100+ workers).

dummies for various levels of completed education such as primary, secondary and university. Results of the full model (for the specifications with dummies for completed levels of education) can be summarized as follows:

First, the conform that all levels of education are progressively important in improving wage income.[15] The coefficients for the various levels of schooling confirm our initial OLS estimates that there is an increasing returns to schooling for higher levels of education. The results show that completing elementary schooling, completing high school and having a university degree increase wages by 4%, 7%, and 13%, respectively for each schooling year compared with a completed education one level below.

The full model also confirms that gender matters in determining individual wages in the context of Ethiopia's manufacturing sector. The coefficients for the gender dummy 'FEMALE' are negative and very significant for all the various types of specifications. In the most basic model, the coefficient for the 'female' dummy is −13%, but controlling for more determinants, being female reduces hourly wages by as much as 20%.[16]

Firm level characteristics such as enterprise size, type of ownership, and sector are also important determinants of wages. Workers in small and medium sized establishments earn respectively up to 47% and 34% less than those in larger ones; while we find that foreign owned firms pay much higher than locally owned private firms (the excluded category). Workers in foreign owned establishments receive up to 35% more than those in locally owned private firms, controlling for other variables in the model; also it looks, at first sight that public enterprises pay more than private firms (*i.e.* they on average pay almost 18% more than privately owned local enterprises). However, this is because of the size characteristics of the public firms than the ownership *per se*. Once we control for size variables, however, the coefficient for the 'public' dummy ceases to be significant (see Appendix Table 3). Thus, controlling for size, public

[15] Note that the coefficients for the dummies of all education levels are significant at 1% level.

[16] Another related study using this same data decomposes this gender based earnings differential in to two components: A part related to differences in human capital and a part related to differing returns to human capital (termed by the literature as discrimination) for the two gender groups (see Temesgen (2004)).

enterprises actually do not pay more than private establishments, we also get that the textile and garment sector (the base or excluded sectoral category) pays significantly less than the food/beverages and leather/leather products sectors.

Unions also seem to matter. The results show that union membership of individual workers is also among the important determinants of a worker's wage. Workers who are union members receive at least 15% more than their non-union member colleagues.

V. Conclusions

The study confirms that both establishment level and individual (worker) level characteristics play important roles in wage determination in the case of the Ethiopian urban manufacturing sector. Previous estimates of wage determinants without establishment level characteristics therefore, essentially overestimate the effects of individual characteristics. There are, however, a number of points related to the literature and data characteristics that should be kept in mind when interpreting the results from this study:

First, as our sample of workers consists only of wage earners in the manufacturing sector, the results obtained can not be generalized as applicable to other types of workers and to workers in the non-manufacturing employment activities. Especially, results of the returns to schooling can not be taken as 'economy wide'. Any extrapolation of the results to the whole economy should therefore be interpreted cautiously.

Secondly, we extended the standard Mincerian Earnings framework by introducing establishment level characteristics. However, the standard framework itself assumes its two important variables (education and experience) as given (exogenously determined); while the endogeneouity of education is widely believed. A better specification would therefore treat education as endogenous and use instrumental variables to investigate the factors that determine schooling, but not wages. Given the data characteristics we are dealing with, that was not done. Moreover, as the information on earnings and individual characteristics was collected from workers already on the job, the data set lacks information on others who do not participate in the labor market or those that do, but are employed in non-manufacturing or informal activities.

Despite such potential shortcomings mainly related to the datasets, however, the results presented here are very important for a variety of reasons:

First, the results add an additional compelling reason for the importance of a public policy with a focus on human capital development. Strengthening the educational system with relatively more focus to women's training is an important priority. The results also add to our conviction that a better educated labor force means more productivity, more income to the households and a better standard of living. Related to this, the relatively higher returns to on-the-job training (experience) for females means that more gender targeted human capital development at a company level will have both income and equality enhancing components and hence a better social pay off. With improved educational attainment of females, in addition to a proportionately larger increase in total income for each additional year of schooling, gender inequality in pay may also decline. The study also shows that women's participation in the urban industrial labor force is relatively low compared with their total participation level. Moreover, even those women who are working in the urban manufacturing sector are more likely to be working in low paying non-production or unskilled production occupational categories. Relatively quite a few women work in the skilled production or management occupational categories.

Another importance of this study is that it uses data from a manufacturing sector of an African country and as a result, it adds to the limited knowledge about the African manufacturing sector and its labor market.

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APPENDIX TABLE 1

DEFINITIONS AND BASIC STATISTICS OF VARIABLES USED IN REGRESSIONS

Variable	Definition	Mean	Std. Dev.
lnHwages	Log of hourly wages	0.73	0.92
addis	Dummy equals 1 if firm located in Addis	0.54	0.50
amhara	Dummy equals 1 if firm located in Amhara region	0.07	0.26
east	Dummy equals 1 if firm located in eastern region	0.11	0.31
educyrs	Years of education completed	10.20	3.87
emplsize	Total number of workers (employment size)	154.10	317.39
expr	Experience in years	12.88	11.15
expr_edu	Interaction term: experience * years of education	1.26	1.23
exprsq	Experience squared	290.16	575.14
female	Dummy equals 1 if worker is female	0.22	0.41
food_bev	Dummy equals 1 if firm in food and beverage sector	0.28	0.45
foreign	Dummy equals 1 if firm has foreign ownership	0.06	0.23
large	Dummy equals 1 if firm is large size (100+ workers)	0.29	0.45
leather	Dummy equals 1 if firm in leather sector	0.08	0.27
medium	Dummy equals 1 if firm size is medium (11-100 workers)	0.45	0.50
no_educ	Dummy equals 1 if worker has not completed any level of education	0.12	0.33
oromia	Dummy equals 1 if firm located in Oromia	0.10	0.30
primdum	Dummy equals 1 if primary education completed	0.34	0.47
public	Dummy equals 1 if firm is public owned	0.11	0.31
secondum	Dummy equals 1 if secondary education completed	0.50	0.50
small	Dummy equals 1 if firm is small size (<=10 workers)	0.26	0.44
south	Dummy equals 1 if firm located in southern region	0.11	0.31
tenure	Tenure (work experience) in the current establishment in years	7.82	8.08
tex_garm	Dummy equals 1 if firm in textile and garments sector	0.14	0.34
tigray	Dummy equals 1 if firm located in Tigray region	0.07	0.26
union_dummy	Dummy equals 1 if worker is member of a union	0.23	0.42
univdegr	Dummy equals 1 if university degree completed	0.05	0.21
wood_fur	Dummy equals 1 if firm in wood and metal furniture product sector	0.51	0.50

APPENDIX TABLE 2

REGRESSION WITH YEARS OF EDUCATION

	Basic (1)	With Sector (2)	With Union and Ownership (3)	With Size (4)	With Region (5)	Size and Region (6)
female	-0.132 (3.45)**	-0.141 (3.61)**	-0.167 (4.40)**	-0.212 (5.74)**	-0.196 (5.21)**	-0.23 (6.29)**
educyrs	0.102 (22.97)**	0.103 (23.54)**	0.091 (20.85)**	0.081 (18.44)**	0.087 (19.55)**	0.078 (17.75)**
expr	0.064 (19.09)**	0.063 (18.96)**	0.052 (14.54)**	0.046 (13.41)**	0.048 (13.21)**	0.043 (12.32)**
exprsq	-0.001 (12.07)**	-0.001 (12.11)**	-0.001 (9.90)**	-0.001 (9.79)**	-0.001 (9.19)**	-0.001 (9.00)**
food_bev		0.311 (6.21)**	0.22 (4.41)**	0.182 (3.73)**	0.228 (4.43)**	0.198 (4.00)**
leather		0.27 (3.89)**	0.311 (4.57)**	0.169 (2.66)**	0.216 (3.12)**	0.102 (1.58)
wood_fur		0.166 (3.32)**	0.188 (3.90)**	0.192 (4.14)**	0.193 (3.89)**	0.197 (4.14)**
foreign			0.476 (6.13)**	0.327 (4.01)**	0.4 (5.15)**	0.27 (3.31)**
public			0.165 (4.00)**	0.001 (0.02)	0.107 (2.36)*	-0.062 (1.26)
union_dummy			0.381 (9.55)**	0.13 (3.18)**	0.397 (9.93)**	0.142 (3.50)**
medium				-0.425 (9.16)**		-0.458 (9.99)**
small				-0.646 (11.47)**		-0.618 (10.88)**
amhara					-0.407 (5.74)**	-0.416 (5.88)**
east					-0.275 (5.42)**	-0.223 (4.38)**
oromia					-0.073 (1.18)	-0.067 (1.11)
south					-0.318 (5.94)**	-0.286 (5.49)**
tigray					-0.032 (0.45)	0.032 (0.46)
Constant	-0.843 (15.47)**	-1.043 (14.80)**	-0.927 (13.00)**	-0.288 (3.16)**	-0.732 (9.30)**	-0.132 (1.41)
Observations	2235	2235	2175	2172	2175	2172
R-squared	0.31	0.33	0.37	0.41	0.39	0.42

Robust *t*-statistics in parentheses

* Significant at 5% level; ** Significant at 1% level

Dependent Variable = Log of hourly wages

APPENDIX TABLE 3

REGRESSION WITH EDUCATION LEVEL AND GENDER DUMMIES

	Basic (1)	With Sector (2)	With Union and Ownership (3)	With Size (4)	With Region (5)
female	-0.145 (3.69)**	-0.143 (3.55)**	-0.169 (4.33)**	-0.216 (5.73)**	-0.233 (6.25)**
primdum	0.268 (4.99)**	0.279 (5.22)**	0.257 (4.88)**	0.23 (4.51)**	0.22 (4.40)**
secondum	0.848 (16.43)**	0.864 (16.82)**	0.773 (15.30)**	0.684 (13.91)**	0.663 (13.46)**
univdegr	1.521 (15.23)**	1.517 (15.23)**	1.345 (13.25)**	1.194 (11.90)**	1.165 (11.64)**
expr	0.062 (18.41)**	0.062 (18.46)**	0.05 (14.10)**	0.044 (13.01)**	0.042 (12.10)**
exprsq	-0.001 (12.14)**	-0.001 (12.26)**	-0.001 (9.99)**	-0.001 (9.93)**	-0.001 (9.25)**
food_bev		0.261 (5.07)**	0.175 (3.44)**	0.138 (2.80)**	0.155 (3.10)**
leather		0.24 (3.45)**	0.288 (4.22)**	0.142 (2.24)*	0.074 (1.16)
wood_fur		0.173 (3.36)**	0.2 (4.00)**	0.202 (4.23)**	0.202 (4.15)**
foreign			0.454 (5.72)**	0.304 (3.67)**	0.253 (3.08)**
public			0.167 (3.93)**	0.002 (0.05)	-0.066 (1.34)
union_dummy			0.407 (10.04)**	0.148 (3.59)**	0.161 (3.95)**
medium				-0.424 (9.27)**	-0.458 (10.13)**
small				-0.666 (11.92)**	-0.644 (11.42)**
amhara					-0.444 (6.24)**
east					-0.204 (3.99)**
oromia					-0.035 (0.58)
south					-0.257 (4.88)**
tigray					0.055 (0.78)
Constant	-0.366 (6.46)**	-0.559 (7.69)**	-0.507 (7.11)**	0.093 (1.10)	0.232 (2.67)**
Observations	2242	2242	2182	2179	2179
R-squared	0.31	0.32	0.36	0.4	0.42

Robust *t*-statistics in parentheses

* Significant at 5% level; ** Significant at 1% level

Dependent Variable = Log of hourly wages

APPENDIX TABLE 4

RETURNS TO INDIVIDUAL AND FIRM CHARACTERISTICS
ALL SAMPLE *VERSUS* BY GENDER

	With Education Dummies			With Years of Education		
	All Sample (1)	Men (2)	Women (3)	All Sample (4)	Men (5)	Women (6)
expr	0.046 (13.42)**	0.043 (11.35)**	0.049 (6.56)**	0.048 (13.87)**	0.045 (11.60)**	0.051 (7.20)**
exprsq	-0.001 (9.97)**	-0.001 (8.63)**	-0.001 (6.38)**	-0.001 (9.90)**	-0.001 (8.50)**	-0.001 (6.25)**
primdum	0.239 (4.68)**	0.241 (4.24)**	0.154 (1.39)			
secondum	0.67 (13.51)**	0.681 (11.92)**	0.72 (7.68)**			
univdegr	1.199 (11.73)**	1.29 (11.51)**	0.851 (4.12)**			
food_bev	0.153 (3.09)**	0.158 (2.62)**	0.108 (1.27)	0.199 (4.06)**	0.207 (3.49)**	0.145 (1.74)
wood_fur	0.254 (5.36)**	0.235 (4.18)**	0.08 (0.80)	0.247 (5.37)**	0.226 (4.15)**	0.064 (0.67)
leather	0.159 (2.51)*	0.137 (1.81)	0.156 (1.44)	0.187 (2.92)**	0.183 (2.38)*	0.15 (1.37)
union_dummy	0.149 (3.58)**	0.135 (2.82)**	0.166 (2.06)*	0.13 (3.14)**	0.112 (2.36)*	0.171 (2.11)*
small	-0.634 (11.18)**	-0.64 (9.96)**	-0.845 (6.90)**	-0.612 (10.70)**	-0.634 (9.73)**	-0.766 (6.36)**
medium	-0.42 (9.06)**	-0.409 (7.60)**	-0.456 (5.19)**	-0.418 (8.90)**	-0.427 (7.79)**	-0.4 (4.51)**
foreign	0.307 (3.71)**	0.3 (3.18)**	0.345 (1.97)*	0.331 (4.03)**	0.339 (3.57)**	0.299 (1.80)
public	-0.005 (0.11)	-0.008 (0.14)	0.035 (0.41)	-0.009 (0.19)	-0.014 (0.24)	0.038 (0.44)
educyrs				0.08 (18.04)**	0.08 (15.72)**	0.091 (10.64)**
Constant	-0.011 (0.13)	0.062 (0.64)	-0.086 (0.52)	-0.389 (4.26)**	-0.294 (2.76)**	-0.615 (3.69)**
Observations	2181	1698	481	2173	1693	479
R-squared	0.39	0.39	0.44	0.40	0.39	0.45

Robust *t*-statistics in parentheses

* Significant at 5% level: ** Significant at 1% level

Dependent Variable = Log of hourly wages

Note: Primdum denotes a dummy for completed primary education attained after six years of elementary education. Secondum denotes workers who completed secondary education after six years of schooling beyond primary. Univdegr denotes workers who are assumed to have earned a degree after four years of university education.

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