

Trade Reforms, Mark-Ups and Bargaining Power of Workers: The Case of Ethiopian Manufacturing Firms¹

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Abstract

There is a predominant proposition in trade theory that firms operating in an imperfect market with trade barriers often set prices with a positive mark-up. Workers using insider information tend to bargain and share the rent from firms' market power; which is negatively associated with to decline with trade reforms. Empirical evidences are, nonetheless, mixed. Trade reforms that took place between 1991 and 2002 in Ethiopia inspired the study to investigate the proposition. Using firm level unbalanced data of manufacturing firms employing more than 100 permanent workers between 1996 and 2007, a model of mark-up with labor bargaining power was estimated using random effects and LDPDM. The estimates of the two models are similar. Albeit huge inter-firm variations, the average estimated mark-ups has not only been positive but also increased even after the reform. This may be perhaps because of the 17.5 percent weighted average tariff rate that has still been maintained after the reform. Workers' bargaining power parameter estimate remained negative over the study period; possibly because of high unemployment and low reservation wage. The rate of rent extraction from workers declined on average in the post reform period. Thus, further opening up of markets may bring a competitive push to improve firm performance, reduce market power of firms and the rent extraction from workers. There is a need to attract additional investment (both public and private) in the economy and addressing causes of capacity underutilization of incumbent firms may lessen unemployment problems and thereby improve workers bargaining power and their earnings.

Keywords: Trade reform, mark-up, bargaining power, rent, trade unions

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1. Introduction

The period between 1974 and 1991 was characterized by high level of protectionist policy and socialist economic management in Ethiopia. The country undertook policy reforms between 1991 and 2002 including reducing the weighted average tariff rate from 41.6 percent to 17.5 percent, the tariff band from 23 to 6 and the maximum tariff rate from 230 percent to 35 percent respectively [MOFED, 2008] that was intended, among other things, to improve the performance and competitiveness of local industries. Trade reforms may bring both negative and positive effects on employment and wages. Neglecting the negative consequences of trade is very detrimental to society as its potential benefit is generally small for a large number of people but it can hugely cost small groups of individuals [G rtzgen, 2002].

Trade openness increases mobility of capital and superior quality intermediate inputs which can partly substitute the services of labor [Rodrik, 1997]. It increases both price elasticity of demand for goods and labor demand [Slaughter, 2001]; which in turn, affects bargaining power of workers to secure their job and improve their wage. The response of firms to trade reforms is heterogeneous depending, for instance, on their productivity and market orientation [Melitz, 2003 and Melitz and Ottaviano, 2008]. Productive firms tend to improve the reward for factor inputs; whereas inefficient firms cut back production or exit out of the market and affect employment and wages.

A number of studies evidenced that wage responses are greater than employment following trade liberalization because of labor market rigidities for possible reallocation [Hoekman and Winters, 2005], which requires to give more emphasis to study the effect of trade reforms on wages. A positive association was observed between trade barriers and wages in the works of G rtzgen (2002), Mezzetti and Dinopolos (1991) and Huizinga (1993). Goldberg and Pavcnik (2005) find workers operating in more protected sectors earn larger than those in more open sectors with similar observable characteristics, in the case of Colombia. On the contrary, Fisher and Wright (1999) find a negative relationship between wages and protection.

The amount of fair wage expectation and the interest to work with depends positively on the level of firm's productivity [Egger and Kreickemeier, 2009]. Workers, with secured job, may share rent with firm owners arising from imperfect markets with entry barriers. Such opportunity for workers arises because of labor market imperfection due to heterogeneity in skills; experience and motivation of workers. Trade openness erodes this rent [Rama, 2003] in [Hoekman and Winters, 2005] and may negatively affect workers in import-substituting firms as against exporting firms [Greenaway et al. 1999].

Trade unions (TUs) play a key role for workers to get a premium over what marginal conditions' wage rate warrants. TUs have a relatively long history in Ethiopia. There are however some restrictions on their establishment [Aidt and Tzannatos, 2002]. TUs in state owned enterprises are often represented in the board to influence firms to properly consider the working and payment conditions of workers. TUs in the private sector also bring issues to the attention of the management of firms or request government to arbitrate their cases.

In spite of the presence of TUs, workers' wage is likely to be lower than their marginal revenue product, let alone involve in rent sharing because of limited alternative job opportunities for bargaining. The competitive push in the goods market because of economic reforms is to have depressing effect on mark-up, bargaining power of workers and amount of rent.

Whether there firms used to charge visible price mark-ups and share part of the rent to workers before and during trade reforms and what changes have been observed in this regard afterwards are questions that need to be addressed. Theories and empirical evidences elsewhere and the situations in the Ethiopian manufacturing sector lead to two testable hypotheses: (i) firms' were able to obtain mark-ups; whose magnitude declines in the post reform because of loss of market power and (ii) firms do not share a rent with their workers given weak bargaining power of the later.

The aim of this paper is, therefore, to estimate firm mark-ups and the share of rents accruing to workers and how much it has changed between "during" and "post" trade reform periods. To this effect, the paper jointly estimates firm

mark-up and workers' bargaining power parameters and assesses the change in magnitude between the two trade regimes and across groups of firms.

The study used panel data of manufacturing firms that employ 100 or more permanent workers² between 1996 and 2007 drawn from Central Statistical Agency of Ethiopia. Linear Dynamic Panel Data Method (LDPDM) was applied to obtain coefficients that are used to calculate mark-up and bargaining-power parameters. Mean and median equality tests were used to check the validity of hypotheses using STATA 12.

To the knowledge of the writer, this is the first attempt in the context of Ethiopia at the very least and one of the few attempts made in the context of developing countries. Thus, it may lend some policy implications and modest contribution to literature on how rents are distributed between firms and workers and whether trade reforms affected the pattern of distribution.

The remaining part of the paper is organized as follows. Section 2 reflects some of the theoretical and empirical literature on mark-up and rent sharing. Section 3 portrays the theoretical framework and estimation strategy of the study. Section 4 discusses estimation results and Section 5 concludes with some implications for policy.

2. Literature Review

2.1 Theoretical Literature

In an imperfect labour market, workers' pay may tend to deviate from the marginal conditions of the classical competitive markets. The risk-averse model postulates a positive association between wages and profits because of uncertainty [Blanchflower, et al. 1996]. Workers may have insider sufficient information on the level of profit and exert pressure through their TUs to have a share. Sometimes firms face product demand shock and upward sloping labor supply curve that may cause a temporary positive correlation between

² This is simply because of the higher likelihood of these enterprises to have TUs as against smaller firms with fewer than 100 permanent workers. The study used a unbalanced panel data with a total of 1663 data points ($N \times T$).

wages and profits in the short-run [Goos and Konings, 2001]. Such imperfections force workers and firms to involve in negotiation to set wage premiums.

Theories provide different channels through which workers' negotiation power and wage rates may be affected following trade reforms. Built based on the assumption of monopolistic competition in the goods market and possibility of bargaining in the labor market, the macroeconomic model predicts that market deregulation lowers prices of goods and raises real wages but at the same time reduces mark-ups and the rent that goes into workers because of bargaining [Blanchard and Giavazzi, 2003].

Heterogeneity in firm performance after trade reforms becomes a source of wage inequality. Inefficient firms either pay lower wages or lay off their workers, whereas workers in productive firms benefit from higher returns [Egger and Kreckemeier, 2009].

2.2 Empirical Evidence

Empirical evidences on the impact of trade openness on wages and the bargaining power of workers is mixed. As documented in Goldberg and Pavcnik (2007), Feliciano (2001) for Mexico and Pavcnik, et al. (2004) for Brazil find no association between trade liberalization and wage premium. Goldberg and Pavcnik (2004) find both positive and negative association in the case of Colombia attributed to skill differences. Mishra and Kumar (2005) find a negative association for urban India.

Crépon et al. (1999, 2002) in Boulhol et al. (2007) argue that estimations based on perfect competition in the labor market might give a misleading result about wages. They found, using a model that consider imperfect product and inputs market, a bargaining power estimate of about 0.66 associated with higher mark-up of the firms. Dobbelaere (2004) also indicated how ignoring imperfections in the labor market leads to underestimation of mark-up among Belgian firms. Actually he found heterogeneous mark-up and bargaining power parameter estimate. Lopez and Gallardo (2006) also found an imperfect

labour market in Mexico influenced by wage-bargaining and insider-outsider models. Workers in productive firms get greater proceedings than otherwise.

Brock and Dobbelaere (2006) found little evidence on the impact on the workers' bargaining power using fixed effects model and a separate equation for wage bargaining as against Boulhol et al. (2007), who found a significant drop on both mark-up and workers bargaining power using GMM as a response to globalization.

Using Olley and Pakes (1996) method to correct simultaneity bias in the first stage and fixed effects in the second stage, Abraham et al.(2009) jointly estimated mark-up and bargaining power parameters and find a positive association between the two and also firms facing high import-penetration to have lower estimated values for both parameters in the case of Belgian manufacturing firms. Using French firms, Dobbelaere and Mairesse (2009) found large values for both union bargaining and firm mark-up. The study also found firm and industry heterogeneity in the size of mark-up and rent-sharing parameters.

Moreno and Rodríguez (2009) assumed constant returns to scale in their model and used Roeger (1995) strategy to address endogeneity problems associated with total factor productivity on a panel of Spanish firms and come up with a positive association between workers' rent sharing parameter and firms' mark-up and negative correlation between these parameters and imports of final goods.

2.3 Nature and Role of Trade Unions in Ethiopia in Wage Fixing

Trade Unions may be established in an enterprise with twenty or more workers. Freedom of organization of workers applies if it conforms to national security, public safety and economic well-being, health or morals and also involvement of country's political affairs (FDRE: Proclamation 42/1993, 88/1994 & 377/2003). It is indicated that

“Employers owe remuneration to workers for work performed according to contracts of employment. Wages are set either on

individual contract or through collective agreements. ... Collective bargaining is an important feature of industrial relations in Ethiopia although a very negligible percent of the labor force which is less than 15% is covered by it” [Bersoufekad, 2003, 13-15].

Formation of TUs has a fairly long history in Ethiopia. Confederations of Ethiopian Trade Unions (CETU) were established in 1963; which constitute 9 trade union federations in 2012 with members between 350,000 and 400,000 [Goldberg, 2012]. The bigger the firm and the number of workers, the higher the likelihood of facing workers pressure to form TUs and so do for firms to respect the labour laws. Formation of TUs is seriously challenged by small-sized private firms. Thus, this study considered firms that employed 100 or more permanent workers are likely to have TUs and thus constitute as subjects of analysis.

Firms with TUs put in place a bi-law designed based on workers' collective bargaining with their employers that state the rights and obligations of both parties and on how they jointly maintain industrial peace. The bi-law contains wages, incentives and payment modalities, working conditions, fire and hire procedures and circumstances leading for lawful absence of work and similar closes. Conflicts between the two parties are brought to a tripartite committee drawn from CETU, Ethiopian Employers Federation and government that meets on a bi-monthly basis or to the court if the committee's decision is not accepted by either the party. This indicates the role of TUs in wage bargaining; albeit workers still complain about low payment, job insecurity and delays of judicial institutions [CETU, 2011].

3. Methodological Framework

3.1 Theoretical Framework

The neoclassical economics indicates that profit maximizing firm will increase the level of employment of a variable input until the marginal revenue product (MRP) of that input equals what it is paid off. This condition inherently presumes perfect divisibility, homogeneity and free mobility or perfectly elastic input supply. TUs or insider workers' influence, regulations

and other sources of labor market rigidities do not also exist. In practice, payments are not made based on marginal conditions. Considering this, the paper introduced imperfect labor market condition in the Hall (1988) mark-up equation model following Blanchard and Giavazzi (2003), Crépon et al. (2002) as applied in Dobbelaere (2004), Boulhol et al. (2007), Abraham et al. (2009) and Dobbelaere and Mairesse (2009) to capture the possibility of organized workers' influence on firms' wage setting in the context of Ethiopia.

Assuming a typical production technology of firm i at time t to be characterized by:

$$Y_{it} = A_{it} F(L_{it}, M_{it}, K_{it}) \quad i = 1, \dots, N \quad \text{and} \quad t = 1, \dots, T \quad (3.1)$$

Where, Y_{it} , L_{it} , M_{it} , and K_{it} are output, labor, material and capital inputs respectively. A_{it} i and t are *TFP*, firm and time identification parameters.

Taking the derivative of the natural log of (3.1) with respect to time and making some algebraic manipulations gives

$$y_{it} = S_{Lit} l_{it} + S_{Mit} m_{it} + S_{Kit} k_{it} + a_{it} \quad (3.2)$$

Where, y_{it} , l_{it} , m_{it} , k_{it} and a_{it} are rates of growth of output, labor, material, capital and TFP respectively.

In perfectly competitive markets and constant returns to scale, the elasticity of output with respect to each factor input (S_{Vit} , where $V = L, M, K$) is equal

$$\Gamma_{Vit} = \frac{w_{Vit} V_{it}}{P_{it} Y_{it}},$$

its corresponding cost share from total revenue of the firm or

where w_{Vit} are the prices of factor input (V_{it}) and P_{it} are the prices of output (Y_{it}).

Relaxing the assumption of perfect competition in input and product markets, the short run profit maximization condition of the firm gives

$$S_{Lit} = \tilde{\gamma}_{Lit} r_{Lit} \quad (3.3)$$

$$S_{Mit} = \tilde{\gamma}_{Mit} r_{Mit} \quad (3.4)$$

$$\tilde{\gamma}_{Lit} = \tilde{\gamma}_{Mit} = \tilde{\gamma}_{it} \quad (3.5)$$

Equations (3.3) and (3.4) imply that firms pay for inputs after adjusting their MRP by a certain magnitude $\tilde{\gamma}_{Lit}$ or $\tilde{\gamma}_{Mit}$. Based on (3.2) returns to scale of a firm (γ_{it}) and the coefficient of capital can be written respectively as:

$$\gamma_{it} = S_{Lit} + S_{Mit} + S_{Kit} \quad (3.6)$$

Using (3.5) and (3.6), (3.2) can be written as:

$$(y_{it} - k_{it}) = \tilde{\gamma}_{it} [\gamma_{Lit} (l_{it} - k_{it}) + \gamma_{Mit} (m_{it} - k_{it})] + [\gamma_{it} - 1]k_{it} + a_{it} \quad (3.7)$$

Equation 3.7 enables to run away from the need for computing user cost (or price of capital) and resulting cost share of the capital input for estimation.

The assumption of the above model is further relaxed to include the role of TUs in influencing wage setting behavior of firms (supported by rules or regulations governing certain incentive schemes and arbitration mechanisms). Unlike the standard model of union bargaining, this paper assumes, based on specific conditions of a small developing country; TUs attract lower number of members among workers of a given firm.

Members contribute membership fee, which has an insignificant share from their wage. TUs discuss with firms' managers about wages, overtime payments, bonus or other incentives. Management knows that failure to

address this request may result in collaborative shirking of efforts that may lead to the extent of an open strike. It also knows that joining to TUs may only need to pay a small membership fee at any time; thus excluding non-members from the incentive scheme may not be feasible. Thus, when firms consider addressing requests of TUs, they would do it to the best interest of all workers to ensure industrial peace.

The objective function of the union (or all workers), therefore, is to maximize their utility; which is the function of the difference between their actual pay and their reservation wage in the absence of a negotiation (w_{ait}). In a small developing country, where there is no unemployment benefit, the reservation wage rate may be taken as a weighted average of the cost of offering a labor service (the cost of subsistence, shelter and transport) assuming no employment elsewhere (w_s) and the likely pay from other alternative jobs (w_0) subject to the probability of securing alternative employment. This is expressed as:

$$w_{ait} = w_{sit} f(u) + w_{oit} (1 - f(u)), \quad (3.8)$$

where $w_{oit} > w_{sit}$, $f(u)$ is the probability of being unemployed given stock of unemployment (u). The higher the rate of unemployment in an economy and/or the lower the cost of rendering labor services, the lower will be the reservation wage rate.

Using a simplified form of a Stone-Geary utility function as in Kraft (2006), workers through their TUs, maximize their group utility

$$L_{it}(w_{Lit} - w_{ait}) \quad (3.9)$$

Where the expected nominal wage rate after negotiation is given by:

$$w_{Lit} = F(P_t, u_t, w_{ait}, Z_t, \tilde{it}) \quad (3.10)$$

(3.10) shows that w_{Lit} is determined by (u_t) , (w_{ait}) , firm's mark-up (\tilde{it}) , the general price level in the economy (P_t) and other factors affecting wage rates (Z_t) such as government regulations (such as minimum wage, income tax, etc). The lower w_{ait} , P_t and/or \tilde{it} , the lower would w_{Lit} be. w_{Lit} tends to decline as u_t increase. The sign of the partial correlation between w_{Lit} and Z_t depends on the type of intervention.

Following Rodrik (1997), Slaughter (2001) and Tybout (2000), removal of trade barriers increases imports and price elasticity of goods; which in turn reduces market power of firms (\tilde{it}) . Lower profits translate into lower rents to firms and workers (Abraham, et al., 2009). Decline in the general price level (P_t) reduces the demand for workers for a wage increase. Poor performing firms may exit out of the market. Surviving firms may tend to use modern technologies. These two forces may lead into an increase in u_t ; which subsequently reduce (w_{ait}) , workers' bargaining power and w_{Lit} . Despite this expected overall effect, the reaction of firms is heterogeneous [Melitz and Ottaviano, 2008].

Following Abraham et al., (2009) and Dobbelaere and Mairesse (2009), firms' objective function is to maximize their short-run profit while strategizing for their long-run growth. This is given by the difference between total revenue and cost of labor and materials:

$$f_{it}(w_{Lit}, w_{Mit}, L_{it}, M_{it}) = P_{it}Y_{it} - w_{Lit}L_{it} - w_{Mit}M_{it} \quad (3.11)$$

The equilibrium outcome is obtained by maximizing the asymmetric Nash bargaining equation of the form:

$$\max_{w_{Lit}, L_{it}, M_{it}} \Theta = [L_{it}(w_{Lit} - w_{oit})]^{it} [P_{it}Y_{it} - w_{Lit}L_{it} - w_{Mit}M_{it}]^{1-it} \quad (3.12)$$

where $0 \leq \beta_{it} \leq 1$, β_{it} and $(1 - \beta_{it})$ are parameters capturing bargaining power of workers and firms respectively. β_{it} has two theoretically possible extreme values “0” and “1”; which imply absolute impotency and absolute power of workers in the wage setting process respectively [Boulhol et al., 2007]. The lower bound $\beta_{it} = 0$ precludes the possibility of extraction of rent from workers themselves. In the context of a developing country, where the bargaining power of workers is limited, there could be a possibility that workers could be paid below their marginal revenue product, which in effect leads to $\beta_{it} < 0$.

The respective first order conditions for the maximization of Equation (3.12) with respect to material, wages and labor inputs are³:

$$\frac{\partial (P_{it}Y_{it})}{\partial M_{it}} = w_{Mit} \quad (3.13)$$

$$w_{Lit} = (1 - \beta_{it})w_{oit} + \beta_{it} \left[\frac{P_{it}Y_{it} - w_{Mit}M_{it}}{L_{it}} \right] \quad (3.14)$$

$$w_{Lit} = \frac{\beta_{it}}{(1 - \beta_{it})} \left(\frac{P_{it}Y_{it} - w_{Lit}L_{it} - w_{Mit}M_{it}}{L_{it}} \right) + \left(\frac{\partial (P_{it}Y_{it})}{\partial L_{it}} \right), \quad (3.15)$$

Manipulating Equation 3.13⁴ yields the condition for profit maximization of a firm operating under imperfect competition. Solving (3.14) and (3.15) simultaneously gives an expression for what is called “the contract curve”:

³ Refer Appendix for the derivations.

⁴ Refer Appendix 1 Equations A3 – A7 for the derivation.

$$\left(\frac{\partial(P_{it}Y_{it})}{\partial L_{it}} \right) = w_{ait} \tag{3.16}$$

(3.16) has a similar economic meaning as (3.13). In the presence of bargaining, the actual share of labour from the gross value of production can be given by

$$r_{Lit} = (1 - \beta_{it})r_{Lit}^a + \beta_{it}(1 - r_{Mit}) \tag{3.17}$$

where r_{Lit}^a and r_{Lit} are the possible shares of the labor cost from the total value of production calculated based on alternative wage without bargaining and with bargaining respectively; whereas r_{Mit} represents the same as before. Assuming that a firm maximizes its short-run profit by equating its MRP of labor but with the alternative wage, Equation (3.3), which is implicitly in Equation 3.7, can be written as:⁵

$$b_{Lit} = m_{it} a_{Lit}^a \tag{3.18}$$

However (3.14) could be written as⁶

$$r_{Lit}^a = r_{Lit} + \left(\frac{\beta_{it}}{1 - \beta_{it}} \right) (r_{Lit} + r_{Mit} - 1) \tag{3.19}$$

Equation 3.19 helps to avoid computing the share of labor cost based on the alternative wage.

Following Abraham et al. (2009) and Dobbelaere and Mairesse (2009), substituting (3.18) into (3.17) yields:

$$b_{Lit} = m_{it} a_{Lit} + m_{it} \left(\frac{\beta_{it}}{1 - \beta_{it}} \right) (a_{Lit} + a_{Mit} - 1). \tag{3.20}$$

⁵ Similar process is followed as Equations A.1.3 –A.1.7 in the Appendix.

⁶ Refer Appendix for the derivation.

3.2 Empirical Models and Estimation Methods

Based on the above theoretical models, the empirical model is given by:

$$(y_{it} - k_{it}) = S_{Lit}(l_{it} - k_{it}) + S_{Mit}(m_{it} - k_{it}) + [n_{it} - 1]k_{it} + a_{it} + \epsilon_{it} \quad (3.21)$$

Where, $\epsilon_{it} \sim NID(0, \sigma^2)$.

From the estimated coefficients of Equation (3.21), the estimates of parameters of interest are obtained as:

- i) Mark-up taking account of the labor bargaining process is:

$$\widehat{m}_{it} = \frac{\widehat{b}_{Mit}}{\widehat{a}_{Mit}}. \quad (3.22)$$

- ii) The extent of rent sharing or success of bargaining is obtained by invoking (3.20), (3.21) and (3.22) and rewriting Equation (3.20) as:

$$\widehat{l}_{it} = \frac{\widehat{b}_{Lit} - \widehat{m}_{it}\widehat{a}_{Lit}}{\widehat{b}_{Lit} + \widehat{m}_{it}[\widehat{a}_{Mit} - 1]}. \quad (3.23)$$

- iii) As noted in Boulhol et al. (2007), using estimated coefficients of the parameters in (4.21) and the relationship in (4.22), (4.23) becomes

$$\widehat{l}_{it} = \frac{\widehat{b}_{Lit} - \frac{\widehat{b}_{Mit}}{\widehat{a}_{Mit}} \cdot \widehat{a}_{Lit}}{\widehat{b}_{Lit} + \frac{\widehat{b}_{Mit}}{\widehat{a}_{Mit}} [\widehat{a}_{Mit} - 1]}. \quad (3.24)$$

Estimating (3.21) using Ordinary Least Squares may lead to biased coefficient estimates of the production function and the resultant mark-up values. This is because of the fact that firms' prior expectation of their level of efficiency (which could be captured by the growth of TFP) tends to influence their decision on the amount of input acquisition and thus possibly causes endogeneity problem⁷. Endogeneity problem also comes from the fact that the left hand side variable $(y_{it} - k_{it})$ is correlated with the right hand side variables or regressors $(l_{it} - k_{it})$, $(m_{it} - k_{it})$ and k_{it} .

Fixed effects address the firm time-invariant effects on (a_{it}) while leaving intact the time variant effects. The model uses growth rate figures, which can remove time-invariant effects through differencing. It addresses endogeneity problems neither. In random effects model, firm-specific time-invariant attributes are assumed to have zero mean, constant variance and uncorrelated with explanatory variables; albeit removed through differencing. Thus, random-effects model is estimated for comparison purposes.

GMM and system GMM, as suggested by Arellano and Bond (1991) and Blundell and Bond (2000) respectively, are among the econometric techniques that are often used to address endogeneity problems observed in the production function estimation. Both methods involve lagged dependent variables as explanatory variables; which, however, lead to correlation with unobserved firm level effects (u_i) and lead to have inconsistent estimators. Arellano-Bond (1991) eliminates panel-level effects through first differencing errors and using instruments. Lagged levels of the dependent variable, the predetermined variables and the endogenous variables are used to form GMM-type instruments. First differences of strictly exogenous variables are used as standard instruments. However, lagged level instruments become weak in the Arellano-Bond estimator as the autoregressive process becomes

⁷ This problem of bi-directional causality was first recognized by Marshak and Andrews (1944) and various econometric estimations have been tried to address the problem.

too persistent ($\dagger_v^2 / \dagger_v^2$ becomes too large) as identified by Blundell and Bond (1998).

Blundell and Bond (1998) in StataCorp (2009) proposed a system GMM estimator to address the problem. Lagged differences are used as instruments for the level equation and moment conditions of lagged levels are used as instruments for the differenced equation. Nonetheless, the use of such specification does not allow testing autocorrelation because of the fact robust two-step system GMM estimators has a seriously biased variance-covariance matrix. Linear Dynamic Panel Data model addresses this problem by incorporating Windmeijer (2005) robust estimator for two-step Vector Corrected Errors (VCE) that corrects these biases [Ibid, 2009].

Following StataCorp (2009), the general form of dynamic panel-data model has the form:

$$y_{it} = \sum_j^p \Gamma_j y_{i,t-j} + X'_{it} S_1 + Z'_{it} S_2 + u_i + v_{it}, i = 1, \dots, N; t = 1, \dots, T \quad \dots(3.25)$$

where Γ_j are p parameters to be estimated.

X'_{it} is a $1 \times k_1$ vector of strictly exogenous covariates;

S_1 is a $k_1 \times 1$ vector of parameters to be estimated;

Z'_{it} is a $1 \times k_2$ vector of predetermined and endogenous covariates;

u_i are the panel level fixed effects (which may be correlated with the covariates);

$v_{it} \sim IID(0, \dagger^2)$ and $E[u_i v_{it}] = 0$ for all i and t .

LDPDM uses a similar test statistics as Arellano-Bond and Blundell and Bond system estimators for serial correlation of first differences of error terms and Sargan test for over identifications of instruments. On the basis of the theoretical specification of LDPDM as indicated in Equation 3.25, Equation 3.21 is estimated.

As firms operate longer in the market, there is higher possibility that they would adjust wages so as to ensure job security and industrial peace. Thus, firm age is used as a standard instrument in the LDPDM. Mark-ups and rent premium of workers and enterprises are jointly estimated using data for the overall period (1997 – 2007); trade reform period (1997-2002) and post reform period (2003-2007). Random effects model as suggested in Baltagi and Wu (1999) in Baltagi (2005) is also estimated for comparison purposes, which incorporates AR (1) to entertain unbalanced panels whose observations are unequally spaced.

This study has two major added values as compared to many other previous studies. With the exception of few, previous studies used OLS, fixed effects or system GMM; which may not address inherent econometric problems in the production function specification such as endogeneity. Secondly, this paper attempts to expand the possible values of the labour bargaining power parameter estimates taking into account a developing country context, which becomes consistent with the actual finding.

3.3 Source of Data and Description of Variables

Central Statistical Agency is the source of data large and medium scale firms for the period between 1996 and 2007. The study used unbalanced and unequally spaced panel data⁸ of firms employing 100 or more permanent workers. Because of the use of growth rate figures, one observation is missed for every firm and thus limiting the time dimension to eleven years. Variables used in the estimation of (3.21) are defined as follows.

Y_{it} stand for nominal gross value of production of firms. M_{it} capture the value of local and imported raw and intermediate inputs at the current factory gate prices. K_{it} represent the book value of fixed assets at the beginning of each period (taking care of the stock at period $t = t_0$, depreciation allowance deductions and investments made at period t). W_{it} include all types of

⁸ The total number of data points ($N \times T$) is 1663.

incomes of workers including basic wages and salaries, overtime-payments and incentives. Γ_{Lit} and Γ_{Mit} are ratios of workers' income and cost of material inputs to gross value of production respectively.

4. Empirical Results

4.1 Descriptive Statistics Results

Table 4.1 shows the descriptive statistics of the growth of nominal values of gross value of production(GNGVP), incomes of workers, cost of raw materials and values of fixed assets between 1996 and 2007.GNGVP was growing at an average rate of 20.7 percent per annum. The growth rate of values of fixed assets was the highest among the three different factor inputs because of entry of new firms with relatively high investment cost during the study period. The measures of dispersion such as range, standard deviations and coefficient of variation show considerable heterogeneity in the growth rate of outputs and inputs among firms. This is perhaps because of differences in size, input sources, market orientation, owner ship structure and other firm specific internal capabilities in terms of technology, skilled manpower and managerial endowments.

Table 4.1: Descriptive Statistics of Growth of Nominal Output and Input Variables

Statistics	Output	Wages and Salaries	Raw Materials	Fixed Assets
Minimum	-2.64	-2.32	-3.35	-4.05
Mean	0.207	0.236	0.188	0.245
Maximum	7.78	7.29	8.21	9.22
Standard Deviation	0.937	0.849	0.988	1.16
Coefficient of Variation	4.53	3.59	5.24	4.71

Source: Own Calculation based On CSA (Various Years).

Table 4.2 indicates the descriptive statistics of the relative share of labor and raw materials of firms over the period between 1996 and 2007.

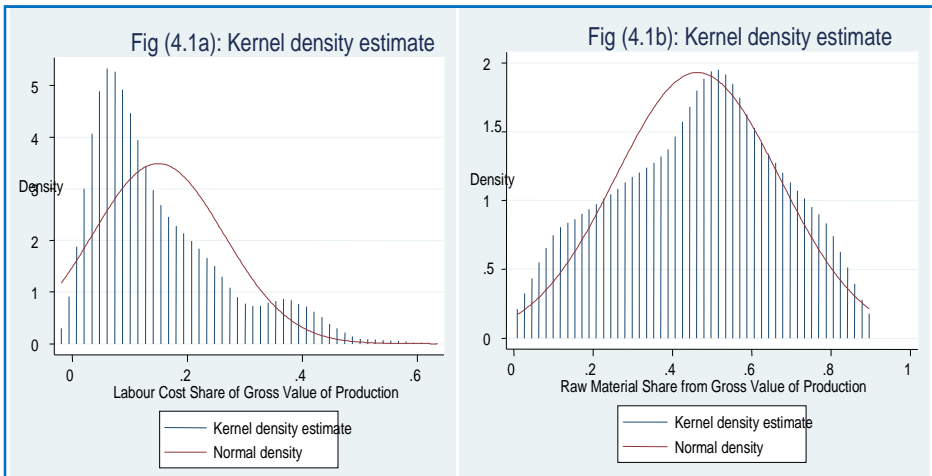
Table 4.2: Descriptive Statistics of Input Cost Shares from GVP (1996-2007)

Statistics	Labor Cost Share	Raw Materials Cost Share
Minimum	0.002	0.05
Mean	0.149	0.463
Median	0.113	0.483
Standard Deviation	0.114	0.207
Max	0.612	0.855

Source: Own Calculation based on CSA (Various Years).

The share of labor and raw material costs from gross value of production of firms vary from 0.1 percent to 61.2 percent and 5 percent to 85.5 percent respectively. Significant variation in the relative share of labor and raw materials cost across firms may be explained by the degree and complexity of processing, productivity and bargaining power of workers, the responsiveness of managers or owners for wage increment and other firm specific and external circumstances. Mean and median share of raw materials and intermediate input costs to the value of output goes as much as 3.4 and 4.6 fold of the corresponding share of labour cost.

Figure 4.1: Distribution of Share of Labor and Raw Materials Cost from Gross Value of Production



Source: Own Calculation based on CSA (Various Years).

Estimated Pearson coefficients of skewness for firm level labor and raw material cost shares from gross value of production showed 0.95 and 0.28 are respectively showing apparently different distributional patterns. This is because some firms spend relatively very high share of their gross value of production on wages and salaries as against the majority. This is witnessed from the mean share values exceeding the median and positively skewed distribution. Raw material cost shares show a tendency towards a normal distribution.

Table 4.3: Labor and Raw Material Cost Shares by Different Groups of Firms

Firm Groups		Labor Cost Share		Raw Materials Cost Share	
		Mean	Median	Mean	Median
Ownership	Public	0.169	0.134	0.476	0.487
	Private	0.120	0.084	0.479	0.454
Input Source	Domestic Resource Based	0.159	0.122	0.456	0.484
	Import-Intensive	0.134	0.098	0.474	0.481
Output Market	Exporting	0.126	0.103	0.467	0.479
	Non-exporting	0.154	0.118	0.462	0.484

Source: Own Calculation based on CSA (Various Years).

As it is indicated in Table 4.3 state-owned, non-exporting and domestic resource-based firms⁹ spent on average a higher percentage of their gross value of production on wages and salaries as compared to private, exporting (firms that fully or partially sell their products to the external market) and import-intensive firms (firms whose imported inputs cover 50 percent or more of the total cost of raw materials) respectively. Whereas the action of state-owned firms may be driven by the principal-agent problem, the actions of non-exporting firms may be somehow reflected in their relative unproductive and hence uncompetitive behaviour in the face of the global economy.

⁹ Domestic resource based firms are those which 50% or more than 50 percent of their inputs from domestic sources; Otherwise, they are called import intensive firms.

4.2 Econometric Results on Mark-up and Workers' Premium

Table 4.4 summarizes the empirical results of LDPDM and random effects models of mark-up and bargaining power premium of TUs estimated based on data for the entire period. The model uses various instruments; lagged dependent variable (the difference between the growth rates of GVP and nominal values of fixed assets), endogenous variables (differences nominal values of fixed asset from the growth rates of wages and salaries and growth rates of the values of raw materials), the exogenous variable (growth rate of nominal values of fixed assets) and standard instrumental variables (firm age and lagged two and above values of dependent, endogenous and exogenous variables).

Wald chi-square, $\chi^2(3)$, test in LDPDM shows that all estimated coefficients of covariates are jointly statistically different from zero. First differenced errors are first-order serially correlated (AR (1)) by design. This does not necessarily show the moment conditions to be invalid unless the problem persists on a higher order [StataCorp, 2009]. The null hypothesis for the absence of AR (2) is not rejected; implying absence of statistical indication to believe that the estimated model suffers from misspecification. Sargan test fails to reject the null hypothesis that over-identifying restrictions are valid.

The random effects model also shows that estimated coefficients for covariates are jointly statistically different from zero. The coefficient for the growth rate of fixed asset variable ($S_k = (r - 1)$) was not statistically different from zero in both models; implying that firms with 100 or more permanent workers operate at constant returns to scale. The coefficients of the difference between growth rates of the labour cost and value of fixed assets and also the difference between growth rate of materials costs and value of fixed assets have had comparable estimates in both estimation methods. This shows consistency of results in both models.

Table 4.4: Regression Results of Mark-up and Labor Bargaining Power

Coefficient and Test Parameters	Random Effects	LDPDM
01	02	03
Growth rate differences of nominal values of wages and fixed assets	0.378*** (0.017)	0.387*** (0.048)
Growth rate differences of nominal values of raw materials and fixed assets	0.543*** (0.014)	0.562*** (0.044)
Growth rate nominal values of fixed assets	-0.003 (0.011)	0.013 (0.024)
Constant	-0.003 (0.106)	
JST for all coefficients (Wald – $t^2(3)$) P-value	0.00	0.00
AR(1): P-value		0.00
AR(2): P-value		0.26
Sargan (Chi-square 190): P-value		0.37
Bultagi-Wu LBI (AR (1))	2.65	
N	1663	1663

Source: Own computations based on CSA (Various Years).

Note: Two-step GMM with lag values of covariates and first differences of level variables are used as instruments for differenced and level equations. Log age is a standard instrument. The values in bracket are standard errors. *, ** and *** refer level of significance of 10%, 5% and 1% respectively.

Table 4.5 summarizes the regression results of mark-up and labor bargaining power premium model for both the reform period (1997-2002) and post reform period (2003 -2007). The growth rate of the nominal values of fixed assets became statistically insignificant once again in the two periods implying that trade regime change had no impact on scale economies of firms.

The estimated coefficients of the two other variables vary between the two regimes. The coefficient for the difference between the growth rates of labor cost and capital variable was relatively higher during the reform period than the post reform period. On the contrary, the coefficient for the difference between the growth rates of the values of materials and the values of fixed assets increased during the post reform period.

Table 4.5: Regression Results of Mark-ups and Labor Bargaining Power for Two Trade Regimes

Coefficient and Test Parameters	Up to Year 2002		Year 2003 and above	
	Random Effects	LDPDM	Random Effects	LDPDM
01	02	03	04	05
Growth rate differences of nominal values of wages and fixed assets	0.442*** (0.03)	0.475*** (0.056)	0.339*** (0.016)	0.373*** (0.06)
Growth rate differences of nominal values of raw materials and fixed assets	0.510*** (0.024)	0.506*** (0.052)	0.557*** (0.016)	0.586*** (0.047)
Growth rate nominal values of fixed assets	-0.013 (0.021)	0.003 (0.031)	-0.001 (0.013)	0.004 (0.029)
Constant	0.003 (0.016)		-0.008 (0.013)	
JST for all coefficients (Wald –chi-square) P-value	0.00	0.00	0.00	0.00
AR(1): P-value		0.00		0.00
AR(2): P-value		0.96		0.14
Sargan (Chi-square 190): P-value		0.18		0.64
Bultagi-Wu LBI (AR (1))	2.69		2.53	
N	803	803	860	860

Source: Own computations based on CSA (Various Years).

Note: Two-step GMM with lag values of covariates and lags of first difference were used as instruments for differenced and level equations. Log of age is a standard instrument. The values in bracket are standard errors. *** indicates 1% level of significance. Differences on the coefficients of the two variables in different periods have their own implications on the magnitudes of mark-up and also the bargaining power parameter or the rents accrue to workers following trade regime change. Mark-ups are estimated using (3.21), whose central tendency and measures of dispersion results are displayed in Table 4.6.

Table 4.6: Mark-up among Different Groups Firms (1997-2007)

Industrial Category		Mark-up +1				Mean t-ratio test
		Mean	Median	inter-quintile range	Coefficient of Variation	
Years (1997-2007)						
	Total	1.69	1.17	0.79	0.92	
Ownership	Public	1.8	1.17	1.01	0.92	-3.46
	Private	1.53	1.17	0.63	0.9	
Market	Exporter	1.56	1.19	0.93	0.63	1.58
Orientation	Non-exporter	1.72	1.17	0.77	0.96	
	Domestic	1.84	1.17	0.96	0.97	4.76
Input Source	Import	1.47	1.18	0.62	0.73	
Years (1997-2002)						
	Total	1.58	1.03	0.74	1.06	-1.29
Ownership	Public	1.62	1.03	0.82	1.04	
	Private	1.47	1.01	0.65	1.09	
Market	Exporter	1.31	1	0.65	0.76	2.08
Orientation	Non-exporter	1.62	1.03	0.76	1.08	
Input Source	Domestic	1.74	1.03	0.91	1.11	3.97
	Import	1.31	1.01	0.61	0.78	
Years (2003-2007)						
	Total	2	1.28	1.03	0.97	
Ownership	Public	2.22	1.32	1.46	0.95	-3.45
	Private	1.78	1.24	0.83	0.97	
Market	Exporter	1.9	1.32	1.55	0.71	0.75
Orientation	Non-exporting	2.03	1.26	0.96	1.01	
Input Source	Domestic	2.17	1.28	1.45	0.98	2.96
	Import	1.78	1.26	0.8	0.91	

Source: Own calculations based on CSA Survey (Various Years).

Mean and median values indicate that firms were operating on average with a positive mark-up during the entire period covered by the study. A considerable difference between the two central tendency statistics shows the existence of excessively high mark-ups obtained by few firms as against the majority. Similarly, both inter-quintile range and coefficient of variation

indices indicate large mark-ups' variations among firms. State Owned Enterprises (SOEs), non-exporting and domestic resource-based firms generate more mark-ups as against private, exporting and import-intensive firms respectively.

As against predictions of most recent theories and studies and the hypothesis of this paper, on the average firms raised their mark-ups and consolidated market-power in the post reform period. It might be partly because firms tended to familiarize themselves with subsequent trade policy shifts and developed internal capabilities to withstand competitive pressure. The 17.5 percent weighted average tariff rate is still large enough to safeguard firms from incoming competitive pressure. The positive correlation between trade reforms and mark-up is not an exception to Ethiopia. For instance, Goldar and Aggarwal (2005) found an increase in the price-cost margin in the post-reform period in most industries and the manufacturing sector as a whole in India.

The mark-up difference narrowed down from 23.7 percent to 6.8 percent between exporting and non-exporting and also from 32.8 percent to 21.9 percent between domestic resource-based and import-intensive firms respectively between the two periods. Public firms keep on raising mark-ups at a higher rate than private ones.

The bargaining power parameter estimate has a less than zero value ($\beta_{it} < 0$) during the entire period and across different groups of firms. This is against Dobbelaere (2004) and Abraham et al. (2009) in Belgium, Boulholet al. (2007) in UK and Dobbelaere and Mairesse (2009) in France. This is on account of Belgium, UK and France being a well-developed economy; where workers have alternative sources of living and thus have a strong bargaining power. In the Ethiopian case, however, rents extracted owing to market-power of firms may not partially accrue to workers because of weak bargaining power as a result of high unemployment and limited alternative sources of income generating activities.

Table 4.7: Employer and Workers Premium in the Presence of TU

Parameters	Mean Shares	Overall	Up to 2002	After 2002
Raw material share	Total	0.46	0.48	0.44
	Public	0.45	0.48	0.42
	Private	0.48	0.5	0.46
Labor cost share	Total	0.15	0.15	0.15
	Public	0.17	0.16	0.18
	Private	0.12	0.11	0.12
Coefficients	Growth of the difference between labour cost and capital	0.39	0.48	0.37
	Growth of the differences between materials and capital	0.56	0.51	0.59
Workers premium	Total	-0.79	-4.76	-0.46
	Public	-0.62	-3.84	-0.27
	Private	-1.06	-8.7	-0.71
Employers rent	Total	1.78	5.76	1.46
	Public	1.62	4.84	1.27
	Private	2.06	9.7	1.71
Ratio of rent premium drawn from workers	Total	-0.44	-0.83	-0.31
	Public	-0.38	-0.79	-0.21
	Private	-0.51	-0.90	-0.42

Source: Own calculation based on CSA Survey (Various Years).

The total persons engaged in medium and large-scale firms employing 10 workers were only 133, 673 in 2007/08 [CSA, 2009] in spite of being the second most populous countries in sub-Saharan Africa. Neither there are adequate job opportunities in other sectors. Only about 50 percent of the total active population was engaged in different income generating activities in urban areas; the majority being self-employed in the informal sector in 2006 [CSA, 2006: PP 31-38]. As a result of this, Ethiopia observes high level of unemployment even among the relatively well-educated [Sernees, 2004]. This situation leads to low level of reservation wage; which in turn lessens the bargaining power of workers to the extent of facing a negative premium.

The rent extracted from public workers is lower than their private sector counterparts perhaps because of two reinforcing causes. First, TUs are generally weak but they are relatively stronger among SOEs than in private firms [Martha, 2012: P: 24]. Second, the motive of the private sector is primarily profit. SOEs may go beyond and tend to maximize social benefits [Okten and Arin, 2006]. Overall, the rate of rent extraction from workers has somehow reduced after the reform. This is partly attributed to a further increase in mark-up of firms after the reform. The pattern has been the same in both state and private sector firms.

5. Conclusion

Trade theories advocate that firms operating in an imperfect market have the leverage to set prices above equilibrium outcome of a purely competitive market by a certain mark-up. In the presence of trade barriers, mark-ups and market-power of firms would be higher than otherwise. Because of insider information or otherwise, workers may bargain and influence to have a share of the rent accrued to firms' market-power. Opening up markets will reduce mark-up of firms, bargaining power of workers and the associated rent. This theoretical prediction is not similar across firms; it distinguishes the effect by firm characteristics. The empirical evidences are also mixed.

Motivated by the recent trade reforms that took place between 1991 and 2002 in Ethiopia, the study explored whether there was a positive mark-up during and after trade reform; whether workers were entitled to have wages above the marginal conditions entail and to what extent this has changed during the post reform period.

Using firm level unbalanced data of firms employing more than 100 permanent workers for the period between 1996 and 2007; 1996 and 2002; and also 2003 and 2007, mark-up model with labor bargaining power parameter was estimated using LDPDM and random effects. Econometric tests such as autocorrelation, Sargan test and Wald tests were carried out.

Although they are not entirely the same, the magnitudes of coefficients of covariates are found to be similar in the two estimation methods. On average

firms are found to have a positive mark-ups over the entire period. However, there have been large inter-firm variations. On average, mark-up increased during the post reform. Albeit seemingly contradicts with the theoretical predictions, this result may be justified because of the fact that Ethiopian firms are not exposed fully to liberalized market. The country has still maintained a 17.5 percent weighted average tariff rate. Despite a temporary shock during the trade reform, the prevailing tariff shield enables them to recover and consolidate their mark-ups afterwards.

The estimated value of the parameter capturing the influence of TUs on wage setting is found to be negative. Firms take out rents from workers rather than sharing; perhaps because of weak bargaining power on account of high unemployment, limited alternative job opportunities. The rent extraction from workers tended to decline during the post reform. Rent seeking was found to be lower in SOEs than private firms perhaps because of having weaker group or union influence in the later.

The finding simply the following. It is valuable to consider the heterogeneous responses of firms towards trade reforms. Since trade reforms to-date have not reduced market power of many firms, further opening up, such as joining Common Market for Eastern and Southern Africa Free Trade Area, may bring a competitive push to improve TFP and reduce mark-up and market power of firms for the good of the society. Working towards attracting additional investment in the economy helps to address unemployment and improve bargaining power of workers. Finally, tackling the problems that cause for under capacity utilization of firms, such as shortages of raw materials, finance, etc, helps to improve their performance and pay their workers better.

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Annex 1: Clarification of Labour Bargaining Power Equation

Consider maximization of a Nash bargaining problem between a typical trade union and firm:

$$(A.1.1) \quad \max_{w_{Lit}, L_{it}, w_{Mit}} \Theta = [L_{it}(w_{Lit} - w_{oit})]^{\lambda_{it}} [P_{it}Y_{it} - w_{Lit}L_{it} - w_{Mit}M_{it}]^{1-\lambda_{it}}$$

For simplicity denote $A = [L_{it}(w_{Lit} - w_{oit})]$ and $B = [P_{it}Y_{it} - w_{Lit}L_{it} - w_{Mit}M_{it}]$.

The first order condition for material input (M_{it}) yields:

$$(A.1.2) \quad (A^{\lambda_{it}})([1-\lambda_{it}][B^{-\lambda_{it}}])\left(\frac{\partial(P_{it}Y_{it})}{\partial M_{it}} - w_{Mit}\right) = 0$$

$$(A.1.3) \quad \frac{\partial(P_{it}Y_{it})}{\partial M_{it}} = w_{Mit}$$

$$(A.1.4) \quad \frac{\partial(P_{it}Y_{it})}{\partial M_{it}} \frac{\partial M_{it}}{\partial Y_{it}} = \frac{\partial C_{it}}{\partial M_{it}} \cdot \frac{\partial M}{\partial Y} \cdot \frac{w_{mit}M_{it}}{P_{it}Y_{it}} \cdot \frac{P_{it}Y_{it}}{w_{mit}M_{it}}$$

$$(A.1.5) \quad P_{it}(Y) + P'_{it}(Y)Y_{it} = \frac{\partial C_{it}}{\partial M_{it}} \cdot \frac{1}{S_{Mit}} \cdot r_{Mit} \cdot \frac{P_{it}}{w_{mit}}$$

$$(A.1.6) \quad P_{it}(Y)\left(\frac{1}{1+v(Y)}\right) = P_{it}(Y)\left(\frac{1}{\sim_{it}}\right) = \frac{1}{S_{Mit}} \cdot r_{Mit} \cdot P_{it}$$

$$(A.1.7) \quad S_{Mit} = \sim_{Mit} r_{Mit}$$

The first condition with respect to wages (w_{Lit}) then becomes:

$$(A.1.8) \quad (\lambda_{it} L_{it} A^{\lambda_{it}-1})(B^{1-\lambda_{it}}) + ([\lambda_{it} - 1][-L_{it}] B^{-\lambda_{it}})(A^{\lambda_{it}}) = 0$$

$$(A.1.9) \quad \lambda_{it} \left[\frac{A}{B} \right]^{\lambda_{it}-1} = \left([\lambda_{it} - 1] \left[\frac{A}{B} \right]^{\lambda_{it}} \right)$$

$$(A.1.10) \quad (1 - \lambda_{it})A = \lambda_{it}B$$

Substituting the values of A and B into (A.1.10) gives

$$(A.1.11) \quad (1 - \lambda_{it})(L_{it}(w_{Lit} - w_{oit})) = \lambda_{it}(P_{it}Y_{it} - w_{Lit}L_{it} - w_{Mit}M_{it})$$

$$(A.1.12) \quad L_{it}w_{Lit} = \lambda_{it}(P_{it}Y_{it} - w_{Mit}M_{it}) + (1 - \lambda_{it})L_{it}w_{oit}$$

$$(A.1.13) \quad w_{Lit} = (1 - \beta_{it})w_{ait} + \beta_{it} \left(\frac{P_{it}Y_{it} - w_{Mit}M_{it}}{L_{it}} \right)$$

The first order condition with respect to labour (L_{it}) becomes:

$$(A.1.14)$$

$$\beta_{it} (w_{Lit} - w_{ait}) (A^{\lambda_{it}-1}) (B^{1-\lambda_{it}}) + (1 - \beta_{it}) (B^{-\lambda_{it}}) \left(\frac{\partial (P_{it}Y_{it})}{\partial L} - w_{Lit} \right) A^{\lambda_{it}} = 0$$

$$(A.1.15) \quad \beta_{it} (w_{Lit} - w_{ait}) B = -(1 - \beta_{it}) \left(\frac{\partial (P_{it}Y_{it})}{\partial L} - w_{Lit} \right) A = 0$$

Substituting the value of A and B into (A.1.15)

$$(A.1.16)$$

$$\beta_{it} (w_{Lit} - w_{ait}) [P_{it}Y_{it} - w_{Lit}L_{it} - w_{Mit}M_{it}] = -(1 - \beta_{it}) \left(\frac{\partial (P_{it}Y_{it})}{\partial L} - w_{Lit} \right) [L_{it}(w_{Lit} - w_{ait})]$$

$$(A.1.17)$$

$$\beta_{it} [P_{it}Y_{it} - w_{Lit}L_{it} - w_{Mit}M_{it}] = -(1 - \beta_{it}) L_{it} \left(\frac{\partial (P_{it}Y_{it})}{\partial L} - w_{Lit} \right)$$

$$(A.1.18) \quad \beta_{it} [P_{it}Y_{it} - w_{Lit}L_{it} - w_{Mit}M_{it}] = (1 - \beta_{it}) L_{it} \left(-\frac{\partial (P_{it}Y_{it})}{\partial L} + w_{Lit} \right)$$

$$(A.1.19) \quad w_{Lit} = \frac{\beta_{it}}{(1 - \beta_{it})} \left(\frac{P_{it}Y_{it} - w_{Lit}L_{it} - w_{Mit}M_{it}}{L_{it}} \right) + \left(\frac{\partial (P_{it}Y_{it})}{\partial L_{it}} \right)$$

Solving (A.1.13) and (A.1.19) simultaneously gives

$$(A.1.20):$$

$$(1 - \beta_{it})w_{ait} + \beta_{it} \left(\frac{P_{it}Y_{it} - w_{Mit}M_{it}}{L_{it}} \right) = \frac{\beta_{it}}{(1 - \beta_{it})} \left(\frac{P_{it}Y_{it} - w_{Lit}L_{it} - w_{Mit}M_{it}}{L_{it}} \right) + \left(\frac{\partial (P_{it}Y_{it})}{\partial L_{it}} \right)$$

$$(A.1.21):$$

$$(1 - \beta_{it})w_{ait} + \beta_{it} \left(\frac{P_{it}Y_{it} - w_{Mit}M_{it}}{L_{it}} \right) = \frac{\beta_{it}}{(1 - \beta_{it})} \left(\frac{P_{it}Y_{it} - w_{Mit}M_{it}}{L_{it}} \right) - \frac{\beta_{it}}{(1 - \beta_{it})} w_{Lit} + \left(\frac{\partial (P_{it}Y_{it})}{\partial L_{it}} \right)$$

Substitute (A.1.13) into (A.1.21),

$$(A.1.22): \quad (1 - \beta_{it})w_{ait} + \beta_{it} \left(\frac{P_{it}Y_{it} - w_{Mit}M_{it}}{L_{it}} \right) \\ = \frac{\beta_{it}}{(1 - \beta_{it})} \left(\frac{P_{it}Y_{it} - w_{Mit}M_{it}}{L_{it}} \right) - \frac{\beta_{it}}{(1 - \beta_{it})} \left((1 - \beta_{it})w_{ait} + \beta_{it} \left(\frac{P_{it}Y_{it} - w_{Mit}M_{it}}{L_{it}} \right) \right) + \left(\frac{\partial(P_{it}Y_{it})}{\partial L_{it}} \right)$$

(A.1.23):

$$(1 - \beta_{it})w_{ait} + \beta_{it} \left(\frac{P_{it}Y_{it} - w_{Mit}M_{it}}{L_{it}} \right) = \frac{\beta_{it}}{(1 - \beta_{it})} - \frac{\beta_{it}^2}{(1 - \beta_{it})} \left(\frac{P_{it}Y_{it} - w_{Mit}M_{it}}{L_{it}} \right) - \beta_{it}w_{ait} + \left(\frac{\partial(P_{it}Y_{it})}{\partial L_{it}} \right)$$

(A.1.24):

$$(1 - \beta_{it})w_{ait} + \beta_{it} \left(\frac{P_{it}Y_{it} - w_{Mit}M_{it}}{L_{it}} \right) = \frac{\beta_{it}}{(1 - \beta_{it})} - \frac{\beta_{it}^2}{(1 - \beta_{it})} \left(\frac{P_{it}Y_{it} - w_{Mit}M_{it}}{L_{it}} \right) - \beta_{it}w_{ait} + \left(\frac{\partial(P_{it}Y_{it})}{\partial L_{it}} \right)$$

(A.1.25):

$$(1 - \beta_{it})w_{ait} + \beta_{it} \left(\frac{P_{it}Y_{it} - w_{Mit}M_{it}}{L_{it}} \right) = \frac{\beta_{it}}{(1 - \beta_{it})} (1 - \beta_{it}) \left(\frac{P_{it}Y_{it} - w_{Mit}M_{it}}{L_{it}} \right) - \beta_{it}w_{ait} + \left(\frac{\partial(P_{it}Y_{it})}{\partial L_{it}} \right)$$

$$(A.1.26): \quad \left(\frac{\partial(P_{it}Y_{it})}{\partial L_{it}} \right) = w_{ait}$$

(4.8) of the main text or (A.1.13) in Annex 1 can be written as:

$$(A.1.27) \quad \frac{w_{Lit}L_{it}}{P_{it}Y_{it}} = (1 - \beta_{it}) \frac{w_{ait}L_{it}}{P_{it}Y_{it}} + \beta_{it} \left(\frac{P_{it}Y_{it} - w_{Mit}M_{it}}{L_{it}} \right) \left(\frac{L_{it}}{P_{it}Y_{it}} \right)$$

$$(A.1.28) \quad r_{Lit} = (1 - \beta_{it})r_{Lit}^a + \beta_{it}(1 - r_{Mit})$$

$$(A.1.29) \quad \frac{r_{Lit}}{(1 - \beta_{itt})} = r_{Lit}^a + \frac{\beta_{itt}}{(1 - \beta_{itt})}(1 - r_{Mit})$$

$$(A.1.30) \quad \frac{r_{Lit}}{(1 - \beta_{itt})} - \frac{r_{Lit}\beta_{itt}}{(1 - \beta_{itt})} = r_{Lit}^a + \frac{\beta_{itt}}{(1 - \beta_{itt})}(1 - r_{Mit}) - \frac{r_{Lit}\beta_{itt}}{(1 - \beta_{itt})}$$

$$(A.1.31) \quad r_{Lit} = r_{Lit}^a + \left(\frac{\beta_{itt}}{1 - \beta_{itt}} \right) (1 - r_{Lit} - r_{Mit}) \quad \text{or}$$

$$r_{Lit}^a = r_{Lit} + \left(\frac{\beta_{itt}}{1 - \beta_{itt}} \right) (r_{Lit} + r_{Mit} - 1)$$