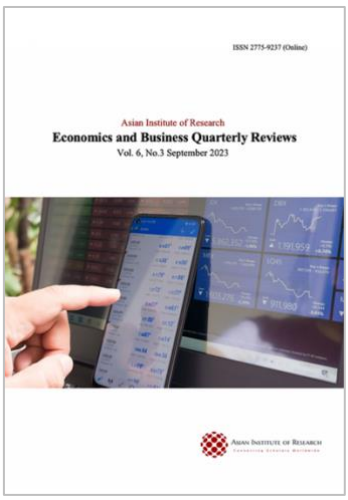

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Offshoring, Globalization, Skill: Impacts of International Offshoring on Employment and Wages

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Abstract
The phenomenon of offshoring has become a prominent topic in contemporary economic discussions, closely tied to globalization and communication. Offshoring involves importing input items from foreign countries at a lower cost, enabling cost-effective production. However, it raises concerns among workers regarding job loss and wage reduction. The aspect of collective bargaining, crucial in understanding the dynamics of offshoring, has often been overlooked in previous research. This journal paper aims to address this research gap by examining the impact of collective bargaining on determining equilibrium wages in the context of offshoring. Through a comprehensive analysis of three cases—Autarky, Small Country, and a two-country scenario—we explore how fluctuations in offshoring costs influence employment levels and wage rates. Additionally, we investigate the policy implications of offshoring decisions in one country and their effects on its partner country. The study also considers the role of skill acquisition in the offshoring process and its multifaceted impact on the labor market. By shedding light on the influence of collective bargaining in determining equilibrium wages within the offshoring framework, this research provides valuable insights for policymakers, academics, and industry practitioners. The findings contribute to a more comprehensive understanding of the complexities surrounding offshoring and its implications for the labor market.

Keywords: Offshoring, Collective Bargaining, Equilibrium Wages, Globalization, Labor Market

1. Introduction

The decline in transportation costs since the 1950s has significantly contributed to the growth of international trade, particularly in the trade of final goods. Nowadays, companies in one country are taking advantage of lower input prices in other countries by either importing goods or relocating their production processes.

One of the most widely discussed topics in economics today is "Offshoring." This term can be divided into two types: material offshoring and service offshoring. Material offshoring involves the assembly and production of intermediate goods for manufacturing, while service offshoring refers to offshore business services such as call centers, financial services, and customer service. Advancements in communication and transportation technologies have played a pivotal role in driving the trend of offshoring in recent times. Many countries are now leveraging offshoring to stimulate economic growth without physically relocating their workforce across borders. Countries like China, India, and South Korea have greatly benefited from offshoring, along with the importers of offshored

products. As offshoring proves to be mutually beneficial for both exporting and importing nations, its popularity continues to increase. However, it is important to consider the impact of offshoring on the job market in both countries, which we will discuss in more detail later.

2. Driving factors behind offshoring

Offshoring is a most common used term in international business and trade for recent days and the major driving force is difference in factor prices in different region. Tough there are large arbitrage gain to be made by offshoring several barriers and restrictions also lay down there. If these barriers are overcome, then it's expected that offshoring will grow more. There are some factors give positive feedback to grow the offshoring.
If there are tariff for crossing every border than production become unworthy. A small reduction in the tariff rate can lower the overall cost. The reduction generates a large effect and there are many proofs of this in last few decades trade history.

The cost of air transportation has falls over the past fifty years but the cost of ocean transport still so high. On the other hand, tax for trade decreases significantly which spurring offshoring activities. Technological improvements are the other most prominent factor for offshoring. In example, China the most popular offshoring zone in recent days made tremendous success in robot technology which makes them one of the successful offshoring exporter in the world.

Globalization is most important key for the increasing level of offshoring in recent decades. For the technological revolution, it is much easier to contact with people stay far miles away. Traders take the chances. The difference in factor prices for production encourage them to spread the production process to another country. In the era of globalization we know everything about every part of the earth by sitting at home. It added an influential dimension to the economy. We use our knowledge of communication in trade to find out which regions are good for the factors we need for production. After that the term ''offshoring '' emerged. Now, it is one of the most important driving force to the international trade. But it has not only a good side, there are also many demerits. In the long run it increases unemployment. Cheap labour offshoring rise unemployment rate home (importing) country. Low-skill people lose their job and skill acquisition become costly for them. As a result offshoring reduced the welfare level of that economy. It became up and down process. Workers tried to be high-skill and find out matching job for them which increase growth level afterwards.

3. The Model

P. Ranjan (2013) descried impact of offshoring in three different way. First, she described autarky equilibrium in a country called home. Second, she described impact of offshoring on home country assuming home is a small country. Third and finally she walks through in a two-country world where price of offshoring input determined endogenously.

4. Autarky equilibrium at Home

In perfect competition market, Union first set the wage and then firm determine their employment level by considering that wage level. P.Ranjan (2013) separated this problem in two different parts, in one parts she described the firms problem and then in another part she analyse the wage determination process. D.Mitra and P. Ranjan (2009) shows how offshoring effected the labour market in the presence of perfect competitive market. In our analysis we will discuss how they framed their work. We will divide it into two sections as they do- 1. The Model analysis 2. Offshoring. Then we will move towards the work of P. Ranjan (2013) where she also followed the similar steps but with broader perspective with a small country world and two country world.

5. Why Perfect Competition instead of Monopoly?

P. Ranjan (2013) in his analysis considered the perfect competition market instead of monopoly. The intuition behind that is to make model analysis easier. In monopoly market union is much bigger that it gains huge power

in wage bargaining process and when union gain so much power, it's become difficult for the firm to make offshoring and gain a reasonable profit. On the other hand, in perfect competitive case firm has more power in wage determination process that it could threat the union/workers to make the job offshore. Its lower wages, increased employment. In that process firms gain more control in offshoring field. Moreover, perfect competitive analysis makes model framework analytically traceable and provide us more comfort to obtain several analytical result rather than depends on numerical simulation.

In model analysis, D. Mitra and P. Ranjan (2009) divided their work in some subsection. We will not go in details in every of those subsections. We will just try to keep our focus how they actually modelled their work.

First, they started their analysis with a lifetime Utility function given by

$$\int_t^{\infty} exp^{-r(s-t)}\, C(s)\mathrm{dS}$$

where asset market are complete.

The final consumption good C is produced under CRS using two goods Z and X as inputs:

$$C = F(Z,X)$$

Now, we are going to moved towards goods and labor markets where X is produced by perfect competitive markets means to produce one unit of X firm need one unit of labor.

Z is produced by slightly more sophisticated technology-

$$Z= (\tau m_h^{\rho}+(1-\tau)m_p^{\rho})$$

Where m_h is the labor input that engaged in home country and m_p is the input of labor that can be offshored. τ is the intensity of headquarters and $\sigma = {}^{1}/_{1-\rho}$ is the elasticity of substitutions between headquarter and production service.

We then proceed to the labour market. By analysing matching function and all other related measures D. Mitra and P. Ranjan (2009) finished in labor market by finding a standard Beveridge curve in pissarides type search model,

$$ui = \frac{\delta}{\delta_i+\theta iq(\theta i)}$$

In firm optimization problem, which is the key in our analysis D. Mitra and P. Ranjan (2009) solved the optimization problem in two stages. In first stages, firm determined the proper employment level by figuring the correct wages. Then in the second stages, wages are determined through the Nash bargaining process between firms and union.

By maximizing the firm's following profit function,

$$\underset{V(s),mh,mp}{\text{Max}} \quad \int_t^{\infty} e^{-r(s-t)}\{P_z(s)Z(s) - w_z(s)N(s) - C_zV(s)\}\,ds$$

Subject to,

dynamics of employment, $N\dot{(}t) = q(\theta_z(t))V(t) - \delta N(t)$

Production function, $Z= (\tau m_h^{\rho}+(1-\tau)m_p^{\rho})$

and total amount of labor employed by firm, $N = m_h + m_p$

D. Mitra and P. Ranjan (2009) bring out a key equation[1]

[1] Hamiltonian method has been used during the maximization problem. Details have been presented on Appendix

$$\frac{\tau' P_z - w_z}{(r+\rho)} = \frac{c_z}{q(\theta_z)} \tag{1}$$

Where marginal benefit from creating a job is equal to cost of creating a job, [2]which is known as job creation condition.

Then, the wage is determined through a Nash bargain process between individual workers and firm. D. Mitra and P. Ranjan (2009) represent a wage equation[3] as like as Pissarides model,

$$w_i = b + \frac{\beta c_i}{1-\beta}\left[\theta_i + \frac{r+\delta}{q(\theta_i)}\right] \tag{2}$$

Where, β is the bargaining power of the workers. This equation represent a wage curve (WC) and clearly this wage curve is upward slopping in (w,θ) space.

Now, the intersection of JC and WC depicted from equation (1) and (2) will provide the equilibrium level of wage (w_i), market tightness (θ_i) and price level (p_i).
D. Mitra and P. Ranjan (2009) then shows how equilibrium in autarky is settled[4]. We will not go in details of those analysis. Now, we will see how they proceed towards the offshoring analysis. They assumes firms of sector Z have the option for offshore input m_p from abroad and then by solving the firm optimization problem they bring out the following expression[5],

$$P_z = (\tau^\sigma(\widetilde{w_z})^{1-\sigma} + (1-\tau)^\sigma w_s^{1-\sigma})^{\frac{1}{1-\sigma}} \tag{3}$$

and Nash bargained wage,

$$w_z = b + \frac{\beta c_z}{1-\beta}\left[\theta_z + \frac{r+\delta}{q(\theta_z)}\right] \tag{4}$$

Productivity effect itself creates greater job creation and lower unemployment[6].

P. Ranjan (2013) in her work also followed the similar procedure where she begin with a production function using sophisticated technology,

$$Z = AX^\gamma$$

She then goes through the model analysis and finished with finding the similar pissarides type Beveridge curve that we discussed above. We are not going in details of those analysis. Now, we moves towards the firms optimization problem and Nash wage bargain process in Autarky case.

Since firms have to look for workers and any job could be destroyed due to an idiosyncratic shock created by union with their wage setting and interaction with policies as described by Pissarides (1986) and Delacroix(2006), P. Ranjan(2013) solved her model in backward direction where she solved the firm's problem in first stage then solve the wage.

In firm's optimization problem they (firm) maximizes their profit function

$$\underset{v_{h(s)}, L_h(s)}{\text{Max}} \int_t^\infty e^{-\rho(s-t)}\left\{A\big(L_h(s)\big)^\gamma - w_h(s)L_h(s) - c_h v_h(s)\right\}ds$$

Subject to,

$$L_h(t) = \mu_h \theta_h(t)^{\delta_h - 1} V_h(t) - \lambda_h L_h(t) \tag{5}$$

[2] A similar calculation can be done for the sector X
[3] Details given in Appendix 7.2 of D. Mitra and P. Ranjan (2009) PP.25
[4] See D. Mitra and P. Ranjan (2009)
[5] Details calculation provided in Appendix
[6] See D. Mitra and P. Ranjan (2009)

taking $w_h(s)$ and $\theta_h(s)$ as given.

And then following Hamiltonian approaches[7] P. Ranjan (2013) find the following expression for employment level,

$$\gamma A {L_h}^{\gamma-1} = w_h + \frac{(\rho+\lambda)c_h}{\mu_h {\theta_h}^{\delta_h - 1}} \quad (6)$$

Here, employment level (L_h) is a function of wage (w_h) and tightness (θ_h). If union demanded higher wages it will resulted in a higher unemployment.

In the wage determination process union's objective is to maximize its member's aggregate surplus or rent,

$$\left(\left(\frac{\bar{L}_h - L_h}{\bar{L}_h}\right)\rho U_h + \left(\frac{L_h}{\bar{L}_h}\right)\rho E_h - \rho U_h\right)\bar{L}_h = \rho(E_h - U_h)L_h = \frac{\rho(w_h - b_h)L_h}{\rho + \lambda_h + \mu_h {\theta_h}^{\delta_h}} \quad (7)$$

Then, by maximizing equation (7) subject to equation (6) subgame perfect equilibrium can be obtained and the solution provided an expression for wage[8],

$$w_h = b_h + \gamma(1-\gamma)A{L_h}^{\gamma-1} \quad (8)$$

6. Offshoring for a Small country case

Now, we move toward a small country case where some input can be imported from the foreign and there have some cost associated with those imported inputs i.e. communication barriers, legal restrictions, cultural differences, trade barrier etc. P. Ranjan (2013) in her work denotes M is the imported inputs, P_f as input prices, ϕ as the offshoring cost and h(M) as adaption cost. In this small country case this country small enough to take $P_f$as exogenous.

Now as like as previous analysis, P. Ranjan (2013) solves firm's problem first by taking $w_{h,}$ θ_h and P_f as given and then the wage.

Firm's maximizes their objection function,

$$\underset{Vh(s),Lh(s),M(s)}{\text{Max}} \int_t^{\infty} e^{-(\rho-t)}\left\{A\big(L_h(s) + M(s)\big)^{\gamma} - w_h(s)L_h(s) - p_{f\emptyset\,h}(M)M(s) - c_h v_h(s)\right\}ds$$

Subject to equation no (5) and then by using Hamiltonian approach and taking $\dot{\psi}$ = 0 in steady sate she found following expression for employment (L_h) and imported input amount (M) respectively,

$$\gamma A(L_h + M)^{\gamma-1} = P_f \emptyset\big(h(M) + h'(M)M\big) \quad (9)$$

and

$$\gamma A(L_h + M)^{\gamma-1} = w_h + \frac{(\rho+\lambda_h)c_h}{\mu_h {\theta_h}^{\delta_h - 1}} \quad (10)$$

Now, by maximizing the equation (7) subject to equation no (9) and (10) offshoring equilibrium wage is obtained [9] which is given by

$$w_h = b_h + \frac{L_h\left((1-\gamma)\gamma A(L_h + M)^{\gamma-2}P_f\emptyset\left(2h'(M) + Mh'(M)\right)\right)}{(1-\gamma)\gamma A(L_h + M)^{\gamma-2} + P_f\emptyset\big(2h'(M) + Mh'(M)\big)} \quad (11)$$

[7] Details calculation provided in the appendix.
[8] See Appendix
[9] See Appendix

P. Ranjan(2013) then make some propositions with comparative statistics[10]. We will not go in details on those propositions. Now we will move our discussion towards bargaining for wages by individual instead of union.

7. Individual Wage bargain with Job loss fear

Offshoring act as a strong weapon for firm in wage bargaining with individual worker if the cost of offshoring become low. Firm threaten the individual workers in the process of individual bargaining to accept the low wage or to shift the job abroad. In that case, worker face a fear for job loss and most of the time willing to accept the lower wages offered by firm. Riedl and Frijters (2012) found evidence that possible treat of offshoring towards low-wage countries increases job loss fear among German workers. Manshki (2004) also mentioned that job insecurity could be a determinant for lower wage means treat of offshoring could be an indicator of lower wages. Meanwhile, skill might play an important role on the bargaining process during offshoring environment. We will discuss later about the skill issue. In this part we will see how individual bargaining could impact the wages during offshoring environment.

During the individual bargaining process firm maximizes its objective function by assuming the domestic employment as well as amounts of offshored inputs in the first stage and anticipating the wages will be determined in the second stage. In maximization process firm have to take into consideration whether the wages taken as given from second stage will have an impact on the firm's employment determination in first stage. There also have two important issues in the bargaining process, whether renegotiation for wages with all workers will takes place or not.

- If it takes place then firm might take an counter decision of overhiring (first indicatd by Stole and Zwiebel (1996)) which will reduce the marginal product of each worker for hiring an extra worker. That will reduce the wages for worker.
- On the other hand, if every single worker doesn't see the renegotiation and firm will also ignore the any possible outcome (i.e. employment decision), outcome will be the same. Wage will be down for each worker, firm will gain more strength in bargaining process.

According to P. Rajan (2013) finding analytical result on the impact of offshoring is difficult for the number one case described above. That's why numerical calibration might be a solution for that case. But for the other case analytical result might work well.

For the above two case P. Ranjan (2013) found two separate equation by which we could determine the number of employed worker hired by firm (L_h), amount of input offshored(M), wage of home worker(w_h) and labor market tightness of home country(θ_h)[11]. From proposition-4 described by her we also get a clear idea about the wage determination in the process of individual bargaining.[12]

$$\frac{1}{\beta_h} L_h^{\frac{1}{\beta_h}} \gamma A \int_0^{L_h} (x+M)^{\gamma-1} x^{\frac{1}{\beta_h}-1} dx = w_{h+} \frac{(\rho+\lambda_h)C_h}{\mu_{h\theta_h}{}^{\delta_h-1}} \quad (12)$$

and,

$$w_h = (1-\beta)b_h + \beta_h C_h \theta_h + \beta_h \gamma A (L_h + M)^{\gamma-1} \quad (13)$$

However, Skaksen (2004) build a framework where he describes firm's decision about offshoring and the wage determination via Nash Bargaining process. He figured out three different scenario of the Nash bargain process depending on the cost of offshoring.

- Scenario-1: Offshoring cost is too high that firm will not be comfortable in doing offshoring. In that case, Union as well as individual will have higher power in the process of wage bargain.

[10] See details P.Ranjan (2013) PP. 177
[11] See P. Ranjan (2013) PP 178. We also provided some details in appendix
[12] See P. Ranjan (2013) PP 178. Proposition-4

- Scenario-2: Offshoring cost is so low that Union as well as individual worker have no option rather than accepting offshoring. Firm have greater power to threat the home labor market. Wage will be lower, employment will be up.
- Scenario-3: It's the most interesting one that bargaining outcome has no analytical result. He proposes a scenario where employment cost will be equal to offshoring so that firm might find it profitable to work at home.

8. Numerical Representation

P. Ranjan (2013) in her work provided some graphical representation by using the data of Sweden collected from the work of Albrecht et al. (2006). She demonstrated how employment and wages effected in the case of individual and collective bargaining. [13] We will see how it worked in case of linear adoption cost.[14]

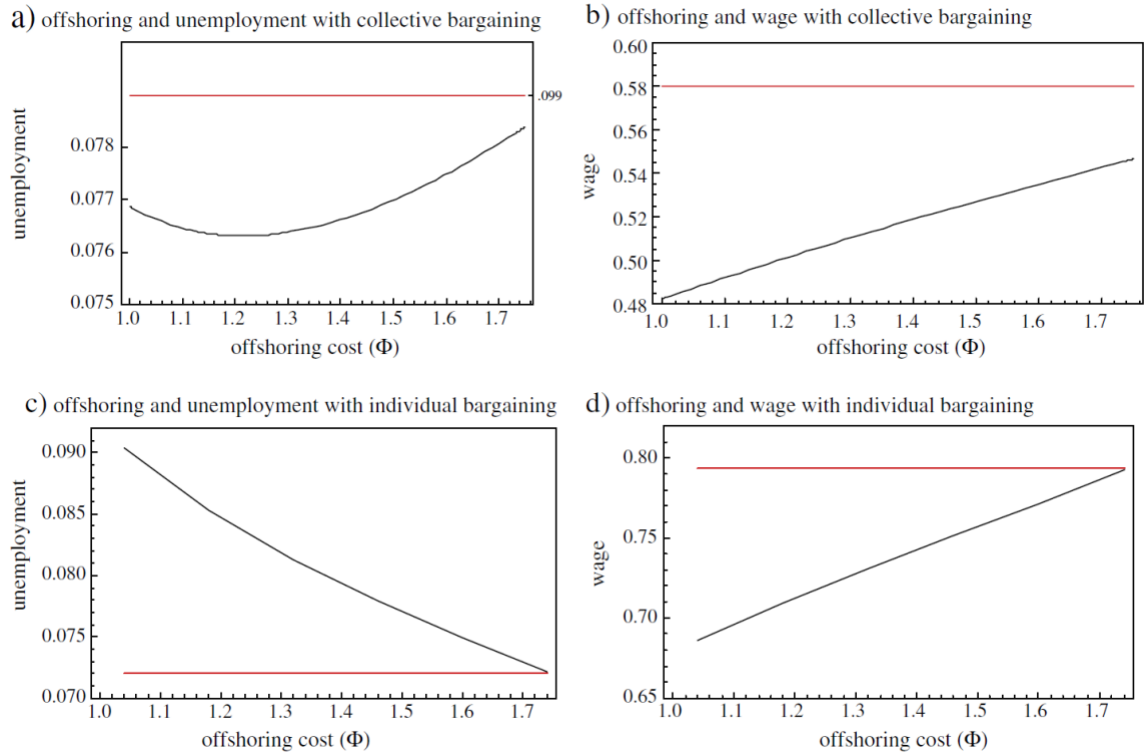

Figure 1: Unemployment, wage, and offshoring (linear adaptation cost).
Source: P. Ranjan (2013) PP 179

In figure 1(a) she has shown how employment decreased due to an increase in offshoring cost. The red horizontal line shows the hypothetical autarky unemployment which says if Sweden were a closed country its unemployment rate was become 9.9% instead of 7.7%. For the offshoring cost 1.7 the amount of offshoring will be zero. On that case unemployment rate is become 7.8% which is still lower than the autarky.

Fig 1(b) says how wage increases along with the increase of offshoring cost. With the high value of offshoring cost 1.7 the wage increases to 5.4% which is still below the autarky level. It happened because due to the rise in offshoring cost union gain more power over wage bargaining and that's why wage demand goes higher but still with the offshoring environment its stays lower than the autarky level.

[13] See P. Ranjan (2013) PP 178 for data description
[14] For other case see P. Ranjan (2013) PP 180, 181

In fig 1(c) and 1(d) she has shown the impact of offshoring in case of individual bargaining. From both figure we can see that each employment and wages going up in case of offshoring cost going higher. [15] It is consistent with our analysis cause as offshoring cost going higher unemployment always become lower and wages moving higher.

9. Two country worlds of offshoring

Now, we move towards the two-country world where one country is the source of offshoring input (we will call it developing countries) and other country will be the importer of those offshoring inputs (we will call it developed nations)[16] and price of offshoring inputs are determined endogenously. In this part we will see how increase in offshoring cost and imposing wage tax or minimum wages can create some impact on labor market in both countries.

According to the work of S. Bandypadhay, A.K. Basu, N.K.Chau and D. Mitra(2017) the reduction of offshoring cost always increase the amount of offshoring, always increased the wage of host(developed country) but decreases the wage of developing countries.

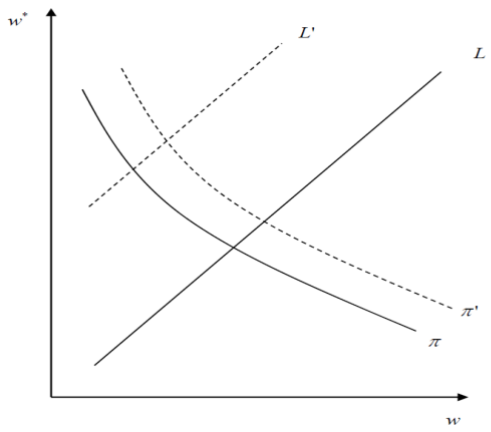

Figure 2: Unequal gain from reduction in offshoring cost
Source: [S. Bandypadhay, A.K. Basu, N. K. Chau and D. Mitra (2017)]

From fig-2 we see that reduction of offshoring cost shifts the π(profit) and labor (developing country) schedule upward. That's bring the wage (w^*) of home country (developed country) higher due to the inelastic labor market but the wage of host country (developing country) going lower.

An interesting finding from the work of S. Bandypadhay, A.K. Basu, N. K. Chau and D. Mitra (2017) will give us some indication how increase/decrease in offshoring cost could make rise/fall of the wage of both host (developing) and offshoring country(developed). In the finding they added two interesting variable- equilibrium relative wage cost(ρ) and equilibrium index of the marginal offshored task(I) which makes the idea more clearer.

[15] See P. Ranjan(2013) PP 178 Proposition 4
[16] The notation used by S. Bandypadhay, A.K. Basu, N.K.Chau and D. Mitra(2017)

Table 1: Impact of offshoring cost on wages

			% change from when β =1.2	
β	ρ	I	in w	in $w*$
0.8	5.053	0.080	-2.33%	1.38%
0.9	4.426	0.077	-1.25%	1.00%
1	3.941	0.075	-0.54%	0.65%
1.1	3.557	0.072	-0.15%	0.31%
1.2	3.246	0.069	0.00%	0.00%
1.3	2.989	0.067	-0.06%	-0.30%
1.4	2.774	0.064	-0.30%	-0.57%
1.5	2.593	0.061	-0.68%	-0.83%
1.6	2.437	0.059	-1.19%	-1.08%
1.8	2.185	0.054	-2.51%	-1.53%

Source: S. Bandypadhay, A.K. Basu, N. K. Chau and D. Mitra (2017)

From Table-1 we see that due to the decrease in the offshoring cost from 1.2 to 0.8 wage of developing country fall sharply whether wage of developed country increased gradually. On the other hand, escalation of offshoring cost reduced the wages of both developing and developed country.

Now we will discuss what happen to the Global welfare when offshoring cost is starting to decline. Its clear, National welfare rises if wage rises due to the cost reduction of offshoring. When wages of both countries increase then joint welfare (which we called global welfare), will rise. But question arises on the case when wage of one country (developing country) decreases and other country increases (developed country), what happened to the global welfare? S. Bandypadhay, A.K. Basu, N. K. Chau and D. Mitra (2017) replied to that question with a answer[17]- yes, Global welfare always increases due to the reduction of offshoring cost.

As wage decreases in the developing country which discussed above, they (developing country) might take some policies to increase the welfare in National level. But offshoring is a form of trade. That's why they always have to fix the trade related distortion before taking any policy consideration. In example, wage tax[18] or minimum wage could be less objectionable to trading partner rather than using direct tax polies. Here we are providing some quick snapshot about how wage tax and minimum wage could increase the welfare of developing country-

- As offshoring export country have monopoly power in the world market they sets a markup over its cost as well as government of this country levies a tax on wages received on this sector in inverse relation to its elastic of demand. The intuition behind it to get a better price for the offshoring product they are exporting. A higher elastic means wage tax could bring a TOT benefits. However there have some adverse effect too. If the offshoring market of developing country is highly responsive to relative wage, a high wage tax might reduce the export amount of offshoring as well as the labor supply to offshoring sector. On the other hand, if the labor supply in developed country is quite elastic then for the hike of wage tax in developing country might significantly reduce the labor supply to the offshoring sector and by feedback effect could reduce the labor demand to the offshoring sector of developing country. The following diagram[19] might provide us more idea,

[17] See S. Bandypadhay, A.K. Basu, N.K. Chau and D. Mitra(2017) PP 16
[18] Wage tax and Export tax could use as synonyms.
[19] See S. Bandypadhay, A.K. Basu, N.K. Chau and D. Mitra(2017) PP 21,22

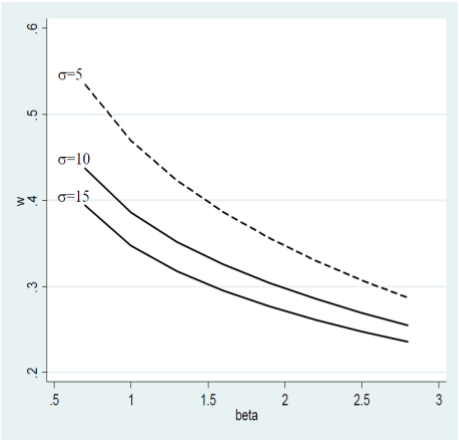

Figure 3a: Developing Country Wage (w) Simulation: (With Optimal Wage Tax)

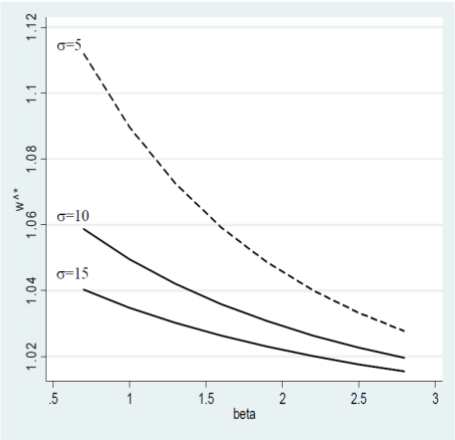

Figure 3b: Developed Country Wage (W*) Simulation: (With Optimal Wage Tax)

Sources: S. Bandypadhay, A.K. Basu, N.K.Chau and D. Mitra(2017)

- Rather than using wage tax to a sector, minimum wage might be more effective.[20] According to the finding of S. Bandypadhay, A. K. Basu, N. K. Chau and D. Mitra (2017) if the employment average weighted labor demand elasticity in the economy is quite inelastic at the equilibrium then by setting a minimum wages slightly above the equilibrium wages a welfare gain is possible.

10. Effects of skill on Offshoring

In the paper of Pablo and Jana (2017) build a matching model with endogenous skill requirement. Skill requirements set by employers and it depends on availability of skilled workers. Workers schooling decision depends on the wage differential between high and low skill jobs. Low-skill job candidate increase if firm increase the low-skill vacancies with low-skill requirements. As a result, low-skill offshoring activities increase low skill productivity and it's not a good sign for long run welfare analysis.

As in Albrecht and Vroman (2002) two equilibria will be discussed. The equilibrium with Cross-skill matching (CSM) and the equilibrium with ex-segmentation (EPS). CSM is reached when high-skill workers and low-skill vacancies are matched. Whereas EPS is what follows when there potential matches do not meet.
With the higher intensity of offshoring home country tends to import from low wage countries.

[20] Different wage taxes in different sectors might be unpopular. Instead of wage tax, minimum wages could be more effective. Because people might take it easy to use higher minimum wages for a foreign designated sector where discrimination in wages with foreign(developed countries) need to be reduced.

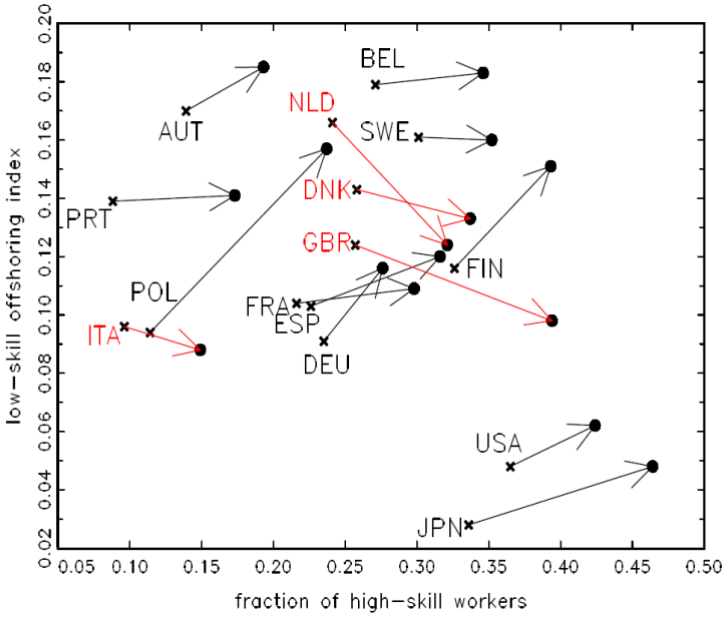

Figure 4: Offshoring trends and high-skill shares, 5-year averages

Source: [Pablo and Jana (2017)]

In the work of Pablo and Jana (2017), they found the mechanism for considering low and high-skill and the workers educational choice related cost. But it's not working well to back in pre-offshoring welfare level. To solve the problem they emphasized on lowering the acquiring skills and in the study the found higher share of high-skill workers leads to economic growth and higher welfare.

11. Model description

Now, we will proceed with a short model provided by Pablo and Jana (2017).

There are two types of agents: workers and firm. Here, the cost acquiring skill is a monotonic function,

$$\frac{dcost(x)}{dx} < 0; \;\; and \; cost(1) = 0$$

Each worker indexed by x, they infinitely lived and x=1. The opportunity cost of being low-skill ranging from 0 to 1. If the value of x is 1, then the opportunity cost of remaining low-skill is the highest and when x is 0 then worker become high skill at zero cost.

Workers choose their skill decision up to the skill acquisition cost and the wage differential between low and high skill jobs. Here,

$$w_H - w_L > cost(x)$$

If the wage differences in high and low skill job is greater than the cost of skill acquisition, then workers chooses to be high skill.

$$w_H - w_L = cost(x)$$

If there are no differences between both wage difference and cost of skill gain, then workers choose to be indifferent.

The firm's cost for financing a vacancy is C (Its mainly firing and hiring cost). An unemployment worker expected life time utility is U_L or $U_H(x)$ and a firm expected lifetime profits are $V_j; j = L \; or \; H$. Low skill workers unemployment benefit is b and high skill workers is $b - cost(x)$. The value of working and unemployment stands for $w_i(x)$ and $U_j(x)$ respectively. J_i stands for the value of the job and V_j for the value of the vacancies.

Wages are set to maximize the weighted surplus of workers and a firm in a Nash bargaining process

$$\max_{\{w_i\}}[w_i(w_i,x)-V_j(x)]^{\beta}[J_i(y_i-w_i-c)-V_j]^{1-\beta}$$

Here, β is the bargaining power of workers.

12. Two types of equilibrium

In analysis of equilibrium Pablo and Jana (2017) found two types of equilibrium-(i)the equilibrium with cross skill matching (CSM)and (ii) the equilibrium with ex-post segmentation(EPS). When high high-skill workers willing to work in low skill job CSM occurs and if high skill workers only in high skill jobs then EPS happened.

Due to the offshoring if the condition of low-skill workers worses then EPS will be the good solution. CSM would be avoided to increase overall welfare of workers of the host country.

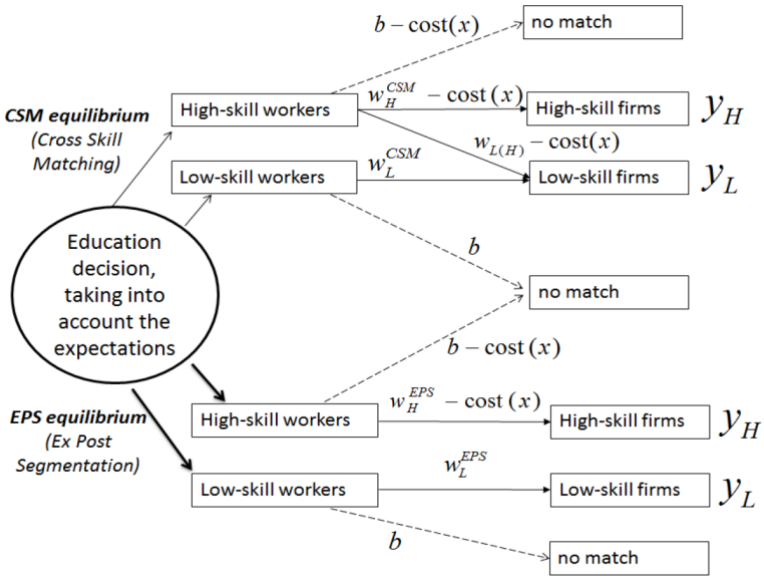

Figure 5: Possible Matches and equilibria

Sources: [Pablo and Jana (2017)]

13. Solution of the model

The cost of acquiring skill,

$$cost(x)=\lambda(1-x)^{a}\ ;where\ a\geq 1\ and\ \lambda>0$$

λ measures the dispersion between the extremes of the distributions. Previous analysis shows worker with $x=1$ have an infinite opportunity cost of remaining low skill. As a result, workers will always become high-skill. Value of a is significant in this equation, lower value of homogenous distribution with respect to the cost of skill acquisition and higher values show higher inequality.

For the CSM equilibrium,
When low-skill firms profit is $V_L=0$;

$$C=z(\theta)[\gamma J_L+(1-\gamma)J_L(H)]$$

And if high-skill firms profit is $V_H=0$;

$$C=\ z(\theta)(1-\gamma)J_H$$

For the EPS equilibrium[21],

When $V_L=0$, $C=z(\theta)\gamma J_L$

and, When $V_H=0$, $C=\ z(\theta)(1-\gamma)J_H$

[21] Bellman principle used. See Pablo and Jana (2017) PP 13

14. Impacts of offshoring

Offshoring wildness the wage gap, the number of low-skill workers will drop-switch from CSM to EPS will take place. It is noticeable that there will be increase in the share high-skill workers as a result of increase in high-skill wages which entice workers into higher productivity levels. As a comparison the wages of low-skill workers drop more than their productivity. Total output of the economy decreases and the unemployment rate of both high and low skill worker increase.

For the workers who remain low-skill, post of sharing phase will be less good because total welfare effects are negative. In that phase skill acquisition also become costly and after gaining skill it also difficult to match with the correct job. Other hand welfare of the average high-skill worker decreases with the offshoring though number of high-skill workers are increased after offshoring. Compare to the CSM equilibrium, in EPS the welfare of high-skill workers is higher. As welfare reduced, the low-skill workforce also reducing with it. In both equilibria, the welfare loss due to offshoring for the both type of worker is not compensable.

If the low-skill workers get grants or specific job training, the share of high-skill worker increase, which equivalently results in higher wages and a higher welfare level for high-skill workers. Growth is another measurement for a economy to calculate the effects of offshoring.

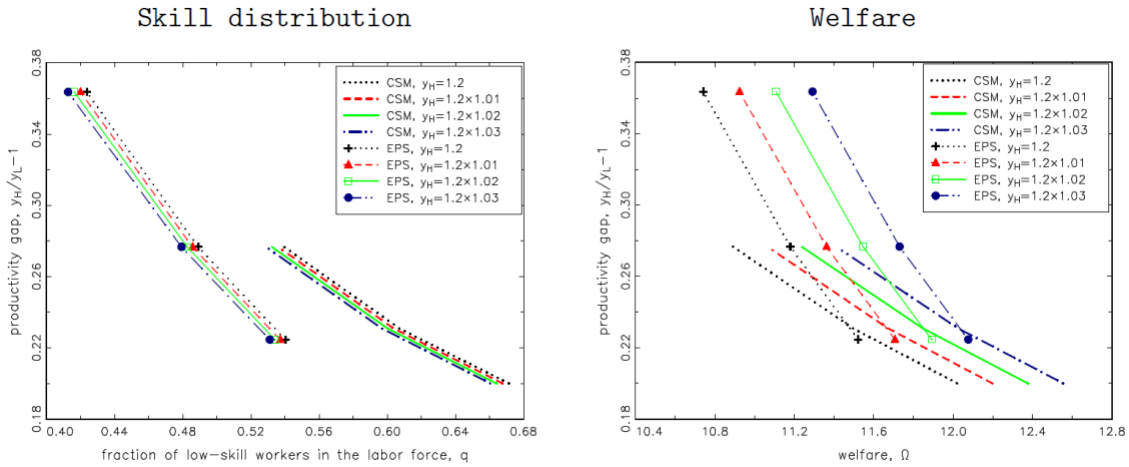

Figure 6: Effects of growth and offshoring on the skill distribution and welfare
Source: [Pablo and Jana (2017)]

Increasing of offshoring in both figure shows that increase of the fraction of high skill workers. The slope indicated the substantial reduction of welfare. Welfare loss due to offshoring could be slightly compensated by increasing in productivity along with switch from CSM to EPS.[22]

15. Final Remarks

In this seminar paper we show the impact of offshoring in determining the level of employment and amount of wages. We saw in case of individual bargaining unemployment may rise due to the weak position of individual worker whereas it could fall in the presence of union. We also see job loss fear can increased unemployment in both individual and collective bargaining case. By using numerical calibration of Swedish labor market data we show how rise/fall in offshoring cost can increase/decrease the unemployment and wages. In extend to the two-country world we show the policy taken one country can create spillover effect on the labor markets of partner country. We have used wage tax and minimum wage to show how labor market from different sectors might express reaction because of unequal policy. Since skill is another important component in offshoring environment we tried to draw some idea how worker from different skill type might affected from offshoring. Our final remarks is that, if workers always have alternative opportunities to find job anywhere else then impact of offshoring on the

[22] For more information see Pablo and Jana (2017) PP 19

unemployment will be low and before taking any policy one country should always think about the labour market of partner country so that global welfare will increase.

16. Research Questions

- How regional offshoring might have less impact on unemployment rather than the international offshoring?

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Appendix

1. Maximization of firms profit function

In firm's maximization problem Hamiltonian method were used.

$$H = P_z Z - w_z N - c_z V + \lambda[q(\theta_z)V - \delta N] + \emptyset\left[N - m_h - m_p\right]$$

Inserting the value of Z,

$$H = P_z\left(\tau {m_h}^{\rho} + (1-\tau){m_p}^{\rho}\right)^{1/\rho} - w_z N - c_z V + \lambda[q(\theta_z)V - \delta N] + \emptyset\left[N - m_h - m_p\right]$$

The first order condition for maximization as follows,

$$\frac{\partial H}{\partial m_h} = \emptyset \Longrightarrow \frac{1}{\rho} P_z\left(\tau {m_h}^{\rho} + (1-\tau){m_p}^{\rho}\right)^{\frac{1}{\rho}-1}.\rho.\tau.{m_h}^{\rho-1} = \emptyset \quad (14)$$

$$\frac{\partial H}{\partial m_h} = \emptyset \Longrightarrow \frac{1}{\rho} P_z\left(\tau {m_h}^{\rho} + (1-\tau){m_p}^{\rho}\right)^{\frac{1}{\rho}-1}.\rho.\tau.{m_h}^{\rho-1} = \emptyset \quad (15)$$

$$\frac{\partial H}{\partial V} = 0 \Longrightarrow c_z = \lambda \mathrm{q}(\theta_z) \quad (16)$$

$$\frac{\partial H}{\partial N} = -\dot{\lambda} + r\lambda \Longrightarrow w_z + \lambda\delta - \phi = \dot{\lambda} - \mathrm{r}\lambda \quad (17)$$

Now, (14) and (15) imply

$$\frac{m_h}{m_p} = \left(\frac{\tau}{1-\tau}\right)^{\frac{1}{1-\rho}} \quad (18)$$

Using (18) in (14) gives

$$\tau^{/} p_z = \emptyset \quad (19)$$

In steady state $\dot{\lambda} = 0$. By using $\dot{\lambda} = 0$ and (16), (19) into the equation no (17) we get,

$$\tau^{/} p_z - w_z = (r+\delta)\lambda = \frac{(r+\delta)c_z}{q(\theta_z)} \quad (20)$$

2. Maximization of firm's profit for the case of Autarky equilibrium at Home

The Hamiltonian is,

$$H = A{L_h}^{\gamma} - w_h L_h - C_h V_h + \psi\left[\mu_h \theta_h^{\delta_{h-1}} V_h - \lambda_h L_h\right]$$

Then the F.O.C is as follows

$$\frac{\partial H}{\partial V_h} = 0 \Longrightarrow -C_h + \psi\mu_h\theta_h^{\delta_{h-1}} = 0 \Rightarrow C_h = \psi\mu_h\theta_h^{\delta_{h-1}} \quad (21)$$

$$\frac{\partial H}{\partial L_h} = -\dot{\psi} + \rho\psi \Longrightarrow w_h + \psi\lambda_h = \gamma A{L_h}^{\gamma-1} + \dot{\psi} - \rho\psi \quad (22)$$

In steady state, $\dot{\psi} = 0$, then from equation (22)

$$\gamma A{L_h}^{\gamma-1} = w_h + \psi(\lambda_h + \rho)$$

$$\gamma A{L_h}^{\gamma-1} = w_h + \frac{(\rho+\lambda)c_h}{\mu_{h\theta_h}{}^{\delta_h - 1}} \quad (23)$$

3. Wage determination for the case of Autarky equilibrium at Home

The asset values are as follows (P. Ranjan (2013)PP. 176).

$$\rho E_h = w_h + \lambda_h(U_h - E_h) \tag{24}$$

and

$$\rho U_h = b_h + {\mu_{h\theta_h}}^{\delta_h}(E_h - U_h) \tag{25}$$

Now, subtracting (24) and (25)

$$\rho E_h - \rho U_h = w_h - b_h + \lambda(U_h - E_h) - {\mu_{h\theta_h}}^{\delta_h}(E_h - U_h)$$

follows,

$$\rho E_h = \frac{\left(\rho + {\mu_{h\theta_h}}^{\delta_h}\right)w_h + \lambda_h b_h}{\rho + \lambda_h + {\mu_{h\theta_h}}^{\delta_h}} \tag{26}$$

Similarly,

$$\rho U_h = \frac{{\mu_{h\theta_h}}^{\delta_h} w_h + (\rho + \lambda_h)b_h}{\rho + \lambda_h + {\mu_{h\theta_h}}^{\delta_h}} \tag{27}$$

Union maximizes equation (7) subject to equation (6). By applying Lagrangian,

$$\Pi = \left(\frac{\rho(w_h - b_h)L_h}{\rho + \lambda_h + {\mu_{h\theta_h}}^{\delta_h}}\right) + \xi\left[\gamma A {L_h}^{\gamma-1} - w_h - \frac{(\rho + \lambda)C_h}{{\mu_{h\theta_h}}^{\delta_h - 1}}\right]$$

The first order condition are,

$$\frac{\partial \Pi}{\partial w_h} = 0 \Longrightarrow \left(\frac{\rho L_h}{\rho + \lambda_h + {\mu_{h\theta_h}}^{\delta_h}}\right) = \xi \tag{28}$$

and,

$$\frac{\partial \Pi}{\partial L_h} = 0 \Longrightarrow \left(\frac{\rho(w_h - b_h)}{\rho + \lambda_h + {\mu_{h\theta_h}}^{\delta_h}}\right) = \xi(1-\gamma)\gamma A {L_h}^{\gamma-2} \tag{29}$$

Now,

$$\begin{gathered}\left(\frac{\rho L_h}{\rho + \lambda_h + {\mu_{h\theta_h}}^{\delta_h}}\right) = \frac{\left(\frac{\rho(w_h - b_h)}{\rho + \lambda_h + {\mu_{h\theta_h}}^{\delta_h}}\right)}{(1-\gamma)\gamma A {L_h}^{\gamma-2}} \\ \Longrightarrow L_h = \frac{(w_h - b_h)}{(1-\gamma)\gamma A {L_h}^{\gamma-2}} \\ \Longrightarrow w_h - b_h = L_h\left((1-\gamma)\gamma A {L_h}^{\gamma-2}\right) \\ \Longrightarrow w_h = b_h + (1-\gamma)A\gamma {L_h}^{\gamma-2+1} \\ \therefore w_h = b_h + (1-\gamma)A\gamma {L_h}^{\gamma-1}\end{gathered} \tag{30}$$

4. Determination of wage in the offshoring case

The Lagrangian,

$$\Pi = \left(\frac{\rho(w_h - b_h)L_h}{\rho + \lambda_h + \mu_h {\theta_h}^{\delta_h}}\right) + \psi\left[\gamma A(L_h + M)^{\gamma-1} - w_h - \frac{(\rho + \lambda)C_h}{{\mu_{h\theta_h}}^{\delta_h - 1}}\right]$$

$$+ \varphi\left[P_f \emptyset\big(h(M) + h'(M)M\big) - w_h - \frac{(\rho + \lambda)C_h}{{\mu_{h\theta_h}}^{\delta_h - 1}}\right]$$

F.O.C is as follows,

$$\frac{\partial \Pi}{\partial w_h} = 0 \Longrightarrow \left(\frac{\rho L_h}{\rho + \lambda_h + \mu_h {\theta_h}^{\delta_h}}\right) = \psi + \varphi \tag{31}$$

$$\frac{\partial \Pi}{\partial L_h} = 0 \Longrightarrow \frac{\rho(w_h - b_h)}{\rho + \lambda_h + \mu_h {\theta_h}^{\delta_h}} = \psi(1-\gamma)A\gamma(L_h + M)^{\gamma-2} \tag{32}$$

$$\frac{\partial \Pi}{\partial M} = 0 \Longrightarrow \psi(1-\gamma)A\gamma(L_h + M)^{\gamma-2} = \varphi P_f \emptyset\left(2h^{/}(M) + Mh^{//}(M)\right) \tag{33}$$

Taking the value of ψ and φ from (32) and (33) and substituting to (31) we get,

$$\frac{\rho L_h}{\rho + \lambda_h + \mu_h {\theta_h}^{\delta_h}} = \frac{\rho(w_h - b_h)}{\rho + \lambda_h + \mu_{h\theta_h}{}^{\delta_h}} \cdot \frac{1}{(1-\gamma)A\gamma(L_h + M)^{\gamma-2}} + \frac{\psi(1-\gamma)A\gamma(L_h + M)^{\gamma-2}}{P_f \emptyset\left(2h^{/}(M) + Mh^{//}(M)\right)}$$

Now Let,

$$\rho + \lambda_h + \mu_h {\theta_h}^{\delta_h} = A$$
$$(1-\gamma)A\gamma(L_h + M)^{\gamma-2} = B$$
$$\text{and, } P_f \emptyset\left(2h^{/}(M) + Mh^{//}(M)\right) = C$$

Then,

$$\frac{\rho L_h}{A} = \frac{\rho(w_h - b_h)}{A} \cdot \frac{1}{B} + \frac{\psi B}{C}$$
$$\Longrightarrow \frac{\rho L_h}{A} = \frac{\rho(w_h - b_h)}{A} \cdot \frac{1}{B} + \frac{\rho(w_h - b_h)}{A} \cdot \frac{1}{B} \cdot \frac{B}{C}$$
$$\Longrightarrow \frac{\rho L_h}{A} = \frac{\rho(w_h - b_h)}{A}\left(\frac{B + C}{BC}\right)$$
$$\Longrightarrow w_h - b_h = L_h \cdot \left(\frac{BC}{B + C}\right)$$
$$\Longrightarrow w_h = b_h + L_h \cdot \left(\frac{BC}{B + C}\right)$$

That's mean

$$w_h = b_h + \frac{L_h\left((1-\gamma)\gamma A(L_h + M)^{\gamma-2} P_f \emptyset\left(2h^{/}(M) + Mh^{/}(M)\right)\right)}{(1-\gamma)\gamma A(L_h + M)^{\gamma-2} + P_f \emptyset\left(2h^{/}(M) + Mh^{/}(M)\right)} \tag{34}$$

5. Determination of Employment, offshoring amount and wage equation in case of individual wage barraging

Hamiltonian as follows,

$$H = A(L_h + M)^{\gamma} - w_h L_h - P_f \emptyset h(M) M - c_h V + \psi\left[\mu_h \theta_h^{\delta_{h-1}} V_h - \lambda_h L_h\right]$$

First order condition is,

$$\frac{\partial H}{\partial V_h} = 0 \Longrightarrow c_h = \psi \mu_h \theta_h^{\delta_{h-1}}$$

$$\frac{\partial H}{\partial L_h} = -\dot{\psi} + \rho\psi \Longrightarrow \gamma \cdot A(L_h + M)^{\gamma-1} - \left(w_h + L_h \frac{\partial w_h}{\partial L_h}\right) - \psi\lambda_h = -\dot{\psi} + \rho\psi$$
$$\Longrightarrow \gamma \cdot A(L_h + M)^{\gamma-1} - L_h \frac{\partial w_h}{\partial L_h} = w_h + \psi\lambda_h - \dot{\psi} + \rho\psi$$

Now taking $\dot{\psi} = 0$ at steady state and placing the value of c_h we get,

$$\gamma \cdot A(L_h + M)^{\gamma-1} - L_h \frac{\partial w_h}{\partial L_h} = w_h + \frac{(\rho + \lambda_h)c_h}{\mu_h \theta_h^{\delta_{h-1}}} \tag{35}$$

Here terms $\frac{\partial w_h}{\partial L_h}$ captures the effect identified by Stole and Zwiebel(1996). Equation (35) shows the employment decision of the firm when there have a possibility of renegotiation.

If there have no chance of renegotiation,

$$\gamma \cdot A(L_h + M)^{\gamma-1} = w_h + \frac{(\rho + \lambda_h)c_h}{\mu_h \theta_h^{\delta_{h-1}}} \tag{36}$$

For the optimal choice of offshoring amount,

$$\frac{\partial H}{\partial M} = 0 \Longrightarrow \gamma \cdot A(L_h + M)^{\gamma-1} = P_f \emptyset \Big(h(M) + Mh^{/}(M)\Big)$$

$$\therefore \ \gamma \cdot A(L_h + M)^{\gamma-1} = P_f \emptyset \Big(h(M) + Mh^{/}(M)\Big) \tag{37}$$