Critical Review of 'A Simple Model of Firm Heterogeneity, International Trade and Wages'

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CRITICAL REVIEW OF THE PAPER

A simple model of firm heterogeneity, international trade, and wages

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1. Organization of the Study

The paper under consideration can be subdivided into three technical sections. Section-I deals with different dimensions of firm heterogeneity by laying focus on production technology, trade costs (fixed and variable) and worker heterogeneity based on skill.[1] Section-II explains the closed-economy dynamics of firm heterogeneity on wage levels, price indices and number of firms in a certain industry by observing three different industries. Finally, section-III compares the identical dynamics under an open-economy scenario and elaborates the impact of reduction in trade costs on revenue and wages.

2. Motivation

The debate over wage and firm heterogeneity is not new. Sophisticated literature on the matter can be sought from mid-1980s.[2] A considerable amount of literature differentiates between exporting and non-exporting firms based on their productive-capacity, their ability to pay higher wages to attract high-skilled labor, and to undertake high costs to exploit new and improved technology. [3] However, contrary to the existing literature, that differentiates firms into exporters and non-exporters by randomly assigning productivity levels to each firm[4], Yeaple introduces a more coherent and elaborate explanation of firm heterogeneity. He distinguishes domestic and exporting firms on the basis of technological differences and skill level of individual workers. This new definition of firm heterogeneity provides a more comprehensive insight into the economic implications of magnitude and costs of international trade on the labor-remuneration, firm revenues and inter- and intra-industry labor movements. It is therefore justified to establish that this study unveils new dimensions of firm heterogeneity and their respective role in international trade.

3. Basic Framework

i. Homogeneous firms, perfectly competitive labor market and technology varying in characteristics and costs, when compounded, give rise to firm heterogeneity.

[1] Other possible dimensions of firm heterogeneity, overlooked by Yeaple (2005) are discussed in later sections of this study.
[2] See Shapiro and Stiglitz (1984), Stiglitz (1985) and Michael P. Keane (1991)
[3] See Bernard and Jensen (1997,1999)
[4] See Melitz (2003) and Bernard et al. (2003)

ii. There are two types of goods; X is a composite differentiated good that follows Constant Elasticity of Substitution over a continuum of varieties, and Y is a homogeneous good that follows basic Cob-Douglas production function.

iii. There is a single technology to produce Y, however there are two distinct technologies to produce X; high-tech (H) and low-tech (L). H-technology incurs higher fixed cost (F_H) for procurement as compared to fixed cost for L-technology (F_L). The market follows monopolistic competition, and there is free entry to the market. However, entering into good-X requires fixed cost of respective technology (F_H or F_L).

iv. Labor is the only factor of production, having three categories; highly skilled, moderate skilled and low skilled. High skilled labor has comparative advantage in high-tech varieties of good-X over the moderate and low skilled labor, and moderate skilled labor has comparative advantage in low-tech section of good-X over the low skilled labor.[5]

v. Assuming Z as an unobservable level of skill, the labor allocation to production of three goods (Y, X_L & X_H) is distinguished by two threshold level of skills Z_1 and Z_2. This implies that low skilled workers ($0 \leq Z \leq Z_1$) are employed in industry producing good-Y, and moderate- ($Z_1 \leq Z \leq Z_2$) and high-skilled ($Z \geq Z_2$) workers are employed in L and H sections of industry producing good-X, respectively.[6] These threshold conditions are determined by zero-profit condition for both sections of industry producing good-X and market clearing condition for industry producing good-Y, under both closed and open economy. [7]

vi. Under open economy, international trade incurs a fixed cost F_X , and a marginal cost ($\tau^{\sigma-1}$). Yeaple binds the fixed cost of trade to be large enough to restrict the low-tech producers' access to international market. Hence, given the condition $F_H > F_X \tau^{\sigma-1} > F_L$, only firms using H technology can enter the international market, earning the revenue $R_H(1+\tau^{\sigma-1})$ if they serve both local and international market. The L-tech firms however keep generating revenue R_L.

[5] See Yeaple (2005); *Eq. 3* for further reference.
[6] *Ibid*. *Eq. (4)* and *Fig. (1):Mapping of log-W* for further reference.
[7] *Ibid. (Eq. 7)* and *Eq. (10)* for closed economy equilibrium conditions and *Eq. (10)* and *Eq. (15)* for open economy equilibrium conditions.

4. Dynamics and Discussion

Yeaple constructs his idea based on two lemmas and seven propositions. His ideas are discussed in detail in the following sections.

4.1 Equilibrium Under Closed Economy: *Proposition-I & –II* and *Lemma-I*

Assuming labor is paid technology-specific efficiency wage, better technology yields higher wage for the labor, higher revenue for the firm and eventually higher average revenue per worker. In other words, the firms using H-technology (hiring high-skilled labor and producing X_H) pay higher wages to the labor and yield higher revenues as compared to the other two industries producing X_L and Y.[8] This reflects that technology influences the entrepreneurs' decision of selecting labor type, and once a certain kind of labor is hired in a specific technology, the workers are given their skill-specific wages. Yeaple further stresses that a worker employed in *wrong* technology yields lesser wage as compared to the wage he could earn had he been employed in *right* technology.

The results in this proposition are very intuitive and cannot be regarded very unique in the sense that similar conclusions have long been drawn in international trade literature[9]. For instance, Abowd *et al*. (1999) studied skill as "*person effects*" (mainly the attributes not associated with observable effects such as education) and provided empirical evidence of dependence of wage variation on these *effects* in France. In another study, by observing a large panel of United Kingdom workers, Guadalupe (2007) showed a positive relationship between skill of workers and their wages through competitiveness of the market. Moreover, in a more theoretical framework, Akerlof and Yellen (1990) introduced the wage-effort hypothesis that explained the interdependence of wages and human effort and asserted that in case of non-payment of fair wage, workers withdraw their effort.

However, the results presented in this study can be distinguished with other studies on the grounds that Yeaple has created a relationship between skill and wages under the scenario of ex-*ante* homogeneous firms, contrary to the firms having ex-ante comparative or absolute advantage in earlier models. The result therefore appears to be interesting since the firms that are identical in the beginning, derive wage- and skill-heterogeneity based on their decisions of technology adoption.

[8] Ibid; *Lemma-I, Proposition-I & -II*

[9] See Idson and Oi (1999) who corroborate the conjecture that higher wages are paid to more skilled labor in the lieu of their ability to best implement the available technology.

4.2 Open Economy and the Impact of Trade Costs: *Propositions IV-VII & Lemma-II*

Yeaple proposes that even homogeneous countries can benefit from international trade. It is suggested that a decline in trade barriers between ex-ante homogeneous countries brings about a positive change in revenue per worker and average skill level of labor in both X and Y industries, and the relative demand for skilled labor rises. Decline in trade barriers is more specifically referred to as a decline in trade costs, i.e. marginal cost of trade (τ), or fixed cost (F_X). However, given that τ is easily quantifiable, Yeaple examines the impact of decline in marginal cost of trade and purports that change in F_X will have similar results.

This proposition provides a unique relationship between the labor share in each industry, distribution in wages in accordance with the worker quality and the firm revenues given a change in trade costs. The basic intuition behind these results lies in the fact that a reduction in trade costs immediately raises the relative demand for labor in the industry using H-technology, which in turn makes the skilled labor dearer and the wage level rises in this industry. This incline in wages has dual effect.

i. H-tech industry becomes more attractive for low-skilled labor currently employed in L-tech industry. They are induced to switch to industry offering higher wages. [10]
ii. Incline in wages in H-tech industry leads to the rise in overall expenditure (E) in the economy, and thus an increase in demand for good-Y. This eventually increases the demand for labor in Y-industry and the wage level in this industry goes up.[11]

These two effects, when coupled, shrink the labor share in L-tech firms, since the least skilled labor in L-tech firms switches to the Y-goods industry, and the most skilled labor in L-tech firms switches to H-tech firms (*Proposition-IV*).[12]

It is noteworthy that the workers switching to Y-industry are of above average productivity and hence the overall level of productivity in this sector increases. Given the zero-profit condition, extra revenue generated in this industry, is distributed

[10] This may be done by acquiring skills to bring these workers parallel to the high-skilled workers, which does not seem compatible with the assumptions of this model. It is referred to as a drawback in this model and has been discussed in succeeding section.
[11] See Yeaple (2005), *Eq. (8), Eq. (10)* and *Eq. (15)* for further reference.
[12] This effect is best explained in Yeaple (2005); "Fig.2: Falling transport cost and the wage distribution"

amongst the workers which raises the overall revenue per worker in industry-Y (*Proposition-V*).

One the other hand, the least skilled workers in X-industry have moved out of the industry, and some of the moderate skilled workers have now become more skilled. Therefore the average revenue per worker is bound to increase in both H- and L-tech factions of industry-X (Proposition-VI).

The discussion above relates to the intuition of proposition-VII that suggests an increase in wage level in H-tech industry and a probable decline in wages in L-tech industry, given the decline in trade costs.

This concludes the discussion of all dynamics discussed in the paper.

5. Critical Analysis and Suggested Inclusions

i. Yeaple has by far overlooked other potential variants of firm heterogeneity and laid focus to substantiate skill and technology as the only sources of heterogeneity. However, there are many other indicators that differentiate one firm with others. One such indicator has been discussed by Caliendo and Rossi-Hansberg (2012), who establish that firm heterogeneity is linked to organization of production. By defining different tiers of management in firms, they conclude that exporting firms will increase the number of layers of management under liberalized trade.

   Soren & Bernhard (2012) have discussed yet another dimension of firm heterogeneity. They maintain that technology adoption in subsequent times, (i.e. not simultaneously), makes some firms followers of other firms and thereby impact their market status.

ii. The assumption of skill being an 'innate and unobserved' ability of a worker is not compatible with this model. Increase in demand for skilled labor can only be met if low-skilled labor can be trained and transformed into high-skilled. Alternatively, if skill level cannot be increased artificially, then it should be assumed that after a certain time, the technology becomes 'less convoluted', such that even low-skilled worker can use it now. However, in this case the distribution of L- and H-technology firms will become meaningless.

iii. Yeaple hasn't discussed the cost of achieving skill. As long as skill is considered a God-gifted ability, Yeaple's propositions stand correct, but as soon as the definition of skill is diverted to other dimensions such as training, education etc., most of the ideas in his paper might collapse, since achieving a certain skill has its costs associated with it, and not every worker has capacity to bear these costs. Given these costs, Lemma-II appears invalid, since the overall skill level in the industry will be restricted by the costs of achieving that skill.

iv. The theory examines labor reallocations in the absence of population growth. Therefore, it is not wrong to suggest that results might become invalid in long run since the labor is bound to grow in accordance to the population growth rate, and varying growth rates for different countries may bring inconsistent implications for respective countries.

v. Yeaple focuses only on two technologies, and misses out on the possibility of more available technologies. However, this issue has been realized and addressed by Sampson (2012) who generalizes the model presented in this paper for a continuum of production technologies. Evolution of increasing number of Research and Development (R&D) sections in firms to assess the market condition and introduce product innovation can substantially be considered as an empirical evidence of diverse technologies in real framework (Bastos & Straume, 2012)

vi. Yeaple assumes that $F_H > F_X > F_L$ holds in all cases. However there may be scenarios in which F_X becomes as high as to prevent even H-tech firms from international market, or becomes so low that all firms in the industry join international market. Both these cases have their own implications on competition, wages and price levels in both domestic and foreign countries.

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