Offshore Production, Student Effort, and Wage Inequality

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Abstract

Student academic effort is added into Findlay and Kierzkowski's (1983) skill formation framework to show that a country with abundant educational resources suffers less from globalization-driven wage inequality. Unlike unskilled workers, students must allot some part of their leisure time to studying, by means of education resources, to effectively absorb "education" in the hope of acquiring more comfort in the future. Increased level of endowed educational resources means less student effort is required to obtain skills, which thus encourages school enrollments, increasing the relative supply of skill workers. This turns out to erode the bias effect of global outsourcing.

Keywords: Global Outsourcing, offshore production, student effort, wage inequality

JEL Classification: F14, F16, I20, J31

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1. Introduction

Findlay and Kierzkowski (1983) assume that each individual in an economy has an equal potentiality to become a skilled worker if he or she is determined to receive an “education”. They apply a skill-formation function to transform students into skilled workers after a fixed length of school time, with the only required input being country-endowed education stock. Therefore, in long-run competitive equilibrium, their model implies identity of real income over the life cycle between skilled and unskilled workers. However, in the real world, it has been widely observed that a significant lifetime skill premium exists.[1] An important factor, in addition to the educational resources, which appears to be overlooked in their argument, is student academic effort.[2]

The American inventor Thomas Edison once said, "Genius is one percent inspiration and ninety-nine percent perspiration." Empirically, Loury and Garman (1995) documented that, in addition to school years, student performance and college selectivity significantly affect earning inequality. Also Martins and Pereira (2004) argue that the schooling has a positive impact upon within-group wage inequality, but that impact is conditioned on the students’ ability and the schools’ quality, along with

[1] Krueger and Perri (2003) investigate the welfare consequences in wage inequality in the US over the last 30 years. Their estimates suggest that the workers that suffer permanent relative income falls (e.g. workers with little education) experience substantial declines in relative consumption by about 2% to 6%, with associated important welfare loss. However, the skilled workers enjoy sizable welfare gains of similar magnitude as the losses of the poorest agents.

[2] Blankenau and Camera (2001) argues that student effort is necessarily for skill formation during education.

other factors. Generally, both student performance and college selectivity are highly determined by student ability and effort, but usually the latter plays a larger role.[3]

Given that skill returns depend not so much on ingenuity as on hard work, I take only the latter into account for the sake of simplicity in this paper.[4] That is, the return to education depends not only on the educational intensity as mentioned in Findlay and Kierzkowski (1983) but also on student academic effort as implied in Loury and Garman (1995) and in Martins and Pereira (2004). Students in school must devote themselves in studying to effectively absorb the "education" that leads to skill formation.

I next incorporate the extended skill formation function into the pattern of global outsourcing trade. As argued by Feenstra and Hanson (1996), offshore production generates a bias towards use of skilled workers, leading to inequality both in wages and employment that favors of the relative skilled workers within a nation. Skilled workers then take advantage of their rising skill premium to purchase services instead of self-production, which creates more demand for various personal services. Meanwhile, the service sector absorbs unskilled manufacturing workers made redundant from outsourcing, which in turn provides increased support for expansion

[3] Barron et al. (2003) find that more than half of the return to college education is associated to student effort rather than student ability.

[4] Among others, Sahin (2004) finds out that the students respond to lower tuition policy in the U.S. by decreasing the level of their studying effort, which results in a potential loss of human capital of around 15%. Her finding confirms the conventional wisdom that student academic effort plays a key role in future earnings.

of personal services to meet the rising demand from skilled workers. This loop, triggered by offshore production, brings about an enlarged service sector. The expanding service sector thus abates, at least partially, the pressure of globalization-driven wage inequality.[5]

In the literature of labor, the phenomenon of education leading to increased income equality redistribution is well documented. In the literature of trade, the process of offshore production leading to income inequality is also well documented. What a currently lacking is a theoretical model that nests the joint impacts of offshore-production and education on income inequality. This paper attempts to fill that gap.

In Section 2, I extend Findlay and Kierzkowski's (1983) skill formation function by adding student academic effort. I then derive the optimal school enrollment, conditioned on a trade-off between academic effort and leisure, from the extended skill formation function. I argue that the heterogeneous preferences for leisure between students and unskilled workers lead to lifetime income inequality. Those who prefer to trade off current leisure for future comfort enroll as students, and the remaining become unskilled workers. Section 3 concludes the findings.

[5] Fiala (1983) found out that the gini ratio exhibiting a positive and significant impact on service sector size in 1970 in less developed countries. While foreign direct investment leads to a bias effect favorable to "a small indigenous elite", she argued that "such an increase in equality, in the context of restricted occupational opportunities for industrial employment, would create an environment favorable to the expansion of service and informal sector employment."

2. The Model

Suppose in a North-South world, the production function of the good industry in the North requires inputs of skilled and unskilled workers as well as outsourced imports. In equilibrium, the factor rewards equal their marginal value of products. Assuming the factor returns to a unskilled worker is w_2, and the returns to a skilled worker is w_1.

The North finds beneficial to carry more offshore production in order to take advantage of the South's relatively low wage costs while the South either decreases its political barriers against foreign direct investment (Feenstra and Hanson, 1996) or improves its contract environment to reduce risk of incomplete contract (Antras and Helpman, 2004). Either way, offshore production leads to increased output of the manufactured good with a lower price. With bias effect in favoring of skilled workers, the skilled workers benefit with a higher real wage with offshore production. Impact of offshore production on unskilled workers is ambiguous in Feenstra and Hanson's (1996) model. However, I assume an unskilled-intensive service sector exists, which somehow is able to absorb, at least partially, the biased impact from offshore production. This enhances the chance that offshore production is also beneficial to unskilled workers.

As the North carries out offshore production in the South, outsourcing imports

replace Northern unskilled labor. A full employment condition holds if these "redundant" unskilled workers, says zL, drop out of the good sector and shift to the service sector. Here z denotes the extent of offshore production and L total unskilled workers. Without any skill barrier, unskilled workers can move freely between the service sector and the good sector. The size of the service sector thus amounts to $w_2 zL$.

The seminal model of Findlay and Kierzkowski (1983) provides the basic structure for my analysis in this paper. They define skill formation as a function of educational stock. Additionally, based on the empirical work from Loury and Garman (1995) and from Martins and Pereira (2004), I partition the returns to education into two parts: the returns to educational resources and the returns to student effort.

2.1 Skill Formation Function

Supposing an economy, here labeled the North, consists of unskilled workers, skilled workers, and students. Each individual consumes good, service, and leisure. The good is internationally tradable, the service is tradable domestically, but leisure cannot be traded. All individuals have similar preferences for both good and service, but the preferences for leisure differ among unskilled workers, students, and skilled workers. All individuals, laboring to earn their good and service, are assumed to be similarly endowed with a leisure time of l. However, the students must allot some

part of their leisure time to studying while other workers relax with their leisure time.

The population is stationary because the "birth" of *N* new individuals is exactly offset by the "death" of *N* old individuals at each instant of time. Every individual has a lifetime *T*, choosing whether she/he goes to school for a fixed length of time θ to acquire skills right after his/her "birth". The decision is based upon the individual's preference for leisure. Suppose that *E* individuals, among the *N* new-born individuals, tend to acquire education, becoming skilled workers, and the remaining $L = N - E$ individuals become unskilled labor for their lives. Those who choose to acquire education become skilled workers after the θ length of learning at school, earning a wage rate with the skill premium for the rest of time. Individuals choose not to enter school, starting to earn the going wage rate for unskilled workers.[6] There is a fixed exogenous supply of education inputs, denoted as *K*, which can be thought of as a composite of teachers, laboratories, libraries, etc (Findlay and Kierzkowski, 1983), making up the educational resources.

For each student, the output of skills, measured in efficiency, is not only positively related to educational resources intensity, $k = \frac{K}{E}$, but also positively related to student academic effort, a. Here a denotes the share of a student's leisure time that has been allotted to studying: the more time a student allots to studying, the

[6] The population census of the economy is given by $LT + E\theta + E(T - \theta) = NT$ (Findlay and Kierzkowski, 1983).

more skills he/she can acquire. A student's skill formation function is then given by

$$q = f(a, k, \theta), \tag{1}$$

where $f'(k) > 0$, $f''(k) < 0$ and $f(0,k) = f(a,0) = 0$. It is widely believed that humans have an unlimited capacity to learn.[7] Clinical findings support the theory that human intellectual development remains constant up to death.[8] Therefore, we may argue that the returns to student effort in skill formation are not diminished within a finite lifetime, implying that $f'(a) > 0$, and $f''(a) \geq 0$.

2.2 Student Effort and Leisure Allocation

All individuals are assumed to have the same preferences and tastes for both good and service, but skilled workers can purchase the services from the market and enjoy higher level of comfort from the increased spare time saved in service creation. Unskilled workers, in contrast, must perform such services for themselves. For example, persons with high income can afford to buy various services, such as eating out at restaurants, having laundry done, child care, housekeeping, etc. Comparatively, the persons with low income generally must perform these necessary tasks on their own. While both skilled and unskilled workers enjoy their leisure time, students must study hard after class during the education period in order to productively absorb what

[7] John Eccles (an Australian Neurology Nobel Laureate) said "The brain indicates its powers are endless." in a speech at University of Colorado, 1974.

[8] Lewin (1980) reports the studies of Dr. John Lorber on cerebral cortex losses, among several similar cases, a young Sheffield University student who had an IQ of 126 and had a first class honors degree in mathematics although over 90% of his brain tissue was lost, in other words, he had "virtually no brain".

they have been taught in the class. The exchange of leisure for education is a sacrifice (i.e., studying effort) in hopes of a later gain (i.e., more leisure) and is made by each individual based upon his/her preference for leisure along the time spectrum.

A student's "sacrifice" in studying is reward with $laf_a(a,k)$ units of future comfort. It is feasible to argue that the "price" of leisure hour is w_1 for skilled workers, and w_2 for both unskilled workers and students (Owen, 1971). Then the cost of studying equals the net value of studying in equilibrium as

$$C(a) = \int_{\theta}^{T} w_1 alf_a e^{-rt} dt - \int_{0}^{\theta} w_2 ale^{-rt} dt \,. \tag{2}$$

While both unskilled workers and students must supply services to themselves, skilled workers use the associated rise in their skill premium, derived from their previous student efforts, to purchase personal services in the market. Market clears in the service sector. The net value of the student effort required per student is equivalent to the value of services he/she can purchase in the future, thus we have

$$\int_{\theta}^{T} w_1 alf_a e^{-rt} dt - \int_{0}^{\theta} w_2 ale^{-rt} dt \equiv \frac{zL}{E} \int_{0}^{T} w_2 e^{-rt} dt \,, \tag{3}$$

where $zL\int_{0}^{T} w_2 e^{-rt} dt$ is the entire service sector size. Note that the lifetime incomes of unskilled workers must be the same in the good and service sectors while unskilled workers can freely move across the two sectors.

The first order condition of (3) with respect to the student effort is then given by

$$f_a(a, \frac{K}{E}) + a\frac{\partial f_a}{\partial a} = \frac{w_2(1-e^{-r\theta})}{w_1(e^{-r\theta} - e^{-rT})} \,. \tag{4}$$

The optimal solution of (4) determines a threshold student academic effort a^*, and the optimal educational intensity $k^* = \frac{K^*}{E^*}$. Given the exogenous school year (i.e., θ), the threshold of student effort decreases with a factor returns ratio of (i.e, $\frac{w_1}{w_2}$). It is because a relatively lower factor return makes students less motivated to study.

Given factor returns, an increase in education resources *K* implies a reduction in the effort threshold a, because the skill formation function $f(a,k)$ is non-decreasing in relation to the student effort a. That is, a country with abundant educational resources requires a smaller threshold of student effort to form sufficient skills, while a country with scarce educational resources finds it relatively inefficient to form skills and thus requires more student effort. On the other hand, the lower threshold in the education effort induces an increased supply of students, reducing the educational intensity until it reaches the optimal level k^* and a^* in equilibrium. A similar analysis also occurs in the factor returns ratio (i.e, $\frac{w_1}{w_2}$).

In my model, individuals have heterogeneous preferences for leisure. There is a group of individuals, students, prefer to allot a^* share of leisure time to studying, and the remaining individuals become unskilled workers. It turns out, with given factor returns and school years, the abundance in educational resources help students' academic activities more efficiency, leading to more school enrollment and, as a consequence, more skilled workers.

2.3 Equilibrium

The productivity of each skilled worker is augmented by a factor of $f(a,k)$, so that the income of a skilled worker is given as $w_1 f(a,k)$. The present value of the gross lifetime income as a skilled worker is given by

$$\int_{\theta}^{T} w_1 f(a,k) e^{-rt} dt = \frac{w_1}{r} f(a,k)(e^{-r\theta} - e^{-rT}). \quad (5)$$

The aggregate cost of education in present value is given by

$$\int_{\theta}^{T} w_1 k f_k e^{-rt} dt + \int_{\theta}^{T} w_2 e^{-rt} dt + \int_{0}^{\theta} w_2 e^{-rt} dt + C(a)$$

$$= \frac{1}{r}[w_1 k f_k (e^{-r\theta} - e^{-rT}) + w_2 (1 + \frac{zL}{E}(1 - e^{-rT})]. \quad (6)$$

The first term in (6) is the "tuition" payment from 0 to θ for each student, which equals the sum of the skill formation function's discounted marginal products over the working life of the student (Findlay and Kierzkowski, 1983). The second and third terms are the opportunity costs of enrolled as a student. The fourth term is the cost of studying effort.

Subtracting (6) from (5), we obtain the net benefit from education as

$$\pi = \frac{1}{r}[w_1 (f - k f_k)(e^{-r\theta} - e^{-rT}) - w_2 (1 + \frac{zL}{E})(1 - e^{-eT})]. \quad (7)$$

Individuals like to acquire education until marginal benefit of education equals marginal cost of education. The optimal solution is derived from the first order condition of (7) with respect to enrollment as

$$\frac{\partial \pi}{\partial E} = \frac{1}{r}[w_1 k f''(e^{-r\theta} - e^{-rT}) + w_2 zL(1 - e^{-rT})]E^{-2} = 0. \quad (8)$$

Defining $\lambda = \frac{w_2}{w_1}\frac{(1-e^{-rT})}{(e^{-r\theta}-e^{-rT})}$ and rewriting (8), we obtain

$$-k^* f''(a,k^*) = \frac{zL}{E}\lambda, \qquad (9)$$

in which the optimal enrollment E^* is determined. The order of $-k^* f''(a,k^*)$ is equivalent to that of $f'(k^*)$ in term of k^*, implying that $-k^* f''(a,k^*)$ is a upward sloping curve with respect to *E* as in Figure 1. Further, $\frac{zL}{E}\lambda$ in (9) is a downward sloping curve in *E*. Figure 1 illustrate the equilibrium.

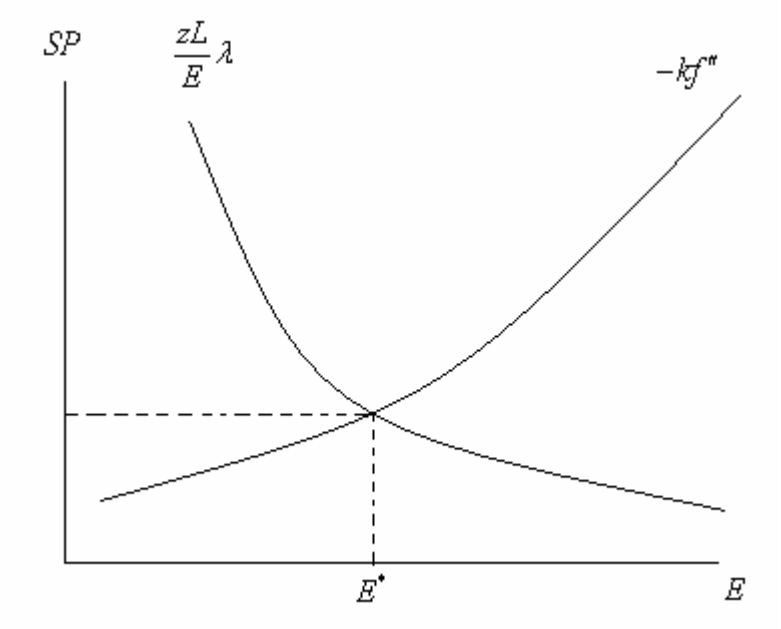

Figure 1. The Equilibrium

In the long run, the net benefit from education must be zero. From (3), (7), and (9), we obtain

$$\frac{w_1(f(a,k^*)-k^* f_k)}{w_2} = (1+\frac{zL}{E^*})(\frac{1-e^{-rT}}{e^{-r\theta}-e^{-rT}}). \qquad (10)$$

The left-hand side of (10) is net income inequality between the skilled and unskilled workers at any instant, which increases with offshore production and decreases with school enrollments. Thus, the *SP* curve in Figure 1 represents an alternative measure

of skill premium, which has not been adjusted for by an exogenous factor $(\frac{1-e^{-rT}}{e^{-r\theta}-e^{-rT}})$.

2.4 Offshore production and Educational Resources

As illustrated in Figure 2, an increase in offshore production expands the service sector, pushing up the skill premium and attracting increased student enrollment. However, their net effect shows a rising skill premium. The illustration is in line with Feenstra and Hanson (1996) that offshore production generates a disproportionate inequality not only in wages but also in employment in favoring of skilled workers.

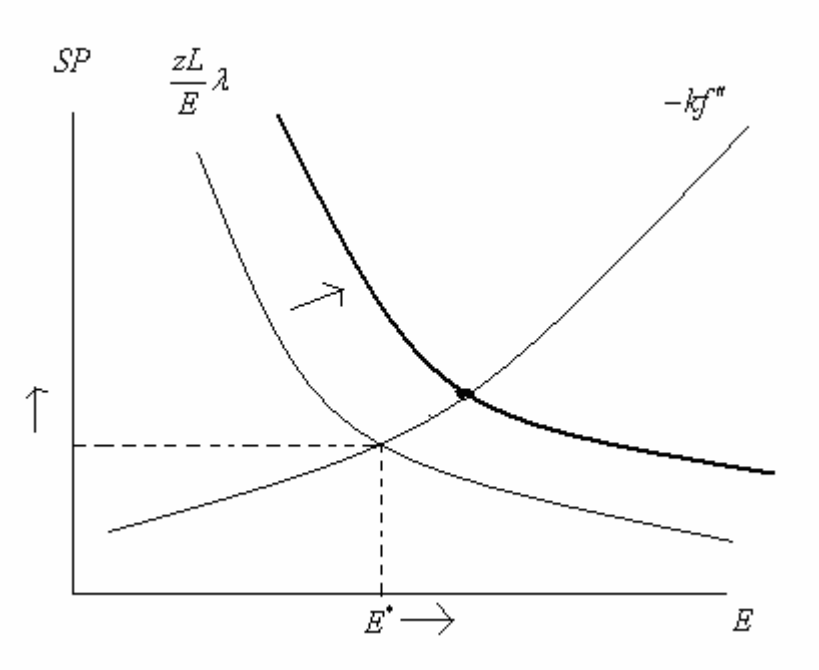

Figure 2 Offshore production Worsens Wage Inequality

On the other hand, as illustrated in Figure 3 and also as implied in (4), an increase in educational resources (i.e., *K*) leads to more enrollments, increasing the relatively supply of skilled workers and then exerting downward pressure on the skill

premium.

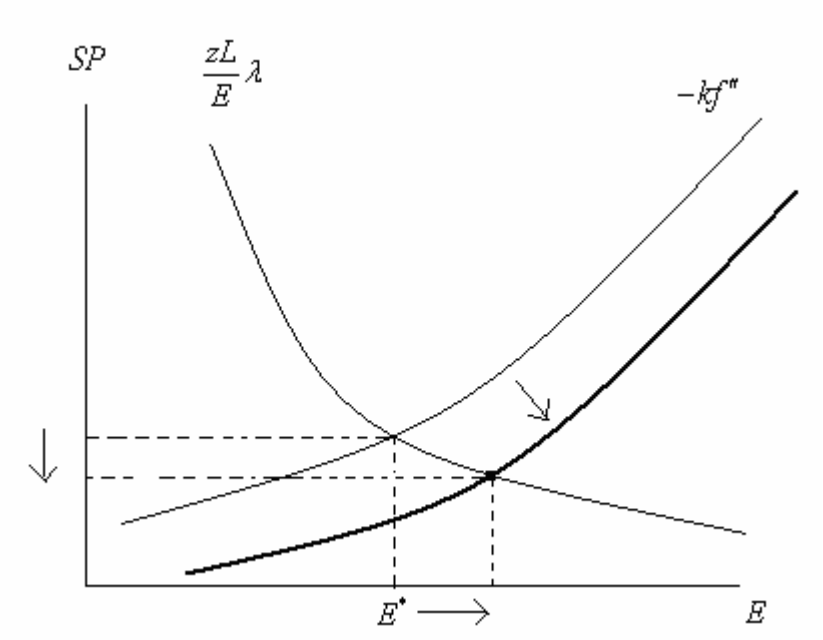

Figure 3 Education Reduces Wage Inequality.

2.5 Lifetime Income Inequality

Next, we can define the lifetime income inequality between the skilled and the unskilled workers as $\omega \equiv \frac{w_1(f(e,k)-f_k k)(e^{-r\theta}-e^{-rT})}{w_2(1-e^{-rT})}$. Rewriting (10), we obtain

$$\omega = 1 + z(\frac{1}{R(K)} - 1), \tag{11}$$

in which the school enrollment rate $R(K) = \frac{E}{N}$ increases with the country's educational resources as implied in (4) and in Figure 3. Contrary to Findlay and Kierzkowski (1983), the lifetime income inequality exists between skilled and unskilled workers, and increases with an increase of offshore production, but decreases with an increase in educational resources. Obviously, a country with higher levels of educational resources suffers less from globalization-driven wage inequality

than the countries with lower levels of educational resources. The policy implication for an economy caught in the rising tide of offshore production is to increase its educational investment in order to accumulate sufficient educational resources rather than resorting to protectionism. This is the main conclusion in this paper, which is in line with the view of Alan Greenspan, who urges to increased emphasis on education and to offer more retraining programs for career changes rather than fighting outsourcing through protection.[9]

3. Conclusions

While global outsourcing integrates world-wide resources in a more efficiency way, benefiting the world economy as a whole, its side effect of worsening inequality is not necessarily inescapable. This globalization-driven inequality can be eroded through educational investment: a nation with higher levels of educational resources and with associated student academic effort suffers less wage inequality than nations with less educational endowment. The resulting increase in school enrollment, encouraged by abundant educational resources, leads to a higher supply of skilled workers that then depresses the skill premium. The policy implication for an economy is to increase educational investment rather than rely on political barriers in the form of protectionism that not only raises costs but slows the flow of people toward skilled

[9] See the speech of this former Federal Reserve chairman at Boston College's Finance Conference 2004.

labor, thus artificially upholding income equality.

This paper also provides a testable framework to determine how income equality, as well as service sector size, is affected by offshore production and education respectively. A country that has lower levels of wage inequality but higher levels of offshore production should have an expanding service sector. I argue that the lifetime income inequality, originates from the heterogeneous preferences for leisure, is augmented by the increase of offshore production but eroded by the increase in educational resources. An empirical analysis of the two factors' joint impact on wage inequality is for future research.

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