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The Location of Economic Activity in Integrated Economic Areas:
European Experiences and Asian Perspectives

Location of Economic Activity and Feasibility for Regional Cooperation: Economic Growth and Regional Development

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NOT FOR QUOTATION

1. Introduction

1970's and 80's were decades for East Asian countries which had achieved so called export-led economic growth. Arayama (1999) emphasized that Japan could have expand her volume of export while she was even increasing her unit price of export in many commodities and pointed out that Japan could had successfully achieved her export-led economic growth. This is an apparent fact already, however, we can easily recognize that it is very difficult to understand this process of export-led economic growth along the standard theoretical framework of international economics for the case of two large countries, analysis which utilize offer curves. It is easy to see that more export should result in deterioration in terms of trade along the simple theory of international economics.

We are obliged to front another theoretical difficulty to analyze the actual process of export-led economic growth. The most popular analytical framework in international economics, Heckscher-Ohlin-Samuelson model, is intrinsically assuming same two technologies, i.e., production functions among countries which are involved commodity trade internationally. I understand that economists are wise enough to assume same two production functions among countries to keep analytical simplicity and consistency. Due to this simplicity we do not want to assume otherwise, however, it is almost obvious that we can not handle the process of economic catch up where new comers have been obtaining new technologies.

Furthermore, economics are expected to provide effective analytical tools in order to analyze location of economic activities along with globalization of the world economy. It is again obvious that we are not dealing with countries which posses the same two production functions, rather we are asked to include two countries which are in different stages of economic development.

In this paper, I applied the idea of traditional and new technologies to produce same one commodity initiated by Professor Mundlak (1979) to the analytical framework for international trade. The beauty of this work can possibly emancipate us from the bondage of the Heckscher-Ohlin-Samuelson model, same two production functions among countries. Newly developing countries (NDCs) posses traditional technology and at the same time they can possibly posses new

technology if developed countries (DCs) make the transfer of new technology.

As Professor Mundlak showed already, production possibility frontier (PPF) has linear part when there are two technologies to produce one commodity. In order to translate this modification in PPF into offer curve (OFF) I will utilize the Mead diagram. This well known classical invention provides us again a good instinct to understand the linkage between commodity price and production including returns to factors of production.

There exist two technologies. This means that we cannot depend on simple calculations to derivate the economic effect for a certain changes, since there exists switching between the two technologies. Therefore, we need diagrammatical analysis to foresee the all range of possible change in an economy.

Economists have been depending of division of labor in the field of international economics, namely we have been using PPF and OFF respectively when we need it. Theoretically the link between PPF and OFF is "so obvious", so that we have been neglecting to pay necessary attention to that link. That is why we cannot derive OFF which corresponding PPF with two technologies to produce one commodity. But we can go back to the division of labor once we successfully find a link between them.

Needless to say, it is indispensable to find this link because we are living the world which is characterized by tariffs, quota, subsidies, technological progress, and changes in factor endowment and so on. In other words, we cannot do without OFF. I will challenge to clarify this link between PPF and OFF in order to regain the most important link between commodity price and income distribution when we have two technologies to produce one commodity.

When we talk about an economic integration or even economic growth, we do not have necessarily two DCs in our mind, rather we have usually DCs and NDCs in our mind. Once we recognize this, it is so important for us to introduce two technologies into our scope of analysis.

2. Economic Model of Two Technologies in X

Basic structure of economic model with two (traditional and new) technologies for a commodity is as follows. F_X^T (traditional technology) and F_X^N (modern technology) are used to produced X, and F_Z is used to produce M. These three production functions are all homogenous degree one and satisfying ordinary requirement.

Supply conditions are given by

$$X^T = F_X^T(L_X^T, K_X^T)$$

$$X^N = F_X^N(L_X^N, K_X^N)$$

and

$$M = F_M(L_M, K_M).$$

Due to the linearity in production functions, production functions can be written as follows;

$$x^T = \frac{X^T}{L} = \frac{L_X^T}{L}\frac{F_X^T(L_X^T, K_X^T)}{L_X^T} = \ell_X^T f_X^T(k_X^T)$$

$$x^N = \ell_X^N f_X^N(k_X^N)$$

$$m = \ell_M f_M(k_M)$$

Full employment conditions are given by

$$(\ell_X^T + \ell_X^M) + \ell_M = \ell_X + \ell_M = 1$$

$$k = (\ell_X^T k_X^T + \ell_X^N k_X^N) + \ell_M k_M = \ell_X k_X + \ell_M k_M$$

We assume that $k_M(\omega) < k_X^T(\omega) < k_X^N(\omega)$ for any admissible wage rental ratio ($\omega = w/r$). Needless to say, assuming this order in capital intensity does not necessarily exclude possible cases for other factor intensities.

Competitive conditions for the export sector are given by

$$p_X f_X^i{}'(k_X^i) \le r \qquad (1.1)$$

$$p_X[f_X^i(k_X^i) - f_X^i{}'(k_X^i)k_X^i] \le w \qquad i = T, N \qquad (1.2)$$

$$f_M'(k_M) = r$$

$$f_M(k_M) - f_M'(k_M)k_M = w$$
$$p_X = P_X / P_M$$

Equations (1.1) and (1.2) imply

$$p_X f_X^i(k_X^i) \le w + p_X f_X^i{}'(k_X^i)k_X^i \le w + rk_X^i .$$

This equality holds when each particular technique is actually utilized.

Production for X and level of production in each technology is shown as

$$X = X^T + X^N$$

$$X / L_X = f_X(k_X) = af_X^T(k_X^T) + (1-a) f_X^N(k_X^N),$$

where $a = L_X^T / L_X$ and $k_X = K_X / L_X = ak_X^T + (1-a)k_X^N$.

When the two techniques are used, the Euler condition implies:

$$f_X^i(k_X^i) = rk_X^i + w \quad i = T, N$$

$$f_X(k_X) = a(rk_X^T + w) + (1-a)(rk_X^N + w)$$
$$= r[ak_X^T + (1-a)k_X^N] + w$$
$$= rk_X + w$$

Proportion of the traditional technique in total production in X is shown by

$$\frac{X^T}{X} = \frac{X^T / L_X}{X / L_X} = \frac{\frac{L_X^T}{L_X}\frac{X^T}{L_X^T}}{X / L_X} = \frac{af_X^T(k_X^T)}{af_X^T(k_X^T) + (1-a) f_X^N(k_X^N)} .$$

Diagram 1 is relating capital labor ratio in X sector to the level of X production, returns to factors and wage/rental (ω) ratio in terms of diagram. It is worth to recognize that wage, interest rate and ω are remaining constant while two technologies for X production are utilized.

Diagram 2 shows PPF shaped by the economic model which includes two technologies for a commodity. Factor intensity is assumed as $k_M < k_X^T < k_X^N$ in upper diagram. New technology can produce more of X when level of production for X is low. On the contrary traditional technology can produce more of X when level of

production for X is high. Two commodities are produced as a linear combination between A(X^N,M) and B(X^T,M), so that PPF appears as linear as is indicated. Due to the nature of traditional and new technologies, the higher is the price of X, the higher is the level of production by traditional technology.

In lower diagram factor intensity is assumed as $k_X^T < k_X^N < k_M$ instead. Traditional technology can produce more of X when level of production for X is high. On the contrary new technology can produce more of X when level of production for X is low. Two commodities are produced as a linear combination between A(X^T,M) and B(X^N,M), so that PPF appears as linear as is indicated. Due to the nature of traditional and new technologies, the higher is the price of X, the higher is the level of production by new technology.

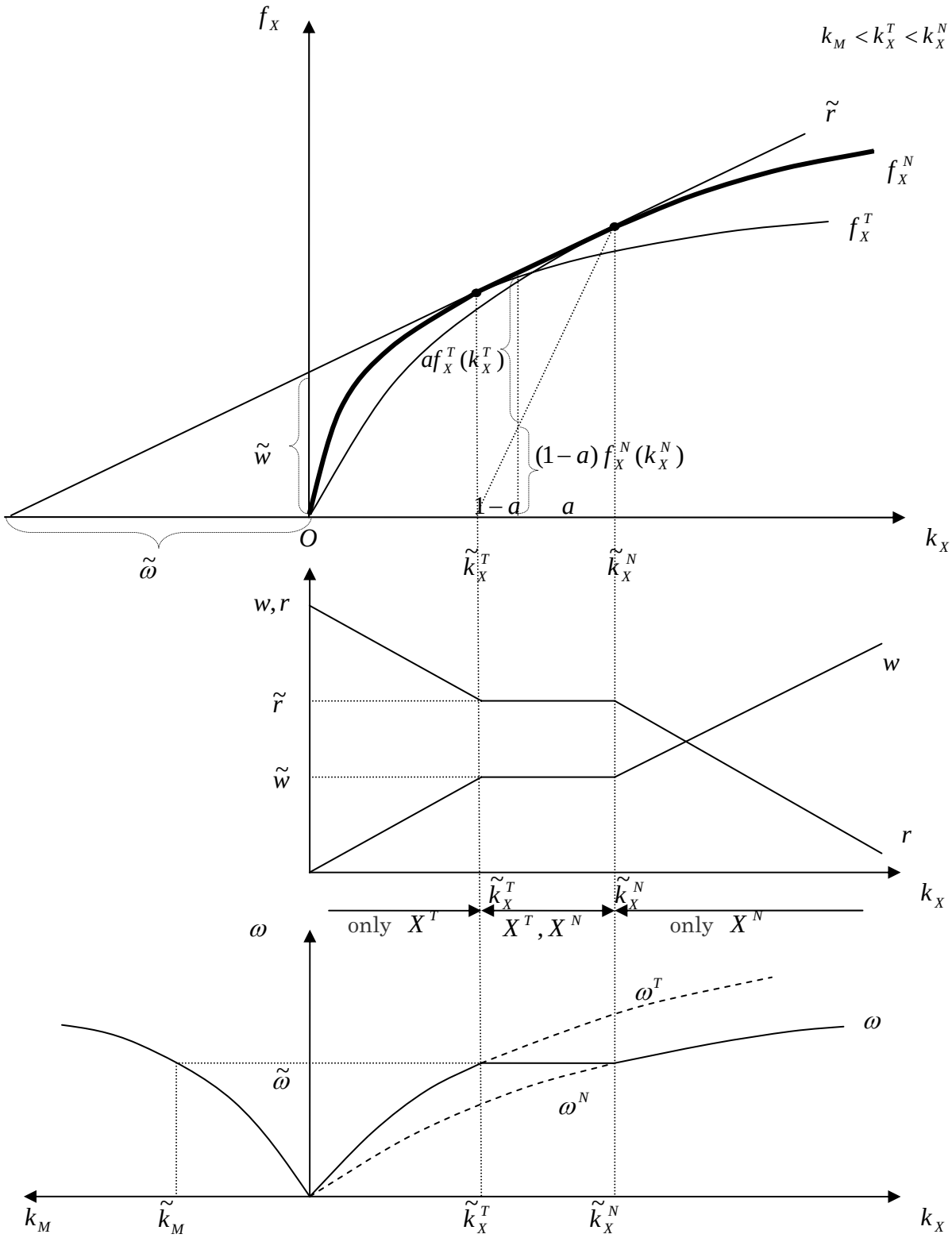


Diagram 1. The Relation between Capital Intensity and Factor Price in X Production

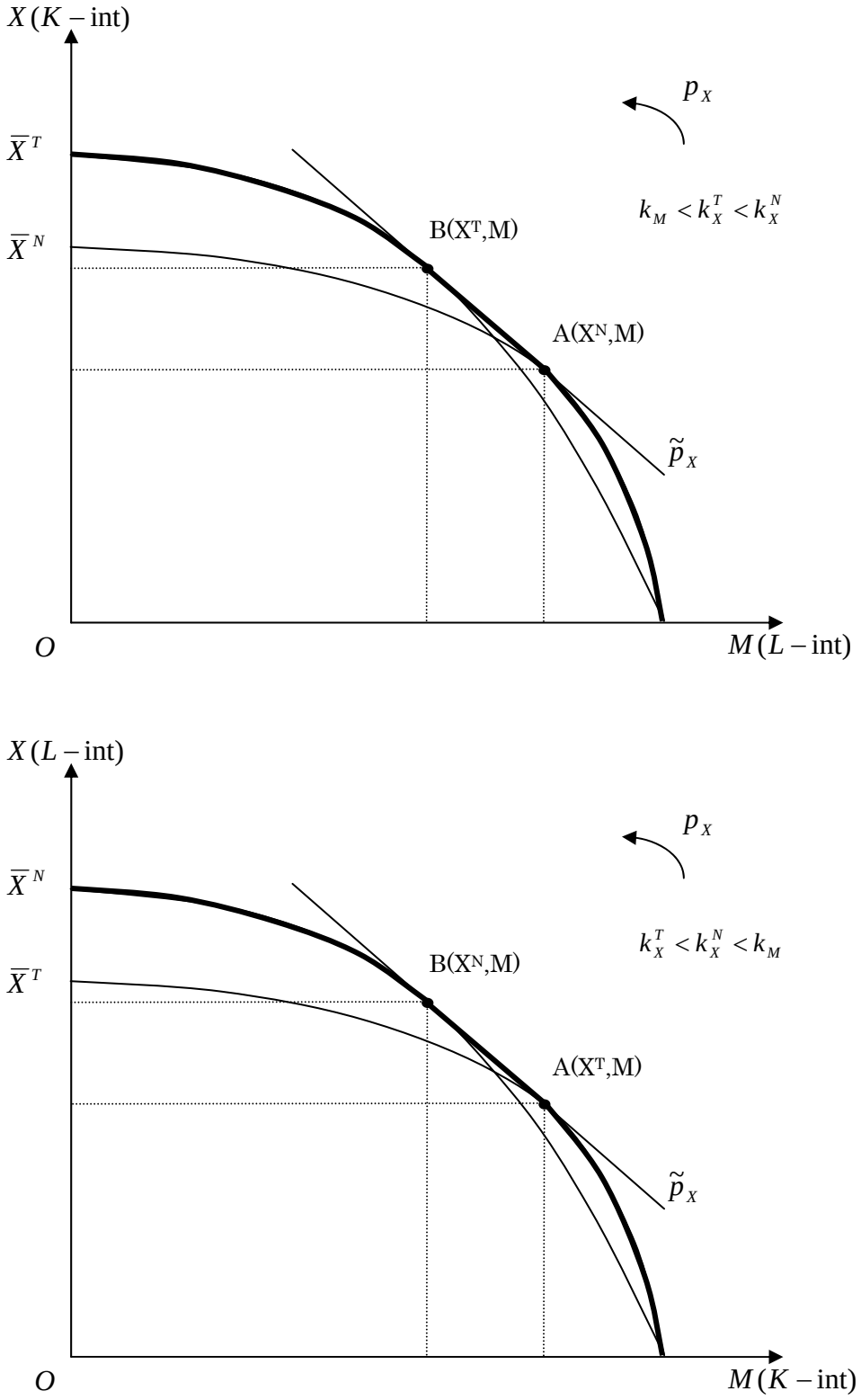
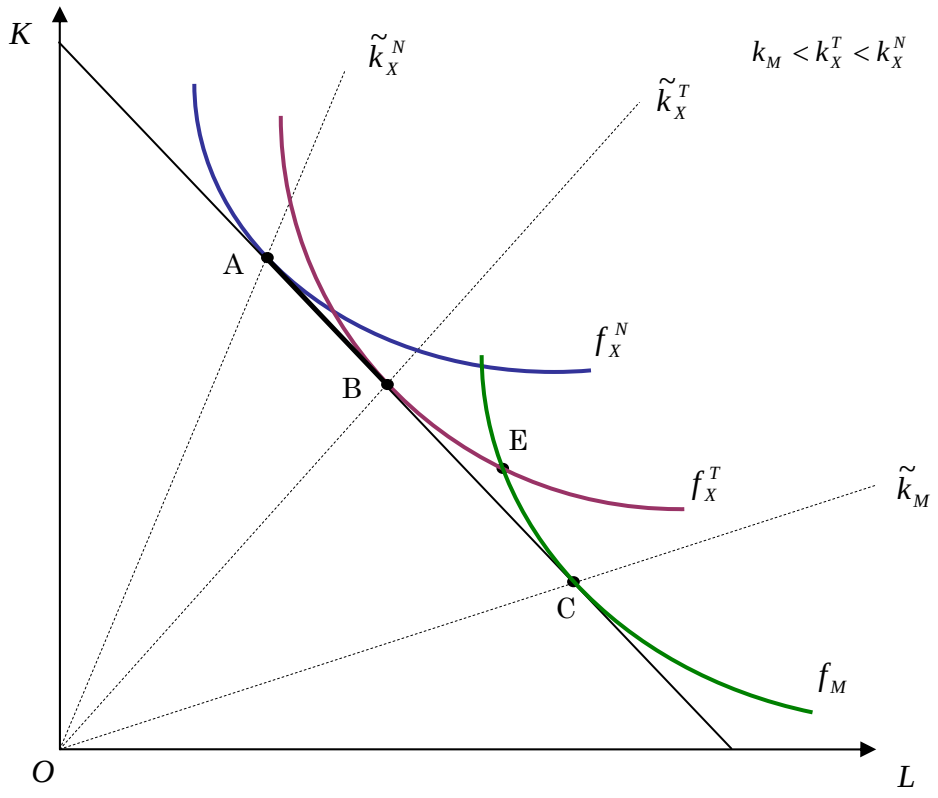


Diagram 2 PPF in the Case of Two Technologies in the Capital-intensive Sector(upper diagram) and Labor-intensive Sector(lower diagram)

3. Determination of Resource Allocation and Production

Diagram 3 indicates iso-quant for X while two technologies are in operation. There are two iso-quant which are corresponding to f_X^N and f_X^T respectively. For an explanatory simplicity, iso-quant for the production of M is drawn along the same line. Needless to say, homogeneity in production function guarantees that production level can be adjusted along the capital-labor ratio indicated by $\tilde{k}_X^N$, $\tilde{k}_X^T$ and $\tilde{k}_M$.

Diagram 3. Two Technologies for X Production in Lerner-Pearce Diagram



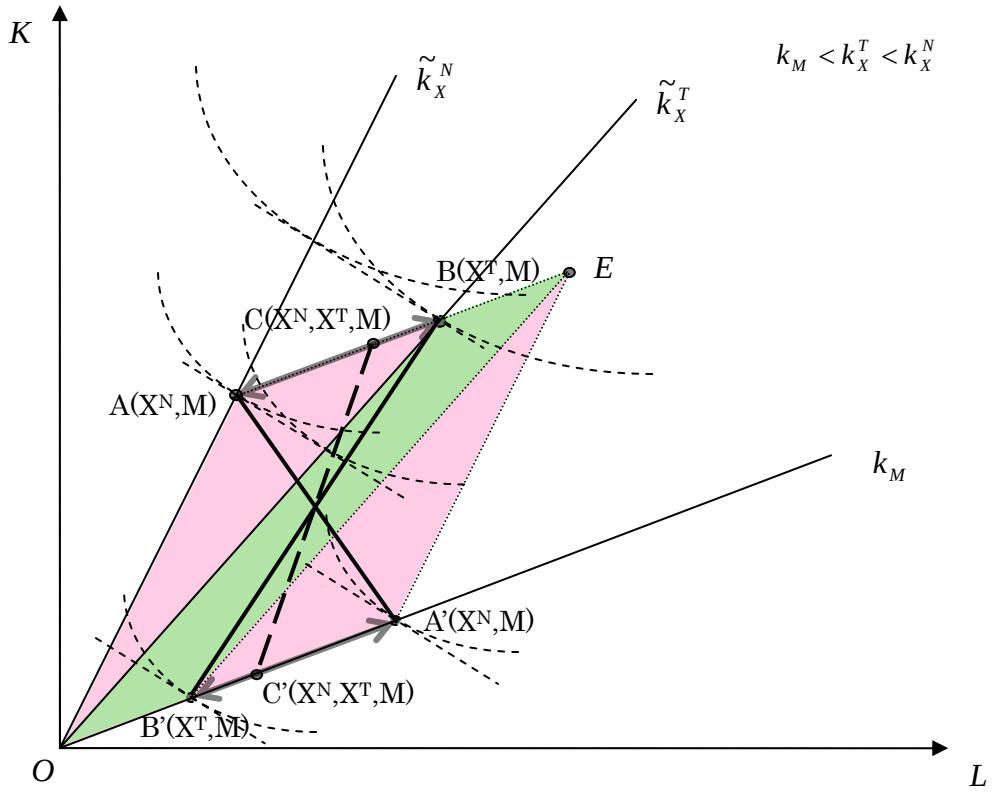


Diagram 4. Division of Operation between Traditional and New Technologies

Division of operation between traditional and new technologies while the two technologies are utilized at the same time as indicated in Diagram 4. Endowment is shown by point E. Two limiting cases are shown by $A(X^N,M)$ and $B(X^T,M)$, where only new technology is in operation and only traditional technology is in operation respectively. $C(X^N,X^T,M)$ is representing the situation when two technologies are utilized at the same time. Iso-quant which goes through at point C is not explicitly described, however, it is obvious that the iso-quant tangents to the same wage-rental ratio corresponding to the price ratio, $\tilde{p}_X$ in Diagram 2.

We can see the corresponding resource allocation to M producing sector in the same Diagram.

4. Evolutionally Process in the Technology for X Production

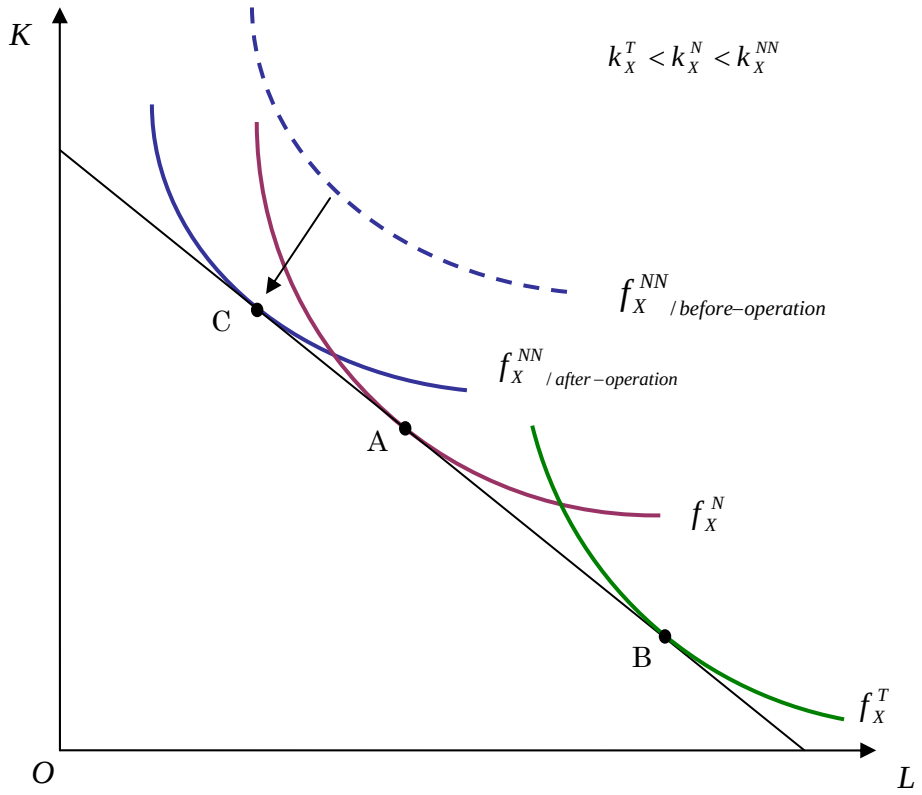
Wage and interest rates appear explicitly in the Lerner-Pearce Diagram, however, commodity price does not. Therefore, it is very inconvenient to utilize the Lerner-Pearce Diagram for the analysis of technological change which can involve changes in relative price among the commodities.

Since we are assuming that traditional and new technologies produce the same one commodity (X), we can get rid out of this inconvenience rested in the

Lerner-Pearce Diagram[1]. Namely price for one unit of X is same regardless of the technologies utilized, traditional or new. Once we can recognize this, we can immediately expand our model of two technologies for X toward an analysis for evolutionally process in production technology for X.

Diagram 5 is describing newer technology (indicated as NN) before and after operation. The iso-quant indicated by $f_X^{NN/before-operation}$ cannot be operational since the cost to produce 1 unit of X of the newer technology exceeds that of new or traditional technologies. After some technological progress to the newer technology, iso-quant can lay along the line where A and B are laying at C.

Diagram 5. New Technology for X Production in Lerner-Pearce Diagram

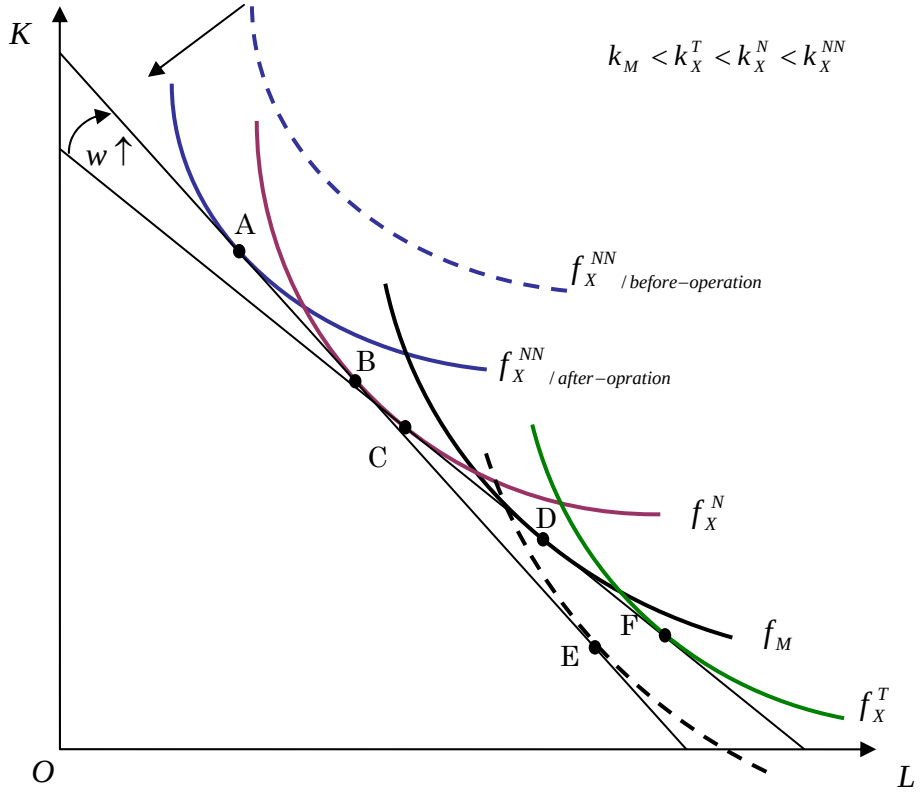


We will put the evolutionally process of an economy further. As is well known as "stylized facts of economic growth," wage rate has been increasing while

[1] Both of traditional and new technologies are assumed the same product, X, so that we are not bothered by the change in relative price between commodities produced by traditional technology or new technology. Otherwise we have to follow Jones (1974) to deal two commodities produce by two different technologies.

returns to capital have rather remained constant throughout the process of economic growth. This wage hike has been driving force to retire the out-of-date traditional technologies. Traditional technologies are labor intensive so that they cannot be operational when they have ceased to progress technologically.

Diagram 6. Turn-over of Technologies along with Wage Increase



Wage hike raised wage/rental ratio higher as is shown in Diagram 6. This relative change in wage/rental ratio makes easier newer technology to attain operational cost conditions and obliges traditional technology to improve production efficiency through technological progress. If there is no room for traditional technology to improve its efficiency, it has to drop out from operation. On the other hand, newer technology can attain cost condition for operation with smaller rate of technological progress[2].

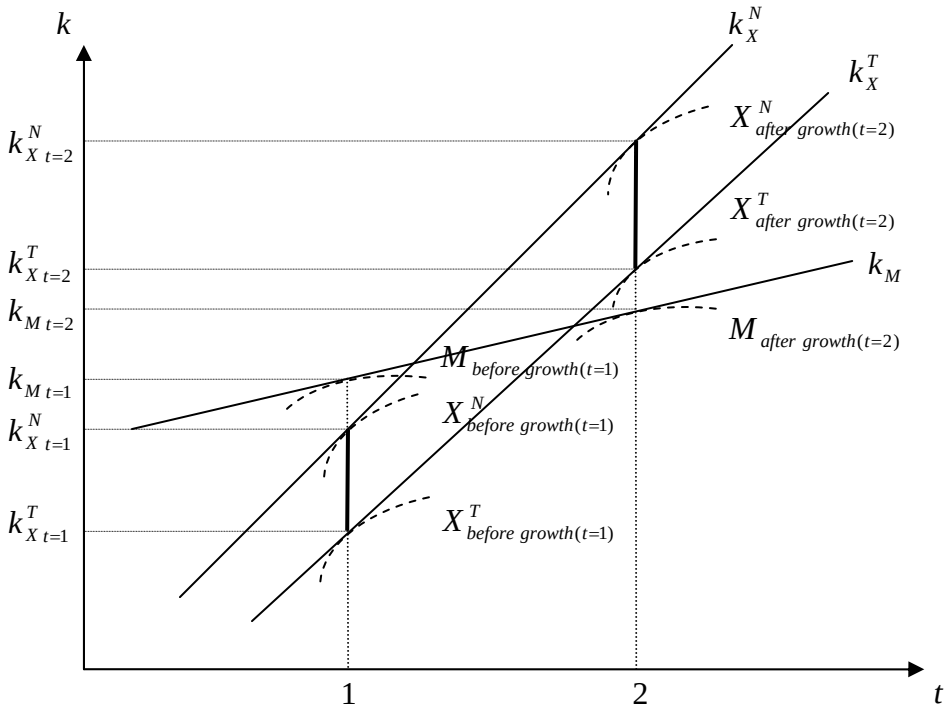
Needless to say, same thing happens to M producing sector. This paper is

[2] This process of technological evolution can explain the reason why more capital intensive technology is more preferable during high economic growth stage. The higher is the capital intensity of the newer technology, the smaller is the required rate of technological progress. If cost for technological progress does not vary much with respect to factor intensities, higher wage could induce more capital intensive technology rather further rate of technological progress itself.

not assuming that M producing sector is composed with two technologies to keep economic model simpler. In fact, the same evolutionally processes should be going along the high economic growth.

Now evolutionally process of capital intensities for the whole process of high economic growth can be depicted by means of "two technologies" to produce one same goods. Observed increase in capital-labor ratio for X and M sector is indicated by real linear line respectively in Diagram 7. In addition Diagram 7 includes evolution in factor intensity of the newer technology at the moment.

Diagram 7. Economic Growth and Capital Intensity



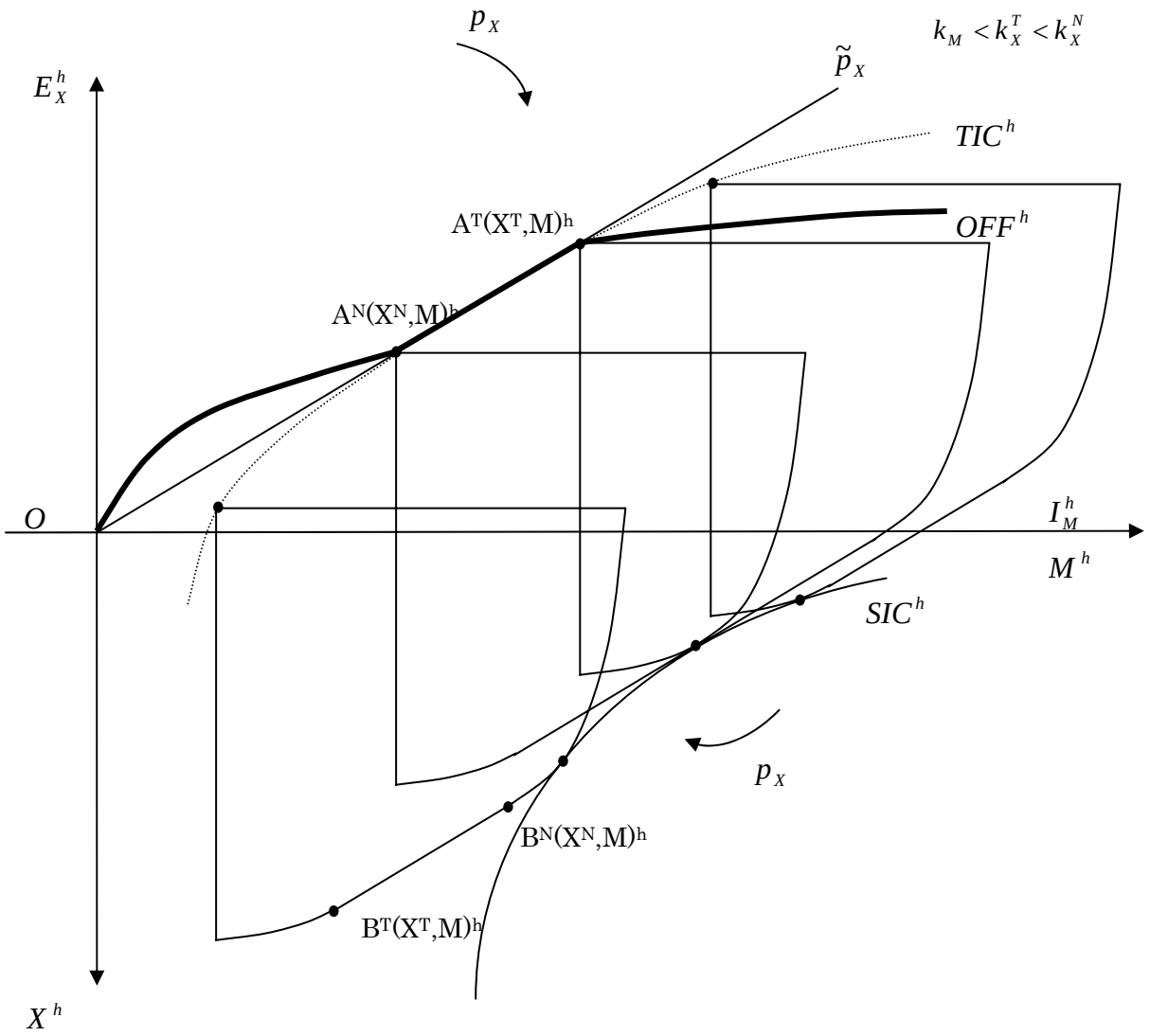
Newer technology comes to an economy as a technology before operation since its cost is not lower enough. Increasing productivity through labor-saving technological progress could make the technology operational[3]. Point A and B are indicating two capital-labor ratios which are operational at some point of time. Other capital-labor ratios indicated by point C and D were existed before but any more.

[3] This paper dealt with Hicks neutral technological progress and changes in capital-labor ratio instead of labor-saving technological progress for analytical simplicity and preciseness.

5. The Offer Curve When There Are Two Technologies in X Production

Here PPF with two technologies for X will be translated to the offer curve in terms of the Mead diagram, so that we can apply our analysis to the framework of international trade.

Diagram 8. Offer Curve When There Are Two Technologies in X Production

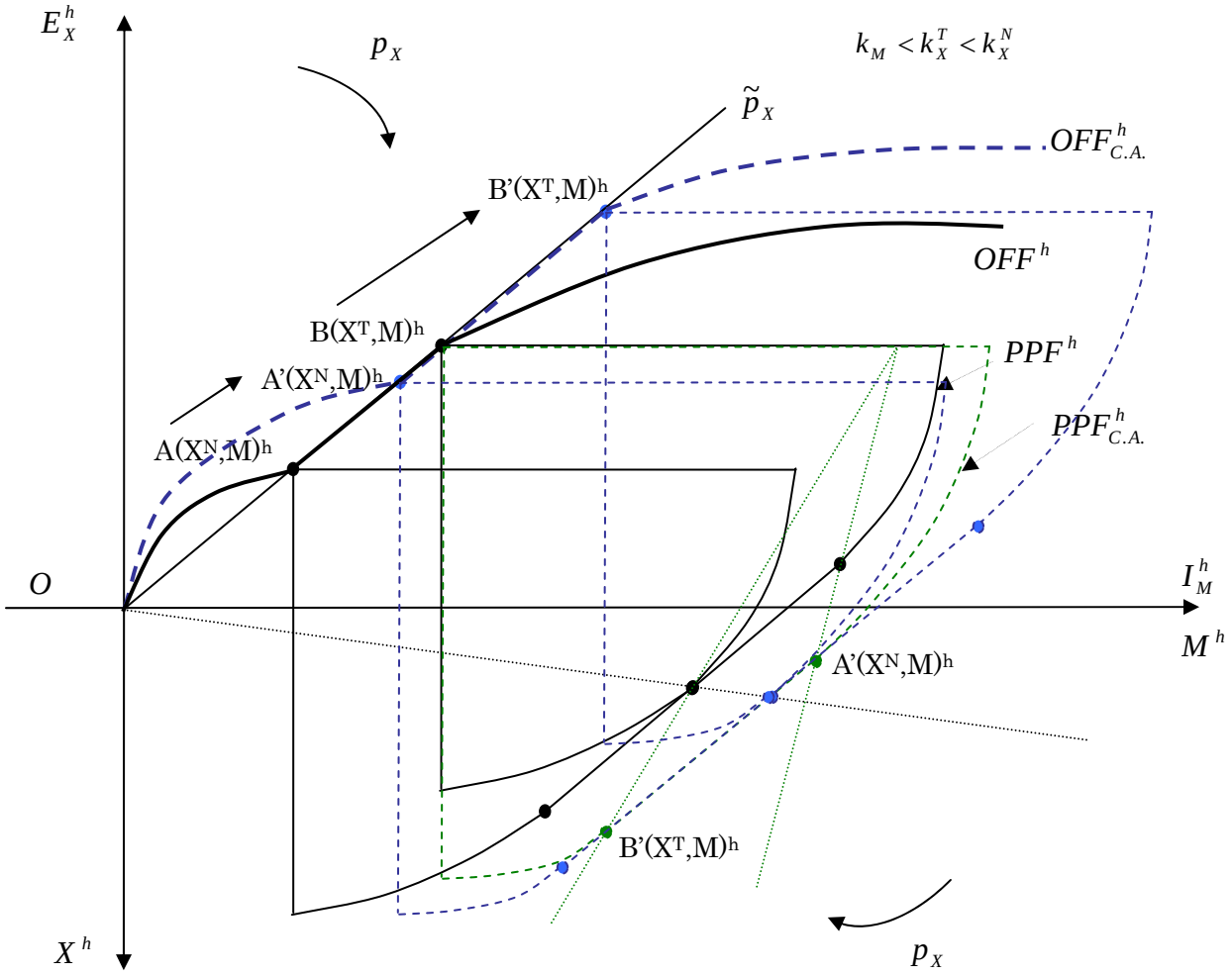


No country is small enough for not affecting TOT through changes in its production. Furthermore, many countries have attained their economic growth through export expansion and intend to sustain their economy through export

oriented policies. Once we have recognized the theoretical convenience and usefulness to assume two technologies for producing one commodity, as is explained already, we need to develop analytical framework of offer curve which can handle tow technologies for one commodity.

Diagram 8 shows the derivation of offer curve (OFF^h) for home countries, which is corresponding to PPF with two technologies for export commodities. Capital-labor ratio for export is assumed higher than that of import here, i.e., $k_M < k_X^T < k_X^N$. SIC^h and TIC^h presents social indifference curve and trade indifference curve respectively.

Diagram 9. Shift of Offer Curve along Capital Accumulation

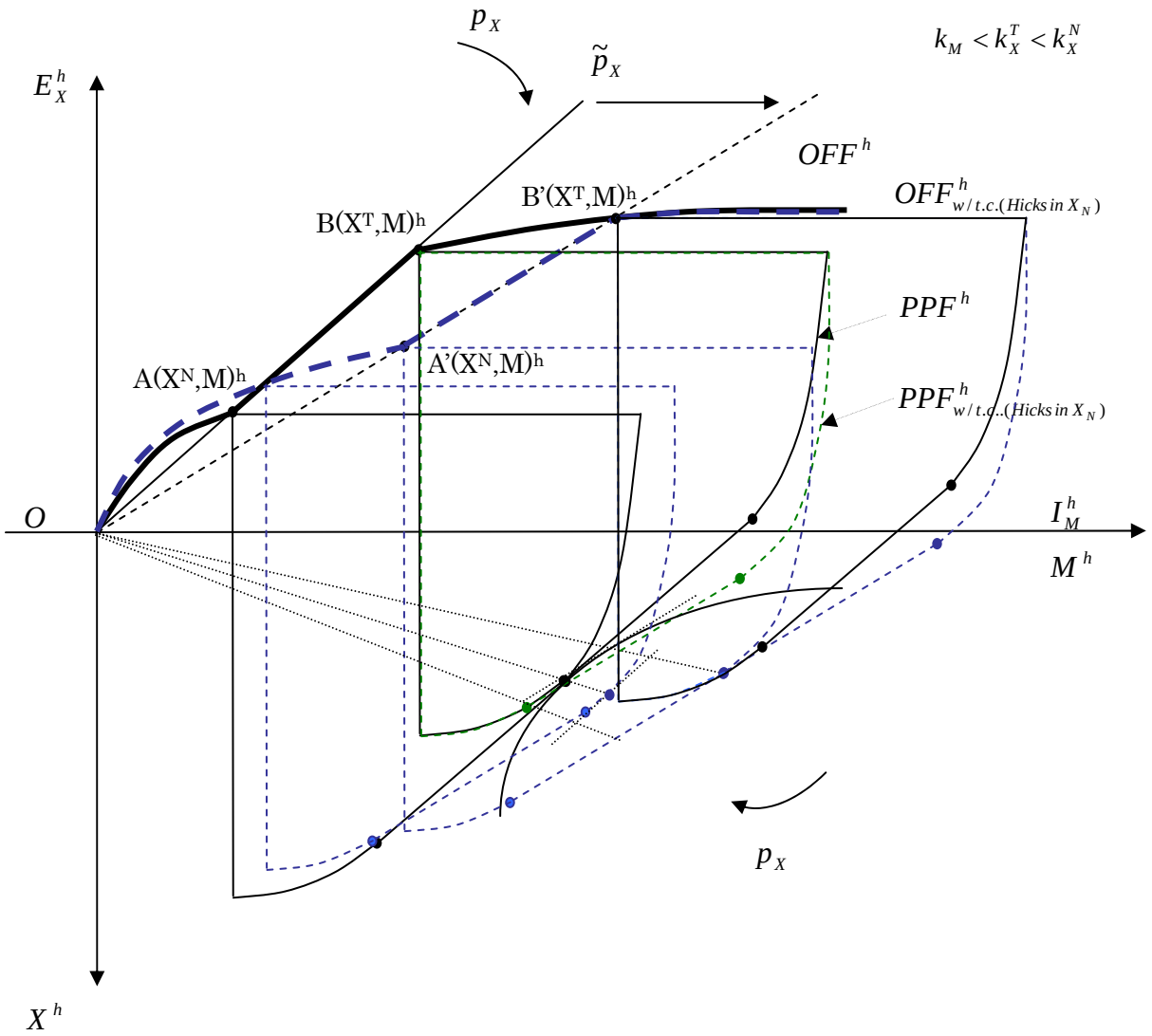


It is important to recognize that OFF^h has linear potion between $A(X^N,M)^h$ and $B(X^T,M)^h$. Since this linear potion appears along a radial line which goes through origin, term of trade (TOT) remains at p_X as long as two technologies for export production are utilized at the same time.

Now we will investigate the effect of capital accumulation in terms of offer

curve. Capital accumulation expands PPF as is shown in Diagram 9. Production of capital intensive sector has received larger benefit. Change in PPF due to the capital accumulation is reflected as an expansion of the offer curve outward.

Diagram 10. Shift of Offer Curve with Technical Progress in New Technology

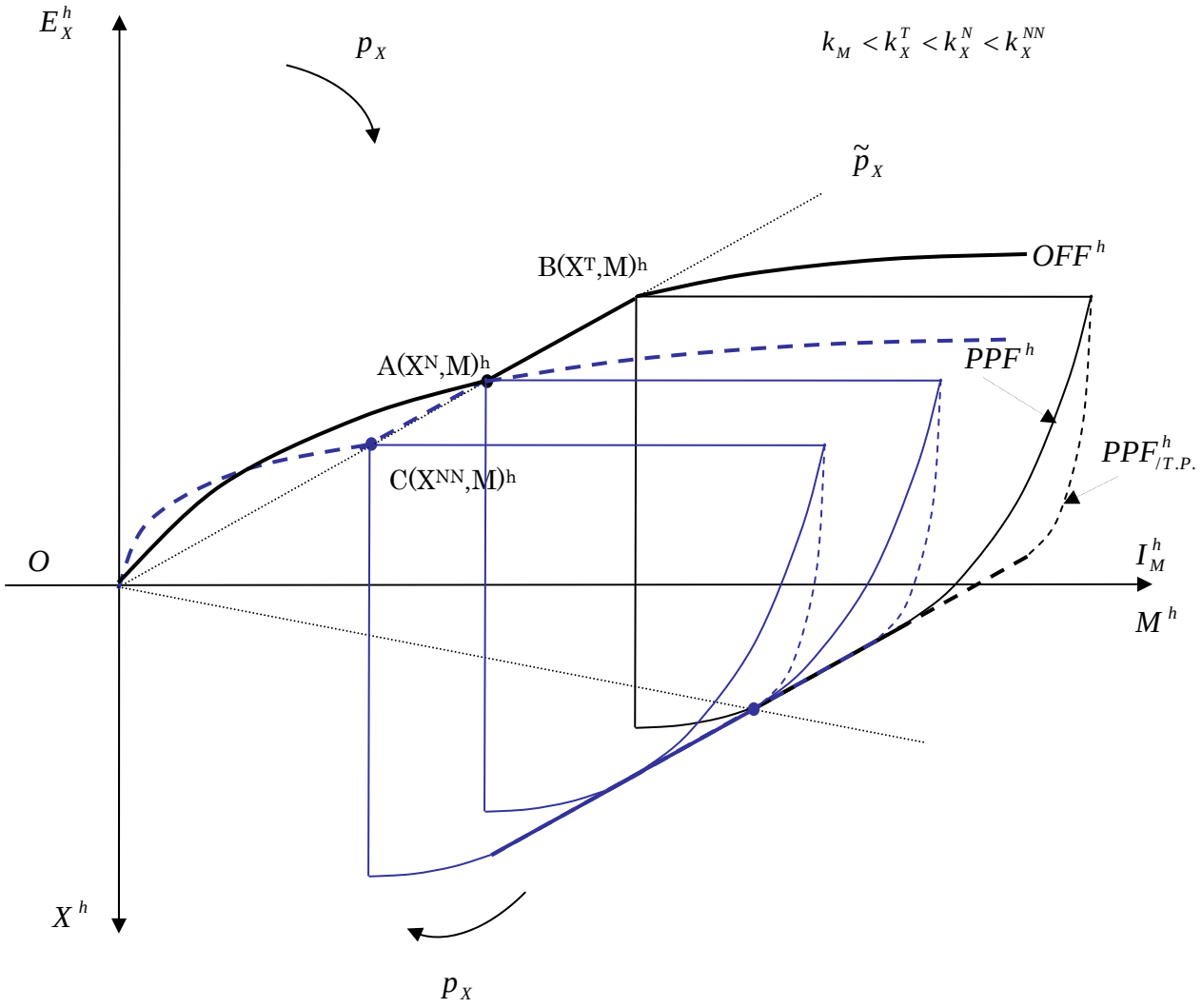


TOT itself is not affected as far as both two technologies are utilizing. Otherwise, TOT, price of X in terms of M will be deteriorated as capital accumulation in capital intensive sector.

Next, we will investigate about the technological progress. First, we will see the case for Hicks neutral technological progress in new technology. Here we assume homothetic indifference curve for analytical simplicity. As is indicated in

Diagram 10, technological progress in the new technology reduces TOT if the economy is continuously utilizing two technologies at the same time.

Diagram 11. Shift of Offer Curve with Technical Progress toward Higher Capital-intensive Technology



Now we will move to the last comparative statics for the offer curve. If technology to produce X increases its capital intensity, as is intuitively recognized, the linear portion of TOT is expanded toward the direction of the origin as is shown in Diagram 11.

6. Concluding Remarks

This paper has started by recognizing that Heckscher-Ohlin-Samuelson

framework does not provide suitable vehicles to understanding the facts observed in the stages of economic high-growth and of location of economic activities in an integrated economy. I have introduced intentionally two technologies, traditional and new, to produce one some commodity a la Professor Mundlak, and shown that this minor modification can extend our scope to analyze economic development to very large extent.

This paper consists of two parts; First, I have introduced Heckscher-Ohlin-Samuelson framework with two technologies for producing one commodity and translated that PPF into offer curve by means of Mead diagram. Second, I have examined the process of economic evolution during export-led high economic growth where location of economic activities in an integrated economy is getting our strong interest. In other words, I tried to modify Heckscher-Ohlin-Samuelson framework into the analytical tool for understanding the outcomes of economic integration which is widely observed with globalization of our economic activity.

I believe that I could successfully present theoretical framework to understand determination for the location of economic activities during the high economic growth and I could derive some economic implication about the determination of economic activity in global economy. Furthermore, this trial may not be completed yet, but I am proposing to overlay evolution in capital-labor ratio on Heckscher-Ohlin-Samuelson framework, so that we can share more understanding on the process of restructuring of our economy, which is very painful to developed countries like Germany or Japan very often.

Although the analytical frame work developed in this paper is still remained primitive, but we can conclude as follows.

First, location of economic activities is determined by technological progress and capital accumulation if we define location of economic activity as location and nature of operating technology in some specific country. It sounds obvious, but it should be noted that this assertion could not have any theoretical base without theoretical development shown in this paper. It has firstly become possible to handle evolution of technologies in terms of Heckscher-Ohlin-Samuelson framework by explicitly assuming two technologies involved in a production of one commodity.

Second, this paper has shown why we have been seeking for labor-saving technological progress to promote our high economic growth. It is again obvious that we have to have labor-saving technological progress to suppress cost increase if wage is increasing. But this argument did not consider the possibility for traditional labor-intensive technology can be also innovated theoretically. In order to make the argument more persuasive, we have to bring evolutional process explicitly into the

analysis.

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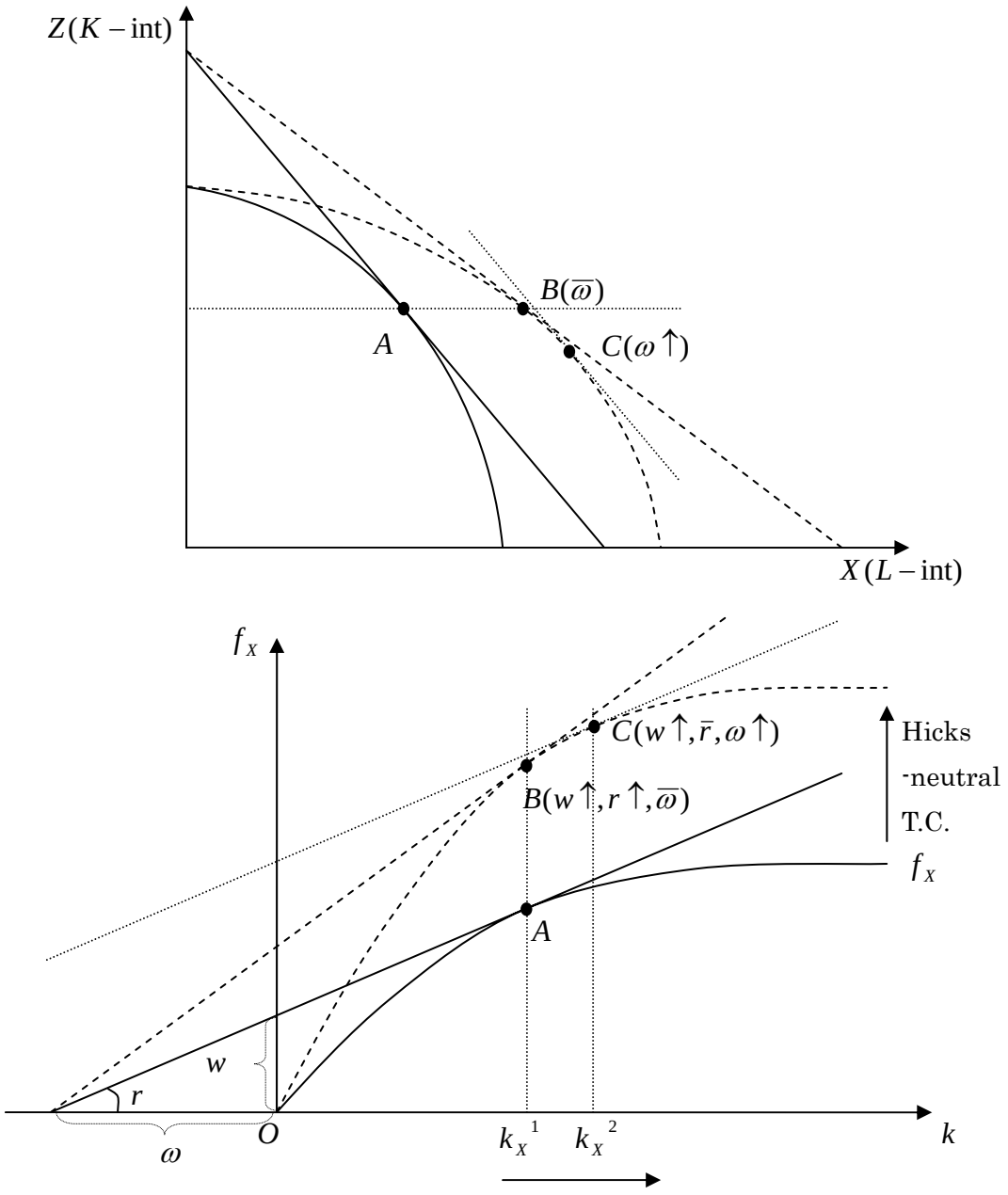
Z(K − int)
B(ϖ)
A
C(ω↑)
X(L − int)
f_X
C(w↑, r̄, ω↑)
B(w↑, r↑, ϖ)
Hicks
-neutral
T.C.
f_X
A
w
r
ω
O
k_X^1
k_X^2
k