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Dariusz Cezary KOTLEWSKI*

Impact of International Trade on Economic Growth

Summary: The aim of the article is to explain how international trade impacts the level of economic growth in both the short and long term. At first the analysis deals with several versions of the Factor Endowment Theory and the reasons for its poor empirical evidence are theoretically explained. The Integrated Equilibrium technique is used to account for all the supply-side motives to trade, which is possible thanks to D.R. Davis' theory of intra-industry trade. This analysis shows that trade generated by endowment differentials will never find its clear representation in aggregated macroeconomic statistical figures, because it is submerged in a larger entity of trade motivated by the need for differentiation. Only when there is no trade at all or it is insufficient the endowments theory can be useful to create some new streams of trade. These facts are already present in the established theory, but some new technical solutions and irrefutable explanations are contributed by this analysis.

In light of the above-mentioned limitations, an initial model of P.R. Krugman, inspired by the well-known formula of A.K. Dixit and J. Stiglitz for diversity-motivated trade, is developed. The model is generalized by extending its basics beyond the unique factor (i.e. labor) used by P.R. Krugman in order to cover all the factors and save some of the logic of the endowments theory. However, the need to use a Cobb-Douglas type function has been confirmed in the process. P.R. Krugman's attempt to consider all goods as perfectly symmetric against the utility function has been proven as definitely feasible and a precondition to express the utility function *désormais* in monetary units. This, in turn, allowed the author to deliver his main contribution by setting a formal model explaining how international trade (and, for obvious reasons, also inter-regional trade in the case of large countries) impacts the level of economic growth. To outline the limitations of the proposed model, the long-term impacts of trade have been presented based on P.R. Krugman's New Economic Geography theory, combined with the author's own findings about non-labor dependent industries belonging to the so-called second sector.

* Central Statistical Office of Poland, e-mail: Dariusz.Kotlewski@vp.pl

The main conclusion is that, at a given moment of economic history, the growth of an economy is strictly related to its international and inter-regional trade, and this can be used to combat downturns. At the same time, a process of differentiation sets in in the level of economic development in the longer term between countries and regions. However, this process is decreasing thanks to the development and modernization of the second sector.

Keywords: international, intra-industry, inter-industry, intra-regional, inter-regional trade, endowment, diversity, economic growth, intervention

JEL classification codes: C01, C02, E17, E60, F11, F12, F13, F42, F43, F44, F47

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Introduction

There is no controversy about the fact that trade, including international trade, is generally beneficial for economic growth. However, researchers differ in their approach to the mechanisms behind trade. A profusion of theories have been proposed to explain both the benefits and the mechanisms of international trade, but most of these theories have been unable to exhaustively explain all the existing streams and consequences of international and inter-regional exchanges, although some valuable (and exquisite) solutions have been proposed. This article aims to contribute to finding a solution to this problem.

At the beginning, a general mainstream view on international trade is presented through the lens of the author of this work insofar as it is germane to this analysis. Some important features are underlined; some aspects important for the discussion below are added. In the following section, the Integrated Equilibrium method is developed in order to explore the explanatory boundaries of the supply-side endowments theory. In the subsequent section, a formal demand-side mathematical framework is developed and important conclusions are presented. A presentation of the long-term effects of trade closes the article.

Established facts

There has been a long discussion about general motives to trade. Several conceptual frameworks have been advanced. They can be divided into supply-side pressures to increase general productivity and the sharing of advantages, on the one hand, and demand-side market requirements to increase the satisfaction of goods recipients, on the other. There are four general supply-side reasons to engage in trade:

– absolute advantage,
– comparative advantage,
– increased returns to scale,
– technological advantage.

The economic absolute advantage is the result of endowments possessed in a substantially greater proportion than the rest of the world, and these can be both natural endowments and built-up endowments (such as capital). Usually, thanks to currency exchange shifts, an absolute advantage is turned into comparative advantage. Sometimes, however, the absolute advantage stays there. It is then rebalanced by capital flows (such as petrodollars), by the direct purchase of services and goods by visitors (tourism), and by crisis-type phenomena. Capital flows allow the disadvantaged countries to finance their unbalanced imports for quite long stretches of time. Visitors allow the relatively disadvantaged countries to increase their relative competitiveness by directly offering their endowments (land and beautiful views) and otherwise non-tradable services and goods. Crisis phenomena are usually linked with considerable currency shifts that restore the absolute advantage to comparative advantage.

Nevertheless, it is the comparative advantage that predominates over the absolute advantage in international trade. This explains why theories of endowments have been developed, based initially on the Heckscher-Ohlin Factor Endowment Theory, in order to explain the existing streams of trade. But the results of these theories have been disappointing as far as empirical verification is concerned. Particularly, the Factor Price Equalization Theorem almost never holds empirically. The Heckscher-Ohlin Theorem, meant to provide advice for economic policy, is not being generally followed (no country is ready to settle for being a poor exporter of labor-intensive goods and few countries want to remain only natural-resource exporters). It seems that only the Stolper-Samuelson Theorem and the Rybczynski Theorem have some empirical significance. There have been attempts to defend the traditional endowments theory: by extending its basics to a continuum of goods [Dornbusch, Fischer, Samuelson, 1980]; by acknowledging the economies of scale and intra-industry trade and trying to merge these with the Factor Endowment Theory [Ethier, 1982]; and by acknowledging, to some extent, its limitations as far as evidence is concerned, while underlining its usefulness for pedagogical and political as well as some empirical reasons [Leamer, 1995]. Critics, however, prevailed [Estevadeordal, Taylor, 2001], [Trefler, Zhu, 2000], [Bernstein, Weinstein, 2002].

In a parallel process, these developments led to the formulation of the New Trade Theory, which is associated mainly with Paul Krugman [1979, 1980, 1995] and is based on the concept of increasing returns to scale. Together with the New Economic Geography theory by the same author [Krugman, 1997, 1998], it explained why the traditional endowments theory does not hold in terms of empirical evidence. The process of concentration (the centripetal forces) fueled by the specifically interpreted transportation costs phenomenon leads to a "lock in" situation in which the centers of economic activity acquire a massive scale advantage. Industries concentrate in clusters of economic activity where they also have a network advantage (cooperation between firms). Therefore, movable endowments (labor and capital) move to the centers of economic activity in the opposite direction than that suggested by the Factor Endowment Theory for

capital, and therefore there will also be a continuous fueling of differentiation in the prices of factors. History seems to confirm that. New economic centers spring up every once in a while, fueled by old ones, and this is all about the equalization that happens between countries, without the involvement of institutional factors. The economies of scale also explain why there is intra-industry trade. Open international trade allows countries (particularly smaller ones) to maintain their monopolies, which are now exposed to foreign competition and are at the same time more competitive than small firms on the international market. The evidence for this theory is not conclusive but much better than for the traditional endowments theory. Although this theory is contradictory to the Factor Endowment Theory, the same method of Integrated Equilibrium (the Edgeworth box) can be used here since the concentrations of economic activity are also concentrations of movable endowments (capital and labor) and therefore can be accounted for in the mentioned technique. In a sense, it is possible to consider this as a somehow "new endowments theory" with different rules.

D.R. Davis [1995] has demonstrated that the Integrated Equilibrium technique can also be used for intra-industry trade and for the technical advantage. In the case of this last motive to trade on the supply side, we may have a situation when a country has developed a technology in contrast to its endowments and even in contrast to its general economic development. Although this (i.e. the development of a unique technology) usually happens in the case of developed countries, to some extent it contradicts the traditional endowments theory. The technical advantage is an absolute advantage that arises from reasons other than the economic absolute advantage. However, *summa summarum* we can use the Edgeworth box to account for all supply-side motives to trade, and this will be done in the next section. There are also attempts to explain the mechanisms of international trade by the so-called New-New Trade Theory and a return to the Ricardo theory (the Ricardo-Sraffa trade theory [Shiozawa, 2007, 2009]), and also by gravity models of trade. Those will not be discussed in this article.

To complement this vision of trade and the concepts that try to explain it, it is also necessary to present what seems to be a unique demand-side motive to trade:

- Increased utility of the consumer.

The increased utility of the consumer by means of diversification in the broad sense, regardless of just how tangible this increased utility is (i.e. whether this diversification brings some discernible benefits or it is a pure diversification just for the sake of diversification), makes it possible to sell more goods for higher prices. If the consumer is presented with more goods at the same time (as in supermarkets) they will buy more goods altogether and sometimes for higher prices. If there are several kinds of a given product in a shop, it is possible to sell more of it and sometimes for higher prices. This is because the consumer is presented with a wider choice (in a sense, consumers feel like visitors to a museum) as well as information, and all the spectacle of the profusion of goods gives him the illusory satisfaction of being able to make an informed choice. The major initial starting model here is based on the Dixit-Stiglitz formula and

will be developed in one of the subsequent sections. The demand-side motive to trade is like a thumb closing the first of all the major motives to trade.

There are also some additional features that are germane to this discussion. One is the divide between labor-dependent and non-labor-dependent sectors. Labor is the most important factor. Even in industrialized countries, it accounts for roughly 3/4 of all factors of production (services included). But there are quite a few non-labor-dependent sectors, the most important of which is energy, particularly electric power. As the labor factor is rather unimportant here, it cannot be presented in the Edgeworth box as one of the two main factors. This leads to somehow different economics of trade for these important sectors and therefore digressions will be made along the mainstream of the following discussion.

Another feature is the workshop definition of inter-regional and intra-regional trade adopted in this article. We define intra-regional trade as trade in which transport costs do not matter. Market forces establish a market price that is unperturbed by commodity transportation costs. In the case of inter-regional trade, on the other hand, transport costs do matter. Any progress in transportation technology leads to a significant expansion in the range of trade. This, of course, is a workshop definition, and it is acknowledged that the range of intra-regional trade may differ for different products. Nevertheless, digressions will be made, when necessary, to this feature of trade.

Supply-side equilibria

Our analyses of the supply-side equilibria will be based on a model developed by D.R. Davis [1995]. This model seems to be a very general model, as it accounts for both inter- and intra-industry trade, and includes the technical advantage as well. Therefore it also accounts for all four above-mentioned supply motives to trade. The main problem with the Integrated Equilibrium technique, i.e. the Edgeworth box, which is also used by Davis in his model, is that it is a two-dimensional presentation that initially allows only for analyses of a two-country, two-factor endowments and two-goods situation.

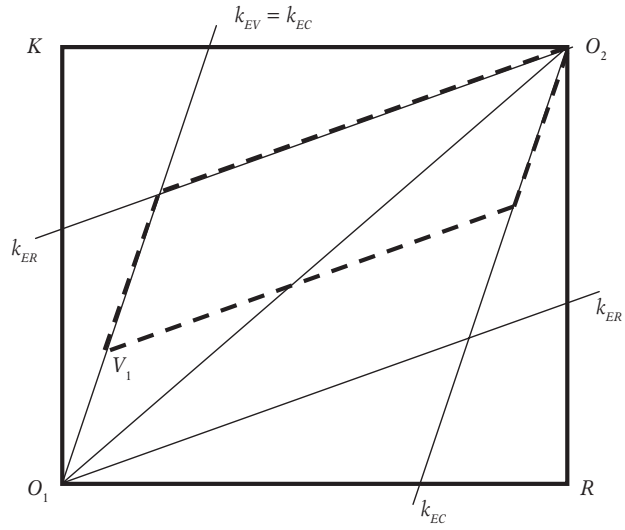
The two-country limitation can be solved by the assumption that One is the country and Two the rest of the world. It is more difficult to reduce, let's say, M factors, to a limited number. We can state that all types of capital can be aggregated on the basis of the NPV (net present value) technique, regardless of whether this is land capital (non-depreciating), sheer traditional buildup capital (depreciating), knowledge capital, software capital, or human capital, etc. The same should be done for labor, but – because it is expressed in physical units that do not represent an additional value of educated labor – that additional remuneration part of the educated staff should be accounted as a return on capital. Human capital has therefore two dimensions. One is capital investment, which should theoretically be equal to the costs of the education system involved. The other dimension is the basic costs borne for work time, which belongs to the labor factor dimension. To increase precision we can only account for employed labor.

Next are resources accounted e.g. by Vanek [1968] in a model called the HOV (Hechscher-Ohlin-Vanek) model[1]. Here, we suggest dividing the resource into two categories. One is the energy resources aggregate. They can be aggregated on the energy content basis using units such as tons of oil equivalents (toe) or others. The extra costs of some energy resources can be accounted as land capital (some renewable energy sources such as wind and the sun can be accounted as traditional buildup capital and land capital because of the extra need for space), thus equalizing the energy factor dimension units. However, there is still a fourth dimension of construction material resources. Construction materials can be accounted together on the basis of the fact that, at the boundary of their use, almost every time there is a substitution margin that makes it possible to devise equivalent units between them. All the resources within the country, both energy and construction resources, can be accounted as land capital using the NPV technique. Only imported resources should be considered as an additional factor dimension. The extra cost of resources from some direction can be accounted as foreign land capital[2].

The first of these dimensions, i.e. the capital dimension, is related to the fixed costs in the microeconomic cost analysis of the enterprise (*TFC – Total Fixed Costs*), whereas the other dimensions express the variable costs (*TVC – Total Variable Costs*).

Figure 1

Davis's modified Integrated Equilibrium



Source: [Davis, 1995]

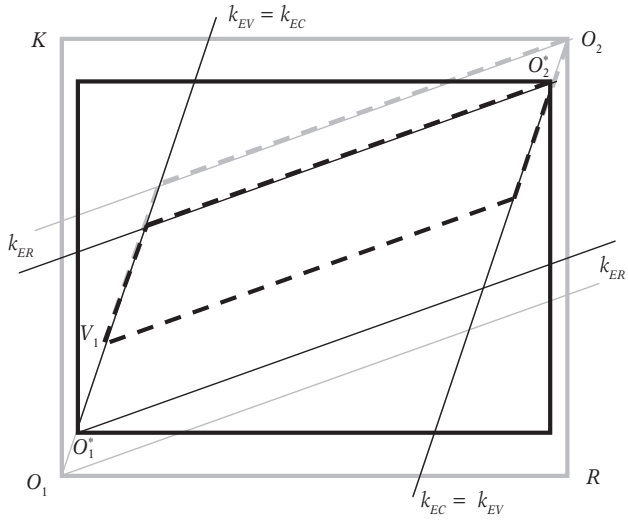
[1] The HOV model still performs poorly as far as empirical evidence is concerned [Estevadeordal, Taylor, 2001].

[2] There are also some special resources, such as rare earth metals. These can be accounted as construction resources and land capital for the extra price of them, therefore they have two dimensions.

The figure above shows Davis's basic model that served him to account for intra-industry trade. In order to show its significance also for non-labor-dependent sectors and for the mesoeconomic level, it has been adapted to illustrate the situation in the energy sector, particularly electric power. The symbols are therefore related to electricity that is traded as an inter- and intra-industry good. The labor dimension, as unimportant, has been replaced by *R* – the resource dimension (in fact, there is only the energy resource dimension). There is no problem in accounting for a multi-goods situation. However, we have high resource content electricity (gas, coal, etc.) represented by the k_{ER} slope, high capital content electricity represented by the k_{EC} slope, and high natural advantage content electricity (hydropower, wind, etc.) represented by the k_{EV} slope, which is also high capital content. This last type of good is similar to Davis's technical advantage good. The endowments content is responsible for inter- and intra-regional, inter- and intra-industry, and international electricity trade. Similarly, we can treat, at the macroeconomic level, the entire mass of goods as, let's say, dyed sweet water; water standing for labor, sweet for capital and dyes for different resources. *Summa summarum* we have about four aggregated dimensions to account for in the entire economy. Still, for obvious simplicity reasons, we will use only two-dimensional graphs.

Figure 2

Partial self-sufficiency case



Source: own development based on [Davis, 1995] from Figure 1

In Figure 1, vector O_1V_1 stands for the entire supply of a good (or goods treated *en masse*, since we assume that it is possible to aggregate any goods into larger aggregates) in which country One has a technical advantage (a natural asset advantage in the case of electricity). This advantage is an

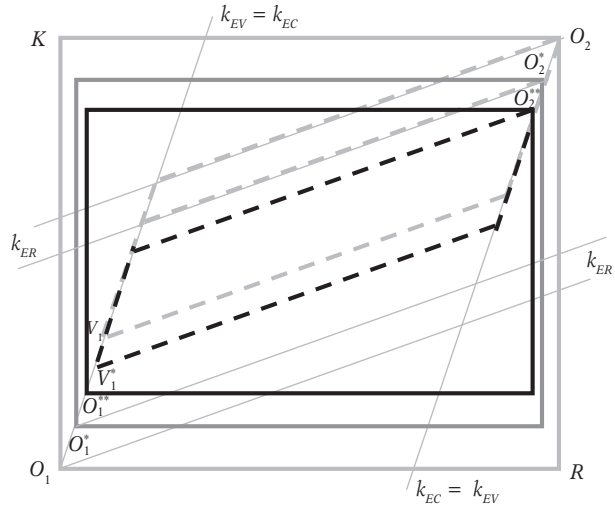
absolute advantage as described by Kravis [1958]. This cannot be considered as a separate factor endowment dimension as both countries can have their technical advantages that cannot be added. Therefore, in Figure 1, we could have vector O_2V_2 as well, but for simplicity, it is not shown.

There is, however, the possibility that country Two (i.e. the rest of the world or *vice versa*) has some self-sufficiency in goods produced mainly by country One because of a technical advantage (or that the natural endowments of country Two allow it to produce an insufficient quantity of electricity with a variable level of production, from e.g. hydropower). This $O_2O_2^*$ amount of goods equivalent to $O_1O_1^*$ is therefore non-exportable from country One to country Two, and therefore these goods become non-tradable. The Edgeworth box is to be reduced to an inner square as shown in Figure 2. Of course, we made the assumption that the Integrated Equilibrium is about tradables in the first place, so only capital and other factor endowments involved in tradable goods, be it labor or resources, are represented here. The same kind of Edgeworth box reduction is, however, possible along the labor or resource slope k_{ER}, since the absolute advantage in the sense mentioned by Kravis can also happen for other combinations of factor content, not only those capital intensive. For simplicity's sake, those other possibilities have not been shown.

But this analysis is only relevant for intra-regional trade as it does not consider transport costs. In the case of inter-regional trade, as defined in the previous section, a larger portion of goods will become non-tradable and therefore excluded from the Edgeworth box. For simplicity's sake, in Figure 3, we will continue with the same good (or aggregate of goods) as in the previous graphs.

Figure 3

When-transport-costs-do-matter case

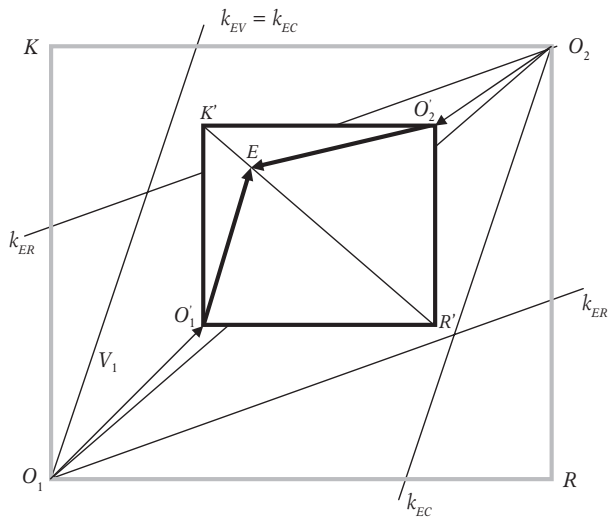


Source: own development based on [Davis, 1995] from Figure 1

In the case of electricity trade, as far as international trade is concerned, and also within medium-sized and larger countries, transport costs do matter almost every time, but this is also true of many other goods worldwide, as long as trade is inter-regional as defined previously. When transport costs do matter, the vector of country One's advantage, $O_1^*V_1$, is reduced further to $O_1^*V_1^*$, because only that part of the given good (electricity or the mentioned aggregate of goods) that remains cheaper in country Two together with transportation costs is still exported from country One. This forces country Two to increase its self-sufficiency from $O_2O_2^*$ to $O_2O_2^{**}$. This means that even a greater portion of factors must be excluded from the Edgeworth box and vector $O_1^*V_1^*$ will further be reduced to vector $O_1^{**}V_1^*$. Alternatively, we can also assert that increasing exports is more effective for the overall production level of the two countries than decreasing imports, as the extension of vector $O_1^{**}V_1^*$ to vector $O_1^*V_1$ is greater than the extension of vector $O_2O_2^*$ to $O_2O_2^*$, i.e. vector $O_2^*O_2^{**}$. Therefore, any progress in transportation technology should lead to an increase in trade, if it is inter-regional trade. This contraction of the Edgeworth box can also happen along the k_{ER} slope (we decided that the symbol k_{ER} will mean the usual labor dimension at the macroeconomic level). Thus, at least some of the "missing" trade in comparison to the predictions of the Factor Endowment Theory, can be explained.

Figure 4

The inner trade box



Source: own development

For all the still tradable goods, the remaining supply has to match the needs of both countries. Home supplied goods (i.e. home produced and home sold), however, can also be entirely excluded from the Edgeworth box in order to leave only exported goods (imported by the other country) in the analysis.

This leaves in the entire Integrated Equilibrium an inner box of traded goods. This inner box has equilibrated vectors of supplies as the trade is relatively balanced regardless of the size of the two countries. Therefore the equilibrium will lie on diagonal *K'R'* of the inner box as shown in Figure 4.

Vector O_1O_1' has a different slope than vector $O_1'E$ because capital-intensive country One covers its home needs for labor-intensive goods (or resource-intensive electricity) proportionally to a greater degree than in its exports. The same can be asserted for a labor-intensive country (or resource intensive for electricity, if the model is used for the electricity sector), but the other way around. The proportion of factor endowments involved in trade is not exactly the same as the proportion of all the factor endowments presented as an external rectangle. The inner box in Figure 4 may not be a rectangle of the same proportions as the external rectangle. Therefore, we can see that international trade will not exactly match the world proportion of factor endowments. The inner box vectors represent the entire aggregates of goods traded because of a technological advantage, endowment sharing between countries, or increasing returns to scale, etc. The contraction of the inner box is caused by all kinds of reasons, including self-sufficiency (which may additionally be stimulated for political reasons) and transport costs. This inner box, however, represents only the supply "push" from abroad to each country. Therefore, the demand side is still not represented in Figure 4. There exists, however, a demand "pull" that complements the synthesized supply motives to trade presented in the graph.

Before presenting this demand-side "pull" of goods, we will engage in a simple but informed analysis. Let us consider a world economy that consists of two almost identical villages inhabited by only a few people. Let one of these villages be called Basket Village and the other Apple Village. Basket Village produces only baskets and Apple Village produces only apples. For unknown reasons, the two villages are close to each other. The obvious pattern of trade is represented by a situation when a Basket Village citizen travels to Apple Village with two baskets, leaves one basket to an Apple Village citizen and returns with one basket filled with apples. Each citizen now has one basket of apples. This eventually leads to an even distribution of baskets and apples between the two "economies".

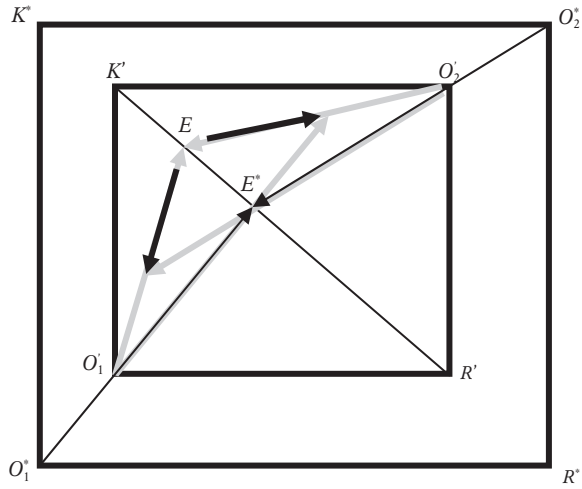
But let us now imagine that baskets are not an endeared good any more, i.e. the endowment difference to produce it has disappeared. Basket Village decides to produce pears, as the endowment difference has also disappeared for fruit. Although there is no endowment difference between the two villages, they still trade one basket of apples for one basket of pears until an even distribution of pears and apples between the two "economies" is achieved. This means that whenever endowment-motivated trade recedes, diversification-motivated trade will take its place in about the same size[3]. Endowment trade is included in diversification trade and therefore can only be accounted qualitatively,

[3] At a given moment of time. We do not introduce the historical evolution aspect here.

not quantitatively, since it is indiscernible in patterns of statistical figures in international trade.

Figure 5

The expanding diversification box



Source: own development

This situation is presented in Figure 5. The black thick arrows represent the demand-side "pull" of goods of the two countries, which adds to the supply-side "push" from Figure 4. At the crossing of the two extended gray arrows that represent cumulative trade, regardless of its reasons, a new equilibrium sets in. When the two arrow-heads are moved to the new equilibrium E^*, they will extend the Edgeworth box of factor endowments that are involved in trade. It is worth noting that the new equilibrium E^* in the new extended box is closer to diagonal $O_1^*O_2^*$ than the previous one, and therefore, according to Davis [1995], there will be more intra-industry trade. This will also remain true when these boxes are put back into the original ones. The factor endowment trade is submerged by the exploding diversity trade, which makes it indiscernible in the pattern of aggregated trade figures. There is no possibility for the Factor Endowment Theory to hold in aggregated empirical figures.

This being the case, it remains true that the endowments theory has a qualitative value. To demonstrate this, let's analyze a most simple situation. Let the world economy consist of only three entities that we will call neighbors. Let neighbors One and Two be engineers (or specialists in some other field) and neighbor Three a physician (or some other professional different from the two others). For "unknown" reasons, neighbor One and neighbor Two meet and trade – this is diversity trade as they offer similar goods. Also, for an "unknown" reason, they do not meet neighbor Three, who is perceived as not needed. However, there comes an economist to explain to them the possibility

of a kind of trade based on endowments, i.e. the relative difference between them and neighbor Three. After rethinking their attitude towards neighbor Three, they eventually engage in trade with him. This is a situation often seen in the real world where there is plenty of "missing trade" (see [Estevadeordal, Taylor, 2001]) based on endowments. Whenever the early stage of development does not allow for diversity trade, the endowments theory can help open new streams of trade based on endowment differentials. But even in developed countries endowments as a motive to trade remain basically important in non-labor-dependent sectors, such as electricity[4]. This non-labor-dependent group of sectors may eventually cover all second-sector industries, as far as the three-sector theory is concerned.

Demand-side formal framework

The fact that factor endowment trade is submerged by diversity trade in aggregated macroeconomic figures suggests that it is possible to account it on the basis of a model initially developed by Dixit and Stiglitz [1977] for the broadest type of diversity trade taken very generally. The basic utility function proposed by these authors represents the following general condition:

$$u = U\left(x_0, \left\{\sum_i x_i^{\rho}\right\}^{\frac{1}{\rho}}\right) \tag{1}$$

where u is the representative consumer's utility, which is a function (U) of constant x_0, consumptions of varieties x_i and a measure of substitutability ρ.

If we treat the mesoeconomic sector in the same way as the economy at the macroeconomic level, which may be particularly useful for non-labor-dependent sectors (such as electricity), we can divide the unique good (electricity) into equal batches of equal value. These batches can stand for separate goods in the model. But it is also possible to divide the entire mass of goods in the economy into small batches of goods so as they would be equal in value at a given moment of time. Because in the entire economy there is a grand multitude of goods they behave as statistical average entities in the same way as these goods would be divided into small equal batches. Of course, there may be goods divided in many batches and goods divided into just a few batches. A small increment of consumption of each batch of goods would then increase the utility of the batch in the same way as for any other batch of goods. Each batch is then a perfect substitute of any other. If these batches of goods are treated as goods for simplicity, we can state that any such good is perfectly symmetric in the utility function. This leads to the adoption of Krugman's utility function [Krugman, 1995]:

[4] We will later explain that it may consist of all the traditional industries that are becoming increasingly non-labor dependent.

$$u = \sum_{i=1}^{n} v(c_i) \tag{2}$$

where $v(c_i)$ is the utility from the consumption of good c_i (i.e. the abovementioned batch of goods) and u is the representative consumer's utility as in the previous formula. Krugman adopts in his model only one factor of production – labor.

However, any factor can be disaggregated into component factors of the same dimension (as discussed in the previous section) and to some extent it is possible to aggregate all factors into a *simulacrum* of factor equivalents of a single dimension (which will be shown later) symbolized here as F. Krugman states that in the two countries (that is in country One and in country Two meaning the rest of the world), the tastes are the same. This applies to the electricity sector, for example, if we assume that all consumers, particularly rich ones, can be divided into many consumers of the same size (consumer equivalents). Because the number of consumers is so large that they behave in a statistical fashion, dividing them into smaller equal entities would not change their behavior at the macroeconomic level (at least in analyses where the size of the consumer is unimportant).

But this is also a good proxy for the entire economy, in the same way as we have stated that each individual batch of goods increments its utility in the same way. Electricity exchange is not always balanced between countries by definition (though it often is in practice), whereas trade between the country in question and the rest of the world is usually balanced by definition (trade is balanced by capital flows from country to country and by the direct purchase of otherwise non-tradable goods by visitors – these can be treated as goods also at the theoretical level), therefore it can be an even better proxy at the macroeconomic level. In this case we will follow Krugman's reasoning by taking a utility function for all the abovementioned consumer equivalents:

$$u = \sum_{i=1}^{n} v(\kappa_i) + \sum_{i=n+1}^{n+n^*} v(\kappa_i) \tag{3}$$

where u is the representative consumer's utility after engaging in international trade between the two countries. Country One produces 1 to n batches of goods and country Two produces $n + 1$ to $n + n^*$ batches. We assume that utility $v(\kappa_i)$ from consumption of good κ_i is smaller than utility $v(c_i)$ from formula (2), because each consumer equivalent consumes fewer goods of each kind, i.e. smaller parts of the batches of goods. This is true in the short period of time before price movements change the size of the batches, as far as their value is concerned.

The number of equal batches of goods produced by each country should be proportional to the level of available factors to each country. Since labor factor L is the most important of all the factors, Krugman takes it as a good proxy for all factors:

$$n = \frac{L}{a + bx} \tag{4}$$

$$n^* = \frac{L^*}{a + bx} \tag{5}$$

where the asterisk indicates country Two (or the rest of the world) and $a + bx$ is the cost of production of each batch of the entire mass of goods. This cost contains fixed element a and variable element x.

This does not work well for non-labor-dependent sectors. If, however, we replace factor L, standing for labor, with F, standing for some factor equivalent units, we will have:

$$n = \frac{F}{a + bx} \tag{6}$$

$$n^* = \frac{F^*}{a^* + b^* x} \tag{7}$$

$$a + bx = a^* + b^* x \tag{8}$$

The *simulacrum* for factor equivalent unit F can be e.g. TFP – *Total Factor Productivity*, i.e. the equivalent of some of the output in theoretical interpretations of economic growth[5]. At the same time, equation (8) allows for different factor content for the different batches of goods, although they are of the same short-period value. The fixed parts of costs a and a^* represent the capital endowment from the endowments theory and the variable part of costs x represents a *simulacrum* of all the other non-capital dimensions from the endowments theory discussed in the previous section. These could be divided into components, but for simplicity's sake we stick with the two-dimensional model[6]. In such conditions, the utility functions for the entire countries will take the shape of:

$$U_T = U + U^* \tag{9}$$

$$U_T = \sum\left(\sum_{i=1}^{n} v(\kappa_i) + \sum_{i=n+1}^{n+n^*} v(\kappa_i)\right) \tag{10}$$

[5] It can be considered as proportionally representing the total weight of all the factors, which cannot be added up because of different physical units used (labor in hours, resources in tons, capital in money, etc.). In this theoretical paper, we do not differentiate the output from the GDP, although statisticians use the formula $Y = O - C_I$, where Y stands for the GDP, O – for output, and C_I for internal consumption.

[6] It is described as a *simulacrum* because these factors are in different physical units that cannot be added up here. However, this does not change the expected result of this analysis, as it is easy to divide bx and b^*x into component factor endowments and their specific prices.

$$U = \frac{F}{F+F^*}\sum\left(\sum_{i=1}^{n} v(\kappa_i) + \sum_{i=n+1}^{n+n^*} v(\kappa_i)\right) \tag{11}$$

$$U^* = \frac{F^*}{F+F^*}\sum\left(\sum_{i=1}^{n} v(\kappa_i) + \sum_{i=n+1}^{n+n^*} v(\kappa_i)\right) \tag{12}$$

where U_T, U and U^* are utilities for both entire countries together (the entire world), entire country One and entire country Two (the rest of the world) respectively. In order for trade to be beneficial for consumers from the two countries, the following inequalities must be met:

$$\frac{F}{F+F^*}\sum\left(\sum_{i=1}^{n} v(\kappa_i) + \sum_{i=n+1}^{n+n^*} v(\kappa_i)\right) > \sum_{One}\sum_{i=1}^{n} v(c_i) \tag{13}$$

$$\frac{F^*}{F+F^*}\sum\left(\sum_{i=1}^{n} v(\kappa_i) + \sum_{i=n+1}^{n+n^*} v(\kappa_i)\right) > \sum_{Two}\sum_{i=n+1}^{n+n^*} v(c_i) \tag{14}$$

On the right-hand side of the inequalities, the symbol Σ must be subscribed as it only concerns the sum of the utilities of the citizens of the single country, whereas on the left-hand side the sums apply to both countries. In general, these inequalities are true when the indifference curves for consumers from the two countries are convex. However, it must be underlined that there may be situations when the benefits from trade between the involved countries are not proportional to their TFP. This is another argument against the precision of the Factor Endowment Theory, as there may be countries less interested than others in developing trade, and this can also happen without state intervention. Therefore, the best way to account this trade is to use Cobb-Douglas-type functions. Therefore, inequalities (13) and (14) should be turned into:

$$\sum\left(\left(\sum_{i=1}^{n} v(\kappa_i)\right)^{\alpha}\left(\sum_{i=n+1}^{n+n^*} v(\kappa_i)\right)^{\beta}\right) > \sum_{One}\sum_{i=1}^{n} v(c_i) \tag{15}$$

$$\sum\left(\left(\sum_{i=n+1}^{n+n^*} v(\kappa_i)\right)^{\gamma}\left(\sum_{i=1}^{n} v(\kappa_i)\right)^{\delta}\right) > \sum_{Two}\sum_{i=n+1}^{n+n^*} v(c_i) \tag{16}$$

if we still presume that trade is beneficial for both countries, though not proportionally to their endowments (i.e. the *simulacrum* TFP).

The utility can be expressed in monetary units, i.e. instead of writing $v(\kappa_i)$ we can write κ_i. This is possible because we operate on equal-value batches of goods as defined above. Therefore:

$$u_M = \left(\sum_{i=1}^{n} \kappa_i \right)^{\alpha} \left(\sum_{i=n+1}^{n+n^*} \kappa_i \right)^{\beta} \tag{17}$$

$$u_M^* = \left(\sum_{i=n+1}^{n+n^*} \kappa_i \right)^{\gamma} \left(\sum_{i=1}^{n} \kappa_i \right)^{\delta} \tag{18}$$

for individual consumers. Subscript M is to show that these utilities are expressed in monetary units. From now on we will continue the analysis for only country One. Equation (17) can be transformed for the entire country into:

$$U_M = \left(\sum_{i=1}^{n} C_i \right)^{\alpha} \left(\sum_{i=n+1}^{n+n^*} C_i \right)^{\beta} \tag{19}$$

where $U_M = \Sigma u_M$ is the entire utility for the country expressed in monetary units and $C_i = \Sigma \kappa_i$ is the consumption of equal entire batches of goods for the entire country. This can be further simplified to:

$$U_M = H^{\alpha} \mathrm{Im}^{\beta} \tag{20}$$

where H stands for home-produced and home-sold goods, and Im stands for imports. This is the monetized sum of the utilities from consumption on the territory of the country. $U_M = Y - X$ and $H = Y - Ex$ here, where Y is the present output, X the net trade balance, and Ex the exports. Because Y would be embedded under α, the equation would be awkward to calculate if we put these into equation (20). For practical reasons, we can calculate the value of H in this way, but Y and Ex are not independent variables, so we will operate only with H.

The country can have a positive trade balance, $X = Ex - Im$, and the country's residents can increase their utilities by directly buying goods and services (capital and non-tradable) abroad as visitors. This means an increased consumer confidence, therefore a greater impact on economic growth. If the trade balance is negative, some goods and services are purchased by non-residents and do not participate in the overall utility of the residents, and therefore they are not directly related to the increase in their consumer confidence[7]. Following this reasoning, equation (20) should be turned into:

$$U_M = H^{\alpha} Ex^{\beta} \tag{21}$$

This is based on the assumption that only the utility of the residents has an impact on economic growth, rather than the utility realized on the territory of the given country. U_M here is not exactly equal to that in formula (20).

[7] Consumer confidence, however, will be increased indirectly later on, after realizing the additional revenues from visitors from abroad.

This, however, may be controversial so we will convert it into the following alternative:

$$U_M = H^{\alpha}\left(\frac{V}{2}\right)^{\beta} \tag{22}$$

where $V = Ex + Im$ is the volume of trade. The absolute net export balance $|X|$ contained in V is therefore considered here as having a partial impact on economic growth, i.e. the two countries share it, whereas in formula (21), when positive, it has a full impact on economic growth since it is contained in Ex.

The additional monetized utility generated by trade is expressed by a greater profit margin now or expected in the near future, as a result of both increased consumer confidence and increased productivity. Therefore, it will impact economic growth in the near future:

$$\Delta Y_{\tau} = U_M - Y \tag{23}$$

where ΔY_{τ} is the expected economic growth in the near future period τ generated by the trade. Putting (21) or (22) into (23) and assuming that α and β can be calibrated for a period of only one year, we have:

$$\Delta Y^{*} = H^{\alpha}(Ex)^{\beta} - Y \tag{24}$$

or:

$$\Delta Y^{*} = H^{\alpha}(V/2)^{\beta} - Y \tag{25}$$

where the values with asterisks stand for next year's values. These equations are theoretically elegant but difficult to use in econometric practice, therefore we will convert them into the form endeared by econometricians and statisticians, using the log-log method and putting them into an exponential form:

$$Y^{*} = \exp(\alpha \ln H + \beta \ln Ex)\eta \tag{26}$$

or:

$$Y^{*} = \exp(\alpha \ln H + \beta \ln V - \beta \ln 2)\eta \tag{27}$$

where η is an error term. For practical reasons, it is, of course, equivalent to calculate the economic growth ΔY^{*} or the next year's output Y^{*}, as Y is known in $\Delta Y^{*} = Y^{*} - Y$ (as explained above, the next year's output is considered here as springing from the present year's utility or, in other words, the next year's output is a market economy response to the present year's utility level).

Now we need to calculate α and β. This can be done by calculating α and β as shares of the remuneration of factors in the same way as it is done in the Cobb-Douglass production function, which is used e.g. in theories of economic growth [Solow, 1956], [Barro, 1993], [Barro, Sala-i-Martin, 2003]. But in such a function there would be a residual similar to the Solow residual. It would stand for some of the unexpected trade by the endowments theories as

additional diversity trade. It would be awkward to calculate as an additional unknown[8]. Therefore, we will use a different method. We will assume that only β is responsible for the additional utility generated by trade. If it were replaced by α, there would be no impact of trade on next year's output value:

$$Y^* = Y = H^{\alpha}(Ex)^{\alpha} \tag{28}$$

or:

$$Y^* = Y = H^{\alpha}(V/2)^{\alpha} \tag{29}$$

where Y is the present level of output equal to the present utility generated by trade that would be indifferent in respect to future economic growth. These can be turned into:

$$\ln Y = \alpha \ln H + \alpha \ln Ex \tag{30}$$

or:

$$\ln Y = \alpha \ln H + \alpha \ln V - \alpha \ln 2 \tag{31}$$

and these can be further transformed into:

$$\alpha = \frac{\ln Y}{\ln H + \ln Ex} \tag{32}$$

or:

$$\alpha = \frac{\ln Y}{\ln H + \ln V - \ln 2} \tag{33}$$

Parameter β represents the long-term general factor endowment conditions and specificities of the given country (e.g. natural conditions and buildup infrastructures) in relation to "abroad" and does not change substantially in the short term. So from equations:

$$Y = H_{(-1)}^{\alpha}(Ex_{(-1)})^{\beta} \tag{34}$$

or:

$$Y = H_{(-1)}^{\alpha}(V_{(-1)}/2)^{\beta} \tag{35}$$

which express the present output in respect to last year's trade formula values, and putting (32) and (33) into (34) and (35) respectively, we have:

$$\beta = \frac{\ln H + \ln Ex}{\ln H_{(-1)}(\ln Ex_{(-1)})} \tag{36}$$

or:

$$\beta = \frac{\ln H + \ln V - \ln 2}{\ln H_{(-1)}(\ln V_{(-1)} - \ln 2)} \tag{37}$$

[8] In contrast to such a residual in economic growth theories where, as TFP, it tends to be proportional to the GDP.

To complement this, we need to calculate the error term, which can be assumed to be a systematic mistake inherited from the past:

$$\eta = Y / \exp\left(\alpha \ln H_{(-1)} + \beta \ln Ex_{(-1)}\right) \tag{38}$$

or:

$$\eta = Y / \exp\left(\alpha \ln H_{(-1)} + \beta \ln V_{(-1)} - \beta \ln 2\right) \tag{39}$$

It is possible to calculate $\alpha_{(-1)}$ and $\beta_{(-1)}$ for the sake of extra precision, but these values would be so close to α and β that there is no guarantee that they would be of any use.

The results can be summarized as follows in the table:

Growth-to-trade bonding formulae	
Weak:	Strong:
$\Delta Y^* = H^{\alpha}(Ex)^{\beta} - Y$	$\Delta Y^* = H^{\alpha}(V/2)^{\beta} - Y$
$Y^* = \exp(\alpha \ln H + \beta \ln Ex)\eta$	$Y^* = \exp(\alpha \ln H + \beta \ln V - \beta \ln 2)\eta$
$\alpha = \frac{\ln Y}{\ln H + \ln Ex}$	$\alpha = \frac{\ln Y}{\ln H + \ln V - \ln 2}$
$\beta = \frac{\ln H + \ln Ex}{\ln H_{(-1)}(\ln Ex_{(-1)})}$	$\beta = \frac{\ln H + \ln V - \ln 2}{\ln H_{(-1)}(\ln V_{(-1)} - \ln 2)}$
$\eta = Y / \exp\left(\alpha \ln H_{(-1)} + \beta \ln Ex_{(-1)}\right)$	$\eta = Y / \exp\left(\alpha \ln H_{(-1)} + \beta \ln V_{(-1)} - \beta \ln 2\right)$

As in many scientific situations where there are weak and strong theoretical assumptions in regards to the reality, we divided our results into weak and strong *growth-to-trade bonding formulae*. The impact of balanced trade on economic growth is assumed to be greater in the strong version of this theory. It may be that one version is true for international trade (probably the "weak" one), whereas the other for inter-regional trade (probably the "strong" one), as the positive balance of trade X impacts the confidence of the country in international trade and stands for "captured" money from abroad, whereas in the case of a large country or an integrated group of countries inter-province advantages do not matter that much for their entire economies. It may also be that the two versions stand for a floor and a ceiling, and the trade may then range between the two values, which are rather close to each other.

Regardless of the (rather small) difference between the two versions, there are important conclusions for economics. In the short to medium term, the economy is strictly bonded to the trade level. In today's heavily taxed and open economies, the traditional Keynesian intervention is no longer as effective as it was in earlier times. This is because taxes and international trade weaken the Keynesian multiplier (and locally this is also true of inter-regional trade in large countries). In the above formulae, Keynesian intervention acts only on market H which is getting smaller with time. Since β is greater in respect to Ex

and V than α in respect to H, supporting trade should be more effective than applying the same amount of Keynesian intervention. International and inter-regional trade is more related to international and inter-regional specialization and cooperation in industries that are more productive parts of the economy than others, and therefore any decrease or increase in this trade has an almost instantaneous impact on output.

This trade can be enhanced by significantly reducing taxes on imported products. This is not only about duties but also indirect taxes such as VAT. Countries can adopt bilateral or multilateral agreements to decrease taxes on imported products. For large countries and closely integrated groups of countries with significant inner inter-regional trade, according to the above definition, it is also advisable to reduce taxes on transportation firms involved in such trade. Instead of punching the economy with heavy horizontal Keynesian intervention – as "they" (the firms) will not start producing or investing more no matter how much more money "they" receive – it is advisable to pull the strings of trade, as "they" will certainly respond to the increased orders, particularly from abroad and from other provinces in the case of large countries.

If one still believes in Keynesian intervention as a complement to trade enhancement, this intervention should be non-horizontal. Only the most promising industries should be supported, particularly those involved in expanding trade, as only the extra growth of these industries is able to repay for the long-term negative macroeconomic consequences of a Keynesian intervention[9] (also, either one would never have enough money for an effective horizontal Keynesian intervention or the intervention would be massive enough to destabilize the economy in monetary terms). This policy comes across the political economic divide:

- the "interventionists" would finance decreases in taxes on international and inter-regional trade by increasing taxes elsewhere. They would complement this by non-horizontally supporting the most promising and necessary industries also in synergy to supporting trade. Obviously, they would invest in infrastructure also in regard to future trade,
- the "liberals" would consider a decrease in taxes on international and inter-regional trade as part of an evolutionary move toward a low-tax economy. They would also support the most promising industries through tax reductions, having in mind the same philosophy of a low-tax economy. They would complement this by finding ways to finance infrastructure development market-wise.

Just as a Keynesian intervention should not be horizontal, an alternative tax reduction intervention should not be horizontal, either, because of the different impact of taxation on the economy at the macroeconomic level depending on the kind of economic activity. The non-trade part of these interventions (regarding H) would be awkward to introduce as it could be viewed as a case of *dumping* and give a country a strategic advantage in a given industry due to factors other

[9] It can be considered not only as a measure of support but also as a kind of investment, therefore repaying for some of the market distortion.

than the interplay of market forces, and would therefore be difficult to negotiate as non-universally advantageous. This, together with the above analyses, leaves trade enhancement as a privileged method of combating downturns nowadays. Increasing international and inter-regional trade will also help large currency areas maintain their stability, in line with the Optimal Currency Area Theory[10].

This theory does not contradict the theories of economic growth. Increased or decreased levels of trade usually mean increased or decreased return rates (often imprecisely referred to as the interest rate). This is accompanied by increased investments. The employment rate also increases as does the pressure for an increase in wages. These values impact the formulae of the theories of economic growth in a somehow different – albeit not contradictory – manner. We can say that this impact is happening in a perpendicular plane.

Long-term impact of trade

In the long term, the impact of trade is based on the abovementioned increase of specialization in the more productive industries, which explains why international and inter-regional trade also promotes long-term economic growth. But the important feature here is the differentiation of this growth between countries and regions. This is described by Krugman's New Economic Geography theory, which holds that there is a concentration process in labor and industries that depend on it, reinforced by the network effects of industries concentrated in clusters and mega-clusters of economic activity and also by increasing returns to scale effects at the level of firms.

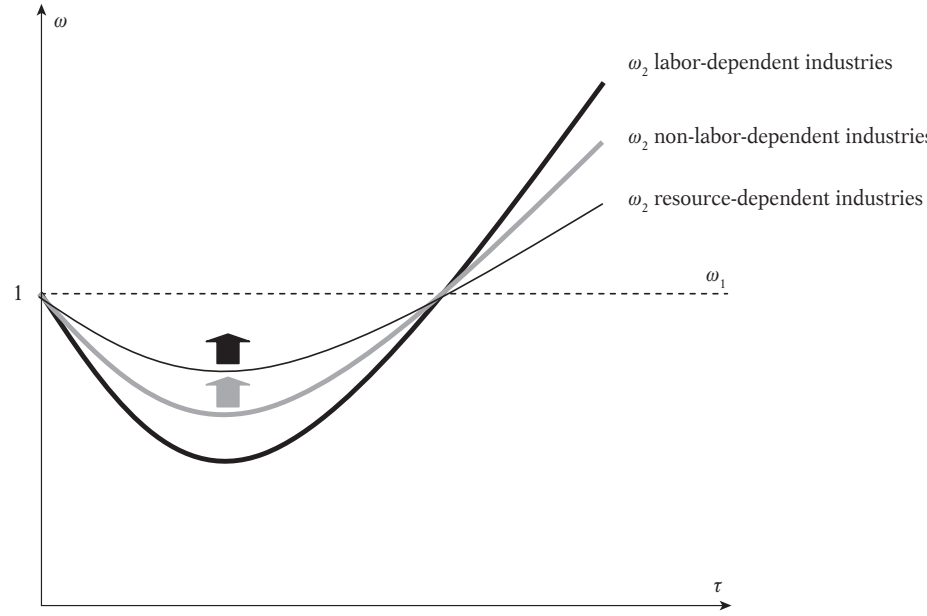
But there are also non-labor-dependent industries. These are mainly energy, particularly electric power, but also all the industries from the second sector – as far as the three-sector theory is concerned – as they become less labor dependent. Therefore, the New Economic Geography theory is increasingly related to service industries that are relatively more labor dependent and expanding. Krugman devised some theoretical models to show how this works. One of these models is a simplified interpretation of his formal mathematical framework that can be solved numerically. Knowing that it is a simplification, as Krugman put it, we will present the situation of non-labor-dependent sectors in the following figure:

Using Krugman's approach, Figure 6 shows how the real wage will be lower in location 2 (ω_2) against location 1 (ω_1), which is the industry concentration pole, because of the costs of transport τ. The real wage at the industrial center ω_1 has been normalized to 1. We can see that the real wage will exert a centripetal force on labor and therefore on labor-dependent industries toward the center of economic activity, which will increasingly concern the third sector, as far as the three-sector theory is concerned. This will happen whenever the black curve is below the unity line.

[10] It should also be less inflationary, because, in contrast to supply-side interventions and particularly demand-side interventions, it tends to lower the prices. This would create more room for money issuance, which would make it even more effective as a result.

Figure 6

The situation of non-labor-dependent industries



Source: own interpretation based on a graph by Krugman [1998, p. 104]

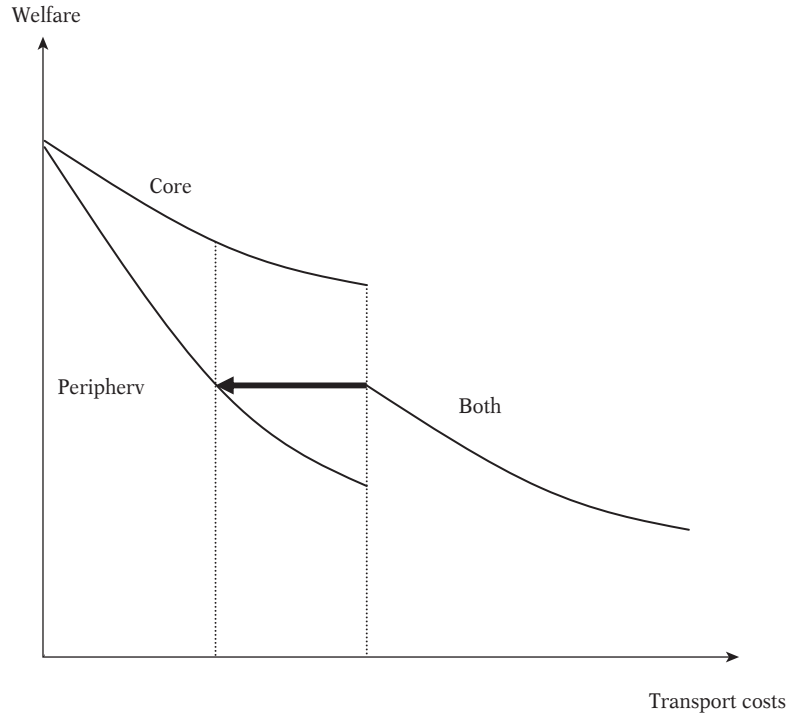
Non-labor-dependent industries are less subject to this centripetal force, depending on their own transport costs but in a different dimension in regards to the existing centers (these costs do not enter into Krugman's formulae, which "translate" costs into labor migration), and these costs are decreasing. This is particularly important for sectors such as electric power, but the world is on track for including all second-sector economic activity here, as far as the three-sector theory is concerned. Finally, resource-dependent industries are less subject to centripetal forces, thanks to special transport technology used. These industries include e.g. Canadian hydropower, some energy resource extraction industries (oilers), and increasingly often the steel industry, etc.

This leads to a situation when the world of industrial centers (mainly labor-dependent services) formed by big cities, clusters and mega-clusters, will be surrounded by the *nebulae* of non-labor-dependent industries belonging to the second sector. These are and will be complemented by some resource-dependent far-flung industries for which special transport techniques are and will be used, in case huge resources are not close to the centers of economic activity.

A centrifugal force is therefore also present and growing, as far as economic activity is concerned. This centrifugal force will impact the welfare of different countries and can be illustrated by the following graph:

Figure 7

The impact of non-labor-dependent industries



Source: own interpretation based on a graph by Krugman [1997, p. 104]

We can see in Figure 7 that, at a certain level, transport costs are disadvantageous for peripheral countries, but non-labor-dependent industries, among which infrastructure industries, such as electric power, which is now the most important of them act as a relief for disadvantaged countries. In the future, we can expect that most of the second-sector industries, as far as the theory of the three sectors is concerned, will act as an equalizer between the peripheries and the core of economic activity. This equalization will not, however, be detrimental for the core, either.

The important conclusion of this analysis is that, to strengthen a regionally integrated group of countries and also to reduce tensions in large economies in the longer term, it is worth developing transport infrastructure for the second sector of the economy and of course infrastructure in general. Reduced tensions between core and peripheral countries will help these regionally integrated groups of countries survive and develop, and this also holds true for the development of large countries.

At a given moment of economic history, the growth of an economy is strictly related to its international and inter-regional trade, and this can be used to combat downturns. At the same time, in the longer term, there are differences

in economic development between regions and countries as a consequence of international and inter-regional trade, which may harm some peripheral regions and countries, but this trend is decreasing.

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WPŁYW HANDLU MIĘDZYNARODOWEGO NA WZROST GOSPODARCZY

Streszczenie

Celem artykułu jest wyjaśnienie mechanizmów wpływu handlu międzynarodowego na poziom wzrostu gospodarczego w krótkim i długim okresie. Najpierw analiza odnosi się do teorii obfitości zasobów i wyjaśnia się teoretyczne przyczyny słabości dowodów empirycznych. Zastosowano skrzynkę Edgewortha w celu ukazania wszystkich podażowych mechanizmów dla prowadzenia handlu, co dzięki teorii handlu wewnątrzgałęziowego D.R. Davisa jest możliwe. Z tej analizy wynika, że handel wywołany różnymi zasobami czynników produkcji nigdy nie znajdzie odzwierciedlenia w zagregowanych makroekonomicznych danych empirycznych, dlatego, że jest zawarty w szerszej kategorii handlu motywowanego potrzebą zróżnicowania. Tylko wtedy, gdy handel nie występuje oraz gdy jest dalece niewystarczający teoria obfitości zasobów może się przyczynić do powstania nowych jego strumieni. Fakty te znane są już w aktualnej teorii handlu międzynarodowego, ale zaproponowane zostały pewne nowe rozwiązania techniczne oraz podano nowe niepodważalne wyjaśnienia.

W świetle powyższych ograniczeń, rozwija się model zaproponowany przez P.R. Krugmana, a inspirowany dobrze znaną formułą A.K. Dixita oraz J. Stiglitza dla handlu wynikającego z potrzeby zróżnicowania. Model ten jest uogólniany poprzez rozszerzenie jego podstaw na wszystkie czynniki, oprócz czynnika praca, który jako jedyny był tu wykorzystany przez P.R. Krugmana, m.in. w celu częściowego uratowania logiki bazującej na teorii obfitości zasobów; jednak mimo wszystko potwierdziła się konieczność zastosowania raczej funkcji typu Cobba-Douglasa. Udowadnia się, że podejście P.R. Krugmana do dóbr, jako doskonale symetrycznych w odniesieniu do funkcji użyteczności jest wykonalne oraz stanowi warunek umożliwiający wyrażenie funkcji użyteczności w jednostkach pieniężnych. To pozwala autorowi artykułu na wprowadzenie własnego modelu formalnego, wyjaśniającego jak handel międzynarodowy (i oczywiście handel międzyregionalny dla dużych krajów) wpływa na poziom wzrostu gospodarczego. Aby zakreślić granice zastosowania modelu, prezentuje się również długoterminowy wpływ handlu, w oparciu o tzw. Nową Geografię Ekonomiczną ww. autora z własnym wkładem dotyczącym sektorów słabo uzależnionych od czynnika praca należących do tzw. drugiego sektora.

Głównym wnioskiem z przeprowadzonej analizy jest fakt, że w danym momencie historii gospodarczej wzrost danej gospodarki jest ściśle związany z poziomem międzynarodowego i międzyregionalnego handlu i to zjawisko może być wykorzystane do walki ze spowolnieniami gospodarczymi. Jednocześnie jednak dochodzi do zróżnicowania w poziomie rozwoju gospodarczego w dłuższym okresie pomiędzy krajami i regionami, który to proces jednak zwalnia, dzięki rozwojowi i modernizacji przemysłów należących do drugiego sektora.

Słowa kluczowe: międzynarodowy, wewnątrzgałęziowy, międzygałęziowy, wewnątrzregionalny, międzyregionalny, handel, wyposażenie, zróżnicowanie, gospodarczy, wzrost, interwencja.

Kody JEL: C01, C02, E17, E60, F11, F12, F13, F42, F43, F44, F47.