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The Development Disparity Model: A Dynamic Approach to International Trade
Gelişim Eşitsizliği Modeli: Uluslararası Ticarete Dinamik Bir Yaklaşım[1]

Tayfun Tuncay Tosun [a**]

[a] Dr., Post-Doctoral, ttayfun078@gmail.com, ORCID: 0000-0003-2489-876X

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ÖZ

Gelişim farkı modeli, gelişmiş sektörlerdeki ticaret dengesinin niteliğini göz önüne alarak ülkelerin ticaret kazançları arasındaki farklılığa odaklanmaktadır. Analiz bölümünde on gelişmekte olan ülke için doğrusal olmayan Yapay Sinir Ağı tekniği kullanılmıştır. Analiz sonuçlarına göre, Çin ve Tayland'ın toplam uluslararası ticaret getirileri artan bir eğilim gösterirken, Endonezya, Paraguay, Kolombiya, Türkiye, Arjantin ve Meksika'nın toplam ticaret getirileri sert bir düşüş eğilimi sergilemektedir. Diğer taraftan, Hindistan ve Brezilya'da toplam ticaret getirilerinin eğilimi genel olarak negatiftir, ancak bu eğilim tutarsız bir şekilde azalmaktadır.

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ABSTRACT

The development disparity model focuses on the difference in the trade yields of countries by considering the nature of the trade balance in the advanced sectors. This paper employs the non-linear Artificial Neural Network technique for ten developing countries in the analysis section. According to the analysis outcomes, while China and Thailand's aggregate international trade yields have an ascending tendency, Indonesia, Paraguay, Colombia, Turkey, Argentina, and Mexico's aggregate trade yields exhibit a drastic descending trend. On the other hand, the tendency of aggregate trade yields in India and Brazil is generally negative, yet this tendency is decreasing inconsistently.

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1. INTRODUCTION

The primary objective of international trade theory is to account for the causes and benefits of international trade. Its other substantial purposes are to explain the relative prices in international trade and yield foresight to trade policy. International trade theory plays a critical role in the efficiency and sustainability of the world economy. Therefore, it is crucial to overcome its shortcomings and consider the benefits of international trade on a more realistic basis.

However, despite its yields and significance, international trade theory is a considerably controversial realm. A considerable part of the empirical studies testing the theory, particularly the factor proportions and similarity in preferences theories, has reached conclusions that contradict the theory. For instance, in the 1950s, the Leontief paradox exacerbated the debates on the Heckscher-Ohlin model and uncovered the need for new trade theories (see Leontief 1953). Moreover, it runs into crucial problems such as having insufficient factor content, basing upon a narrow frame by being formulated in a static structure (see Seyidoğlu 2017), and neglecting the dynamic effects of the trade balance. Above all, it includes many invalid assumptions that are not compatible with the global economic system dynamics.

The development disparity model presents solutions to the primary issues encountered by international trade theory by displaying where to look and measuring countries' trade yields through a more realistic approach and dynamic references. Inspired by the Myrdal (1968) polarization theory, this paper is designed to demonstrate that the development disparity model, based on a dynamic approach and empirical analysis, is critical to international trade theory. The model depends on the fundamental assumption that the aggregate benefits of international trade are not independent of economic development. In other words, the increasing aggregate trade yields of a country are associated with its economic development since global trade has dynamic effects on a country's economy, such as investment, resource allocation, growth (GDP), technology, and competitiveness (see Seyidoğlu 2017). These dynamic effects are closely related to economic development. Around a dozen, interacting factors referring to the social and institutional structure can explain the development disparity among countries (see Nurske 1954; Seers 1967; Myrdal 1968; Hofstede 1980; Sen 1999; Bass 2008). In addition to the factors that international trade theory intensely employs, such as technology, skilled workforce, innovation, knowledge, and experience, these factors also consist of culture, education system, social services structure, institutional structure, state policy, organizational and managerial skills.

The relative prices' analyses are typically useless since the world does not consist of a single market, and the goods are highly heterogeneous in international markets. In addition, relative prices assumed statically by the theory cannot sustain their static structure due to the adverse dynamic effects of the trade balance. Therefore, the dynamic trade balance associated with economic development embodies a country's aggregate trade benefits in the model. In the analysis section, two different equations that include overall macroeconomic balance refer to the dynamic economic development. While one of these equations demonstrates the positive effects of the trade balance, the other uncovers the adverse dynamic effects of the trade balance, which adversely affects the macroeconomic stability. In the model, if the dynamic trade balance can statistically account for the tendency of economic development, in the long run, the aggregate trade benefits of a country taking advantage of the positive dynamic effects of the trade balance will enhance in proportion to the tendency of economic development. On the contrary, the aggregate trade benefits of a country exposed to the adverse dynamic effects of the trade balance will lessen in proportion to economic development.

The remainder of the paper proceeds as follows. First of all, section 2 accounts for the overall results achieved by the famous empirical studies that tested the theory. Section 3 and 4 separately examine international trade theory as the conventional and the new version to comprehend the primary differences between them. The primary objectives of these sections are to explore the primary content of international trade theories and demonstrate their invalid assumptions. Other crucial purposes are to scrutinize how theorists developed international trade theory and explain why it mainly depends on the development disparity among countries. These sections also highlight some of the misconceptions in international trade theory literature (particularly textbook literature). Section 5 first unfolds the positive and negative dynamic effects of the trade balance. Later, it demonstrates the analysis outcomes by formulating the hypothesis and explaining the analysis methodology. Section 6 documents the overall results and evaluates the analysis outcomes.

2. EMPIRICAL STUDIES TESTING INTERNATIONAL TRADE THEORY

Empirical studies performed by MacDougall (1951), Stern (1962), and Balassa (1963) confirmed comparative advantages after testing trade between the USA and England. Likewise, Golub (1994) reached findings that endorsed Ricardo's theory after analyzing

trade between Japan and the USA. Nevertheless, these empirical findings that attribute international trade to labor productivity difference cannot rebuke the correlation between foreign trade and other factors.

The Leontief paradox is the breakthrough in international trade theory. Williams and Leamer criticized Leontief's test statistics. They generated more accurate test statistics and demonstrated that the USA was a capital-intensive country in 1947. Leamer asserted that if Leontief's calculations were conceptually correct, there would not arise a paradox. Leontief's analysis was partially wrong since he eliminated labor-intensive products such as tea, coffee, milk, and other similar goods from the US's import vector (Leamer, 1980: 502). Likewise, Roa also claimed that the decision of Leontief ignored the factor content of the US non-competitive imports (Fisher and Marshall, 2015: 2).

Tatemoto and Ichimura (1959) found enough empirical evidence to support the HO model. They discovered that Japan was exporting capital-intensive goods while importing labor-intensive goods in 1951. Bharadwaj (1962) analyzed the HOS model (Heckscher-Ohlin-Samuelson) for trade between the USA and India; however, he did not find enough evidence to verify the HOS model. Stern and Maskus (1981) uncovered that decomposing natural resources as a third factor would solve the Leontief paradox. They claimed that many goods that Leontief considered labor-intensive derived from natural resources. Deardorff (1984) stated that the HO model would support comprehending the basic logic of international trade's commodity composition, yet it is not sufficient today. Bowen and others (1987) extended the HO model by considering technological differences to test the HOV (Heckscher-Ohlin-Vanek) model, but their empirical evidence did not support the HO model. Lastly, Trefler stated that the HO model's consistency rate with the experimental findings is approximately 50% (Cheng et al., 1999: 1).

The Linder hypothesis is undoubtedly one of the most widely tested trade models. The gravity models commonly tested it in empirical studies. While Tinbergen (1962), Anderson (1979), Caves (1981), Greytak and Tuchinda (1990), and Francois and Kaplan (1996) found enough empirical findings to confirm the Linder hypothesis, Kennedy and McHugh (1980), Hoftyzer (1984), Linnemann and Beers (1988), Chow et al. (1994), and Brun et al. (2005) did not provide enough evidence to ratify it. Even though there are significant empirical studies that accept the Linder hypothesis, non-negligible empirical studies that reject it have emerged in the literature.

Conventional international trade theory depends on many assumptions that have lost their validity in today's world conditions. Along with the debates Leontief created on the HO model, the lack of consensus in the literature for the Linder hypothesis demonstrates how controversial international trade theory is. The fact that the empirical studies' test statistics, which tested conventional international trade theory during the 1950s, are based on one or a few years of data unfolds how extremely static it is. Moreover, international trade theory that formulates the yields of international trade generally tends to neglect the dynamic effects of the trade balance. Therefore, this paper is designed to contribute to the literature by presenting a dynamic and more realistic approach to the yields of international trade by employing the trade balance in advanced sectors. It also aims to enrich the test methods in literature by using the Artificial Neural Network (ANN) technique.

3. CONVENTIONAL INTERNATIONAL TRADE THEORY

3.1. Mercantilism

The Mercantilist approach rests on the abundant capital obtained by foreign trade surplus, which accelerates economic development. Mercantilists take care of keeping the trade balance active. Mercantilism involves excessive state intervention and market expansion (Frieden, 2012: 20). Mercantilists intervened in their colonies' production to protect their interests and prohibited the import of manufactured goods. They put forward the thesis that one side gains from international trade while the other loses (Viner, 1948: 9). For instance, British Mercantilist North asserted that an increase in a country's foreign trade would decline other countries' foreign trade.

It is significant to look at a few statistics of the World Trade Organization to evaluate North's thesis. In world exports, Japan's share was 8%, Britain's 5%, and China's 1,20% in 1983. Nevertheless, Japan's share and Britain's share fell to 4,60% and 2,70%, respectively, while China's share rose to 10,70% in 2011. This statistic is a natural consequence of the development disparity that switches dynamically among countries, on which the Mercantilist approach is indirectly based. It seems that Mercantilists established a link between the development disparity and international trade since they tried to export industrial goods to their colonies while importing precious metals, food, and raw materials from them.

3.2. Vent for Surplus

With his book Wealth of Nations published in 1776, Adam Smith, the pioneer of classical economy, criticized the Mercantilists. A. Smith claimed that

international trade would be lucrative for both sides since he thought the aggregate world welfare was not constant. A. Smith stated that importing from a country at a lower cost than the domestic producer would embody more efficient economic behavior in the free-trade system. He claimed that world welfare would improve in this way. A. Smith established the supply and long-term change of production factors on capital accumulation and labor division that enable a country to develop (Mynit, 1977: 232).

A. Smith attributed the division of labor and specialization to the exchange of the surpluses created in production. The ability of the counter country to exchange surpluses constitutes the principle of mutual benefit. This mutual benefit is briefly called vent for surplus. The complement to A. Smith's theory is the value given on surpluses through labor and specialization division (see Blecker 1997; Schumacher 2012). Contrary to the existent literature, some scholars stated that they could not see a reference to absolute advantages in A. Smith's study (see Ruffin 2005, 2011; Meoqui 2010; Schumacher 2012). According to A. Smith, international competitiveness is determined by the price advantage in the same way as competitiveness within a nation. From this perspective, the international competitive advantage lies in the local advantages of a country.

A. Smith built his theory on the assumptions such as perfect competition, full employment, and free-market conditions. Although the literature documents that A. Smith rests on the labor theory of value, he depends on a general cost-of-production theory of value (King and Yanochik, 2011: 30). His other significant assumption is the immobility of production factors. A. Smith assumed that there was no splendid local or international mobility. Though the literature accepts A. Smith as the pioneer of the neoclassical theory, his theory is not associated with the neoclassical theory (Schumacher, 2012: 71-2).

A. Smith highlighted the importance of transport costs in his study. Although shipping costs play a crucial role in his theory, many sources assume that A. Smith did not mention transport costs. Moreover, A. Smith stated that although France was more developed than Poland both in manufacturing and agricultural production techniques, Poland could export corn to England, which was more evolved than France at that time (Yoshii et al., 2019: 7). In summary, A. Smith was aware of comparative advantages.

His primary intention was to demonstrate that international trade would be profitable for both sides. However, he acknowledged that it would not benefit both parties equally. A. Smith admitted that global trade would bring more advantages to a developed country (Schumacher, 2012: 61). This result is a natural consequence of the development disparity among countries since advanced industrialized countries with high-tech industries benefit more from international trade in the global economic system.

3.3. Comparative Advantages

Some scholars believe that the first analyses of the comparative advantages belong to Robert Torrens (see Viner 1937; Ruffin 2005; Yoshii 2019). It is also stated that John S. Mill played a significant role in the conception of comparative advantage. Mill contended that some preliminary editing of comparative advantages belonged to his own (Faccarello, 2015: 6). Although there are a few claims related to the first studies of comparative advantages, David Ricardo succeeded in bringing comparative advantages to the literature. According to him, international trade's primary parameter is the different comparative advantages (Meoqui, 2010: 5). His theory depends on national cost differences associated with endogenous factors for profitable foreign trade. Ricardo claimed that a country would import a commodity manufactured abroad, even if it was more expensive than domestic production (Faccarello, 2015: 4).

Ricardo's theory rests on primary assumptions such as perfect competition, full employment, the constant returns to scale, factor immobility across countries, the labor theory of value, free-market conditions, and the barter trading system. While the theory's demand side is weak, the supply side is strong (Sen, 2010: 2). In Ricardo's model, labor is the only factor constituted by costs. Although comparative advantages are related to a dynamic concept, Ricardo based his theory on the fixed costs and the static structure, a two-commodity, and a two-country analysis (Gupta, 2015: 10).

Whereas A. Smith mentioned shipping costs, which can inhibit international trade even today at a certain level, Ricardo neglected the importance of shipping costs. He could not also sufficiently explain how the differences in labor productivity occurred in his model. In Ricardo's doctor-secretary example, the crucial point is the development disparity between the two samples since the doctor is more advanced than the secretary. Even if the doctor is more efficient than the secretary in the secretarial profession, the doctor will ultimately be more lucrative by working as a doctor. Consequently, determining one side as a doctor and the other side as a secretary uncovers the significance of the development disparity among countries.

While explaining comparative advantages, Mill preferred to use the expression of relative advantage

instead of the advantage. When economists criticized Ricardo as he could not sufficiently account for comparative advantages, Mill analyzed the difference in labor productivity with a numerical exemplification and claimed that as long as a country manufactures a commodity with less labor, foreign trade will be more lucrative. Mill emphasized the significance of the distribution laws that society would benefit from a proper distribution of goods (King and Yanochik, 2011: 30-1). He stated that international trade would influence technological development via mutual demand. According to him, technical development activities that the production costs of export goods allow a country to take advantage of cheaper import goods through reciprocal demand, thereby increasing international trade benefits. Mill's contribution is essential for the inclusion of demand conditions in international trade.

3.4. Neoclassic Approach to International Trade Theory

Ricardo's theory was unable to account for the formation of equilibrium prices in international trade except for establishing the upper and lower limits of equilibrium prices. Classical economists focused on supply conditions by neglecting demand conditions (Sen, 2010: 2). However, neoclassical economists made up for this deficit of classical economists by taking demand conditions into account. Mill carried out the first study in this field. According to him, if the law of mutual demand determines the severity of a country's need against another country's goods, it can determine the price ratio that ensures the equilibrium (Mill, 1885: 463-4). Mill's study was a first step in explaining foreign trade's equilibrium prices in the international trade theory. Nevertheless, Marshall and Edgeworth successfully clarified equilibrium prices via the bid curves.

The classical theory depends on the homogeneous labor approach. However, as well as the labor factor, there are other significant production factors such as land and capital (Krugman and Obstfeld, 1994: 64). In today's world, labor is not a single production factor, and it also differs in quality between countries (Salvatore, 2001: 41). Of the foremost neoclassical economists, Gottfried Haberler used the concept of opportunity cost to measure goods' value (Haberler, 1933: 177). Haberler, who criticized the classical approach, used multi-factor technologies, including land, manufactured capital goods, and labor inputs, by evolving the concept of opportunity cost (Samuelson, 1996: 1681). According to him, countries should specialize in producing goods for which they are relatively more productive. Haberler put the Ricardo model into a more developed frame by using the opportunity costs to measure comparative advantages.

3.5. The Factor Proportions Theory

Ricardo attributed the comparative advantages to the differences in labor productivity. However, he did not explain the reasons for the differences in the labor productivity of the countries. In the 1930s, Eli Heckscher and Bertil Ohlin developed the factor proportions theory (the HO model) based on the free-market assumptions and countries' production factors to rectify Ricardo's deficiency. According to the theory's primary idea, a country gains a comparative advantage in production by using its dominant factor (Gupta, 2015: 10). For example, if Turkey is a labor-intensive country, there is a scarcity of capital available in Turkey, and thus Turkey exports labor-intensive goods. Likewise, if Germany is a capital-intensive country, labor is scarce in Germany, and therefore Germany exports capital-intensive goods.

The assumption that one side is capital-intensive and the other is labor-intensive uncovers the significance of the development disparity among countries since the capital-exporting country is more developed than the labor-exporting country. The primary factor that distinguishes a developed nation from an undeveloped or developing nation is that a developed country accomplishes a higher development performance in the past, which an underdeveloped or developing country cannot. Thus, a developed country predominantly exports capital-intensive goods, whereas an undeveloped or developing nation proceeds to export labor-intensive goods.

Theorists derived three different theorems from the HO model. These theorems are factor price equality, income distribution, and the Rybczynski theorem. Simultaneously, some countries export labor-intensive goods while others export capital-intensive goods. This consequence leads factor prices to equalize (Rogoff, 2005: 5). In full mobility under the free-market conditions, the labor factor moves from low-wage countries to high-wage countries. This process ends up with the equalization of wages, and hence international trade indirectly creates a factor-arbitrating effect. As Samuelson proved, arbitrage eliminates the differences in the factor prices (Leamer, 1995: 1).

Until the Stolper-Samuelson theorem, international trade theory claimed that countries would achieve production and consumption yields through free trade, though protectionism would result against countries in international trade theory. Stolper-Samuelson rebutted this tenet in 1941. Samuelson's collaboration with Stolper is a milestone in international trade theory

(Rogoff, 2005: 3). Stolper-Samuelson tested the HO model via a two-commodity and two-country approach. They demonstrated that after starting the trade, capital-owners lost (the wages of capital decreased) while wage-earners gained (the wages of labor increased) in the country where the relative labor factor was relatively intense (Neary, 2004: 2). Since the supply increases in the sectors associated with the abundant factor, the prices of relatively plentiful factors increase while scarce factors' prices decrease. Consequently, according to the theorem, free trade increases the prominent factor's income while reducing the shortage factor's revenue.

The Rybczynski theorem revealed another outcome of the HO model to the literature in 1955. It demonstrated that if the supply of a single factor increases, the commodity manufacturing that intensively uses this factor expands, whereas the production of the other commodity shrinks. After Ronald W. Jones had investigated the theorem, more general conclusions emerged. The outcomes revealed by Jones (1965) can be summarized as follows. Given that two different factors expand at different rates, the production of a commodity that uses the fast-growing factor intensively grows faster than both factors. On the other hand, a commodity's production that uses the lower-growing factor intensively grows slower than both factors.

The HO model formulated international trade under restricted assumptions. In practice, a labor-intensive product always is not a less qualified product than a capital-intensive product; that is, it does not have a homogeneous structure. Another crucial weakness of the theory is that it assumes that the production technology is similar in all countries. Nonetheless, many products are different (not homogeneous) in today's world, and there are remarkable differences among consumer demands (Porter, 1998: 13).

The HO model, which is based on the free-market assumptions, does not address why countries have different factor endowments. According to Leamer, the HO Model assumes that tariffs and quotas have redistributive effects, but they ultimately lessen efficiency (Leamer, 1995: 3). That is, along with the classical and neoclassical approach, it underestimates the government's policy tools. Lastly, it neglects economies of scale, increasing marginal costs, incomplete market structures, factor mobility, and unemployment by accepting the full employment level.

4. NEW INTERNATIONAL TRADE THEORY

Leontief (1953) carried out the first practical study to test the HO model with the input and output technique in 1951. He discovered that the US export industry was more labor-intensive than the industry competing with US imports (see Leontief, 1953: 343). However, the USA, which had the wealthiest capital stock, must have exported capital-intensive goods while importing labor-intensive goods according to the HO theory. This consequence did not include the expected outcome predicted by the HO model. This result was called the Leontief Paradox by the literature, and it induced massive confusion among economists and intense debates on the HO model. Consequently, theorists began to design new formulas to improve international trade theory.

4.1. Neo-Factor Proportions Theory

Keesing (1965) underlined that considering labor as a single factor of production would be deceptive. He stated that the US export became more capital-intensive than the import-competing industry after disaggregating labor into the skill categories (see Keesing 1965: 292-4). The subject that Leontief intended to draw attention to was closely associated with the neo-factor proportions theory. The measurement of human capital density was closely related to US industries' export performance (Lowinger, 1975: 233).

Empirical studies testing the skilled workforce found a close relationship between the skill content of exports and income (see Harbison and Myers 1964; Kenen 1970). They also presented that the skilled workforce shapes the production model and thus directly affects foreign trade. Kenen (1970) revealed that R&D expenditures and professional employment associated with R&D are highly correlated with export performance. According to the neo-factor proportions theory, countries that intensively have the skilled labor force take advantage of comparative advantages in producing high value-added goods (see Keesing 1965). On the other hand, countries with scarce skilled labor gain a comparative advantage in manufacturing low value-added goods.

Like the difference between a capital-intensive and labor-intensive country, the primary difference between skilled and unskilled labor is the development disparity. The fundamental conditions that increase the individual's quality are closely related to social and institutional development. Consequently, there is a potent interaction between all factors (as explained in the introduction) and the individual's quality. For dynamic development, this interaction mechanism should work by feeding factors positively and vigorously.

4.2. Technology Gap Theory

Michael Posner developed the technology gap model in 1961. According to the theory, different technological levels and trends characterize the international economic system (Fargerberg, 1987: 2). Technological innovation helps countries provide a comparative advantage (Posner, 1961: 323). Developed countries have avant-garde firms that realize the first invention of a commodity. These companies invent new products thanks to their skilled staff, capital, technology, R&D, and accumulated experiences. Since new products are out of competition, innovative companies yield considerably higher profits from their inventing ability. This multi-synergistic advantage is a significant source of energy that sparks off developed countries.

Innovative companies allow developing countries to produce obsolete goods in their countries. According to the theory, innovative companies purchase the legal rights of the first invented product to protect their rights by-laws. Imitator companies in developing countries start producing the invented product by hiring its patent or concluding a profit-based partnership contract with the innovative companies in developed countries. Even if production moves entirely to the developing country, the developed countries retain significant revenues from licenses and partnership contracts. A developing country can increase its development by producing imitation products, but it is hard to catch up with developed countries without innovative activities (Fargerberg, 1987: 3).

4.3. Product Period Theory

The theory of the product period is an upgraded version of the technology gap theory. Vernon (1966) defined the lifecycle of a new commodity, which was first exported by the USA, based on the technology gap theory. In the model, the US had an overall growth tendency in export markets during the early and middle phases of the product lifecycle. However, after losing its markets (after the maturation process of the product lifecycle was completed), the USA began to import the product it invented (Wells, 1968: 4).

Many new products are produced by industrialized countries thanks to innovative activities in the North (Antràs, 2005: 1). Invented products are predisposed to reflect the specifications of the designed market. A strategic rule for avoiding competition stems from differentiation as a result of specialization. Thus, diversification may occur owing to differentiation. Radios, for example, differentiated and took a unique form such as clock radios, automobile radios, portable radios. Nonetheless, although sub-categories may proliferate and product differentiation efforts increment, increasing adoption of certain overall standards appears typical (Vernon, 1966: 196).

The innovative product, which has not yet transformed into a standard product, is not appealing for Southern production. At the maturation stage of the product lifecycle, incremented competition demonstrates that high profits are over. Consequently, Southern production becomes attractive. Low wages are very appealing in the South when the invented product matures, and less product development is required (Antràs, 2005: 4). According to the theory, a triggering factor must happen for moving production to a developing country. The triggering event usually occurs when the avant-garde is in danger of losing its monopoly position. The severity of the threat influences foreign investment decisions, and innovative companies prefer destinations in which they can beat their competitors. According to the product period theory, global corporations based on some real or imagined monopolistic advantages build up production facilities abroad characteristically (Vernon, 1979: 255-7). The competition seems to have a critical effect on the cyclical flow of the theory. This factor also indicates that the competition structures have transformed into a more complex and multi-clustered level. As a result, developing countries acquire innovations and make production at lower costs, so the innovative company withdraws from the markets at the product cycle process (Salvatore, 2001: 185).

The product period theory is a highly functional theory to assess the emergence of multinational enterprises. It has attractive features such as underestimating comparative costs, paying attention to innovation, considering invention's timing, and the effectiveness of economies of scale (Taylor, 1986: 751-2). Nevertheless, Porter asserted that the product period theory would leave some questions unanswered, even if it proved that domestic demand fueled innovation. According to Porter, the model cannot sufficiently explain why some corporations are leaders in some new industries (Porter, 1998: 17).

Technological and innovative companies in developed countries make significant revenues in developing countries' markets through licensing or partnership agreements. As a result, the technology is not accessible, as the HO model assumed. In today's world, countries achieve prosperity through technological developments. However, taking one side as an innovator and the other as an imitator in the model establishes a close relationship with the development disparity among countries. Moreover, both the technology gap and the product period theory clarify

the sustainability of the development disparity among countries via international trade.

4.4. Similarity in Preferences Theory

The Swedish economist Staffan B. Linder developed the similarity in preferences theory in 1961. Linder demonstrated that the idea of quality is a significant variable that determines the direction of the trade (Hallak, 2010: 3). Economists extensively employed the similarity in preferences model to account for the remarkable heterogeneity of commodities and intra-industry trade among widely industrialized countries. While the HO model formulates countries' trade with different demand structures, Linder models international trade in countries with similar and overlapping demand patterns. Linder presumed that the more similarity in preferences between the two countries converges, the more trade volume between them augments (Choi, 2002: 601).

Essential criteria such as similar supply-demand, production-consumption patterns, and income levels refer to trade growth in the model. In theory, countries' per capita incomes are closely related to the structure of their demands. On the demand side, a nation with a higher per capita income devotes a remarkable share of its revenue to quality goods. On the supply side, on the other hand, a country takes advantage of comparative advantage for goods with higher domestic demand (Hallak, 2010: 3). High-income countries have a comparative advantage in producing high-quality goods since they have potent domestic needs. Linder argued that intense local demands would strengthen export by promoting productive capacity (Fajgelbaum et al., 2014: 1).

Johnson (1964) stated that the geographical proximity among countries with similar wealth levels leads to the positive relationship between trade intensity and the Linder variable -similar per capita (GNP). Nevertheless, gravity models have to cope with a significant issue regarding geographic proximity: Countries make around 80% of their trade via sea transportation which does not have substantial price differences according to the distance. The similarity in preferences theory has often been confirmed by practical studies. However, it has not been sufficiently thriving in explaining international trade. For example, two countries can trade based on cost regardless of preferences and income levels. On the other hand, a country can export to specific industries since it has plentiful natural resources (e.g., oil and gas) or abundant raw material resources. Furthermore, intermediate goods trade, which increases through vertical specialization, has a significant share in world trade.

The development disparity among countries plays a significant role in explaining trade in the Linder model. Since countries evolve to a certain extent, the demands of their local market enhance towards quality goods. On the other hand, the comparative advantage level in producing quality products increases on the supply side. Furthermore, there are also developmental disparities based on products and sectors, particularly on the supply side. For instance, even though German citizens have many powerful local alternatives in Germany, they may opt for Volvo® due to security preference. Although consumer preference is the determining factor, a manufacturing enterprise can make a development disparity based on the quality difference in the field in which it differs. The source of the difference, i.e., the development disparity, is that Volvo® climbed the development ladder in the past in safety compared to its competitors. This factor also plays an essential role in the explanation of intra-industry trade.

4.5. Intra-Industry Trade

In the 1960s, Dreze and Balassa drew attention to intra-industrial trade (IIT) growth in Europe (Das, 2007: 10). Although Balassa carried out the first analyses on the IIT, Grubel and Lloyd brought it to literature. Grubel and Lloyd (1971) developed an index based on Standard International Trade Classification (SITC) to measure the IIT by performing definitive empirical studies. The increasing economic cooperation among countries after World War II influenced the new theory of international trade. Therefore, the world trade system required new ideas to account for trade among significant free trade zones such as the EU and NAFTA. For this purpose, practical studies extensively tested the similarity in preferences, gravity models, and intra-industry. A considerable amount of the experimental studies ratified the theoretical results of the IIT. Jones and Helpman based the IIT on product differentiation determined by monopolistic competition and economies of scale (Arip et al., 2011: 2). In summary, classical, neoclassical, and HO models have lost their popularity in explaining international trade since the 1950s. New international trade theory solved the significant shortcomings of the conventional version. Thus, international trade events have been explained by the new version more realistically.

4.6. Economies of Scale Theory

Economies of scale that emerge from the increasing returns to scale through higher productivity make it advantageous for companies to specialize in a small number of goods. By broadening Krugman's monopoly competition theory, Melitz stated that companies should first prove themselves at home and discover

their capabilities and limits (Sun, 2009: 136). Countries like China and India have huge markets, so this factor reinforces their economies of scale. Larger companies that afford higher fixed costs yield more benefits than smaller companies regarding overall productivity, well-being, and wages (Melitz, 2003: 1707). Thus, either a few monopolies or oligopolies dominate the markets. In this situation, economic agents must consider incomplete market conditions (Krugman et al., 2012: 138). Thanks to its superiority obtained in production technology, the monopoly company has more advantages for economies of scale. The monopolistic enterprise gets a certain degree of control over the differentiated goods' markets by yielding a competitive advantage via economies of scale. Herewith, monopoly powers push the companies with lower productivity out of the industry. Therefore, the resource allocation of productive firms gets stronger (Melitz, 2003: 1716). Accordingly, efficient monopoly companies increase their market share and profit rates. This factor refers to the significance of the development disparity among countries. Since most developing and undeveloped countries cannot sufficiently achieve economies of scale in production, particularly in quality goods, they cannot mature their development dynamics.

4.7. Monopolistic Competition Theory

In monopolistic competition theory rolled out by Stiglitz and Dixit in 1977, a few companies characterized the market solution in monopoly competition. The Stiglitz-Dixit model constituted a framework for formulating the trade of manufactured products among developed countries and took into account the effects of higher returns on economies of scale and differentiated goods (Neary, 2000: 1). Monopoly power that is a necessary component of non-convex markets in the model diverts resources from the relevant sector. It helps companies pay their fixed costs, yet there is no way to prevent the entry and exit sectors (Stiglitz and Dixit, 1977: 308).

Trade depends on an IIT format among countries with similar technology and factor endowment in the model. In the model, each product is unique, and consumers ask for as many varieties as possible. The driving force of the model is the total factor productivity. In the model, the increasing specialization leads to increasing productivity globally rather than in the national industry (Neary, 2000: 11-2). Stiglitz and Dixit (1977) clarified that the optimum amount, which equates the price and the marginal cost, is possible with perfect discriminatory pricing on the market; otherwise, contradictory issues occur. A competitive market, which fulfills the marginal condition, cannot be sustainable since total profits are negative (Stiglitz and Dixit, 1977: 297).

Monopolistic competition theory is closely related to imperfect markets, the IIT, economies of scale, and differentiated goods. According to Krugman, even if countries have similar technologies, factor endowments, cost structures, and preferences, they can take advantage of international trade under the conditions of free-trade and monopolistic competition market, thanks to the cost advantages of economies of scale and differentiated goods (see Krugman 1979, 1980). However, the monopolistic competition theory rests on restrictive and controversial assumptions. Stiglitz and Dixit (1977) assume that countries have similar technology, factor endowments, and preferences. Moreover, the scope of goods is limited to intra-industry trade in the model. In today's world, many countries have different technologies, factor endowments and, preferences, and inter-industrial commodities continue to form a significant part of international trade. The monopolistic competition theory has critical importance in explaining current or future disparities among countries. Developed countries have monopoly enterprises intensely, particularly in advanced sectors. This factor is of vital importance in sustaining the development disparity among countries. As a result, the concentration of monopoly structures in advanced sectors in international markets is not a casual situation.

5. EMPIRICAL ANALYSIS

As reviewed in sections 2 and 3, theories that formulate the yields of international trade typically tend to neglect the trade balance. The trade balance brings about the dynamic effects that affect international trade yields and macroeconomic stability. Thus, this paper rolls out a realistic approach to this issue with the development disparity model, which takes into account the trade balance and the dynamic references for macroeconomic stability. This section first draws attention to a common point in terms of reserve flow and general macroeconomic balance equations in the external deficit situation. Later, considering this point, it clarifies the positive and dynamic effects of the trade balance before forming the hypothesis and starting the analysis.

5.1. Dynamic Effects of the Trade Balance

Johnson's (1976) monetarist model sets out the money supply and demand and the money equilibrium condition. The equilibrium condition of the model consists of the following group of equations. The point at which the money supply equals the money demand is the money stock balance. Definitions of variables are as follows: M_s money supply, M_d money demand, and M is money stock balance.

$$M_s = M = M_d \quad (1)$$

R international reserves, D domestic loans, Y income (GDP), P price level, and I_n is interest level. International reserves and domestic loans determine the money supply M_s. Money demand M_d, on the other hand, is measured by a function determined by income, interest, and price level.

$$M_s = (R + D) \quad (2)$$

$$M_d = f(Y, P, I_n) \quad (3)$$

Equation (4) is obtained by equating the second and third equations. After leaving the reserve alone, equation (5), i.e., the reserve flow equation, emerges. As seen in the reserve flow equation, the coefficient of D embodies a negative value. It denotes the inverse correlation between the reserve and domestic credit (Dhliwayo, 1996: 45-6).

$$(R + D) = L(Y, P, I_n) \quad (4)$$

$$\Delta R = \Delta[f(Y, P, I_n)] - \Delta D \quad (5)$$

Domar assumed that output Y is proportional to the stock of physical capital K available at the beginning of the year, i.e., GDP growth is just proportional to last year's investment/GDP ratio (Easterly, 1997: 3). In Domar's model, growth depends on a simple exponential function and integral. The income growth rate is φ^* and $Y = Y_0 e^{\varphi t}$. If a constant fraction ρ of GDP is invested, these aggregate investments (K) are equal to equation (6). To sum up, equation (7) emerges (Mauro, 2015: 7).

$$K = \rho Y_0 \int_0^t e^{\varphi t} d(t) = \frac{\rho Y_0}{r}(e^{\varphi t} - 1) \quad (6)$$

$$\lim_{t\to\infty} \frac{K}{Y} = \frac{\rho}{\varphi} \quad (7)$$

The balance rests on the savings, and investments and savings are proportional to income in the model. Savings indirectly mean investments in terms of equilibria. The warranted growth rate means the model's equilibrium growth rate (Blume and Sargent, 2015: 350-1). Domar's model is based on the open economy, and it implies macroeconomic balance. Of course, Domar could not correctly define the actual growth path. Nevertheless, it provides fundamental insight into the balance in growth (see Domar 1952, 1957).

Equation (9) is the warranted growth rate P_w, where J is the ratio of saving to income, and T is the ratio of the trade balance to income. X is the aggregate exports, M is the aggregate imports, equation (8) denotes the trade balance. S is savings, and I_v is investments. P_w is equal to the difference between J and T. Equations (9), (10), and (11) reveal equation (12), e.i., general equilibrium. The left-hand side of equation (12) denotes internal equilibria, while the right-hand side indicates external equilibria (if we do not divide the general balance into the private and state). Inner and outer balance is equal to each other in the overall balance.

$$T = X - M \quad (8)$$

$$P_w = J - T \quad (9)$$

$$P_w = \frac{\Delta Y}{Y} \cdot \frac{\Delta K}{\Delta Y} = \frac{I_v}{Y} \quad (10)$$

$$\frac{I_v}{Y} = \frac{S}{Y} - \frac{(X-M)}{Y} \quad (11)$$

$$I_v = S - X + M \rightarrow S - I_v = X - M \quad (12)$$

The M-L condition formulated under the specific assumptions states that if the sum of the domestic demand of import goods (E_m) and the external demand of exports elasticities (E_x) is greater than one $(|E_m + E_x| > 1)$, devaluation of the local currency will improve the trade balance. On the other hand, the absorption approach postulates that the aggregate production and expenditures are equal in the overall equilibria. In an open economy, the Keynesian equation of national income is $(Y = C + I_v + X - M)$. After leaving T alone, the Keynesian equation of national income equals $[T = Y - (C + I_v)]$ in which the aggregate production and expenditures determine the external balance. In this equation, C is the aggregate consumption, and $(C + I_v)$ denotes the aggregate expenditures. According to the absorption approach, if the aggregate outlays surpass the aggregate output $[(C + I_v) > Y]$, an external deficit arises. If vice-versa $([(C + I_v) < Y]$, an external surplus occurs. Lastly, the monetarist approach points to the stock imbalance between supply and demand in the market for deficit or surplus money in the external balance.

After obtaining the general equilibrium from Domar's model, equations (13) and (14) denote the disparity among countries in terms of overall balance in this study. The balance of savings and the trade balance are equivalent under the general macroeconomic balance in both equations. The distinction of negative $[(M > X;\ I_v > S \rightarrow (-\beta_1)]$ and positive $[(X > M;\ S > I_v \rightarrow (+\beta_1)]$ parameters represents countries with external deficits or surplus. E is the foreign debt, and the difference between reserves and external debts $(RE = R - E)$ indicates RE. Equation (13) represents countries with a foreign deficit.

$$RE_t = \beta_0 - \beta_1[(M - X)_t \approx (I_v - S)_t] + \varepsilon_t \quad (13)$$

In the case of external deficit, which indirectly refers to the lack of economic performance, the long-term primary dynamic effects can be explained by the reserve flow and general equilibrium equations as follows: While interest rates rise in countries that

cannot preferentially borrow, reserves decline due to the descending nominal currency. Since ascending interest rates increase production costs, the upward inflation tendency gets strength. In this case, both the decrease in income and welfare level verify the inefficiency. In countries, which can borrow at preferential rates, the resulting increase in production costs may be relatively lower. However, increasing foreign debts and decreasing reserves adversely affect the dynamic economic development in these countries. While Frieden (2009, 25) attributing the root cause of the 2008 global financial crisis to macroeconomic disequilibria, he pointed out that the US and Western states' foreign deficits and debts exacerbated.

In monetary theory, an increase in propensity to domestic loans brings about a decrease in reserves. Johnson (1977, 13) stated that foreign equilibria' improvement is inversely proportional to domestic credit expansion. On the other hand, investment and consumption outlay that surpass savings augment the external deficits in overall balance, thus inducing an adverse effect on reserves. Hence, a critical common point takes place in terms of the reserve flows and overall balance. An increase in domestic loans augments investment and consumption expenditures that exceed savings, causing a rise in (GDP) and external deficits. Kandil (2009, 154) stated that the foreign deficits would be balanced by foreign financing that increases foreign debts; otherwise, it would cause a decrease in reserves. This factor is the primary reason why this paper employs the RE vector as a critical dynamic development variable. While increasing external debts and decreasing reserves in proportion to the deterioration in the consumption-saving balance confirm the inadequacy of the economy, economic growth (GDP) may rise somewhat or more due to augmented consumption. Evaluating GDP as an economic performance indicator in an economy in which RE denotes a consistent negative tendency may cause misleading outcomes. Just as RE plays a critical role in foreign financing inflows, it has a dominant determinant role in economic growth. On the other hand, it contains significant knowledge about a country's savings and cumulative assets. Consequently, RE is the reference point of the developmental disparity model.

In terms of overall equilibria, a soaring saving gap means enhancing the external deficit. The difference between investments and savings emerges the financing gap (Easterly, 1997: 2). Since external debts cover the financial gap, increasing foreign financing outlays and external debt pressure adversely affect competitiveness and make the resource allocation mechanism problematic. The rise in foreign financial expenses and instability stemming from external debts adversely affect production costs. Consequently, augmenting production costs adversely influences foreign direct investments (FDI) and technology transfer, and the employment problems become permanent in proportion to the decrease in physical investments. As a result, the economic development of countries with external deficits is in a vicious circle.

In equation (13), the primary growth source is foreign debt, indicating high pressure on reserves. Ferretti and Razin (1998) found that a lower reserve level would trigger higher interest rates, thereby decreasing economic performance and leading to a currency crisis. Increasing interest rates and appreciating foreign currency during the currency crisis period adversely affect production costs. After dragging an economy into a devaluation (by damaging the nature of comparative advantages), appreciating foreign currency adversely affects foreign trade benefits. Rabin and Yeager (1982, 12) state that devaluation mechanically affects purchasing power negatively. Kandil (2009, 155), on the other hand, underlines that the increase in an exchange rate diminishes competitiveness, so the value of imports augments while the value of exports lessens. Although under the elasticity assumption (as explained above), the Marshall-Lerner condition postulates that the trade balance will demonstrate a positive trend, in a global system where countries are tightly integrated with each other, devaluation (except for an artificial adjustment for competitiveness) in the long run confirms the inadequacy of economic development. Rose and Yellen reached significant empirical findings demonstrating that the M-L condition was not valid in their empirical analyses (see Rose and Yellen 1989; Rose 1991; Brooks 1999).

On the other hand, if a country grows based on savings, as opposed to equation (13), a trade surplus arises according to equation (14). Instead of domestic loans that increase foreign borrowing, the dominant parameter of growth is savings, so the RE vector enhances positively in equation (14). Since there is no trade deficit, the capacity of foreign debt to threaten macroeconomic stability and induce inefficiency is low in equation (14). Of course, this does not mean the whole efficiency, but the real problem is the equation (13).

$$RE_t = \beta_0 + \beta_1[(X-M)_t \approx (S-I_v)_t] + \varepsilon_t \qquad (14)$$

In the case of external surplus resulting from relatively strong economic performance, the long-term primary dynamic effects can be explained by the reserve flow and general equilibrium equations as follows: While the interest rates descend, reserves increase owing to

ascending nominal amounts of money. The diminution in interest rates naturally leads to a decrease in financial expenses, so production costs decrease while GDP and productivity increase. In countries with foreign surpluses, the employment structure gets stronger because soaring savings bring about more investments. In theory, more savings mean more physical investments that reduce idle capacity in employment. Since the increasing foreign surplus and reserves strengthen resource allocation, FDI and technology transfer fortify accordingly. As a result, economic development has more robust dynamics in countries with foreign surpluses.

The trade surplus does not increase inflation and reduce competitiveness by making the local currency more valuable unless it circulates in a country. For instance, as a requirement of the bilateral trade agreements between China and the US, China uses the trade surplus it obtains from the US in the US financial markets. Even though the surplus of funds dragged the USA with high foreign deficits into a severe crisis in 2008, China grew around 9% in 2009. Furthermore, Frieden (2009, 26) attributes the global financial crisis to the growth policies of countries, which have external surpluses. While having massive foreign capital inflows during 1999-2008, China had only 2% (according to CIA Factbook data) annual average inflation. This statistic demonstrates that Hume's quantity theory is invalid today. Johnson (1977, 5) also stated that Hume's analysis was relevant to the period of his time.

5.2. Formulation of Hypothesis

The disparity in development among countries is associated with the trade balance's adequacy in dynamic sectors. In international markets, the muscles of the monopoly order are stronger in advanced sectors. The vicious circle for a developing country is the trade balance in advanced sectors. Therefore, parameter β_1 in equations 13 and 14 is tested for advanced sectors in the hypothesis. The successes in dynamic sectors that strengthen technology and added value at the endogenous level exogenously create economies of scale to other sectors, and thereby business cycles, technological transformation, and terms of foreign trade evolve accordingly. The long-run driving force of dynamic sectors is government policy, managerial and organizational capabilities, education, and social and institutional factors. The ascending tendency of positive dynamic trade balance, which is closely related to economic development, increases total trade returns in proportion to economic development in the long run. In order to test this correlation, this paper employs sectoral trade balances by decomposing the aggregate trade balance and clusters them into specialization groups such as low, medium, and advanced. Herewith, the empirical analysis statistically explores whether the dynamic trade balance, that is, advanced sectors, can account for economic development sufficiently or not. The dependent variable is RE, and the independent variable is DTB. $H_0: \rho = 0$ denotes that the dynamic trade balance DTB is not associated with the RE. Vice-versa, H_1 constitutes the alternative hypothesis.

5.3. Analysis Methodology

The difference between developed and developing countries is evident. As A. Smith stated, international trade is more advantageous for a developed country. The punchline is that nations in a similar category (particularly developing countries) yield from international trade at different levels that affect their development levels. This difference further strengthens the hypothesis that international trade provides different yields to countries. A developing country turns into a developed country after maturing its development dynamics. Before a developing country turns into a developed country, comparing its international trade yields with other developing countries is critical for understanding the development disparity among countries. Therefore, this paper analyses potential developing countries such as China, India, Turkey, Argentina, Thailand, Mexico, Brazil, Colombia, Indonesia, and Paraguay. However, since developing EU member countries are inside of the EU union and use loans at preferential rates, they are not included in the analysis. Likewise, Middle Eastern countries, which export oil and have immense natural advantages, and African countries, which do not have sufficient development dynamics, are not included in the analysis. This paper takes trade data from the digital database of the World Trade Organization (WTO) and the reserve and external debt data from the digital database of the World Bank. The analysis period covers the post-1980 period (annual data during 1981-2017). Due to higher trends, lower R^2, and inability to ensure assumptions encountered in the parametric models, the statistical analyses are performed to account for RE by a non-parametric model, the ANN technique.

5.4. Dependent and Independent Variables

The dependent variable RE consists of the difference between international reserve and external debt. RE denotes a third vector where the tendency of the difference between the two vectors turns into an accurate economic performance indicator (as explained in section 5). R is the aggregate international reserve (including gold, current USD), and E is the aggregate

external debt (DOD current USD). Equation (15) demonstrates the formulation of RE.

$$RE = R - E \quad (15)$$

Equation (16) demonstrates the optimization of variables with minimum Mean Squared Error (MSE). According to the SITC Rev.3 classification, the aggregate foreign trade consists of 13 separate sectors. So, N equals 13. δ denotes the actual trade balance in each sector according to the SITC Rev.3 classification. λ is the multiplier that stands for the dynamic impact coefficients, as shown in equation (17).

$$\lim_{mse \to 0} cor\ (X; Y) \quad (16)$$

$$DTB = \sum_{i=1}^{n=13} [\delta_1.\lambda_1 + \delta_2.\lambda_2 + \delta_3.\lambda_3 \ldots + \delta_{13}.\lambda_{13}] \quad (17)$$

International trade theory typically considers goods in two separate categories as homogeneous and heterogeneous. Nevertheless, the dynamic effects of some sectors/goods on economic development are higher than others. In the analysis, the multiplier (λ), which adjusts the correlation between the actual sectoral trade balance (δ) and RE, figures out which sectors have a higher correlation with the dependent variable. If a sector with a higher multiplier value (λ) establishes a higher correlation with RE, the dynamic effects of this sector are higher.

5.5. Artificial Neural Network Test Method

ANN, which has flexible forecasting, excellent generalization capability, trainable and adaptive structure, employs more general functional forms than advanced statistical methods. Moshiri and Cameron (2000) compared the performance of ANN with ARIMA, VAR, and BVAR models. The consequence indicated that the Artificial Neural Network generally performed more effective results than these models. The algorithm employed in this study is the Levenberg-Marquardt (LM) backpropagation algorithm, which exhibits a dynamic behavior. LM can adaptively alter the parameter updates between Gradient-Descent and Gaussian-Newton algorithms. Thus, it successfully draws advantage of both algorithms to achieve swift and impressive outcomes. In ANN analysis, with iteration-in dept, the network training must converge to maximum verification performances, i.e., Minimum MSE values. Besides, training, test, and verification performances must also converge to each other in order to enhance network efficiency (to prevent it from memorizing). The theory points out that opting for a hidden layer is crucial to achieving more effective results since more than one hidden layers lead to confusion and decelerate the learning capacity. To sum up, Table 1 reports the details of the ANN test method below.

Table 1. ANN Test Specifications

Neurol Network	Input-Output and Curve Fitting
Serial Conversion	Normalization [0-1]
Distribution of Data	70% Training, 15% Test, 15% Validation
Samples	Matrix Rows
Network Structure	Multiple Neural Network
Algorithm	Levenberg-Marquardt (LM)
Hidden Layer Function	Sigmoid Function
Output Layer Function	Linear Function
Hidden Layer Number	1 pcs.
The Number of Hidden Neurons	10 pcs.
Performance Criteria	Mean Squared Error (MSE)
Max Iterations	1000
Max. Verification Check	6
Time Constraint	None
Program	Matlab R2021a

5.6. Sectoral Classification

The coefficients of determination (R^2) vary between (0-1), so the range of the multiplier is between ($0_{min} - 1_{max}$). The multiplier employs the minimum (0) and maximum (1) values to obtain the optimum correlation coefficient between dependent and independent variables. The sectoral clustering is determined by the correlation tests and the characteristics of the sectors. Different specialization groups such as A advanced specialization, B moderate specialization, and C labor-intensive divide the aggregate trade balance into three distinct groups. Table 2 rolls out the clustering details of the sectoral trade balances.

Table 2. Sector Classification According to World Trade Organization (SITC Rev.3)

Description of Sectors	**Category**
Office and telecom equipment	A
Electronic data and office equipment	
Telecommunications equipment	
Integrated circuits and electronic components	
Fuels and mining products	B
Iron and steel	
Chemicals	
Pharmaceuticals	
Transport equipment	
Automotive products	
Agricultural products	C
Textiles	
Clothing	

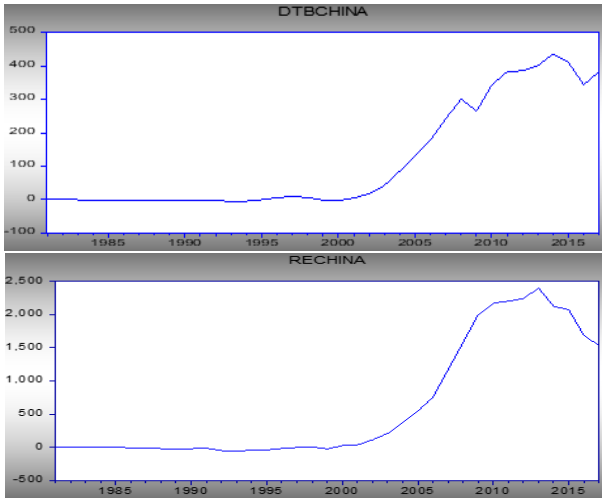
Determining the multiplier as zero for two specialization groups shows at what level the other specialization group can explain the economic development. Thus, with a practical application, it can be determined whether the dynamic trade balance,

that is, advanced sectors, can adequately explain economic development. Moreover, the analysis demonstrates to what extent the aggregate trade balance and other specialization groups can account for the economic development separately.

5.7. Analysis Results

Despite the relatively downward tendency, which has occurred since 2013, China has the highest positive RE. Between 2000-2013, RE has a consistent drastic upward trend in China. While China's aggregate trade balance can account for the RE tendency only by 47%, the advanced specialization group, i.e., the dynamic trade balance, can sufficiently explain it at 98%. The graphical tendencies of the variables in China are almost similar to each other (see Figure 1 and Table 3).

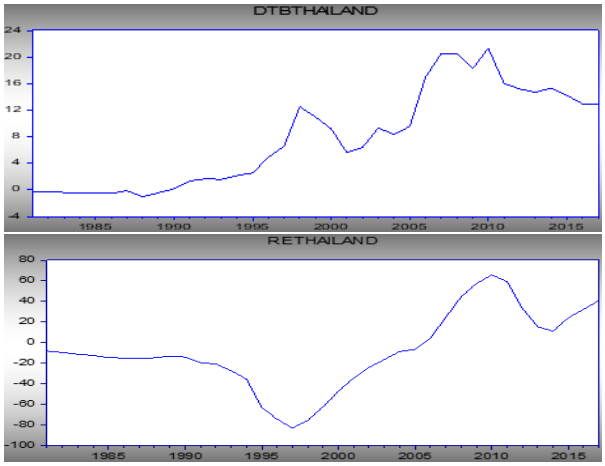
Figure 1. DTA and RE at Level in China (Billion Dollars).



Source: WTO and World Bank.

Being more unstable than China, RE has an overall positive outlook, and it has shown a resistant ascending tendency since 1997 in Thailand. Whereas the aggregate trade balance of Thailand accounts for the RE tendency only at 53%, the dynamic trade balance can explain it by 87%. There is an overall upward tendency in the variables in Thailand after the second half of the 1990s (see Figure 2 and Table 3).

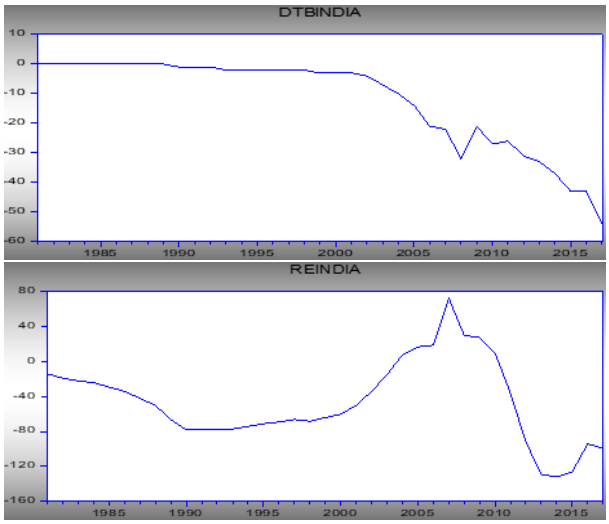
Figure 2. DTA and RE at Level in Thailand (Billion Dollars).



Source: WTO and World Bank.

The outlook of RE is generally negative in India because it has a steep downward tendency between 2007-2015. Between 2007 and 2015, net imports concentrated in the advanced sectors in India followed almost a similar behavior with RE. Whereas the aggregate trade balance explains the RE tendency in India at 64%, the dynamic trade balance can account for it by 79% (see Figure 3 and Table 3).

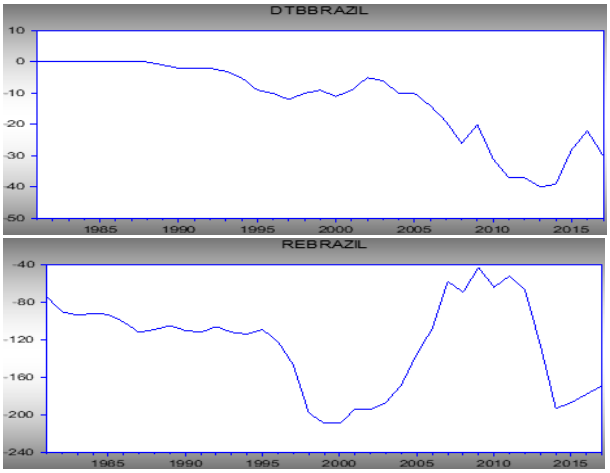
Figure 3. DTA and RE at Level in India (Billion Dollars).



Source: WTO and World Bank.

In Brazil, RE has an inconsistent trend, particularly after 1995, yet it is generally negative. Although Brazil has a surplus in the aggregate trade balance based on agricultural products, it has a negative tendency in RE. This outcome reveals the significance of the advanced (dynamic) sectors for macroeconomic stability. While the aggregate trade balance explains the RE tendency at 33%, the dynamic trade balance can account for it by 71% in Brazil (see Figure 4 and Table 3).

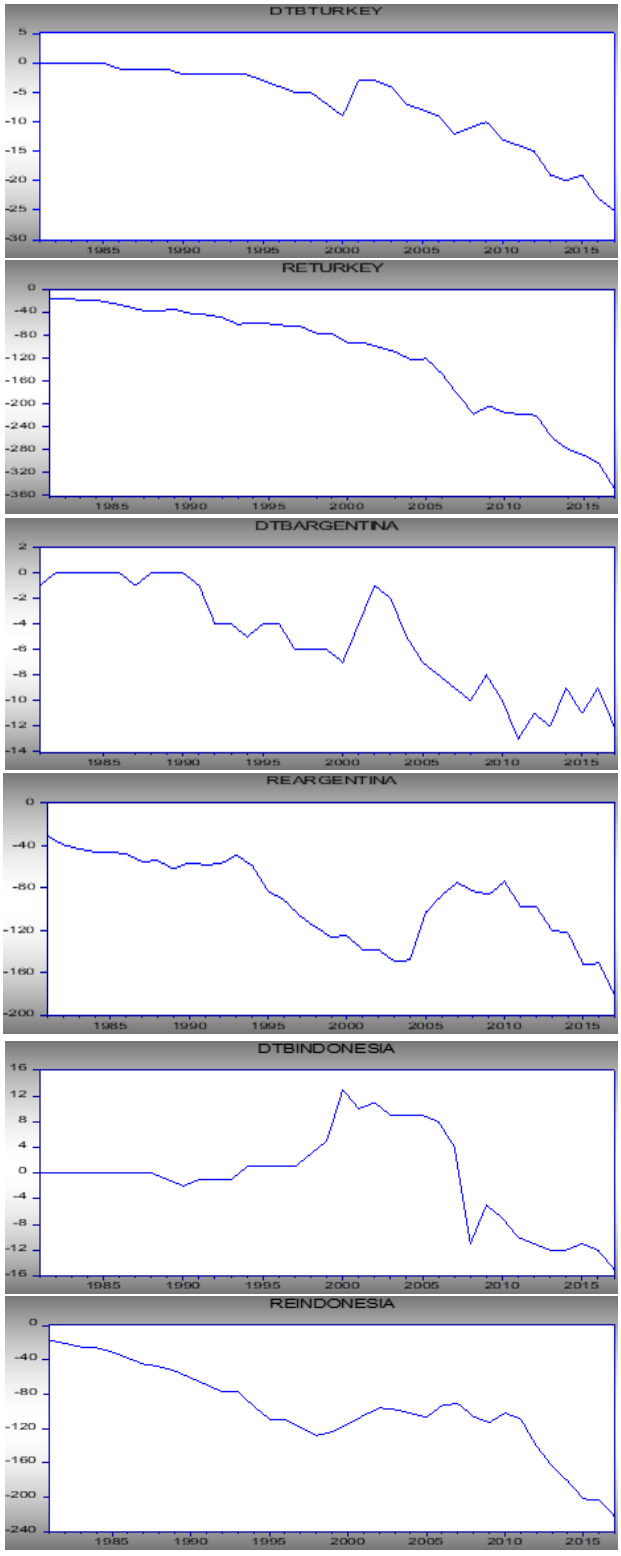
Figure 4. DTA and RE at Level in Brazil (Billion Dollars).

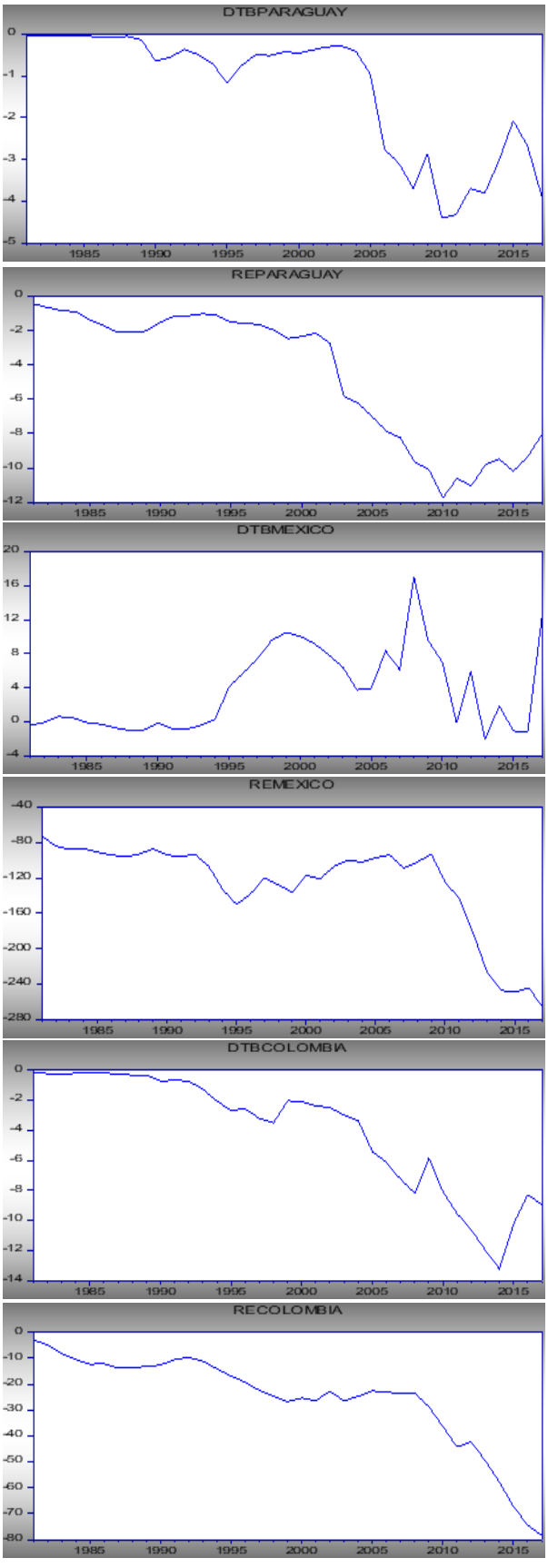


Source: WTO and World Bank.

RE exposes an overall drastic downward tendency in Turkey, Columbia, Argentina, Indonesia, Paraguay, and Mexico except for a steep ascending trend in Paraguay after 2010 and Argentina between 2004-2010. In these countries, RE typically has a negative outlook. Except for Mexico, the net imports in advanced sectors have exhibited a steep downward trend in these countries, especially since 2000. There are overall negative tendencies in the variables in all countries in Figure 5, except for DTB in Mexico (see Figure 5 and Table 3).

Figure 5. DTA and RE at Level in Turkey, Argentina, Indonesia, Paraguay, Mexico, and Colombia (Billion Dollars).





Source: WTO and World Bank.

Except for a slight deviation in Mexico, the analysis demonstrates that the dynamic trade balance (the trade balances in the advanced sectors) can effectively explain the RE tendencies. According to the average coefficient of determinations, while the aggregate trade balance's explanatory rate is 61%, the dynamic trade balance increases this rate to 85%. Furthermore, other sector groups (B and C) have not successfully explained RE's tendency than the advanced sectors. According to the analysis result, this paper rejects the H_0 hypothesis by accepting the alternative hypothesis (see Table 3).

Table 3. Determination Coefficients (R^2) According to Specialization Criteria

Speciali-zation Mode	The Aggregate Trade Balance	Labor Intensive	Moderate Speciali-zation	Advanced Speciali-zation
(λ) Multipler	A=1 B=1 C=1	A=0 B=0 C=1	A=0 B=1 C=0	A=1 B=0 C=0
China	0,47	0,93	0,99	0,98
India	0,64	0,89	0,63	0,79
Turkey	0,93	0,90	0,96	0,98
Argentina	0,66	0,78	0,58	0,77
Thailand	0,53	0,88	0,58	0,87
Mexico	0,90	0,23	0,91	0,72
Brazil	0,33	0,55	0,25	0,71
Colombia	0,83	0,90	0,59	0,84
Indonesia	0,29	0,77	0,81	0,86
Paraguay	0,53	0,97	0,61	0,93
Mean R²	**0,61**	**0,78**	**0,69**	**0,85**

CONCLUSION

International trade theory rests on the development disparity among the countries. The fact that Mercantilists exported industrial goods to their colonies while importing raw materials demonstrates they were aware of the relationship between trade and economic development. Even though A. Smith contends that both parties can benefit from international trade, he admits that international trade is more advantageous for a more developed country. This acceptance of him uncovers the significance of the development disparity among countries.

Many of the theories modeling international trade imply, in their core context, the development disparity among countries. For instance, the doctor is more developed than the secretary. Hence, the secretary exports labor-intensive goods, as she does not have a skilled workforce. These goods do not require intensely innovative efforts. Likewise, since the doctor developed from the secretary, the doctor mainly exports capital goods. These goods rely heavily on innovative efforts. Therefore, developed countries intensely export innovative products. As a result, international trade theory must focus on the reasons for the disparity in development among countries. It is highly related to all of the factors stated in the introduction section.

Countries that succeed in maturing all the factors explained in the introduction, in the past, are developed countries. The critical point of evolving these factors is closely related to the consistent increase in the adequacy of the trade balance in advanced sectors in the long run. In today's global conditions, the fact that a country, through its own endogenous dynamics, exports more than its imports in advanced sectors means that this country exogenously disseminates its internal economies of scale advantages from advanced sectors to other many sectors. Consequently, the development dynamics of the economy get stronger in proportion to the strength of the trade balance in advanced sectors.

Compared to the conventional version, the new version of international trade theory explains the trade events with more realistic assumptions. Nonetheless, its content implicitly ratifies the validity of the Mercantilist formulation. Unlike the Mercantilists, the new version ignored the trade balance, which can cause severe macroeconomic ramifications. The trade balance should not have a long-run inconsistent tendency to sustain the validity of the static trade profits formulated by international trade theory. Otherwise, trade yields will shrink due to negative reversals to terms of trade.

When a country is compulsorily dragged into devaluation by the adverse dynamic effects of the trade balance, its trade volume and benefits of imported goods diminish significantly. A country's trade yields lessen since its structure of comparative advantages deteriorates due to devaluation. Therefore, trade yields that international trade theory deals with at the static level decrease when considering the adverse dynamic effects of the trade balance. On the other hand, countries that take advantage of the positive dynamic effects of the trade balance do not have only a positive trade balance but also have a structural, technological transformation in their industries. Accordingly, since the structure of comparative advantage strengthens, countries that benefit from the positive dynamic effects of the trade balance yield more from international trade.

Thanks to the better development dynamics, countries become the doctor or maintain to be the doctor; they mainly export capital-intensive goods and remain innovative. On the other hand, due to insufficient development dynamics, countries continue to be the secretary; they mainly produce and export labor-intensive goods. An economy subject to the adverse dynamic effects of the trade balance runs into increasing production costs, primarily owing to higher external debts and financial expenses that decrease its competitive edge and technological competence. On the other hand, countries like China, which benefit from the positive dynamic effects of the trade balance, manage to diminish production costs through increasing competitiveness, technological competence, and abundant financing.

In the analysis chapter, this paper has analyzed the relationships between RE, a significant economic development variable representing the development disparity among countries, and the DTB, which embodies the dynamic trade balance, via ANN for ten leading developing countries. According to the analysis outcomes, whereas China and Thailand benefit from the positive dynamic effects of the trade balance, Turkey, Indonesia, Colombia, Paraguay, Argentina, and Mexico are exposed to the adverse dynamic effects of the trade balance. On the other hand, India and Brazil are generally subject to the adverse dynamic effects of the trade balance, yet relatively at lower levels.

Of the countries analyzed in the paper, China takes advantage of the highest positive dynamic effects of the trade balance. Like China, Thailand also benefits from the positive dynamic effects of the trade balance, but these yields are not stronger than China. The ability of the dynamic trade balance to explain RE has increased in analysis countries, except for Mexico. In Mexico, moderate specialization sectors account for RE more strongly. The conclusion that emerged in Mexico causes an insignificant deviation (Consequently, DTB can explain RE at the rate of 72%, which is not a low rate) from the primary idea of this paper, but this is an exceptional situation since it only occurs in Mexico.

These consequences endorse that international trade yields differ in proportion to disparities in economic development among countries.

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ANNEX 1. Advanced Script and Functions Employed for ANN

```
% Solve an Input-Output Fitting problem with a Neural Network
% Script generated by Neural Fitting app
% Created 01-May-2021 22:04:26
% This script assumes these variables are defined:
%   input - input data.
%   output - target data.
x = input';
t = output';
% Choose a Training Function
% For a list of all training functions type: help nntrain
% 'trainlm' is usually fastest.
% 'trainbr' takes longer but may be better for challenging problems.
% 'trainscg' uses less memory. Suitable in low memory situations.
trainFcn = 'trainlm';  % Levenberg-Marquardt backpropagation.
% Create a Fitting Network
hiddenLayerSize = 10;
net = fitnet(hiddenLayerSize,trainFcn);
% Choose Input and Output Pre/Post-Processing Functions
% For a list of all processing functions type: help nnprocess
net.input.processFcns= {'removeconstantrows','mapminmax'};
net.output.processFcns= {'removeconstantrows','mapminmax'};
% Setup Division of Data for Training, Validation, Testing
% For a list of all data division functions type: help nndivision
net.divideFcn = 'dividerand';  % Divide data randomly
net.divideMode = 'sample';  % Divide up every sample
net.divideParam.trainRatio = 70/100;
net.divideParam.valRatio = 15/100;
net.divideParam.testRatio = 15/100;
% Choose a Performance Function
% For a list of all performance functions type: help nnperformance
net.performFcn = 'mse';  % Mean Squared Error
% Choose Plot Functions
% For a list of all plot functions type: help nnplot
net.plotFcns= {'plotperform','plottrainstate','ploterrhist', ...
    'plotregression', 'plotfit'};
% Train the Network
[net,tr] = train(net,x,t);
% Test the Network
y = net(x);
e = gsubtract(t,y);
performance = perform(net,t,y)
% Recalculate Training, Validation and Test Performance
trainTargets = t .* tr.trainMask{1};
valTargets = t .* tr.valMask{1};
testTargets = t .* tr.testMask{1};
trainPerformance = perform(net,trainTargets,y)
valPerformance = perform(net,valTargets,y)
testPerformance = perform(net,testTargets,y)
% View the Network
view(net)
% Plots
% Uncomment these lines to enable various plots.
%figure, plotperform(tr)
%figure, plottrainstate(tr)
%figure, ploterrhist(e)
%figure, plotregression(t,y)
%figure, plotfit(net,x,t)
% Deployment
% Change the (false) values to (true) to enable the following code blocks.
% See the help for each generation function for more information.
if (false)
% Generate MATLAB function for neural network for application
% deployment in MATLAB scripts or with MATLAB Compiler and Builder
% tools, or simply to examine the calculations your trained neural
% network performs.
genFunction(net,'myNeuralNetworkFunction');
y = myNeuralNetworkFunction(x);
end
if (false)
% Generate a matrix-only MATLAB function for neural network code
% generation with MATLAB Coder tools.
genFunction(net,'myNeuralNetworkFunction','MatrixOnly','yes');
y = myNeuralNetworkFunction(x);
end
if (false)
% Generate a Simulink diagram for simulation or deployment with.
% Simulink Coder tools.
gensim(net);
end
function [Y,Xf,Af] = myNeuralNetworkFunction(X,~,~)
%MYNEURALNETWORKFUNCTION neural network simulation function.
% Auto-generated by MATLAB, 01-May-2021 00:33:11.
% [Y] = myNeuralNetworkFunction(X,~,~) takes these arguments:
% X = 1xTS cell, 1 inputs over TS timesteps
% Each X{1,ts} = Qx1 matrix, input #1 at timestep ts.
% and returns:
% Y = 1xTS cell of 1 outputs over TS timesteps.
% Each Y{1,ts} = Qx1 matrix, output #1 at timestep ts.
% where Q is number of samples (or series) and TS is the
```

```
    number of timesteps.
% #ok<*RPMT0>
% ===== NEURAL NETWORK CONSTANTS =====
% Input 1
    x1_step1.xoffset = 0;
x1_step1.gain = 2;
x1_step1.ymin = -1;
% Output 1
y1_step1.ymin = -1;
y1_step1.gain = 1.99999999999904;
y1_step1.xoffset = 4.66136648496152e-13;
% ===== SIMULATION ========
% Format Input Arguments
isCellX = iscell(X);
if ~isCellX
  X = {X};
end
% Dimensions
TS = size(X,2); % timesteps
if ~isempty(X)
  Q = size(X{1},1); % samples/series
else
  Q = 0;
end
% Allocate Outputs
Y = cell(1,TS);
% Time loop
for ts=1:TS
% Input 1
X{1,ts} = X{1,ts}';
Xp1 = mapminmax_apply(X{1,ts},x1_step1);
% Layer 1
a1 = tansig_apply(repmat(b1,1,Q) + IW1_1*Xp1);

% Layer 2
a2 = repmat(b2,1,Q) + LW2_1*a1;

% Output 1
  Y{1,ts} = mapminmax_reverse(a2,y1_step1);
  Y{1,ts} = Y{1,ts}';
end
% Final Delay States
Xf = cell(1,0);
Af = cell(2,0);
% Format Output Arguments
if ~isCellX
  Y = cell2mat(Y);
end
end
% ===== MODULE FUNCTIONS ========
% Map Minimum and Maximum Input Processing
Function
function y = mapminmax_apply(x,settings)
y = bsxfun(@minus,x,settings.xoffset);
y = bsxfun(@times,y,settings.gain);
y = bsxfun(@plus,y,settings.ymin);
end
% Sigmoid Symmetric Transfer Function
function a = tansig_apply(n,~)
a = 2 ./ (1 + exp(-2*n)) - 1;
end
% Map Minimum and Maximum Output Reverse-
Processing Function
function x = mapminmax_reverse(y,settings)
x = bsxfun(@minus,y,settings.ymin);
x = bsxfun(@rdivide,x,settings.gain);
x = bsxfun(@plus,x,settings.xoffset);
end
```