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# BLOWING IN THE WIND: THE TRADE PATTERNS OF PARTS OF WINDMILLS

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**Abstract**

This paper investigates the trade and specialization pattern of windmills and windmills equipment, in order to make predictions about future trade patterns.

The data is collected from organization for Economic Cooperation and Development (OECD) countries, international Trade by Commodity Statistics (ITCS) in windmills and windmills equipment in Europe (OECD-Europe) and the world (OECD-World) especially during the period 1996-2009.

The results of my study show evidence of a high trade pattern of Comparative Advantage (CA) in some countries, but at the same time the Intra-Industry Trade (IIT) increased, which means that more and more countries produce windmill equipment and trade with each other, between OECD countries and Europe (OECD-Europe) and between OECD countries and the world (OECD-World), during the period 1996 to 2009.

These results provide us with an analysis and prediction of a changing world and competitive future markets. The technological development and integration between countries (OECD-Europe), and (OECD-World), led to changes in the data of resources. As a result there is comparative advantage (CA) and increase return to scale (IRS).

**Key words**: Inter -Industry trade, Intra- Industry Trade, comparative advantage, Increase return to scale.

***The Trade Patterns of Parts of Windmills***

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| List OF abbreviations | Definition |
|---|---|
| CA | Comparative advantage |
| CD | Comparative disadvantage |
| CHOS | Chamberlain Heckscher Ohlins Samuelsson |
| COMT | Commodity Trade |
| DM | Direct Measure |
| DOM | Domestic markets |
| ECA | Export Credit assistance |
| EG | Economic growth |
| ES | Economic OF scale |
| FTI | Financial tax Incentives |
| GL | Grubel-Lloyds |
| HS | Harmonization system |
| HK | Helpman & Krugman |
| H&K | Hamilton & Kniest |
| HCI | Human captial intensive |
| HOT | Heckscher-Ohlins Theory |
| IM | Indirect magsure |
| IRS | Increase return To scale |
| ITCS | International trade by commodity statistics |
| IIT | Intra Industry trade |
| INIT | Inter Industry trade |
| IP | Industrial policy |
| ISM | Indirect supply mechanism |
| LCR | Local content requriements |
| LI | Labor intensive |
| M | Imports |
| MIIT | Marginal intra Industry trade |
| MCA | Measure OF comparative advantage |
| NTT | New trade theory |
| OECD | Organization for economic cooperation & development |
| X | Exports |
| PCT | Product cycle theory |
| QA | Quantitive Assistant |
| R&D | Research and development |
| SI | State intervention |
| SS | Autarky or Self satisfiction |
| TS | Trade specialization |
| TTT | Traditional trade theory |
| UN | United nations |
| UNSD | United nations statistical division |
| US | United States |

# 1. Introduction

The idea of free international trade engaged economist since the 19th century until today´s global trading. The assumption is based on comparative advantage (CA) model or gains from trade explained as being the differences between self-sufficient(SS) and free trade prices (Gordon 1984). This indicates that if a country trade at a price ratio other than its domestic price it will be better than self- sufficient (autarky). In small countries world prices differ from self-sufficient (autarky) prices (Samuelsson 1939). In large countries the free trade is superior to self-sufficiency (autarky) due to availability of many products with variable suppliers (Kemp 1962). It is argued that if trade could benefit all country´s population assuming their incomes are identical, it will lead to an income redistribution. It varies between differences in technologies or differences in factor endowments. Other factors that lead to benefits or gains from trade are not only differences between countries, but also gains due to economic of scale(ES), variety of products, to eliminate monopoly or increase production, or trade that leads to a positive economic growth (EG). The assumption of international trade is combined with theories that explains trade: For example North-South trade might be explained by the models that joins trade patterns to differences between countries, while a model of monopolistic competition explain trade between similar countries. The theoretical economic studies are combined with empirical work to examine and predict traditional and different types of gains from trade.

In this essay I focus on the economic growth (EG) of the production in windmills and windmills equipment, changes in economics and innovation that affect the economics at the aggregate level.

The aim of this essay is to analyses trade and specialization pattern of windmills equipment. We investigate the trade patterns (TP) with the help of several trade indices and then we use several theoretical models such as the product cycle theory(PCT), traditional trade theory (TTT) and new trade theories (NTT)in order to analyses the possible welfare implications of these changes.

The results of the essay in section five shows that trade patterns are steered by comparative advantage (CA), but the role of economies of scale (ES)and product differentiation may gain a driving direction since Intra-industry trade (IIT) increase overtime.

The plan of this essay is as follows. The first section is an introduction. Section two describes the theoretical background and framework of inter industry (INIT) versus intra industry trade (IIT). The third section discusses the methodology of measuring (I) intra-industry trade (IIT) and (ii) inter-industry trade (INIT). The fourth section presents the data while the fifth section shows the results from 33 (OECD) countries . The final section contains a summary and a conclusion.

# 2. Theoretical Background

The aim of this section is to show the relationship between the product cycle theory (PCT)and the two types of inter industry (INIT) specialization and intra industry(IIT) specialization that are influenced by differences in comparative advantage(CA) and economics of scale (ES).

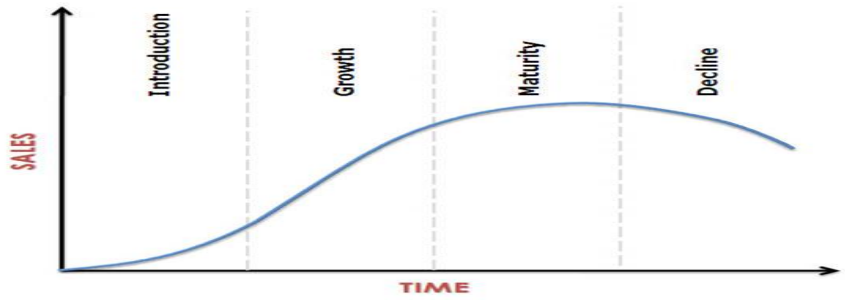
This section is divided into three parts: the first part describes the product cycle theory (PCT) illustrated by a diagram. The second part focus on the product cycle and trade specialization, inter industry (INIT) and intra industry trade (IIT) related to the product cycle theory (PCT). And also an explanation of the combination between the (PCT) considers how the production changes over time while Heckscher-Ohlin theory (HOT) explains the location of the product changes in order to follow the pattern of (CA). The third part of this section shows how state intervention (SI) (industrial policy (IP) or other measures) can influence the product cycle and trade specialization.

First, given the assumption of (PCT), the model predicts that the production starts in the country of origin in which it is invented. After the production is known in the world market, It is domestically consumed and when the product is matured, then the producer start exporting it. The model aims to provide laborsaving, capital using products that starts first in high income countries (HIC). For example in the United States (US) the new production are used and consumed in the (US), no export trade occurs. In the maturity, the production are developed and foreign demand increase in the developed countries. The (US) exports the products to other countries. When the product matures and becomes more standardized and less capital is needed (human and/or physical), then the country with a (CA) of producing the good changes since it moves perhaps into becoming a more labor intensive (LI) product instead of human capital intensive (HCI). This model is explained by Vernon (1966)

When the capital intensity of the product changes as it matures, then the pattern of (CA) in this product changes (e.g. countries with an abundance in labor may have a (CA)as a product matures while countries with an abundance in capital lose its (CA)

The (PCT) has three faces of introduction, growth and maturity. In the introductory phase, the increase in production and trade leads to quick growth until the maturity phase. Some countries gain (CA) and enjoys a first mover advantage that benefit from inter industry trade (INIT) as a result of increasing domestic markets (DM). In the second stage production starts in other countries and intra industry (IIT) specialization takes over. Thistheoretical chapter describe the case of an industry that is characterized by economic of scale (ES) and product differentiation (Petersson (1984). Figure 1 shows the Product cycle Theory stages (Vernon,R 1966).

Figure 1: The Product cycle Theory.




The second part of this section is related to Heckscher-Ohlin theory (HOT) describes the product cycle & trade specialization, inter industry trade (INIT) and intra industry trade (IIT) that product cycle theory (PCT) gives rise to:

The (INIT) specialization explains the assumption of (CA) in countries with different characteristics. This is explained by Heckscher Ohlin Theory (HOT), (1985). The low of (CA) in economics is explained as the ability of a country to produce products at lower marginal and opportunity costs over another (i.e. "the amount of resources use in making it could have been used to produce other products instead"). The (CA) assumption explains that each country gain specialization in the products it has a (CA) and trading that product to the other. The assumption of (CA) aims to predication patterns of trade that is based on differences of factor endowments. This is based on (HOT) and the Ricardian Theory (RT). The Theory says that countries export products that are abundant using cheap factor of production and import products that have scarce factor. This is explained by (HOT). The inter industry trade (BL),(INIT) or one way trade arise due to differences in resources between countries so that any type of products might be exported or imported but not both.

A more extensive trade occurs between countries with similar characteristics (in the 20$^{th}$ centuries) In the (IIT) assumption explains that a product may be differentiated so that we find several different varieties of one product. The (IIT) or two ways trade arise as a result of economics of scale (ES) that allows a variety of products that a country provide in a large scale to export(X) and then import (M)from the others. This is explained by Helpman and Krugman (HK), (1985)

The New Trade Theory ( NTT) involves both intra industry trade (IIT) and inter industry trade (INIT) or(BL). (NTT) uses Chamberian Heckscher Ohlin Samuelsson (CHOS) focuses on the variety demand of the product relates to horizontal differentiated products. The New trade theory (NTT) involves two assumptions: This is explained by (HK), (1985).

- "First a specialization pattern (SP) in line with (TTT) through differences in factor endowments. That is, a country specialize according to their (CA)".
- "Second, a specialization between firms in the same industry that lead to (IIT), economics of scale (ES), arise within industries. Each firm within a particular industry specialize its production of varieties that is not available in any other firm. This lead to Bilateral (IIT) between any two countries as a result of factors of small economies of scale (ES). The number of varieties, exported from one country, depends on the specialization at the

aggregated level. That is determined by (CA). A higher (IIT) in total trade occur when relative factor endowments between two trade countries become similar.

The performance of first mover advantage and how this may influence the trade patterns (TP) and whether the trade becomes (INIT) or (IIT) due to these characteristics, is explained in this section.

The analysis in this section discuss the (PCT) combined with the (HOT): The (PCT) considers how the production changes over time while the (HOT) explains the location of the production. Hence if the product´s production changes over time, then the location of the product changes in order to follow the pattern of (CA).

This section describes the theoretical background of trade patterns (TP) by using the (PCT) Petersson (1984). The (PCT) described above related to windmills in this essay as the results shows a (CA) in some countries and a decreasing (IIT) in some of those countries which suggests that the markets become more specialized. But at the same time the (IIT) increased in some other countries, which means more countries produce windmills equipment's and trade with each other. This suggests a competitive future market between OECD countries (OECD-World) and (OECD-Europe).The traditional (TTT) and (NTT) are based on (HK), (1985) with its two assumptions of: (INIT), (CA), (one way trade) that arise due to differences in factor endowments. (IIT) or (two ways trade) arise due to (ES) between firms in the same industry. This section also included the relationship between the (PCT) and (HOT). As the (PCT) l considers how the production changes overtime, (HOT) explains the location of the product changes in order to follow the pattern of comparative advantage (CA). The Revealed comparative advantage (RCA) indicates the export competitiveness in renewable energy industries and its relationship to economic factors.

The third part of this section discuss the development of windmills industry combined with the role of the state and how the state intervention(SI), (industrial policy(IP) and other measures) can influence the product cycle and trade specialization.

Policies that support local wind turbine manufactures and assist policy makers to encourage domestic manufacturing of wind turbines consists of direct (DM) and indirect measures (IDM). (DM) policies measure the local wind manufacturing industry development specific in countries where barriers to entry and competition is high. Some polices support international and domestic companies to manufacture while others support domestically owned wind turbines manufacturers. The (IDM) policies support wind power utilization, focus on environment for local wind manufacturing industry (by creating sizable, stable markets for wind power) manufactures. For example,

**Local content requirements (LCR)** policy influence the trade patterns (TP) in the point of view of the (PCT) by protecting and utilization of the domestic production and consequently prevent it to move abroad to other countries. It is a (DM) aims to support, encourage domestic manufacturing of wind turbines specific in countries where barriers to entry and competition is high. This policy requires a certain percentage of (LCR) for wind turbine installed in the projects within a country where manufacturers should be able to meet the local requirements suggested by the governments. This policy is useful in that it force wind companies that aims to sell to a domestic market (DM) or/companies that aims to obtain from abroad (outsource) components used in their turbines, to turn to domestic companies. **Financial and Tax incentives(FTI)**: encourage local manufacturing and

developers in turbines made locally by providing low-interest loans for project financing or providing financial subsidies to wind power generated with locally made turbines. (FTI) encourage local companies to be involved in the wind industry through eg tax credits, reduction for investments in wind power technology manufacturing or (R&D). Alternative a reduction in sales value added tax (VAT) or income tax for buyers/sellers of domestic wind turbines technology or production can increase the competitiveness of domestic manufacturers. In addition a tax deduction can be permitted for labor costs within local wind industry. (FTI) is useful to companies of joint ventures between foreign and local companies in order to promote international cooperation and technology transfer in wind industry and specially encourage local ownership of wind turbines manufacturing**.** **Favorable customs duties (FCD)**: a policy to create incentives in customs duties (CSD) for local manufacturing through using of (CSD) to encourage the import(M) of turbine components over the import (M) of entire turbines. This creates a market for firms trying to manufacture wind turbines domestically by allowing them to pay a lower (CSD) to import (M)components that companies are importing(M). **Export Credit Assistance (ECA)** Government can support expansion of domestic wind power industries operating in overseas markets through (ECA), providing different support to locally owned manufacturers. (ECA) can be in the form of low-interest loans or "tied aid" given from the country where the turbine manufacturer is based to countries purchasing technology from that country. **Quality certificate (QC)**: in order to promote creditability of an emerging wind power company´s turbine is through participation in a certification and testing program that meets international standards. .**Research and Development (R&D**): found to be most effective in the coordination between private wind companies and public institution such as national laboratories and universities (Swain 2001, Kamp 2002). The wind turbine technology and commercialization program play role in the performance of new domestic wind technology before those turbines proceed into commercial production.

**Indirect support mechanisms (ISM)**: The success in domestic markets is based on the success in the international market. In order to achieve a stable local market, a performance of wind power policies is required. The polices mentioned below aims to create a demand for wind power at the domestic level in order to achieve a stable local market. **Feed-in tariffs (FIT):** stable markets and feed in tariffs policies to promote wind power development. **Mandatory renewable energy targets (MRET): or renewable portfolio standards(RPS) or the purchase obligations** is a new policy that requires a fixed percentage of electricity in each retail supplier´s portfolio generated by renewable resources, through policy designed to a specific domestic markets. **Government tendering (GT)**. Another way for the government to achieve wind development is by competitive auctions for wind projects or resources tenders for prime wind size combined with benefits in long term power purchase agreements.

# 3. METHODOLOGY: The Measurements

In this section we present two different measures that will be used to investigate the pattern of trade in windmills between OECD countries. The two measurements are: (i) measurement of Intra Industry Trade (IIT), by using Grubel and Lloyds (GL) Index (1975), where the same classification are both exported and imported. (ii) Measurement of Inter-industry trade(INIT) (comparative advantage) (CA), due to differences in resources between countries, where the products are either exported(X) or imported (M)but not both.

**Measurement of Intra-Industry Trade (IIT):**

The intra-industry trade (IIT) defined as the two-way trade of goods of similar factors within industries, measured by Grubel-Lloyds (GL) (1975) Index formula:

GL=IIT= 1-abs (X-M)/(X+M)

Where: GL=Grubel and Lloyds Index formula (1975), IIT= Intra Industry Trade, X=exports, M= Imports. The minimum value of ZERO (0), in case, there are no products in the same class that are both imported(M) and exported(X). The Maximum value of (one) or 100%, when all trade is intra-industry (IIT). Grubel Lloyds (1975) measures of intra industry trade(IIT) showed (negative/positive) results of the relation between intra industry trade (IIT)and scale of economics(ES).

GL=1, means that there is only intra industry trade (IIT), no inter –industry trade(INIT). This means that the country is exporting as much products as it is importing. If GL = 0, means that there is no intra industry trade (IIT) only inter-industry trade (INIT). This means that the country is either only exporting (X)or only importing(M) products (Willmann.com).

The measures vary between (0 )and (100). The level of intra-industry trade IIT) is (100), when the exports(X) are exactly equal to the imports(M) of an industry the measure of intra industry trade(IIT) is (100), and when there are exports(X) but no imports(M) or the opposite the measure is (0).

**Measurement of Comparative advantage (BL) or (CA)**

Inter Industry Trade(INIT) or one-way trade, where countries specialize in producing the products in which they have a comparative advantage(CA) so that they will export (X)this products, so as to import (M)the products on which they don´t have a comparative advantage(CD). The formula used in BL measurement:

BL = (X-M)/(X+M)

According to Balassa (1965), a developed measure of (RCA), the results range between (-1) to (1). The (-1) shows a comparative disadvantage (CD), the results (1) refers to comparative advantage(CA), and (0) ambiguous. The results OF the RCA, divided Into Three Groups,

- The results between (1) and (0.5) considered as products of (CA).
- Results between ((-1) and (-0.5) considered as (CD).

Results between (-0.5) and (0,5) neither (CA) nor (CD) ambiguous. The importance of each products/group products is determined by its specialization, according to: share of total trade/total exports. The greater share of total trade a greater importance to the economy since changes will show greater impact on the economy.

Given the assumption of (GL) (1975) explained intra industry trade (IIT) as a share of total bilateral trade in a specific industry. Where( X) and (M )refer to country´s exports and imports to/from a country over one specific year. This measure values are between (Zero) and (one) and increases in the share of (IIT). The indexes for pairs of countries, where (IIT) measures comes from the observation of simultaneous (M )and( X) between a given pair of countries and this definition of( IIT) also identify similarity of trade among country pairs. (GL) (1975) p86, defined (IIT) as “Treaded

differentiated products that are close substitutes ". Over time, the substitutability in production (a) shows trade flows to production patterns and (b) links between( IIT) and factor-market adjustment.

Given the assumption of Marginal Intra-Industry Trade (MIIT),( GL) index refers to the pattern of trade in one year, (i.e. a static measure). This is suitable in international specialization patterns at a specific point in time. (i.e.) the development of dynamic measures or (MIIT) , (Brulhart, M ),2009)

A high proportion of( IIT) in one particular period of time does not show the prediction of the pattern of changes in trade flows. An increase in (IIT) between two periods (GL1 – GLt-1 >0) could have a change in trade flows, combined with inter-industry rather than intra-industry adjustment. (H&K, 1991)

(MIIT) means increase or decrease of M /X in an industry. Such matched changes of trade volumes can be combined with an effect on employment. e.g. if industry I (M) expand, domestic jobs may be threatened in that industry, but if industry I (X) expand by a comparable amount, this may offset lost market share domestic market and results a ZERO net change in the industry´s domestic employment. Lovely and Nelson (2000) shows that in general equilibrium, (MIIT) can be combined with inter-industry reallocation of factors if productivity is also allowed to change (Brulhart, M), 2009)

The differences between (IIT) and (MIIT) shows that, (MIIT) measures have developed to the "matchedness" of trade changes. The most used measure is a change of the (GL) index to first differences of sectoral trade flows:

MIIT = 1-((changes in X – changes in M)/ (changes in X + changes in M)).

Where changes stands for the differences between years t and (t-T). This index, like the (GL )index completely of the inter-industry type, and ( 1 )represents marginal trade entirely intra industry type. (Brulhart, M 2009)

**(MIIT)** assumption in international economics, refers to the change in country´s (X) over a certain period of time that are of the same products as its change in (M) over the same period. This assumption is closely related to the assumption of (IIT). I.e. (X) and (M) of the same items, but the changes in (X)and (M) between two points in time. The assumption is useful due to the fact that the adjustment in costs is combined with changing trade flows or the changes in distribution of income. The formula used is:

MIIT= 1-((changes in X- changes in M) /(changes in X+ changes in M))

Where changes in (X )represents the change in (X) between two points in time and changes in (M) represents the changes in (M) over the same period of time. The changes in trade flows might be negative. When (X) and (M) of a product change by the same amount, the index is one, while if (X) increase while (M) do not (or vice versa) then the index is (Zero). Adjustment costs or distribution effects are small if the (MIIT) index is high. The choice of time period is random but might affect the results. The index calculation is a sum of the different changes in (M) and (X) in different (sub sectors). The formula used is:

MIIT = 1- sum of (changes in X – changes in M)/(changes in X + changes in M).(Wikipedia, free encyclopedia)

Studies in the **properties of (MIIT),** shows how useful the index is related to measurement changes in ( IIT) and adjustment. For example Hamilton & Kniest (H&K)(1991) measurements is valuable since it has characteristics that locate the (GL)measures similar way to the index. It focuses on changes in trade flows, regarding adjustment questions. (Greenaway, D 1994)Several problems are found in the properties that influence the measure upwards, and make it unsuitable in evaluating adjustment problems such as: the data is examined in a non-random way that led to excluding important information. It inflates the measures ( MIIT) by using nominal rather real data. And it is unscaled. The conclusion suggested how to measure ( MIIT) more effectively in evaluating the adjustment and consequences of trade expansion. ((H&K) 1991); (Greenaway, D 1994)

In measuring (MIIT), (H &K) argues that the investigation of the adjustment to trade in the economic system estimates the share of (IIT) in new trade flows. The index calculates the proportion of the increase in (M) or (X) of a particular industry that is matched by an increase of (X) or (M) of the same industry. If all additional trade is matched, then the index will equal unity. By contrast, if it is all unmatched trade, it will equal( zero). e.g. 0 <MIIT<1, then change in X, changes in M>0. if changes in X or changes in M<0, then the index Is undefined,(i.e.) if a fall in exports or imports occurs, then the index is undefined. (H &K) use this index to investigate the relationship between (MIIT), and structural adjustment (H &K, 1991)

Considering the problems with the measure: First: (MIIT) can be calculated for non-negative values of (X) and (M). If either changes in (X ) or changes in (M) is negative, then (MIIT) is undefined. In evaluation of changes in (IIT), this means ignoring relevant information, the sample we use is biased.

A second problem that (H&K) measures only takes into account changes in nominal value of( X) and (M). If between t-n and t the economy experiences inflation, then this biases is (MIIT). As measured by the (H&K) index, in an upward direction. To adjust to this, it is suggested that one reduce the data by the appropriate price index to obtain estimates of real (MIIT). Once it is adjusted in this way, the proportion of cases where the index is undefined increases up to two thirds of the total.

A third problem is one which shared with the( G-L) index that (MIIT) is unscaled. It tells us something about the importance of (IIT) in new trade (or new trade when both changes in (X) and changes in (M) are non-negative), without references to either the amount of new trade, or the level of trade. Thus, if an industry A (X) and (M) both increase by $1, while in industry B they both increase by $1000 million, (MIIT) would turn out to be one in both cases. This turn out to be the case because it is a trade share measure. In evaluating the economic significance of any changes, this is not a desirable characteristic. Moreover, the economic importance will also influenced by where we started-if industry A has an annual turnover of $3million , while B has a turnover of only $50 million, then the economic effect of both changes will be quite different (this relates to adjustment issue and is something to which we will return below).

There are difficulties in using this kind of measure to make conclusion about adjustment pressure. This is the reason why (H&K),(1991) calculate (MIIT): the adjustment describes the process of reallocating resources from one sector to another. In industries where (IIT) is an important factor, measuring amounts of properties are similar between branches of the same industry and or expanding and contracting branches are geographically close, then adjustment may be possible. Adjustment means the performance of changes in the pattern of specialization , not changes in the shares of( X) and( M) in increased trade ( Greenaway and Hine, 1991). All information index is

needed , as trade changes the negative are not excluded , we also need to scale changes in trade for initial gross trade or , for the initial value of production in the industries concerned, prior to the changes in (IIT). Only by doing so, it can relate changes in (MIIT) to the structural changes indicator. (H&K) rely upon (e.g. changes in employment, changes in number of establishments, changes in turnover).

By testing the determinants of (IIT), the literature suggests an important variable in econometric analysis (i.e.) the share of (IIT) in each industry´s gross trade. Problems combined with the use of the (GL) index of IIT; the use of each industry´s gross trade in the dominator of the index means that the position of the industries according to (GL) index may be poorly correlated with one based on the absolute amounts of (IIT) in each industry (Milner1988). Trade barriers, such as transport costs, affect absolute amounts, rather than the share (IIT), (Greenaway & Milner 1987, 1986, 1988)

To distinguish between the share and the amount of (IIT) especially in the adjustment of (IIT). An economic integration (e.g. in the EC and North America) research focus on how great the integration effects (changes) (IIT) specialization (employment and production changes) at the margin. Consequently, the (IIT) specialization may involve different adjustment processes than those combined with increase in (INIT) and specialization.

(H&K) index is undefined when the value of (IIT) falls, and as a result there is an irregular shape. Since the index faces changes in trade flows measured in nominal terms, it may also increase (IIT) that would not be defined in real terms. Similarly in the case of inflation, all defined (MIIT) is upwards. Finally (MIIT) index also suffers from lack of adjustment, since it measures the share of (IIT) in the changes in total trade. Therefore no correlation between the position of the industries according the (H&K) (MIIT) index and the position according to changes in absolute amount of (IIT).

The (RCA) measures the relative competitiveness of products on export(X) markets. To examine trade patterns related to policy interventions and economic change, Hidalgo (2007) defines a global product space that explains the relationship between trade patterns (TP) to different products: The product space examines a network of related products and the development of those networks over time. Furthermore, combined with Hidalgo (2007) and Haussmann (2009), the product space shows the causes of economic factors that influence competitiveness. Since wind turbines appear in the global markets later than hypothesized supporting sectors, the emergence of the global trade in wind turbines and its relationship to preexisting patterns of industrial competitiveness shows the economic abilities of individual countries

This section discusses two measures that investigate the pattern of trade (TP) in windmills between OECD countries. (i)The measurement of (IIT), by using the (GL) Index (1975), where the same classification are both (X )and (M). (ii) Measurements of the (INIT), (CA), due to differences in resources between countries, where the products are either (X)or (M). The ( IIT) between two periods (GL1 – GLt-1 >0) could have a change in trade flows, combined with (INIT) rather than (IIT). The (MIIT) i.e. (X)and (M) of the same items, but the changes in (X) and (M) between two points in time. The properties of (IIT), (GL) and (MIIT) combined with problems that influence these properties are discussed. The assumption is useful due to adjustment in costs combined with changing trade flows.

# 4. DATA

The aim of this section is to presents the data collected by the Organization for Economic Cooperation and Development (OECD) countries, International Trade by Commodity Statistics (ITCS) in windmills and windmills equipment, commodity (850231), Generating Sets, wind powered, for the inter-industry trade(INIT), comparative advantage (CA), and intra-industry trade (IIT) between countries( OECD -Europe)and (OECD- World) between the period 1996-2008.´

The OECD international trade in products data basis consist of (ITCS) works in partnership with the United Nations (UN) Statistics Division (UNSD) and collected data from the United Nations Commodity Trade Statistics data base (COMTRADE). International Trade by Commodity Statistics (ITCS) is OECD reliable source of annual data providing detailed (M) and (X) data in US dollars by country and by partner country. Commodities are Harmonized system (HS), (1996). The OECD international trade data is presented in total trade (partner in the world) exports, total trade ( with partner world) imports, and total trade(with partner world)balance.

UNCOMTRADE statistics database: contains details (M) and (X) statistics reports by statistical countries/areas. UNCOMTRADE is the record most comprehensive database available with more than million record (eg) the (X) of a certain commodity from one country to another in a specific year in terms of currency, weight, quantity (number of commodities). The database is contentiously updated. Whenever trade data are received from the national authorities, they are standardized by (UN SD) and then added to (UNCOMTRADE).

In this essay the data is collected in (ITCS) in windmills and windmills equipment commodity (850231) wind power for the international trade for the (INIT), comparative advantage (CA) and (IIT) between countries(OECD - Europe) and (OECD- World) during the period 1996-2008.

The (HS) wind power equipment is (850231) wind power generating sets. (HS) 850231 capture trade in wind energy products. (850231) illustrate trade development in products groups (COMTRADE in wind turbines).

OECD countries are: Australia , Austria, Belgium, Canada, Chile, Chez republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Latvia Mexico, Netherlands, Newzeland, Norway, Poland, Portugal, Slovak republic, Slovenia, Spain, Sweden, Switzerland, Turkey , UK and US ( see attached OECD countries` map p. 24).

# 5. RESULTS

The aim of this section is to analyses and discusses the results of the research of (IIT) and (INIT), between countries (OECD-World) and between (OECD-Europe) for commodity 85231, Generating wind powered during the period 1996-2009. The (INIT) for Generating wind powered between (OECD-World) is shown in table (1) and (INIT) between (OECD-Europe) shown in table (3). The (IIT) for Generating wind powered between (OECD-World) is shown in table (2) and (IIT) between (OECD-Europe) shown in table (4). The measures range between (0) and (1) for (CA) and between (0) and (-1) for (CD).

This section first discusses the emergence/ prevalence of (INIT). Second, development of (IIT). Third, the results proof that the theoretical assumption of the (PCT) is in line with the empirical result of this essay. A conclusion, a tentative discussion of the next step of the industry and trade in windmills.

First, The empirical results of this essay shows that some countries enjoy a (CA) level (1) at (INIT) between(OECD-World) such as Belgium, Chez Republic, Denmark, Spain, Netherlands, Newzeland (table 1) between 1996-2009. And an (INIT), (CA) at level (1) between (OECD-Europe) in Chez Republic, Denmark, Belgium, Finland, and France (table 3) during1996-2009.

Second, an (IIT) influenced in countries between (OECD-World) such as Belgium, Chez Republic, Denmark, Spain, Netherlands and Newzeland, with a (DA) as the results shows decline to level Zero (0), (table 2) between 1996-2009. And a (CD) between (OECD-Europe) in Chez-Republic, Denmark, Belgium, Finland, France (table 4) between the period 1996-2009.

An interesting results of this essay is that the countries that enjoyed (CA) level (1) in the (INIT) is facing a ( IIT) level (0). This is due to that the production in patterns become more separated with few countries exporting and most of other countries mostly imports.

In this section is a combination between the empirical results of this essay and the theoretical background of the product cycle theory (PCT)(i.e.):

(i) Given the assumption of the product cycle theory (PCT), that the expectation of a country to first show a pattern of inter industry trade (INIT), while when it matures an intra-industry trade (IIT) influence (i.e.)the assumption that the product cycle theory (PCT)has three faces of introduction, growth, and maturity. In the introductory phase, the increase in production and trade leads to quick growth until the maturity phase. Some countries gain comparative advantage (CA) and enjoys a first mover advantage that benefit from inter industry trade (INIT) as a result of increasing domestic markets (DM). In the second stage production starts in other countries and an intra industry (IIT) specialization takes over. This is the theoretical chapter describe in the case of an industry that is characterized by economic of scale (ES) and product differentiation (Petersson, L (1984). Combined with the empirical results of this essay shows that this pattern exists since the countries that enjoyed a comparative (CA) level (1) is facing a decreasing( IIT)level(0), between( OECD-World) and (OECD-Europe).

The assumption of the (PCT) predicts that the production starts in the country of origin in which it is invented .After the production is known in the world market, it is domestically consumed and when the product is matured, then the producer start exporting it. The model aims to provide labor saving, capital using products that starts first in high income countries. Combined with the empirical studies of this essay shows that Belgium, Chez Republic, Denmark, Netherlands, Newzeland, where the new production are used and consumed in these high income countries, no export trade occurs. In the maturity, the production is developed and foreign demand increase in these developed countries: Belgium, Chez Republic, Denmark, Netherlands, Newzeland exports the products to other countries. When the product matures and become more standardized and less capital is needed (human/physical)then the country with a comparative advantage(CA) of producing the product i.e. Belgium, Chez republic, Denmark, Netherlands, Newzeland,

changes since it moves into becoming a more labor intensive(LI) product instead of human capital(HCI) intensive. The model is explained by Vernon, R (1966)

(ii) Given the assumption of the product cycle theory(PCT)implies that we expect the cycle from one country to another (Lewis, J & Wise R(2006) ,combined with the results of this essay shows that this fact also exists since the countries mentioned that shows a (CA) with level (1) but at the maturity declines to level(0)

The cycling from one country to another is shown by empirical studies experiences, where a joint trade starts between a developing turbine manufacturer and a developed manufacturer. The developing countries are allowed to manufacture turbines made by developed technology only within the developing market. The acquisition of technology from overseas companies leads new wind company to obtain advanced international technology and begin manufacturing turbines, it is a disadvantage for the leading wind turbine manufacturers (hold in ownership) to companies that could become competitors (eg) the developed countries allowed its turbine technology to developing, is now competing with it for sales in the global markets. Experience suggested preventing treatment with the leading wind turbines manufacturer that imitate/ replicate (copy) throughout the world. This occur for technology transfer from developed to developing countries, where a similar technology could be manufactured in a developing country with less expensive labor, materials and result in an identical but cheaper turbine. The result is that new developing country manufacturers obtain technology from second or third international wind power companies that have less to lose and more to gain.

That is (i.e.) by combining the empirical results of this essay with the product cycle theory(PCT) it is shown that: the wind turbines start in their home markets where the largest markets in inter-industry trade between (INIT) between(OECD-World, table 1) are: Belgium, Chez rep., Denmark, Netherland, Newzeland (according to this essay´s results) . And Inter-industry Trade (INIT), (OECD-Europe, table 3) is Chez rep., Denmark, Belgium. A stable home market provides local manufacturers with the technology and manufacturing strategies. Once greater technical maturity has been achieved within local markets, local companies can then transition to the global markets and concentrate on exports and basic foreign subsidiaries (i.e.) Intra-industry Trade(IIT) (OECD-World, table 2) are: Belgium, Canada, Italy, Japan, U.K US and an Intra-industry Trade(IIT) between (OECD-Europe, table 4) are: Italy, Ireland, Sweden, Netherland, Germany, Austria, Poland, Portugal, Spain **A** stable home market can benefit both local manufactures and foreign firms that they have planning that allows them to invest in the market. Unstable companies facing unstable, small markets will be less willing to spend money on (R&D) product development and local manufacturing.

The table (1.a) below shows a summary combination of the empirical results of this essay with the (PCT) and the fact that countries expectation to first show (INIT)- (level 1)while when maturity an (IIT) influence (0 level). The results shows the cycle from one country to another as countries enjoyed CA (level 1) at (INIT)while (0 level) at the (IIT). More details of (INIT) and (IIT) between (OECD-World) and (OECD-Europe) is shown in (tables 1-4).

**Table 1.a combination between empirical results of this essay and PCT**

***The Inter-Industry Trade between OECD countries and the World(OECD-World)***
***and OECD countries and Europe (OECD-Europe)***

| *Inter Industry Träde (CA)* | *Table (1)* | | *Intra Industry Träde (table (2)* | |
|---|---|---|---|---|
| *Country* | *1996-2000* | *2005-2009* | *1996-2000* | ***2005-2009*** |
| *Belgaum (CA)* | *0,5* | *1* | *0,7* | *0,05* |
| *Chez Rep.* | *1* | *1* | *0* | *0,02* |
| *Danmark* | *1* | *1* | *0,01* | *0* |
| *Span* | *0,5* | *0,5* | *0,05* | *0,03* |

*High and decreasing Inter-industry Trade*

| | | *2005-2009* | | |
|---|---|---|---|---|
| | *1996-2000* | | *1996-2000* | ***2005-2009*** |
| *Nederländsk (CA)* | *1* | *-1* | *0,02* | *0,02* |
| *NewZeland* | *1* | *-1* | *0,3* | *0,02* |
| *Francen* | *0,5* | *-1* | | |

*The Intra-Industry Trade (IIT) between OECD countries and Europe (OECD-Europe)*

| *Inter-Industry Träde (CA)* | *Table (3)* | | *Intra-Industry Träde (Table 4)* | *Table (4)* |
|---|---|---|---|---|
| *country* | *1996-2000* | *2005-2009* | *1996-2000* | ***2005-2009*** |
| *Chez-Republik* | *1* | *1* | *0,1* | *0,01* |
| *Danmark* | *1* | *1* | *0,01* | *0,1* |
| *Belguim* | *1* | *..* | | |
| *Finland* | *0,5* | *1* | *0,3* | *0,1* |
| *France* | *0,5* | *-1* | *1* | *0,1* |

**Table 1b: Inter-Industry Trade(BL)(INIT),OECD-World: Commodity 850231: Generating Sets: Wind Powered**

Comparative Advantage(CA)/Comparative Disadvantage (CD):

| | | 1996-2000 | | 2005-2009 |
|---|---|---|---|---|
| **High and Increasing Inter-Industry Trade** | | | | |
| Belguim | (CA) | 0,5 | (CA) | 1 |
| Chez Republic | | 1 | | 1 |
| Danmark | | 1 | | 1 |
| Spain | | 0,5 | | 0,5 |
| **High and Decreasing Inter-Industry trade** | | | | |
| Nederländsk | (CA) | 1 | (CD) | -1 |
| New Zealand | | 1 | | -1 |
| | | | | |
| France | | 0,5 | | -1 |
| **low and Increasing Inter-Industry Trade** | | | | |
| **Comparative disadvantage (CD)** | (CD) | | (CA) | |
| Finland | | -1 | | 1 |
| Japan | | -0,5 | | 1 |
| Slovenia | | -1 | | 0,5 |
| Chienese | | -1 | | 0 |
| **Low and Decreasing Inter-Industry Trade** | | | | |
| Australia | (CD) | -1 | (CD) | -1 |
| Austria | | -1 | | -0,5 |
| Canada | | -0,5 | | -1 |
| Germany | | -0,5 | | -0,5 |
| Greece | | -1 | | -1 |
| Hungary | | -1 | | -1 |
| Irland | | -1 | | -1 |
| Italy | | -0,5 | | -0,5 |
| Korea | | -1 | | -1 |
| Mexico | | -0,5 | | -1 |
| Norway | | -1 | | -1 |
| Poland | | -1 | | -1 |
| Portugal | | -1 | | -1 |
| Republic | | -1 | | -1 |
| Sweden | | -1 | | -1 |
| Turkey | | -1 | | -1 |
| United Kingdom | | -1 | | -0,5 |
| United States | | -1 | | -1 |

**Table 2: The Intra- Industry Trade (IIT),OECD-World, Commodity 850231: Generating Sets :Wind Powered**

| | 1996-2000 | 2001-2004 | 2005-2009 |
|---|---|---|---|
| **High and Increasing Intra-Industry Trade** | | | |
| **High and Decreasing Intra-Industry Trade** | | | |
| Belgium | 0,7 | 0,15 | 0,05 |
| Canada | 0,62 | 0,08 | 0,08 |
| Italy | 0,85 | 0,13 | 0,47 |
| Japan | 0,52 | 0,01 | 0,2 |
| United Kingdom | 0,82 | 0,58 | 0,09 |
| United States | 0,92 | 0,58 | 0,09 |
| **Low and Increasing Intra-Industry Trade** | | | |
| Astoria | 0,05 | 0,75 | 0,35 |
| Germany | 0,28 | 0,4 | 0,7 |
| Greece | 0,09 | 0,01 | 0,12 |
| Korea | 0,02 | 0,15 | 0,2 |
| Netherlands | 0,02 | 0,51 | 0,02 |
| Poland | 0,02 | 0,6 | 0,02 |
| Portugal | 0,01 | 0 | 0,35 |
| Slovenia | 0,05 | 0 | 0,65 |
| Spain | 0,05 | 0,35 | 0,43 |
| Sweden | 0,05 | 0,05 | 0,05 |
| Turkey | 0,01 | 0,09 | 0,09 |
| Luxmburg | 0,02 | 0,15 | 0,2 |
| **Low and Decreasing Intra Industry Trade** | | | |
| Chez Republik | 0 | 0,29 | 0,02 |
| Denmark | 0,01 | 0 | 0 |
| Finland | 0,29 | 0 | 0,21 |
| Mexico | 0,45 | 0,93 | 0,25 |
| Australia | 0,02 | 0 | 0,05 |
| NewZeland | 0,3 | 0,02 | 0,02 |
| Norway | 0,03 | 0,03 | 0,02 |
| Switzerland | 0,19 | 0,05 | 0,02 |

**Table 3: Inter-Industry Trade(BL), (INIT) OECD-Europe: Commodity 850231: Generating Sets: Wind Powered (BL)** Comparative Advantage (CA)/Comparative Disadvantages(CD)

| | | 1996-2000 | | 2005-2009 |
|---|---|---|---|---|
| **High and Increasing Inter-Industry Trade** | | | | |
| Chez Republik | (CA) | 1 | (CA) | 1 |
| Denmark | | 1 | | 1 |
| | | | | |
| **High and Decreasing Inter-Industry Trade** | | | | |
| Belgium | (CA) | 1 | (CD) | -1 |
| France | | 0,5 | | -1 |
| Iceland | | 0,5 | | -1 |
| Mexico | | 0,5 | | -1 |
| Netherlands | | 0,5 | | -1 |
| New Zeland | | 0,5 | | -1 |
| **Low and Increasing Inter-Industry Trade** | | | | |
| Finland | (CD) | -0,5 | (CA) | 1 |
| Germany | | -1 | | 0,5 |
| Republic | | -1 | | 0,5 |
| Slovenia | | -1 | | 0,5 |
| Tapiet | | -1 | | 0,5 |
| Spain | | -1 | | 0,5 |
| **Low and decreasing Inter-Industry trade** | | | | |
| Australia | (CD) | -1 | (CD) | -1 |
| Austria | | -1 | | -0,5 |
| Canada | | -1 | | -1 |
| Greece | | -1 | | -1 |
| Hungary | | -1 | | -1 |
| Irland | | -1 | | -1 |
| Italy | | -0,5 | | -0,5 |
| Japan | | -1 | | -1 |
| Korea | | -1 | | -1 |
| Luxemburg | | -1 | | -1 |
| Norway | | -1 | | -1 |
| Portugal | | -1 | | -0,5 |
| Sweden | | -0,5 | | -1 |
| Switzerland | | -1 | | -1 |
| Turkey | | -1 | | -1 |
| United Kingdom | | -1 | | -1 |
| United States | | -1 | | -1 |
| Tapiet | | -1 | | -1 |

T**able 4:Intra-Industry Trade(IIT) OECD-Europé, Commodity 850231: Generating Sets: Wind Powered**

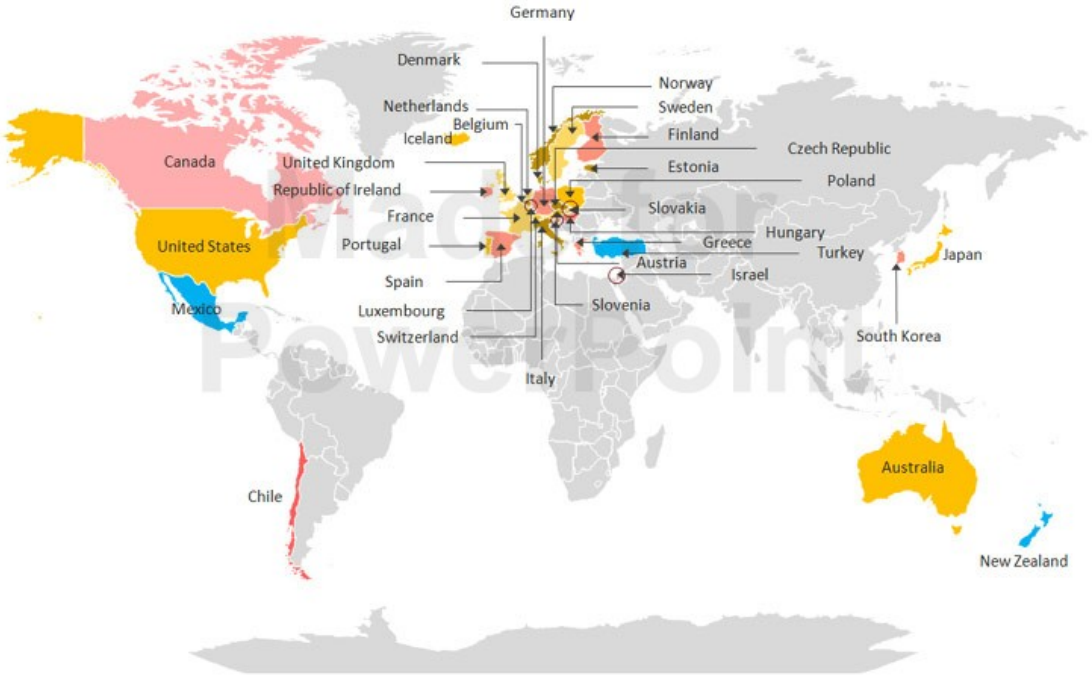
| | 1996-2000 | 2001-2004 | 2005-2009 |
|---|---|---|---|
| **High & Increasing Intra-Industry Trade** | | | |
| Italy | 0,8 | 0,9 | 0,7 |
| **High and Decreasing Intra-Industry Trade** | | | |
| Ireland | | 0,5 | 0,1 |
| Sweden | 0,7 | 0,1 | 0,01 |
| Netherlands | 0,78 | 0,5 | 0,05 |
| France | 1 | 0,1 | 0,01 |
| **Low and Increasing Intra-Industry Trade** | 0,01 | 0,1 | 0,1 |
| Germany | 0,1 | 0,3 | 0,85 |
| Austria | 0,1 | 0,7 | 0,3 |
| Poland | 0,1 | 0,6 | |
| Portugal | 0 | | 0,39 |
| Spain | 0,1 | | 0,59 |
| Denmark | 0,01 | 0,1 | 0,1 |
| **Low and Decreasing Intra-Industry Trade** | | | |
| Australia | 0,1 | 0,1 | 0,1 |
| Chez Republic | 0,1 | 0,1 | 0,01 |
| Finland | 0,3 | 0,1 | 0,1 |
| Greece | 0,1 | 0,3 | 0,17 |
| Norway | 0,1 | 0,01 | 0,05 |
| Slovenia | 0,1 | 0,1 | 0,05 |
| Switzerland | 0,1 | 0,1 | 0,1 |
| United Kingdom | 0,1 | 0,2 | 0,1 |
| United States | 0,1 | 0,2 | 0,1 |

# 6. Conclusion

The aim of this essay is to study the trade and specialization pattern of windmills and windmills equipment in order, to say something about the determinants of trade patterns as well as making a tentative prediction, of future trade patterns in this important renewable energy industry. The analysis is based on the product cycle theory (PCT) Petersson, L (1984) that indicates how one may expect an industry to first show a pattern of inter industry trade (INIT)while when it matures a pattern of intra-industry trade(IIT) emerge. And the new trade theory (NTT) Helpman and Krugman(HK) (1985) that synthesis both the traditional trade theory (TTT) based on comparative advantage(CA) as well as trade flows due to economies of scale(ES) and product differentiation. The empirical part focus on two measures in order to capture revealed comparative advantage(RCA) as well as the importance of intra-industry trade(IIT) of windmills equipment in Europe and the World, between the years 1996 and 2009.

The results of the empirical analysis shows, a clear pattern, of comparative advantage(CA) in some countries (such as Belgium, Denmark and Chez Republic) and an increasing advantage in other (such as Finland and Japan) and several of these countries shows a decreasing intra-industry trade(IIT), which suggests that the production in patterns becomes more specialized. But at the same time the intra-industry trade (IIT) have increased in some countries, which means that more and more countries produces windmill equipment and trade with each other. This suggests a competitive future-market between (OECD – Europe) and (OECD – world).

# OECD Countries



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