The "pattern approach" to world trade structures and their dynamics

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DRAFT

Abstract

A new way to get the most out of world trade data produces the following results:

- a graph of the world hierarchical structure, revealing the balance of strength among countries;
- a clear-cut definition of "core", "periphery", and "semi-periphery", much in line with World Systems orientation;
- a conducive environment for further "value chain analyses";
- the perspective of original policy tools.

The simple methodology proposed in the paper establishes 16 different patterns of bilateral relationships between nations, ranging from full integration to dominance, in one direction, and to the absence of significant links, in another.

The structural role of each country emerges from its relationships with all others, taken separately. The 16 patterns can be ranked worldwide, so as to give a metrics to the degree of hierarchy and "justice" around the globe.

In an initial application of the methodology, we describe how the world - interpreted as an oriented network - was structured in 1998 and 2003, pointing at some interesting structural dynamics.

JEL classification: F13, F14, F15, F42, O24, C67, R15, C65.

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Introduction

This short paper describes a method to simplify the information contained in international trade statistics at country level, so as to obtain a readable structure of the whole world, interpreted as a network.

Once attained a robust image of the world, you can return to the national level, broaden the analysis, and establish which are the key facts that should be changed for a different role of that country in the global and regional economy.

Policies aimed at a different structure of the world are given a new exciting analytical context, pointing at unusual outcomes of micro events, potentially elastic relative to the activities of national policy-makers, both public and private.

In another vein, "global value chains" are better exhibited in their paths across core, periphery, and semi-periphery countries, once a clear-cut criterion arises to allocate specific countries to those structural regions.

The paper progressively introduces the following elements: section 1 provides a broad context for the analysis with some discussion of the literature; section 2 plainly describes the "pattern approach"; section 3 concentrates on the relationship of "dominance" of a country over another, so as to propose a definition of "core", "periphery", "semi-periphery"; section 4 implements the methodology to 1998 international trade data; section 5 replicates the analysis for 2003, showing how the dynamics of world structures can be tracked by our method; section 6 outlines some interesting future directions of research and policy-making.

Annex I enlist all countries included in the analysis. The robustness of the results is discussed in Annex II.

The MS Excel file *pattern.xls* is distributed together with the paper to allow an autonomous exploration of the results.

1. The context

Globalization is tightening the **links** among nations in a thrust of frantic trade of an ever growing list of commodities, goods, and services. The global GDP is highly unevenly distributed among and within countries, with dynamics that both reinforce and modify the existing balances. Policies transmigrate from one country to another, as fashion waves, out of hopes and disappointments.

In the very long term, globalizations have seen the **rise and fall** of hegemonic countries with changes in the **structural role** played by their neighbors and distant nations[1].

All this has a micro-foundation in the behavior and performance of private and public bodies, social groups and entire societies, engendering a large variety of interaction among different social, anthropological, political, institutional, and economic factors.

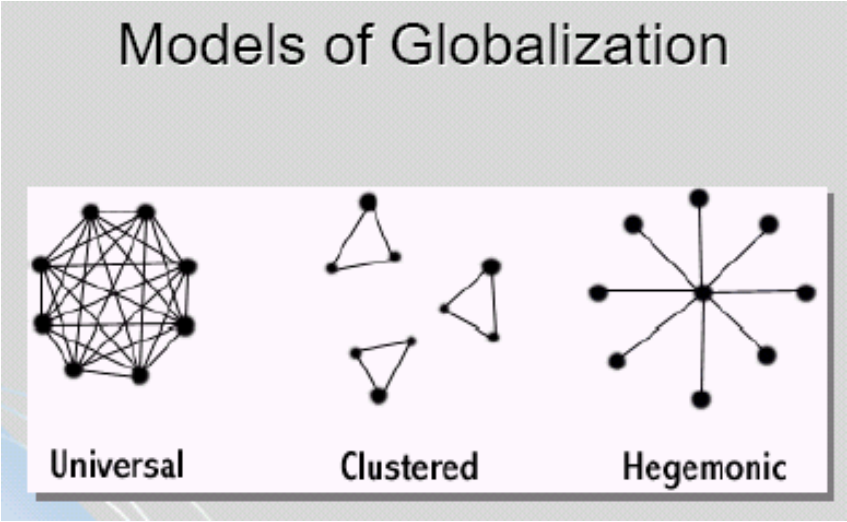
To shed light on this extremely complex nexus of facts, perceptions, and expectations, several methodologies have been proposed to address the many issues at hand.

We shall discuss here just one method in relation to one key issue, raised by Centeno, Curran, Galloway, Lloyd and Sood (2005): **which are the models of nowadays globalization** or, in slightly different terms, which is the "shape of the world" (the comprehensive graphical map visualizing how countries are related)?

This "shape" should be free to change and evolve over time, to be compared across a very long time scale, to offer hints about the forces that influence it, so as to forecast where the world is going and to devise proper policies.

[1] Throughout the paper, we shall use the word "countries" and "nations" as they were synonymous. The same holds for "dominance" and "domination".

Some of the alternatives to be evaluated are the following[2]:



The methodology we shall apply - and, to some extent, innovate - is the representation of the world as a **network**. The mathematical concept of "network" - which has received a new impetus in last decades[3] - has been widely used to map the relationships between "agents" of globalization (countries, companies, cities, people,…)[4].

Indeed, the analogy is quite immediate: each agent is a node and each repeated transaction with the others creates or uses a link. As Kali and Reyes (2004) puts it, "A network is a set of points, called nodes or vertices, with connections between them, called links or edges. In our context, each country is considered to be a node of the network"[5].

The main advantage of using networks is that, instead of relying on comparisons in mono-dimensional variables, they let complex **structures** emerge among nations[6].

Obtaining a network sufficiently **rich** to show intriguing relationships while keeping it **simple enough** to be grasped visually and qualitatively is the difficult game of equilibrium this literature does not always win.

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[2] Centeno, Curran, Galloway, Lloyd and Sood (2005), p.9. For a longer discussion, see Centeno (2005).
[3] See for instance Granovetter (1983), Albert and Barabasi (2002).
[4] See for instance Kali and Reyes (2004), Rauch (2001), Krempel and Pluemper (1999; 2002), Serrano and Boguñá (2005), Van Rossem (1996). For general reference see also the Journal of Social Structure at http://www.cmu.edu/joss/.
[5] P. 6, *idem*.
[6] The "emergence of structures" is a key tenet of agent-based simulation research, where micro- and macro-levels interact. See Tesfatsion's site: http://www.econ.iastate.edu/tesfatsi/ace.htm

Indeed some network is so abundant and complex that one can feel the need of some sort of **interactivity** with the graph, so as to have the opportunity of simplifying parts of the graph, leaving only the largest and most significant relationships, or of zooming into certain regions of the world.

The key decision is how to simplify the trade data into a graph. "Since international trade is usually measured using the monetary value of exports and imports between countries, trading relationships are analogous to valued links in a network, and these vary from country to country. In order to chart the structure of the network we are interested in the magnitude of these relationships but not specifically in their exact value"[7].

The most common approach in the literature is what can be called the "**threshold approach**", to which we contrast the "pattern approach" later on in this paper. A link is present in the graph if the trade between two countries is greater than a certain threshold.

There are four main formulas for the threshold:

1. a threshold equal to zero, with whatever positive trade leading to a link in the graph;
2. a threshold equal to a fixed amount of a given currency, usually the dollar in constant value;
3. a threshold expressed as a percentage of total world trade;
4. a threshold expressed as a proportion of country's total exports or imports.

Using the first formula, almost all the countries turn out to be connected. A comparison over time of the networks would show a dynamics based exclusively on extremely marginal trade link. Many countries report trade of just some thousands dollars, with the effect that even minor statistical mistakes can change the network. Moreover, all trade links are treated equally, with no distinction between large and small, growing and falling, etc. In short, this choice provides a vision of the world much alike to the old saying "by night, all cats are grey".

The second formula might have some sense to certain policy-maker (in firms and outside), if a specific decision has to be taken (e.g. to establish a representative office abroad, to open a school of language or a logistics track,…). But for general purposes of analysis, this threshold is arbitrary and quickly becomes obsolete, due to the general rise in trade we see in

[7] *Idem.*

contemporary world. Moreover, it has no clear applicability to historical data or non-monetary data.

The third formula, perhaps the most used, leaves an extremely wide range of possible values and makes answers to relevant questions completely in the hands of the choice. World trade totals are huge and even a small change in the selected percentage has dramatic effects on which links resist and which do not. When percentages as high as 1% or 1.5% are chosen, only very few bilateral links appear, giving to the world the shape of a plethora of disconnected islands with links only among economic giants. Smaller countries have no hope to trade so much to overcome the threshold, since it would imply a level of trade possibly several times higher than their GDP.

Much lower percentages would propose a world more connected, but still all dynamics would happen around the threshold. Who has already crossed the line cannot be tracked in its new movements.

More importantly, using this formula often - although not always - the author considers the sum of imports and exports among the two countries. But being flooded by imports is not the same thing as being extremely competitive on the partner's market. This is not only an evident economic consideration, but also from the point of view of politics the two situations are polar, with the first usually being conducive to cries for protection and the second to proud statements in favor of free trade.

When the two flows are not summed up, the separate consideration of exports from imports provokes the birth of two distinct graph. The world seems different if viewed through the lens of imports or through that of exports, without offering the advantages of a combined pair of glasses.

This is exacerbated by the fourth formula, which leads to as much as four different networks. A certain export flow can be larger than the threshold for the exporter but lower than the same percentage threshold imposed on the total import of the commercial partner.

The disadvantages mentioned earlier manifest themselves again. "We define a trade-link between country *i* and country *j* to be present if the value of exports from country *i* to country *j* as a proportion of country *i*'s total exports is greater than or equal to a given magnitude. […] Considering different threshold values for the ratio of exports to country *j* out of total exports of country *i* in order to define the presence of a link from *i* to *j* enables us to study the structure and evolution of the network for different levels of trade.

For instance, it is possible that for low levels of the trade-link threshold (such as 1%) the network displays evenly distributed node degree and thus seems decentralized or 'egalitarian', while for higher levels of trade-link thresholds (such as 5%) there is a well defined center of gravity, which could be interpreted as being more centralized or hierarchical'."[8]

[8] *Idem.*

2. The "pattern approach"

2.1. The intuition

The intuition behind our approach is to take full advantage of the information that transactions reveal about the **reciprocal importance** two agents attach to each other.

We emphasize the issue of "reciprocity" because "globalization is a process leading to greater interdependence and **mutual awareness** (reflexivity) among economic, political, and social units in the world, and among actors in general"[9]. It is the distorting mirror of others' eyes that gives the picture of the role we play.

It is when "we are very important to somebody we do not care about" that we can exert a powerful influence on him, because there can be no serious retaliation[10]. On the contrary, true integration emerges from agents that both rank their relationships highly.

In this perspective, who's the seller and who's the buyer does matter and the information about imports and exports is considered at the same time. Instead of simply stating the existence of a relationship when total trade reaches a certain threshold, we propose to **qualify** the relationship according to the balance of strength it reveals.

In this vein, there are potentially several "patterns" of relationships between any two agents. The "shape of the world" is the composition of all reciprocal relations.

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[9] Guilleñ (2001).

[10] If a certain country B is a major market for the exports of a country A, the economic conditions of B (e.g. recession) will significantly affect the exports of A, thus - if they do not constitute a too small amount - its GDP, then the conditions of A's labor market (e.g. unemployment) and the market of goods. Similarly, if, the country B decides to protect its domestic market through tariff (and non tariff) barriers, it is likely that country A will heavily suffer and will try to negotiate.

Conversely, if a certain country B is a top component in the imports of country A, this means that A "needs" the B supply and it is sensitive to possible disruption. It will be heavily affected by large fluctuations of the relative exchange rate. A revaluation of B currency would imply a rising cost of B products, which represent a large share in A import, hurting all the people needing those goods, if they cannot quickly and easily find substitutes.

These relations are not necessarily symmetric: to be a major exporter for B does not mean automatically that B is a major receiver of our exports. B could be so little in terms of GDP and of total imports that its share on our total exports could well be too small.

Relative to the choice of transactions, we follow the tradition of applying the method to **trade data**. In a conference devoted to "Observing trade" this may seem quite obvious; however, this data has indeed several initial advantages to start with:

1. it is available for most countries in the world in bilateral detail;
2. it is distributed in long time series;
3. it is updated quite frequently (in some countries even monthly);
4. it expresses purposeful activities of a large number of business agents (firms and intermediaries);
5. it creates and maintains **business communities** culturally and economically linked to international partners and interests, usually exerting pressure on governments and society.

In short, it can be used as a sedimentation of several meaningful relationships and it can provide early detection of structure and its dynamics.

This does not preclude applying the "pattern approach" to any other data about transactions, as those provided by INA, a bold ongoing attempt to collect relevant data about globalization[11].

[11] http://www.princeton.edu/~ina/index.html

2.2. The formalization

There are two independent steps that are needed to formalize our approach[12]. First, one has to simplify the data at the national level by discriminating major trade partners from the rest, because a certain amount of trade is almost always present between any two countries but only a few relationships are politically sensitive.

The second step is to combine all together the pieces of information resulting from the simplification (being or not being a major "trade partner" in different respects). In fact, trade relations between, first, country A and, second, country B can be characterized by **four conditions**, each of which can be "true" or "false":

1. "For B, A is a major export destination"

2. "For B, A is a major import source"

3. "For A, B is a major export destination"

4. "For A, B is a major import source".

These propositions are **logically independent**, as each one can be true or false independent of the value of the others.

For each proposition, we build **a binary variable** that will take the value of 1 if the proposition is true and zero in the opposite case.

The "binary description" of a two-country "pattern" is obtained simply by putting the four binary variables one after another, in the same order as we presented them. For instance the "binary description" 1100 means that, for B, A is both a major export destination and a major import source while, for A, B isn't important. We shall call this relationship the "dominance" of A over B.

In naming these patterns, we care about the situation of A versus B, so e.g. we call "dependence" the situation in which A is completely subjugated by B (0011).

[12] We first introduced this formalization in Piana (2004).

In short, this is the exhaustive list of the 16 patterns:

Name	Binary description	Qualitative description	Examples[13]
Absence of relationships	0000	The countries "ignore" each other	Australia-Andorra; USA-Iran
Source dependence	0001	B is an important provider for A	Ecuador-Venezuela; Morocco-USA
Destination dependence	0010	B is an important market for A	Denmark-USA; Viet Nam-USA
Dependence	0011	B is very important to A, but the reverse is not true	Philippines-USA; India-UK
Source dominance	0100	A is an important provider of B, but A can ignore B	South Africa-Kenya; Sweden-Faeroe Isds
Source integration	0101	They both need each other as providers	*No real world example in 1998 or in 2003*
Mono out-integration	0110	One flow is important for both: the exports of A to B	Saudi Arabia-Rep. of Korea; Estonia-Latvia
Dependent source interconnection	0111	A depends on B, but B needs A only as a source of supply	Australia-Japan; Indonesia-Japan
Destination dominance	1000	A is an important destination for B, while A can ignore B	Peru-Bolivia; Australia-Viet Nam
Mono in-integration	1001	One flow is important for both: the exports from B to A	Republic of Korea-Australia; Peru-Colombia
Destination integration	1010	They both need each other as exporters	Poland-Czech Republic[14]
Dependent destination interconnection	1011	A depends on B, but B needs A only as a destination	Ecuador-Colombia, Belgium-Germany
Dominance	1100	A is very important to B and can afford to ignore it	France-Algeria; USA-Colombia
Dominant source interconnection	1101	A is very important to B but A needs B only as a source	Germany-Netherlands; Singapore-Thailand
Dominant destination interconnection	1110	A is very important to B but A needs B only as a destination	Spain-Portugal; United Kingdom-Ireland
Integration	1111	They need each other on an equal foot.	France-Germany; Argentina-Brazil

[13] These examples anticipate a few results from the empirical application of the methodology of world trade data. We chose relationships holding for both 1998 and 2003, unless otherwise stated. The couples are ordered: the relationships is referred to the first of them (taking the role of "A").
[14] Only in 2003. In 1998 there are no examples of this pattern.

"Integration" - as a word appearing in more than one pattern - means that there is reciprocity. "Interconnection" means that there are three 1s, i.e. there is quite a strong relation between the two countries. "Mono" means that the same flow of goods and services is important for both.

By counting the number of internal relevant links in the pattern, one sees that Integration is the richest pattern, with 4 links, interconnections follow with 3, then at level 2 we can have both symmetric and asymmetric relationships (domination or a weak level of integration), at level 1 only weak forms of domination. At the lowest level, an absence indicates zero inner relationships.

The examples show that there are many possible nuances and factors at work between two countries, e.g. in terms of reasons, political choice, historic and contingent factors.

Needless to say, these relationships express **a material and objective base** for "strength balances" that can be modified by **subjective political and social leadership**, as in the case of "benign" domination, e.g. supportive of aid. At the same time, it would be very interesting to see how internally the different **social groups** profit or suffer from their country's position.

Moreover, there are many other elements to be considered (direct foreign investments, language, historical linkages, legal and military pacts, distance in political orientation of the two governments,...) but trade data purposefully interpreted do provide a concise expression of the material base for the "balance of power" between two nations.

This classification in 16 patterns stands up independently on the criterion that fixes "**how many**" top partners have to be taken into account as "major" partners. The idea is to take as many of them as bounded-rational agents (such as ministries, political parties, specialized input suppliers, logistics service providers…) would considered in major decisions. Being a major trade partner of a country means to have an open potential for influencing and being influenced[15].

In this paper we shall consider "major trade partner" the **top 5 countries** in one's trade, without any hierarchy among the five.

[15] Bounded rationality is a key concept introduced by H. Simon and J. March in both economics and managerial sciences. It is now widely used in models of evolutionary economics, stemming from the seminal work by Nelson and Winter (1982).

There are several reasons why 5 is a focal point (in a Schelling's sense) when looking at major partners:

- five is a acceptable number of items on a "short list" in consumers/ producers' mind both in terms of memory and attention[16];
- C(5) is a common measure in industry concentration as well as in export (or import) concentration;
- these countries receive a good media coverage as in the CIA World Factbook or the Economist "Pocket World in Figures".

The effects on the analysis of taking different numbers of "top partners" are shown in the Annex II.

3. Core, periphery, semi-periphery: a new definition

Core, periphery, and semi-periphery are key concepts of World Systems theory, the broad historical, sociological and economic approach to world structures pioneered by Immanuel Wallerstein[17].

In the literature, these three terms are quite clearly defined as world regions with specific roles. However, the specific allocation of one country to another over time has been an object of controversy[18].

The preceding analysis offers the opportunity of proposing the following definitions:

- the "core" is the set of free countries exerting domination on others;
- the "semi-periphery" is the set of countries being dominated by one (or more) countries while, in turn, actively dominating others;
- the "periphery" is the set of dominated countries that do not exert any domination over other countries.

In this vein, it is possible to obtain another category of countries that are outside any domination – dependent relationship (the "independent").

[16] Incidentally, at Princeton "Top 5" is a bi-weekly compilation of the 5 most important international stories that students on campus should know. http://www.princeton.edu/~piirs/people/top5.html
[17] See for instance Wallerstein (1979) and Wallerstein (1974).
[18] See for recent reviews of the issue Peschard (2005) and Babones (2005).

Using the previously introduced notation, given a clear-cut definition of the domination of one country over another (pattern "1100"), we define:

- the "core" as the set of countries having at least one 1100 pattern and no 0011;
- the "semi-periphery" as the set of countries under at least one 0011 pattern but exerting at least one 1100 pattern
- the "periphery" as the set of countries under at least one 0011 pattern and showing no 1100 pattern.

Please note that we are using only 2 out of 16 possible patterns, leaving room for a lot of improvement and nuance in the interpretation of the "shape of the world", possibly corresponding to the sometimes-invoked "**continuum**" of positions between being "weak" and "strong". In particular, it is certainly true that the three regions lack internal homogeneity and are rich of a structural articulation, as shown below.

This definition has several advantages, especially with respect to the known proposal of using thresholds in Gross National Product (per capita or total) to separate the three regions[19]:

1. it relies on the "strength balance" between nations, considering their actual bilateral transactions[20];
2. it is not dependent on fluctuations in exchange rates, since it does not rely on the international value of the dollar but just on the rankings within the trade import and export sheets;
3. it can be used in the very long term and across continental cultures (for instance, in presence of little data, it can be identified for the British empire, the Roman empire, the changes in Asia-Europe relationships due to the *Pax mongolorum* in the XIII century, etc.)[21];
4. it imposes no global constraints, so it is compatible with a structure of a world – alternative to our present one - without a core or without the periphery and the semi-periphery[22];
5. in policy terms, the advice to periphery countries might point, if necessary, to try to modify specific dependent relationships[23].

[19] See Babones (2005), Arrighi and Drangel (1986).
[20] It is not a mere comparison among unrelated countries.
[21] For a paper on historical world systems interpreted using empirical data see Tieting Su (2001).
[22] In the threshold approach, some countries are always below the average or the threshold, while other are above.
[23] Whereas the threshold approach is limited to say them: "Enrich yourself".

We shall see which countries belonged in 1998 to these regions and which changes took place up to 2003 in the next chapters, by applying all our definitions, but we underline that the definition provided here can be used in other contexts and with other data, since **this definition works with any definition of "domination" involving couples of countries**.

4. Implementing the methodology with world trade data

4.1. The dataset

To provide a preliminary hint of the potentiality of the "pattern approach" to provide an interpretation of the real world, in this section we apply our formal definitions to a large database of international trade. Our data has been extracted from United Nations COMTRADE online database[24], using the declarations of importer countries[25]. It includes 99 countries, accounting for about 97% of world GDP and about the 85% of world trade[26].

The selection criteria for the inclusion was the availability of import reports in both 1998 and 2003, so as to have a full description of dynamics[27].

Since states at war or with particularly opaque (or unstable) regimes often do not provide statistical data, the picture of the world we shall present is somewhat "rosier" than the real one with an intrinsic "optimistic bias"[28].

[24] http://unstats.un.org/unsd/comtrade

[25] Mainland China, Hong Kong and Macau are included in one "China", Belgium includes Belgium and Luxembourg, South Africa stands for Southern African Customs Union. The data for Taiwan was taken from the Ministry of Economic Affairs (http://www.moea.gov.tw).

[26] The full list of countries is provided in Appendix 1.

[27] The inclusion of further countries, which we leave for future developments, would mainly enlarge the periphery, while changing not too much of the relations inside the present set.

[28] See Annex II for a further discussion on data quality.

4.2. Results

The distribution of frequency of the 16 patterns of diadic relationship and their ranking in the world in 1998 were the following:

Name	Binary description	Occurrences	% of all non-absence relationships	% of all relationships
Absence of relationships	0000	4226	-	87,11%
Dependence	0011	241	38,60%	4,97%
Dominance	1100	241	38,60%	4,97%
Source dependence	0001	165	26,40%	3,40%
Source dominance	0100	165	26,40%	3,40%
Destination dependence	0010	163	26,10%	3,36%
Destination dominance	1000	163	26,10%	3,36%
Integration	1111	21	3,40%	0,43%
Dependent destination interconnection	1011	13	2,10%	0,27%
Dominant destination interconnection	1110	13	2,10%	0,27%
Mono out-integration	0110	11	1,80%	0,23%
Mono in-integration	1001	11	1,80%	0,23%
Dependent source interconnection	0111	11	1,80%	0,23%
Dominant source interconnection	1101	11	1,80%	0,23%
Destination integration	1010	0	0,00%	0,00%
Source integration	0101	0	0,00%	0,00%
Total		4851		100%

Absence of major relationships (0000) is **the most common** characterization of bilateral linkage. It constitutes up to 87.1% of all pair-wise pattern. Most countries live far away from each other, possibly maintaining kind diplomatic relationships with only minor trade exchange flows[29].

A model of globalization where all countries are connected with each other ("Universal globalization") is thus rejected. Some of this result is due to the methodology itself, although it is possible to device a fictious dataset where this pattern occurs much less[30].

Domination is **the most frequent non-absent** relationship, giving our world a quite distinctive hierarchical characterization. The 38.6% of all (non-absent) relationships is a domination/dependence pattern.

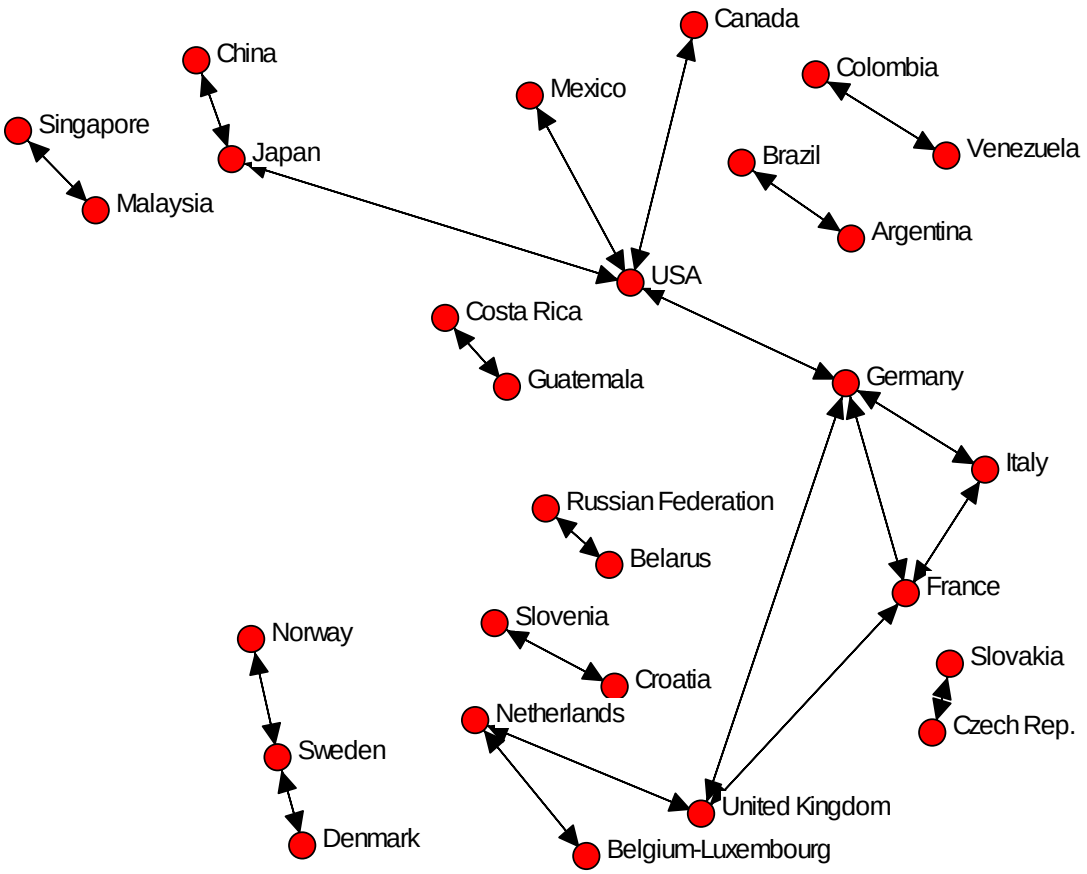
The heavy weight of "Dominance relationships" in international trade is magnified by the fact that in the ranking two relationships follow that one can collectively call "weak dominance" by a country over another: Source dependence and Destination dependence - two incomplete but still heavily asymmetric relationships.

By summing up the strong and the weak domination relationships, one obtains 569 diadic relationships, i.e. 91.1% of non-absent relationships.

[29] Some differences with Piana (2003) are due to a much larger dataset used here, the inclusion of Hong Kong, Macau, and mainland China in one country, the different source of data as well as some further minor details. The main statements are the same.
[30] See Annex II for a discussion.

The data ranking shows at the 8.th place the pattern of "Integration" with 21 occurrences (3.4% of non-absent relationships, less than 1% of the total), visualized by the following graph:

The graph of world integration



Each arrow is a relationship of integration (1111)
(e.g. Sweden and Denmark are integrated)

The European Union is present with several countries, sometimes integrated even triangularly. Its independent voice in the international arena is thus given a material base and a mutual shield.

NAFTA countries are already enjoying a full integration. Embryos of regional integration are present in Latin America and in East Asia.

Through their integration with Germany and Japan, the US "keeps the world together" across the continents.

By contrast, Africa and Arab countries do not provide signs of integration.

The connected countries have succeeded in establishing strong bi-lateral relationships where each needs the other. Four basic explanations come to mind:

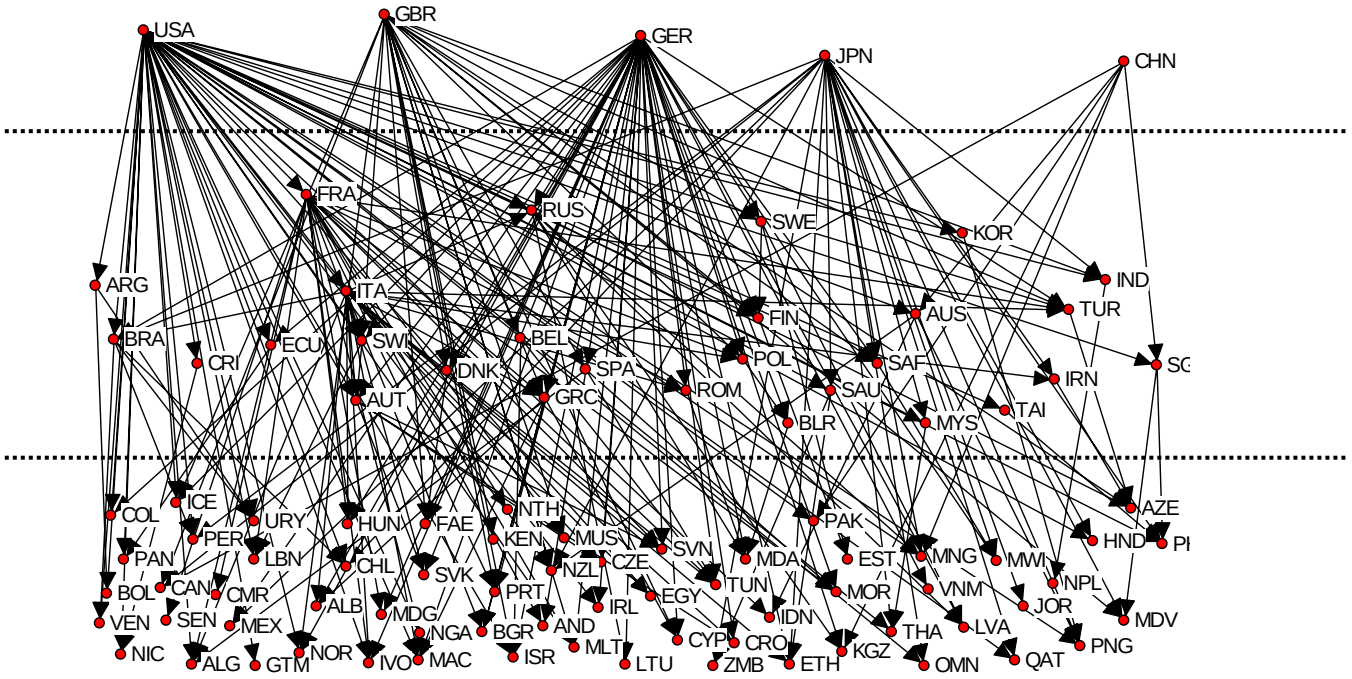
1. an intentional trade policy coupled with desirable trade conditions for private operators;
2. the complementarity of production capabilities (agriculture, manufacture, oil, services,...) as well as intra-industry trade and "value chains";
3. the continuity of historical links (e.g. previous common state structure);
4. a large stock of Foreign Direct Investments, generating flows in both directions of raw materials, manufactured and semi-manufactured goods.

Going on with the other patterns in descending order, after Integration there are four kinds of interconnection and two forms of weaker integration (characterized by a major flow of goods that is very important to both). It's not surprising that that flow is often that of oil.

Finally, at the bottom of the ranking, there are two types of relationships that are completely absent in 1998 world: Destination integration and Source integration.

Widespread as these patterns are, almost all the countries in the world are involved in Dominance relationship(s), as you can see in the following visualization:

The graph of world hierarchical structure, expressed by Dominance relationships



Each arrow is a domination relationship (1100)
(e.g. Argentina is shown as dependent from USA in 1998)

Three layers are distinguishable: the core at the top, the periphery at the bottom, and the semi-periphery in the intermediate area[31].

In terms of the world regions, in 1998 the core of the world economy system was made up by 5 countries: the US, the United Kingdom, Germany, Japan, and China.

[31] For the country codes, see Annex I. See *pattern.xls* for the underlying data.

While being "free" from the rest of the world, they all exerted a direct domination over most of the other countries, sometimes alone and sometimes in a sort of co-dominion of two (or more) "dominators".

The semi-periphery comprehended 28 countries. In the Americas, it included Argentina, Brazil, Costa Rica, Ecuador; in Europe Austria, Belarus, Belgium, Denmark, Finland, France, Greece, Italy, Romania, Poland, Spain, Sweden, Switzerland, Turkey; in the other continents Australia, India, Iran, Malaysia, Rep. of Korea, Russian Federation, Saudi Arabia, Singapore, South Africa, Taiwan[32].

This composition broadly corresponds to the general image of "semi-periphery" and to other tentative allocations[33]. It is noteworthy that both developed and (emerging) developing countries are included[34].

The other countries constitute the periphery of the world system, being dependent at least on one of the countries in the core or in the semi-periphery[35].

Overall, the attribution of countries to World Systems regions seems reasonable and in line with expectations, although it identifies a smaller core and a more selective semi-periphery than other analyses[36].

Using this interpretation of international trade networks, one can address the issue of the **"shape of the world"**[37].

On one hand, the core is made up of more than one country, leaving preliminary support to an hypothesis of "**multi-polar world**" rather than a hegemonic model[38].

[32] For an idea of the internal stratification of semi-periphery, see the "Country profiles" in *pattern.xls*.
[33] For instance, it includes about the half of the countries mentioned by Wallerstein (1979), p. 100.
[34] It would be interesting to re-classify FDI flows to see whether they mainly go from the core to the semi-periphery (as – to some extent – the international product life cycle would imply) or follow more complex allocations.
[35] The unique exceptions being Bangladesh and Uganda that are not involved in any (strong) dependent relationship. For the list of the allocation of all countries see the Annex I.
[36] See for instance Kick (1987) and Babones (2005).
[37] In another direction, this graph can be studied with the tools of standard social network analysis. See the bibliography for suitable software.
[38] In this vein, the hegemony of US would be better appreciated across other axes, for instance in terms of media or military power.

However, the position of the US is central to the relationships among the core countries:

	USA	**United Kingdom**	**Germany**	**Japan**	**China**
USA		1110	1111	1111	1101
United Kingdom	1011		1111	0000	0000
Germany	1111	1111		1000	1000
Japan	1111	0000	0010		1111
China	0111	0000	0010	1111	

The US are fully integrated with two components of the core and have a dominant interconnection with the other two. They exhibit the largest number of inner links to the patterns (14), compared with Germany (10), Japan (9), China (8), and UK (7).

To understand the differences among the core countries, here is an analysis of the number of patterns they have relative to the whole of other countries[39]:

Pattern	**USA**	**United Kingdom**	**Germany**	**Japan**	**China**
0000	15	47	9	47	71
0001	0	0	0	0	0
0010	0	0	0	1	2
0011	0	0	0	0	0
0100	**10**	9	**19**	18	4
0101	0	0	0	0	0
0110	0	0	0	0	0
0111	0	0	0	0	1
1000	**18**	12	**20**	2	11
1001	0	0	0	0	0
1010	0	0	0	0	0
1011	0	1	0	0	0
1100	**49**	**24**	**44**	**23**	**6**
1101	1	1	1	3	2
1110	1	1	1	2	0
1111	**4**	3	**4**	2	1

The US have the largest number of dominance relationships (1100), with Germany following. Germany defends itself quite well: it has (slightly) more weak dominance patterns (0100, 1000) than the US and the same number of integration (1111). China is the less impressive of the core countries, with much more countries unrelated to it (0000) and the minimum number of

[39] Needless to say, to fully evaluate one country's role in the world structure further elements are required (e.g. in terms of specific commodity chains, the ownership of the firms involved in trade, etc.).

domination relations. But the same fact that in 1998 it reached the core region is already a great achievement.

Apart from global projection, the US already enjoyed an extremely powerful position in continental terms in 1998. Not only it is completely integrated (1111) with Mexico and Canada, but these two countries have an extremely concentrated trade[40].

In short, the world is not an absolute monarchy where all but the king are equal. It is rather an oligarchy with US being the "*princeps*" "*primus inter pares*".

5. The dynamics of world structure

How much does the world structure, revealed by international trade data, change over time? What is the rate of change? Is current globalization a mere quantitative proportional expansion of long-term relationships or is it better to interpret it as a "rotation" of major flows shifting from one region to another? Which are the typical transition of each pattern? Is dependence shrinking, leaving more room for integration? Or rather, is our world getting more and more hierarchical?

These are only some of the theoretical questions that we would like to address, since understanding change is the first step to manage it.

A simple way to proceed is to repeat the same analysis as 1998 at a later date. A year-by-year approach might give a high-frequency "picture flow", but we – in this phase of our work – are going to compare the results on a five-year basis, in order to provide enough time for structural changes to take place.

[40] Mexico and Canada lead the worldwide ranking of import and export concentration when C(1) – the share of the top partner - is used as the concentration index.

In 2003, the comparable data was as follows[41]:

Name	Binary description	Occurrences	% of all non-absence relation-ships	% of all relation-ships	Percentage change[42]	Change in the number of occurrences
					In comparison to 1998	
Absence of relationships	0000	4217	-	86,93%	-0.18%	-9
Dependence	0011	231	36,44%	4,76%	-0.21%	-10
Dominance	1100	231	36,44%	4,76%	-0.21%	-10
Source dependence	0001	176	27,76%	3,63%	+0.23%	+11
Source dominance	0100	176	27,76%	3,63%	+0.23%	+11
Destination dependence	0010	171	26,97%	3,53%	+0.17%	+8
Destination dominance	1000	171	26,97%	3,53%	+0.17%	+8
Integration	1111	24	3,79%	0,49%	+0.06%	+3
Mono out-integration	0110	12	1,89%	0,25%	+0.02%	+1
Mono in-integration	1001	12	1,89%	0,25%	+0.02%	+1
Dependent destination interconnection	1011	11	1,74%	0,23%	-0.04%	-2
Dominant destination interconnection	1110	11	1,74%	0,23%	-0.04%	-2
Dependent source interconnection	0111	8	1,26%	0,16%	-0.07%	-3
Dominant source interconnection	1101	8	1,26%	0,16%	-0.07%	-3
Destination integration	1010	1	0,16%	0,02%	+0.02%	+1
Source integration	0101	0	0,00%	0,00%	0%	0
Total		4851		100%		

The overall proportions among the different patterns are extremely similar, indicating a preliminary support of the thesis of robustness and resilience of world structure[43]. A closer look, however, shows some further phenomena.

[41] Data provided by the same 99 countries as above, based on the declaration of the importers. The same source as above.

[42] On the total number of all relationships.

[43] The ranking is the same as in 1998, with 3 exceptions: Mono Integration overcomes Destination Interconnection, which in turn becomes more widespread than Source Interconnection; at the bottom, Destination Integration "overcomes" Source Integration.

204 bilateral relationships have change – a small percentage (4.2%) but not a small absolute number. There is a fall in dominance/dependence pattern (-10) and a rise in integration (+3). Also the area of weak forms of integration slightly widens, whereas interconnections shrink as the absence of relationship does. In this picture, which is going into the direction of a reduction of "hierarchical relationships" in favor of more "justice", there is a counter-tendency shown by the rise of weak forms of dominance (Source and Destination). In terms of the speed of change, it is an extremely slow dynamics.

This is, however, the situation looking at net changes, balancing, for each pattern, the increase due to certain countries with the decrease due to others. For instance, total integration patterns rise from 21 to 24 because there are 5 new relationships of this kind but 2 of previously existing links have melted.

To analyze in details which are the transformation changing the relationships, it is useful to look at the "transitions matrix" of the next page.

A preliminary analysis of it shows several intriguing features. In a 5 years time span, the only way out of "Absence" is towards "Destination dependence". In turn, strong dependence is rather the transformation from "Source dependence" than from "Destination dependence".

The (unlikely) ways out of Dependence are "Destination Integration" and "Mono Integration", although a more likely path is to fall back to Absence.

The main entry path to Integration is through Source Interconnection.

A linear path from Absence to Integration seems full of obstacles.

The transition matrix from one pattern to another

	Absence of relationships	Source dependence/ Source dominance	Destination dependence / Destination dominance	Dependence/ dominance	Source integration	Mono out-integration / Mono in-integration	Dependent source interconnection/ Dominant source interconnection	Destination integration	Dependent destination interconnection/ Dominant destination interconnection	Integration		Tot. 1998
Absence of relationships	4154	0	72	0	0	0	0	0	0	0		4226
Source dependence/ Source dominance	0	144	0	20	0	1	0	0	0	0		165
Destination dependence / Destination dominance	63	0	99	0	0	0	0	1	0	0		163
Dependence/ dominance	0	30	0	208	0	1	0	0	2	0		241
Source integration	0	0	0	0	0	0	0	0	0	0		0
Mono out-integration / Mono in-integration	0	1	0	0	0	9	0	0	1	0		11
Dependent source interconnection/ Dominant source interconnection	0	0	0	0	0	0	6	0	0	5		11
Destination integration	0	0	0	0	0	0	0	0	0	0		0
Dependent destination interconnection/ Dominant destination interconnection	0	1	0	3	0	1	0	0	8	0		13
Integration	0	0	0	0	0	0	2	0	0	19		21
Tot. 2003	4217	176	171	231	0	12	8	1	11	24		4851

The matrix indicates how many relationships of a given pattern in 1998 have been confermed in 2003 (diagonal values) or have transformed in others (data out of the diagonal).

Who is at the hearth of these changes? Well, the top five countries by number of pattern modifications are as follows:

Country	N. of changes[44]
China	19
France	18
Germany	17
USA	15
United Kingdom	12

This data implies that China is at the center of a structural rotation of world relationships, going even beyond the mere quantitative rise of its measured GDP.

On the opposite side of the ranking, 14 countries did not change even one relationship with the rest of the world.

In which directions are these changes going? Who is getting stronger and stronger? Who is losing its grasp on other countries?

In terms of integration relationships, the new entries are: France-Belgium, Mexico-Canada, China-Rep. of Korea, China-USA, China-Japan. The continental platforms are strengthening their inner ties, with China being a pivot not only for Asian integration but also for its partnership with USA[45].

In terms of dominance integration, the following tables show the situation of top 5 and bottom 5 countries in order of total changes of the various forms of dominance patterns.

The "winners"

	Increase		Decrease		
Country	**Dominance**	**Weak dominance[46]**	**Dominance**	**Weak dominance**	**Tot. change[47]**
1. China	1	14	0	2	13
2. Canada	0	5	0	0	5
3. Mexico	3	4	0	3	4
4. Belgium	0	4	0	1	3
5. Spain	0	4	0	1	3

[44] Note that since the maximum amount of possible changes was 99 the absolute number is also a good approximation for the percentage of changes over the total.
[45] The two integrations that "melted down" are Costa Rica-Guatemala and the Netherlands-United Kingdom.
[46] Source dominance and Destination dominance.
[47] Net value of increases less decreases, without distinguishing strong and weak forms.

The "losers"

	Increase		Decrease		
Country	**Dominance**	**Weak dominance**	**Dominance**	**Weak dominance**	**Tot. change**
95. Greece	0	0	1	2	-3
96. India	0	0	0	3	-3
97. Viet Nam	0	0	0	3	-3
98. France	1	7	3	9	-4
99. Germany	4	4	3	13	-8

One could much deeper go into the details at country level, also taking more patterns into consideration. But are there changes in the "shape of the world"? Well, the four regions identified by the presence of domination patterns are reproduced also in the new dataset. The general "shape of the world" did not change between 1998 and 2003.

The composition of the regions did, however, exhibit a few changes on the margin. The core widens by one (net) increase, the semi-periphery loses 3 countries, the periphery widens by two:

N. of countries in the four regions of the World Economy

	1998	**2003**
Core	5	6
Semi-periphery	28	25
Periphery	64	66
Independence	2	2

France and Belgium enter into the core, while the United Kingdom leaves it – as the result of its losing importance for the USA, which transforms their relationship from interconnection to dependence[48].

We don't go further into this analysis, leaving a file for the autonomous exploration of the interested reader[49]. We simply underline that the "pattern approach" is able to detect minor and major changes in the structure of international relationships both among the "strong" and the "weak" countries.

[48] The Annex I enlists all changes in composition of the regions.
[49] *pattern.xls*

6. Future directions of research and policy

The "pattern approach" to the identification and visualization of world structures is just beginning to provide some hint for understanding the world we live in and for devising how to improve it.

Apart from refinement of the methodology itself and its application to further data, a major direction of enquiry is relative to the identification of micro- and macro-processes that give rise to patterns and structures[50]. The **reasons** why two countries are integrated or interconnected, the historical and economic sources of dominance and dependence, the language & immigration factors, the business histories that give rise to trade networks of imports and exports, the mechanisms of change - all this needs to be added into the picture, including new and existing evidence.

We need to grasp what the role is of imperfect competition, economies of scale and scope, bounded rational decision-making at the level of firms, governments, NGOs. All this influences the choice of preferred partners, leveraging geographical proximity as well as going beyond that[51].

The kind of research sketched in the present paper can turn out to be useful in order to design strategies for **regional integration**, along lines that are connected – but not restricted – to free trade formal agreements[52]. There is large room for WTO-compliant non-protectionist trade policies that would boost the trade between "privileged partners" without any trade diversion, but rather through a more than proportional rise in their bilateral trade.

Intentional pro-active public policies can be directed into improving the role of a country in the world, by implementing a given political choice.

For instance, if **integration** is the goal, then the analysis provides a strong rationale to choose neighbors for cooperation in trans-border trade and infrastructure. Out of the 21 integration relationships in the world, 12 are

[50] A further line of enquiry should be relative to the effects of certain patterns on performance and behaviors. For instance, what behaviors are implied by a dependence pattern? Does it lead to similarities in politics or voting in the international arena? For a conference presentation on an dataset of voting in the United Nations General Assembly see Lloyd (2005).

[51] A very first simulation model of the behavior of individual exporter is available for download at the site of the Economics Web Institute (Piana, 2003). A new version, including FDI decisions, is underway. A model of imperfect competition with product differentiation, R&D, advertising, and finance is available at the same site, while we are considering the possibility of extending it to international trade (Piana, 2003b).

[52] For instance, the integration of Latin America might be an interesting issue to explore. A large part of the present debate about ALCA and MERCOSUR seems biased towards the legal framework and the desirable degree of protectionism. By contrast, our perspective is rather focused on pro-active (and induced) activities of economic and social agents.

between co-bordering countries by land and there are several where only a short expanse of sea is separating them[53]. In this vein, "Trade with thy neighbor" is better than "Beggar thy neighbor".

In another cases, escaping from **dependence** might be the goal of a new government or a certain political group. In this case, our analysis suggests several routes, opened not only to rich countries but also to poor ones. For instance that country might try to increase its share in its dominant country trade sheet, so to prospectively reach **interconnection** (as it really happened between New Zealand and Australia between 1998 and 2003). Or it can try to boost trade with certain countries which are in the position to become even more important partners than the dominant one.

At the same time, the present spontaneous rate of change is extremely slow and a mechanism of facilitation would be probably needed.

The tools developed to analyze the dynamics of pattern structure can be used for further tasks: given a target alternative world whatsoever, they can single out **the changes necessary** to reach it from our present one. In a more computationally demanding task, they can propose which is **the shortest path** from our world to another which possesses certain politically desirable features (e.g. more integration, no periphery, US hegemony, etc.).

Not only policy-makers at national level are given operational goals and tools, but also multilateral organizations (as WTO, World Bank, IMF or UNCTAD) might be supported in finding out general rules or facilities to be implemented if certain agreed goals are to be met.

The "pattern approach" can also be used for trilateral relationships; in particular if two countries are major providers of the same product to a third one, they can be defined as "direct competitors". We are going to introduce quantitative measures of the degree any two countries are "direct competitors", so that the (often quoted, often vaguely-defined) concept of "**competitiveness**" can be given a measurable meaning.

The "value chain analysis" or "commodity chain analysis"[54], insisting on a less aggregated level than the one used in this paper, might give decisive insights on these - and other - issues.

[53] Due to low maritime transport costs, the sea is more a bridge than a barrier.
[54] See Gereffi (1994) and, for a comparison between the two approaches, Bair (2003).

Conversely, to the extent two countries buy more or less the same products from the same providers, one can develop measures of "similarity in tastes", opening the path to empirically test the idea that "globalization is the spreading of uniform tastes from an hegemonic country around the globe"[55].

In a wider picture, the operationalization of key World Systems concepts offers the opportunity to test certain bold generalizations that historians and observers might propose about "rules of movement" of entire World-Economies[56].

[55] See Cassels (2006) for a related insight.

[56] All this relates to uses of the methodology applied to trade data. But it can be equally be employed for any square matrix of transactions. Most immediately come to mind the following matrices:

- the input-output matrix by W. Leontieff of intersectoral interdepences;
- the regional matrix by W. Isard for regional development;
- the innovation source matrix, based on patents cross-citation data, following K. Pavitt and its widely-used taxonomy;
- the firm matrix of industrial district division of work, in a quantitative analysis referring to G. Becattini's contributions;
- the intra-firm matrix of socio-metrics distance among employees, introduced by J. Moreno to identify key managers in informal hierarchies.

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Annex I – The list of countries included in the analysis

Name	Region in 1998	Region in 2003	Code
Albania	PERIPHERY	PERIPHERY	ALB
Algeria	PERIPHERY	PERIPHERY	ALG
Andorra	PERIPHERY	PERIPHERY	AND
Argentina	SEMI-PERIPHERY	SEMI-PERIPHERY	ARG
Australia	SEMI-PERIPHERY	SEMI-PERIPHERY	AUS
Austria	SEMI-PERIPHERY	SEMI-PERIPHERY	AUT
Azerbaijan	PERIPHERY	PERIPHERY	AZE
Bangladesh	INDEPENDENCE	INDEPENDENCE	BGD
Belarus	SEMI-PERIPHERY	SEMI-PERIPHERY	BLR
Belgium	SEMI-PERIPHERY	CORE	BEL
Bolivia	PERIPHERY	PERIPHERY	BOL
Brazil	SEMI-PERIPHERY	SEMI-PERIPHERY	BRA
Bulgaria	PERIPHERY	PERIPHERY	BGR
Cameroon	PERIPHERY	PERIPHERY	CMR
Canada	PERIPHERY	PERIPHERY	CAN
Chile	PERIPHERY	PERIPHERY	CHL
China	CORE	CORE	CHN
Colombia	PERIPHERY	PERIPHERY	COL
Costa Rica	SEMI-PERIPHERY	SEMI-PERIPHERY	CRI
Croatia	PERIPHERY	PERIPHERY	CRO
Cyprus	PERIPHERY	PERIPHERY	CYP
Czech Rep.	PERIPHERY	PERIPHERY	CZE
Denmark	SEMI-PERIPHERY	SEMI-PERIPHERY	DNK
Ecuador	SEMI-PERIPHERY	PERIPHERY	ECU
Egypt	PERIPHERY	PERIPHERY	EGY
Estonia	PERIPHERY	PERIPHERY	EST
Ethiopia	PERIPHERY	PERIPHERY	ETH
Faeroe Isds	PERIPHERY	PERIPHERY	FAE
Finland	SEMI-PERIPHERY	SEMI-PERIPHERY	FIN
France	SEMI-PERIPHERY	CORE	FRA
Germany	CORE	CORE	GER
Greece	SEMI-PERIPHERY	SEMI-PERIPHERY	GRC
Guatemala	PERIPHERY	PERIPHERY	GTM
Honduras	PERIPHERY	PERIPHERY	HND
Hungary	PERIPHERY	PERIPHERY	HUN
Iceland	PERIPHERY	PERIPHERY	ICE
India	SEMI-PERIPHERY	SEMI-PERIPHERY	IND
Indonesia	PERIPHERY	PERIPHERY	IDN
Iran	SEMI-PERIPHERY	PERIPHERY	IRN
Ireland	PERIPHERY	PERIPHERY	IRL
Israel	PERIPHERY	PERIPHERY	ISR
Italy	SEMI-PERIPHERY	SEMI-PERIPHERY	ITA
Ivory Coast	PERIPHERY	PERIPHERY	IVO
Japan	CORE	CORE	JPN
Jordan	PERIPHERY	PERIPHERY	JOR
Kenya	PERIPHERY	PERIPHERY	KEN

Name	Region in 1998	Region in 2003	Code
Kyrgyzstan	PERIPHERY	PERIPHERY	KGZ
Latvia	PERIPHERY	PERIPHERY	LVA
Lebanon	PERIPHERY	PERIPHERY	LBN
Lithuania	PERIPHERY	PERIPHERY	LTU
Madagascar	PERIPHERY	PERIPHERY	MDG
Malawi	PERIPHERY	PERIPHERY	MWI
Malaysia	SEMI-PERIPHERY	SEMI-PERIPHERY	MYS
Maldives	PERIPHERY	PERIPHERY	MDV
Malta	PERIPHERY	PERIPHERY	MLT
Mauritius	PERIPHERY	PERIPHERY	MUS
Mexico	PERIPHERY	SEMI-PERIPHERY	MEX
Mongolia	PERIPHERY	PERIPHERY	MNG
Morocco	PERIPHERY	PERIPHERY	MOR
Nepal	PERIPHERY	PERIPHERY	NPL
Netherlands	PERIPHERY	PERIPHERY	NTH
New Zealand	PERIPHERY	PERIPHERY	NZL
Nicaragua	PERIPHERY	PERIPHERY	NIC
Nigeria	PERIPHERY	PERIPHERY	NGA
Norway	PERIPHERY	PERIPHERY	NOR
Oman	PERIPHERY	PERIPHERY	OMN
Pakistan	PERIPHERY	PERIPHERY	PAK
Panama	PERIPHERY	PERIPHERY	PAN
Papua New Guinea	PERIPHERY	PERIPHERY	PNG
Peru	PERIPHERY	PERIPHERY	PER
Philippines	PERIPHERY	PERIPHERY	PHL
Poland	SEMI-PERIPHERY	SEMI-PERIPHERY	POL
Portugal	PERIPHERY	PERIPHERY	PRT
Qatar	PERIPHERY	PERIPHERY	QAT
Rep. of Korea	SEMI-PERIPHERY	PERIPHERY	KOR
Rep. of Moldova	PERIPHERY	PERIPHERY	MDA
Romania	SEMI-PERIPHERY	SEMI-PERIPHERY	ROM
Russian Federation	SEMI-PERIPHERY	SEMI-PERIPHERY	RUS
Saudi Arabia	SEMI-PERIPHERY	SEMI-PERIPHERY	SAU
Senegal	PERIPHERY	PERIPHERY	SEN
Singapore	SEMI-PERIPHERY	SEMI-PERIPHERY	SGP
Slovakia	PERIPHERY	PERIPHERY	SVK
Slovenia	PERIPHERY	PERIPHERY	SVN
South Africa	SEMI-PERIPHERY	SEMI-PERIPHERY	SAF
Spain	SEMI-PERIPHERY	SEMI-PERIPHERY	SPA
Sweden	SEMI-PERIPHERY	SEMI-PERIPHERY	SWE
Switzerland	SEMI-PERIPHERY	SEMI-PERIPHERY	SWI
Taiwan	SEMI-PERIPHERY	SEMI-PERIPHERY	TAI
TFYR of Macedonia	PERIPHERY	PERIPHERY	MAC
Thailand	PERIPHERY	PERIPHERY	THA
Tunisia	PERIPHERY	PERIPHERY	TUN
Turkey	SEMI-PERIPHERY	SEMI-PERIPHERY	TUR
Uganda	INDEPENDENCE	INDEPENDENCE	UGA
United Kingdom	CORE	SEMI-PERIPHERY	GBR

Name	Region in 1998	Region in 2003	Code
Uruguay	PERIPHERY	PERIPHERY	URY
USA	CORE	CORE	USA
Venezuela	PERIPHERY	PERIPHERY	VEN
Viet Nam	PERIPHERY	PERIPHERY	VNM
Zambia	PERIPHERY	PERIPHERY	ZMB

Annex II – Some technical notes on the robustness of the analysis

In this annex, we discuss some underlying assumptions of the empirical part of the paper. We also provide elements to assess the robustness of those results to changes in datasets.

Assumptions

1. The first underlying assumption is that "trade matters".

In a sense, we take for granted that export and import flows are fairly large with respect to GDP, that their fluctuations are relevant to the business cycle and that many (adaptive and pro-active) activities of firms, households, and governments are linked to them. However, there may be countries that are so closed to international trade that their overall reliance on it turns out to be minimal; in that case they are less "dependent" on the overall trade situation. One should, however, be careful in this judgement of "irrelevant" trade, since the specific goods traded can be extremely important for the proper function of the economy.

In a second sense, commercial links are obviously not the unique transactions taking place between nations. We do not ignore that many other economic, social, cultural, political, military relations exist. On the contrary: the "pattern approach" can be applied to those matrices, so as to highlight coherence and tension (some would say "between the economic structure and the super-structure").

2. The second underlying assumption is that it makes sense to take the top partners as key discriminant factor for the existence of the relationship. This is acceptable if they constitute a large share of total trade and they are appreciably larger than the rest, so that they command attention from key decision-makers.

In the most drastic objection, if in the trade of a country all partners have the same share plus a small disturbance (let's say a "white noise"), then taking the top partners is meaningless because they do not represent a large share on the total (exports are not concentrated enough) and they are highly unstable (every year the disturbance can fluctuate).

This objection can be empirically tested. In our set of 99 countries, if it is true, every country would have 1% of total exports plus a minor disturbance[57].

[57] The argument is the same for imports.

Accordingly, top five partners could have, say, 10% or 15% of the total (with a positive disturbance that can lead to a 2 or 3 times higher share than the average).

Well, the concentration measure C(5) – i.e. the total share of top five exporters on the sum of 98 export partners – calculated in our 1998 dataset shows values from a minimum of 38.5% up to 92.1%. In 88 countries it is higher than 50%. Import concentration is quite similar, ranging from 38% to 86%, with 87 countries experiences a value higher than 50%. In both cases, the "flat scenario" is rejected by the data[58].

[58] It is true that C(5) would fall if the dataset were comprised of more countries; however, symmetrically, the average share requested in the "flat scenario" would fall even more. In a set with 198 countries, the average share would be more or less 0.5%, so that top five should have 3-4.5% of the total.

3. The third assumption is the choice of "five" top partners, in lieu of another number. How would the world structure appear using a different assumption? The following would occur[59]:

Name	Binary description	Top 1	Top 2	Top 3	Top 4	Top 5	Top 6	Top 7
		% of all relation ships	% of all relation ships	% of all relation ships	% of all relation ships	% of all relation ships	% of all relation ships	% of all relation ships
Absence of relationships	0000	97,20%	94,76%	92,08%	89,49%	87,11%	84,93%	82,70%
Source dependence	0001	0,80%	1,30%	2,10%	2,82%	3,40%	3,75%	4,23%
Destination dependence	0010	0,82%	1,36%	2,08%	2,82%	3,36%	3,65%	4,04%
Dependence	0011	1,13%	2,31%	3,30%	4,14%	4,97%	6,33%	7,15%
Source dominance	0100	0,80%	1,30%	2,10%	2,82%	3,40%	3,75%	4,23%
Source integration	0101	0,00%	0,00%	0,00%	0,00%	0,00%	0,02%	0,02%
Mono out-integration	0110	0,00%	0,06%	0,10%	0,10%	0,23%	0,21%	0,39%
Dependent source interconnection	0111	0,02%	0,08%	0,04%	0,16%	0,23%	0,19%	0,25%
Destination dominance	1000	0,82%	1,36%	2,08%	2,82%	3,36%	3,65%	4,04%
Mono in-integration	1001	0,00%	0,06%	0,10%	0,10%	0,23%	0,21%	0,39%
Destination integration	1010	0,00%	0,00%	0,00%	0,00%	0,00%	0,02%	0,06%
Dependent destination interconnection	1011	0,00%	0,02%	0,06%	0,16%	0,27%	0,29%	0,35%
Dominance	1100	1,13%	2,31%	3,30%	4,14%	4,97%	6,33%	7,15%
Dominant source interconnection	1101	0,02%	0,08%	0,04%	0,16%	0,23%	0,19%	0,25%
Dominant destination interconnection	1110	0,00%	0,02%	0,06%	0,16%	0,27%	0,29%	0,35%
Integration	1111	0,02%	0,10%	0,23%	0,29%	0,43%	0,62%	0,80%
Lowest export concentration		14.2%	18.2%	26.3%	32.6%	38.5%	43.1%	47.5%
Highest export concentration		83.4%	87.9%	88.9%	89.9%	92.1%	94.2%	95.6%
N. of countries with export concentration higher than 50%		11	25	46	75	88	95	98

[59] Data from 1998.

It's immediate that taking less partners reduces the number of "1"s across the patterns. However, the pecking order of the patterns remains overall the same: domination (in strong and weak forms) continues to be much more widespread than integration (in full or weak forms).

The choice of five seems not to distort the analysis in any particular direction. It results in no country having less than one third of their export recognized as a "priority" destination, with a very large majority having that share above 50%.

Data requirements and comments

The method requires a very basic data about each included country: the list of its top 5 source of imports and the list of its top 5 destination of export. The order in the list is irrelevant. Exact totals are not needed. The inclusion in the set of country is thus easy also for very small countries or countries that have a minimal accountancy of flows. In case of a lack of monetary data, proxies (e.g. from logistics data) might be used, if recognized reflecting the main exchanges.

In a previous paper we, indeed, used the data available from general economic information. In the paper , however, we wanted to verify the methodology over time in a comparable way for different number of "major" partners, so we introduced, this time, the request of a full square matrix of all flows between any two countries.

The UN COMTRADE is the largest dataset in the field; however, it suffers from some inconveniences. First, it measures only merchandise data, while trade in services is rising in importance. Second, although it is open to all members of UN[60], in reality some countries do not report the entire composition of trade each year. More importantly, there are wide discrepancies about the same flow when reported as export (by the exporter) and as import (by the importer). We chose import reports, which are usually considered more reliable than exports. We did not integrate the two in case of missing data, as some experts have done.

Indeed, in order to obtain a coherent square matrix with all flows between each couple, we simply dropped the rest of the world (as well as the residual categories as "Areas not elsewhere specified" or "Bunkers"). This shrinks the world totals and the total export / import flows for each country. However,

[60] With Taiwan being a large country outside the UN system; however we added direct data from Taiwan official sources to include it in our dataset.

the ranking (not the absolute value) is what matters in the application of our methodology. And the ranking is quite insensitive to, for instance, a proportional increase of all values to attribute what the UN does not attribute to single nations.

In other words, it is plausible that other researchers have "better" data than that used for the analysis. We are ready to share the instruments to apply the "pattern method" to any dataset proposed.