Modeling the International Economic Order: Absolute and Relative Gains

Kazutoshi Suzuki,

要約

国際公共財である自由貿易体制が維持されうるかという問題は、国際関係論の中心的な論題の一つとなった。この問題が論争に発展した一因は、協力体制が維持されると考えるネオリベラリストと、それに懐疑的なネオリアリストが、異なる国家像を前提として議論を組み立てていたことである。前者は、国家は自国の利益だけを考え行動する(絶対利得)とする一方、後者は、国家は他国との相対的な利益の差を重視する(相対利得)との立場であった。

　では、各学派の国家像に基づいた国家エージェントが相互作用をしたら、それぞれの学派が論ずる通りの秩序を作り上げるのだろうか? 現実の秩序は、どちらのエージェントが創り出した秩序に近いのだろうか? どちらの国家像に近い戦略が有利で、したがって採用されやすいと考えられるのだろうか?

　これらの点を検証するため、本稿では、国際関係論の理解に基づいた国家間の貿易自由化交渉モデルを作成した。国家は貿易による利害を計算し、他国と交渉して貿易量を決定する。交渉は「交渉力」や「貿易からの利害」といった関数(市場の大きさや貿易依存度等に依存)に基づいて行われる。このモデルの試行結果から、個々のエージェントの傾向と創り出される秩序が一致するとは限らない事を示し、国家像を相互作用の中で再検証する必要性を指摘する。

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Introduction

It is hard to confirm a hypothesis that says, "social phenomenon A is due to property B of its members", especially when empirical data is scarce, potential variables too many, the process of interaction complex, or experiments not feasible. These are often the cases with International Relations. Multi-agent simulation can open a new way for social scientists that are stuck in such mire with only conventional methods in hand. By codifying agents and letting them interact in an "artificial society", it is now possible to estimate at least the logical validity of such hypotheses.

This article examines the logical consequences of well-known assumptions of IR, absolute and relative gains. When we assume "states calculate their own interests and act rationally", the word "interests" can mean more than just the costs and benefits, as the controversy between neo-liberals and neo-realists makes clear. The former posit that states are indifferent to other states' well being, while the latter insists that states are interested in their relative capabilities and therefore in economic conditions of the others. [2]

Different recognition of national interests can result in different behavior and thus in different order. States with absolute gains are interested only in their individual wealth. From this perspective, states are "homo economics", which evaluate deals regardless of how much others gain form the same agreement. Based on this assumption, neo-liberals assert that creation and maintenance of an open world trade system is possible, with the help of repetition of interaction and/or configurations of global wealth. (c.f. Keohane 1984) Orthodox economists and liberal political scientists usually adopt this assumption.

On the other hand, proponents of relative gains, mostly political realists, claim that the cooperation among sovereign states is more difficult. For them, the most important objective of a state is to survive. Therefore, power, which matters in relation to the others and thus is a relative concept, counts for its behavior. Concerned about relative powers, states often refuse to make an agreement that can benefit both party but differently: if the agreement favors the opponents more, sovereign states tend not to accept it. (Grieco 1988,

[1] University of Tokyo   ktoshi@yf7.so-net.ne.jp
[2] For overview of the discussion, refer to Baldwin (1993).

1990)   From this perspective, the resulting system is expected to be less open.

The purpose of this article is twofold: to examine the logical consequences of absolute and relative gains, and to see if the emergent orders fit the pattern of the real world trade order. "Do states with absolute and relative gains create orders predicted by these theoretical considerations?"   "Do the emerged orders resemble the real world trade order?"

In the first section, I elaborate a model of international trading system in which each state calculates costs/benefits of various degrees of trade liberalization and bargains with other states to achieve its optimal level of market openness.   The second section deals with the created orders.   I demonstrate that different recognitions of interests make up very different orders, and that absolute gain does not mean more open world.   Then I use economic statistics of OECD countries to show that the real world order is more like the one that states concerned with relative gains create.   The concluding section sums up the results and implications.

Simulating the International Trade Order

The simulated world is composed of "states", which have "markets" of varying sizes and trade dependencies.[3]   Each state negotiates for trade liberalization or closure to achieve its optimal level of trade.   Agreements are reached by consensus or coercion, depending on the preferences and relative bargaining powers of relevant states.   As they implement the trade agreements, determinants of their bargaining power such as "trade dependency" and "size of economy" shift.   This in turn influences the cost/benefit calculations and relative bargaining powers in the next round of negotiation.

This section explains the process of the model in details.   First, based on the interdependence literature, I formulate the relation between international trade on one hand, and the cost and the benefit of states on the other.   The second part specifies how the bargaining powers of the states are determined.   After a quick description of the sequence of the bargaining, the two behavioral rules originated from different recognitions of interests (absolute and relative gains) are formalized.

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[3]   "Trade dependency" is defined as the proportion of the sum of export and import in "market size" (=GDP).   This definition is not completely erroneous because the overall import and export of real states are highly correlated.   (In the case of 31 OECD economies in 2001, R = 0.892.)

Limitless Greed, Limited Tolerance: the Cost and the Benefit of Trade

Trade liberalization levy costs as well as benefits.[4]   The blessings of trade liberalization such as economic efficiency and diversity of goods are often accompanied by sensitivity to international price level, adjustment cost, and social instability.   Domestic pressure groups translate these socio-economic costs and benefits into political ones.   Let us take a closer look at how the cost and benefit of trade change in relation to the market openness.

The more open the economy becomes, the more damage it will incur.   The marginal cost of liberalization increases as the openness of the market rises.   This is because states will first open the sectors that cost relatively less and politically feasible.   Indeed, this pattern is obvious in actual negotiations.   One prominent example is the GATT Tokyo Round negotiation, where "difficult" issues such as agricultural liberalization were put aside while other sectors were liberalized.   Therefore, the cost of trade is represented by an upward curve (red curve in Figure 1).

The benefit of trade also increases in accordance with the market liberalization, but the marginal profit of trade decreases as the trade dependency approaches 100%.   The basic logic is parallel: scarce goods imported first, profitable goods exported first.   As long as these market demands turn into political ones, decision-makers will act accordingly. Additionally, the benefit of trade is relatively greater for smaller states, because small economies have more difficulty attaining the economy of scale and the diversity of goods in the absence of trade.   Therefore, I assume the total profit of trade as

$$PROFIT = A\sqrt{DEPENDENCY} - \frac{(DEPENDENCY)^2}{B \times 10} \qquad (1)$$

where, *A* stands for smallness of economic size (5-15), and *B* for insusceptibility to the harm caused by increased trade.[5]

As a result, net profit of a state is shown by a convex (green line in the Figure 1).   The peak indicates the most preferred trade dependency, and moves toward upper-right direction as the market size of the state becomes smaller.

Each state uses this formula (1) to calculate its optimal level of trade dependency (aggregate quantity of trade / market size) and the direction of preferred action (increase or

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[4] The following discussion on the preference of states is based on the concept shown by Susumu Yamakage. Refer to Yamakage (1982) for details.

[5] The degree to which a state is harmed by international trade may vary due to country specific elements such as political institution and factor mobility.   However, for the sake of simplicity and tractability, I set this value at 10 throughout this paper.

decrease trade).　After that they proceed to negotiation phase.　By carrying out the agreed trade, states acquire profits, and this in turn grows the market when accumulated.[6]

The Dependent is Timid: Determinants of the Bargaining Strength

What makes a state more advantageous or disadvantageous in negotiations?　I assume trade dependency and the size of economy do.　States with large market are more advantageous in negotiations because they can offer attractive deals of reciprocal liberalization, or threaten others with protectionist measures.　The larger the power base, the stronger it will become. Thus, I assume that a state's bargaining advantage is proportional to its market size.

In contrast, heavily dependent states would be prone to such threats and expected to be weak, other things being equal.[7]　There is empirical evidence that dependent states are more susceptive to the threats of the Section 301 of U.S trade law. (Bayard and Elliott 1994) Therefore I assume that a state's disadvantage in negotiation is inversely related to trade dependency.

These advantage and disadvantage are to some extent compensatory: even if a state has large market as potential leverage, high dependency would make it difficult to put the threat into practice.　Thus, I define the overall bargaining power as

$$POWER \ = C(SIZE \ ) - D(DEPENDENCY \ ) \qquad (2)$$

There are at least two possible problems with this formulation.　First, relative salience of market size and dependency is not clear either from theoretical works or empirical investigation.　I have set the ratio of C to D at 1:2, because the values of market size are distributed between 1-100, while typical values of the most preferred dependency are less than 50.[8]　Second, how much bargaining power one needs to compel others cannot easily be specified.　I use a variable that represents state autonomy (or sovereignty), and change the value later to check if the same result holds.

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[6]　500 points are needed to grow the market 1 size larger.

[7]　In this article, the dependency is calculated from overall trade amount.　It is pointed out, however, that trade diversification helps dependent state to keep its bargaining power.　(Keohane and Nye 1989)　The effects of calculating dependencies of each dyad are left for further research.

[8]　I conducted pilot experiments to find these values.

Recognition, Behavior, and the Negotiation

The sequence of the simulation is as follows.   First, each state calculates its bargaining power, trade dependency, and optimal trade dependency.   Then, every state randomly selects a negotiating partner and begins negotiating to increase or decrease the amount of trade between the two.   In the next phase, states carry out agreed trade.   Although the negotiations are all bilateral, each nation usually trades with multiple partners after several turns.

How exactly do the negotiations proceed?   First, consider the case of a state with absolute gains.   Randomly selected pairs compare their direction of preference.   If they coincide, the states agree.   If not, they compare the bargaining power of each other, and the stronger state compels the other to agree with it.

The operational rule of states with relative gains is basically the same except one point. It not only compares the direction of preference, but also the expected profit of itself and the opponent.   It does not agree if the expected net profit of the opponent is larger by certain margin.[9]   Thus, states with relative gains do not accept some deals that states with absolute gains do.

Note that the negotiation process is gradualist: only one unit of trade is increased or decreased at one negotiation.   This is to allow states to have the opportunities to establish trade relations with all the other states.   Otherwise, those who have negotiated in the beginnings of the simulation by chance tend to have strong ties, excluding the others and distorting the resulting order.

The Emerging Order

The International Relations literature points out that distribution of economic power has great influence on the consequent order. (Kindleberger 1973; Krasner 1976)   To see the effect of different distributions of wealth, I use three patterns of distribution.   In RANDOM, market size of each state is randomly determined in the range between 1 and 100.   In UNIFORM distribution, 20 states' market size are   {5, 10, 15…100}.   HEGEMONY is a distribution based on actual GDPs of top 20 OECD nations in the year 1970, characterizing U.S. hegemony.[10]

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[9] The default value is 2, which means that the state agrees if the opponent's profit is less than 2 times its own profit.   I change the value later to check the robustness of the result.

[10] The actual values are {100, 21, 20, 15, 12, 11, 9, 4, 4, 4, 4, 4, 3, 2, 2, 2, 1, 1, 1, 1}.

Table 1. Main features of the system (after 200 rounds of negotiations)

		The sum of all states' profits	The sum of distances to the most preferred points	Average profit of large states	Average profit of small states	Average trade dependency
RANDOM	ABS	792.76	28.00	23.59	56.65	0.3262
	HALF	715.98	156.58	24.21	43.90	0.3537
	REL	693.92	240.04	24.08	38.63	0.3693
UNIFORM	ABS	781.48	27.36	23.94	55.43	0.3215
	HALF	710.08	153.40	23.94	43.50	0.3498
	REL	665.98	235.68	23.95	36.25	0.3569
HEGE-MONY	ABS	1187.20	46.46	18.69	61.50	0.4142
	HALF	1152.42	90.26	18.69	59.66	0.4270
	REL	1044.54	270.96	18.71	53.98	0.4737

*Small states are ones that had markets smaller than 30 at the beginning, large states larger than 70.

In each of these three distributions, I tested three conditions of the recognition of interests. ABSOLUTE is a world composed only of states with absolute gains, and RELATIVE, of ones with relative gains. In HALF&HALF, each state has 1/2 chance of being relative-gains-minded. Thus, we have 9 sets of conditions. In the following experiments, each set of the simulation is run 50 times and each run contains 200 rounds of negotiations.

The Order in the Simulation

Table 1 shows the main results. Although the distributions of global wealth seem to alter the resulting figures, it does not change the tendencies of the result. As more states become concerned about relative gains, the sum of all states' profit decreases. The second column shows the sum of the distances between each state's actual dependency and the most preferred one. The value is the largest in RELATIVE, the smallest in ABSOLUTE, with HALF&HALF somewhere in between. These results seem natural because relative-gains-minded states do not agree to some of the deals that are profitable. The more concerned with profits of the others, the less wealthy the world becomes.

Note that these figures designate profits, not utilities. Relative-gains-minded states will count the other state's stagnation as its utility. Thus, these states may feel happier when the

world as a whole is in stagnation.   Although I do not define how much utility one gets by seeing the others being poor, we can extract some implications from a closer look at the different parts of the same order.

The third and fourth columns show the profits of small states and that of large states. As relative gains minded states increase, the average profit of small states decrease drastically, while the profit of large states remains the same.   Large states with relative gains are expected to have higher utilities than those with absolute gains, because their material profits do not decrease, while they find extra utility from hampering the others.

As for small states, the economic growths are hindered both in absolute and relative terms, if other states are relative-gains-minded.   The profits in absolute terms are greatly reduced by the presence of relative-gains-minded states.   In this situation, the disparity between small and large states will not narrow in comparison with the absolute-gains-minded world.   Thus, small states' utilities will be smaller in a relative-gains-minded world regardless of its own recognition of interest.

Finally, contrary to our intuition and theoretical prediction, trade dependency is the highest in RELATIVE and the lowest in ABSOLUTE.   One would guess that this is because the states in ABSOLUTE achieve higher economic growth, and the consequent larger sized markets make them prefer lower trade dependency.   However, the same result is observed even when the contribution of trade to economic growth is set at zero. [11]   Moreover, not only the ratio of trade but also the total real amount of trade was larger in RELATIVE than in ABSOLUTE in all cases.   The cause seems to be that some small states are coerced into trading excessively.   (c.f. Figure 2)

This phenomenon is interesting in that a combination of the logic of established discourses leads to a counterintuitive result.   Most of the premises of this model come from widely accepted propositions: there exists some optimal level of states' openness; small states prefer relatively higher trade dependencies; market size and trade dependency matters in negotiations….   If we were to accept these propositions, using the openness as the indicator of international cooperation and harmony may be preposterous.   Relative gains, which supposed to hinder international cooperation, may in fact lead to more open trade order.

Now, let us examine in details the charactaristics of the emergent patterns.   Figure 2 shows the resulting patterns in UNIFORM distribution.   In ABSOLUTE, we see all states line up on the most prefered dependencies.   The larger the state's market, the lower the trade dependency.   This is the situation states want, as we have seen in Table 1 that the distance to the most prefered point is minimal in this setting.

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[11] Keeping other conditions constant, I checked three recognitions (ABSOLUTE, HALF&HALF, RELATIVE) in UNIFORM distribution.

In RELATIVE, trade dependencies of large states are mostly the same as those in ABSOLUTE.   However, the small states' dependencies tend to deviate greatly from the optimal points, in both upper and lower directions.   Also, some of medium sized states have lower dependencies, but no higher.

In the case of HALF&HALF, some small states have higher dependencies, but none had a low dependency.   Large and medium sized states remained near the prefered points. What deserves more attention in this distribution is the fact that a state's recognition of interest do not affect its own trade dependency.   We see no distinctive points in the trading patterns of two kinds of states, relative and absolute-gains-minded.   Efforts of a state to be rational in economic terms (i.e. being absolute-gains-minded) do not affect the trading pattern of that state; recognitions of all the others will.   The main victim of the relative gains are small states, which would have obtained absolute profit or secured larger relative profit to catch up in the absense of relative-gains-minded states.

The only operational difference between absolute-gains minded state and relative ones is that the latter do not agree to certain deals that the former do agree.   This seemingly small difference creates very different orders.

The Order in the Reality

We have seen how the simulated states work.   How much do these simulated orders resemble the real trade order?   To see this, we will examine the characteristics of the real order.

Figure 3 shows the GDPs and trade dependencies of top 31 OECD countries in the year 2001.   Large states have relatively low trade dependencies. [12]   Although the sample of large states is small, it is not a great concern here because this result is expected both from absolute and relative gains model.   What is more important for our present concern is the dependencies of small and medium sized states.   A medium sized state is situated at the bottom and not at the top, and obviously, small states' dependencies are widely dispersed. These patterns are similar to those appeared in RELATIVE, indicating that relative gains explain the real order at least better than absolute gains do.   Although the resemblance in results does not guarantee the identical cause, relative gains can be a candidate for the explanation of international trade order.   This result shows the need for further investigation on the effect of interest recognitions in the context of interaction.

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[12] The second largest indicates all the euro area combined.   The dependency in the figure may be higher than the real value, because of intra-area international trade.

Conclusions and Further Research

The simulations produced some counterintuitive results. First, a realist struggle for relative power makes the world trade system more open than does the more harmonious interaction of liberal economists. This result indicates that we may have to reconsider using the openness as a proxy of international cooperation. Paradoxically, an open system can result from conditional non-cooperation at process level. Although this seems to be due to interactions of interests and power, the cause is not clear. Future research would have to specify the exact process of this phenomenon.

Second, interest recognitions of individual state do not affect its own trading pattern. A state, be it large or small, cannot become more dependent or independent solely by adopting specific bargaining strategy based on absolute or relative gains.

What deserves careful attention here is that the emergent order contradicts the tendency at unit level. When gathered, states that cooperate less create a more open system. Recognition of interests of all states will greatly change the order, but that of single state does not alter the trading pattern of its own. This suggests that we need a more extensive research on the assumptions of absolute and relative gains in the context of the system, not in a single-shot interaction.

Finally, absolute gains cannot account for divergent dependency of small states. The characteristics observed in the real order emerge only in the model of relative gains. Of course, this does not assure that the underlying mechanism is the same. It only implies that realists explain the order better than the liberals. This result reinforces findings of the empirical case studies that the states are political entities and cares about relative gains. (Grieco 1990; Mastanduno 1991) If one wants to analyze the real world and analyze it better, he may need "Economic Politics" rather than Political Economy.

Sensitivity Analysis

- Negotiation rule: In the negotiations of the original model, the stronger always wins. I changed the rule and made the degree of power gap work as the probability of winning. The results remained basically the same.
- Strength of sovereignty: The value is sifted from 1.5 to 2.5 (default value 2.0). This changes the threshold of being "small states". The higher the value, the more resistant small states become.
- Strength of relative concerns: In RELATIVE, states do not agree to a deal if the other's

profit is more than 2 times larger than its own.　Does this value influence the results?　I set the value at 1.5 and 2.5.　The larger this value, the closer it becomes to ABSOLUTE setting, but the basic characteristics of the results were the same.

- Data sample: Another problem is that the number of the sample of the real order (especially of large and medium sized states) is too small.　One possible remedy would be to use time series data.　This task is left for further research.

References

Baldwin, DA ed. (1993) *Neorealism and Neoliberalism: the contemporary debate,* New York: Columbia University Press.

Bayard TO, Elliott KA (1994) *Reciprocity and Retaliation in U.S. Trade Policy,* Washington DC: Institute for International Economics.

Grieco JM (1988) "Anarchy and the limits of cooperation: a realist critique of the newest liberal institutionalism", International Organization 42: 485-507.

——— (1990) *Cooperation among nations: Europe, America, and non-tariff barriers to trade*, Ithaca: Cornell University Press.

Keohane RO (1984) *After Hegemony*, Princeton: Princeton University Press.

Keohane RO, Nye JS (1989) *Power and interdependence*, 2nd edn. HarperCollins Publishers.

Kindleberger CP (1973) *The World in Depression, 1929-1939*, Berkeley: University of California Press.

Krasner SD (1976) "State power and the structure of international trade", World Politics 28: 317-343.

Mastanduno M (1991) "Do relative gains matter?: America's response to Japanese industrial policy", International Security 16: 73-113.

Waltz KN (1979) *Theory of international politics,* New York: McGraw-Hill.

Yamakage S (1982) "Modeling interdependence and analyzing conflict: mathematical representation", International Political Science Review 3: 479-503.
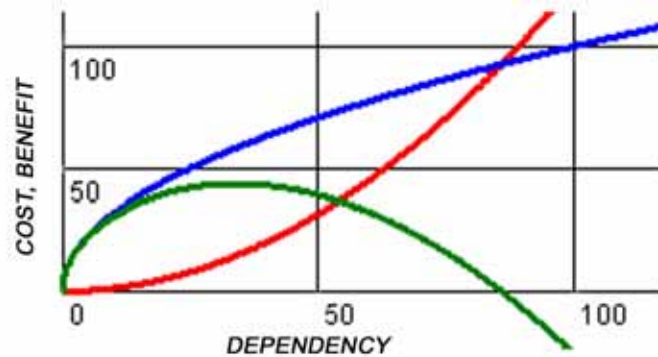
Figures

Fig. 1. The increasing cost and diminishing benefit of a state (market size 70).
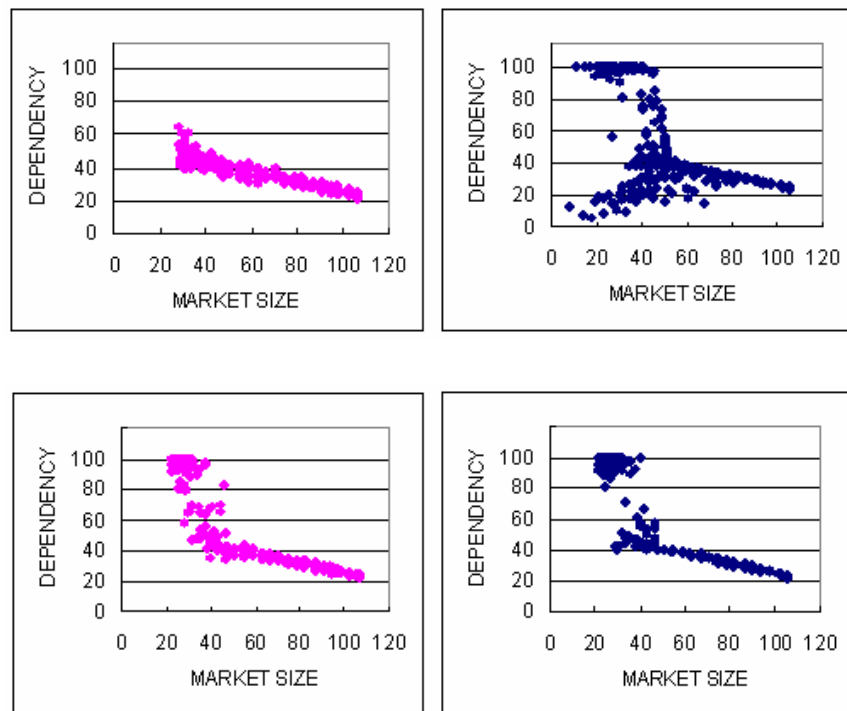The convex shows the total net profit of trade.

Fig. 2. Market size and dependency in UNIFORM distribution.
upper left: ABSOLUTE
upper right: RELATIVE
lower right: states with absolute gains in HELF&HELF
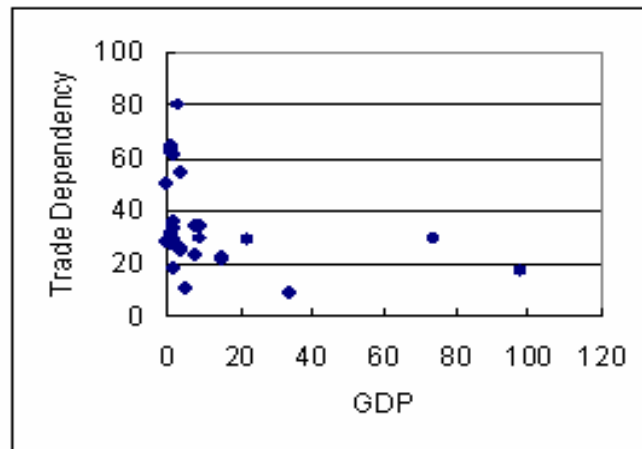lower right: states with relative gains in HELF&HELF

Fig. 3. The GDPs and trade dependencies of OECD countries (in the year 2001).