The Architecture of Globalization: A Network Approach to International Economic Integration[1].

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Abstract

We combine data on international trade linkages with network methods to examine the global trading system as an interdependent complex network. We outline the topology of the international trade network and suggest new network based measures of international economic integration, at both a local country-level and a global system-wide level. These measures incorporate the structure and function of the network and may provide a more meaningful approach to "globalization" than current measures based on trade volumes. We find that in terms of participation in the network, global trade is hierarchical with a core-periphery structure at meaningful levels of trade, though integration of smaller partners into the network increased considerably over the 1990's. The network is strongly "balkanized" according to geography of trading partners but not as strongly by income or legal origin. We develop network based measures that incorporate not only the volume of trade but also the influence that a country has on the international trading system. These measures may provide sharper insight into why and how financial crises are propagated than simple volume-based measures. We find that a country's position in the network can have substantial implications for economic growth. We therefore suggest that a network approach to international economic integration has potential for useful applications in international finance and development.

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I. Introduction.

While popular usage of the term "globalization" provokes strong and polarizing opinions across the world, such sentiments are usually associated with the effects, real or perceived, of what economists refer to as international economic integration. The increase in international economic integration that has characterized the last half-century has been associated with the spectacular economic performance and move out of poverty for large parts of the world (Sachs and Warner, 1995), but also with the increase in the volatility of country-level performance, reflected in several recent episodes of economic and financial "crises" (Forbes 2001). There is also a growing perception that the process of globalization has accelerated over the last decade and that the benefits and costs of increasing economic integration have not been evenly distributed across the world (Stiglitz, 2002; Bhagwati, 2004).

Despite a sharp increase in academic and policy interest on these issues, discussions are often handicapped by the dearth of meaningful measures of international economic integration. Most studies of international economic integration or globalization in the economics literature focus on the volume of trade (exports and/or imports as a fraction of total trade) between countries, or define "trade integration" as the sum of exports and imports divided by GDP (see for example Rodrik, 2000, IMF World Economic Outlook, 2002). While these indicators[3] have been useful, the literature recognizes their shortcomings (which we describe in more detail below). Nevertheless, they are still widely used for studying international economic integration, primarily for lack of better alternatives.

However, recent advances in the study of networks (Albert and Barabasi, 2002; Newman, 2003) have placed elegant and powerful tools at our disposal, enabling us to suggest alternative measures of international economic integration (henceforth IEI) that turn from a sole focus on individual country trade levels to a consideration of the pattern of linkages that tie together countries around the world as a whole. In this paper we combine a network approach with data on international trade linkages in order to examine the global trading system as an interdependent complex network[4]. We use this change in perspective toward IEI to suggest new measures of integration that provide insights into global trade that have been overlooked by the literature. We believe a network approach to IEI holds promise for many potential applications in international

[3] Other measures based on volumes such as gross private flows to GDP, and total trade to merchandise value added also fall into this category.

[4] Complex networks are large scale graphs that are composed of so many nodes and links that they cannot be meaningfully visualized and analyzed using standard graph theory. Recent advances in network research now enable us to analyze such graphs in terms of their statistical properties. Albert and Barabasi (2002) and Newman (2003) are excellent surveys of these methods.

finance and development and provide an application of our new measures to the relationship between economic growth and trade. To the best of our knowledge this paper is the first attempt in the economics literature to explicitly view the international trading system as a complex network and examine its structure and function from such a viewpoint.

With this as our objective, we proceed in the following manner. We first map the topology of the international trade network with a view to understanding its structure and properties. Armed with such an understanding, we then suggest new measures of IEI, at both a "local", country-level, and a "global", system-wide level, that incorporate the structure and function of the network. These measures arguably provide a more meaningful approach to "globalization" than current measures based on trade volumes. We use these measures to parse IEI along a number of different lines: geography, income and legal origin. We suggest network-based measures that capture not only the volume of trade but also the "influence" that a country may have on the international trading system. We find that ranking countries according to such measures of "importance" to the network provides sharper insight into why and how financial crises are propagated than simple volume-based measures. For example, using 1992 data to construct the international trade network, we find that Thailand, a country which was the epicenter of the 1997 Asian financial crisis, ranks 22nd in terms of global trade share but 12th by our measure of network "importance". We therefore believe these measures could add to our understanding of financial and economic contagion.

Since we have data on the network of international trade linkages at two points in time, 1992 and 1998, we are able to construct these measures for both years and examine how the network and thus "globalization" has evolved over the 1990's. We find that at low levels of trade, the global trading network has become much more integrated, while at higher levels of trade it has not changed much. We find that at low levels of trade, the global trade network is quite decentralized (and homogenous) but at higher levels of trade the network looks much more hierarchical (and heterogeneous). At higher levels of trade the network thus has a core-periphery configuration. We find that there is a high level of multilateralism in global trade and this has not changed much between 1992 and 1998.

As an application, and to demonstrate the potential of the network approach to IEI, we use our measures of network importance in a cross-country growth regression and find that they are all statistically and economically significant, have the expected signs and raise the explanatory power of the regression above that obtained using only volume based measures current in the literature. Using one of our measures of local integration, degree centrality, we find that an improvement in the degree centrality ranking of ten units increases the average GDP per

capita growth rate by 0.27%[5]. A country's position in the network can thus have substantial implications for development outcomes.

The paper is organized as follows. Section II sets the stage for our approach by providing a critique of currently used measures of IEI and introducing the network approach that we take to the data. Section III describes the data and definitions that we use to organize the trade-link data. Section IV applies concepts from network analysis to understand properties of the network. We first provide an overview of the topology of the network and then delve deeper into the data and propose measures of local and global economic integration. Section V is our application to economic growth. Section VI concludes by suggesting avenues for future research.

II. A Network Approach to Measuring International Economic Integration.

A number of recent studies have used international trade data and gross private capital flows to assess the current status and evolution of economic integration, globalization and trade openness (Krugman, 1995; World Development Indicators, 2002; World Economic Outlook 2002). On the basis of measures using ratios of total merchandise trade to gross domestic product (GDP) and gross private flows to GDP, the findings of these studies are that these ratios have not changed much for developed economies, while for some developing and emerging economies they have increased significantly.

This apparent asymmetry is puzzling, and according to Rodrik (1996) and Feenstra (1998), caution should be exercised when using these ratios to make statements about globalization. A problem with these indicators is that they do not capture important dynamics of the international trade and/or internal economic structures of different countries. For example, over the past few decades, developed countries have dedicated a large share of their economies to services trade rather than merchandise trade. Also, as a country becomes more open, government spending increases in order to offset external risks from international trade and capital flows. These two effects, not accounted for by these indicators, decrease the proportion of merchandise trade relative to GDP and may lead to erroneous conclusions about changes in the extent of economic integration.

An alternative indicator proposed by Irwin (1996) and used by Feenstra (1998), is the ratio of total merchandise trade to merchandise value-added. Feenstra (1998) calculates this

[5] This is judged to be a substantial effect by the standards of the literature. For example, Yanikkaya (2003) finds that an increase of 10% in the total trade to GDP ratio would increase the average growth rate of per capita GDP by 0.18%.

indicator for a group of developed countries and obtains more intuitive results. He shows that the ratios increased considerably over the past three decades and offers this as evidence for a higher degree of globalization. This statistic avoids some of the issues mentioned above but still has some deficiencies. The denominator is value added and therefore avoids double counting, but the numerator is not. The ratio is therefore biased upward since trade in components and finished products are double-counted when we use total trade data (exports plus imports).

Even though the literature recognizes the shortcomings of these indicators -- total trade to GDP, gross private flows to GDP, and total trade to merchandise value added -- they are still widely used when studying IEI, primarily for lack of better alternative measures. A different way to look at globalization or economic integration is in terms of the dense web of cross-border relationships between countries. By combining country level information such as total trade to GDP ratios with network analysis indicators, we should be able to draw more meaningful conclusions about globalization.

The indicators described above do not take into account interactions between countries, the number of trading partners and volume of trade with each partner. Network analysis provides measures that incorporate these features and therefore provide a richer picture of the economic integration of the network as a whole. Moreover, a network approach enables us to derive statistics that describe the structure and evolution of global trade in ways that existing measures do not capture, such as the number of actual and potential trading partners, the structure of regional trading and the influence of individual countries and groups of countries for the whole network and for specific regions.

While we believe this is the first exercise to explicitly chart the topology of the international trade network and suggest the use of this topology for the understanding of economic integration and financial contagion, we are by no means the first to use network ideas in international economics. A number of recent studies in international economics have used a network approach to understand the relationship between trade patterns and informational barriers to trade (Rauch, 1999; Rauch and Trindade, 2002; Rauch and Casella, 2001; Casella and Rauch, 2002), or to understand vertical and horizontal integration in emerging economies (Feenstra, Huang and Hamilton, 2003). The focus of the first group of papers is on the use of information sharing through ethnic networks to facilitate trade in differentiated products. The second paper examines the relationship between market power and boundary-of-firm issues in the context of business groups, an organizational form widely observed in many emerging economies, notably in East Asia. This literature is set in the context of the debate between networks and markets as efficient organizational arrangements. An excellent introduction to this literature is Rauch and

Casella (2001) and the critique by Zuckerman (2003). However, our line of inquiry is quite distinct from these papers as they do not focus on explicitly mapping and using the network of international trade linkages and are not geared toward measuring international economic integration.

The Network Approach

The first step in our approach is to identify the fundamental building blocks of the network and their specific properties. 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. 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. Thus, 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.

The number of links each node (i.e., country) possesses is called the *degree* of the node. The first step to obtaining an understanding of the global structure of the network is by examining the number of trading partners for each country in our dataset, an exercise known as node *degree analysis* (Wasserman and Faust, 1994). The results of the degree analysis enable us to form a picture of the general structure of the network and its properties, such as core - periphery configurations, influential nodes for the network, and network density, defined as the number of links actually present out of all possible ones. We also measure inequality in node degree by computing Lorenz curves and Gini coefficients for the degree distribution.

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".

We then examine country specific characteristics such as the number of trading partners, income levels, and legal structure to investigate the existence of trade patterns driven by similarities between countries. In network terminology, the presence of such patterns is referred

to as assortative mixing and community structure[6] (Newman, 2003). Such patterns seem particularly relevant given current globalization debates and allow us to view IEI from a number of different angles. For example, if high income countries trade with other high income countries twice as much today relative to previous years, and less with low income countries, we could say that the network as a whole is becoming more "balkanized" rather than more "globalized" along the income dimension. If more trade occurs between instead of within groups, then this could be considered evidence of a more economically integrated system.

The 1990's have been a booming era for international trade agreements like the NAFTA, MERCOSUR, and the EU. In light of these preferential trade arrangements, an interesting question is the extent to which trading partners of a particular country are also linked to each other. This corresponds to the analysis of the proportion of multilateral trade relationships relative to bilateral ones. In a more globalized world the share of multilateral relations relative to bilateral ones should be higher than in a more balkanized world. In terms of network concepts, the clustering coefficient (Watts and Strogatz, 1998; Newman, 2003) measures the ratio of complete triangles (multilateral trade) to triples in the network (bilateral trade) and can be used to examine this property for the whole network.

While these measures enable us to gain an understanding of the "global" structure of trade, a network approach also provides a number of measures that we can use to understand integration at a "local", country-specific level. In network terminology, these indicators are called *flow* measures and they measure how well a specific node is connected into the network and assess the degree of influence that it has on other nodes and on the network as a whole (Hanneman 2001). These flow measures allow us to evaluate the influence that each country has on its trading partners and on the entire trade network.

We thus aim to analyze the topology of the international trade network and devise new measures of international economic integration, at both a local country-level and a global system-wide level, that incorporate the structure and function of the network. We believe these measures provide a more meaningful approach to "globalization" than current measures based on trade volumes.

[6] We describe these concepts in more detail in Section IV.

III. Definitions and Data.

Nodes or vertices and links, edges or ties are the basic building blocks of a network (also referred as a graph in the mathematics literature). When two vertices are associated a link between them represents this relationship. A network is simply a collection of vertices joined by edges that can be non-directed, directed and/or valued by weights, magnitude or length. Undirected edges are used in networks where it is not possible to distinguish between the link from node A to node B and the one from node B to node A[7]. Directed edges represent relations that go only one way, like A (sender/source) exporting to B (receiver/recipient) and/or B (sender/source) exporting to A (receiver/recipient). In this case it is possible to have one of the links without the other, in other words the association is not necessarily reciprocal. Networks or graphs formed by directed edges are called digraphs or directed networks.

Network data can also be presented in matrix form, where rows and columns headings represent vertices and the cells of the matrix describe the type of association between each vertex. It is standard in the networks literature (see for example Newman, 2003) to use rows for the source vertices and columns for receivers. The values of the cells can be zeros when the vertices in question are not associated and ones or other values when they are. Note that symmetric matrices would correspond to undirected graphs while directed graphs may or may not have symmetric matrices.

For a network with a small number of nodes it is easier and sometimes more appealing to use a graphical representation. As the number of vertices increases, graphical analysis of the network becomes more difficult and its characteristics and patterns are hard to identify through the naked eye. Table 1 shows the matrix form representation for a directed network and Figure 1 shows the graphical representation of two directed networks drawn from the data in Table 1. The first network is a subset of the second and it only includes the first five 5 nodes and the edges between them (12 in total), while the second includes all 10 nodes and the 56 edges.

[Insert Figure 1 and Table 1 here]

The data used for our international trade network was extracted from the COMTRADE Database of the United Nations[8]. We use the US dollar value of exports and imports of all

[7] A simple example of a non-directed relation is that of recording if two nodes are close to each other, distance wise. If we conclude that A is close to B, then B must be close to A as well.
[8] United Nations database STIC 1.

commodities between 182 countries for the years 1992 and 1998[9]. Countries are the vertices of the network and an edge between them represent trading relationships among these countries. We study imports and exports relations separately and therefore we have a directed graph where country A can export to country B without having country B exporting to country A. We analyze the flow of payments instead of the flow of goods. This means that exporting countries will be recipients of payments for their exports, while importing countries will be sources of payments for their imports. This methodology allows us to analyze the influence of importing countries on exporting ones as influential buyers. We use the share of exports of country A to country B out of the total exports of country A and construct binary matrices for different magnitudes of trade. If country A's exports to country B, out of total exports of country A, are greater or equal to a given threshold then the edge B→A is present[10]. The purpose of using thresholds enables us to avoid working directly with valued-directed links even though implicitly these thresholds embody the values of the trade links in our data.

Table 2 shows the binary matrix for the first five countries in our sample when we use a trade-link threshold of 0% for 1992. That is, the edge between country A (source) and B (receiver) exists and the cell entry (source = A, receiver = B) is 1 as long as imports of A from country B are greater than zero[11].

[Insert Table 2 here]

IV. Network Properties

IV.I Network Overview

Just as nodes/vertices and links/edges are the basic components of any network, node degree is the basic component of complex network analysis. The degree is the number of links connected to a given node. For directed networks we have two different measures, in-degree and out-degree. The first one deals with inbound links, in other words how many times a specific node acts as a receiver. The latter one works with the outbound links, counting how many times a specific node acts as a source. These two measurements provide the first overview of network structure. We can locate highly connected nodes, referred to sometimes as hubs[12], and by looking

[9] List of countries included in Table 1A of the Data Appendix.
[10] The directed edge goes from A to B because A is the source of payment and B is the recipient of this payment.
[11] Note that this also means that the exports from B to A are also greater than zero.
[12] Barabasi (2002).

at in- and out- degree measures separately, identify potentially influential source and receiver countries. It is also possible to obtain an overall idea of how homogeneous the network is. In a homogeneous network, flows are not dominated by a small group of nodes, implying that there should be no dominant nodes.

Table A1, included in the data appendix, shows the in and out degree results for all countries in the 1992 and 1998 trade networks at the 0, 0.5, 1 and 2 percent thresholds. We chose the 1 and 2% thresholds because the mean ratio of exports to country *i* out of total exports of country *j* for all the countries included in the study, is equal to 2.2% in 1992 and 1.3% in 1998. Therefore we believe that these thresholds are close to embodying what we could refer to as meaningful or representative trade. The 0 and 0.5% thresholds on the other hand are useful for capturing the dynamics of the trade network at relatively low levels of trade. The 0% threshold indicates the existence of trade among two countries and in this sense it is the least restrictive case. It simply acknowledges the presence of positive trade.

The analysis of in and out degree provides a number of insights into the international trade network. The first insight is that the top fifteen block of most influential sources (of payments for imports/out-degree) includes most of the G-7 countries (Canada, the UK, Italy, Germany, France, US, and Japan) for the different thresholds considered and the two time periods analyzed, 1992 and 1998. Other countries present in this block include developed countries like Austria, Spain, Denmark, Australia and Switzerland.

The second result, which is more surprising, is related to the change of the in and out degree distribution at different thresholds. For relatively low levels of trade the results for both measures are similar. We observe that most of the nodes have a relatively high in and out-degree which means that most of the countries have a high number of trade partners (for exports and imports). But as the threshold is increased, the distribution of the in-degree and out-degree changes dramatically. The in-degree (receipts for exports) drops considerably for all the nodes while the out-degree remains constant for a very small group of vertices (most of the G-7 appear in this group) and drops substantially for the others.

The interpretation is that for meaningful levels of trade, a small block of influential sources import from most of the other 170 - 175 countries, while the rest of the countries only import from a small number of countries. On the other hand, looking at the in-degree results, we see that all the countries (G-7 included) export to a relatively small number of countries -- mainly the G-7. The asymmetric drop of the out-degree implies that from the imports (source) perspective the network is quite skewed, but from the exports (receiver) perspective it is quite evenly distributed. That is, most of the world's importers are just a handful of countries, the G-7

plus Austria, Spain, Denmark, Australia and Switzerland. These countries account for almost 50% of world imports. On the other hand, most countries export to almost the same number of countries. The mean of the in-degree distribution is 9 countries at the 2% trade-link threshold and 15 countries at the 1% threshold.

[Insert Figure 2 here.]

To better understand and visualize these results, Figure 2 shows the node degree distribution for the 0 and 1% thresholds for 1992 and 1998[13]. These plots are simple histograms of the in and out-degrees and show that the in-degree (exports) distribution approaches a normal distribution (homogeneous network) as the threshold for defining trade links is increased, while the out-degree (imports) resembles an exponential distribution (heterogeneous network) at higher thresholds.

Another way to assess the inequality of the degree distribution is by computing Lorenz curves and Gini coefficients. Figure 3 presents the Lorenz curves plots for the 1 and 2% thresholds and the results for the Gini coefficients derived from the difference of the forty five degree line and each of the Lorenz curves. These plots and numbers reveal that the 36 most connected countries (20%) account for almost 80% of the outbound links in 1992 and 75% in 1998 at the 1% trade-link threshold. These numbers are almost completely reversed for the inbound links, where the 36 (20%) most connected countries account for only 30% of all inbound links, in 1992 and 1998[14]. Similar conclusions arise from the analysis of the 2% trade-link threshold.

The 80/20 finding has special significance in the study of networks as it reflects the existence of a Pareto distribution, as opposed to a random network where the distribution of node degree is random. This kind of distribution is also often referred to as a power-law (exponential) distribution as the number of nodes with degree k, N(k) follows a power law, i.e., $N(k) \sim k^{-\gamma}$ where γ is the degree exponent. Power laws mathematically formulate the fact that in many networks the majority of nodes have only a few links and that these nodes coexist with a few big hubs, nodes with an anomalously high number of links. In contrast, for a random network, the peak of the distribution implies that the majority of nodes have the same number of links. Therefore a random network has a characteristic *scale* in its node connectivity, embodied in the average node

[13] The other thresholds are not graphed given that the results of the 0.5 and 2 percent are very similar to the one percent histograms. But they are available by request.

[14] Perfect equality, in this case perfect symmetry, would correspond to 36 countries (twenty percent) accounting for twenty percent of the in or outbound links.

and fixed by the peak of the degree distribution. In contrast, the absence of a peak in a power-law distribution implies that there is no such thing as characteristic node. In other words, there is no intrinsic scale in a power-law network. Such networks are therefore referred to as being *scale-free*[15]. The international trade network is thus scale-free at meaningful levels of trade. This is especially interesting as it implies that it does not make much sense to speak of a "typical" country in terms of the number of trading partners.

IV.2. Measures of Integration

Having introduced the key building blocks for network analysis, we now introduce more detailed measures of global and local integration.

A. Global Integration Measures

Mean Degree

The first of the global measures we present is *mean degree*. This indicator is simply an extension of the node degree analysis presented above, but when comparing results across time it is possible to draw conclusions about the evolution of the network and its connectivity. We calculate the average number of trading partners that a country has (average node degree).

The mean in-degree, $\bar{d}_I$, and the mean out-degree, $\bar{d}_O$, are calculated as follows:

$$\bar{d}_I = \frac{\sum_{i=1}^{g} d_I(n_i)}{g} = \bar{d}_O = \frac{\sum_{i=1}^{g} d_O(n_i)}{g} \qquad (1)$$

where $d_I(n_i)$ and $d_O(n_i)$ represent the in- and out-degree of the i^{th} node, and g denotes the number of nodes in the network.

[Table 3 here]

Table 3 contains the mean degree results for the different thresholds in 1992 and 1998. It is worth noting that the mean in- and out-degree are the same since they consider the same set of

[15] A startling discovery from recent research on complex networks has been that almost all complex networks in nature are scale-free (see Albert and Barabasi, 2002; Barabasi, 2002).

edges, albeit in different directions. As can be seen in Table 3, the mean degree for the 0% threshold is relatively high in comparison to the mean degree for other thresholds.

The results show that for low levels of trade (zero and 0.5 percent thresholds) the mean degree of the network changed substantially between 1992 and 1998 while for higher thresholds it remained essentially constant. The mean degree increased by 32% and 15% for the 0 and 0.5% thresholds respectively, while for the 1 and 2% thresholds it increased by 8 and 3% only. These results imply that economic integration has increased substantially for low levels of trade but not for higher, more meaningful levels of trade.

Centrality

Degree analysis suggests that the international trade network has a core-periphery configuration from an out-degree (imports) perspective with the industrialized countries as the center of gravity. In this type of system the countries at the core are the most influential nodes since shocks to the core will affect the whole network.

Another way to examine this feature of the network is through the notion of *centrality*. In many complex networks, centrality is used as a measure of power and influence. Sociologists have been interested in measures of centrality since these indicators show where the action is in the network. According to Wasserman and Faust (1994), central actors (nodes) must be the most active because they have the most ties to other actors (nodes). For our trade network, we can compute the measures of node centrality and network centrality.

Centrality indicators measure how central a given node is with respect to the others and also determine how centralized the network is with respect to a perfectly centralized network. Here we present the results on network centrality; we address individual node centrality in the section on local measures of integration.

In order to analyze the centrality of the international trade network from a degree centrality perspective, we compare it to a perfectly centralized network of the same size. A perfectly centralized network is one in which only one node sends/receives information to/from the other vertices. This is called a *star* network (the most unequal possible network)[16]. Freeman (1979) proposes the following expression as a centralization index:

$$C_I = \frac{\sum_{i=1}^{g}\left[C_{\max} - C_D(n_i)\right]}{\max \sum_{i=1}^{g}\left[C_{\max} - C_D(n_i)\right]} \qquad (2)$$

[16] In a star network, all nodes but one have an in/outdegree of one, and the central node has an in/outdegree of the number of nodes in the network minus one.

where C_{max} represents the maximum possible degree centrality for an individual node in the network and $C_D(n_i)$ denotes the degree centrality of vertex i[17]. The denominator in expression (2) is the summation for the star network, and equals *(g-1)(g-2)*. The degree centrality of an individual node can be simply represented by its degree $d(n_i)$ but a more standard way is to normalize the individual node centrality in the following fashion

$$C_D(n_i) = \frac{d(n_i)}{g-1} \qquad (2.1)$$

The way in which the star-like configuration of the out-degree (imports) international trade network evolves between 1992 and 1998 provides information regarding the proportion of countries that have moved toward or away from the center of gravity. With the increasing volume of international trade observed during the nineties and the opening of countries like China and former Soviet-bloc countries, it is conceivable that the international trade network has been becoming less of a star-like network. This would result in a lower level of influence for the G-7 countries and the emergence of a number of other influential countries that previously belonged to the periphery.

Given that the international trade network is a directed graph, we have both in- and out-degree centrality measures. Table 3 presents the results for the in- and out-degree network centralization indices[18]. These indices show that for the lowest threshold, 0%, the network centralization indices for in- and out-degree are around 56% for the period of 1992 and 43% for 1998. In other words the network is not very centralized. As we move to higher thresholds, 0.5, 1, and 2%, we observe dramatic changes that corroborate those obtained with the node degree distribution analysis. As the threshold increases, the out-degree (imports) network becomes extremely centralized while the in-degree (exports) network becomes very decentralized. The comparisons of these indices across time imply that the core-periphery structure did not change noticeably over the nineties and a relatively small number of countries still constitute the core of the network, a core that exercises an enormous amount of influence on the periphery.

Network Density and Clustering

Node degree and centrality analyses are useful because they allow us to identify the presence or absence of a center of gravity for the network and give us an overview of the structure and configuration of the network as a whole. But these indicators do not directly

[17] A more in depth discussion for degree centrality for an individual node is discussed in the section of Local Measures of Integration.
[18] Calculated using UCINET software package, specifically Freeman's degree centrality measures routine.

address how integrated the network as a whole really is. One way to start looking at the extent of global integration of the network is to measure the proportion of all possible links (trading relationships) that are actually present in the network. This ratio is called *network density*[19].

A number of multilateral trade agreements like the European Union, MERCOSUR and NAFTA, and many bilateral agreements were established in the mid nineties. This in turn resulted in a 40% increase, from 1992 to 1998, in the value of total world trade. An interesting question is whether this translated into higher levels of economic integration for the world[20]. Factors that ultimately determine the level of economic integration are the number of countries trading between themselves, the value of trade amongst them, and the patterns of trade.

The maximum number of edges for a network is determined by

$$E_{\max} = \frac{g(g-1)}{2}$$

$$E^{D}{}_{\max} = g(g-1)$$

where $E_{\max}$ and $E^{D}{}_{\max}$ denote the maximum number of edges for an undirected and a directed graph, respectively and g is the number of edges. The density of a network is simply the ratio of the edges actually present to the maximum possible,

$$\Delta = \frac{2L}{g(g-1)} \qquad \Delta^{D} = \frac{L}{g(g-1)} \qquad (3)$$

where Δ is for undirected graphs and Δ^{D} is for directed ones.

The density calculations for the international trade network are also presented in Table 3. As the threshold increases the number of active/present edges decreases while the number of nodes stays the same. Network density therefore drops. The results across years allow us to compare changes in economic integration. For the period of 1992 – 1998, network density increased by 35% at the 0% threshold and 18% at the 0.5 % threshold. At higher thresholds, or what we have termed meaningful trade, density increased as well but by a smaller margin, 10 and 5% respectively for the 1 and 2% thresholds. Once again, the implication is that economic integration increased much more at lower levels of trade.

Another insightful global property of the network is the extent of *clustering* or *network transitivity* (Watts and Strogatz, 1998; Watts, 1999). A network is said to show clustering if the probability of two nodes being connected by an edge is higher when the nodes in question have a common neighbor. That is, there is another node in the network to which they are both linked.

[19] Wasserman and Faust (1994).
[20] Calculations based on the data used in this study.

Clustering thus measures the probability that "the partner of my partner is also my partner" and provides insight into what could be referred to as the neighborhood structure of the network. In topological terms, a higher level of clustering means that there is a heightened density of loops of three in the network. Watts and Strogatz (1998) measured the clustering of a network by defining a *clustering coefficient,* C, which is the average probability that two neighbors of a given node are also neighbors of each other and can be expressed as the proportion of triples that form a triangle out of all the triples present in the network[21].

$$C = \frac{3 \times Number \quad of \quad triangles}{number \quad of \quad connected \quad triples} \qquad 0 \leq C \leq 1$$

In terms of the international trade network we are looking for the number of countries that trade with a same third country and also trade with each other. A higher clustering coefficient thus signifies a more integrated network. The results for the international trade network presented in Table 3 show that the clustering coefficient is 0.42 at the 2% threshold for the 1998 network and is very high at all thresholds. Moreover, the clustering coefficient has remained practically constant between 1992 and 1998. The implication of this is that both the number of complete triangles and triples increased proportionally[22]. In other words the new trade partner of my trade partner has also been my new partner.

Assortative Mixing and Degree Correlation

It is possible to argue that the structure of the international trade network is not randomly determined. International trade linkages may be the result of social, geographic or structural characteristics of the countries. The international economics literature has found evidence that countries located in a common region or that are adjacent to each other or confined within the same region have higher volumes of bilateral trade than those that are not[23]. The existence of these and others patterns of trade can be examined through complex network analysis. If countries that share similar characteristics trade more between themselves than with countries that do not, then it can be concluded that the international trade network is an *assortative* network and

[21] For example a complete triple (triangle) would be A→B, A→C and B→C and/or C→B, and connected triple can be just A→B, A→C. The factor of 3 accounts for the fact that each triangle contributes to three triples and ensures that 0≤C≤1. Newman (2003).
[22] We at least know that the number of triples increased because network density has increased.
[23] For a detailed discussion about regional trading blocks look at Frankel (1997), Frankel et. al. (1995), and Frankel and Romer (1999).

that there is a definite pattern of preferential attachment[24]. The specific characteristics that we use to partition the data are income level, region and legal origin[25].

While the rationale for splicing the data along income and geographical region are fairly obvious, the reason for using legal origin is the idea, emphasized by Rodrik (2000) and others, that transaction costs associated with contractual enforcement owing to differences in legal systems can be a major impediment to trade. Legal origin (La Porta et al. 1997, Shleifer and Glaeser, 2002) has been found to exert an important impact on many developmental outcomes[26].

Newman (2003) shows that assortative mixing can be quantified by the following assortativity coefficient,

$$r = \frac{\sum_i e_{ii} - \sum_i a_i b_i}{1 - \sum_i a_i b_i} = \frac{Tr(e) - \left\| e^2 \right\|}{1 - \left\| e^2 \right\|} \qquad (4)$$

where e is the matrix containing the elements e_{ij}, which is defined to be the fraction of links in a network that connect a vertex of type i (i.e. region 1) to one of type j (i.e. region 2) and $\|e\|$ means the sum of all elements of the matrix e. If $r = 0$, then we conclude that there is no assortative mixing. If r =1, the network is said to be perfectly assortative, and if the network is disassortative then r is negative and its value is determined by,

$$r_{\min} = -\frac{\sum_i a_i b_i}{1 - \sum_i a_i b_i},$$

which will generally lie in the range of $-1 \le r < 0$.

[Table 4 here]

[24] Studies of networks that represent food webs or the internet have identified that relationships between nodes are determined by specific characteristics. In the case of food webs natural differences determine this pattern; herbivores are highly connected to plants and carnivores are highly connected to herbivores, while very few links exist between herbivores or between carnivores and plants. For the internet the pattern is dictated by structural differences; there are many links between end users and ISPs, many links between ISPs and backbone operators, but few links between backbone operators and end users (Newman, 2003).

[25] The countries are grouped according to the World Bank classification of income, the WTO classification for Regions and Legal Origin.

[26] See Rodrik, et al. (2002) for a survey of the results in this area

The results for the assortativity coefficient obtained for the variously partitioned data sets, presented in Table 4, show evidence of relatively high assortativity in international trade from a regional perspective. For this case the assortativity coefficient, *r*, is positive and it has also increased over time, between 1992 and 1998. These findings imply that trading relationships, over the nineties, have been predominantly established or strengthened between countries of the same region. In particular, trading relationships within African countries and within CES countries increased significantly. This can be observed in Table 5 where the percentage change in density, from 1992 to 1998, within and across regions is reported for the 1% threshold[27].

[Table 5 here]

The assortativity coefficients based on income or a legal origin partitions of the network also show preferential attachment within countries of the same group but the assortativity coefficients are not as strong as in the case of regional partitions and the mixing patterns have not changed significantly during the nineties. The assortativity coefficients are presented in Table 4 and the density changes for these cases are also reported in Table 5.

Assortative mixing on the basis of a scalar characteristic such as node degree is known as *degree correlation*. This measure determines whether there is preferential attachment between high-degree nodes and low-degree nodes, or if there is preferential attachment between low and high degree nodes, referred to as disassortative mixing. Newman (2003) shows that it is possible to compute the degree correlation coefficient simply by calculating the Pearson correlation coefficient of the degrees at either ends of a link. This calculation should give a positive number for assortatively mixed networks and negative for disassortative ones.

The results for the degree correlation coefficient, presented in Table 3, show that, the international trade network is a disassortative network. High degree countries trade with low degree countries, and vice versa. In other words, countries with lots of trading partners trade with countries with few trade partners.

Note that by no means should these results be interpreted as a contradiction of our previous assortative mixing results. In this case there are no groupings of nodes according to some specific attribute. Degree correlation only records the node degree at both ends of each link and then calculates the correlation between both series. The disassortative mixing result, from this viewpoint, is something that makes sense from an economics perspective. International trade

[27] Density changes for other thresholds are not presented here for reasons of space, but are available upon request from the authors.

relations are not determined by the number of trading partners that each country has. They are determined by structural or natural characteristics like natural resources and cultural, social, or geographical attributes.

B. Local Integration Measures

International trade to GDP ratios and individual country shares of international trade out of total world trade are two indicators that have frequently been used as measures of a country's degree of openness. These measures do not take into consideration important features implicit in international trade linkages, like the number and importance of trading partners and the specific configuration of the international trade network. By not doing so they over or underestimate a country's degree of economic integration and cannot be used to make arguments about the influence that a given country can exercise on others. International trade is not only about exports and imports of goods and services, but is also a source of payments and receipts of foreign exchange. Because of this, a country's economic shocks can affect the economic, financial and exchange rate stability of others by reducing or increasing the demand and supply of imports and exports from and to the world.

The local measures of integration presented in this section take into account the fact that international trade relationships form a network that establishes direct links between countries (A trades with B) and indirect links through third-partner trading relationships (A trades with B, and B trades with C, therefore A can affect C indirectly through B). Recognition of these dependencies allows for the differentiation between a country that may have a high volume of trade relative to others but that has a few trading partners and another country that may have a lower volume of trade, but that has a higher number of trading partners. In this case using only volumes of trade to rank the degree of openness of a country would overlook the fact that the second country may have an influence on a larger number of countries than the first one.

Recent advances in complex network analysis offer a variety of tools that can be used to measure the degree of economic integration at the individual country level. These indicators, which incorporate information on volumes of trade, also take into account the number of trading partners, the position in the network of the country in question (core-periphery), and the degree of influence that a country has on others. By incorporating these characteristics in their calculations, these measures provide a richer perspective on the degree of economic integration at the country level.

Node Degree Centrality

This is the simplest measure of local integration and has been discussed in the node degree analysis section. The number of in and out-bound edges will ultimately determine the connectivity of an individual node, but there are different dimensions in which this connectivity can be measured. The first of these measures is *Node Degree Centrality*. Equation (2.1) shows how it is possible to calculate an index for node degree centrality. This index can show which countries are at the core, or close to the core, of the network. If a country is at the core of the network then its node degree centrality will be close to one. For a periphery country, this number will be close to zero, given that the number of international trade linkages is relatively small.

In Table A2, included in the data appendix, we report the out-degree centrality indices for the 0, 1 and 2 % thresholds for the years of 1992 and 1998[28] for all the countries in our sample. Higher numbers indicate more central countries. We present only out-degree centrality indices for two reasons. First, we already know from the node degree analysis that the in-degree distribution is very homogenous and therefore not much information would be added by analyzing the differences of the in-degree centrality indices. Second, and more importantly, we are interested in understanding which countries are influential importing counties countries in the international trade network.

As expected, the industrialized economies are part of the core of the network, from an import perspective, ranking in the top 20 for the different thresholds and periods considered. These numbers corroborate the finding that the centrality of the network has not changed significantly over the nineties since very few countries have dramatically increased their centrality indices. In essence, if the top twenty five countries from the 1992 data are compared with the top twenty five of 1998, very few changes are observed.

Note that countries like Brazil, the Dem. Rep. of Korea, Indonesia, Malaysia, Russian Federation, Thailand, and Turkey are among the top thirty (some in the top fifteen) most central countries in the international trade networks. These countries have been behind the wave of financial, currency and balance of payments crises and contagion observed during the nineties. These results suggest the importance of international trade linkages for contagion during economic crises (Forbes, 2001; Abeysinghe and Forbes, 2002).

For comparisons across methodologies, Table A2 in the data appendix presents the share of international trade out of total world trade and the ratio of total trade (imports plus exports) to GDP for all the countries considered. In the interests of brevity we do not present country rankings according to these indices, but there are significant differences when country rankings

[28] Calculated using UCINET software.

obtained with these indicators are compared with those that are obtained when we rank countries according to node degree centrality.

Node Influence or Importance

Node degree centrality provides a preliminary approach to the identification of influential nodes. It is based on the number of countries that can be reached through direct links by an individual country. But it misses important features of the international trade network. The number of trading partners is a relevant statistic, but the specific characteristics of these trading partners may increase or decrease the level of influence that a specific country has on others and on the whole network. In other words, it is not only the quantity of your partners that matter for influence, but also how influential they are in turn. If country A trades with country B and B trades with fifty other countries, then A exerts indirect influence on these fifty countries.

In an influential paper, Salancik (1986) argues that "Accurate assessments of the structural power of several interdependent parties are hampered by the fact that parties depend on one another indirectly as well as directly and that any one's dependencies are not equally important for all parties." He goes on to propose an index for dependency networks in which nodes are defined as more important if others nodes depend more on them and if the other nodes depending on them are themselves important. Applying his index to our context, the *importance* of country *i* is a function of its dependence of other nodes and the importance of these other nodes.

$$imp_{(i)} = \sum_{j} dep_{(ij)} imp_{j} + \text{int}_{(i)} \quad \text{for all } j \neq i \qquad (6)$$

where $imp_{(i)}$ is the importance of country i , $dep_{(ij)}$ is the extent to which country i depends on country j, and $\text{int}_{(i)}$ denotes the intrinsic value of country i. Holding the intrinsic value constant for all countries, equation (6), which represents a system of i equations, determines that if a country is not depended upon by other countries, then this country will be unimportant. Also, if a country is depended upon only by unimportant countries, then it would also be considered unimportant.

Equation (6) can be rewritten in matrix form as follows,

$$\text{IMP}_i = [\text{D}]_{ij} * \text{IMP}_i + \text{INT}_i \qquad (7)$$

where $[\text{D}]_{ij}$ denotes the dependency matrix of country i on country j. For the international trade network exporting countries depend on the importing ones. Therefore the elements in $[\text{D}]_{ij}$ show

the share of exports of country *i* to country *j* out of the total exports of country *i*. This is essentially the same matrix that has been used in the calculation of all the measures so far reported in this study, but in this case there is no need for the threshold analysis. By solving the system of equations, denoted by equation (8), it is possible to determine the importance of an individual country relative to the 181 other countries included in the study. The indices computed take into consideration volumes of trade and the number and importance of all trading partners.

[Table 6 here]

Table 6 shows the results for the top thirty countries, but the indices for all one hundred and eighty two countries are included in Table A2, located in the data appendix. Once again it is worth noticing that the countries that were at the center of the economic crises of the nineties appear at the top of the list of country level importance for the international trade network and that country rankings according to importance are starkly different from those obtained when countries are ranked according to world trade shares and the ratio of total trade to GDP.

Maximum Flow

Another way to measure the influence that a given country has on others is by counting the number of direct and indirect ways in which a shock to the country in turn affects others. When a particular country is hit by a shock that forces a reduction of its domestic demand for foreign goods, this translates into a diverse number of direct and indirect hits on a number of countries in the international network. The reduced demand for foreign goods of country A translates into a reduced cash flow for country B, given that this country's exports to A have decreased. In turn, country B's domestic demand for foreign exports from country C may drop and this implies an indirect effect of a shock to A on country C.

Given the size and structure of the international trade network, 182 countries with more than thirteen thousand links between them in 1992 and around eighteen thousand in 1998, shocks to one country translate into a cascade of direct and indirect effects on other countries. A meaningful indicator would be one that captures the number of times, direct and indirect, that a shock from country A translates into effects on all the other members of the network. Such a measure has been used in complex network analysis and has been termed *maximum flow*. Hanneman (2001) offers a brief explanation of this measure and others that can be used to capture these types of cascading effects through the network.

In simple terms, the maximum flow measures the number of nodes in the neighborhood of a source that lead to pathways to a target. If a shock to country A can only be transmitted to country C through country B then the connection of country A is weak (even if B affects C through many other countries). On the other hand, if a shock to A is transmitted to C via three different countries (each of which has one or more ways in which the shock is transmitted to C), then the A's connection is stronger.

It is possible to calculate a maximum flow matrix (182 by 182) for our international trade data. The elements of this matrix show the number of "choke points" for shock transmission from country *i* to country *j*. The results of this matrix can be summarized by summing up row elements[29]. These summations signify the number of choke points that each country has on the whole network. Better connected countries will have a higher number than poorly connected ones.

[Table 7 here]

Table 7 shows the top thirty countries according to this methodology and Table A2, included in the data appendix, shows the results for all the countries considered in the study[30]. Once again the countries that were behind the crises and contagion effects observed during the nineties appear near the top of this list. In fact in some cases, these countries are ranked higher than or are tied in rank with G-7 countries.

It is possible to extend the results of the maximum flow analysis by looking at specific cases, such as the countries involved in the crises-contagion that started in 1997-1998 with the crisis of Thailand and ended with the collapse of Argentina in 2002. Thailand devalued its currency in July of 1997. This event ignited the East Asian Crisis in which Indonesia, Malaysia and Korea were the main participants. The contagion effect of these events reached Russia and Brazil in 1998, when the Ruble and the Real were devalued and flexible exchange rate regimes were adopted in both countries. Thereafter Ecuador, Turkey and Argentina collapsed in 1999, 1999 and 2001 respectively.

[Table 8 here]

[29] The flow matrix is available on request.
[30] Maximum flow routine of UCINET software which uses the algorithm due to Gomory and Hu (1964).

From the maximum flow matrix it is possible to identify the countries that would be more affected, directly or indirectly, by a shock to a given country. Table 8 lists the top twenty countries that would be affected by shocks to Thailand, Korea, Russia and Brazil, according to the maximum flow measure at the 1% trade-link threshold. This lists shows that it is possible to identify Brazil, Ecuador, Indonesia, Korea and Russia as candidate countries for severe aftershocks of the Thai currency devaluation. A similar picture emerges when we look at the corresponding lists for Korea and Russia. The list for Brazil shows that the impact on Argentina, which was directly affected by the devaluation of the Real in 1998, was to be expected due to their close ties through MERCOSUR.

V. Application to Economic Growth

This section illustrates the usefulness of the local integration indicators discussed above by introducing them in a growth accounting exercise where the objective is to determine the effect that international economic integration, sometimes referred to as "openness", has on economic growth. Harrison (1996), Frankel and Romer (1999), Irwin and Tervio (2002), and Yanikkaya (2002), among others, have used different indicators and methodologies, based on volumes of trade, in order to examine the relationship between openness and growth. Most of these studies consider a long-run growth model where a country's GDP or income per capita growth rate (γ_{y_t}) is a function of initial GDP conditions (y_t), physical capital (k_t), human capital (h_t), and a vector of control variables ($Z_{(t)}$) that represent country specific characteristics (degree of openness, geographical, and political characteristics).

$$\gamma_{y_t} = F(y_t, k_t, h_t; Z_{(t)}) \qquad (8)$$

Following Harrison (1996) and Yannikkaya (2002), we use data from the World Development Indicators of the World Bank to calculate GDP per capita growth rates. Initial GDP per capita levels are obtained from the Penn Tables Mark 5.6. Life expectancy and telephone lines/1000 data, obtained from Easterly and Lu's Global Development Network Growth Database, are used as proxy variables for human and physical capital, respectively[31]. Political regime and war deaths data is also obtained from Easterly and Yu. The geographical control variables

[31] Global Development Network Grotwth Database, by William Easterly and Mirvat Sewadeh at the World Bank. http://www.worldbank.org/research/growth/GDNdata.htm

included in the study are physical access to international waters and tropical climate, both obtained from the Sachs and Warner dataset [32].

For the degree of openness two types of variables have been considered in the literature. The first category includes indicators based on volumes of trade, like total trade (imports plus exports), the ratio of total trade (imports plus exports) to GDP, and total trade with OECD countries and Non-OECD countries. The other category includes indicators based on trade restrictions, like tariffs, export duties and taxes on international trade in general.

We use the basic total trade to GDP ratio as the control variable for economic openness and compare these results to those obtained when we add our local integration measures, namely importance, maximum flow and degree centrality.

Harrison (1996) and Yannikkaya (2002) estimate the following equation,

$$\gamma_{y_t} = \beta_0 + \beta_1 \log(GDP_I) + \beta_2 \log(Life) + \beta_3 Phone + \beta_4 Tropical + \beta_5 Water + \beta_6 Political + \beta_7 War + \beta_8 Open + \varepsilon_t \quad (9)$$

and report a positive and strong relationship between trade shares in GDP and economic growth. Specifically Yannikkaya (2000), through a panel regression analysis spanning three decades (70's, 80's and 90's), concludes that the coefficients (and their signs) for the variables, initial GDP conditions (-), human (+) and physical (+) capital, climate (-), and the total trade to GDP ratio (+) are strongly significant and robust, while those for the political regime (-), war deaths (-) and the physical access to international waters (-) are weakly significant.

Due to limited data availability for the international trade network we only have network indicators for 1992 and 1998. Therefore we cannot follow Yannikkaya's three period panel regression approach. We consider the data for 1987 to 1998 and divide the data into the periods 1987 - 1992 and 1993 - 1998. We average the variables for these two sample periods and perform a panel regression where the 1992 local integration indicators are used for the 1987 – 1992 sample and the 1998 indicators are used for the 1993 – 1998 sample.

Our results are presented in Table 9. Column 1, which corresponds to the regression that uses the total trade to GDP ratio as the control variable for openness, shows that changing the panel regression from a three decade approach to the two sub-samples of 1987 – 1992 and 1993 – 1998 does not affect the results obtained by Yannikkaya. The coefficient for total trade to GDP

[32] Sachs and Warner data set is published on the Center for International Development Web site accessible from http://www.cid.harvard.edu/

ratio (+) is significant at the 5 percent probability level while the other coefficients and their signs are also in line with his findings[33]. Columns (2) through (8) present the results for two different regressions. Sub-columns (a) report results for the regressions where the local integration indicators are used as the sole control variables for international economic integration, while sub-columns (b) present the results where both control variables, total trade to GDP ratio and a local integration indicator, are considered in the regression. We present both sets of results since our aim is to demonstrate that our network indicators of country-level IEI (importance, degree centrality, and maximum flow) are relevant on their own and do not substitute for the explanatory power of the total trade to GDP ratio but instead complement it.

These indicators incorporate network based measures of IEI for each country that embody more than just trade volumes. They capture a country's relevance for the international trade network, whether it is at the center or the periphery of the trade network, and the magnitude of the direct and indirect effects that it has on other countries. For the regressions we used the country rankings for each of the local indicators, where a lower number (higher ranking) denotes higher degree centrality, importance and maximum flow. Therefore we expect negative signs for these variables in the regression results. As a country drops in the rankings, its relevance or its extent of IEI falls and therefore the advantages from trade and its positive effects on economic growth diminish accordingly.

[Table 9 here]

The results of Table 9 show that the local integration indicators are statistically significant and have the expected negative sign. They posses explanatory power individually when they are included as the sole control variable for economic integration, and they add information to the economic growth regression whey they are considered in conjunction with the total trade to GDP ratio. Moreover, the effect of higher centrality in the network can be quite significant. For example, sub-column 5-b reports that an increase in the centrality ranking of 10 units at the 2% threshold increases the average growth rate of per capita GDP by 1.11 percentage points. A country's position in the network can thus have substantial implications for economic growth.

[33] Our results show a positive sign for the control variable for access to international waters, while in Yannikkaya (2000) the sign is negative. This is explained by the definition of the variable. We use the proportion of land with access to international waters, while Yannikkaya uses the proportion of landlocked land. We did not include war deaths in our regression given that there is no data available for the late nineties.

IV. Conclusion

We have attempted to chart the international trading system explicitly as a network and examine its structure and function from such a perspective. This has enabled us to obtain a clearer understanding of the structure of the global trading system and construct measures of international economic integration at both the global, system-wide level and at a local, country level. While these metrics are implicitly based on the volume of international trade, they add new dimensions to the analysis of global integration that have not been previously considered and offer a new approach to describing local, country level integration into the global network.

The literature on financial contagion (Kaminsky and Reinhart, 2000, 2003; Forbes, 2001, Forbes and Rigobon, 2003) continues to puzzle over why many of the recent crises that began in relatively small economies had such global repercussions and why shocks originating in one economy spread to some markets, while markets in other countries were relatively unaffected. We find that network based measures identify several of the countries behind the financial crises and contagion of the 1990's as highly influential countries, with a number of them even ranking above G-7 countries in terms of influence in the network. We believe that a network approach that is capable of incorporating the cascading of interdependent ripples that happens when a shock hits a specific part of the network will provide us with a deeper understanding of economic and financial contagion. It is also possible that such network-based measures may have real policy relevance in terms of identifying countries that are potentially vulnerable nodes for the entire network in case of economic and financial collapse. Future research could examine these issues in more detail and use these network measures of country-level and global integration as the backbone upon which to explore transmission mechanisms for international economic crises[34].

[34] Previous studies about transmission of infectious diseases through social networks and computer viruses through the WWW have shown the usefulness of complex network analysis for the study of contagion (Newman, 2003).

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FIGURE 1. Directed Network Graphical Representation

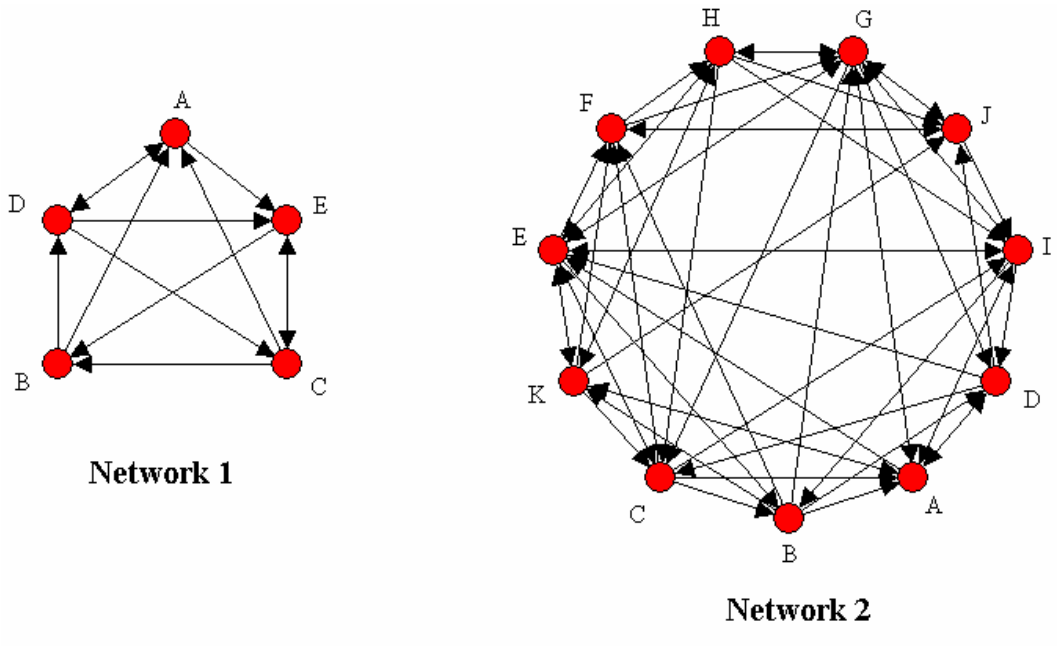

FIGURE 2. IN AND OUT DEGREE DISTRIBUTION FOR ZERO AND ONE PERCENT THRESHOLDS IN 1992 AND 1998

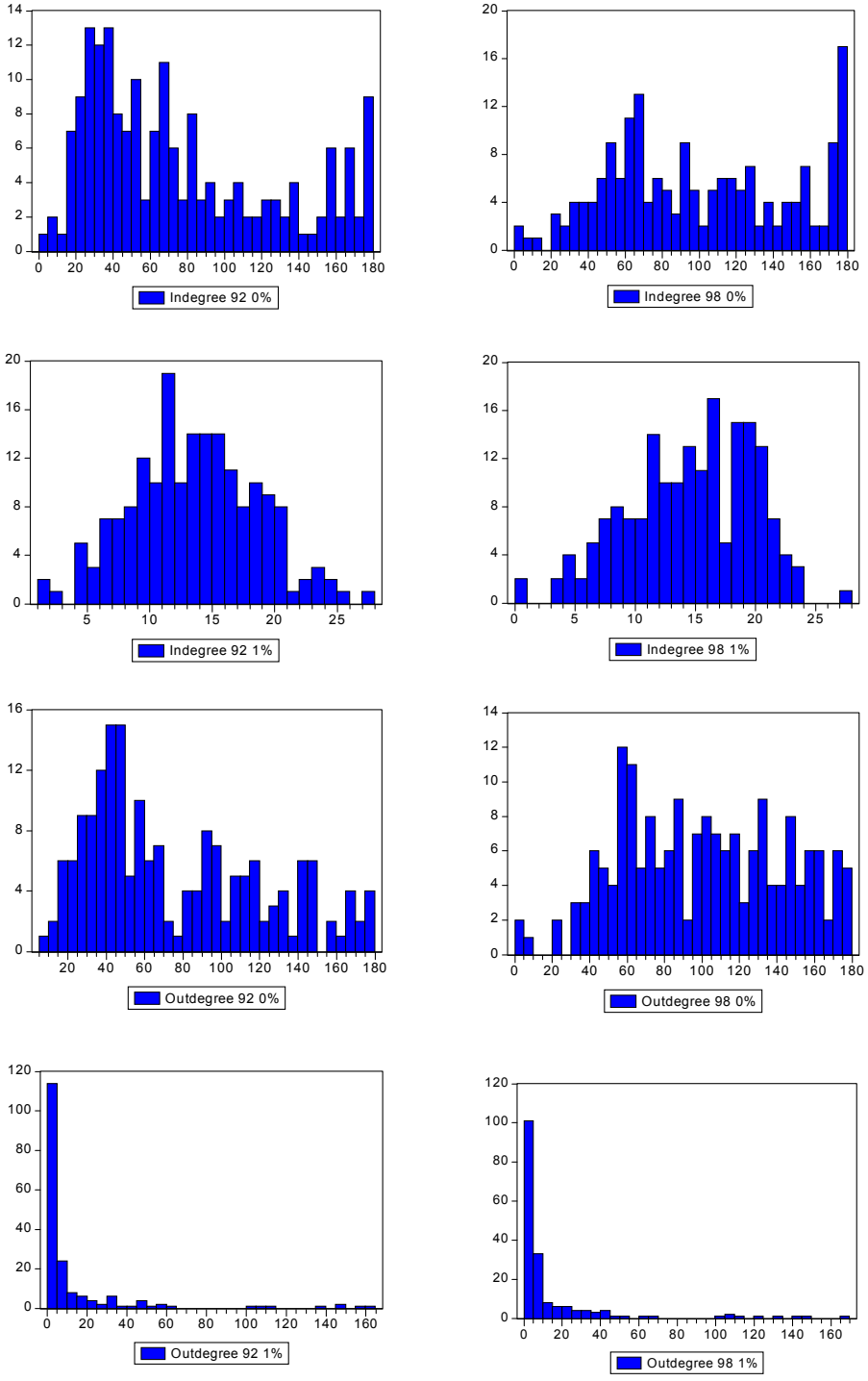

FIGURE 3. IN AND OUT DEGREE DISTRIBUTION LORENZ CURVES AND GINI COEFFICIENTS

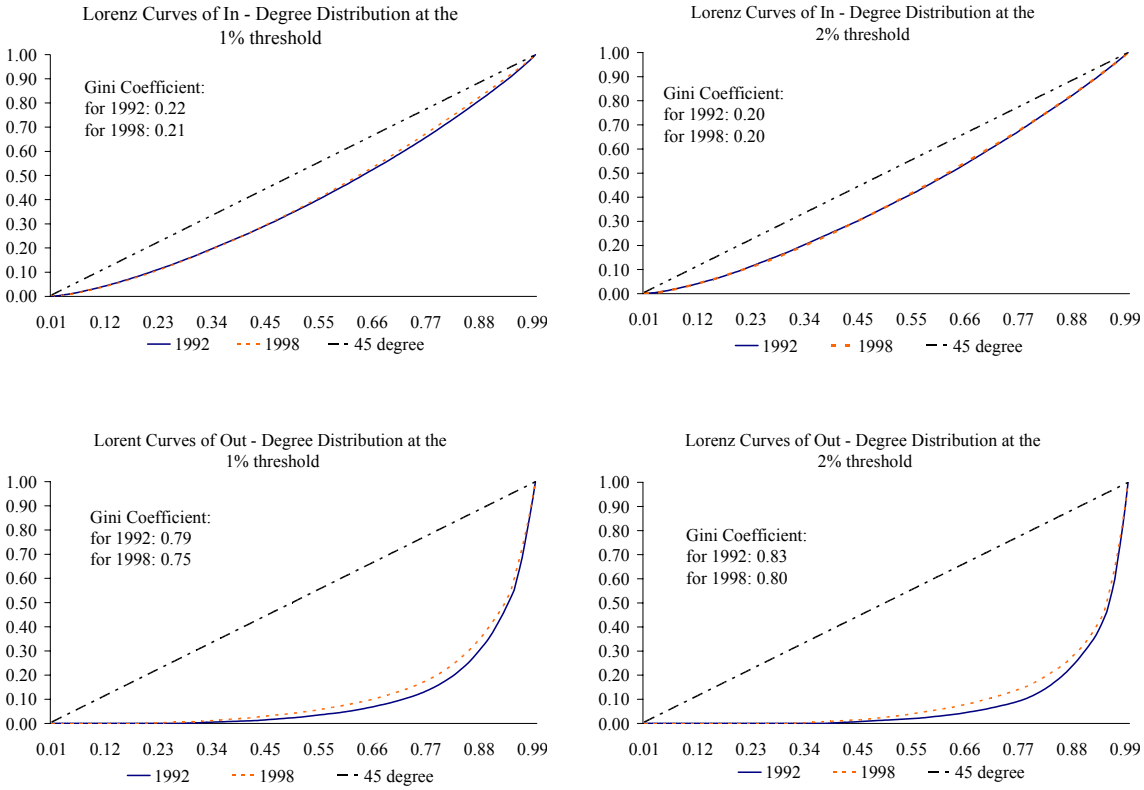

TABLE 1. Directed Network Matrix Form Representation

R e c e i v e r

S o u r c e	A	B	C	D	E	F	G	H	I	J	K
A	0	0	0	1	1	0	1	0	1	0	1
B	1	0	0	1	0	1	1	0	0	0	1
C	1	1	0	0	1	1	0	0	1	0	0
D	1	0	1	0	1	0	0	0	0	1	0
E	0	1	1	0	0	1	1	1	1	0	1
F	0	0	0	0	0	0	1	1	0	1	0
G	1	0	1	1	1	0	0	1	1	1	0
H	0	0	1	0	1	0	1	0	1	1	1
I	1	1	0	1	1	0	1	0	0	0	0
J	0	0	0	0	0	1	1	0	1	0	0
K	1	0	1	0	1	1	0	1	0	1	0

TABLE 2. PARTIAL BINARY MATRIX FOR ZERO PERCENT THRESHOLD IN 1992

	Afghanistar	Albania	Algeria	Angola	Antigua and Barbuda	Argentina	Armenia	Aruba	Australia	. . .
Afghanistan	0	0	0	0	0	0	0	0	1	
Albania	0	0	0	0	0	1	0	0	1	
Algeria	0	1	0	1	0	1	0	0	1	
Angola	0	0	0	0	0	1	0	0	1	
Antigua and Barbuda	0	0	0	0	0	1	0	0	1	
Argentina	1	1	1	0	0	0	0	0	1	
Armenia	0	0	0	0	0	0	0	0	0	
Aruba	0	0	0	0	0	0	0	0	0	
Australia	1	1	1	0	0	1	0	0	0	
.										
.										
.										

TABLE 3. SUMMARY RESULTS: NETWORK OVERVIEW

	Outdegree								**Indegree**							
	0.00%		**0.50%**		**1.00%**		**2.00%**		**0.00%**		**0.50%**		**1.00%**		**2.00%**	
	1992	**1998**	**1992**	**1998**	**1992**	**1998**	**1992**	**1998**	**1992**	**1998**	**1992**	**1998**	**1992**	**1998**	**1992**	**1998**
MEAN DEGREE (levels)	75.79	100.06	17.63	20.28	13.05	14.08	8.91	9.19	75.79	100.06	17.63	20.28	13.05	14.08	8.91	9.19
Network Centralization (levels)	56.78	42.74	82.98	84.29	82.75	83.84	78.38	78.78	57.34	43.30	9.65	9.84	7.75	7.18	3.39	4.34
Network Density (levels)	41.87	56.52	9.74	11.45	7.21	7.95	4.92	5.19								
Clustering Coefficient (overall graph)	0.78	0.78	0.55	0.51	0.50	0.47	0.45	0.42								
Weighted Clustering Coefficient (overall graph)	0.60	0.69	0.23	0.25	0.18	0.19	0.13	0.14								
Degree Correlation	-0.48	-0.36	-0.21	-0.16	-0.17	-0.13	-0.12	-0.11								

TABLE 4. ASSORTATIVE MIXING

		Classification		
	Threshold	Regional	Income	Legal Origin
1992	0%	0.062	-0.044	0.015
	1%	0.238	0.056	0.156
	2%	0.241	0.066	0.175
1998	0%	0.076	-0.026	0.024
	1%	0.272	0.075	0.162
	2%	0.274	0.087	0.188

Notes: Regional classification according to World Trade Organization classification.
Income classification according to World Bank classification.
Legal Origin classification according to La Porta (1998).

TABLE 5. PROPORTIONAL CHANGE IN DENSITY BETWEEN AND ACROSS CLASSIFICATIONS (1992 – 1998)

Regional Classification

	1	2	3	4	5	6	7
1 North America (3)	0.00	0.07	0.00	-0.06	-0.03	-0.09	0.08
2 Latin America (36)	1.00	0.06	NA	-0.50	0.29	-1.00	0.00
3 Western Europe (24)	0.11	-0.06	0.02	-0.16	-0.05	-0.23	-0.02
4 C./E. Europe/Baltic States/CIS (21)	NA	NA	0.56	0.46	0.50	-1.00	0.50
5 Africa (47)	NA	2.00	0.00	NA	1.24	0.33	3.00
6 Middle East (13)	NA	0.00	-0.20	1.50	0.00	-0.04	0.25
7 Asia (38)	-0.29	-0.11	0.42	-0.36	0.23	0.02	0.06

Income Classification

	1	2	3	4	5
1 High Income: OECD (23)	0.03	-0.01	0.04	0.00	0.01
2 High Income: nonOECD (23)	0.25	-0.03	-0.04	-0.20	0.06
3 Upper middle Income (29)	0.17	0.00	0.09	-0.09	-0.02
4 Lower middle Income (47)	0.44	-0.04	0.20	0.22	0.43
5 Low Income (60)	0.10	0.43	-0.21	0.70	0.94

Legal Origin Classification

	1	2	3	4	5	6
1 British (56)	0.00	0.02	-0.02	-0.05	0.09	-0.23
2 French (77)	-0.01	0.04	0.06	-0.06	-0.04	0.03
3 Socialist (25)	0.43	0.18	0.38	0.33	4.00	-0.14
4 German (5)	0.10	0.01	-0.08	0.00	0.11	-0.06
5 Scandinavian (5)	-0.13	0.63	-0.08	1.00	0.08	-0.50
6 Not Classified (14)	1.50	-0.33	-1.00	-1.00	NA	0.00

Notes: Numbers in parenthesis denote the number of countries for each classification. The off-diagonal values in the matrices above denote proportional changes in density across groups, from 1992 to 1998, while the diagonal values refer to proportional density changes within groups, for the same period.

TABLE 6. TOP THIRTY COUNTRIES ACCORDING TO IMPORTANCE

	Importance		Total Trade Share		Total Trade to GDP Ratio	
	1992	1998	1992	1998	1992*	1998*
USA	1	1	1	1	147	148
Germany	2	2	2	2	104	122
Japan	9	3	3	3	149	151
France	3	4	4	4	117	127
United Kingdom	4	5	5	5	100	104
Italy	5	6	6	6	125	121
Belgium-Luxembourg	6	7	9	10	16	14
Spain	7	8	12	12	127	124
Netherlands	8	9	7	9	37	42
Russian Federation	33	10	24	20	96	114
China	10	11	10	8	142	137
Thailand	12	12	23	24	61	57
India	18	13	31	28	150	147
Rep. of Korea	11	14	13	14	75	88
Canada	14	15	8	7	95	78
Singapore	15	16	15	15	1	1
Brazil	26	17	25	21	151	149
China, Hong Kong SAR	21	18	11	13	2	2
Portugal	13	19	29	34	62	87
Australia	20	20	20	22	135	134
Norway	32	21	26	27	64	77
Turkey	22	22	32	30	138	125
Switzerland	16	23	14	16	65	83
Saudi Arabia	17	24	21	31	54	73
Denmark	19	25	22	25	72	90
Sweden	34	26	18	17	81	76
Austria	24	27	17	19	57	66
Greece	50	28	38	39	114	133
Mexico	25	29	16	11	132	108
Poland	23	30	33	32	118	113

Note: Countries ranked according to 1998 Importance index

* For the ranking according to the Total Trade to GDP ratio the data in the 1992 column is the average for the 1987 – 1992 period, while for the 1998 column the average is for the 1993 – 1998 time period.

TABLE 7. TOP THIRTY COUNTRIES ACCORDING TO MAXIMUM FLOW

	Maximum Flow						Total Trade Share		Total Trade to GDP Ratio	
	1992			1998						
	0%	1%	2%	0%	1%	2%	1992	1998	1992*	1998*
Canada	11	1	12	6	1	18	8	7	95	78
China	8	3	4	18	2	1	10	8	142	137
Belgium-Luxembourg	5	4	2	5	3	3	9	10	16	14
Netherlands	4	3	2	1	3	3	7	9	37	42
China, Hong Kong SAR	17	5	1	17	4	6	11	13	2	2
Switzerland	5	6	10	7	4	12	14	16	65	83
Austria	5	6	14	3	4	10	17	19	57	66
USA	2	9	7	1	5	4	1	1	147	148
France	2	2	2	1	5	2	4	4	117	127
United Kingdom	6	9	5	2	5	5	5	5	100	104
Spain	3	4	2	4	5	2	12	12	127	124
Turkey	15	15	18	21	5	13	32	30	138	125
Poland	16	19	21	24	5	14	33	32	118	113
Japan	66	7	6	5	6	6	3	3	149	151
Italy	1	6	3	4	6	4	6	6	125	121
Thailand	14	8	11	8	6	20	23	24	61	57
Singapore	33	6	8	33	6	8	15	15	1	1
Germany	1	7	5	1	7	7	2	2	104	122
Sweden	68	13	13	14	7	11	18	17	81	76
Russian Federation	73	20	19	25	8	17	24	20	96	114
India	27	12	17	22	8	16	31	28	150	147
Rep. of Korea	12	8	9	13	8	9	13	14	75	88
Greece	73	38	53	20	9	23	38	39	114	133
Indonesia	29	16	22	13	9	29	27	26	107	111
Malaysia	15	10	16	27	10	15	19	18	11	6
Australia	18	11	23	10	11	28	20	22	135	134
Norway	19	23	20	21	12	21	26	27	64	77
Portugal	9	14	29	15	13	37	29	34	62	87
Mexico	23	18	26	12	14	40	16	11	132	108
Saudi Arabia	20	8	28	30	15	22	21	31	54	73

Note: Countries ranked according to maximum flow index at the 1% threshold in 1998
* For the ranking according to the Total Trade to GDP ratio the data in the 1992 column is the average for the 1987 – 1992 period, while for the 1998 column the average is for the 1993 – 1998 time period.

TABLE 8. TOP TWENTY COUNTRIES AFFECTED BY SHOCKS TO COLUMN HEADING COUNTRY ACCORDING TO MAXIMUM FLOW

Thailand	Rep. of Korea	Russian Federation	Brazil
Jordan	Jordan	Jordan	Ecuador
India	India	India	Panama
Rep. of Korea	Russian Federation	Rep. of Korea	Chile
Russian Federation	Ecuador	Ecuador	Cote d'Ivoire
Ecuador	Panama	Panama	Togo
Panama	Saudi Arabia	Saudi Arabia	Uruguay
Saudi Arabia	United Rep. of Tanzania	United Rep. of Tanzania	Argentina
United Rep. of Tanzania	Cote d'Ivoire	Cote d'Ivoire	Benin
Cote d'Ivoire	Cyprus	Cyprus	Burkina Faso
Cyprus	Finland	Finland	Neth. Antilles
Finland	Germany	Germany	Peru
Germany	Kenya	Kenya	Costa Rica
Kenya	Sweden	Sweden	Mali
Sweden	Ukraine	Ukraine	Saint Vincent and the Grenadines
Ukraine	Bahrain	Bahrain	Senegal
Bahrain	Brazil	Brazil	Nigeria
Brazil	Burkina Faso	Burkina Faso	Solomon Isds
Burkina Faso	Chile	Chile	Trinidad and Tobago
Chile	Greece	Greece	Australia
Greece	Indonesia	Indonesia	Austria

TABLE 9. PER CAPITA GDP GROWTH RATE REGRESSION (1987 - 1992 and 1993 - 1998)

Variable	(1)	(2)		(3)		(4)		(5)		(6)		(7)		(8)	
		(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
Log (IGDP)	**-0.757**	**-0.841**	**-1.164**	**-0.781**	**-1.091**	**-0.808**	**-1.095**	**-0.820**	**-1.102**	**-0.782**	**-1.099**	**-0.787**	**-1.091**	**-0.937**	**-1.277**
	-2.06	*-2.38*	*-3.13*	*-2.22*	*-2.93*	*-2.37*	*-3.06*	*-2.41*	*-3.10*	*-2.21*	*-2.93*	*-2.27*	*-2.99*	*-2.67*	*-3.46*
Human Capital	**1.436**	**2.085**	**2.550**	**1.931**	**2.407**	**2.353**	**2.838**	**2.428**	**2.909**	**1.897**	**2.371**	**2.063**	**2.531**	**2.409**	**2.910**
	2.05	*2.94*	*3.49*	*2.74*	*3.28*	*3.35*	*3.90*	*3.46*	*4.02*	*2.70*	*3.23*	*2.96*	*3.50*	*3.37*	*3.96*
Physical Capital	**0.012**	**0.007**	**0.009**	**0.006**	**0.008**	**0.003**	**0.004**	**0.004**	**0.006**	**0.007**	**0.008**	**0.005**	**0.006**	**0.006**	**0.008**
	3.01	*1.60*	*2.02*	*1.51*	*1.79*	*0.68*	*0.97*	*0.91*	*1.32*	*1.65*	*1.97*	*1.18*	*1.47*	*1.43*	*1.96*
Regime	**-0.092**	**-0.158**	**-0.044**	**-0.078**	**0.027**	**-0.099**	**0.003**	**-0.092**	**-0.001**	**-0.079**	**0.023**	**-0.161**	**-0.065**	**-0.181**	**-0.068**
	-0.26	*-0.46*	*-0.12*	*-0.23*	*0.07*	*-0.30*	*0.01*	*-0.28*	*0.00*	*-0.23*	*0.06*	*-0.47*	*-0.18*	*-0.54*	*-0.19*
Climate	**-0.750**	**-0.758**	**-0.600**	**-0.808**	**-0.695**	**-0.656**	**-0.495**	**-0.642**	**-0.464**	**-0.819**	**-0.710**	**-0.669**	**-0.500**	**-0.592**	**-0.353**
	-1.64	*-1.74*	*-1.33*	*-1.85*	*-1.53*	*-1.52*	*-1.11*	*-1.49*	*-1.04*	*-1.87*	*-1.56*	*-1.53*	*-1.10*	*-1.36*	*-0.78*
Access to Water	**1.352**	**1.216**	**0.965**	**1.376**	**1.225**	**1.332**	**1.132**	**1.274**	**1.035**	**1.378**	**1.223**	**1.253**	**1.037**	**1.131**	**0.878**
	2.42	*2.18*	*1.68*	*2.49*	*2.16*	*2.46*	*2.05*	*2.36*	*1.87*	*2.49*	*2.15*	*2.27*	*1.83*	*2.05*	*1.56*
Total Trade to GDP Ratio	**0.010**		**0.010**		**0.009**		**0.009**		**0.009**		**0.009**		**0.009**		**0.010**
	2.48		*2.24*		*1.97*		*2.10*		*2.14*		*1.96*		*2.14*		*2.38*
Importance		**-0.011**	**-0.017**												
		-2.52	*-3.61*												
Centrality 0%				**-0.017**	**-0.027**										
				-2.15	*-3.16*										
Centrality 1%						**-0.060**	**-0.080**								
						-3.43	*-4.35*								
Centrality 2%								**-0.085**	**-0.111**						
								-3.66	*-4.59*						
Max. Flow 0%										**-0.011**	**-0.017**				
										-2.06	*-3.07*				
Max. Flow 1%												**-0.028**	**-0.040**		
												-2.72	*-3.74*		
Max. Flow 2%														**-0.028**	**-0.038**
														-3.31	*-4.36*
Adj. R squared	0.134	0.124	0.167	0.116	0.1526	0.148	0.1944	0.156	0.204	0.114	0.15	0.129	0.172	0.145	0.195
Number of observations	183	188	171	188	171	188	171	188	171	188	171	188	171	188	171

Notes: t-statistics for the coefficients in italics. Rankings data for local IEI indicators was used in these regressions.

DATA APPENDIX

TABLE A1. COUNTRY RESULTS FOR IN (EXPORTS) AND OUT (IMPORTS) DEGREE DISTRIBUTIONS

	Outdegree								Indegree							
	0.00%		0.50%		1.00%		2.00%		0.00%		0.50%		1.00%		2.00%	
Country	1992	1998	1992	1998	1992	1998	1992	1998	1992	1998	1992	1998	1992	1998	1992	1998
Afghanistan	39	61	0	1	0	0	0	0	50	77	21	21	15	13	13	11
Albania	37	87	0	2	0	1	0	1	43	66	19	12	16	9	11	5
Algeria	116	126	17	16	7	9	2	5	84	95	18	18	14	12	10	10
Angola	45	71	2	1	1	1	1	0	37	54	11	13	9	8	8	5
Antigua and Barbuda	49	66	3	5	2	3	1	2	38	53	14	25	11	15	5	9
Argentina	113	127	16	17	11	8	8	5	135	152	35	32	22	19	11	11
Armenia	18	56	0	0	0	0	0	0	19	50	15	12	10	9	7	6
Aruba	28	44	2	2	1	1	0	0	23	45	11	10	7	8	6	4
Australia	141	162	45	49	31	29	16	12	162	174	26	28	20	19	15	13
Austria	169	174	72	64	48	32	22	18	172	172	26	27	16	16	9	9
Azerbaijan	16	89	2	6	0	3	0	3	19	74	8	18	7	14	7	10
Bahamas	59	91	3	3	2	1	1	0	64	102	12	18	11	12	10	9
Bahrain	56	71	4	3	2	1	1	0	57	83	25	32	24	20	15	11
Bangladesh	107	142	10	20	6	13	2	10	121	141	26	23	15	14	10	8
Barbados	94	113	11	8	9	6	3	5	74	92	21	23	16	16	10	14
Belarus	21	119	2	18	2	12	1	5	27	113	15	15	13	7	10	5
Belgium-Luxembourg	169	173	129	131	101	107	66	76	179	178	19	25	14	14	8	9
Belize	82	78	1	2	1	0	0	0	63	73	13	18	9	12	6	7
Benin	90	117	3	6	3	4	2	3	69	90	25	24	22	19	13	13
Bermuda	95	67	4	0	2	0	1	0	60	65	7	15	6	11	5	10
Bhutan	35	36	0	0	0	0	0	0	28	33	14	11	8	8	5	6
Bolivia	96	112	6	3	3	1	1	0	88	91	18	21	14	16	11	11
Bosnia Herzegovina	18	58	2	3	1	2	1	2	23	62	13	15	11	9	8	7
Br. Virgin Isds	33	57	0	1	0	1	0	0	32	50	15	15	12	12	10	8
Brazil	113	145	41	59	27	30	19	18	153	167	34	30	18	20	12	12
Brunei Darussalam	94	86	1	0	0	0	0	0	38	71	8	6	8	6	7	5
Bulgaria	125	132	24	13	18	6	11	2	73	150	33	32	18	16	12	13
Burkina Faso	36	105	1	4	1	3	0	2	35	80	13	28	11	20	10	14
Burundi	41	73	0	2	0	2	0	1	35	59	14	18	11	15	9	13
Cambodia	35	56	0	1	0	0	0	0	40	63	10	17	7	14	7	9
Cameroon	56	109	0	5	0	5	0	3	50	89	11	20	8	11	7	10
Canada	148	171	95	102	61	66	23	26	158	174	11	12	7	6	4	2
Cape Verde	29	45	1	1	0	0	0	0	19	34	11	8	8	7	4	5
Cayman Isds	38	50	1	1	0	1	0	0	33	54	12	8	12	7	8	5
Central African Rep.	35	59	0	0	0	0	0	0	33	65	9	14	7	7	3	5
Chad	32	53	0	1	0	0	0	0	32	58	12	17	11	11	8	10
Chile	116	112	14	19	12	13	8	10	131	147	27	25	17	20	12	12

TABLE A1. COUNTRY RESULTS FOR IN AND OUTDEGREE DISTRIBUTIONS (..continues)

China	157	156	77	78	56	60	41	38	178	178	18	17	13	13	7	6
China, Hong Kong SAR	142	157	57	70	37	39	23	21	152	168	23	29	15	16	6	10
China, Macao SAR	58	75	1	1	0	0	0	0	84	102	16	15	10	10	6	6
Colombia	129	148	17	18	13	11	7	6	125	138	25	28	16	16	10	9
Comoros	34	55	0	0	0	0	0	0	28	50	6	8	6	6	3	5
Congo	48	76	1	4	0	2	0	0	43	69	9	15	8	11	7	9
Costa Rica	86	119	7	11	3	5	3	4	109	129	16	27	12	18	8	8
Cote d'Ivoire	57	133	3	13	3	9	1	6	62	132	17	30	12	21	8	12
Croatia	119	137	13	14	8	8	4	6	124	133	19	19	15	14	8	8
Cyprus	115	134	5	4	3	2	3	1	115	150	30	31	19	21	12	11
Czechoslovakia	62	0	8	0	5	0	4	0	81	0	21	0	17	0	9	0
Dem. Rep. of the Congo	41	59	1	5	0	3	0	1	53	68	11	12	9	8	7	7
Denmark	163	163	48	43	30	24	16	12	177	178	25	29	14	17	11	13
Djibouti	48	60	1	0	1	0	1	0	30	41	10	17	9	12	5	10
Dominica	45	64	4	5	3	4	2	2	44	72	13	18	11	14	7	10
Dominican Rep.	53	72	5	8	2	2	1	1	81	81	9	11	4	4	1	1
Ecuador	87	127	8	12	4	9	1	3	96	124	21	27	13	22	10	14
Egypt	68	138	12	26	5	15	2	7	72	149	21	29	18	19	12	9
El Salvador	68	107	5	10	4	9	4	6	65	90	17	15	14	6	5	6
Equatorial Guinea	29	43	0	0	0	0	0	0	25	38	9	11	9	10	7	8
Estonia	25	129	1	11	1	7	0	4	25	127	15	18	15	14	11	12
Fiji	94	52	5	1	3	0	2	0	68	49	16	13	13	8	8	4
Finland	145	156	41	41	17	16	9	9	165	173	26	34	17	21	12	14
Fmr Ethiopia	95	0	4	0	4	0	3	0	71	0	16	0	12	0	9	0
France	177	177	158	157	148	141	127	114	178	177	26	30	12	18	8	8
French Polynesia	35	115	1	2	0	0	0	0	28	63	10	11	8	10	6	9
Gabon	42	64	0	2	0	2	0	0	43	69	13	17	11	10	7	6
Gambia	44	89	0	2	0	1	0	0	36	63	7	13	4	8	4	5
Georgia	22	62	0	4	0	2	0	1	23	65	12	17	11	15	8	11
Germany	178	177	165	161	158	146	142	125	179	178	34	29	18	21	11	13
Ghana	133	85	8	6	5	5	3	4	104	90	17	24	16	15	13	11
Greece	68	151	21	48	6	25	2	12	79	170	20	32	14	20	10	13
Greenland	81	88	1	1	0	0	0	0	30	43	8	10	6	7	4	3
Grenada	46	95	3	6	2	3	1	1	34	61	13	22	10	16	9	11
Guatemala	59	96	3	8	1	6	1	5	67	118	15	23	11	16	5	8
Guinea	49	103	0	4	0	1	0	0	43	86	12	22	11	16	9	11
Guinea-Bissau	32	45	0	2	0	1	0	0	18	30	6	12	6	10	6	8
Guyana	92	64	5	3	5	3	1	2	48	69	16	20	12	12	6	8
Haiti	48	69	0	0	0	0	0	0	53	64	9	8	5	4	4	3
Honduras	61	100	3	6	3	5	1	3	66	107	16	17	12	10	5	5

TABLE A1. COUNTRY RESULTS FOR IN AND OUTDEGREE DISTRIBUTIONS (..continues)

Hungary	134	148	19	26	11	17	4	6	147	157	22	23	18	16	8	11
Iceland	99	115	1	2	0	1	0	0	88	108	18	19	15	15	11	12
India	125	149	48	53	32	36	25	25	164	175	31	33	23	23	12	12
Indonesia	120	160	33	36	23	25	11	11	132	177	20	23	15	20	12	13
Iran	56	99	23	26	14	14	6	7	73	146	24	25	20	18	13	14
Iraq	31	59	2	3	2	1	1	1	33	52	1	20	1	17	1	10
Ireland	149	161	22	37	11	13	5	6	165	174	21	22	13	13	9	10
Israel	97	127	14	21	7	11	2	3	111	147	23	27	12	18	11	9
Italy	178	174	159	144	145	122	117	95	178	178	34	36	16	19	9	10
Jamaica	106	116	12	11	8	9	5	5	91	118	13	15	13	11	8	8
Japan	82	173	62	131	55	109	38	84	83	178	23	26	18	19	12	12
Jordan	94	104	13	10	8	4	4	3	93	120	33	35	27	27	14	11
Kazakhstan	22	63	1	8	1	5	0	3	24	68	14	21	13	15	10	10
Kenya	99	107	7	7	3	3	3	0	109	125	31	31	23	21	13	11
Kiribati	40	40	1	1	0	1	0	0	25	35	9	10	6	8	4	6
Kuwait	71	127	9	12	4	7	3	5	68	115	17	16	17	12	13	8
Kyrgyzstan	17	81	0	5	0	5	0	3	21	64	10	16	6	12	5	10
Lao People's Dem. Rep.	35	49	0	1	0	0	0	0	38	57	13	20	11	14	8	12
Latvia	25	102	1	5	1	2	1	2	26	117	17	21	14	16	12	9
Lebanon	63	157	3	11	2	6	1	2	65	135	20	28	17	18	14	15
Liberia	48	70	5	4	3	3	0	1	48	64	13	12	10	10	8	7
Libya	55	63	6	9	5	7	2	3	45	58	14	14	10	11	8	8
Lithuania	55	88	14	8	14	5	14	3	63	111	21	24	16	19	10	17
Madagascar	90	104	3	2	2	2	0	0	101	120	21	16	17	14	11	10
Malawi	45	83	1	4	1	4	1	2	50	79	20	28	15	20	9	11
Malaysia	144	146	37	41	26	24	15	12	158	173	21	24	16	16	9	11
Maldives	33	56	0	1	0	0	0	0	30	46	11	12	8	9	8	8
Mali	47	70	0	6	0	5	0	5	47	69	19	21	15	19	12	11
Malta	112	113	2	2	0	1	0	0	96	129	14	19	10	15	7	11
Marshall Isds	16	34	1	0	0	0	0	0	9	26	3	5	2	5	2	5
Mauritania	41	64	0	2	0	1	0	1	33	67	9	17	9	16	8	11
Mauritius	118	123	6	8	6	6	2	4	112	128	12	15	9	12	7	9
Mexico	133	160	38	47	22	25	14	3	136	157	10	11	6	3	3	2
Micronesia	13	22	0	0	0	0	0	0	3	12	1	4	1	3	1	3
Mongolia	29	61	0	0	0	0	0	0	31	63	9	10	9	9	8	6
Morocco	67	132	7	21	5	8	1	4	69	138	24	25	14	13	9	9
Mozambique	44	58	1	0	1	0	1	0	52	62	22	19	18	14	12	12
Nepal	44	74	0	2	0	2	0	1	51	78	15	15	11	11	7	5
Neth. Antilles	84	66	7	5	6	2	4	1	90	69	30	26	23	19	12	10
Netherlands	173	177	134	130	112	104	81	68	179	178	19	23	13	14	8	9

TABLE A1. COUNTRY RESULTS FOR IN AND OUTDEGREE DISTRIBUTIONS (..continues)

New Caledonia	35	44	0	1	0	1	0	1	31	41	10	13	9	11	7	8
New Zealand	122	89	11	5	7	1	4	1	143	114	27	27	20	19	9	11
Nicaragua	49	99	3	6	2	5	2	4	54	92	17	20	13	13	11	6
Niger	43	95	1	4	0	4	0	1	38	77	6	9	4	6	2	4
Nigeria	70	130	9	10	2	3	2	3	62	107	15	22	13	17	13	11
Norway	140	150	40	45	18	23	11	17	166	172	20	20	17	15	11	11
Oman	85	109	4	4	2	2	2	2	76	120	12	14	10	11	8	10
Pakistan	132	144	27	24	19	17	14	10	155	161	32	30	24	20	12	13
Palau	12	22	0	0	0	0	0	0	12	21	4	4	4	4	3	3
Panama	67	97	10	10	5	6	2	3	67	111	25	31	19	22	12	13
Papua New Guinea	41	109	2	5	1	3	0	2	41	79	15	18	13	16	11	11
Paraguay	69	78	4	3	1	3	0	1	82	83	23	15	18	13	13	7
Peru	110	120	12	10	9	9	4	4	104	129	25	24	19	19	14	14
Philippines	101	138	31	24	21	21	12	11	135	158	17	16	15	14	10	11
Poland	143	148	47	51	30	31	19	15	156	156	28	21	17	18	12	11
Portugal	155	158	66	69	41	39	23	23	170	170	18	20	15	14	11	8
Qatar	94	103	5	8	4	2	3	0	72	96	20	14	13	11	11	6
Rep. of Korea	147	160	73	71	53	51	44	32	167	178	27	32	19	23	11	8
Rep. of Moldova	20	92	1	4	1	2	0	0	25	80	12	14	9	9	9	7
Romania	62	141	4	19	3	11	0	5	79	159	23	31	19	17	12	12
Russian Federation	68	147	30	62	16	41	10	30	80	157	26	35	18	23	15	15
Rwanda	38	103	1	4	1	4	0	3	27	49	12	22	11	15	9	12
Saint Kitts and Nevis	34	42	2	3	1	2	0	1	25	31	6	7	5	5	3	4
Saint Lucia	87	86	7	8	7	6	5	4	49	46	12	12	7	7	4	4
Saint Vincent and the Grenac	43	81	2	7	1	4	1	1	28	42	11	20	9	18	8	13
Samoa	29	31	2	0	1	0	0	0	16	23	5	9	5	8	4	6
Sao Tome and Principe	30	39	0	0	0	0	0	0	20	28	15	16	14	15	11	12
Saudi Arabia	137	143	55	42	34	20	19	13	116	155	23	31	19	22	14	10
Senegal	55	110	1	7	1	2	0	1	45	96	18	27	14	18	9	13
Seychelles	63	57	1	0	1	0	1	0	42	52	11	13	9	11	5	7
Sierra Leone	44	62	0	0	0	0	0	0	38	57	12	17	11	11	7	6
Singapore	116	139	65	60	48	42	33	29	125	151	22	24	16	19	11	14
Slovenia	146	154	16	11	12	7	4	3	135	140	19	20	13	13	9	10
Solomon Isds	27	35	0	0	0	0	0	0	28	38	16	20	12	18	9	11
Somalia	43	48	1	2	1	1	1	0	36	49	13	13	8	9	5	7
Spain	174	174	135	141	105	113	72	79	169	175	26	27	14	18	8	8
Sri Lanka	100	81	11	6	8	3	3	1	126	111	26	25	15	13	8	6
Sudan	49	130	2	13	1	9	0	3	62	93	22	30	14	20	10	14
Suriname	44	75	3	3	3	3	1	3	39	75	11	16	10	13	8	9
Sweden	77	159	33	56	22	31	9	11	82	178	27	28	15	21	12	13

TABLE A1. COUNTRY RESULTS FOR IN AND OUTDEGREE DISTRIBUTIONS (..continues)

Switzerland	169	169	78	69	49	43	25	18	175	177	31	33	16	16	11	11
Syria	60	82	5	9	3	5	1	2	58	93	17	22	14	16	10	9
Tajikistan	17	48	0	2	0	1	0	1	19	56	12	27	11	20	8	12
Thailand	145	167	62	65	46	46	29	31	157	175	21	24	19	19	9	9
Timor-Leste	7	5	0	0	0	0	0	0	5	8	4	8	4	7	4	6
Togo	44	107	2	5	2	3	1	1	37	97	24	28	21	20	14	12
Tonga	27	33	1	0	1	0	1	0	16	24	7	6	7	4	7	4
Trinidad and Tobago	107	116	12	11	8	9	5	6	94	105	28	25	20	17	7	9
Tunisia	112	133	13	16	6	3	0	2	109	128	20	15	15	11	11	9
Turkey	144	150	56	67	33	40	21	19	157	164	33	38	20	18	11	9
Turkmenistan	20	54	1	3	0	1	0	1	22	54	13	17	11	13	9	10
Uganda	47	132	1	6	1	5	1	5	48	99	22	29	19	19	12	14
Ukraine	32	146	2	28	2	21	1	13	38	139	15	36	11	21	10	9
United Arab Emirates	107	96	8	30	6	15	3	9	86	109	26	23	25	15	15	11
United Kingdom	165	176	148	151	135	130	116	109	168	178	32	30	20	18	11	11
United Rep. of Tanzania	53	131	3	9	1	3	1	1	57	122	24	31	19	22	14	13
Uruguay	54	113	3	7	3	4	1	2	67	118	23	23	14	20	14	11
USA	177	177	167	172	162	165	150	151	179	177	33	33	20	18	13	11
Uzbekistan	20	59	1	7	1	2	0	1	24	61	13	25	11	18	9	10
Vanuatu	35	40	1	0	0	0	0	0	21	35	10	16	10	12	9	8
Venezuela	99	120	19	21	15	17	6	7	108	118	24	25	10	16	6	6
Viet Nam	48	80	4	6	1	3	0	0	65	113	28	25	20	19	13	16
Yemen	53	69	3	4	3	3	1	2	51	67	14	15	13	11	12	7
Zambia	51	104	1	6	1	3	1	1	50	94	21	26	16	20	9	14
Zimbabwe	106	74	5	1	3	1	0	1	123	89	28	31	18	18	14	13

TABLE A2. RESULTS FOR LOCAL MEASURES OF ECONOMIC INTEGRATION

		World Trade Share		Total Trade to GDP Ratio		Out - Degree Node Centrality (Index)						Importance		Maximum Flow					
						1992			1998					1992			1998		
		1992	1998	1992*	1998*	0%	1%	2%	0%	1%	2%	1992	1998	0%	1%	2%	0%	1%	2%
1	Afghanistan	0.0052	0.0051	-	-	21.547	0	0	33.702	0	0	0.10011	0.10025	6,363	0	0	20,144	0	0
2	Albania	0.0075	0.0110	51.2	56.0	20.442	0	0	48.066	0.552	0.552	0.10009	0.10052	6,109	0	0	26,040	179	179
3	Algeria	0.2985	0.2118	40.2	52.8	64.088	3.867	1.105	69.613	4.972	2.762	0.10346	0.10386	12,111	1,063	182	32,139	1,385	218
4	Angola	0.0852	0.0529	71.1	137.8	24.862	0.552	0.552	39.227	0.552	0	0.10096	0.10047	7,088	181	181	22,650	179	0
5	Antigua and Barbuda	0.0027	0.0041	197.1	205.0	27.072	1.105	0.552	36.464	1.657	1.105	0.10053	0.10103	7,538	360	181	21,406	537	32
6	Argentina	0.3981	0.5706	15.7	17.0	62.431	6.077	4.42	70.166	4.42	2.762	0.11031	0.11145	11,954	1,530	569	32,098	1,383	362
7	Armenia	0.0009	0.0063	94.4	94.0	9.945	0	0	30.939	0	0	0.10005	0.10023	3,211	0	0	18,702	0	0
8	Aruba	0.0122	0.0151	-	-	15.47	0.552	0	24.309	0.552	0	0.10034	0.10036	4,850	181	0	15,070	179	0
9	Australia	1.0714	1.0658	35.1	40.2	77.901	17.127	8.84	89.503	16.022	6.63	0.12546	0.12348	12,935	2,341	881	35,074	2,527	714
10	Austria	1.4105	1.1607	76.2	78.6	93.37	26.519	12.155	96.133	17.68	9.945	0.11870	0.11555	13,539	2,359	1,233	35,676	2,546	1,456
11	Azerbaijan	0.0039	0.0156	-	101.2	8.84	0	0	49.171	1.657	1.657	0.10022	0.10322	2,861	0	0	26,356	359	3
12	Bahamas	0.0411	0.0243	117.1	-	32.597	1.105	0.552	50.276	0.552	0	0.10082	0.10057	8,526	360	181	26,706	179	0
13	Bahrain	0.0492	0.0475	198.5	185.4	30.939	1.105	0.552	39.227	0.552	0	0.10369	0.10066	8,237	182	1	22,562	179	0
14	Bangladesh	0.0832	0.1150	19.0	27.1	59.116	3.315	1.105	78.453	7.182	5.525	0.10942	0.10740	11,686	890	2	33,596	895	234
15	Barbados	0.0101	0.0125	96.6	97.4	51.934	4.972	1.657	62.431	3.315	2.762	0.10239	0.10236	11,051	396	183	30,356	556	35
16	Belarus	0.0188	0.1479	93.0	126.5	11.602	1.105	0.552	65.746	6.63	2.762	0.10151	0.10520	3,724	360	181	31,148	1,688	541
17	Belgium-Luxembourg	3.5523	3.0389	130.3	129.9	93.37	55.801	36.464	95.58	59.116	41.989	0.18506	0.17924	13,539	2,361	1,612	35,634	2,548	1,662
18	Belize	0.0066	0.0056	126.0	105.4	45.304	0.552	0	43.094	0	0	0.10034	0.10034	10,353	181	0	24,115	0	0
19	Benin	0.0087	0.0108	58.9	59.5	49.724	1.657	1.105	64.641	2.21	1.657	0.10436	0.10406	10,832	183	2	30,926	538	6
20	Bermuda	0.0165	0.0130	-	-	52.486	1.105	0.552	37.017	0	0	0.10072	0.10026	11,119	360	1	21,630	0	0
21	Bhutan	0.0019	0.0015	78.2	74.9	19.337	0	0	19.89	0	0	0.10005	0.10007	5,850	0	0	12,494	0	0
22	Bolivia	0.0242	0.0318	45.9	49.0	53.039	1.657	0.552	61.878	0.552	0	0.10123	0.10083	11,145	3	1	30,210	179	0
23	Bosnia Herzegovina	0.0083	0.0276	-	-	9.945	0.552	0.552	32.044	1.105	1.105	0.10072	0.10236	3,211	181	181	19,256	358	211
24	Br. Virgin Isds	0.0017	0.0161	16.1	17.9	18.232	0	0	31.492	0.552	0	0.10009	0.10045	5,571	0	0	18,989	179	0
25	Brazil	0.8618	1.1181	-	-	62.431	14.917	10.497	80.11	16.575	9.945	0.11801	0.12782	11,954	2,118	801	33,858	2,376	461
26	Brunei Darussalam	0.0574	0.0362	87.0	101.1	51.934	0	0	47.514	0	0	0.10034	0.10026	11,087	0	0	25,765	0	0
27	Bulgaria	0.0875	0.0904	37.7	39.4	69.061	9.945	6.077	72.928	3.315	1.105	0.10967	0.10259	12,484	1,901	403	32,634	1,058	357
28	Burkina Faso	0.0048	0.0102	36.4	32.5	19.89	0.552	0	58.011	1.657	1.105	0.10017	0.10117	5,978	181	0	29,138	537	31
29	Burundi	0.0029	0.0023	22.0	62.6	22.652	0	0	40.331	1.105	0.552	0.10008	0.10054	6,614	0	0	23,040	358	6
30	Cambodia	0.0096	0.0193	36.3	43.0	19.337	0	0	30.939	0	0	0.10014	0.10021	5,843	0	0	18,690	0	0
31	Cameroon	0.0375	0.0338	52.9	71.7	30.939	0	0	60.221	2.762	1.657	0.10019	0.10156	8,243	0	0	29,758	541	4
32	Canada	3.5770	4.1132	65.8	85.0	81.768	33.702	12.707	94.475	36.464	14.365	0.13045	0.13015	13,125	2,368	1,320	35,546	2,556	1,248
33	Cape Verde	0.0020	0.0026	-	-	16.022	0	0	24.862	0	0	0.10017	0.10012	5,003	0	0	15,408	0	0
34	Cayman Isds	0.0112	0.0125	40.3	44.2	20.994	0	0	27.624	0.552	0	0.10023	0.10035	6,244	0	0	16,934	179	0
35	Central African Rep.	0.0028	0.0032	45.6	51.1	19.337	0	0	32.597	0	0	0.10001	0.10004	5,845	0	0	19,533	0	0
36	Chad	0.0025	0.0025	62.5	57.7	17.68	0	0	29.282	0	0	0.10002	0.10015	5,429	0	0	17,824	0	0
37	Chile	0.2799	0.3164	27.8	39.0	64.088	6.63	4.42	61.878	7.182	5.525	0.10575	0.10698	12,079	1,530	577	30,168	1,476	422
38	China	2.9186	4.0012	32.7	34.6	86.74	30.939	22.652	86.188	33.149	20.994	0.14933	0.13698	13,347	2,362	1,610	34,712	2,549	1,665
39	China, Hong Kong SAR	2.5358	2.2184	56.9	62.9	78.453	20.442	12.707	86.74	21.547	11.602	0.12392	0.12444	12,963	2,360	1,614	34,780	2,546	1,659
40	China, Macao SAR	0.0539	0.0398	49.3	42.2	32.044	0	0	41.436	0	0	0.10029	0.10025	8,431	0	0	23,454	0	0
41	Colombia	0.2008	0.2599	86.5	136.5	71.271	7.182	3.867	81.768	6.077	3.315	0.11020	0.10701	12,573	1,250	222	34,134	1,454	55
42	Comoros	0.0017	0.0006	74.7	87.5	18.785	0	0	30.387	0	0	0.10010	0.10005	5,713	0	0	18,413	0	0
43	Congo	0.0297	0.0211	59.7	76.3	26.519	0	0	41.989	1.105	0	0.10017	0.10071	7,423	0	0	23,686	358	0
44	Costa Rica	0.0787	0.1190	147.2	95.2	47.514	1.657	1.657	65.746	2.762	2.21	0.10412	0.10295	10,579	361	185	31,136	887	66
45	Cote d'Ivoire	0.0580	0.0799	105.8	97.7	31.492	1.657	0.552	73.481	4.972	3.315	0.10119	0.10442	8,335	538	181	32,738	900	39
46	Croatia	0.1094	0.1210	110.6	114.0	65.746	4.42	2.21	75.691	4.42	3.315	0.10813	0.10744	12,199	1,061	187	33,140	1,225	214
47	Cyprus	0.0616	0.0450	65.8	66.0	63.536	1.657	1.657	74.033	1.105	0.552	0.10174	0.10130	12,038	538	184	32,836	358	179
48	Czechoslovakia	0.3254	0.0000	128.6	106.9	34.254	2.762	2.21	0	0	0	0.10272	0.00000	8,809	889	706	0	0	0
49	Dem. Rep. of the Congo	0.0255	0.0171	122.8	111.2	22.652	0	0	32.597	1.657	0.552	0.10018	0.10126	6,608	0	0	19,533	537	2
50	Denmark	1.0130	0.8504	70.2	99.2	90.055	16.575	8.84	90.055	13.26	6.63	0.12638	0.11684	13,456	2,340	1,182	35,130	2,391	1,182

TABLE A2. RESULTS FOR LOCAL MEASURES OF ECONOMIC INTEGRATION (…continues)

51	Djibouti	0.0055	0.0039	59.1	54.7	26.519	0.552	0.552	33.149	0	0	0.10086	0.10011	7,436	181	181	19,846	0	0
52	Dominica	0.0038	0.0028	52.5	50.3	24.862	1.657	1.105	35.359	2.21	1.105	0.10073	0.10091	7,081	376	187	20,880	546	31
53	Dominican Rep.	0.0871	0.1165	44.4	56.4	29.282	1.105	0.552	39.779	1.105	0.552	0.10157	0.10147	7,942	360	181	22,788	358	28
54	Ecuador	0.0865	0.1067	110.3	177.6	48.066	2.21	0.552	70.166	4.972	1.657	0.10141	0.10339	10,638	539	1	32,104	1,421	44
55	Egypt	0.2082	0.1975	114.6	156.7	37.569	2.762	1.105	76.243	8.287	3.867	0.10328	0.10609	9,327	889	196	33,230	2,244	585
56	El Salvador	0.0294	0.0567	21.2	35.8	37.569	2.21	2.21	59.116	4.972	3.315	0.10146	0.10397	9,330	365	187	29,442	1,084	66
57	Equatorial Guinea	0.0013	0.0067	111.2	116.3	16.022	0	0	23.757	0	0	0.10001	0.10004	4,997	0	0	14,764	0	0
58	Estonia	0.0064	0.0779	49.4	66.2	13.812	0.552	0	71.271	3.867	2.21	0.10017	0.10273	4,381	181	0	32,326	1,224	366
59	Fiji	0.0149	0.0111	43.9	43.8	51.934	1.657	1.105	28.729	0	0	0.10149	0.10014	11,057	183	2	17,536	0	0
60	Finland	0.6577	0.7033	-	-	80.11	9.392	4.972	86.188	8.84	4.972	0.11063	0.11000	13,045	2,078	872	34,712	1,941	884
61	Fmr Ethiopia	0.0119	0.0000	81.8	96.3	52.486	2.21	1.657	0	0	0	0.10893	0.00000	11,108	188	187	0	0	0
62	France	6.5926	5.6436	124.4	115.8	97.79	81.768	70.166	97.79	77.901	62.983	0.24522	0.21621	13,605	2,363	1,612	35,756	2,544	1,663
63	French Polynesia	0.0087	0.0129	84.2	67.5	19.337	0	0	63.536	0	0	0.10018	0.10028	5,850	0	0	30,700	0	0
64	Gabon	0.0435	0.0326	49.3	46.8	23.204	0	0	35.359	1.105	0	0.10011	0.10046	6,729	0	0	20,880	358	0
65	Gambia	0.0064	0.0041	43.4	57.4	24.309	0	0	49.171	0.552	0	0.10008	0.10033	6,973	0	0	26,378	179	0
66	Georgia	0.0027	0.0136	44.6	40.4	12.155	0	0	34.254	1.105	0.552	0.10004	0.10218	3,891	0	0	20,354	358	3
67	Germany	11.5092	9.1661	-	-	98.343	87.293	78.453	97.79	80.663	69.061	0.31206	0.24626	13,611	2,357	1,609	35,756	2,541	1,658
68	Ghana	0.0471	0.0434	105.3	107.8	73.481	2.762	1.657	46.961	2.762	2.21	0.10209	0.10272	12,731	720	186	25,536	887	45
69	Greece	0.3789	0.3845	41.1	42.7	37.569	3.315	1.105	83.425	13.812	6.63	0.10441	0.11473	9,327	890	182	34,352	2,534	908
70	Greenland	0.0116	0.0078	55.0	43.0	44.751	0	0	48.619	0	0	0.10016	0.10011	10,320	0	0	26,219	0	0
71	Grenada	0.0015	0.0025	53.1	48.5	25.414	1.105	0.552	52.486	1.657	0.552	0.10055	0.10084	7,205	360	181	27,492	537	27
72	Guatemala	0.0569	0.0889	159.2	192.8	32.597	0.552	0.552	53.039	3.315	2.762	0.10090	0.10449	8,526	181	181	27,598	1,058	65
73	Guinea	0.0163	0.0141	37.0	31.5	27.072	0	0	56.906	0.552	0	0.10013	0.10052	7,533	0	0	28,798	179	0
74	Guinea-Bissau	0.0014	0.0014	63.1	84.6	17.68	0	0	24.862	0.552	0	0.10004	0.10022	5,443	0	0	15,416	179	0
75	Guyana	0.0104	0.0084	259.6	281.0	50.829	2.762	0.552	35.359	1.657	1.105	0.10140	0.10094	10,966	385	1	20,880	537	33
76	Haiti	0.0069	0.0123	67.5	74.3	26.519	0	0	38.122	0	0	0.10006	0.10024	7,418	0	0	22,116	0	0
77	Honduras	0.0370	0.0628	65.6	68.4	33.702	1.657	0.552	55.249	2.762	1.657	0.10105	0.10216	8,715	364	181	28,270	887	62
78	Hungary	0.3004	0.4698	16.6	24.1	74.033	6.077	2.21	81.768	9.392	3.315	0.10461	0.10669	12,734	1,381	536	34,114	1,955	548
79	Iceland	0.0470	0.0456	48.9	52.7	54.696	0	0	63.536	0.552	0	0.10041	0.10071	11,301	0	0	30,610	1	0
80	India	0.5953	0.7607	30.2	47.5	69.061	17.68	13.812	82.32	19.89	13.812	0.12729	0.13388	12,432	2,340	932	34,196	2,539	1,261
81	Indonesia	0.8570	0.8142	-	-	66.298	12.707	6.077	88.398	13.812	6.077	0.11260	0.10945	12,239	2,285	890	34,960	2,534	587
82	Iran	0.4059	0.2666	112.4	130.5	30.939	7.735	3.315	54.696	7.735	3.867	0.10508	0.10808	8,237	2,075	560	28,104	1,823	545
83	Iraq	0.0137	0.0634	82.1	79.2	17.127	1.105	0.552	32.597	0.552	0.552	0.10153	0.10161	5,286	361	181	19,547	179	179
84	Ireland	0.7160	1.0019	39.0	47.4	82.32	6.077	2.762	88.95	7.182	3.315	0.10823	0.10871	13,151	1,064	362	35,018	1,387	390
85	Israel	0.4079	0.4750	110.3	125.8	53.591	3.867	1.105	70.166	6.077	1.657	0.10377	0.10503	11,188	1,060	359	32,098	1,815	533
86	Italy	5.1263	4.2995	18.7	16.7	98.343	80.11	64.641	96.133	67.403	52.486	0.21963	0.20217	13,611	2,359	1,611	35,672	2,543	1,661
87	Jamaica	0.0450	0.0476	128.9	129.0	58.564	4.42	2.762	64.088	4.972	2.762	0.10384	0.10577	11,653	397	197	30,734	745	45
88	Japan	7.0019	6.5451	149.3	79.0	45.304	30.387	20.994	95.58	60.221	46.409	0.15601	0.21639	10,334	2,357	1,608	35,634	2,543	1,659
89	Jordan	0.0586	0.0503	53.0	70.9	51.934	4.42	2.21	57.459	2.21	1.657	0.11331	0.10293	11,032	1,223	187	28,926	538	214
90	Kazakhstan	0.0124	0.0952	130.6	-	12.155	0.552	0	34.807	2.762	1.657	0.10025	0.10396	3,891	181	0	20,621	715	188
91	Kenya	0.0380	0.0506	63.6	66.4	54.696	1.657	1.657	59.116	1.657	0	0.10162	0.10133	11,290	183	183	29,408	537	0
92	Kiribati	0.0006	0.0006	102.4	93.6	22.099	0	0	22.099	0.552	0	0.10013	0.10014	6,501	0	0	13,802	1	0
93	Kuwait	0.1209	0.1791	78.1	78.4	39.227	2.21	1.657	70.166	3.867	2.762	0.10316	0.10374	9,563	716	188	32,122	1,224	221
94	Kyrgyzstan	0.0009	0.0120	38.0	62.0	9.392	0	0	44.751	2.762	1.657	0.10003	0.10171	3,036	0	0	24,766	715	6
95	Lao People's Dem. Rep.	0.0038	0.0069	103.5	107.4	19.337	0	0	27.072	0	0	0.10007	0.10014	5,843	0	0	16,630	0	0
96	Latvia	0.0132	0.0595	103.1	73.0	13.812	0.552	0.552	56.354	1.105	1.105	0.10046	0.10221	4,381	181	181	28,602	358	357
97	Lebanon	0.0470	0.0721	-	-	34.807	1.105	0.552	86.74	3.315	1.105	0.10200	0.10344	8,900	360	181	34,824	1,058	215
98	Liberia	0.0657	0.0670	-	-	26.519	1.657	0	38.674	1.657	0.552	0.10106	0.10171	7,418	538	0	22,346	537	179
99	Libya	0.1948	0.1167	93.5	128.7	30.387	2.762	1.105	34.807	3.867	1.657	0.10200	0.10204	8,149	717	2	20,631	1,224	211
100	Lithuania	0.0494	0.0892	141.2	117.4	30.387	7.735	7.735	48.619	2.762	1.657	0.11460	0.10288	8,139	549	194	26,129	887	366

TABLE A2. RESULTS FOR LOCAL MEASURES OF ECONOMIC INTEGRATION (…continues)

101	Madagascar	0.0110	0.0122	40.9	49.0	49.724	1.105	0	57.459	1.105	0	0.10055	0.10050	10,811	360	0	28,926	2	0
102	Malawi	0.0085	0.0077	57.6	62.3	24.862	0.552	0.552	45.856	2.21	1.105	0.10037	0.10120	7,080	181	1	25,146	538	3
103	Malaysia	1.1481	1.3531	140.6	183.0	79.558	14.365	8.287	80.663	13.26	6.63	0.11302	0.11107	13,018	2,346	1,174	33,946	2,530	1,301
104	Maldives	0.0035	0.0045	124.9	-	18.232	0	0	30.939	0	0	0.10008	0.10016	5,573	0	0	18,710	0	0
105	Mali	0.0077	0.0107	50.3	56.6	25.967	0	0	38.674	2.762	2.762	0.10009	0.10215	7,306	0	0	22,336	887	46
106	Malta	0.0542	0.0450	177.9	194.7	61.878	0	0	62.431	0.552	0	0.10067	0.10059	11,928	0	0	30,314	179	0
107	Marshall Isds	0.0009	0.0017	-	-	8.84	0	0	18.785	0	0	0.10007	0.10004	2,868	0	0	11,844	0	0
108	Mauritania	0.0105	0.0116	105.4	100.7	22.652	0	0	35.359	0.552	0.552	0.10009	0.10050	6,616	0	0	20,880	179	2
109	Mauritius	0.0400	0.0359	131.3	125.6	65.193	3.315	1.105	67.956	3.315	2.21	0.10200	0.10225	12,165	722	2	31,628	542	45
110	Mexico	1.5541	2.3881	36.5	50.9	73.481	12.155	7.735	88.398	13.812	1.657	0.11847	0.11352	12,702	2,159	758	34,966	2,481	385
111	Micronesia	0.0008	0.0012	-	-	7.182	0	0	12.155	0	0	0.10001	0.10001	2,340	0	0	7,758	0	0
112	Mongolia	0.0041	0.0082	116.4	122.1	16.022	0	0	33.702	0	0	0.10003	0.10015	4,993	0	0	20,083	0	0
113	Morocco	0.1701	0.1800	85.3	120.7	37.017	2.762	0.552	72.928	4.42	2.21	0.10255	0.10469	9,246	889	3	32,634	1,225	186
114	Mozambique	0.0131	0.0062	54.3	58.2	24.309	0.552	0.552	32.044	0	0	0.10052	0.10012	6,965	181	1	19,256	0	0
115	Nepal	0.0107	0.0155	47.4	54.4	24.309	0	0	40.884	1.105	0.552	0.10025	0.10053	6,965	0	0	23,234	180	1
116	Neth. Antilles	0.0522	0.0396	34.4	56.4	46.409	3.315	2.21	36.464	1.105	0.552	0.10218	0.10138	10,459	386	197	21,380	358	27
117	Netherlands	3.9133	3.2258	101.8	99.3	95.58	61.878	44.751	97.79	57.459	37.569	0.15711	0.15347	13,575	2,362	1,612	35,756	2,548	1,662
118	New Caledonia	0.0145	0.0115	-	-	19.337	0	0	24.309	0.552	0.552	0.10020	0.10056	5,847	0	0	15,076	1	1
119	New Zealand	0.2697	0.2317	-	-	67.403	3.867	2.21	49.171	0.552	0.552	0.10545	0.10198	12,318	546	187	26,326	179	179
120	Nicaragua	0.0128	0.0234	54.8	58.6	27.072	1.105	1.105	54.696	2.762	2.21	0.10121	0.10180	7,527	360	185	28,118	887	66
121	Niger	0.0060	0.0071	67.7	85.1	23.757	0	0	52.486	2.21	0.552	0.10010	0.10096	6,854	0	0	27,460	714	5
122	Nigeria	0.2854	0.1725	38.7	39.8	38.674	1.105	1.105	71.823	1.657	1.657	0.10230	0.10690	9,491	360	184	32,472	359	9
123	Norway	0.8601	0.7624	63.3	83.4	77.348	9.945	6.077	82.873	12.707	9.392	0.11245	0.12187	12,907	2,076	901	34,276	2,516	947
124	Oman	0.1240	0.1118	70.9	71.8	46.961	1.105	1.105	60.221	1.105	1.105	0.10206	0.10314	10,528	360	183	29,718	358	180
125	Pakistan	0.2262	0.1734	83.1	90.1	72.928	10.497	7.735	79.558	9.392	5.525	0.11340	0.10986	12,670	1,797	223	33,770	1,563	373
126	Palau	0.0008	0.0007	34.8	36.8	6.63	0	0	12.155	0	0	0.10001	0.10001	2,153	0	0	7,740	0	0
127	Panama	0.1346	0.0533	-	-	37.017	2.762	1.105	53.591	3.315	1.657	0.10236	0.10209	9,246	889	183	27,768	1,058	49
128	Papua New Guinea	0.0291	0.0282	69.9	76.7	22.652	0.552	0	60.221	1.657	1.105	0.10039	0.10159	6,608	181	0	29,778	359	2
129	Paraguay	0.0304	0.0406	93.3	101.3	38.122	0.552	0	43.094	1.657	0.552	0.10063	0.10096	9,406	181	0	24,105	537	179
130	Peru	0.1057	0.1312	62.6	101.6	60.773	4.972	2.21	66.298	4.972	2.21	0.10332	0.10428	11,831	1,381	186	31,264	1,384	52
131	Philippines	0.3629	0.6075	24.5	27.0	55.801	11.602	6.63	76.243	11.602	6.077	0.11081	0.10990	11,392	2,247	565	33,230	2,389	716
132	Poland	0.4297	0.6741	58.9	84.8	79.006	16.575	10.497	81.768	17.127	8.287	0.11903	0.11161	12,991	2,145	898	34,114	2,544	1,317
133	Portugal	0.6979	0.6045	43.7	50.3	85.635	22.652	12.707	87.293	21.547	12.707	0.13143	0.12358	13,302	2,334	589	34,842	2,501	447
134	Qatar	0.0550	0.0855	71.3	67.5	51.934	2.21	1.657	56.906	1.105	0	0.10153	0.10130	11,053	716	190	28,778	358	0
135	Rep. of Korea	2.1538	2.0091	-	-	81.215	29.282	24.309	88.398	28.177	17.68	0.14449	0.13239	13,099	2,356	1,595	34,960	2,539	1,650
136	Rep. of Moldova	0.0017	0.0201	45.1	59.1	11.05	0.552	0	50.829	1.105	0	0.10013	0.10066	3,555	181	0	26,915	358	0
137	Romania	0.0957	0.2021	52.8	50.8	34.254	1.657	0	77.901	6.077	2.762	0.10122	0.10464	8,809	538	0	33,506	1,815	538
138	Russian Federation	0.9265	1.1286	23.9	38.5	37.569	8.84	5.525	81.215	22.652	16.575	0.11169	0.15212	9,327	2,144	917	34,032	2,539	1,260
139	Rwanda	0.0033	0.0034	97.9	115.4	20.994	0.552	0	56.906	2.21	1.657	0.10015	0.10111	6,250	181	0	28,872	545	8
140	Saint Kitts and Nevis	0.0015	0.0016	95.2	116.3	18.785	0.552	0	23.204	1.105	0.552	0.10034	0.10053	5,716	181	0	14,458	358	28
141	Saint Lucia	0.0065	0.0043	80.6	74.2	48.066	3.867	2.762	47.514	3.315	2.21	0.10350	0.10224	10,676	398	190	25,815	556	37
142	Saint Vincent and the Grenadines	0.0032	0.0034	55.4	69.3	23.757	0.552	0.552	44.751	2.21	0.552	0.10057	0.10106	6,864	181	181	24,810	546	27
143	Samoa	0.0031	0.0011	121.0	125.3	16.022	0.552	0	17.127	0	0	0.10028	0.10001	5,006	181	0	10,838	0	0
144	Sao Tome and Principe	0.0005	0.0006	36.6	45.0	16.575	0	0	21.547	0	0	0.10001	0.10006	5,151	0	0	13,490	0	0
145	Saudi Arabia	1.0578	0.6970	375.6	352.4	75.691	18.785	10.497	79.006	11.05	7.182	0.12746	0.11854	12,844	2,356	596	33,682	2,442	915
146	Senegal	0.0214	0.0230	138.6	113.3	30.387	0.552	0	60.773	1.105	0.552	0.10036	0.10334	8,149	181	0	29,898	180	1
147	Seychelles	0.0037	0.0035	119.5	-	34.807	0.552	0.552	31.492	0	0	0.10034	0.10009	8,921	181	1	18,985	0	0
148	Sierra Leone	0.0076	0.0026	41.3	-	24.309	0	0	34.254	0	0	0.10003	0.10009	6,971	0	0	20,364	0	0
149	Singapore	1.7836	1.8183	38.3	45.5	64.088	26.519	18.232	76.796	23.204	16.022	0.12940	0.12786	12,079	2,359	1,605	33,324	2,543	1,652
150	Slovenia	0.1456	0.1790	66.1	79.4	80.663	6.63	2.21	85.083	3.867	1.657	0.10737	0.10473	13,083	1,227	186	34,598	1,059	212

TABLE A2. RESULTS FOR LOCAL MEASURES OF ECONOMIC INTEGRATION (…continues)

151	Solomon Isds	0.0028	0.0031	140.5	127.5	14.917	0	0	19.337	0	0	0.10007	0.10004	4,692	0	0	12,160	0	0
152	Somalia	0.0033	0.0020	163.3	137.9	23.757	0.552	0.552	26.519	0.552	0	0.10025	0.10027	6,856	181	181	16,320	179	0
153	Spain	2.3100	2.3571	140.2	112.6	96.133	58.011	39.779	96.133	62.431	43.646	0.15794	0.16196	13,588	2,361	1,612	35,672	2,544	1,663
154	Sri Lanka	0.0812	0.0892	16.7	-	55.249	4.42	1.657	44.751	1.657	0.552	0.10353	0.10236	11,341	1,061	3	24,732	359	1
155	Sudan	0.0133	0.0269	49.4	10.9	27.072	0.552	0	71.823	4.972	1.657	0.10047	0.10377	7,527	181	0	32,500	1,234	35
156	Suriname	0.0143	0.0107	59.5	72.0	24.309	1.657	0.552	41.436	1.657	1.657	0.10057	0.10094	6,970	377	181	23,454	537	37
157	Sweden	1.3409	1.4819	70.8	68.5	42.541	12.155	4.972	87.845	17.127	6.077	0.11118	0.11672	9,994	2,337	1,273	34,902	2,541	1,415
158	Switzerland	1.8864	1.5912	52.7	72.0	93.37	27.072	13.812	93.37	23.757	9.945	0.12791	0.12114	13,539	2,359	1,541	35,450	2,546	1,337
159	Syria	0.0707	0.0727	-	187.2	33.149	1.657	0.552	45.304	2.762	1.105	0.10128	0.10234	8,623	538	181	24,935	887	216
160	Tajikistan	0.0012	0.0060	44.1	58.7	9.392	0	0	26.519	0.552	0.552	0.10003	0.10047	3,036	0	0	16,320	179	6
161	Thailand	1.0046	0.9521	71.5	85.8	80.11	25.414	16.022	92.265	25.414	17.127	0.13669	0.13604	13,045	2,356	1,343	35,348	2,543	1,106
162	Timor-Leste	0.0000	0.0000	-	-	3.867	0	0	2.762	0	0	0.10000	0.10004	1,263	0	0	1,770	0	0
163	Togo	0.0126	0.0097	82.3	68.8	24.309	1.105	0.552	59.116	1.657	0.552	0.10111	0.10105	6,972	360	181	29,428	537	3
164	Tonga	0.0009	0.0005	84.9	-	14.917	0.552	0.552	18.232	0	0	0.10036	0.10001	4,703	181	2	11,512	0	0
165	Trinidad and Tobago	0.0450	0.0550	73.0	91.8	59.116	4.42	2.762	64.088	4.972	3.315	0.10414	0.10420	11,699	398	189	30,756	565	42
166	Tunisia	0.1513	0.1422	85.4	89.9	61.878	3.315	0	73.481	1.657	1.105	0.10254	0.10282	11,915	890	0	32,746	359	209
167	Turkey	0.5400	0.6996	32.8	44.6	79.558	18.232	11.602	82.873	22.099	10.497	0.12346	0.12180	13,018	2,328	927	34,276	2,544	1,320
168	Turkmenistan	0.0036	0.0100	-	-	11.05	0	0	29.834	0.552	0.552	0.10011	0.10067	3,555	0	0	18,116	179	3
169	Uganda	0.0072	0.0156	27.8	31.3	25.967	0.552	0.552	72.928	2.762	2.762	0.10066	0.10679	7,306	181	181	32,700	539	8
170	Ukraine	0.0540	0.2678	54.2	80.4	17.68	1.105	0.552	80.663	11.602	7.182	0.10198	0.11002	5,429	360	181	33,960	2,325	892
171	United Arab Emirates	0.2151	0.4947	106.5	127.9	59.116	3.315	1.657	53.039	8.287	4.972	0.10371	0.10893	11,707	1,059	192	27,598	2,156	763
172	United Kingdom	5.4348	5.3724	50.4	56.5	91.16	74.586	64.088	97.238	71.823	60.221	0.22917	0.21391	13,489	2,355	1,609	35,730	2,544	1,660
173	United Rep. of Tanzania	0.0202	0.0220	20.7	23.8	29.282	0.552	0.552	72.376	1.657	0.552	0.10079	0.10167	7,942	181	181	32,548	537	1
174	Uruguay	0.0540	0.0674	43.5	42.7	29.834	1.657	0.552	62.431	2.21	1.105	0.10090	0.10514	8,041	538	181	30,314	714	180
175	USA	13.8680	15.9373	72.7	93.8	97.79	89.503	82.873	97.79	91.16	83.425	0.42446	0.43029	13,605	2,355	1,607	35,756	2,544	1,661
176	Uzbekistan	0.0086	0.0435	107.4	-	11.05	0.552	0	32.597	1.105	0.552	0.10031	0.10194	3,555	181	0	19,533	358	6
177	Vanuatu	0.0015	0.0019	53.2	52.6	19.337	0	0	22.099	0	0	0.10012	0.10002	5,857	0	0	13,802	0	0
178	Venezuela	0.3956	0.3279	47.7	84.2	54.696	8.287	3.315	66.298	9.392	3.867	0.10772	0.10958	11,290	1,422	227	31,268	1,508	55
179	Viet Nam	0.0610	0.1836	-	-	26.519	0.552	0	44.199	1.657	0	0.10069	0.10153	7,418	181	0	24,527	537	0
180	Yemen	0.0415	0.0357	44.8	70.4	29.282	1.657	0.552	38.122	1.657	1.105	0.10141	0.10113	7,944	366	181	22,110	537	213
181	Zambia	0.0215	0.0147	70.6	73.6	28.177	0.552	0.552	57.459	1.657	0.552	0.10056	0.10160	7,740	181	1	28,946	359	1
182	Zimbabwe	0.0389	0.0245	49.1	73.7	58.564	1.657	0	40.884	0.552	0.552	0.10102	0.10056	11,638	361	0	23,234	179	1