LEM

Working Paper Series

Using a complex weighted-network approach to assess the evolution of international economic integration: The cases of East Asia and Latin America

Javier Reyes[†], Giorgio Fagiolo[‡], Stefano Schiavo[*]

[†]Department of Economics, Sam M. Walton College of Business, University of Arkansas, USA.
[‡]Sant'Anna School of Advanced Studies, Pisa, Italy.
[*]Department of Economics and School of International Studies, University of Trento, Italy, and OFCE, France.

2008/10   April 2008

Using a complex weighted-network approach
to assess the evolution of international economic integration:
The cases of East Asia and Latin America

Javier Reyes[*]   Giorgio Fagiolo[†]   Stefano Schiavo[‡]

April 2008

Abstract

Over the past four decades the High Performing Asian Economies (HPAE) have followed a development strategy based on the exposure of their local markets to the presence of foreign competition and on an outward oriented production. In contrast, Latin American Economies (LATAM) began taking steps in this direction only in the late eighties and early nineties, but before this period these countries were more focused on the implementation of import substitution policies. These divergent paths have led to sharply different growth performance in the two regions. Yet, standard trade openness indicators fall short of portraying the peculiarity of the Asian experience, and to explain why other emerging markets with similar characteristics have been less successful over the last 25 years. We offer an alternative perspective on the issue by exploiting recently-developed indicators based on weighted-network analysis. We study the evolution of the core-periphery structure of the World Trade Network (WTN) and, more specifically, the evolution of the HPAE and LATAM countries within this network. Using random-walk betweenness centrality measure, the paper shows that the HPAE countries are more integrated into the WTN and many of them, which were in the periphery in the eighties, are now in the core of the network. In contrast, the LATAM economies, at best, have maintained their position over the 1980 - 2005 period, and in some cases have fallen in the ranking of centrality.

Keywords: Networks; World trade web; international trade; weighted network analysis; integration; trade openness; LATAM vs. HPAE countries.

JEL Classification: F10, D85.

1   Introduction

Over the past four decades two groups of countries have occupied center stage in the discussion of economic development. These two groups have been generally referred to as the High Performing Asian Economies (HPAE) and the Latin American Economies (LATAM). Table 1 presents the list of countries that are considered for the analysis presented here. These two regions of the world have been compared from many different perspectives. For instance, some studies focussed on their divergent trends in economic policies

---

[*]Department of Economics, Sam M. Walton College of Business, University of Arkansas, USA. Email: JReyes@walton.uark.edu

[†]Sant'Anna School of Advanced Studies, Pisa, Italy. Email: `giorgio.fagiolo@sssup.it`

[‡]Department of Economics and School of International Studies, University of Trento, Italy, and OFCE, France. Email: `stefano.schiavo@ofce.sciences-po.fr`

regarding openness and import substitution programs over the eighties. Other contributions stressed their similarities with respect to macroeconomic imbalances and fragile institutional frameworks that lead to the financial crises observed in those regions over the late nineties[1].

HPAE	LATAM
China	Argentina
Indonesia	Brazil
Korea	Chile
Malaysia	Mexico
Philippines	Venezuela
Thailand	

Table 1: Countries. Note. HPAE: High Performing Asian Economies. LATAM: Latin American Countries.

Instead of focussing on the specific difference and/or similarities observed between the two regions regarding economic policies, economic growth and stability, here we take these characteristics as given and we center the attention on a different issue, one related to the relationship that exists between economic development and international economic integration. The objective of the current study is to show that the contrasting experiences of economic growth and stability observed in the HPAE and LATAM countries can be associated with different degrees of international economic integration. We use trade flows and a complex network approach to measure network centrality and to assess and characterize the position of the countries of each region within the World Trade Network (WTN). The underlying assumption is that higher degrees of international economic integration are related to more central positions within the WTN. The results show that the early efforts towards more liberalized markets in HPAE countries, combined with a stable economic environment, have led to substantial differences between these countries and the LATAM economies. And these differences go beyond economic growth rates and/or stability. The HPAE countries are more integrated into the WTN and have moved consistently, over the past 25 years, towards its core while LATAM economies have, at best, remained stable in the ranking of centrality.

2 Comparing HPAE and LATAM Regions: Growth, Instability and Openness

The literature includes several studies that have provided extensive and in-depth discussions regarding the differences and similarities among the HPAE and the LATAM regions as far as macroeconomic perspectives are concerned[2]. In this section we present a brief comparison based on four macroeconomic indicators that,

---

[1] See World Bank (1993), Kaminsky and Reinhart (1998), Barro (2001) and De Gregorio and Lee (2004).

[2] See Sachs (1985) and Lin (1989) for early comparisons between Latin America and East Asia. More recent studies include Weeks (2000), De Gregorio and Lee (2004) and Krasilshchikov (2006). For specific country/region studies, see Amsden (1989,

we believe, provide enough evidence to support the "Miracle East Asian Economies" and the "Latin American Lost Decade" arguments[3]. These indicators are wealth, economic growth, inflation, and trade openness.

Strong arguments regarding the different paths of development followed by the two regions can be put forward after a simple examination of the evolution of per capita gross-domestic product (GDP), GDP growth rates, inflation rates (as a proxy for stability[4]), and total trade to GDP ratios (as a proxy for openness) in both regions. Figures 1–4 present the evolution of the averages of these variables for the 1970 - 2003 period.
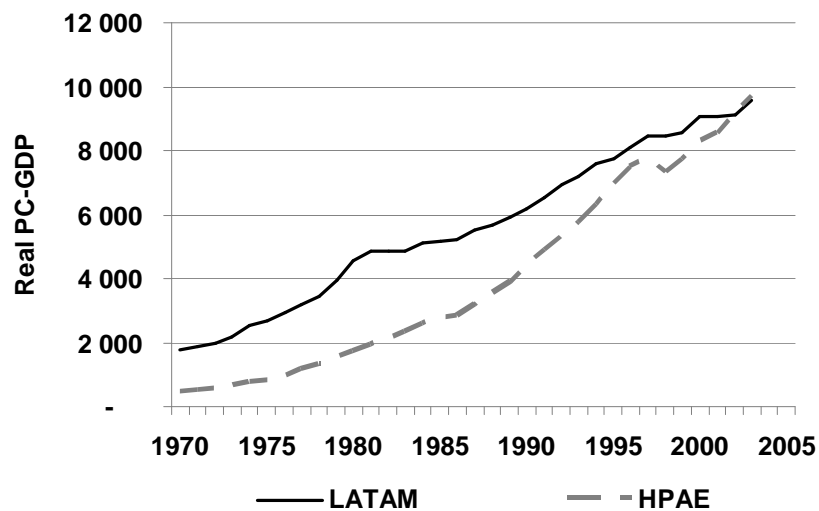

Figure 1: Real GDP per capita. *Source*: Penn World Table 6.2.

It is very clear that the HPAE countries have grown more and faster, they have been more stable, and, if the total trade (exports plus imports) to GDP ratio is used to assess trade openness and integration[5], then it is evident that the LATAM average total trade to GDP ratio has been – and still is – substantially below that of the HPAE region. Yet, since the liberalization of the late 1980s, LATAM countries have increased their openness, with the share of total trade to GDP moving from 25% in 1990 to 50% in 2004. However, as it is discussed in the next section, complex network analysis tells us that increased openness has not translated into deeper integration into the WTN.

1994), De Gregorio (1992, 2006), Edwards (1995), Rodrick (1995), Gavin and Perotti (1997), Singh (1998), Stiglitz (2001), Park and Lee (2002), Lora and Panizza (2002) and Weiss and Jalilian (2004).

[3]See World Bank (1993), Weeks (2000), De Gregorio and Lee (2004) and De Gregorio (2006).

[4]Fischer (1993) argues that high rates of inflation are the summary statistics for mismanagement of the economy, at the macroeconomic level, and the inability of governments to implement sound economic policies. This point of view is also implied by Corbo and Rojas (1993) in their study of macroeconomic instability in Latin America.

[5]De Gregorio and Lee (2004) and De Gregorio (2006) have used this measure of openness in studies that deal with the HPAE and the LATAM regions specifically.
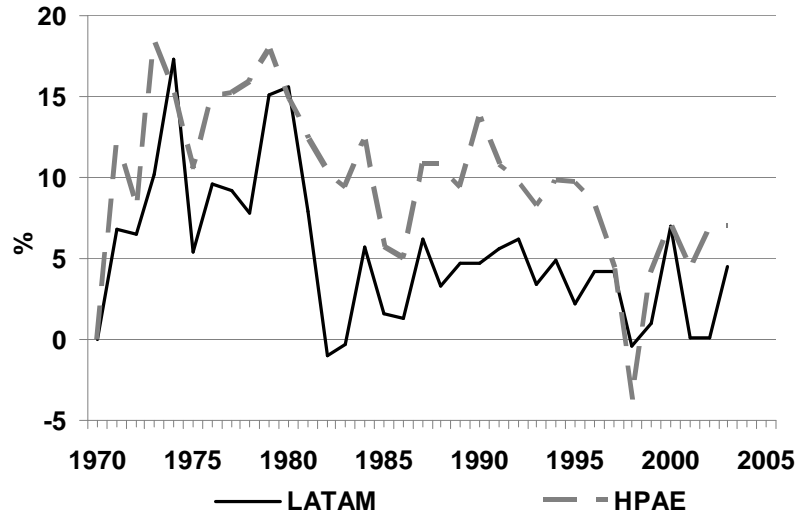
Figure 2: Real GDP per capita Growth Rates. *Source*: Penn World Table 6.2.

3 Methodology, Data, and Results

The appeal for using complex network analysis for the study of international economic integration emerges from the fact that it allows for the recovery and consideration of the whole structure of the web of trade interactions. Furthermore, by doing so, it allows for the exploration of connections, paths, and circuits. When exports and imports to GDP ratios are used to characterize the degree of integration into the world economy of a given country, only first-order trade relationships are captured. Network analysis, on the other hand, accounts for higher-order trade relationships and therefore results in a more in-depth picture of integration. For example, it is possible to assess and fully exploit the length of trade chains, and to characterize the importance of a given country in the network. The study of these properties, as shown by Kali and Reyes (2007a,b), can go beyond the description of stylized facts for the overall network and, if used properly, they can be used to assess the overall degree of international economic integration of the whole network or of a subset of it. In their studies, Kali and Reyes (2007a,b) used a network analysis to derive country specific network indicators and employed these descriptions for the explanation of macroeconomic dynamics like economic growth and financial contagion. These features of network analysis have been exploited recently in the study of other socioeconomic structures. For example, Goyal et al. (2006), Currarini et al. (2007), Hidalgo et al. (2007) and Battiston et al. (2007) have used network analysis to study, respectively, the interaction among academics through co-authorship, friendship networks based on individuals preferences, networks within the "product space", and credit chains and bankruptcy propagation[6]. Previous studies that

---

[6]More on complex network analysis is in Barabási (2002), Newman (2003), Pastos-Satorras and Vespignani (2004), and Watts and Strogatz (1998).
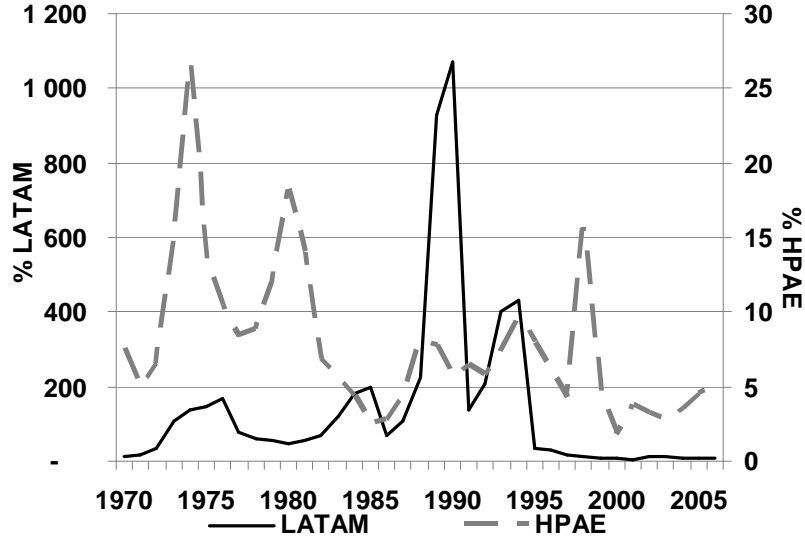
Figure 3: Inflation Rates. *Source*: International Financial Statistics (IFS) database, IMF.

have looked at the specific characteristics of the WTN include those by Snyder and Kick (1979), Nemeth and Smith (1985), Smith and White (1992) and, more recently, Serrano and Boguñá (2003), Garlaschelli and Loffredo (2004, 2005), and Fagiolo et al. (2007). The findings reported in these studies suggest that the WTN is very symmetric, it has a core-periphery structure, there is evidence of a "rich club phenomenon" where countries that have higher trade intensities trade a lot among themselves and, surprisingly, that the overall network structure is fairly stationary through time. The current paper follows closely Kali and Reyes (2007a,b) to the extent that it uses network indicators to assess the degree of integration of a set of countries, and then exploits this methodology to draw conclusions regarding the different degrees of integration observed for the HPAE and the LATAM economies.

The data used to carry out the study are extracted from the COMTRADE database. Bilateral trade data for 171 countries over the 1980 – 2005 period is used to build the trade matrix for the countries considered (more on that in the appendix). In the resulting matrix, columns represent importing countries, while rows denote exporting countries. This matrix is used to build adjacency (A) and weighted (W) matrices needed for the computation of network indicators. The adjacency matrix simply reports the presence of a trade relationship between any two countries, therefore we set the generic entry for the matrix as $a_{ij}^t = 1$ if and only if exports of country i to country j (defined as e_{ij}^t) are strictly positive in year t. As to the weighted matrix (W), Fagiolo et al. (2007) have shown that the majority of network indicators for the WTN are robust to different weighting procedures. For example, one can use the actual trade flow as the weight for each link, $w_{ij}^t = e_{ij}^t$, or a weighted trade measure like exports as a proportion of GDP, i.e.,$w_{ij}^t = e_{ij}^t/GDP_i^t$. In this
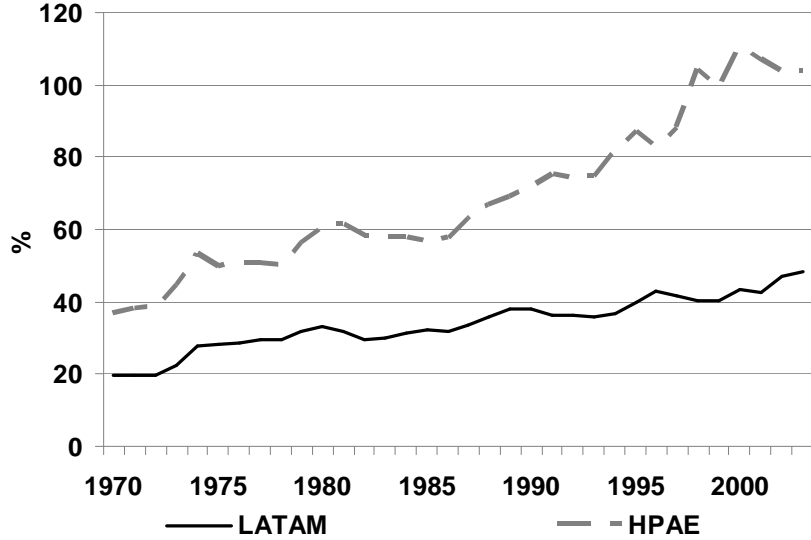
Figure 4: Total Trade to GDP ratio. *Source*: Penn World Table 6.2.

study we use actual trade flows (i.e., levels) for the benchmark analysis and we provide some discussion, for robustness purposes, on alternative weighting schemes later in the paper.

It should be noted that the WTN is, by nature, a weighted (valued links) and directed network (exports and imports). Following Fagiolo et al. (2007) the analysis employs a weighted and undirected (WUN) approach since the WTN turns out to be sufficiently symmetric[7]. For this WUN analysis each entry of the original weighted matrix (W), $w_{ij}^t = e_{ij}^t$, is replaced by $w_{ij}^{t*} = \frac{1}{2}\left(e_{ij}^t + e_{ji}^t\right)$.

3.1 Random-Walk Betweenness Centrality

In this paper, we proxy country integration (centrality) in the WTN by means of random-walk betweenness centrality (RWBC). Following Newman (2005) and Fisher and Vega-Redondo (2006), consider a generic node i for which we want to compute the RWBC and an impulse generated from a different node h, that works its way through the network in order to get to target node k. Let $f(h,k)$ be the source vector $(N \times 1)$, such that $f_i(h,k) = 1$ if $i = h$, $f_i(h,k) = -1$ if $i = k$, and 0 otherwise. Newman (2005) shows that the Kirchoff's law of current conservation implies that:

$$v(h,k) = [D - W]^{-1}f(h,k), \tag{1}$$

---

[7]The results for the symmetry index, as computed by Fagiolo (2006), range between 0.006 (lowest) and 0.013 (highest) for the period 1980 to 2005. The symmetry index ranges from 0 to 1, where zero denotes full symmetry and 1 represents maximum asymmetry.

where $v(h,k)$ denotes the $N \times 1$ vector of node voltages, $D = diag(s)$ and $[D - W]^{-1}$ is computed using the Moore-Penrose pseudo-inverse. This implies that the intensity of the interaction flowing through node i originated from node h and getting to target node k, is determined by:

$$I_i(h,k) = \frac{1}{2} \sum_j |v_i(h,k) - v_j(h,k)|, \tag{2}$$

where $I_h(h,k) = I_k(h,k) = 1$. Therefore RWBC for node i can be computed as:

$$RWBC_i = \frac{\sum_h \sum_{k \neq h} I_i(h,k)}{N(N-1)}. \tag{3}$$

RWBC is a measure of node centrality that captures the effects of the magnitude of the relationships that a node has with other nodes within the network as well as the degree/strength of the node in question. Newman (2005) offers an intuitive explanation for RWBC. He assumes that a source node sends a message to a target node. The message is transmitted initially to a neighboring node and then the message follows an outgoing link from that vertex, chosen randomly, and continues in a similar fashion until it reaches the target node. In the original measure presented by Newman (2005) the probabilities assigned to outgoing edges are all equal but in Fisher and Vega-Redondo (2006) these probabilities are determined by the magnitude of the outgoing trading relationships. Hence links that represent greater magnitude for a trading relationship will be chosen with higher probability. In other words, RWBC exploits (randomly) the whole length of the trade chains present in the network for country i and, therefore, is a good measure for the degree of integration that a given node has within the WTN.

RWBC is a measure that allows for the characterization of the core-periphery structure of the WTN and also permits the identification of the countries in the core and the periphery. Using a percent-rank analysis, the network is divided into core countries (C), inner-periphery countries (I-P), secondary-periphery countries (S-P), and outside-of-the-periphery countries (O). A country is classified as a C, I-P, S-P, or O according to where it lies within the RWBC distribution for the overall network (171 countries). A country is classified as a "C" country if its RWBC is above the 95th percentile, "I-P" if it is above the 90th but below the 95th percentile, "S-P" if it is above the 85th but below the 90th percentile, and "O" otherwise. The results for the HPAE and the LATAM regions, as well as the results for India and the average for the G7 countries are presented and discussed here. The reason to include the G7 and India, a recent globalizer, is for the purpose of comparison. Indeed, HPAE countries have attained a high level of integration within the WTN and it is interesting to analyze their relative position with respect to other countries.

Table 2 presents the evolution using the core-periphery classification while averages of the RWBC dis-

tribution over time for India, the G7, the HPAE, and the LATAM countries are presented in Figure 5. The clear picture that emerges is that the gap, according to RWBC, between the G7, the HPAE (with and without China) and India has been closing while that between all these regions and the LATAM economies has remained. It should be noted that when analyzed independently, one country that clearly diverges from the path of the LATAM region is Brazil. The results for this country (Table 2) show that Brazil is clearly among the top countries according to RWBC but it is also true that its initial value in 1980 was already high. RWBC levels for Argentina, Chile, and Mexico have remained constant. Yet, the result for Venezuela shows that this country is moving away from the core of the WTN. All of the LATAM countries, except Brazil, are currently at or below the 80th percentile of the distribution, while countries like China and Korea are above the 95th percentile and can be considered as part of the core of the network along with the G7 countries. The only HPAE country that is outside 80th percentile is the Philippines, and to some extent it can be argued that its degree of integration has stalled. It should be noted that the argument regarding the integration of India into the WTN seem to be well founded. This country has moved up in the RWBC rankings, consistently.
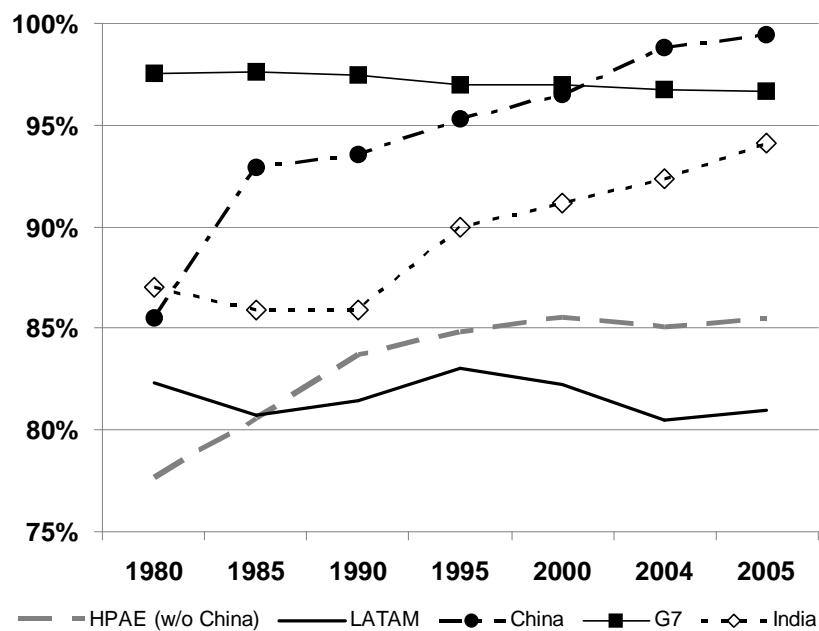

Figure 5: Random-Walk Betweenness Centrality (RWBC) based on Trade Flows.

8

3.2 Robustness Checks

As mentioned before, the weighted approach followed in the current study can be carried out using different weighting procedures. In the previous sections, the RWBC measure was computed by using the actual trade flows as the weights for the links between the countries considered in the study.

An alternative meaningful weighting procedure is to employ trade flows divided by GDP. Table 3 and Figure 6 report the results for this alternative weighting procedure. The conclusions regarding the increased level of centrality for the HPAE countries and the stagnant position of the LATAM regions still hold, even though there are some differences for individual cases.

The robustness of the results across weighting procedures matches the findings reported by Fagiolo et al. (2007). They used international trade data provided by Gleditsch (2002) for the 1981 - 2000 period and included 159 countries. Their findings regarding the constitution of the core of the network matches those reported here, since they showed that China and South Korea were part of the core of the WTN in the year 2000. As a final robustness check, Fagiolo et al. (2007) report a surprising stationarity for the characteristics of the overall network. The population averages for the RWBC, throughout the sample period, are around 0.036 - 0.038 for the case that uses the trade flows as the weights for the links between countries and 0.045 - 0.048 for the case that uses the total trade to GDP ratios. The stability of these averages confirms that the stationarity of the characteristics of the WTN is also present in our study. That is, the overall network distribution does not change much through time, but the composition of the core and the periphery do change.

4 Concluding Remarks

The objective of the paper was to assess whether the observed high economic growth rates and stability of the HPAE region, compared to the LATAM region, could be associated with different (higher) degrees of international economic integration. To answer this question the paper goes beyond the standard analysis of total trade (exports plus imports) to GDP ratios and argues that complex network analysis provides a better understanding of integration. It proposes to proxy the degree of international economic integration of a given country by analyzing the position of this country within the WTN in terms of RWBC.

The increasing total trade to GDP ratios, observed throughout the past 35 years, would point in the direction of a higher degree of economic integration for both regions, more so for the HPAE region but still substantially increasing for both. The averages for the total trade to GDP ratio for these regions went from twenty to twenty five percent for both regions in 1980 to levels around fifty and eighty percent for the
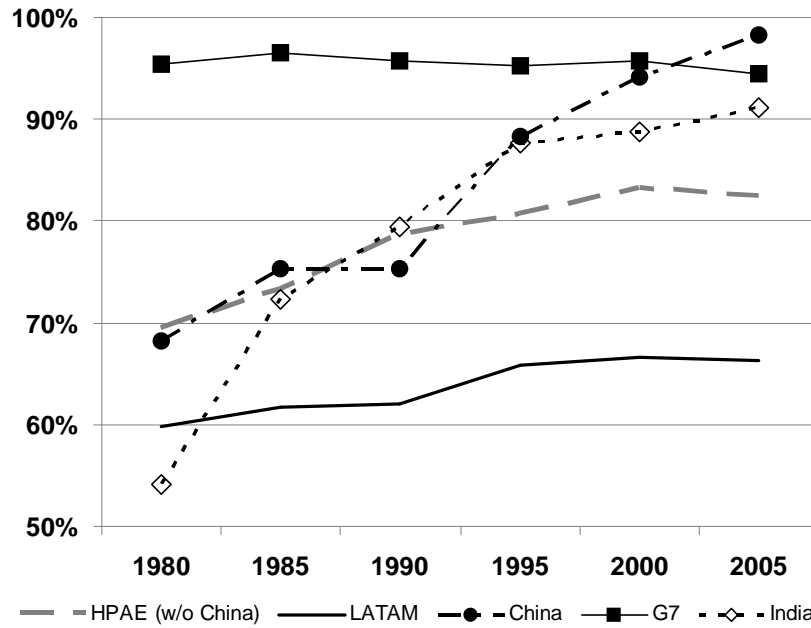
Figure 6: Random-Walk Betweenness Centrality (RWBC) based on Trade to GDP Ratios.

LATAM and HPAE economies, respectively. Contrary to these conclusions, using the RWBC measure, the paper exploits the characteristics of the WTN and shows that there are clear differences in the levels and patterns of international economic integration between the two regions. The pattern that emerges is that of a steady increase in the degree of integration for the HPAE regions, a result that is consistent with the increase in the total trade to GDP ratio. Conversely, the degree of integration of LATAM economies, according to RWBC, has remained constant, contrary to what suggested by the mere observation of an increase in the ratio of total trade to GDP.

The increased presence of the HPAE region in the WTN has policy implications that concern international institutions like the World Trade Organization. This rise in economic integration, due to the number and intensity of trading relationships, enhances the "presence" of the HPAE economies and this could lead to pressure for changes regarding international-trade policies and negotiations in current and future trade negotiations rounds. Given that the results are sensible and point towards interesting patterns, otherwise not identified through standard trade openness measures, we believe that network analysis may suggest a new and, presumably, very fruitful route for the analysis of trade flows that go beyond aggregate flows.

References

Amsden, A. (1989), *Asia's Next Giant: South Korea and Late Indstrialization*, Oxford: Oxford University Press.

Amsden, A. (1994), "Why isn't the Whole World Experimenting with the East Asian Model to Develop? Review of the East Asian Miracle", *World Development*, 22: 627–33.

Barabási, A. (2002), "Statistical Mechanics of Complex Networks", *Rev. Mod. Phys.*, 74: 47–97.

Barro, R. (2001), "Economic Growth in East Asia Before and After the Financial Crisis", Working Paper 8330, NBER.

Battiston, S., D. Delli Gatti, B. Greenwald and J. Stiglitz (2007), "Credit Chains and Bankruptcy Propagation in Production Networks", *Journal of Economic Dynamics and Control*, 31: 2061–84.

Corbo, V. and P. Rojas (1993), "Investment, Macroeconomic Instability and Growth: the Latin American Experience", *Revista de Analisis Economico*, 8: 19–35.

Currarini, S., M. Jackson and P. Pin (2007), "An Economic Model of Friendship: Homophily, Minorities and Segregation", Dept. of economics research paper, University Ca' Foscari of Venice.

De Gregorio, J. (1992), "Economic Growth in Latin America", *Journal of Development Economics*, 39: 59–84.

De Gregorio, J. (2006), "Economic Growth in Latin America: from the Dissapointment of the Twentieth Century to the Challenge of the Twenty-First", Working Paper 377, Central Bank of Chile.

De Gregorio, J. and J.-W. Lee (2004), "Growth and Adjustment in East Asia and Latin America", *Economia*, 5: 69–134.

Edwards, S. (1995), *Crisis and Reform in Latin America: from Despair to Hope*, Oxford: Oxford University Press.

Fagiolo, G. (2006), "Directed or Undirected? A new Index to Check for Directionality of Relations in Socio-Economic Networks", *Economics Bulletin*, 3: 1–12.

Fagiolo, G., J. Reyes and S. Schiavo (2007), "The Evolution of the World Trade Web. A Weighted-Network Analysis", Lem Working Paper Series, 2007-17, available at: http://www.lem.sssup.it/wplem/files/2007-17.pdf.

Fischer, S. (1993), "The Role of Macroeconomic Factors in Growth", *Journal of Monetary Economics*, 32: 485 –512.

Fisher, E. and F. Vega-Redondo (2006), "The Linchpins of a Modern Economy", California Poly.

Garlaschelli, D. and M. Loffredo (2004), "Fitness-Dependent Topological Properties of the World Trade Web", *Physical Review Letters*, 93: 188701.

Garlaschelli, D. and M. Loffredo (2005), "Structure and evolution of the world trade network", *Physica A*, 355: 138–44.

Gavin, M. and R. Perotti (1997), "Fiscal Policy in Latin America", *NBER Macroeconomics Annual*, 12: 11–61.

Gleditsch, K. (2002), "Expanded Trade and GDP data", *Journal of Conflict Resolution*, 46: 712–24, available on-line at http://ibs.colorado.edu/ ksg/trade/.

Goyal, S., J. L. Moraga and M. van der Leij (2006), "Economics: Emerging Small World", *Journal of Political Economy*, 114: 403–12.

Hidalgo, C., A. Klinger, B. Barabási and R. Hausmann (2007), "The Product Space Conditions and the Development of Nations", *Science*, 317: 482–7.

Kali, R. and J. Reyes (2007a), "The Architecture of Globalization: a Network Approach to International Economic Integration", *Journal of International Business Studies*, 38: 595–620.

Kali, R. and J. Reyes (2007b), "Financial contagion on the International Trade Network", University of Arkansas.

Kaminsky, G. and C. Reinhart (1998), "Financial Crises in Asia and Latin America: then and Now", *American Economic Review*, 88: 444–9.

Krasilshchikov, V. (2006), "The East Asian 'Tigers': Following Russia and Latin America?", Working Papers - Programa Asia & Pacifico 17, Centro Argentino de Estudios Internacionales.

Lin, C.-Y. (1989), *Latin America Vs. East Asia: a Comparative Development Perspective*, New York: M.E. Sharpe Inc.

Lora, E. and U. Panizza (2002), "Structural Reforms in Latin America under Scrutiny", Research Department Working Paper 470, IADB.

Nemeth, R. and D. Smith (1985), "International Trade and World-System Structure: a Multiple Network Analysis", *Review: A Journal of the Fernand Braudel Center*, 8: 517–60.

Newman, M. (2003), "The Structure and Function of Complex Networks", *SIAM Review*, 45: 167–256.

Newman, M. (2005), "A measure of betweenness centrality based on random walks", *Social Networks*, 27: 39–54.

Park, Y. C. and J.-W. Lee (2002), "Recovery and Sustainability in East Asia", in M. Dooley and J. Frankel, (eds.), *Managing Currency Crises in Emerging Markets*, Chicago: The Chicago University Press, 275–320.

Pastos-Satorras, R. and A. Vespignani (2004), *Evolution and Structure of the Internet*, Cambridge: Cambridge University Press.

Rodrick, D. (1995), "Getting Intervention Right: How South Korea and Tawian Grew Rich?", *Economic Policy*, 20: 55–107.

Sachs, J. (1985), "External Debt and Macroeconomic Performance in Latin America and East Asia", *Brookings Papers on Economic Activity*, 2: 523–73.

Serrano, A. and M. Boguñá (2003), "Topology of the World Trade Web", *Physical Review E*, 68: 015101(R).

Singh, A. (1998), "Savings, Investment and the Corporation in the East Asian Miracle", *Journal of Development Studies*, 34: 112–37.

Smith, D. and D. White (1992), "Structure and Dynamics of the Global Economy: Network Analysis of International Trade, 1965-1980", *Social Forces*, 70: 857–93.

Snyder, D. and E. Kick (1979), "Structural position in the world system and economic growth 1955-70: A multiple network analysis of transnational interactions", *American Journal of Sociology*, 84: 1096–126.

Stiglitz, J. (2001), "From Miracle to Crisis to Recovery: Lessons from Four Decades of East Asian Experience", in J. Stiglitz and S. Yusuf, (eds.), *Rethinking the East Asian Miracle*, Oxford: Oxford University Press, 509–25.

Watts, D. and S. Strogatz (1998), "Collective dynamics of 'small-world' networks", *Nature*, 393: 440–442.

Weeks, J. (2000), "Latin America and the 'High Performing Asian Economies': growth and debt", *Journal of International Development*, 12: 625–54.

Weiss, J. and H. Jalilian (2004), "Industrializatin in an Age of Globalization: Some Comparisons Between East and South Asia and Latin America", *Oxford Development Studies*, 32: 283–307.

World Bank (1993), *The East Asian Miracle: Economic Growth and Public Policy*, Oxford: Oxford University Press.

A   Data Appendix

The bilateral trade data are extracted form the COMTRADE database housed by the United Nations (UN). The database contains more than 200 countries as reporters and more than 250 as partners. After eliminating regional and income aggregations, and other classifications (free trade zones, neutral zones and unspecified origin), the database has been reduced to participating countries for the WTN for the period of 1980 - 2005. Before performing the analysis, a decision has to be made with respect to countries that stop existing or begin existing after the breakup of a given original country (for example the USSR and Yugoslavia), or because these countries reported their trade flows as one for some of the periods considered (this is the case for Belgium and Luxembourg). In this paper, for simplicity, the following groups are considered as one node (reporter and partner):

- **Belgium - Luxembourg:** Belgium and Luxembourg

- **Czechoslovakia**: Czech Republic and Slovak Republic

- **Eritrea - Ethiopia**: Eritrea and Ethiopia

- **Yugoslavia, FR**: Croatia, Macedonia, Yugoslavia, Slovenia, Serbia/ Montengegro

- **Russia**: Armenia, Azerbaijan, Belarus, Estonia, Georgia, Kazahkstan, Kyrgyz Republic, Lithuania, Latvia, Moldova, Russian Fed., Tajikistan, Turkmenistan, Ukraine, Soviet Union, and Uzbekistan.

The aggregation of these nodes into one, for every column, has been simply done to avoid a sudden change in the number of nodes in the network that could have resulted in structural network changes even though the trade flows did not changed so dramatically. An alternative would be to drop these countries from the analysis, and only consider countries that existed throughout the whole 1980 - 2005 period, but we believe that this could lead to a greater loss of information than the one that could result from the aggregation. In the end the trade data for the study includes 171 countries for the 1980 - 2005 period. Given the stationarity of the network properties, reported in previous studies and confirmed here, we only perform the analysis for 1980, 1985, 1990, 1995, 2000, 2004, and 2005.

The data for GDP per capita and the trade shares as percentage of GDP are extracted from the Penn World Table 6.2, while the data for inflation is computed from Consumer Price Indices extracted from the International Financial Statistics (IFS) Database, housed at the International Monetary Fund (IMF).

	1980			1985			1990		
Country	Level	% Rank	Location	Level	% Rank	Location	Level	% Rank	Location
Thailand	0.039279	0.776471	O	0.048451	0.852941	S-P	0.065137	0.888235	S-P
Philippines	0.022693	0.670588	O	0.019405	0.664706	O	0.022873	0.711765	O
Malaysia	0.037326	0.770588	O	0.043355	0.823529	O	0.043893	0.835294	O
Korea, Rep.	0.045780	0.841176	O	0.070845	0.905882	I-P	0.081054	0.929412	I-P
Indonesia	0.043084	0.823529	O	0.036996	0.782353	O	0.038554	0.817647	O
China	0.056850	0.854800	S-P	0.095359	0.929412	I-P	0.094082	0.935294	I-P
Venezuela	0.062095	0.888235	S-P	0.039246	0.805882	O	0.039137	0.823529	O
Mexico	0.041764	0.811765	O	0.040738	0.811765	O	0.043985	0.841176	O
Chile	0.025003	0.711765	O	0.019173	0.652941	O	0.024066	0.729412	O
Brazil	0.075479	0.911765	I-P	0.083947	0.917647	I-P	0.065014	0.882353	S-P
Argentina	0.040152	0.794118	O	0.046107	0.847059	O	0.034541	0.794118	O
G7 (average)	0.323516	0.975630	C	0.334540	0.976471	C	0.331762	0.974790	C
India	0.021532	0.870588	S-P	0.021357	0.858824	S-P	0.020628	0.858824	S-P
	1995			2000			2005		
Country	Level	% Rank	Location	Level	% Rank	Location	Level	% Rank	Location
Thailand	0.103296	0.923529	I-P	0.081254	0.900000	I-P	0.093140	0.900000	I-P
Philippines	0.023502	0.705882	O	0.028893	0.735294	O	0.024583	0.700000	O
Malaysia	0.065441	0.882353	S-P	0.064900	0.882353	S-P	0.069236	0.888235	S-P
Korea, Rep.	0.109788	0.929412	I-P	0.117940	0.923529	I-P	0.143452	0.958824	C
Indonesia	0.039664	0.800000	O	0.048593	0.835294	O	0.049413	0.823529	O
China	0.135878	0.952941	C	0.180883	0.964706	C	0.325165	0.994118	C
Venezuela	0.046267	0.829412	O	0.047605	0.823529	O	0.029988	0.729412	O
Mexico	0.056934	0.847059	O	0.056888	0.864706	S-P	0.052696	0.841176	O
Chile	0.028365	0.747059	O	0.028107	0.729412	O	0.030849	0.747059	O
Brazil	0.085754	0.917647	I-P	0.080247	0.894118	S-P	0.103615	0.911765	I-P
Argentina	0.041236	0.811765	O	0.042337	0.800000	O	0.044955	0.817647	O
G7 (average)	0.302488	0.969748	C	0.288532	0.969748	C	0.256792	0.966387	C
India	0.025881	0.900000	I-P	0.028695	0.911765	I-P	0.034545	0.941176	I-P

Table 2: Results for Random-Walk Betweenness Centrality (RWBC) based on Trade Flows. Level: Random-Walk Betweenness Centrality Result extracted from the computations of the RWBC for all the 171 countries included in the analysis; % Rank: Percent Rank of the Overall Distribution; C: Core (Percent ≥ 95th); I-P: Inner Periphery (95th > Percent ≥ 90th), S-P: Secondary Periphery (90th > Percent ≥ 85th); O: Outside the periphery (85th > Percent). Notes: The results for all 171 countries included in the analysis are available upon request from the authors

	1980			1985			1990		
Country	Level	% Rank	Location	Level	% Rank	Location	Level	% Rank	Location
Thailand	0.052404	0.788235	O	0.076882	0.870588	S-P	0.078883	0.882353	S-P
Philippines	0.029813	0.482353	O	0.027834	0.488235	O	0.042509	0.652941	O
Malaysia	0.073293	0.900000	I-P	0.081343	0.894118	S-P	0.085683	0.905882	I-P
Korea, Rep.	0.043805	0.705882	O	0.069545	0.841176	O	0.064290	0.800000	O
Indonesia	0.036196	0.600000	O	0.035984	0.570588	O	0.046190	0.688235	O
China	0.042251	0.682353	O	0.055406	0.752941	O	0.055682	0.752941	O
Venezuela	0.035307	0.594118	O	0.036379	0.594118	O	0.043760	0.658824	O
Mexico	0.024482	0.358824	O	0.019171	0.400000	O	0.030901	0.500000	O
Chile	0.034417	0.582353	O	0.040207	0.641176	O	0.043812	0.664706	O
Brazil	0.056695	0.800000	O	0.052671	0.735294	O	0.054677	0.741176	O
Argentina	0.040038	0.658824	O	0.050291	0.717647	O	0.033394	0.535294	O
G7 (average)	0.239884	0.953782	C	0.290615	0.964706	C	0.248044	0.957983	C
India	0.032835	0.541176	O	0.032521	0.723529	O	0.032044	0.794118	O

	1995			2000			2005		
Country	Level	% Rank	Location	Level	% Rank	Location	Level	% Rank	Location
Thailand	0.100207	0.923529	I-P	0.085699	0.900000	I-P	0.124368	0.935294	I-P
Philippines	0.037276	0.588235	O	0.047563	0.747059	O	0.044365	0.652941	O
Malaysia	0.109241	0.947059	C	0.088432	0.905882	I-P	0.112258	0.900000	I-P
Korea, Rep.	0.081728	0.888235	S-P	0.081259	0.882353	S-P	0.097548	0.888235	S-P
Indonesia	0.043357	0.688235	O	0.044980	0.729412	O	0.049943	0.747059	O
China	0.078488	0.882353	S-P	0.108261	0.941176	I-P	0.182582	0.982353	C
Venezuela	0.038517	0.600000	O	0.043642	0.705882	O	0.034356	0.523529	O
Mexico	0.040210	0.629412	O	0.036897	0.600000	O	0.038545	0.582353	O
Chile	0.041653	0.652941	O	0.040202	0.652941	O	0.047249	0.729412	O
Brazil	0.076469	0.870588	S-P	0.061009	0.829412	O	0.061729	0.811765	O
Argentina	0.034179	0.541176	O	0.032881	0.541176	O	0.044554	0.664706	O
G7 (average)	0.231594	0.952101	C	0.236830	0.957143	C	0.210240	0.945378	C
India	0.031995	0.876471	S-P	0.037629	0.888235	S-P	0.037042	0.911765	I-P

Table 3: Results for Random-Walk Betweenness Centrality (RWBC) based on Trade to GDP Ratios. Level: Random-Walk Betweenness Centrality Result extracted from the computations of the RWBC for all the 171 countries included in the analysis; % Rank: Percent Rank of the Overall Distribution; C: Core (Percent $\geq$ 95th); I-P: Inner Periphery (95th > Percent $\geq$ 90th), S-P: Secondary Periphery (90th > Percent $\geq$ 85th); O: Outside the periphery (85th > Percent). Notes: The results for all 171 countries included in the analysis are available upon request from the authors.