CORE-PERIPHERY RELATIONS IN THE INTERNATIONAL MERGERS AND ACQUISITIONS NETWORK

GALASO, Pablo*
SANCHEZ-DIEZ, Angeles

Abstract:
This article studies the transnational corporations' ownership and investment relationships between countries. Using Thomson Reuters SDC Platinum database on mergers and acquisitions and social network analysis techniques, the paper analyzes the international mergers and acquisitions network (IMAN), where vertices are 211 countries and edges represent the flow of international mergers and acquisitions between them. After elaborating the IMAN, it estimates the fitness of Borgatti and Everett (2000) core-periphery model to the network. Furthermore, it analyzes the fitness evolution between 1999 and 2013 and identifies core, semi-periphery and periphery countries. Results confirm the existence of a sharp and persistent core-periphery structure in the relations between countries. The core is made of only 15 nations that are almost completely interconnected among them and responsible for most of investments in transnational corporations. 41 semi-peripheral countries are relatively well connected while achieving about one fourth of investments. Finally, the remaining 155 nations in the periphery are mostly disconnected among them and only receive marginal investments from the core and semi-periphery nations. These results reveal that the ownership and control of the means of production at the global level is driven by polarized and unequal relationships between countries.
Keywords: mergers and acquisitions, foreign direct investment, world economy, social network analysis, core-periphery, transnational corporations.
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1. Introduction

One of the most important manifestations of globalization, particularly in the last decades, has been the strong expansion of foreign direct investment (FDI), reflecting the growing relevance of offshoring production and shaping the global value chains that have led to the so-called "global factory". Production delocalization had an immediate effect on the increase in international trade of intermediate goods and services, which has been estimated between 50 per cent and 60 per cent of total trade (OECD, 2010; Sturgeon and Memedovic, 2010; WTO, 2013). This trade is, in part, associated with transnational corporations, which are responsible for 37 per cent of total trade (UNCTAD, 2016). Moreover, the operation of this "global factory" has led to crucial changes in the ownership and control of the means of production at the global level through extensive processes of cross-border mergers and acquisitions (M&A).

*Pablo Galaso. Instituto de Economía. Facultad de Ciencias Económicas y de Administración. Universidad de la República. Ángeles Sánchez Díez. Dpto de Estructura Económica y Economía del Desarrollo. Universidad Autónoma de Madrid[1]

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[1] Both authors are members of the Study Group on Transformations of the World Economy/Grupo de Estudio de las Transformaciones de la Economía Mundial (GETEM).

FDI and, in particular, cross border M&A operations have been motivated by different factors. In the so-called eclectic paradigm, Dunning (1988, 1992 and 1994) argues that in order for FDI flows to take place, there must be advantages of ownership, localization and internalization. However, this theoretical model allows to explain, essentially, new investments (greenfield FDI), from developed countries. The growth of investment from emerging countries, without clear ownership advantages and the internationalization of companies through M&As have required a redefinition of FDI theories. Facing this need, the Linkage, Leverage and Learning (LLL) perspective argues that companies search for new property advantages, e.g. access to technology, forms of organization, experience or brands (Mathews, 2006). In addition, by acquiring other companies that were already transnational, firms may benefit from the international experience of acquired companies. Moon and Roehl (2001) and Aulakh (2007) studied the internationalization of the productive sector in developing countries, concluding that companies that invest abroad seek to accumulate resources and strategic assets that previously had no access. In this way, they overcome the disadvantages derived from their late insertion in world markets. In this line, Luo and Tung (2007) and Dunning (2009) argue that, in the absence of the classic property advantages, the search for knowledge and learning experiences is a driving force for the internationalization of companies from emerging countries. Therefore, the eclectic paradigm is complemented by the analysis based on the LLL framework to explain the international insertion of companies from these economies.

Several authors have analyzed the causes of M&As, since the pioneering studies of Hale & Hale (1962), Mandelker (1974), Dodd (1980), Asquith and Kim (1982), Asquith and Kim or Trebing (1985). A recent literature review on this topic can be found in Yaghoubi, et al. (2016).

Cross-border M&As may have important implications for national economies. Previous literature has focused mainly on prices, competition or the relationship between power groups (lobbies) and governments (see, e.g., Brock, 2011; Whinston, 2006). Some authors found great heterogeneity in the effects of M&As, with different results depending on the studied countries (Ormosi et al., 2015; Kwoka, 2015).

For this research we are more interested in the approach taken by other authors who focus on the transformations that can be transmitted, through M&As, from one country to another as network effects. The arrival of transnational corporations can generate transformations in the productive capacity of countries through the transfer effects (Aitken and Harrison, 1999). These transfers can be given as flows of information, knowledge, learning of forms of organization, human capital, financing and technology. In addition, transnational corporations can help national firms to modernize their production processes, training and the quality of their production (Blomström et al., 2003). Therefore, both economies (the recipient and the acquirer) may be affected by transfer effects in the forms of knowledge flows, new business practices or human resources. Yet, negative effects can also arise from ownership concentration that can be generated through M&As, leading to collusion, power capture or reproducing processes of economic dependence between countries (Sánchez Díez et al., 2015).

Beyond their possible causes and consequences, cross border M&As constitute an interesting example of international economic relations (see Annex A1 for more detail

on World trends of FDI and transnational M&As). Indeed, when a firm acquires other company located in a different country, we can assume that a relationship between both nations is established. A relationship in which one country (that of the buyer company) exerts some control over certain business assets -or means of production- located in another nation (that of the acquired firm). In order to study these relationships at a global scale, we can account for cross-border M&A operations between all countries in the world. This will lead us to trace links between nations, obtaining a network of international mergers and acquisitions. In this article, we propose to study this network through the methodology of social network analysis and interpret the results from an international economics perspective. Such methodology allows to systemically study the complex dynamics of interactions, influences and interdependencies between countries, beyond the aggregate financial data on M&A.

Literature on social network analysis offers solid theoretical foundations as well as a wide range of methodological tools for studying complex realities based on interactions (see e.g. Wasserman and Faust, 1994; Jackson, 2008). In particular, the use of network analysis to study international economic relations has proven to be highly relevant to obtain a better understanding of macroeconomic dynamics. Most of these studies analyzed the topological properties of the international trade network, while research on financial networks is scarcer due to the more difficult data availability (see Fagiolo, 2016 for a review).

While some recent studies found that FDI and trade links are correlated (Metulini et al., 2017), research on financial networks reports important differences between the topologies of trade and finance networks. For example, density of interactions is much lower in finance networks, revealing a lower level of financial links among most countries. Furthermore, these interactions are very heterogeneous and mainly concentrated in developed economies, financial centers and tax havens, while most nations are only marginally connected to the network, with minimal financial relationships to the rest of the world (Minoiu and Reyes, 2013). In this respect, Joyez (2017) report a decentralization trend in the multinationals network during the last years. Sánchez Díez et al. (2016) analyzed the international M&A network in Latin America, breaking down the networks in the telecommunications, energy and finance sectors, and concluding that networks are very concentrated, although sectoral networks are somewhat less centralized. The International M&A network at a global scale has been studied by Dueñas et al. (2017), who found that it is a highly concentrated and low-density network, with low levels of reciprocity, revealing that most countries are targets of a few acquirers. Finally, Galaso et al. (2018) estimated the influence of the international M&A network on FDI, and found that each country's position in the network have a positive impact on foreign investment inflows. However, almost all of this research focus on studying network topologies while offering only a narrow interpretation from the perspective of international economic relations.

Facing these gaps, the main goal of this article is to analyze the international mergers and acquisitions network (IMAN) during the period 1999-2013. To do so, we propose two specific objectives with their corresponding hypotheses:

1. Test whether the IMAN is characterized by the co-existence of a small and well-connected core, and a periphery made of numerous countries maintaining

economic relationships essentially with the core (objective 1). We expect such core-periphery structure fits well into the IMAN (hypothesis 1).

2. Identify the core, semiperipheral and peripheral countries in the IMAN (objective 2). In this regard, we expect that the core is made of developed nations. However, transformations in the global economy will be contributing to a greater presence of emerging economies in M&A processes and, therefore, these nations will occupy more central positions in the network after 2009 (hypothesis 2).

Since the mid-twentieth century, Latin American structuralism and dependency theory adopted a core-periphery approach to understand international relations, based on the general idea that resources flow from poor peripheral countries to core wealthy nations. Authors like Samir Amin (2010) analysed how core countries highly interact among them. Core states, where both the means of production and the producers of consumer goods are located, manage to improve their working classes' incomes. This achievement is not reached in the peripheral countries that are mainly export-oriented and with very low levels of domestic consumption.

The dynamic of capital accumulation has also been analysed from a core-periphery approach. In this line, Baran and Sweezy (1969) studied the surplus generation and appropriation by large corporations (mostly monopolies). Periphery countries have greater difficulties in retaining advances in productivity, which is transferred to core nations as a result of differences in labour markets and presence of foreign capital (Cimoli and Porcile, 2015; Rio Casarola, 2019).

In spite of all these contributions, no previous studies on the core-periphery relations of transnational capital are based on social network analysis theories and methods. Therefore, this paper makes two key contributions to the literature: first, the application of a core-periphery model to the international M&A network, with the consequent classification of core, semiperiphery and periphery nations. Second, the interpretation from the perspective of international economy theories of both the network topological properties and the classification of countries. In summary, the article sheds light on how ownership and control relations between nations are organized at a global level, contributing to a broader and richer understanding of transnational relations.

The rest of the article is structured as follows. The following section describes the methodological issues that will be used in this research. Section 3 presents the results of the analysis. Finally, Section 4 concludes and explains the research and policy implications of the study.

2. Foreign direct investment and mergers and acquisitions in the world economy

The growth of FDI over the last few decades can be explained in part by the proliferation of global M&As, particularly before the 2009 crisis. As shown in Table 1, during the period 1999-2013, more than 40 per cent of FDI has corresponded to purchases of companies in third countries, which had an average value per operation of 48.6 million dollars. The 2009 crisis has been reflected in a lesser importance of M&As as a mechanism of firm internationalization (25 per cent of total FDI) and a reduction in the average value of these operations (37.1 million dollars).

Table 1. Foreign direct investment and cross-border mergers and acquisitions in the global economy. Annual means

	1999-2003	2004-2008	2009-2013	1999-2013
FDI inflows (in billions of dollars)	852	1,288	1,415	1,185
M&As (in billions of dollars)	472	601	356	476
Number of M&As (in unit value)	8,480	10,134	9,487	9,367
M&As on FDI (in %)	51.4	45.0	25.0	40.5
Average value of M&As (in millions of dollars)	52.0	56.7	37.1	48.6

Source: UNCTADstat

According to UNCTADstat, around 60 per cent of FDI has been directed to developed economies in the period 1999-2013. Yet, their relative importance as recipient countries has been significantly reduced during these years, as they have gone from receiving almost three-quarters of total FDI at the beginning of the period to receiving approximately half of it by the end of the period. On the other hand, developing economies have experienced a relative increase in their incoming investment flows, revealing an improvement in their location advantages, according to Dunning's terminology, which lead them to receive up to 43.6 per cent of total flows during 2009-2013. FDI outflows are clearly dominated by developed countries (responsible for 80.3 per cent of 1999-2013 total outflows). Despite their less importance as investor economies, developing countries are experiencing a great dynamism: from 7.3 per cent of total outflows during the first years to 26.1 per cent by the end of the period.

The distribution and trends of cross-border M&As show very similar patterns. Indeed, more than 80 per cent of M&A operations have been carried out by companies in developed countries while only 14-16 per cent by firms in developing countries. However, the evolution of these operations reveals very interesting patterns: in the post-crisis period, 30 per cent of purchases were made by developing-country firms (essentially in emerging economies) compared to only 6.1 per cent of M&As during 1999-2003. These facts confirm the increasing relevance that transnational corporations from emerging economies are adopting in the "global factory". Such firms are progressively becoming significant owners of the means of production worldwide, which is in line with the LLL theoretical proposals, mentioned above.

Furthermore, these transformations are affecting significantly the world economic relations. The classic north vs. south and developed vs. underdeveloped economies divisions are giving way to a more complex reality. A reality in which some of the traditionally considered underdeveloped countries play a crucial role in the "global factory". Transnational corporations from these nations are increasingly participating in complex production phases, which require higher value added intermediary goods, more intensive innovation processes and higher labor qualification, among other factors. However, the vast majority of national economies still present very low levels of international insertion, remaining in the periphery of the "global factory".

2. Data and Methods

We use data from Thomson Reuters SDC Platinum database on Mergers and Acquisitions. Based on multiple sources, such as SEC filings, press releases, and newswires, this database registers detailed and accurate information on M&A transactions in all sectors. Network elaboration requires the identification of both

nodes and links. In this study, nodes are countries and links represent cross-border M&As. Data allows to trace weighted and directed links. The direction identifies the host countries of both buyer companies (in the origin of the link) and acquired companies (in the end). The weight of links corresponds to the sum of all M&A values in US million dollars. We trace and analyze both the weighted networks (which account for the total M&A transaction values) and the binary networks (which identify the presence or absence of M&A operations between countries). Aiming to study the evolution of the network, we group the database into three periods of five years and trace one network for each period.

Afterwards, and in order to test hypothesis 1, we use the Borgatti and Everett core-periphery network model (Borgatti and Everett, 2000). This methodology allows to estimate the extent to which our empirical networks resemble an ideal core-periphery structure, i.e. a network where core nodes are perfectly connected to each other, while periphery nodes are completely disconnected among them. We apply this method using both the weighted networks and the binary networks.

To test hypothesis 2, we propose to identify not only the core of the network, made of best-connected countries, but also the semieriphery, i.e. the group of nations maintaining close relations with the core while keeping an intermediate level of interaction among them. Our country classification (core, semiperiphery, periphery) does not correspond to the development level of countries, but to their relative position in the network. Since such a position directly depends on the ownership and control exercised over transnational corporations, it will be conditioned, among other aspects by the size of the economies. The methodology used to classify countries in such groups combines the core-periphery partition set by Borgatti and Everett algorithm and the eigenvector node centrality. The combination of these two tools allows us to observe, more accurately, which are the best-connected countries in the IMAN and to discriminate correctly between the core, the semiperiphery and the remaining periphery (See Annex A1 for more information on the methodological issues we followed to elaborate the networks, apply the core-periphery model and classify the countries).

3. Results

The analysis of the IMAN reveals it is a poorly connected network, mostly through non-reciprocal links which are highly concentrated in a reduced number of countries. We found that a large number of nations have not carried out any M&A operation and, therefore, they stand aside the economic transformations that are being registered trough such operations. In addition, significant differences have been observed when analyzing M&As from the perspective of buyers and sellers. There is a strong concentration of the purchasing power of productive assets in a small number of countries, reflecting a greater role of firms from developed countries in cross border M&As. However, from the perspective of the selling countries, such high levels of concentration are not observed (Annex A3 presents a detailed analysis on the topology and evolution of the IMAN). These results show that the global distribution of M&As is similar to that of FDI, with a strong concentration of capital outflows, essentially from developed countries, compared with a more equal distribution of investment inflows between developed and developing countries.

Furthermore, the core-periphery structure fits very well to the network, confirming our first hypothesis. Correlation between the data and the ideal core-periphery network is

high in both the binary (0.736) and the weighted networks (0.796). Also, the blocked adjacency matrices reveal that the core block is substantially much denser than the periphery block, proving that core nations are strongly interconnected among them while periphery economies are almost disconnected. Furthermore, matrices reveal that core-to-periphery block is denser than the periphery-to-core block, which proves an asymmetrical relationship between the core and the periphery: core nations invest more in the periphery than vice-versa. Finally, the analysis of the periodical networks reveals that the model fits very well to the network in all the three periods, confirming that the core-periphery structure of the IMAN remains very stable during the analyzed years (See Annex A4 for more information on the application of the core-periphery model).

Regarding the identification of the core and semi-periphery countries in the IMAN, results reveal that Canada, United Kingdom and United States constitute the hard core of the network between 1999 and 2013 and in each of the subperiods (see Table 2). These three countries accounted for around 40.1 per cent of business assets purchases and 30.9 per cent of sales (see Figure 4), with a slight drop in their relevance in the period 2009-2013. Such slight decrease reveals that the hard core loses relative importance, most probably as a consequence of the recession. Companies from the United Kingdom and United States are at the top of the global ranking of non-financial transnational corporations according to UNCTAD (2016). Among them, Royal Dutch Shell plc (1st place), General Electric Co (3rd), BP plc (5th), Exxon Mobil Corporation (6th) or Chevron Corporation (7th) can be highlighted. In turn, hard core nations have been great recipients of investments, attracted by the large size of their markets, the search for efficiency and even their natural resources. The three hard core countries register high levels of GDP per capita (greater than $40,000) and occupy top positions in the World Bank's Doing Business index (United States in the 8th place, United Kingdom in the 9th and Canada in the 22nd). These facts can be reflected also in the high values of their centrality indicators such as indegree, outdegree, instrength and outstrength.

Table 2: Hard core, core and semiperipheral countries. 1999-2013

Typology	Countries
Hard core	Canada, United Kingdom and United States
Core	Australia, Brazil, China, France, Germany, Hong Kong, India, Italy, Japan, Netherlands, Spain and Sweden
Semi periphery	Argentina, Austria, Belgium, Bermuda, British Virgin, Cayman Islands, Chile, Colombia, Cyprus, Czech Republic, Denmark, Egypt, Finland, Greece, Guernsey, Hungary, Indonesia, Ireland-Rep, Israel, Jersey, Luxembourg, Malaysia, Mexico, New Zealand, Norway, Peru, Philippines, Poland, Portugal, Romania, Russian Fed, Saudi Arabia, Singapore, South Africa, South Korea, Switzerland, Taiwan, Thailand, Turkey, Ukraine and United Arab Emirates

Source: Created by authors

In addition to the hard core, other 12 core countries are identified in the core. This group includes eight developed economies such as Australia, France, Germany, Italy, Japan, Netherlands, Spain and Sweden (see Table 2). Some of these nations have had extensive experience in the internationalization of their companies for more than half a century or even the colonial period, while others, such as Spain, have been very dynamically inserted in world markets since the 1990's. These countries have also been

core investment recipients searching for market access through the acquisition of local firms. For the European Union countries, the structural reforms associated with the implementation of the Internal Market (1993) and the Monetary Union (1999) transformed the advantages of localization of the host economy, to which the FDI theory gives increasing relevance. In the case of Spain, regulatory changes and privatizations in the energy, telecommunications and financial markets influenced in a decisive way, leading to the proliferation of mergers among national companies, who searched to increase their size and to initiate an internationalization process, which initially focused on Latin America and later on Europe (Sánchez Díez, 2002). That is, the developed countries located in the core, occupy their position in the network due to their relevance both issuing and receiving financial capital.

Four emerging countries, such as Brazil, China, Hong Kong and India belong to the core as well (see Table 2). In these cases, their central position rests essentially on their power to attract capital, that is to say, in their role as business-selling countries. Centrality indicators confirm this last statement, as indegree and instrength results for these nations are higher than outdegree and outstrength results. Following Dunning's terminology, the reasons why these countries have attractive results for foreign firms can be multiple: the large size of the Brazilian market, the lower production costs in China, and to a certain extent in India, the pursuit of efficiency in certain investments in India and Hong Kong and their insertion in the more advanced stages of global value chains.

All core countries remain in the core during all sub-periods except Hong Kong, which becomes a semi-peripheral nation in the last period. These nations were responsible for 36.3 per cent of sales and 32.7 per cent of purchases of companies between 1999 and 2013 (see Figure 4). Finally, neither their buyer position nor their seller role experienced noticeable changes during the analyzed years.

As mentioned above, a semiperiphery is also identified. Semiperiphery countries are economies maintaining important relations channeled through M&As with core countries and, at the same time, showing a certain interrelation between them. Such countries are not marginalized from the international M&A processes but do not constitute the core of the ownership of the means of production worldwide either. They can be grouped in three different categories of nations, as follows:

1. Developed countries of small and intermediate size but with very dynamic companies, like Austria, Belgium, Denmark, Finland, Greece, Ireland, Israel, New Zealand, Norway, Luxembourg, Portugal and Switzerland.
2. Countries considered tax havens such as Bermuda, British Virgin, Cayman Islands, Guernsey and Jersey.
3. Others, including emerging countries of intermediate size, countries of recent incorporation in the OECD and EU countries with low per capita income: Argentina, Chile, Colombia, Cyprus, Czech Republic, Egypt, Hungary, Indonesia, Malaysia, Mexico, Peru, Philippines, Poland, Romania, Russian Fed, Saudi Arabia, Singapore, South Africa, South Korea, Taiwan, Thailand, Turkey, Ukraine and United Arab Emirates.

The semiperiphery accounts for 26.9 per cent of total capital income derived from sales of companies and 24.6 per cent of capital outflows in the period 1999-2013. The

relative importance of these countries slightly increased after the recession of 2009 (see Figure 4).

Figure 4: Capital Inflows and outflows of hard core, core and semiperiphery countries (in % of total flows)
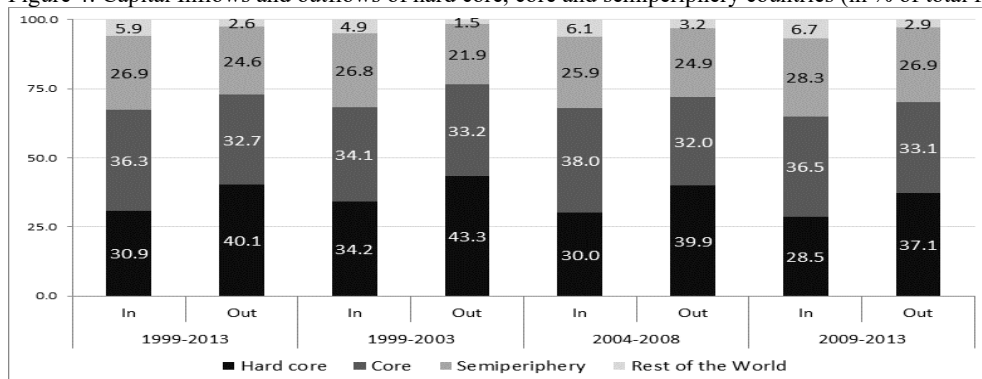
Source: Created by authors

During the analyzed period, the composition of the semiperiphery is unstable. Indeed, some peripheral countries improved their position in the network while others worsened it. For example, Norway and South Korea moved from semiperipheral positions to core positions in the last period and Cayman Islands, Colombia, Cyprus, Guernsey and United Arab Emirates evolved from very peripheral positions (i.e. almost isolated), to the semiperiphery. By contrast, Greece, Hungary, the Philippines, Portugal, and Romania left the semiperiphery, moving to weakly connected positions in the network.

The semiperiphery is very heterogeneous. It includes capital emitting nations, with dynamic companies acquiring assets abroad: Austria, Belgium, Bermuda, British Virgin, Cayman Islands, Cyprus, Egypt, Finland, Greece, Guernsey, Ireland, Israel, Jersey, Luxembourg, Malaysia, Saudi Arabia, Singapore, South Africa, Switzerland and United Arab Emirates. On the other hand, there are countries standing out as sellers of companies such as Argentina, Chile, Colombia, Czech Republic, Denmark, Hungary, Indonesia, Mexico, Peru, Philippines, Poland, Taiwan, Thailand, Turkey and Ukraine.

In summary, we confirm hypothesis 2, regarding the existence of a core composed of a reduced set of developed countries with a growing presence of emerging economies, and a large periphery. However, it is important to note that there has been no significant improvement in the position of emerging countries during the period under study. No emerging economies have been added to the hard core of three countries. Also, with the exception of Mexico, Norway and South Korea, which have moved from the semiperiphery to the core, the rest of the core has remained unchanged.

6. Conclusions

Globalization and, in particular, the proliferation of global value chains during the last decades are reflected in the expansion of FDI, specifically in M&As. Developed countries are the major investors worldwide, although an increasing importance of emerging economies is recorded. In addition, investment flows are directed, with similar importance, to the old industrial economies and to the new emerging and

developing countries. These transformations in the world economy have implications for international economic relations, so that the ownership and control relations among national economies exercised through their enterprises can be transformed.

Using social network analysis techniques, this paper has analyzed the economic relations between countries resulting from M&A in the period 1999-2013. These cross-border operations give rise to a complex network, where national economies constitute the nodes and the capital flows derived from the sale of businesses are the links.

First, we analyzed the structure of the network and observed that it registers high levels of concentration, asymmetry and centralization. Significant differences have been observed when analyzing M&As from the perspective of buyers and sellers. These results can be interpreted from the perspective of Narula and Dunning (2010), who argue that countries go through a path of investment: they start being mainly receivers of capital, with a small presence of their companies abroad, and progressively become both issuers and receivers of FDI.

Second, we studied whether M&A operations generate a polarized system of interactions between nations. A system characterized by the co-existence of a small and well-connected core of countries, and a periphery formed by numerous nations maintaining economic relationships essentially with the core. We tested such hypothesis estimating the extent to which the so-called core periphery model developed by Borgatti and Everett (2000) fits into the IMAN, finding that the fitness is high and persistent in time.

Finally, we identified the hard core, the core and the semiperiphery countries using network analysis techniques. We observed that the US, UK and Canada constitute a reduced and stable hard core while the core is composed of eight developed countries and four large emerging economies. We also identified a larger and more heterogeneous semiperiphery (with 41 countries), including developed economies of intermediate size, emerging nations and tax havens. Changes over the years are minimal, as only two countries moved from the semiperiphery to central positions and some tax havens left the periphery.

Therefore, hypothesis 2, suggesting a predominant presence of developed countries in the core and a progressively larger share of emerging economies in such group is confirmed, but with important caveats: while developed economies and large emerging nations have central positions in the network, no large emerging economy reached to the hard core of the network, the emerging countries of intermediate size do not significantly approach the core, nor the isolated economies manage to be connected to the IMAN.

The article has important research implications. The combination of social network analysis theories and methods with a transnational relations perspective contributes to the cross-fertilization of both research fields. Furthermore, the evidence provided on how cross-border M&As are structured according to a core-periphery network model contributes to a broader and richer understanding of transnational relations and globalization. Finally, the study of the IMAN topology can be valuable for policy makers as well. Especially, the classification of countries in core, semiperiphery and periphery economies should be taken into account when designing policies for investment attraction and local firms' internationalization.

7. References

Amin, S. (2010) *The Law of Worldwide Value.* NYU Press, New York.

Asquith, P., & Kim, E. H. (1982) The impact of merger bids on the participating firms' security holders. The Journal of Finance, 37(5), 1209-1228.

Aulakh, P. (2007) Emergening multinationals from developing economies: motivations, paths and performance, *Journal of International Management,* Vol. 13 (3), 235-240.

Baran, P. and Sweezy, P. (1969): *El capital monopolista*, México D.F.: Siglo XXI.

Barnes, B. G., L. Harp, N. and Oler, D. (2014) Evaluating the SDC Mergers and Acquisitions Database. *Financial Review*, *49* (4), 793–822.

Blázquez, L. and González-Díaz, B. (2015) International automotive production networks: how the web comes together, *Journal of Economic Interaction and Coordination*, *11*(1), 119–150.

Blomström, M., Kokko, A. and Mucchielli, J.L. (2003) The Economics of Foreign Direct Investment Incentives. In Heinz Herrmann, H. and Lipsey, R. *Foreign Direct Investment in the Real and Financial Sector of Industrial Countries* Springer, Berlin, Heidelberg, pp. 37–60.

Borgatti, S. P. and Everett, M. G. (2000) Models of core/periphery structures, *Social Networks*, *21*(4), 375–395.

Brock, J. W. (2011). Economic concentration and economic power: John Flynn and a quarter-century of mergers. The Antitrust Bulletin, 56(4), 681-730.

Cimloli, M. and Porcile, G. (2015) Productividad y cambio estructural: el estructuralismo y su diálogo con otras corrientes heterodoxas, in: Bárcena, A. and Prado, A. (ed.) *Neoestructuralismo y corrientes heterodoxas en América Latina y el Caribe a inicios del siglo XXI*. Libros de la CEPAL, N° 132 (225-242), Santiago de Chile.

Csermely, P., London, A., Wu, L.-Y. and Uzzi, B. (2013) Structure and dynamics of core/periphery networks, *Journal of Complex Networks*, *1*(2), 93–123.

Della Rossa, F., Dercole, F. and Piccardi, C. (2013) Profiling core-periphery network structure by random walkers, *Scientific reports*, 3, 1467.

Dodd, P. (1980): Merger Proposals, Management Discretion and Stockholder Wealth, *Journal of Financial Economics* 105-137.

Dueñas, M., Mastrandrea, R., Barigozzi, M. and Fagiolo, G. (2017) Spatio-Temporal Patterns of the International Merger and Acquisition Network, *Scientific Reports*, 7: 10789, 1-14.

Dunning, J. H. (1988) The Eclectic Paradigm of International Production: A Restatement and Some Possible Extensions, *Journal of International Business Studies*, *19*(1), 1–31.

Dunning, J.H. (1992) The competitive advantage of countries and the activities of transnational corporations, *Transnational Corporations*, *1*(1), 135–168.

Dunning, J.H. (1994) Re evaluating the benefits of foreign direct investment, *Transnational Corporations*, *3*(1).

Dunning, J.H. (2009) "Location and the multinational enterprise: a neglected factor?, *Journal of International Bussiness Studies*, núm. 40. Pág. 5-19.

Fagiolo, G. (2016) The Empirics of Macroeconomic Networks: A Critical Review. In P. Commendatore, M. Matilla-García, L. M. Varela and Cánovas J.S. (Eds.) *Complex Networks and Dynamics,* Springer International Publishing, pp. 173–193.

Fagiolo, G., Reyes, J. and Schiavo, S. (2009) The evolution of the world trade web: a weighted-network analysis, *Journal of Evolutionary Economics*, *20*(4), 479–514.

Galaso, P., Sánchez Díez, A., García, S. and Olivas, C. (2018) Los efectos de la red mundial de fusiones y adquisiciones sobre la inversión: un estudio para América Latina, *Revista de economía mundial*, (48), 67-100.

Hale R. y G.E. Hale (1962) More on Mergers, *Journal of Law and Economics*, 119-130.

Holme, P. (2005) Core-periphery organization of complex networks, *Physical Review E*, *72*(4), 046111.

Jackson, M. O. (2008) *Social and Economic Networks,* Princeton University Press.

Joyez, C. (2017) On the topological structure of multinationals network, *Physica A: Statistical Mechanics and its Applications*, *473*, 578-588.

Kwoka, J. (2015) The changing nature of efficiencies in mergers and in merger analysis. The Antitrust Bulletin, 60(3), 231-249.

Langfield, S., Liu, Z. and Ota, T. (2014) Mapping the UK interbank system, *Journal of Banking & Finance*, *45*, 288–303.

Luo, Y. and Tung, R. (2007) International expansion of emerging market enterprises: a springboard perspective, *Journal of International Business Studies*, Vol. 38, 481-498.

Mandelker, G. (1974) Risk and Return: The Case of Merging Firms, *Journal of Financial Economics*, 303-335.

Mathews, J.A. (2006) Dragon multinationals: New players in 21st century globalization, *Asia Pacific Journal of Management*, 23, 5-27

Metulini, R., Riccaboni, M., Sgrignoli, P., and Zhu, Z. (2017) The indirect effects of foreign direct investment on trade: A network perspective, *The World Economy*, Vol. 40 (10), 2193–2225.

Minoiu, C. and Reyes, J. A. (2013) A network analysis of global banking: 1978–2010. *Journal of Financial Stability,* 9(2), 168-184.

Moon, H. and Roehl, T. (2001) "Unconventional foreign direct investment and the imbalance theory", *International Business Review,* Vol. 10, 197-215.

Narula, R. (1996) *Multinational Investment and Economic Structure: Globalisation and Competitiveness,* Routledge.

Narula, R. and Dunning, J. H. (2010) Multinational Enterprises, Development and Globalization: Some Clarifications and a Research Agenda, *Oxford Development Studies*, *38*(3), 263–287.

OECD (2010) *Economic Globalisation Indicators*, OECD, Paris.

Ormosi, P., Mariuzzo, F- and Richard, H (2015) A review of merger decisions in the EU: What can we learn from ex-post evaluations? European Commission.

Río Casasola, Alfredo del (2019) *Análisis centro-periferia en la UE-20 (1995-2014)*, Tesis Doctoral. Universidad Complutense de Madrid.

Sánchez Díez, A. (2002) *La internacionalización de la economía española hacia América Latina: los elementos determinantes en el inicio y consolidación del proceso*. Servicio de Publicaciones de la Universidad de Burgos, Burgos.

Sánchez Díez, A., Galaso, P. and García de la Cruz, J. M. (2016) Mergers and acquisitions carried out by Spanish firms in Latin America: a network analysis study, *CEPAL Review*, 120, 51-69.

Sánchez Díez, Á., García de la Cruz, J. M and del Sur Mora, A. (2015) Comercio internacional, materias primas y enfermedad holandesa: estudio comparativo de los efectos estáticos en Noruega y Chile, *Revista de economía mundial*, 39, 179-199.

Sturgeon, T. and Memedovic, O. (2010) Measuring global value chains: intermediate goods trade, structural change and compressed development. *Vienna: UNIDO working paper*.

Trebing, H.M. (1985) The impact of diversification on economic regulation, Journal of Economic Issues, 19(2) 463-474.

UNCTAD (2016) World Investment Report 2016, UNCTAD, Geneve.

Wasserman, S., & Faust, K. (1994) *Social Network Analysis: Methods and Applications*, CUP.

Whinston, M. D. (2008). Lectures on antitrust economics. MIT Press Books, 1.

WTO (2013) Global value chains in a changing world. WTO

Yaghoubi, R., Yaghoubi, M., Locke, S., & Gibb, J. (2016) *Mergers and acquisitions: a review*. Part 1. Studies in Economics and Finance, 33(1), 147-188.

Annex on line at the journal Website: http://www.usc.es/economet/eaat.htm

ANNEXES

A1. Methodological aspects

A1.1. Elaboration of the network

We use Thomson Reuters SDC Platinum database on Mergers and Acquisitions. Its accuracy and completeness have improved over time, so that data from the last decades are highly reliable (Barnes et al., 2014). For each transaction, we use the following information: the country of the parent purchasing company (country issuing the capital), the country of the purchased company (country receiving capital), the value of the transaction, in US millions of dollars, and the transaction final completion date. The database allows to identify the country of the parent purchasing company, regardless of whether the purchase has been made by a subsidiary located in an intermediary country, for example, in a low-tax country. In many cases the purchasing company is legally constituted in a tax haven or in a low-tax country, in those cases the purchase will be considered to be made from that country.

Network analysis requires the identification of both nodes and links. In this study, nodes are countries and links represent cross-border M&As. Links can be weighted and directed. The direction allows to identify the host countries of both buyer companies (in the origin of the link) and acquired companies (in the end). For example, links in Figure 1 indicate that companies located in country A have bought others in B, while firms in B acquired firms in both A and C. Therefore, countries can be acquirers and/or targets depending on their outgoing and/or incoming links: C is a target country as it only presents an incoming link, while A and B are simultaneously acquirers and targets because they have both in and out links. The weight of links corresponds to the sum of all M&A values in US million dollars. In our example, link weights reveal that firms in A acquiring firms in B paid, in total, 25 million dollars; meanwhile, firms in B paid, respectively, 5 and 10 million dollars to buy firms in A and C. In this respect, the information required to properly build and analyze the networks is the value of each link relative to value of the remaining connections at each time point. This implies that deflating values is not required in this research and, therefore, we use current dollar values. This methodology allows to account for the complexity of relationships between nations describing the ownership of (and investment in) transnational corporations.

Figure A1. Example of the M&A network with three countries
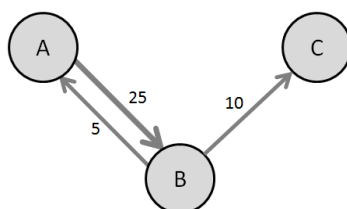
Source: Created by authors

In order to study the evolution of these interactions, we use the date of the M&A transactions and trace one network for each year. However, once a transaction has materialized and a link between two countries is established, the relationship between the two nations continues for some time, until the acquiring company disinvests in the

destination country. In order to account for these mid-term relationships between countries, we group the database into three periods of five years (1999-2004, 2005-2008 and 2009-2013) and trace one network for each period. These five-year periods allow analyzing both the aforementioned mid-term relationships between countries and the evolution of the network before and after the international financial crisis of 2009 (with two periods before and one period after the crisis). Finally, we build the cumulative network containing links traced with all M&A transactions between 1999 and 2013.

A1.2. The core-periphery network model

Core-periphery structures have been widely studied by network scholars (e.g. Holme, 2005, Della Rossa et al., 2013, Csermely et al., 2013). One of the most relevant and well-tested models of such structure have been developed by Borgatti and Everett (2000). According to Borgatti and Everett (2000), an ideal core-periphery network is that where core nodes are perfectly connected to each other, while periphery nodes are completely disconnected among them.

Such structure can be summarized in a blocked adjacency matrix (see Table A1) where all the core-to-core elements are 1 (representing the complete connection among core nodes), while the periphery-to-periphery elements are 0 (revealing the complete disconnection among them). The elements in the core-to-periphery and periphery-to-core regions of the matrix (CP and PC) can take any value, so that the model seeks only to maximize density in the core block and minimize density in the periphery block (Borgatti and Everett, 2000). To measure the extent to which this ideal core-periphery structure approximates to empirical data, the authors propose a genetic algorithm that searches for the composition of the core and the periphery blocks, maximizing the correlation between the empirical adjacency matrix (A) and an ideal core-periphery adjacency matrix with the same dimension (Δ). Therefore, the core-periphery structure will fit to empirical network data to the extent that the correlation between A and Δ is large (Borgatti and Everett, 2000).

Table A1. Perfect core-periphery density matrix

	Core	Periphery
Core	1	CP
Periphery	PC	0

Source: Borgatti and Everett 2000

We use UCINET software to run the algorithm that sets the core and periphery groups of countries, calculating the correlation (i.e. the fitness) between the IMAN and the ideal core-periphery network. We run this exercise twice: first using the binary network, that identifies the presence or absence of M&A operations between countries; and, second, using the weighted network, which accounts for the total M&A transaction values between countries. Although the stylized core-periphery matrix is binary –elements are either zero or one–, the model allows testing weighted networks, because it estimates the extent to which the mean of elements in the core block is greater than the mean of elements in the periphery block (Langfield et al. 2014).

We also compare the blocked adjacency matrices of our empirical data with that of the ideal core-periphery network (Table A2). As stated above, Borgatti and Everett (2000) consider the elements in the off-diagonal regions of the matrix (PC and CP) as missing data arguing that there is no good reason for choosing one density value over another in such blocks. However, in the case of the international M&A network, we can argue that the number of firms in core nations acquiring companies in periphery countries will be greater than the opposite; therefore, we expect that, when applying the algorithm, the density in the core-to-periphery block will be higher than the density in the periphery-to-core block: CP>PC.

A1.3. Methodology for identifying the core and semiperiphery of the network

The methodology used to classify countries combines the core-periphery partition set by Borgatti and Everett algorithm and the eigenvector node centrality. We choose eigenvector centrality as it measures the prominence or relative importance of nodes by considering not only their direct links, but also the links of their direct and indirect neighbors (see e.g. Jackson, 2008 for a formal definition). Table A2 summarizes the selection criteria used for such classification.

Table A2: Selection criteria used to identify hard core, core and semiperipheral countries

Typology	Criterion 1	Criterion 2
Hard core	Core country according to Borgatti and Everett (B&E) in the weighted network	
Core	Core country according to B&E in the binary network	Eigenvector centrality > 0.1
Semiperiphery	Core country according to B&E in the binary network	Eigenvector centrality ϵ [0.02, 0.1)

Source: Created by authors

Figure A2: Eigenvector centrality distribution. 1999-2013
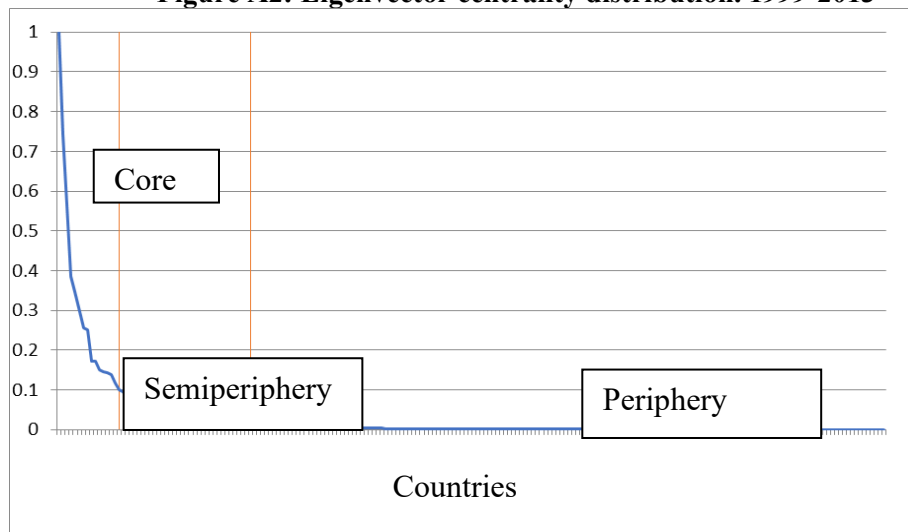
Source: Created by authors

Eigenvector thresholds (0.1 and 0.02) have been determined after the analysis of the distribution of the countries according to the value of such indicator (see Figure A2). Aiming to observe changes in the composition of the core and the periphery, we apply this selection criteria to the three periodical networks and the cumulative network.

A2. The structure of the international M&A network and its evolution in the period 1999-2013

According to results summarized in Table A3, three topological properties characterize the IMAN: its sparseness, asymmetry and centralization. In other words, the network is poorly connected, mostly through non-reciprocal links which are highly concentrated in a reduced number of countries.

**Table A3. Topological properties of the IMAN**

	Cumulative Network	1999-2003	2004-2008	2009-2013
Number of nodes	211	211	211	211
Number of links	3,597	1,820	2,366	2,302
Network density	0.12	0.06	0.08	0.08
Isolate countries	0	35	17	20
Countries in the giant component	211	176	194	191
Reciprocity	0.35	0.31	0.32	0.32
In-degree centralization	0.37	0.29	0.31	0.29
Out-degree centralization	0.61	0.45	0.51	0.46

Source: Created by authors

First, the network is very sparse. This fact is revealed by the low levels of density indicators. Network density is calculated as the ratio of existing edges over the maximum number of possible edges (given a certain number of vertices). We observe that the IMAN presents very low density scores every year (below 0.1). Even considering the cumulative network, density is considerably low (0.12), compared to that of other macroeconomic networks. The evolution of this indicator reveals a clear stable pattern, however, from 2004-2008, there is a slight increase in density, which slows down after the crisis.

Due to the low levels of density, a large proportion of countries are completely isolated, with no link connecting them to the rest of nations (see Figure A3), that is, they do not participate in any M&A operation, neither as buyers nor as sellers. Meanwhile, the rest of the countries are connected to one single component (the so-called giant component). In fact, except for the years 2003 and 2004, the IMAN network is always made of one single giant component connecting around two thirds of the countries, while the remaining one third of the countries are completely isolated from the rest of the world. The evolution of both isolated nodes and the size of the giant component reveal a slight increase in the number of countries connected to the giant component together with a decrease in the number of isolated countries. Isolated countries constitute a large marginalized periphery in terms of the ownership relations of the means of production at the international level. This is another important difference with trade networks, where all countries, almost without exception, maintain trade relationships with third countries via exports and imports.

Figure A3: International M&A network

1999-2003   **2004-2008**


2009-2013
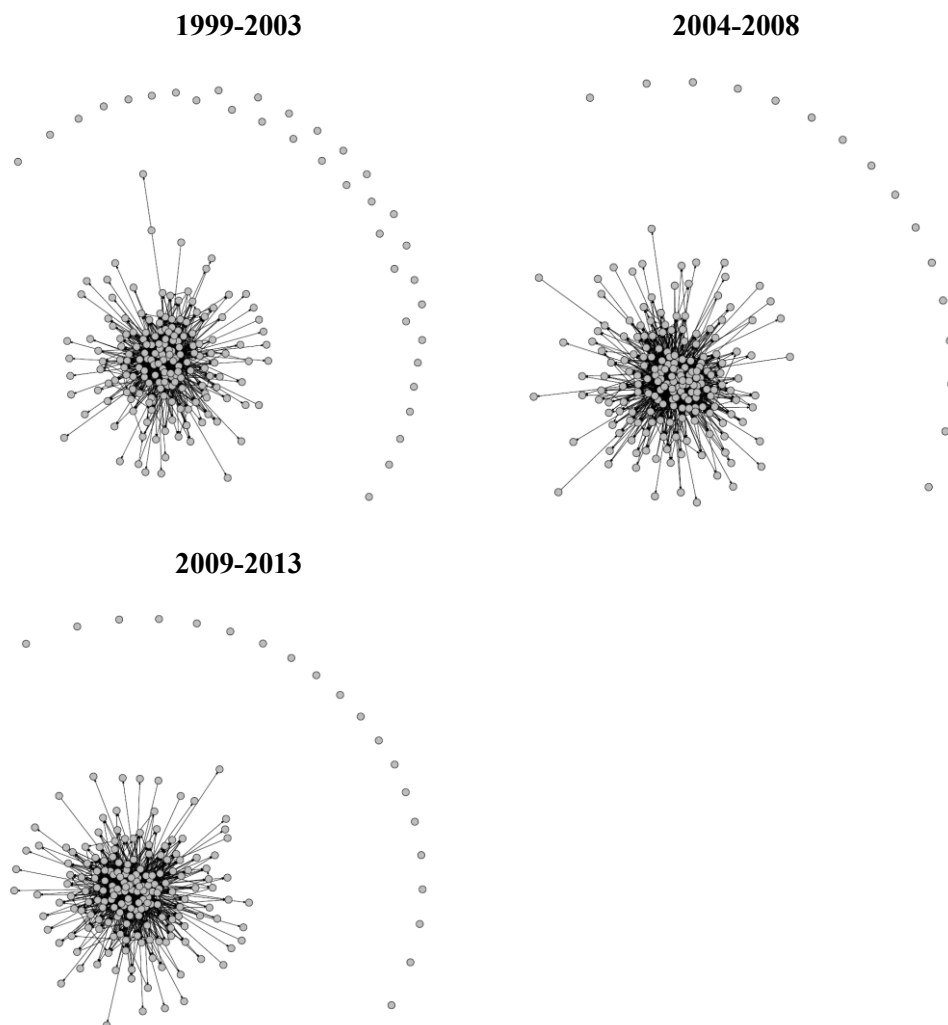
Source: Created by authors

Second, the network is highly asymmetric. Analyzing this aspect allows to observe the extent to which relationships between countries are reciprocal, with related nations acting both as acquirers and targets. To analyze this aspect, we use the reciprocity ratio, which is calculated as the number of reciprocally connected pairs of countries divided by the total number of connected pairs (both reciprocally and non-reciprocally). Results show that only around one third of interactions between countries are reciprocal (see Table 2). This indicator is relatively stable over time. Even in the cumulative network, the percentage of reciprocal relations is slightly above one third (35 per cent), revealing that the IMAN is a highly asymmetric network compared to other macroeconomic networks (e.g, in the ITN, the reciprocity is closer to 100 per cent, Fagiolo et al., 2009). The high levels of asymmetry registered by the M&A

network can be interpreted from the perspective of research on the path of investment (Narula, 1996; Narula and Dunning, 2010) who related development levels of countries to its investment capacity: countries with low levels of development will be recipients of investments, while nations with high levels of development and strong internationalization of their domestic enterprises will be both recipients and issuing countries. As the network is made of both developing and developed countries, relationships will be asymmetric. These results have also important implications in the methodology: due to the high levels of asymmetry in the IMAN, we can expect important differences in analyzing the network from the perspective of buyer and seller countries; therefore, in contrast with other research on macroeconomic networks that adopted and undirected approach (see e.g. Fagiolo et al., 2009), our study uses a directed network approach.

Third, the network is very centralized, with only a few countries being responsible for the vast majority of links, while the rest of nations are poorly connected or even disconnected from the network. Several indicators allow reaching to this conclusion. The degree and strength distribution give a first picture of the heterogeneity of the connections in the network (Figure A4).[2]

Figure A4: In-degree, in-strength, out-degree and out-strength distribution
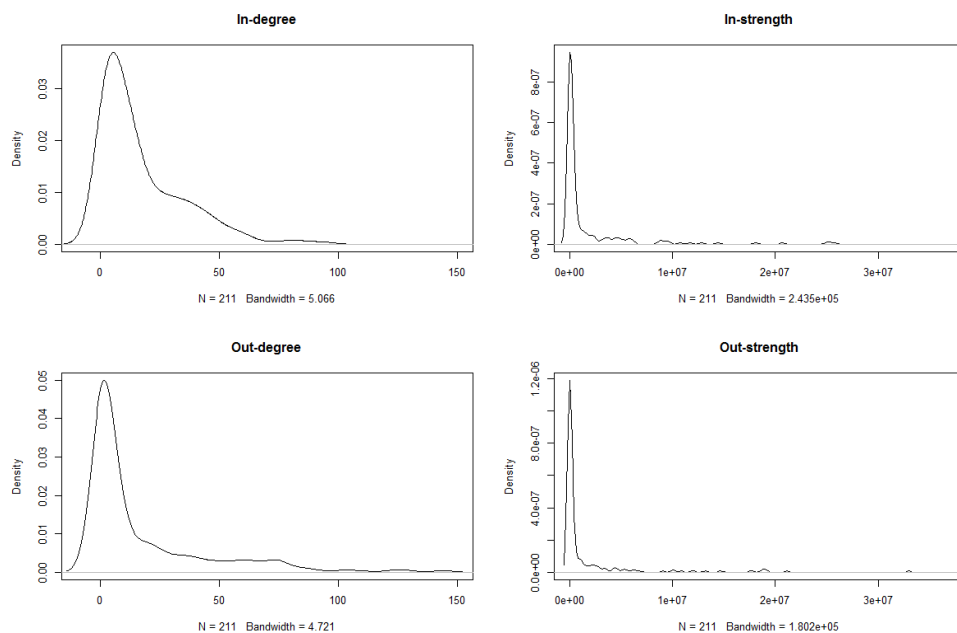
Source: Created by authors

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[2] The indegree and outdegree of a country measure, respectively, the number of incoming and outgoing links. Instrength and outstrength measures the total flow in dollars that represent, respectively, the investments in the country and from the country through cross-border M&A operations.

The right-tailed degree distribution reveals another important difference with the international trade network (with a more homogeneous distribution). Furthermore, the heterogeneity is even greater when considering the weighted links: only a slight proportion of countries present high levels of strength while the great majority of the world is very poorly connected. The greater levels of concentration showed by the weighted analysis are in line with results reported by studies of the ITN. Studying the directed networks allows us to reach to another interesting conclusion: out-degree and out-strength distributions are clearly more heterogeneous than the in-degree and in-strength distributions. This fact means that countries receiving investments are better distributed than countries hosting buyer companies.

These results are confirmed also by centralization indexes. The higher levels of out-degree centralization compared to those of in-degree centralization reveal that destination of M&As are more distributed while the origins, (i.e., the countries where buyer companies are located), are clearly more concentrated in a few number of nations. In other words, the network presents a star-shaped topology, but this structure is more pronounced when considering countries of buying companies, while when considering the receiving countries, the network connections are more evenly distributed. These results have important implications regarding the distribution of the international production capacity associated with transnational corporations: first, this capacity is highly concentrated; second, this concentration is much greater from the perspective of the purchasing countries than from the selling countries. In other words, ownership and control of productive capacity rest in the hands of fewer nations while investment opportunities are more evenly distributed throughout the world. These implications are also in line with the theory of the development path of investment (Narula, 1996; Narula and Dunning, 2010).

The high levels of centralization and asymmetry offer preliminary clues regarding the core-periphery structure of the IMAN. Figure A3 presents graphical appearance of this structure: some countries (the core) are tightly connected among them while the rest of nations (the periphery) seem to be poorly connected or even disconnected to the network. The existence of such structure (hypothesis 1) is formally tested in Section 3 and Annex 5.

A4. Core-periphery structure of the IMAN

Results presented in Table A4 prove that the Borgatti and Everett (2000) core-periphery structure fits very well to the IMAN. There is high correlation between the data and the ideal core-periphery network in both the binary and the weighted networks. The blocked adjacency matrices show that the core block is substantially much denser than the periphery block. Core-to-periphery block is denser than the periphery-to-core block (CP>PC), which shows an asymmetrical relationship between core and the periphery countries.

Table A4. IMAN fitness to core periphery model

	Cumulative network		1999-2003		2004-2008		2009-2013	
	Core	Peri-phery	Core	Peri-phery	Core	Peri-phery	Core	Peri-phery
Core	0.635	0.135	0.57	0.084	0.645	0.111	0.598	0.096
Periphery	0.05	0.008	0.027	0.004	0.049	0.007	0.039	0.006
Fitness								
Binary	0.736		0.701		0.727		0.71	
Weighted	0.796		0.807		0.778		0.763	
Number of countries								
Binary	54	157	41	170	41	170	44	167
Weighted	3	208	3	208	3	208	3	208

Source: Created by authors

Testing the fitness of the Borgatti and Everett model to the IMAN, also allows to obtain classifications of core and periphery countries. When applied to the binary network, the algorithm sets a group of 54 core nations and 157 periphery countries; meanwhile, when applied to the weighted network, the algorithm identifies only 3 countries in the core and classifies the remaining 208 nations in the periphery. These differences can be explained by observing the strength distribution, characteristic of the weighted network, which is much more concentrated than the degree distribution, characterizing the binary network (see Figure A4). The relatively more homogeneous distribution of links in the binary network facilitates a relatively more homogeneous configuration of core and periphery blocks compared to those resulting in the weighted network. Due to these differences, we may ask which classification of countries best fits the current relationships of ownership and control of the means of production at the global level. In section 4 we aim to answer this question by identifying a unique classification of core, semi-periphery and periphery countries in the IMAN.