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The dynamics of firms' export portfolio:

A network analysis with an application to Mexico and Bulgaria

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Abstract

In this paper we use network-analysis tools to identify communities in the web of Bulgarian and Mexican exporters' destinations. We show that the network-based community measure is superior to extended gravity measures to predict the dynamics of firm's export-portfolio. This superiority stems from the fact that community is a revealed measure, is country-specific and can be calculated at the industry level. We show that a one unit increase in the number of destinations previously served by the exporter within a community rises between 49% and 66% the probability of selecting a new export destination in that community. The network-based community variable improves the accuracy of the model between 8% and 17% relative to a model that only includes gravity and extended-gravity variables. We also show that industry-specific communities and general communities play similar roles in determining the dynamics of Bulgarian and Mexican exporters' portfolio.

JEL Code: F1

Keywords: export market, network analysis, modularity, extended gravity, Mexico, Bulgaria.

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1. Introduction

The international literature provides broad support for the assumption that sunk costs influence firms' export decisions. However, until recently firm-level research in this area has tended to treat export status as a binary variable - firms are either exporting or they are not. Hence, empirical studies of entry into exporting have focused on the initial entry decision, particularly on identifying the firm-specific characteristics which set exporting firms apart from non-exporters. In this paper we focus our enquiry on a subsequent question: given that a firm has the ability to export, what determines the choices they make about where to export?

Exporters do not add new destinations to their portfolio at random. In fact, firms have a higher probability of adding destinations that are similar to their domestic market. This similarity is governed by the so-called gravity factors, such as income, geography or culture. Firms also have a higher probability to add new destinations that are similar to their previous destinations. This latter similarity is governed by the so-called extended-gravity variables that capture the geographical and cultural proximity between previous and new destinations (Morales et al., 2011).

The novel feature of this paper is to use network analysis to construct a "revealed" indicator of similarity between countries. In particular, we identify communities of countries within the web of export markets of two separate countries: Bulgaria and Mexico. Because our similarity measure is derived from the actual portfolio of Bulgarian and Mexican exporters, the first advantage of this indicator is that it captures not only all proxies used for closeness in the previous literature, but also any non-measurable or non-observable characteristic that might also affect how similar export destinations are. The second advantage of the community measure is that it is a country-specific measure. In the case of extended gravity variables, the similarity between two export destinations is always the same, irrespective of the location of the exporter. For example, the (extended gravity) distance between Country A and Country B is the same for a Mexican exporter or for a Bulgarian exporter. However, it might be the case that Country A and Country B belong to the same community for Mexican exporters but not for Bulgarian exporters. For example, Country A and Country B might have the same preferences for Mexican products, but not for Bulgarian products. The third advantage of our network-based measure is that we can identify industry-specific communities. It might be the case that countries belong to the same community in one industry but to a different community in another industry. For example, in the case of

tequila, Country A and Country B might form a community, because both countries have the same regulations regarding the maximum alcohol content in tequila. In this case, the tequila that has been modified to meet the requirements in Country A will also be suitable for Country B, leading these two countries to form a community. In contrast, for book sales, Country A and Country B might belong to different communities because they speak different languages. Extended-gravity measures cannot control for these differences because geographical and cultural variables do not usually vary across industries.

We test whether the network-based similarity measure explains the dynamics of new exporters' destination-portfolio during the period 2003-2006 for Bulgaria and during the period 2003-2009 for Mexico. We show that a one unit increase in the number of communities served by an exporter within a community raises between 49% and 66% the probability of selecting a new export destination in that community. The network variable keeps its strong predictive capacity even when we control for gravity and extended-gravity variables. In fact, the network-based similarity measure improves the accuracy of the model between 8% and 17% relative to a model that only includes gravity and extended-gravity variables. We also identify industry-specific destination-communities and general destination-communities and find that both have a similar influence on the evolution of export-portfolios.

The analysis in this paper is related with different strands of literature that analyze firms' exports dynamics. Recently, several theoretical papers have investigated the role of uncertainty and learning in export markets on the selection of export markets and the timing of entry. Albornoz et al. (2012) and Nguyen (2012) develop alternative multi-market export models based on the idea that a firm's foreign demands are uncertain and correlated across markets. When faced with multiple destinations to which they can export, many firms will choose to sequentially export in order to slowly learn more about its chances for success in untested markets. Experimentation becomes an optimal strategy leading to path-dependence in firms' export destinations. These models also predict that new exporters are more likely to add new export destinations and to exit from export markets than more established exporters. Chaney (2011) proposes a model of international network formation where firms obtain information about new potential partners from their current trading partners. The network formation game yields equilibria where firms' export destinations are path-dependent.[1]

Our paper is also related to the concept of "the geographic spread of trade", a term originally proposed by Evenett and Venables (2002). They showed that geographic and

[1] See Freund and Pierola (2010) and Eaton et al. (2010) for theoretical models that describe firms' export dynamics within one market.

linguistic proximity to an existing market was a consistently significant factor in determining expansion into new markets for sector-level exports from developing countries, implying a role for learning from existing export experiences. Using firm-level export data, Morales et al. (2011) for Chile, Lawless (2011) for Ireland and Defever et al. (2011) for China explore the role of "extended gravity" forces and show that firms tend to choose new export destinations that are similar (geographically, culturally or economically) to destinations the firm is already exporting.

This paper is also related with the novel literature that applies network methods to analyze international trade. Kali and Reyes (2007) map the topology of international trade and develop new measures of economic integration based on network analysis. De Benedictis and Tajoli (2011) apply network analysis to describe the evolution of international trade and to analyze some topics debated in the literature, such as the role of the World Trade Organization, the extensive and intensive margins of trade, multilateral resistances and the existence of regional blocks. Hidalgo et al. (2007) use the probability of exporting products in tandem to develop a measure of proximity between products, which is displayed into a map using network analysis. These authors show that the product-map determines the evolution of countries productive specialization. Based on the product-map, Kali et al. (2013) show that countries' growth prospects are enhanced if their export basket is closer, measured using network analysis tools, to more complex products that the country does not export yet. Hidalgo and Hausmann (2009) and Hausmann and Hidalgo (2011) use network analysis to develop new measures of countries and products complexity level. They use a bipartite network, one formed by countries and another formed by products, and they link both networks measuring the number of products exported by a country (diversification) and the number of countries that export a product (ubiquity). Using a method of reflections they iterate these measures to get a proxy of countries and products economic complexity. They show that countries tend to converge to the level of income predicted by their economic complexity.

The remainder of the paper is organized as follows. Section 2 presents the web of Bulgarian and Mexican exporters' destinations and applies network analysis tools to identify communities within these webs. Section 3 introduces the empirical model to examine how "connectedness" between countries affects the choice of new destinations by firms that expand their export portfolio. Section 4 explains the characteristics of the databases and Section 5 presents the results of the empirical analyses. Section 6 concludes.

2. Communities in the network of export markets

We start by examining the network of firms' export destinations using tools from network analysis. Figure 1a and Figure 1b present the network of Bulgarian and Mexican exporters' destinations respectively. In these webs export destinations are nodes. Two nodes are connected by an edge if there is at least a firm that exports to both nodes; we do not include self-loops. The weight of the edge is the number of firms that export to both destinations. The size of the node is correlated with the number of firms that export to that destination and the size of edge is correlated with the weight of the edge.

In Bulgaria the network has 177 destinations and 7848 edges. The density of the network is 0.506.[2] The most important destinations for Bulgarian exporters in 2002 were Macedonia (2,537 exporters), Germany (2,236 exporters), Greece (2,056 exporters), Serbia & Montenegro (1,462 exporters) and Italy (1,367 exporters). The edges with the highest weights were Serbia & Montenegro-Macedonia with 538 firms exporting to both destinations, Greece-Macedonia with 383 firms, Germany-Italy with 370 firms, Germany-France with 356 firms and Austria-Germany with 308 firms. There are four nodes that are not connected in the network: Bostwana, Cape Verde, Haiti and Zimbabwe.[3] For Bulgaria, each node has an average degree of 89 destinations; that is, the total number of additional destinations served by firms that export to a destination is, as average, 89. Interestingly, the destination with the highest (unweighted) degree is Great Britain (167), followed by the US (166), Germany (165), and Spain and Turkey with 159 each. Macedonia, despite being the most important destination for Bulgarian exporters, occupies the sixth position in the degree ranking. This result points out that firms exporting to Macedonia have a narrower export-portfolio than firms exporting to the other top-five destinations.

For Mexico the network has 175 nodes and 9576 edges. The density of the network (0.629) is higher than in Bulgaria (0.510). The most important destinations for Mexican exporters in the year 2002 were the US (25,730 firms), Guatemala (2,534 firms), Canada (1,931 firms), Costa Rica (1,855 firms) and El Salvador (1,394 firms). The edges with the highest weights were Canada-US with 1,534 firms exporting to both destinations, Guatemala-US with 1,368 firms, Costa Rica-US with 1,084 firms, Costa Rica-Guatemala with 923 firms and Colombia-US with 913 firms. All the nodes are connected in the network; this means that

[2] If all nodes were connected with each other density would be 1.

[3] There are three Bulgarian firms that only exported to Botswana in 2002, and only one firm to Cape Verde, Haiti and Zimbabwe.

there is no destination where all exporters to that destination only exported to that destination. Each node has an average degree of 55; this figure is much lower than the one in Bulgaria. As expected, the destination with the highest degree is the US: 170 edges. It is followed by Chile (164), Canada (160), Guatemala (159) and Colombia (158).

Network analysis provides us with additional variables to measure the centrality of destinations. First, *betweeness* measures how often a node appears on the shortest path between two nodes. For Bulgaria, the top five group is composed by the US, Germany, Great Britain, Spain and Italy. For Mexico, within the top five group, we find the US, Chile and Canada. We also find Dominican Republic and Japan, showing that these two countries are important hubs in the network. Second, *closeness* measures the average distance between the node and all other nodes. For Bulgaria, the countries with the lowest average distance are Great Britain, the US, Germany, Spain and Turkey. For Mexico, within the top five group, we find the US, Chile, Canada, Guatemala and Colombia. Finally, the *eigenvector centrality* calculates the centrality of a node depending on the centrality of its neighbors. For Bulgaria, we find again Great Britain, the US, Germany, Turkey and Spain. For Mexico, within the top five, as expected, we find the US, Chile, Colombia and Canada. However, according to this centrality measure, Germany also becomes one of the top five destinations.

Although Figures (1a) and (1b) portray dense networks, there might be clusters of countries within the web where ties among destinations are higher than average. The identification of these communities plays a crucial role in our analysis. As explained in the introduction, the literature has shown that exporters tend to expand their portfolio with markets that share characteristics with their previous destinations. The existence of a community reveals that its members share some characteristics. We expect that Bulgarian and Mexican exporters will tend to expand their portfolio with destinations that belong to the same community of any of their previous destinations.

To determine whether ties among some of countries are stronger than the average, network analysis introduces the concept of modularity (Newman and Girvan, 2004). Modularity compares the number of edges within the community with the number of edges we would expect if edges where distributed randomly in the network, providing that the number of relationships each destination has is not altered. If the number of edges in the community is higher than the expected number modularity takes a positive value, reflecting the existence of a community. Algebraically, a community (module) exists if:

$$\frac{l_s}{L} > \left(\frac{d_s}{2L}\right)^2 \quad (1)$$

where l_s is the number of edges within the community s, L is the total number of edges within the network and d_s the total degree of the nodes within community s. The left hand-side of the inequality is the fraction of edges that fall within community s and the right hand-side of the inequality the fraction of edges we would expect to fall in the community if all edges were distributed randomly, preserving the degree of nodes.

One widely used procedure to identify communities within a network is the maximization of a modularity function (Newman, 2006), which is expressed as follows:

$$Q = \frac{1}{2m}\sum_{ij}\left[A_{ij} - \frac{k_i k_j}{2m}\right]\delta(c_i, c_j) \qquad (2)$$

where Q is the modularity index, m is the number of edges in the network, A_{ij} is the number of edges between node i and node j, k_i and k_j are the degree of nodes i and j respectively, and $\delta(c_i,c_j)$ is a delta function that takes the value of 1 if i and j belong to the same community. Note that similar to equation (1), the term in brackets compares whether the number of edges between two destinations is larger than the one if edges were distributed by random. The network will be partitioned in a number of communities that maximizes the value of Q.

The procedure to determine the optimum number of communities is not trivial, as the number of possible combinations of destinations rises exponentially with the number of destinations, making the exhaustive comparison of all possibilities unfeasible. To overcome this problem, different algorithms have been proposed to maximize modularity and identify communities within a network. In this paper, we use the algorithm proposed by Blondel et al. (2008). However, as pointed out by Fortunato and Berthelemy (2007), the modularity maximization algorithm has a resolution-limit limitation, as it might aggregate small communities within a broader community. In order to resolve this limitation they suggest applying the maximization algorithm iteratively. First, the algorithm is applied on the whole network. Second, the algorithm is applied only on each community identified in the first step. The process stops once the algorithm does not find any further partition. In each step, it should be checked that the communities identified by the algorithm meet the equation (1) inequality. This iterative process has the advantage of identifying hierarchies of communities. At the beginning, the algorithm identifies few communities, characterized by a large number of members with only just above the average connections between them. However, with each iteration, large communities are fragmented into smaller communities characterized by stronger ties among members.

To avoid a too long iterative process and awkward relationships, we run the community detection algorithm on a sample of destinations which are served, at least, by 50 exporters in 2002. In addition to that, exporters have to export, at least, to two different destinations. After applying this filter, the number of nodes declines from 177 to 58 in Bulgaria (representing 97% of total exports) and from 175 to 65 in Mexico (representing 79% of total exports) in 2002. Figure 2 (a) and (b) display the process of community-identification in Bulgaria and Mexico respectively.

For Bulgaria we find nine final communities. The first community is formed by four Central European countries that belong to the European Union: Czech Republic, Hungary, Poland and Slovakia. The second community is composed by countries of the former Soviet Union: Armenia, Azerbaijan, Belarus, Kazakhstan, Latvia, Lithuania, Moldavia, Russia and Ukraine. The third community encompasses two small Mediterranean islands: Cyprus and Malta. The fourth community is formed by Middle East countries (Iran, Jordan, Lebanon, Syria and United Arab Emirates) and Northern African countries (Algeria and Egypt). The fifth community encompasses three former members of Yugoslavia: Bosnia & Herzegovina, Croatia and Slovenia. The sixth community is formed by a mix of countries located relatively close to Bulgaria: Albania, Georgia, Greece, Macedonia, Romania, Serbia & Montenegro and Turkey. The seventh community is composed by a large group of European countries (Austria, Belgium, Denmark, Finland, France, Germany, Great Britain, Ireland, Italy, Netherlands, Norway, Spain, Sweden and Switzerland) plus the US and Canada. The eighth community is formed by Asian countries: China, India, Japan, Korea, Malaysia and Taiwan. Finally, the ninth community is a mix of three very different countries: Australia, Mexico and Portugal.

For Mexico, in the first iteration, the algorithm identifies two big communities. The first community is composed by countries located in the American continent, except for USA and Canada; and the second community by the rest of countries. When we apply the algorithm on the community of countries located in the American continent, three final communities (shaded in yellow) emerge. The first community is formed by South American countries: Argentina, Bolivia, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay and Venezuela. The second community is formed by Central American countries and three Caribbean countries: Belize, Costa Rica, Cuba, Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua, Panama and Puerto Rico. The third community is formed by Caribbean countries: Bahamas, Barbados, Haiti, Jamaica and Trinidad and Tobago. When we apply again the modularity maximization algorithm on the rest of countries community we get a fourth final

community composed by large developed countries: Canada, France, Germany, Great Britain, Italy, Spain and USA. If we further iterate the group of remaining countries we end up with six additional final communities. The fifth group is composed by small European countries: Austria, Belgium, Denmark, Finland, Netherlands, Norway, Sweden and Switzerland. The sixth community only includes three large Asian countries: India, Indonesia and Turkey. The seventh community encompasses countries located in or near the Middle-East area: Egypt, Israel, Saudi Arabia and United Arab Emirates, and two peripheral European Union countries: Portugal and Greece. The eight community is composed by two Eastern European countries: Poland and Russia. The ninth community is formed mostly by Asian countries: China, Hong-Kong, Japan, Korea, Malaysia, Philippines, Singapore, Taiwan and Thailand; countries located in Oceania: Australia and New Zealand; and two emerging countries: Brazil and South Africa. The final community is formed by two small European Union countries: Hungary and Ireland.

We should stress that the communities identified in the Bulgarian network are different to those identified in the Mexican network. Some of the differences are explained by differences in the sample's country-composition. For example, Guatemala and Costa Rica are very important destinations for Mexican exporters; in contrast, these countries do not appear in the Bulgarian sample. However, some differences are explained by how destinations are grouped. For example, Mexican exporters seem to distinguish between large high-income and small high-income European countries; however, for Bulgarian exporters large high-income and small high-income European countries belong to the same community. For example, Turkey and Greece belong to the same community for Bulgarian exporters but to different communities for Mexican exporters. These differences highlight that the network-based community measure is a country-specific measure. This is in contrast with extended gravity measures. For example, for extended gravity measures, the similarity between Turkey and Greece is always the same, irrespective of the location of the exporter. However, for the network measure, Turkey and Greece belong to the same community for Bulgarian exporters, but to different communities for Mexican exporters.

We can observe that extended-gravity variables, such as geographical location, play a role in the formation of communities. For example, in the case of Mexico most of South American countries are located in the same community and most of Central American countries are located in the same community. However, we also observe that there are some countries that do not obey the geographical rule. For example, Brazil does not belong to the community of South American countries, but rather to a heterogeneous group that

encompasses distant and emerging countries. We also observe that Canada and the US do not form a North American community, but are integrated in a broader large high-income countries' community. In the case of Bulgaria, we also observe that geography plays a role in forming communities, but there are also countries that do not obey this rule. For example, as in the case of Mexico, Canada and the US are part of a large group of European countries.

These cases point out that there might be other reasons besides those captured by extended-gravity variables that might explain similarity between countries. As the network of Bulgarian and Mexican export-destinations are built upon the choices taken by Bulgarian and Mexican exporters, the communities identified in those networks are a revealed measure, capturing all the variables that might determine the degree of similarity among export destinations. Hence, belonging to a community might be a superior criterion to identify similarities between countries than extended-gravity measures.

What does community capture besides the forces controlled by extended gravity variables? As mentioned before, community captures variables that influence the degree of similarity among countries that are difficult to observe or to measure. For example, at the broad level, the existence of large distribution chains that happen to be present in some countries, but not in others, might explain why some exporters have a higher presence in a community of countries. It might also be the case, as suggested before, that countries share similar preferences for the exporter country products, and these similar preferences are not well captured by extended gravity measures. At the product level, as mentioned before, the use of similar regulations might explain why some destinations happen to be more similar for some products, but not for others. Other variables, such as orographic conditions, might also play a role for similarity. For example, Austria and Canada have a large number of ski resorts, making these destinations similar for a Bulgarian ski-boots manufacturer. However, this similarity might not be relevant for Bulgarian tomato producers.

To test that community captures other variables besides those control for extended gravity measures, we run a regression to determine to what extent gravitational variables explain the variation in the probability of belonging to the same community. The gravitational variables we use to explain the similarity between two destinations are distance, sharing a border, speaking the same language, being located in the same region, belonging to the same income per capita quintile, having a common colonizer, belonging to the same regional trade agreement and the combined number of migrants (number of citizens born in destination *i* that live in destination *j* plus the number of citizens born in destination *j* that live in destination *i*). As shown in Table 1, both for Bulgaria and Mexico, a larger distance reduces the probability

of belonging to the same community; sharing a border, speaking the same language, being located in the same region and having a similar income per capita level increase the probability of belonging to the same community. The number of migrants born in one destination and living in the other destination also raises the probability of belonging to the same community. In the case of Bulgaria, sharing the same colonizer and belonging to the same regional trade agreement also increase the probability of belonging to the same community. In contrast, these coefficients are not statistically significant for Mexico. We can observe that gravitational variables only explain 35% of the differences in the probability of belonging to the same community in Bulgaria and 26% in Mexico. These results confirm that, besides extended-gravity measures, community captures other variables that enhance the degree of similarity among countries.

3. The empirical model

We use a simple model of export participation into specific foreign markets by rational, profit-maximizing, firms to derive our econometric equation. Consider a firm that produces one good in the local market and sells part of the production abroad. There are several alternative markets and the firm has to decide which markets to export to. At any period, the exporting firm has the choice of entering into a number of markets if it did not export to those markets in the previous period.

Let π_{igt} be firm *i's* profits from exporting to market *g* in year *t*. We assume that the expected profits of exporting to country *g* by firm *i* is a linear function of factors affecting the destination choice,

$$\pi_{igt} = I_{-g,t-1}\alpha + z_g\gamma + \theta_g + \varepsilon_{ig} \quad (3)$$

where $I_{-g,t-1}$ measures the "mass" of information about destination *g* that firm *i* might obtain from previous exporting experience in other destinations. The variable z_g is a vector of observable attributes of the destination-country, the variable x_i is a vector of firm-specific characteristics, θ_g is a vector of fixed effects or destination-specific constants and ε_{ig} is a random term denoting the unobservable (by the researcher) unique profit advantage to the firm *i* from selling in country *g*.

Let $\boldsymbol{y_{igt}} = (y_{i1t}, y_{i2t}, \ldots, y_{iGt})$ denote the vector of firm *i's* current participation into export markets ($g=1 \ldots G$). The variable y_{igt} is a binary variable that indicates whether a firm exports to market *g* in period *t* ($y_{igt}=1$) or not ($y_{igt}=0$). This paper focuses on the decision of an exporter about expanding the portfolio of destinations **G**, given that it is already exporting. If

destinations share common characteristics, having served one destination might reduce the sunk cost of entering similar destinations. Hence, previous export destinations might determine the export-path. Our interest lies in the quantification of the effect of "similarity" between countries on the probability of entering a new export destination, $I_{-g,t-1}$. In particular we want to examine two types of measures: those based on gravity-type indicators and those based on network analysis.

An exporter will choose to export to a particular country if she earns the highest possible profit. Formally, the *g*th country is chosen by firm *i* as the destination of exports if (we omit the subscript time *t*),

$$\pi_{ig} = \max(\pi_{ik}, k = 1 \dots K) \quad (4)$$

If the firm-specific random terms are independently distributed, each with a Type I extreme value distribution, McFadden (1974) showed that the probability of a firm *i* to choose a destination *g* is

$$P_{ig} = Pr(\pi_{ig} > \pi_{ik}, j \neq k) = \frac{\exp(I_{-g,t-1}\alpha + z_g\gamma + \delta_g)}{\sum_k \exp(I_{-g,t-1}\alpha + z_g\gamma + \delta_g)} \quad (5)$$

where P_{ig} is the population relative frequency of exporting to destination *g*. The estimates are obtained by maximizing the likelihood function, $L = \prod_i \prod_g P_{ig}$. The model described above is known as a conditional logit model (CLM). It is important to emphasize that the CLM does not allow explanatory variables that are not directly related to the choices. In our case, it means that we cannot estimate a single parameter to capture the impact of firm-specific characteristics or source-location characteristics on the firm's probability to export a particular destination. We estimate the CLM with and without country-fixed effects. Train (1986) shows that the inclusion of choice-specific fixed effects contributes to improve the specification of the CLM as it reduces the risk of violation of the Independence Irrelevant Alternatives (IIA) assumption. What is left is a possible correlation across export destinations induced by destination-firm specific effects. We capture this aspect with our explanatory variables. We cluster standard errors at the firm-level. This takes into account unobserved within-firm correlation across destinations.

4. Data

To bring the model to the data, we use transaction level customs data on the universe Bulgarian exporters over the period 2001-2006 and the universe of Mexican exporters over

the period 2000-2009.[4] In order to investigate the importance of past export portfolio on the decision about where to export next, we select new exporting firms since 2003. For Bulgaria, the set of new exporting firms only includes firms that did not export in 2001 and 2002 and once begin to export carry on exporting until 2006. For Mexico, the set of new exporting firms only includes the firms that did not export in 2000, 2001 and 2002 and once begin to export carry on exporting until 2009. For these samples of firms we know the complete past export destination portfolio.

Table A1a and A1b in the Appendix display information on the number of trading firms, number of transactions and value (in millions US$) in the 2001-2006 period for Bulgaria and the 2001-2009 period for Mexico. For Bulgaria, the number of regular exporting firms for the period 2001-2006 is 3102, representing 28% of total firms, 53% of all transactions and 75% of all value of exports in 2006. The number of firms that start exporting after 2002 and do not stop is 2909 in 2006, representing 26% of total firms, 24% of all transactions and 18% of all value of exports in 2006.[5] For Mexico, the number of regular exporting firms for the period 2000-2009 is 5697, representing 20% of total firms, 46% of all transactions and 69% of all value of exports in 2009. The number of firms that start exporting after 2002 and do not stop is 6026 in 2009, representing 21% of total firms, 23% of all transactions and 21% of all value of exports in 2009.[6] The weight of new successful exporters in Bulgarian and Mexican exports is high and confirms the importance of the extensive margin as a source of growth of exports in the medium and long run.[7]

In Table A2 (a) and (b), we can examine the dynamics of the export destination portfolio of the new regular exporters. For Bulgaria, considering year-to-year changes, a large percentage of new regular exporters (almost 50 percent) does not modify the export destination portfolio. Every year some firms only enter into new destinations (20%), others opt for only exiting (10%) and, finally, others decide to enter and exit simultaneously (20%).

[4] In the Mexican dataset the firm identification code changes from 2007 onwards. For the year 2007 we have data with the old firm classification and with the new firm classification. Matching firm-level country and HS 6-digit specific records we can establish a correspondence between the old firm classification and the new firm classification for firms that exported in 2007. For the rest of firms that exported in 2008 and/or 2009, we cannot know whether they are new exporters or they are firms that exported in the 2000-2006 period.

[5] In the set of new Bulgarian regular exporters, 740 started to export in 2003, 899 in 2004 and 1270 in 2005.

[6] In the set of new Mexican regular exporters, 757 started to export in 2003, 948 in 2004, 1110 in 2005, 1283 in 2006 and 1928 in 2007.

[7] Focusing on the behavior of already-exporting firms is essential for understanding the processes by which aggregate export value increases over time. Recent studies show that changes in the product-country mix of existing exporters account for the largest percent of net export growth in the long run, well above the share associated with net export entry and exit or net growth in existing relationships (see Bernard et al., 2009, de Lucio et al., 2012).

For Mexico, considering year-to-year changes, the largest percentage of firms (about 60 percent) does not modify the export destination portfolio. Every year some firms only enter into new destinations (15%), others opt for only exiting (9%) and, finally, others decide to enter and exit simultaneously (17%). The dynamics in the export destination portfolio are quite similar for regular exporters (those exporting before 2003) in both countries. The most important difference is that those firms show more probability to change their portfolio compared to new regular exporters.

We also analyze the number of communities served by a new regular exporter each year. For Bulgaria, 81% of new regular exporters only serve one community, 13% of new regular exporters serve two communities, 3% of new regular exporters serve three communities and 1% of new regular exporters serve four or more communities. The community with the highest number of exporters is the one formed by high-developed European Countries, the US and Canada: 57%; 43% of exporters also serve the community of countries located close to Bulgaria (Albania, Georgia, Greece, Macedonia, Rumania, Serbia & Montenegro and Turkey). The third community in the ranking is the one formed by former Soviet Union countries: 9% and the fourth community the community formed by four Central European and European Union members: 8%.

For Mexico, 75% of new regular exporters only serve one community, 14% of new regular exporters serve two communities, 6% of new regular exporters serve three communities and 5% of new regular exporters serve four or more communities. As the US is the most important destination for Mexican firms, a very large percentage of new regular exporters serve the community in which the US is integrated: 84%[8]; 22% serve the community of Central American countries, 13% serve the community of South American countries and another 13% the community of Asian countries. The community of small European countries is served by 5% of new regular exporters; the community of Middle East countries, the community formed by India, Indonesia and Turkey, and the community of Caribbean countries are only served by 2% of the new regular exporters. The rest of communities are served by very few new regular exporters.

As explained above, our dependent variable is a firm-specific vector of export indicators $\boldsymbol{y_{it}} = (y_{i1t};...; y_{ijt}; ...; y_{iGt})$ which indicates whether a firm exports to a specific destination g in year t. Notice that (1) the total number of potential destinations changes every

[8] 79% of new regular exporters served the US market in the period 2003-2009.

year for each firm and (2) the number of potential destinations is constrained to those countries that the firm has never been before.

In Table A3 in the Appendix, we aggregate our dependent variable at the firm-year level and count the number of new destinations. The majority of firm-year pairs take a value of 1 (59% in Bulgaria and 56% in Mexico), that is, when a firm decides to expand its destination portfolio she enters a single new destination. The number of firms that expand their destination portfolio in more than 6 destinations is very small (less than 3% of the firm-year cases in both Bulgaria and Mexico).

Regarding independent variables, we argue that a firm profitability is correlated to both similarity between domestic market and the new market, and similarity between the new market and previous export markets. Similarity between our domestic markets (Mexico and Bulgaria) and new export markets is determined by standard gravity measures, such as distance between the domestic and the new export market, whether they speak the same language, whether they share a border, whether they belong to the same regional trade agreement and the number of migrants born in the domestic market living in the new export market plus the number of migrants born in the new export market living in the domestic market. We also use GDP and GDP per capita as a proxy for the attractiveness of the new export market.

We use a network variable and extended-gravity variables to proxy the similarity between a new export market and previous export markets. The network variable counts the number of destinations belonging to the same community of the new export market that have been previously served by the exporter. Note that communities are identified using data for exporters in 2002. We use this year to identify the communities because it is just previous to the one used to identify new exporters. In this way, we avoid any endogeneity between the path followed by new exporters from 2003 onwards and the identification of communities, and maximize the number of destinations in the web.[9] For extended gravity, we control for distance, border, language, regional trade agreement, migration, income level and geographical region. The variable $N_{-g,t-1}^{distance}$ characterizes the countries' geographical relationship to prior export destinations of the firm. It is defined as the number of prior export destinations of a firm whose capital city is less than certain number of kilometers away from the capital city of the destination under consideration. In the benchmark analysis, we use a 1,500 km. radius. We also proxy for the geographical links between countries using a

[9] Previous years have a lower number of destinations. In any case, in the sensitivity analyses section, we show that results are robust to using different samples to identify communities and exporters.

common border dummy variable, $N^{border}_{-g,t-1}$, which captures the number of prior export destinations with a common land-border with the new possible export destination; and $N^{region}_{-g,t-1}$, which equals the number of previous export destinations that are in the same region of the new export market. We also consider cultural closeness measures such as common language between export destinations. Specifically, the variable $N^{language}_{-g,t-1}$ denotes the number of all destinations to which a firm exported in previous periods speaking the same language of the new export destination. We also proxy for economic proximity controlling the number of previous export destinations that are in the same income quintile of the new export market. We also consider other variables that might enhance the proximity between destinations, such as migration flows and belonging to the same regional trade agreement. Specifically, the variable $N^{migr}_{-g,t-1}$ measures the number of previous destinations that have at least 100 immigrants and 100 emigrants in the new export destination; the variable $N^{rta}_{-g,t-1}$ captures the number of previous export destinations that share a regional trade agreement with the new export destination.

Data for the construction of the gravity and extended-gravity measures come from different sources. Data on income and population in 2002 are taken from World Bank (2012). Distance, contiguity, common language, colonial relationship and same continent are obtained from Head et al (2010). Bilateral migration stocks in 2000 are from Ozden et al. (2011) and common membership in a regional trade agreement (RTA) in 2002 is obtained from Baier and Bergstrand (2007).[10]

5. Estimation results

In this section we present the results from the econometric analyses. First, we analyze whether communities identified in the whole network of Bulgarian and Mexican exporters determine the export path of new exporters. Second, we analyze whether industry-specific destination-communities have a larger role in determining the export path than general destination-communities. Finally, we perform a set of sensitivity analyses to test the robustness of our results.

[10] The web link for publicly available databases are: World Development Indicators: http://data.worldbank.org/data-catalog/world-development-indicators
CEPII gravity dataset: http://www.cepii.fr/anglaisgraph/bdd/gravity.asp; RTA database: http://kellogg.nd.edu/faculty/fellows/bergstrand.shtml;
World Bilateral Migration database: http://data.worldbank.org/data-catalog/global-bilateral-migration-database

5.1. Estimations with the complete network

Table 2 reports estimates of the conditional logit allowing for simultaneous exports to multiple destinations. The table is divided in two panels. Panel A reports the results for Bulgaria and Panel B reports the results for Mexico. In specification (1) and (5) we estimate the model with community as the only independent variable. The communities used in the benchmark analysis are the final communities identified in Figures 2a and 2b. The community coefficients have large positive values and are statistically significant. The transformation of the community coefficients into odds-ratios provides an easy way to interpret economically the estimates. For Bulgaria, a one unit increase in the number of destinations previously served by the exporter within a community rises by 49% (=exp(0.401)) the probability of selecting a new export destination in that community. For Mexico, a one unit increase in the number of destinations previously served by the exporter in a community rises by 66% (=exp(0.507)) the probability of selecting a new export destination in that community.

Specifications (2) and (5) introduce gravitational variables, such as GDP, GDP per capita, distance, common border, common language, belonging to the same regional trade agreement and migration stocks to proxy the similarity between the domestic (Bulgaria or Mexico) and the new export market, and the attractiveness of the new export market. The language dummy variable does not enter the estimation for Bulgaria, as there is no destination that also speaks Bulgarian. There is a reduction in the size of the community coefficients, but they keep the expected sign and are statistically significant. According to the new coefficients, once we control for gravity measures, a one unit increase in the number of destinations previously served within a community rises the probability of selecting a new export destination in that community by 26% in Bulgaria and by 48% in Mexico. Regarding gravitational variables, as expected, the larger the size of new export market and the higher the number of bilateral migrants the larger the probability of choosing that market as a new export destination; and the larger the bilateral distance the lower the probability of selecting the new export destination. For Mexico, speaking the same language, having a land border and belonging to the same trade agreement also raise the probability of choosing the new export destination. In contrast, the larger the new export market's income per capita the lower the probability of selecting that market. For Bulgaria, income per capita and sharing a border are not statistically significant, and sharing a free trade agreement, surprisingly, has a negative effect on the probability of choosing a new export destination.

Specifications (3) and (7) also control for extended-gravity measures. The values of the community coefficients are further reduce, but they keep the expected sign and are statistically significant. This result confirms that the network-based revealed variable captures additional factors affecting the degree of similarity among destinations in addition to those controlled by gravity and extended gravity measures. According to the coefficients reported in specifications (3) and (7), once we control for gravity and extended gravity measures, a one unit increase in the number of destinations previously served within a community rises the probability of selecting a new export destination in that community by 13% in Bulgaria and by 29% in Mexico. Regarding extended gravity variables, as expected, we find that a new export destination has a larger probability of being chosen the larger the number of previous destinations speaking the same language, sharing a border and being located in the same income-quintile. Probability is also enhanced with the number of previous destinations with a significant number of bilateral migrants with the new export market. However, surprisingly, we find that neither being in the vicinity of the exporter's previous export destinations nor belonging to the same regional trade agreement enhance the probability of selecting a destination. For Mexico, the number of previous destinations in the same geographical region of the new export destination also raises the probability of selection, but not in the case of Bulgaria.

Finally, specifications (4) and (8) introduce destination-specific fixed effects. These fixed effects preclude the estimation of time-invariant gravity variables so, for the sake of clarity, we remove all gravity variables from the estimation. The community coefficients remain positive and statistically significant at the 1 percent level. Once we control for gravity, extended-gravity and destination-specific effects, a one unit increase in the number of destinations previously served within a community rises the probability of selecting a new export destination in that community by 12% in Bulgaria and by 28% in Mexico.

To confirm that community is a better measure to capture similarity between countries than extended-gravity measures we compare the predictive capacity of the former versus the latter. After a logistic regression that also includes gravity variables, extended-gravity variables predict righty that the firm will expand its portfolio to a given destination in 35% of cases for Bulgaria and 32% of cases for Mexico; these figures rises to 38% of cases if we substitute extended-gravity variables by the community variable both in Bulgaria and Mexico. They represent a 8% increase in the accuracy of the model for Bulgaria and a 19% increase in the accuracy of the model for Mexico.

As mentioned above, the results presented in the benchmark estimation use the final communities identified in Figures (2a) and (2b). In order to test the robustness of our results we estimate specifications (4) and (8) with communities identified with fewer iterations of the modularity maximization algorithm. For Bulgaria, the maximum number of iterations needed to arrive to a final destination is three; in the case of Mexico five. For Bulgaria we can use the communities identified after two iterations and the communities identified after one iteration. For Mexico, we can use the communities identified after four iterations, three iterations, two iterations and one iteration. As we reduce the number of iterations, the number of communities is also reduced. With a lower number of communities, clusters have a larger number of members but we expect similarities between members to be lighter. These effects might drive the community coefficient in opposite directions. On the one hand, as there are more destinations within a community, exporters will have a larger probability of choosing a destination within a community. On the other hand, as similarities within the community are lighter exporters will have a lower probability of choosing a destination belonging to the community.

Table 3 presents the results of the estimations for different community hierarchies. For comparison we also reproduce the results when estimating the model with the final communities. For Bulgaria, the community coefficient becomes larger as we use a lower number of communities; for Mexico, the community coefficients in the fourth and third iteration are very similar to the final community coefficient. The coefficient drops when only two iterations are performed and drops substantially, and becomes statistically, not significant when only one iteration is applied.

For Bulgaria, from the first iteration, there is a clear distinction between exporters that focus on former Soviet block countries and exporters that focus on other western countries. Hence, the number of iterations needed to arrive to the final communities is small and aggregate communities contribute to explain the behavior of exporters. However, in the case of Mexico the first iteration yields less delimited communities, explaining why a larger number of iterations are needed to arrive to the final communities and why the community coefficient is not statistically significant in the first iteration.[11]

5.2. Industry-specific estimations

[11] The value of the modularity function in the first iteration is twice higher for Bulgaria than for Mexico, confirming that the first iteration yields more delimited communities in Bulgaria than in Mexico.

As explained in the introductory section of the paper, one the key advantages of the network-based similarity measure versus extended-gravity measures is that the former can be calculated at the industry level. Whereas the marginal distance from an incumbent destination to a new destination is the same irrespective of the industry, the incumbent and the new destinations might belong to the same community in some industries but not in others. To capture this possibility, we classify exporters in one of seven industries: agriculture, chemicals, machinery and transport equipment, metals, non-metallic minerals, paper and textiles. For each industry, we identify the industry-specific destination-communities and the rest of industries destination-communities. Using these two network-based measures we test whether industry-specific communities contribute more than general communities to determine the dynamics of new exporters' portfolio. The limitation of this analysis is that the number of destinations at the industry level is smaller than at the aggregate level. To keep a sufficient amount of destinations we set a less stringent criterion to determine the sample used to identify communities. In particular, we only exclude from the sample those destinations that are served only by one exporter. The sample that meets this requirement and is common for the seven industries is formed by 41 destinations in Bulgaria and 55 in Mexico. They represent 93% and 69% of Bulgarian and Mexican exports respectively in 2002. To identify the communities we follow the same procedure as the one used to identify communities in the whole network.

Tables A4 (a) and (b) in the Appendix display the identified communities in each of the seven industries in Bulgaria and Mexico respectively. We should stress that results should be taken with care as we use highly aggregated industries and few firms might be linking some marginal destinations, leading to firm-specific communities. As shown in the figures, there are differences in the number of communities among industries and countries. For Bulgaria, there are four industries with a relatively small number of communities: chemicals, machinery & transport equipment, metals and textiles. In contrast, the number of communities rises to nine in the paper industry. The communities that are more consistent across industries are the cluster of high-developed countries and the cluster of countries that are geographically close to Bulgaria. For Mexico, the highest number of communities is found in chemicals, 10, and the lowest in paper, 8. We observe that there are some broad communities that are present in most industries, such as a cluster of South American countries, a cluster for Central American countries and a cluster for Caribbean countries. However, the size of these clusters and its members vary from industry to industry. Moreover, in some cases, the communities of South American and Central American countries are merged. Asian countries tend to stay in

the same community as other Asian countries; however, the members vary from industry to industry, and sometimes the Asian countries form different communities. This is also the case for large and high-income developed countries, and smaller and high-income European countries.

To assess the similarity among communities across industries we calculate an adjusted Rand index. This index, ranging between -1 and +1, calculates the fraction of destination pairs that belong to the same community in two different industries.[12] As shown in Table A5 - Panel A in the appendix, the adjusted rand indexes lie between 0.09 and 0.59 for Bulgaria, and between 0.17 and 0.41 for Mexico. In most of cases there is a weak or negligible correlation across partitions, confirming that some destinations might belong to the same community in some industries but to different communities for other industries. In Table A5 - Panel B we calculate the adjusted Rand index for the industry partitions and the rest of industries partitions for each industry. Both for Bulgaria and Mexico there is a weak correlation between partitions. These results point out that the communities identified at the industry-level are different to those identified for the whole set of exporters.

Table 4 presents the results of estimating the model with industry-specific communities and rest of industries communities. Both coefficients are positive and statistically significant in Bulgaria and Mexico. In Bulgaria the industry community coefficient is larger than the rest of industries community coefficient; in contrast, in Mexico the rest of industries community coefficient is larger than the industry community coefficient. However, the differences are small and we cannot reject the null hypothesis that the rest of industries community coefficient and the industry community coefficient are equal neither for Bulgaria nor for Mexico. Hence, we conclude that industry-specific communities and rest of industries communities play similar roles in determining exporters' export-path.

5.3. Sensitivity analyses

We perform a series of sensitivity analyses to assess the robustness of our results. First, we want to confirm that the communities identified by the network-analysis algorithm do not have a strong explanatory capacity by chance. To rule out this possibility we assign destinations to communities randomly. To carry out this exercise we assume that the number of communities, and the number of members within each community, is the same as in the

[12] Specifically, the index calculates the fraction of correctly classified (respectively misclassified) elements to all elements. The index is adjusted to ensure that the expected value of the index for two random partitions is zero (Hubert and Arabie, 1985).

benchmark estimations. We perform the exercise 50 times; each time, once the random communities are generated we run the same model as the one in Table 2 - specifications (4) and (8). Both for Bulgaria and Mexico, in all 50 estimations the community coefficient is negative and statistically significant. These results point out that the communities generated by the network-analysis algorithm do not exert an influence on export dynamics by chance. On the contrary, it confirms that belonging to a community is a very important determinant of the evolution of the export path.

Second, we analyze whether the community coefficient is robust to the use of a larger sample to identify communities. For Bulgaria, instead of using the year 2002 as the sample to identify communities, we use data from all exporters that exported at least to two destinations per year in 2001 and 2002. For Mexico we expand the sample including the years 2000 and 2001. To avoid marginal destinations, we exclude from the sample the destinations with less than 50 exporters during the period 2001-2002 in Bulgaria and the period 2000-2002 in Mexico. The longer period and a less stringent threshold to admit a destination raises the number of destinations to 71 in Bulgaria (58 previously) and to 90 in Mexico (65 previously). After applying iteratively the modularity maximization algorithm, we identify 12 communities in Bulgaria and Mexico. Compared to the sample used in the benchmark analyses, the number of communities rises in three in Bulgaria and in two in Mexico. As shown in Tables A6 (a) and (b) in the Appendix, the communities are very similar to the ones obtained in the benchmark analyses. For Bulgaria, the Asian countries are distributed now in two separated communities, and the Middle East and African countries into three separated communities. For Mexico, the community of Caribbean countries is now divided in two communities and there is a new community of Scandinavian countries, a community of Central European countries plus Ireland, a community of Arab countries, a heterogeneous community of some African and Asian countries, and a small community of an African and Pacific British colonies; Australia, New Zealand and South Africa also form now an independent community.

Table 5 - columns 1 and 2 present the results of estimating the model with the new samples. The community coefficients remain positive and statistically significant. Compared to the benchmark estimation, the value of the community coefficient increases for Bulgaria but declines for Mexico. According to the new estimates a one unit increase in the number of destinations previously served by the exporter within a community raises the probability of selecting a new export destination in that community by 17% in Bulgaria and by 22% in Mexico.

Third, we analyze whether the community coefficients are robust to different extended distance variables. The variable used in the benchmark analyses is the number of previous destinations within a 1,500 kilometers radius. We re-estimate the model with a shorter distance: 500 kilometers, and a larger distance 3,000 kilometers. A shown in columns 3-6 in Table 5, the community coefficient is robust to the alternative extended-gravity distance radius. The coefficient for the number of countries in the 500 km. radius is positive and statistically significant for Bulgaria and Mexico. It is interesting to note that for Bulgaria the extended distance coefficient in the benchmark analysis, a 1,500 km. radius, was statistically not significant. In contrast, the extended gravity distance is not longer statistically significant if we stretch the radius to 3,000 km both in Bulgaria and Mexico.

Fourth, we use a more stringent threshold to determine whether a firm is a new exporter. Now, we define a firm as a new exporter if it does not export in 2001, 2002 and 2003 in Bulgaria and in 2000, 2001, 2002 and 2003 in Mexico. As shown in Table 5 - columns 7 and 8, the community coefficients remain positive and statistically significant. There is a substantial increase in the community coefficient, relative to the benchmark estimation, in Bulgaria; for Mexico the coefficients are very similar.

Fifth, we convert the community and the extended gravity variables from count variables into discrete variables. For example, now, the community coefficient takes the value of one if the firm has exported to a country that belongs to the same community of the new export destination. As shown in Table 5, columns 9 and 10, now the community coefficient get much larger positive values and remain statistically significant. Moreover, the community coefficient for Bulgaria is very similar to the community coefficient for Mexico. According to the community coefficients reported in columns 9 and 10, Mexican and Bulgarian exporters have almost a twice higher probability to expand their portfolio with a destination that belongs to the same community of any of their previous destinations.

Sixth, we analyze whether results for Mexico are robust to excluding all transactions with the US. As explained previously, 79% of new regular exporters in Mexico have the US in their portfolio and, hence, most of new regular exporters serve the community in which the US is integrated: 84%. To ensure that the Mexican results are not driven by the large percentage of exporters having the US as destination, we remove all export transactions to the US from the new regular exporters' database. As shown in Table 5 - column 11 the community coefficient is very similar to the reported in the benchmark analysis table. This result confirms that our estimations for Mexico are not driven by the large percentage of new regular exporters that serve the US market.

6. Conclusions

How do exporters choose new export destinations? While there are many factors that are important for this decision, an empirical regularity strikes out: firms tend to choose new export markets that are similar to their prior export destinations. Network analysis, through the community-detection algorithm, provides a tool to identify destinations that share a common set of characteristics. This measure has three advantages over the extended-gravity measures. First, it is a revealed measure and, hence, encapsulates all the observable and non-observable factors that may influence the degree of similarity among destinations. Second, it is a country-specific measure. Third, it allows the calculation of industry-specific similarity measures.

We apply this methodology to the web of Bulgarian and Mexican exporters' destinations and find that there are nine communities in the Bulgarian web and ten communities in the Mexican web. We show that belonging to the same community of a previous export destination exerts a strong influence on the dynamics of the exporter. In particular, a one unit increase in the number of destinations previously served by the exporter within a community rises between 12% and 66% the probability of selecting a new export destination in that community. We show that the strong predictive capacity of the network-based similarity measure remains once we control for gravity and extended-gravity measures. In fact, the use of the network-based similarity measure improves the accuracy of the model predictions between 8% and 17%. We also show that industry-specific community of destinations and general community of destinations exert a similar influence on the dynamics of Mexican exporters' destination-portfolio.

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Figure 1a. The network of Bulgarian firms export destinations, 2002

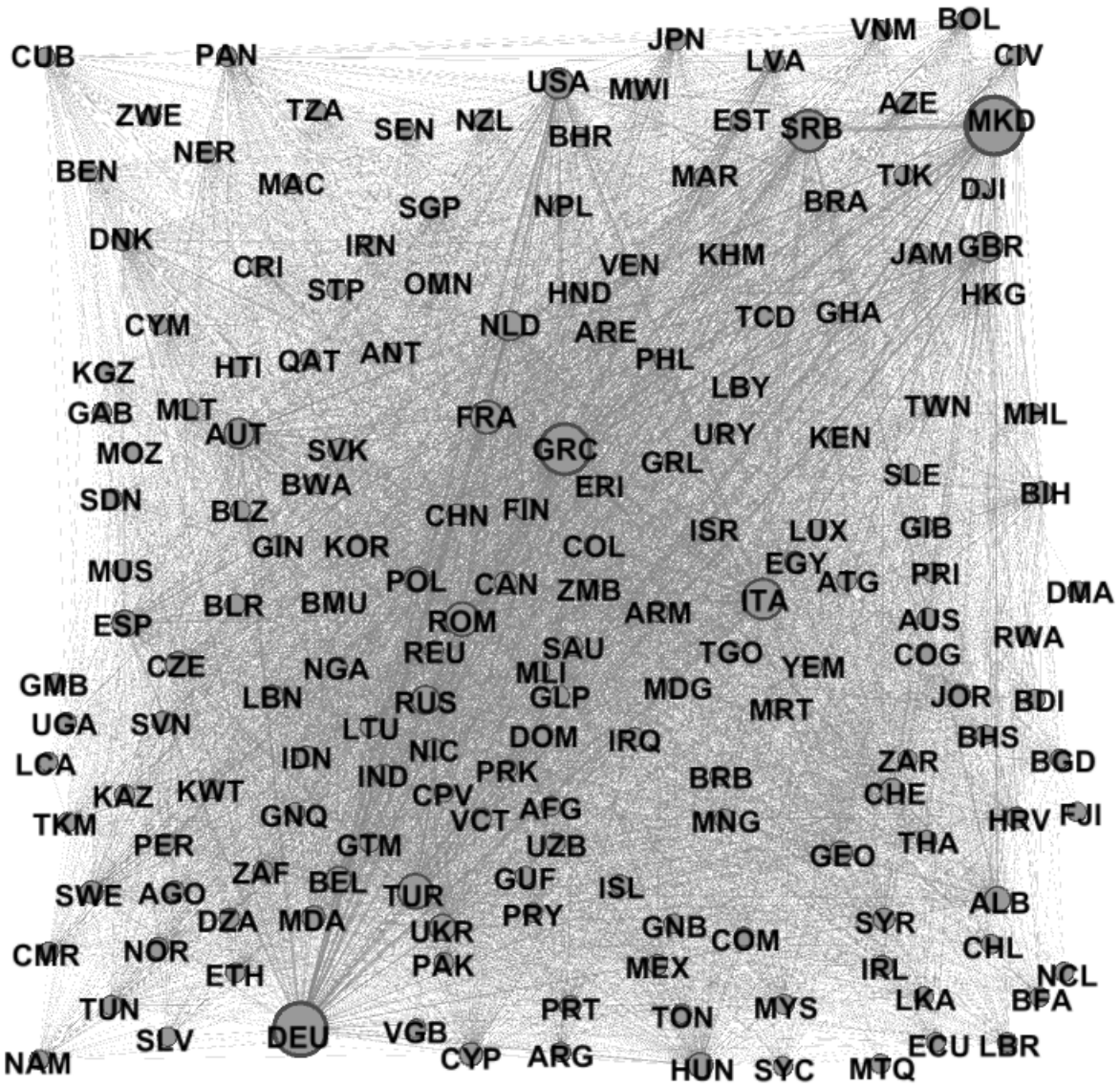

Figure 1b. The network of Mexican firms export destinations, 2002

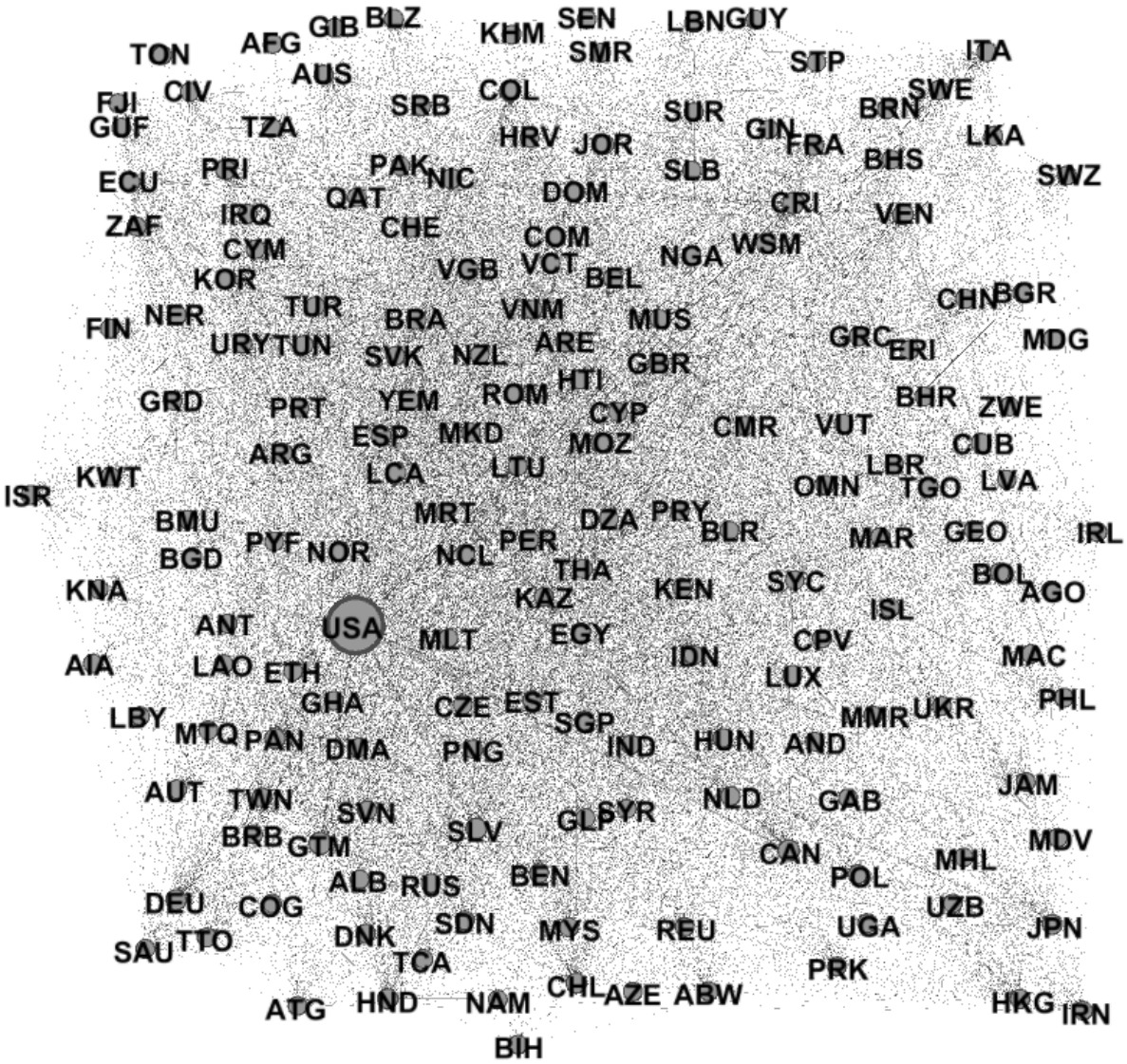

Figure 2a. Community detection process in the network of Bulgarian exporters' destinations

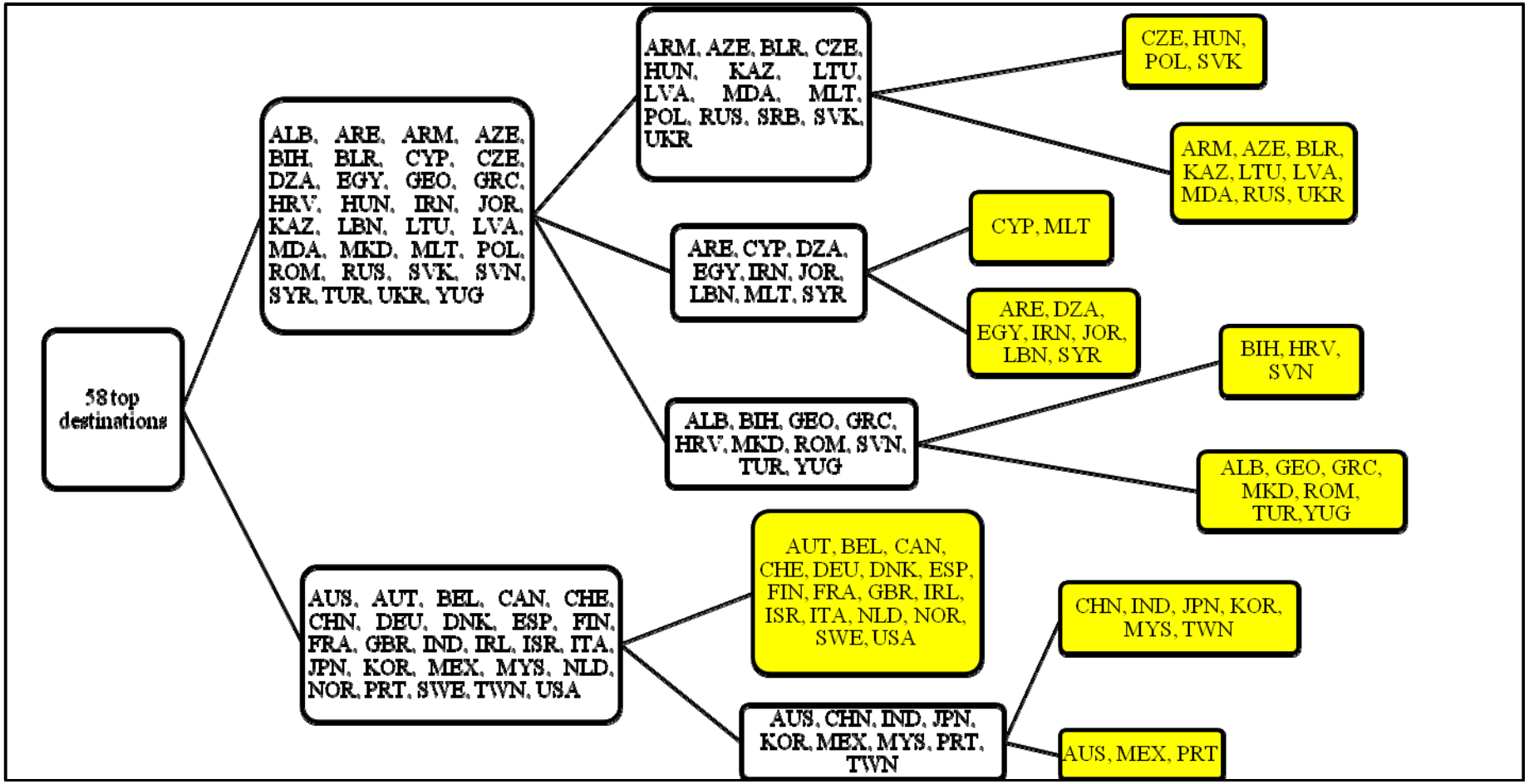

Figure 2b. Community detection process in the network of Mexican exporters' destinations

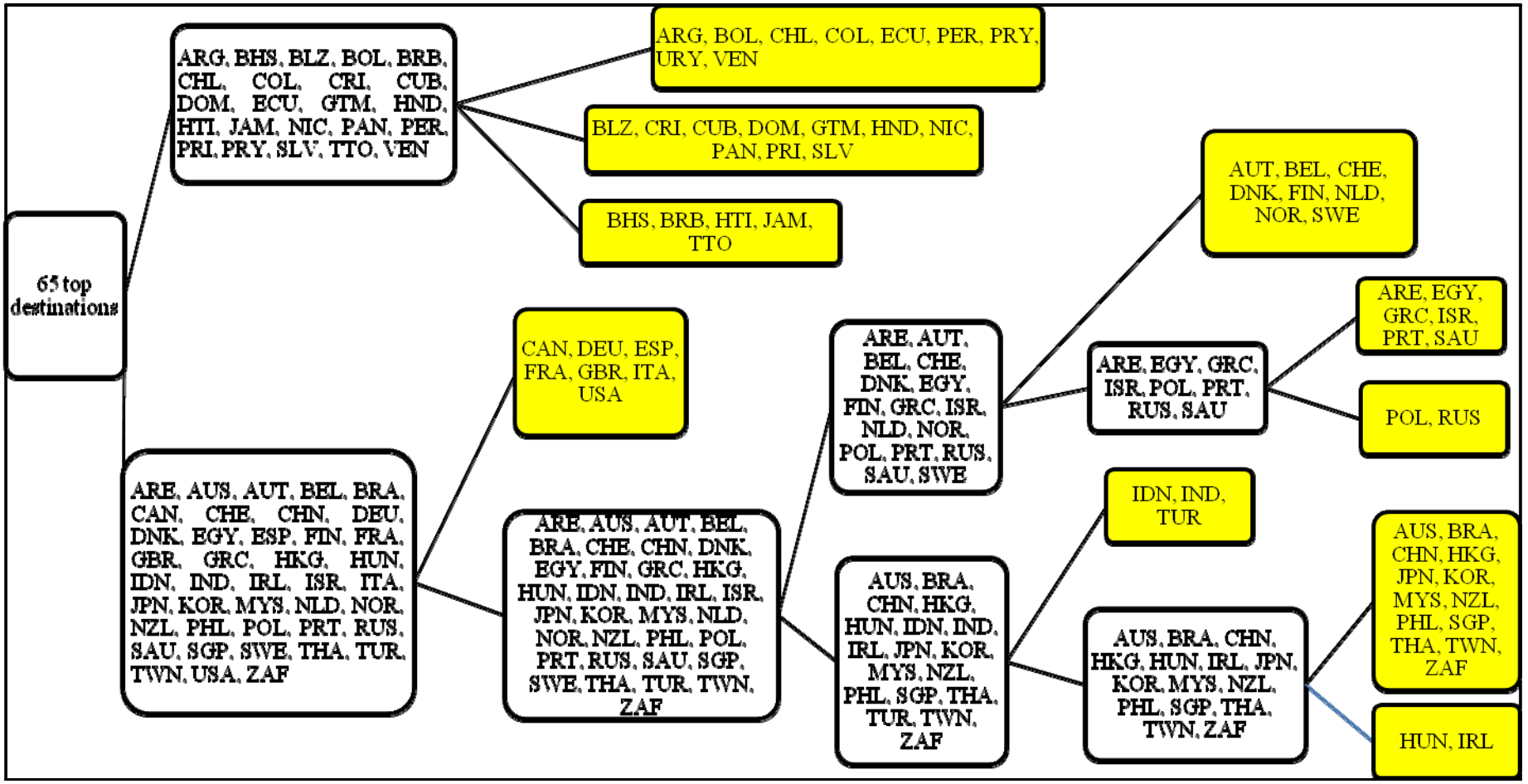

Table 1. Regression results of the probability of belonging to the same community on gravity measures

	Mexico	Bulgaria
Distance (Ln)	-0.016** (0.008)	-0.044*** (0.009)
Border	0.166*** (0.025)	0.133*** (0.028)
Language	0.294*** (0.025)	0.135*** (0.013)
Region	0.070*** (0.014)	0.177*** (0.016)
Income	0.182*** (0.011)	0.034*** (0.009)
Common colonizer	0.413*** (0.029)	0.034 (0.027)
Regional trade agreement	0.106*** (0.013)	-0.020 (0.016)
Migration flows (Ln)	0.017*** (0.001)	0.011*** (0.001)
Constant	0.024 (0.068)	0.359*** (0.085)
R-square	0.35	0.26
Observations	3,306	4,160

Note: Linear probabilistic model. Standard deviations in parentheses. ***, ** statistically significant at 1% and 5% respectively.

Table 2. Main results. Conditional logit estimations. Baseline results. (Dependent variable: Choice of new export destination)

	Panel A: Bulgaria				Panel B: Mexico			
Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Community	0.401*** (0.026)	0.234*** (0.021)	0.124*** (0.021)	0.113*** (0.023)	0.507*** (0.015)	0.391** (0.013)	0.255*** (0.013)	0.250*** (0.012)
GDP		0.538*** (0.018)	0.520*** (0.019)			0.506*** (0.009)	0.523*** (0.009)	
GDP pc		0.032 (0.026)	0.002 (0.026)			-0.176*** (0.012)	-0.178*** (0.012)	
Distance		-1.288*** (0.053)	-1.160*** (0.056)			-1.024*** (0.026)	-1.010*** (0.027)	
Border		0.102 (0.067)	0.195*** (0.069)			0.426*** (0.033)	0.336*** (0.043)	
Language						0.390*** (0.031)	0.430*** (0.034)	
RTA		-0.264*** (0.074)	-0.104 (0.077)			0.235*** (0.023)	0.154*** (0.024)	
Migrants		0.017* (0.009)	0.022** (0.009)			0.036*** (0.005)	0.013** (0.005)	
N_distance 1500			-0.068** (0.028)	-0.044 (0.028)			-0.027 (0.020)	0.070*** (0.020)
N_border			0.315*** (0.035)	0.399*** (0.037)			0.307*** (0.025)	0.294*** (0.023)
N_language			0.112*** (0.037)	0.171*** (0.044)			0.030*** (0.010)	0.036*** (0.009)
N_RTA			-0.131*** (0.017)	-0.065*** (0.016)			-0.017*** (0.005)	0.027*** (0.005)
N_income			0.100*** (0.019)	0.117*** (0.020)			0.078*** (0.009)	0.066*** (0.010)
N_migration			0.086*** (0.022)	0.052** (0.022)			0.078*** (0.010)	0.007 (0.009)
N_region			0.059*** (0.017)	0.013 (0.018)			0.064*** (0.012)	0.071*** (0.011)
Country dummies	No	No	No	Yes	No	No	No	Yes
Observations	131,655	110,163	110,163	131,655	446,161	427,847	427,847	446,161
Nº of firms	1,781	1,781	1,781	1,781	3,339	3,339	3,339	3,339
Nº of countries	58	58	58	58	65	65	65	65
R2	0.04	0.13	0.14	0.17	0.06	0.16	0.17	0.18

Note: Robust t-statistics of the estimated coefficients in parentheses using clustered standard errors at the firm-level. ***, **, * significant at 1 percent, 5 percent and 10 percent respectively.

Table 3. Estimations for different community hierarchies (Dependent variable: Choice of new export destination).

	Panel A: Bulgaria			Panel B: Mexico				
Community type	Final	2 iterations	1 iteration	Final	4 iterations	3 iterations	2 iterations	1 iteration
Community	0.113*** (0.023)	0.124*** (0.022)	0.145*** (0.017)	0.250*** (0.012)	0.245*** (0.012)	0.253*** (0.011)	0.192*** (0.011)	0.012 (0.009)
N_distance 1500	-0.044 (0.028)	-0.043 (0.028)	-0.051* (0.028)	0.070*** (0.020)	0.070*** (0.020)	0.076*** (0.020)	0.088*** (0.020)	0.101*** (0.020)
N_border	0.399*** (0.037)	0.385*** (0.037)	0.384*** (0.035)	0.294*** (0.023)	0.301*** (0.023)	0.309*** (0.022)	0.329*** (0.022)	0.358*** (0.024)
N_language	0.171*** (0.044)	0.173*** (0.043)	0.172*** (0.037)	0.036*** (0.009)	0.036*** (0.009)	0.044*** (0.009)	0.069*** (0.009)	0.076*** (0.009)
N_RTA	-0.065*** (0.016)	-0.055*** (0.016)	-0.014 (0.016)	0.027*** (0.005)	0.023*** (0.005)	0.013*** (0.005)	0.002 (0.005)	0.027*** (0.005)
N_income	0.117*** (0.020)	0.114*** (0.020)	0.094*** (0.019)	0.066*** (0.010)	0.066*** (0.010)	0.068*** (0.010)	0.045*** (0.009)	0.093*** (0.010)
N_migration	0.052** (0.022)	0.050** (0.022)	0.048** (0.022)	0.007 (0.009)	0.011 (0.009)	0.020** (0.009)	0.031*** (0.009)	0.013 (0.009)
N_region	0.013 (0.018)	0.004 (0.018)	0.005 (0.017)	0.071*** (0.011)	0.073*** (0.011)	0.069*** (0.011)	0.088*** (0.010)	0.095*** (0.011)
Observations	131,655	131,655	131,655	446,161	446,161	446,161	446,161	446,161
Nº of firms	1,781	1,781	1,781	3,339	3,339	3,339	3,339	3,339
Nº of countries	58	58	58	65	65	65	65	65
R2	0.17	0.17	0.17	0.18	0.19	0.20	0.17	0.19

Note: All estimations include destination-specific fixed effects. Robust t-statistics of the estimated coefficients in parentheses using clustered standard errors at the firm-level. ***, **, * significant at 1 percent, 5 percent and 10 percent respectively.

Table 4. Estimations with sector-specific communities

Dependent variable: Choice of new export destination.

	Bulgaria	Mexico
Community sector	0.096*** (0.022)	0.085*** (0.009)
Community no-sector	0.062*** (0.023)	0.105*** (0.009)
N_distance 1500	-0.052* (0.030)	0.064*** (0.021)
N_border	0.364*** (0.039)	0.316*** (0.023)
N_language	0.183*** (0.043)	0.063*** (0.009)
N_RTA	-0.074*** (0.015)	0.008 (0.006)
N_income	0.130*** (0.023)	0.054*** (0.010)
N_migration	0.048** (0.023)	0.010 (0.009)
N_region	0.021 (0.022)	0.101*** (0.011)
Observations	104,748	407,742
Nº of firms	1,840	3,440
Nº of countries	41	58
R2	0.16	0.20

Note: All estimations include destination-specific fixed effects. Robust t-statistics of the estimated coefficients in parentheses using clustered standard errors at the firm-level. ***, **, * significant at 1 percent, 5 percent and 10 percent respectively.

Table 5. Sensitivity Analyses (Dependent variable: Choice of new export destination)

Specification	Larger sample		N_distance 500		N_distance 3000		New exporter		Discrete		No US
	(1) Bulgaria	(2) Mexico	(3) Bulgaria	(4) Mexico	(5) Bulgaria	(6) Mexico	(7) Bulgaria	(8) Mexico	(9) Bulgaria	(10) Mexico	(11) Mexico
Community	0.160***	0.197***	0.112***	0.249***	0.110***	0.253***	0.158***	0.252***	0.572***	0.587***	0.259***
	(0.022)	(0.011)	(0.023)	(0.012)	(0.023)	(0.012)	(0.032)	(0.014)	(0.051)	(0.031)	(0.012)
N_distance 1500	-0.037	0.066***					-0.021	0.076***	-0.010	0.334***	0.066***
	(0.030)	(0.021)					(0.039)	(0.023)	(0.042)	(0.030)	(0.021)
N_distance 500			0.198***	0.170***							
			(0.046)	(0.033)							
N_distance 3000					-0.032	-0.039					
					(0.045)	(0.028)					
N_border	0.386***	0.287***	0.318***	0.242***	0.406***	0.280***	0.415***	0.288***	0.356***	0.436***	0.267***
	(0.037)	(0.024)	(0.044)	(0.023)	(0.037)	(0.022)	(0.052)	(0.026)	(0.047)	(0.030)	(0.023)
N_language	0.197***	0.051***	0.173***	0.029***	0.175***	0.035***	0.168***	0.047***	0.437***	0.331***	0.029***
	(0.043)	(0.009)	(0.044)	(0.009)	(0.044)	(0.009)	(0.062)	(0.010)	(0.061)	(0.037)	(0.009)
N_RTA	-0.054***	0.020***	-0.066***	0.028***	-0.064***	0.030***	-0.063***	0.028***	0.092	0.216***	0.026***
	(0.015)	(0.005)	(0.016)	(0.005)	(0.016)	(0.005)	(0.021)	(0.006)	(0.069)	(0.034)	(0.005)
N_income	0.093***	0.071***	0.117***	0.065***	0.117***	0.067***	0.105***	0.059***	0.330***	0.174***	0.072***
	(0.020)	(0.010)	(0.020)	(0.010)	(0.020)	(0.010)	(0.028)	(0.011)	(0.050)	(0.030)	(0.009)
N_migrants	0.039*	-0.006	0.049**	0.008	0.049**	0.006	0.040	0.007	0.226***	0.503***	0.019**
	(0.021)	(0.009)	(0.023)	(0.009)	(0.022)	(0.009)	(0.030)	(0.010)	(0.073)	(0.059)	(0.009)
N_region	0.001	0.082***	-0.001	0.083***	0.003	0.085***	0.010	0.079***	0.498***	0.523***	0.064***
	(0.018)	(0.018)	(0.016)	(0.010)	(0.016)	(0.010)	(0.024)	(0.013)	(0.109)	(0.039)	(0.011)
Observations	156,218	468,883	131,655	446,161	131,655	446,161	77,244	357,715	131,655	446,161	333,126
Nº of firms	1,840	3,328	1,781	3,320	1,781	3,320	1,224	2,826	1,781	3,320	2,750
Nº of countries	71	90	58	65	58	65	71	65	58	65	64
R2	0.19	0.21	0.17	0.19	0.17	0.19	0.16	0.20	0.18	0.21	0.16

Note: All regressions include destination-specific fixed-effects. Robust t-statistics of the estimated coefficients in parentheses using clustered standard errors at the firm-level. ***, ** significant at 1 percent and 5 percent respectively.

APPENDIX

Table A1a. Bulgarian exporters database (2001-2006)

	2001	2002	2003	2004	2005	2006
Number of exporting firms	11,533	11,457	11,262	11,104	10,961	11,007
Number of transactions	48,402	54,938	60,015	60,505	61,120	63,516
Value of exports (current US$ million)	5,397	6,180	7,755	10,146	11,731	15,092
Regular exporters (N=3102) (% firms)	27%	27%	28%	28%	28%	28%
% total transactions	54%	55%	55%	57%	56%	53%
% value of total exports	76%	72%	71%	69%	73%	75%
Regular new exporters Number			740	899	1,270	2,909
(% in total firms)			7%	8%	12%	26%
Transactions			2,345	3,455	3,597	15,189
(% in total transactions)			4%	6%	6%	24%
Value of exports			1,476	2,274	2,903	2,685
(% in total exports)			19%	22%	25%	18%
Memorandum						
Merchandise exports (Source: WDI)	5,117	5,933	7,544	9,932	11,739	15,096

Note: The term "firm" refers to any individual operator that makes a transaction in a year. The dataset contains all the transactions with a value above 1,500US$. The area in dark grey refers to the number of firms, number of transactions and value of exports in 2006 of the new regular exporters, that is, firms that started exporting after 2003 and did not stop exporting until 2006 (our Bulgarian firm sample).

Table A1b. Mexican exporters database (2000-2009)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Number of exporting firms	35.509	34.318	31.592	30.420	30.441	30.984	30.171	30.283	29.796	28.690
Number of transactions	183.586	181.343	171.029	161.899	167.905	173.620	174.308	187.267	190.584	183.036
Value of exports (current US$ million)	165.974	158.539	160.669	164.941	187.736	213.902	249.510	270.776	290.160	228.728
Regular exporters (N=5697) (% firms)	16%	17%	18%	19%	19%	18%	19%	19%	19%	20%
% total transactions	35%	38%	40%	40%	43%	46%	46%	46%	46%	46%
% value of total exports	60%	64%	65%	66%	66%	66%	67%	67%	68%	69%
Regular new exporters Number				757	948	1.110	1.283	1.928		6.026
(% in total firms)				2%	3%	4%	4%	6%		21%
Transactions				3.207	3.907	5.081	5.145	7.177		41.571
(% in total transactions)				2%	2%	3%	3%	4%		23%
Value of exports				30.890	29.351	28.498	33.411	62.596		47.805
(% in total exports)				19%	16%	13%	13%	23%		21%
Memorandum										
Merchandise exports (Source: WDI)	166.367	158.547	160.682	165.396	187.980	214.207	249.961	271.821	291.265	229.712

Note: The term "firm" refers to any individual operator that makes a transaction in a year. The dataset contains all the transactions with a value above 1,500US$. The area in dark grey refers to the number of firms, number of transactions and value of exports in 2009 of the new regular exporters, that is, firms that started exporting after 2003 and did not stop exporting until 2009 (our Mexican firms sample).

Table A2a. Bulgaria - Changes in export destination portfolio.

	(1)	(2)	(3)	(4)
Type of firm	New exporting firms since 2003 that do not stop exporting			Regular exporters 2001-2006
Years exporting	**03-04**	**04-05**	**05-06**	**05-06**
# new regular exporters	740	899	1270	
# firms in each period	740	1639	2909	3102
Changes in country portfolio (%)				
Only entries	26	22	20	16
Only exits	9	12	13	18
Simultaneous entry & exit				
same entries and exits	5	6	6	5
entries>exits	11	11	8	15
entries < exits	5	6	6	12
No change in portfolio	44	43	46	34

Table A2b. Mexico - Changes in export destination portfolio.

	(1)	(2)	(3)	(4)	(5)	(6)
Type of firm	New exporting firms since 2003 that do not stop exporting					Regular exporters 2000-2009
Years exporting	**03-04**	**04-05**	**05-06**	**06-07**	**07-08**	**07-08**
# new regular exporters	757	948	1110	1283	1928	
# firms in each period	757	1705	2815	4098	6026	5697
Changes in country portfolio (%)						
Only entries	21	17	15	14	15	16
Only exits	4	6	8	8	9	7
Simultaneous entry & exit						
same entries and exits	5	6	5	6	6	6
entries>exits	8	7	7	7	7	7
entries < exits	1	3	4	4	4	3
No change in portfolio	61	62	61	61	60	61

Source: Own elaboration using Census of Exporting Mexican Firms, 2000-2009.

Table A3. Dependent variable. Number of new export destinations per firm-year.

# entries per	**Bulgaria database**		**Mexico database**	
firm-year pair	Frequency	Cum. Freq.	Frequency	Cum. Freq.
1	1595	59,51	4104	56,63
2	549	20,49	1524	21,03
3	224	8,36	701	9,67
4	129	4,81	363	5,01
5	64	2,39	212	2,93
6	40	1,49	129	1,78
7	19	0,71	54	0,75
8	18	0,67	49	0,68
9	16	0,60	41	0,57
10	11	0,41	38	0,52
11 or more	15	0,56	32	0,44
Total	2680	100,00	7247	100,00

Table A4a. Communities by industries. Bulgaria 2002

Agriculture	Chemicals	Machinery & Transport equipment	Metals	Non-metallic minerals	Paper	Textiles
AUT	AUT	AUT	AUT	AUS	AUT	AUS
BEL	BEL	CHE	BEL	AUT	BEL	AUT
DEU	CAN	DEU	CHE	CAN	DEU	BEL
DNK	CHE	DNK	CYP	DEU	ESP	CAN
ESP	DEU	ESP	DEU	FRA	FRA	CHE
FIN	DNK	FRA	DNK	GBR	ITA	DEU
FRA	ESP	GBR	ESP	NLD	USA	DNK
GBR	FIN	IRL	FIN	POL	CHE	ESP
IRL	FRA	ITA	FRA	SWE	DNK	FIN
ITA	GBR	NLD	GBR	USA	TUR	FRA
NLD	GRC	SWE	HRV	FIN	KOR	GBR
SWE	IRL	USA	IRL	JPN	TWN	ITA
GEO	ITA	BEL	ISR	KOR	AUS	NLD
HUN	JPN	FIN	ITA	TWN	FIN	POL
LTU	NLD	ISR	NLD	ALB	JPN	SWE
LVA	SWE	SVN	SVN	BIH	SWE	TUR
CZE	TWN	TWN	SWE	ESP	CAN	USA
MDA	USA	AUS	TWN	GRC	GBR	CYP
POL	GEO	CAN	USA	HRV	IRL	HUN
ROM	LTU	JPN	AUS	ITA	ISR	IRL
RUS	LVA	KOR	CAN	LBN	NLD	JPN
SVK	AUS	CZE	JPN	MKD	BIH	KOR
TUR	CYP	HRV	KOR	SRB	CZE	LVA
UKR	ISR	HUN	ALB	TUR	HRV	TWN
CYP	KOR	LBN	BIH	BEL	HUN	CZE
GRC	SVN	LTU	GEO	CYP	LTU	HRV
LBN	CZE	LVA	GRC	DNK	POL	ISR
ALB	MDA	MDA	LBN	SVK	SVK	CAN
BIH	POL	POL	MKD	GEO	SVN	ROM
HRV	RUS	RUS	SRB	LTU	GRC	SVN
MKD	SVK	SVK	CZE	LVA	MKD	GEO
SRB	TUR	UKR	HUN	MDA	ROM	LTU
AUS	UKR	ALB	POL	UKR	SRB	MDA
ISR	ALB	BIH	ROM	CHE	UKR	RUS
KOR	BIH	CYP	SVK	CZE	ALB	SVK
JPN	HRV	GEO	TUR	HUN	CYP	UKR
CAN	HUN	GRC	LTU	IRL	GEO	ALB
CHE	LBN	MKD	LVA	ISR	LBN	BIH
JPN	MKD	ROM	MDA	ROM	LVA	GRC
TWN	ROM	SRB	RUS	RUS	MDA	MKD
USA	SRB	TUR	UKR	SVN	RUS	SRB

Table A4b. Communities by industries. Mexico 2002

Agriculture	Chemicals	Machinery & Transport equipment	Metals	Non-metallic minerals	Paper	Textiles
ARG	BOL	CHL	BOL	ARG	CHL	CHL
BOL	CHL	COL	CHL	BRA	COL	COL
BRA	COL	CRI	COL	CHL	CRI	CRI
CHL	CUB	CUB	ECU	COL	CUB	CUB
COL	ECU	DOM	PER	ECU	DOM	DOM
DOM	PAN	ECU	VEN	ESP	ECU	ECU
ECU	PER	GTM	BHS	PER	GTM	GTM
PER	VEN	HND	BLZ	VEN	HND	HND
PRI	BHS	NIC	BRB	BLZ	JAM	NIC
VEN	BRB	PAN	HTI	GRC	NIC	PAN
BHS	JAM	PER	JAM	HTI	PAN	PER
BLZ	TTO	SLV	TTO	JAM	SLV	PRI
BRB	CRI	USA	CRI	TTO	VEN	SLV
CUB	DOM	VEN	CUB	BHS	ARG	VEN
HTI	GTM	BHS	DOM	CHE	BRA	BZL
JAM	HND	BLZ	GTM	CRI	CAN	BOL
TTO	NIC	BOL	HND	CUB	HKG	BRB
URY	SLV	BRB	NIC	DOM	IDN	HTI
CRI	ARE	HTI	PAN	GTM	KOR	JAM
GTM	CHN	JAM	PRI	HND	MYS	TTO
HND	HKG	PRI	SLV	NIC	PER	CHN
NIC	IDN	TTO	HKG	PAN	PHL	HKG
PAN	KOR	ARG	HUN	PRI	URY	HUN
SLV	THA	IDN	MYS	SLV	AUS	THA
CHN	TWN	MYS	NLD	USA	AUT	TWN
KOR	AUS	NZL	SGP	ARE	BEL	BRA
PHL	GRC	PHL	THA	IDN	BHS	CAN
THA	MYS	SGP	TWN	KOR	BRB	CHE
HKG	NLZ	THA	AUS	THA	CAN	DEU
IDN	PHL	TWN	AUT	TWN	DEU	IDN
NZL	SGP	URY	BEL	CHN	ESP	KOR
SGP	DEU	ZAF	BRA	HKG	FIN	PHL
TWN	ESP	AUS	CHN	JPN	FRA	SWE
AUS	FRA	BEL	GBR	PHL	GBR	USA
BEL	GBR	BRA	JPN	ZAF	GRC	ARE
CAN	ITA	CAN	KOR	CAN	HUN	BEL
CHE	JPN	CHN	ZAF	FRA	ITA	BHS
DEU	BLZ	DEU	CAN	GBR	JPN	ESP
ESP	CAN	ESP	CHE	ITA	NLD	FRA
GRA	HTI	FRA	DEU	SAU	NZL	GRC
GBR	PRI	GBR	ESP	SWE	PRI	ITA
ITA	USA	HKG	FRA	FIN	PRT	NLD
JPN	FIN	ITA	ITA	MYS	SAU	PRT
NLD	HUN	JPN	USA	NLZ	SWE	AUS
SWE	SAU	KOR	ARE	BOL	TWN	FIN
USA	ARG	NLD	SAU	HUN	USA	GBR
ARE	BRA	ARE	ARG	SGP	ARE	JPN
GRC	PRT	FIN	IDN	URY	BLZ	MYS
MYS	URY	GRC	PHL	AUS	BOL	SGP
PRT	ZAF	SAU	URY	AUT	SGP	ZAF
SAU	AUT	AUT	FIN	BEL	THA	ARG
AUT	BEL	CHE	GRC	BRB	TTO	AUT
FIN	CHE	HUN	NZL	DEU	CHE	NZL
HUN	NLD	PRT	PRT	NLD	HTI	SAU


ZAF
SWE
SWE
SWE
PRT
ZAF
URY

Table A5. Adjusted Rand indexes

Panel A. Community-partitions across industries

Bulgaria

	Agriculture	Chemicals	Machinery & Transport equipment	Metals	Non-metallic minerals	Paper	Textiles
Agriculture	**1.00**						
Chemicals	0.59	**1.00**					
Machinery & Transport equipment	0.39	0.37	**1.00**				
Metals	0.41	0.45	0.45	**1.00**			
Non-metallic minerals	0.15	0.10	0.20	0.10	**1.00**		
Paper	0.14	0.13	0.22	0.14	0.09	**1.00**	
Textiles	0.34	0.40	0.29	0.32	0.27	0.16	**1.00**

Mexico

	Agriculture	Chemicals	Machinery & Transport equipment	Metals	Non-metallic minerals	Paper	Textiles
Agriculture	**1.00**						
Chemicals	0.31	**1.00**					
Machinery & Transport equipment	0.34	0.32	**1.00**				
Metals	0.37	0.31	0.38	**1.00**			
Non-metallic minerals	0.26	0.24	0.24	0.32	**1.00**		
Paper	0.23	0.16	0.28	0.18	0.17	**1.00**	
Textiles	0.26	0.25	0.41	0.35	0.23	0.25	**1.00**

Panel B. Industry partitions vs. rest of industries partitions

Industry	Adjusted Rand Index Bulgaria	Adjusted Rand Index Mexico
Agriculture	0.42	0.36
Chemicals	0.49	0.14
Machinery & Transport equipment	0.37	0.38
Metals	0.42	0.25
Non-metallic minerals	0.22	0.31
Paper	0.22	0.31
Textiles	0.53	0.22

Table A6 (a). Community detection process in the network of Bulgarian exporters' destinations using the 2001-2002 sample

AUT, BEL, CAN, CHE, DEU, DNK, ESP, FIN, FRA, GBR, IRL, ITA, NLD, NOR, SWE, USA
AUS, ISR, MEX, PRT, THA, ZAF
IDN, MYS, SGP
CHN, HKG, IND, JPN, KOR, TWN
EGY, IRN, JOR, LBN, SYR
ARE, NGA, SAU
DZA, MAR, TUN
CZE, HUN, POL, SVK
BLR, EST, LTU, LVA, RUS, UKR
ARM, AZE, GEO, KAZ, MDA, UZB
BIH, HRV, SVN
ALB, GRC, MKD, ROM, YUG, TUR

Table A6 (b). Community detection process in the network of Mexican exporters' destinations using the 2000-2002 sample

ARG, BOL, CHL, COL, ECU, PER, PRY, URY, VEN
BLZ, CRI, CUB, DOM, GTM, HND, NIC, PAN, PRI, SLV
DMA, HTI, JAM, SUR, TTO
ABW, ANT, ATG, BHS, BMU, BRB, CYM, LCA, VCT, GUY
BEL, BRA, CAN, CHE, DEU, ESP, FRA, GBR, ITA, JPN, NLD, USA
ARE, EGY, JOR, KWT, LBN, SAU, SYR
DZA, LKA, MAR, PAK, TUR
DNK, FIN, NOR, SWE
AUT, CZE, HUN, IRL
NGA, VGB
CHN, HKG, IDN, IND, KOR, MYS, PHL, PRK, SGP, THA, TWN, VNM
AUS, NZL, ZAF