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Abstract

Purpose – The paper aims to examine the locational determinants of the internationalization flows of high-tech start-ups. It also provides a picture of the current patterns of internationalization of high-tech start-ups, through a map of the most attractive countries in terms of inbound and outbound internationalization flows.

Design/methodology/approach – The empirical data have been obtained from a cross-country survey on internationalized high-tech start-ups operating in the ICT and electronics sectors. To explore the determinants of the intensity of internationalization flows of high-tech start-ups between a pair of countries, this study adopts a modified gravity model.

Findings – Results highlight that USA, UK and China are the most competitive countries in terms of inbound flows. This paper obtains evidence that internationalization flows of high-tech start-ups are motivated by the sourcing of host country locational advantages, identified by the strength of the legal and regulatory framework, the availability of VC financing, the innovation potential and the strength of IPR protection.

Originality/value – This paper adds to the international business literature in two ways. First, it provides a picture of the current patterns of internationalization for high-tech start-ups through a map of the most attractive countries in terms of inbound and outbound internationalization flows. Second, this research is an empirical attempt to understand the relationship between internationalization patterns of high-tech start-ups and attractiveness of host countries. To date, the authors are unaware of any other study that has examined the extent to which the internationalization flows of high-tech start-ups are affected by host country conditions in a cross-country context.

Keywords Gravity model, High-tech start-ups, Host country conditions, Internationalization flows

Paper type Research paper

Introduction

In recent years, entrepreneurship has become a topic of major interest for policy-makers, as it increasingly contributes to a country's innovation and economic growth. In several countries, policy-makers have paid special attention to innovative start-ups, characterized by high-technology content and a significant growth potential and have implemented a wide array of financial, economic and legal interventions tailored to the specific economic contexts (Buzzacchi *et al.*, 2013; Cannone and Ughetto, 2014a, 2014b; Wallsten, 2000; Irwin and Klenow, 1996). The rationales often advocated for these policies have been:

- to influence domestic entrepreneurs' incentives and payoffs to create new technology based firms, thus setting the ground for new high-tech industries in the country; and

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- to attract innovative firms from other countries to strengthen the country's extant high-tech sectors.

Setting the conditions to make a country attractive to internationally oriented small firms is a critical issue for host countries because firms' internationalization flows are conditioned by a complex mix of out-selection factors which can constrain or boost firms' preferences for international operations. Out-selection factors are both associated with the host country conditions (such as the general state of the economy, the legal framework, the presence of incentive policies, the cultural background, the strength of bilateral political relationships, of bilateral trade agreements, of internal networks […]) and with global dynamics and challenges (such as changes in currency values, stock market conditions, unnatural or natural events […]).

These issues are particularly relevant today, given that the increased openness of economies, the emergence of global players, the firms' need for new sources of competitiveness and the technological advances in communication, information and transportation which have drastically reduced internationalization costs have been reshaping the business environment of firms. In this context, young technology-based firms increasingly conceive internationalization as a process embedded in their overall growth path, no longer limited to sales activities, as theorized in the traditional internationalization models (Johanson and Vahlne, 1977), but also to R&D and innovation activities (Granstrand *et al.*, 1993; Brockhoff, 1998). In addition, several innovative start-ups tend to adopt a global market vision from the outset and embark on rapid and dedicated internationalization through exportation or any other entry mode (the so-called born globals, Knight and Cavusgil, 1996).

In recent years, the international business literature has offered insights on the internationalization dynamics of firms from two main perspectives. One main strand of research has focused on macro-economic analyses of bilateral foreign direct investment (FDI) or export flows (Buckley *et al.*, 2007; Grosse and Trevino, 1996). Research in this area has examined the factors affecting the extent of trade between countries, looking at economic, cultural, political and juridical differences between host and home countries (Braunerhjelm and Svensson, 1996). The international operations of large multinational firms have been the main focus of such analyses. Instead, little is known about which factors enable a host country to be attractive for high-tech start-ups and which countries are the most attractive for such companies.

Another strand of literature has investigated the modes and determinants characterizing the internationalization process of young and small firms. Under the assumption that this latter is substantially different from the one concerning multinational enterprises (Dimitratos and Jones, 2005), this literature has examined the modes of entry, the timing (in relation to the development stage of the firm) and the scope of the international expansion of small firms. These papers have mainly focused on one particular country (Chetty and Campbell-Hunt, 2004; Kuivalainen *et al.*, 2007; Zucchella *et al.*, 2007), while the few attempts made to compare different experiences in several countries have mainly been of a qualitative nature (Gabrielsson *et al.*, 2008; Gabrielsson and Pelkonen, 2008). Cross-country quantitative survey research in this field of study is somewhat scant and limited by small sample sizes.

This paper adds to the international business literature in two ways. First, it provides a picture of the current patterns of internationalization for high-tech start-ups through a

map of the most attractive countries in terms of inbound and outbound internationalization flows. Second, this research is an empirical attempt to understand the relationship between internationalization patterns of high-tech start-ups and attractiveness of host countries. In particular, the paper examines whether internationalization flows of high-tech start-ups are motivated by the sourcing of the host country locational advantages (such as the legal and regulatory framework, the availability of venture capital [VC] financing, the innovation potential and the strength of protection of intellectual property rights [IPR]), controlling for the host country competitive conditions, market size, similarity of socio-cultural environment and distance from the home country. To date, we are not aware of any other study that has examined to what extent the internationalization flows of high-tech start-ups are affected by host country conditions in a cross-country context.

To address these issues, a sample of 429 firms, represented by respondents to a questionnaire survey conducted over the December 2011-February 2012 period, has been analyzed. The surveyed firms are internationalized high-tech start-ups operating in the information and communications technology (ICT) and electronics sectors, located in different countries throughout the world. Information on internationalization trajectories has been complemented by country-level data on host/home countries.

Results highlight that USA, UK and China are the most competitive countries in terms of inbound flows of high-tech start-ups. We obtain evidence that countries characterized by a high degree of investors' protection, IPR protection and innovation capacity tend to attract a larger number of high-tech start-ups. The cost of contract enforcement in the host country has a negative explanatory power on the intensity of internationalization flows. Finally, another major driver that influences the attractiveness of host countries for high-tech start-ups is the availability of VC financing.

The remainder of this paper is organized as follows. Section 2 puts forward some testable hypotheses in the context of prior research. Section 3 describes the dataset and presents the descriptive statistics. Section 4 introduces the gravity model and discusses the results. Section 5 concludes and summarizes the paper.

Hypotheses

In this section, we formulate a set of hypotheses regarding the association between internationalization flows of high-tech start-ups and the attractiveness of the host country. The theoretical foundation of the determinants that affect the location choice of a firm willing to internationalize its business goes back to the "eclectic paradigm" (also known as OLI model) developed by Dunning (1977)[1]. Dunning (1977) suggests four major motives that drive FDIs:

(1) market-seeking (e.g. economy size);

(2) resource-seeking (e.g. availability of natural resources);

(3) efficiency-seeking (e.g. infrastructure quality); and

(4) strategic asset seeking (e.g. availability of strategic assets).

Although Dunning (1977)'s model applies only to FDI, it can provide some useful insights to interpret the location decisions of firms that internationalize through

different entry modes. The model has been also used to explain the internationalization of innovation activities by technology-based firms (Granstrand *et al.*, 1993).

In this paper, we concentrate only on host country endowments that make it attractive for foreign firms to operate in the host country. We consider several dimensions that characterize the attractiveness of a host country environment:

- the legal and regulatory framework;
- the dimension of the VC industry;
- the innovation capacity; and
- the degree of IPR protection.

The legal and regulatory framework of a host country can heavily influence the easiness of starting and operating a business in that country. This is particularly important for small firms, which are endowed with limited financial resources and which face a harsh competition with larger and more experienced firms. Poorly designed business regulations, combined with weak legal institutions that protect property and investor rights, can become obstacles to doing business and more generally constrain economic growth and trade performance. A large body of evidence suggests that policy-makers interested to attract FDI in their country need to pay attention to the quality of business regulations, laws, institutional arrangements and to their enforcement (Alesina *et al.*, 2005; Antunes and Cavalcanti, 2007; Freund and Bolaky, 2008; Barseghyan, 2008; Klapper *et al.*, 2009; Naudè and Krugell, 2007). A business-friendly environment is more likely to attract the activities of foreign companies because it creates the incentives to create jobs, to innovate and to increase productivity (Antunes and Cavalcanti, 2007; Klapper *et al.*, 2009; Hornberger *et al.*, 2011; Busse and Groizard, 2008).

A favorable environment to set up a business is characterized by an adequate level of investors' protection and by a limited cost of enforcing contracts. Countries that can best create a welcoming environment for investors, in terms of protection and contracts enforcement, can attract greater and more competitive inflows of foreign companies. The strength of shareholder protection has been widely recognized to matter for companies because it determines investor confidence in markets, makes investment in firms to be less sensitive to financial constraints and leads to greater growth in revenues and profitability (Mclean *et al.*, 2012; Shleifer and Wolfenzon, 2002; La Porta *et al.*, 1998). High-tech start-ups, which are characterized by a low internal financial availability, often rely on external investors to acquire the capital necessary for their growth. These external investors, typically venture capitalists, are very concerned to preserve their investments from potential unfavorable rules which might apply in a different country. A judicial system that provides timely and cheap procedures to resolve commercial disputes is crucial to attract the interest of foreign investors. In particular, it has been found that FDI are greater where the cost of contract enforcement is lower (Ahlquist and Prakash, 2010).

This line of arguments on the strength of the legal and regulatory framework in the host country leads to the following two testable hypotheses:

H1. The extent of shareholder protection in a host country is positively related to the intensity of internationalization flows of high-tech start-ups toward that country.

H2. The cost of contract enforcement in a host country is negatively related to the intensity of internationalization flows of high-tech start-ups toward that country.

VC has traditionally been advocated to play a critical role for high-tech start-ups that find it difficult to access capital markets to fund their operations, finance their investment opportunities and sustain their growth. Financial constraints are particularly acute for innovative entrepreneurial firms because their investment returns are uncertain, they have little collateral to secure debt and they are subject to higher informational frictions (Carpenter and Petersen, 2002; Hall, 2002). A start-up might be interested in the presence of VC funds in target markets for two main reasons:

(1) start-ups that have not yet raised VC money in their home market might decide to move to other countries where there are more opportunities to secure VC investments to scale their businesses; and

(2) more mature start-ups could look for additional funding that the domestic VC market is not able or willing to provide.

The evidence that more available VC allows for an increase in successful entrepreneurial activity (Kortum and Lerner, 2000; Bottazzi and Da Rin, 2002) has led many governments worldwide to implement programs to mobilize VC (Buzzacchi *et al.*, 2013). Founders of start-ups that want to internationalize will certainly consider moving into a country characterized by a greater availability of VC funding. Accordingly, we posit that:

H3. A greater availability of VC financing in the host country is positively related to the intensity of internationalization flows of high-tech start-ups toward that country.

A host country's innovative capacity can form another important motivation driving the internationalization flows of technology-intensive start-ups. This capacity reflects the conditions, investments and policy choices that create the environment for innovation (e.g. the presence of strategic assets such as research centers and laboratories, skilled R&D personnel, high-quality universities, brands and technology […]). The literature has identified two basic motives that drive technology-based firms' decisions to target countries characterized by innovative capacity (Kuemmerle, 1999; Le Bas and Sierra, 2002; von Zedtwitz and Gassmann, 2002). First, according to the "asset exploiting" arguments, firms are interested in promoting the use of their technological assets/products in markets that are receptive to innovation and technological advances. Indeed, the responsiveness of customers to innovations is an important element of location attractiveness. Obviously, some level of modification to the company's products or processes may be required in response to local demand conditions (Dachs and Pyka, 2010; Criscuolo *et al.*, 2005). Second, an "asset augmenting" strategy is followed when the innovation system of the foreign location allows firms to absorb and acquire technological capacities, spillovers or other location-specific technological advantages that are not available at home (Dunning and Narula, 1995; Kuemmerle, 1999). According to this view, establishing a presence abroad responds to the firm's need to augment its existing stock of knowledge by seeking advantageous locations where

complementary competencies are available. These arguments lead to the following hypothesis:

H4. A host country's innovative capacity is positively related to the intensity of internationalization flows of high-tech start-ups toward that country.

IPR protection has a decisive influence on the internationalization trajectory of high-tech firms. If firms engage in R&D and innovation activities in the host country (even if by simply adapting existing products to the local market), the results of these activities may only be protected at the host country patent office (Dachs and Pyka, 2010). IPR protection is relevant for all manufacturing sectors, and increasingly for information technology sectors, whose investments are also sensitive to property rights risks (Jandhyala, 2013). It follows that strong IPR protection should attract FDIs, large volumes of licensed technology and favor international technological collaborations, as it limits the possibility of the threat of imitation (Maskus and Penubarti, 1995). We, thus, advance the following hypothesis:

H5. Strong IPR protection is positively related to the intensity of internationalization flows of high-tech start-ups toward that country.

Sample characteristics and descriptive statistics

Data sources

The data used for the study include information collected both at firm and country level. Data concerning the internationalization path of sample firms have been obtained from a survey conducted over the December 2011-February 2012 period on internationalized high-tech start-ups operating in the ICT and electronics sectors and located in different countries throughout the world. Survey data have been used in a companion paper by Cannone and Ughetto (2014,2014b). The basic data and e-mail contacts for the surveyed companies have been extracted in October 2011 from CrunchBase[2], a free high-technology company and investor database with global geographical focus.

We selected companies operating in the following sub-fields (according to the CrunchBase definition): advertising, e-commerce, enterprise, games and video, mobile, network hosting, search, security and software. This resulted in a sample of 38,585 start-up companies located worldwide. Firms with missing information on e-mail addresses were excluded and the sample was restricted to only internationalized firms, leading the sample to be reduced to 2,604 companies.

Questionnaires were sent out electronically over the December 2011-February 2012 period. A follow-up was undertaken by sending reminders to those who had not responded after six weeks from the first mailing. The respondents were assured confidentiality. In total, 522 responses were gathered, yielding an effective response rate of about 20 per cent. Non-response bias was checked on a number of variables based on the notion that late respondents would be more like non-respondents than earlier respondents (Armstrong and Overton, 1977). The results showed that the non-response bias was minimal, with respect to all the questionnaire items.

Firms were asked to report the country in which they first internationalized. Observations with missing values in this variable were dropped, and the sample was, thus, reduced to 429 companies, targeting 76 countries. For each country of destination, we gathered information on some macro indicators such as GDP, stock of patent applications, FDIs, exports, size of the VC industry, strength of the legal and regulatory

framework and strength of IPR protection. We also collected data on different distance measures connecting home and host countries. We used several data sources: the CEPII database, the World Economic Outlook database (IMF), the Unctadstat database (UNCTAD), Thomson Innovation, Venture Source, the Doing Business report (World Bank) and the International Trade Statistics report (WTO).

Summary statistics

Out of 429 firms, 34.83 per cent operate in the software sector, 25.84 per cent in the web sector and 10.79 per cent in the mobile sector. These firms are mainly based in Europe and North America (48.48 and 30.07 per cent, respectively). Firms located in Asia are 14.22 per cent, followed by Central and South America (4.20 per cent) and Africa and Oceania (3.03 per cent). The sample covers 76 countries.

Internationalization flows of sample firms are directed mainly toward North America. Indeed, internationalization flows to North America represent 40.79 per cent of the total inbound flows, followed by Europe (38.23 per cent), Asia (12.59 per cent), Central and South America (4.20 per cent), Oceania (3.50 per cent) and Africa (0.70 per cent). Table I reports the outbound and inbound internationalization flows for the top-ten countries in terms of flow size. The size of the outbound flow for a country is given by the number of firms founded in that country that internationalize to other countries. The size of the inbound flow for a country indicates the number of firms which have chosen that particular country as the first country in which to internationalize. As Table I shows, the USA ranks first for both outbound and inbound flows. While being the country in which most of sample companies have headquarters, the USA seems to be the most attractive destination for companies founded in other countries. A similar situation characterizes the UK. China does not show a high volume of outbound flows, while being characterized by significant inbound flows. This means that although the number of Chinese companies which internationalize is relatively low, the country seems to be an attractive destination for companies located in other countries.

	Outbound flows			Inbound flows		
Rank	Country	Flow size	%	Country	Flow size	%
1	The USA	98	22.84	The USA	152	35.43
2	The United Kingdom	49	11.42	The United Kingdom	65	15.15
3	Canada	23	5.36	Canada	23	5.36
4	Spain	23	5.36	India	16	3.73
5	France	20	4.66	Australia	12	2.80
6	India	19	4.43	China	12	2.80
7	Italy	13	3.03	Germany	12	2.80
8	Israel	12	2.80	The Netherlands	12	2.80
9	Switzerland	12	2.80	Italy	10	2.33
10	Germany	11	2.56	Argentina	9	2.10

Table I.
Top ten countries for outbound and inbound internationalization flows

Note: The table reports the outbound and inbound internationalization flows for the top ten countries in terms of flow size. The size of the outbound flow for a country is given by the number of firms founded in that country that internationalize to other countries. The size of the inbound flow for a country indicates the number of firms which have chosen that particular country as the first country in which to internationalize

The geography of net flows is illustrated in Figure 1. Net flows are defined as the difference between the inbound and the outbound flows and can be either positive or negative. The green circles indicate countries characterized by negative net flows, whereas the red circles identify countries with positive net flows. The diameter of the circle represents the size of the net flows. The USA is characterized by the highest positive net flows (54), followed by United Kingdom (16), China (9) and Australia (6). The map shows that Europe is characterized by a large number of countries showing large negative net flows; the country with the highest negative net flows is Spain (14), followed by France (12), Switzerland (9) and Israel (9). The presence of significant negative net flows characterizes South America as well, even if the extent of the phenomenon appears to be more limited.

Figure 2 depicts the linkages in terms of bilateral flows that exist among analyzed countries. The size of the link between an hypothetical country A and a country B is given by the number of firms which have internationalized from country A to country B or vice versa. Stronger links are associated with thicker lines. It is possible to observe the presence of strong linkages between countries which are known to have consolidated trade relationships. For example, if we consider the USA which ranks first in terms of bilateral flows, it emerges that the USA and the UK account for 48 bilateral linkages, followed by USA and India (21) and USA and Canada (19).

Empirical analysis

The gravity model

To explore the determinants of the intensity of internationalization flows of high-tech start-ups between pair of countries we adopt a modified gravity model. The gravity model has been largely employed to explain bilateral trade flows (see De Benedictis and

Note: Net flows are defined as the difference between the inbound and the outbound flows and can be either positive or negative. The green circles indicate countries characterized by negative net flows, while the red circles identify countries with positive net flows. The diameter of the circle represents the size of the net flows

Figure 1.
Positive and negative net flows

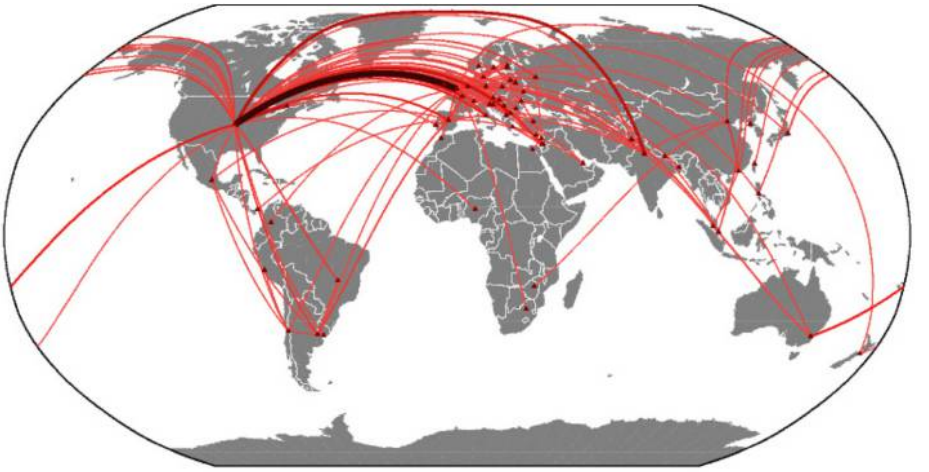

Figure 2.
Bilateral internationalization flows

Note: The size of the link between an hypothetical country A and a country B is given by the number of firms which have internationalized from country A to country B or vice versa. Stronger links are associated with thicker lines

Taglioni, 2011 for a review), as increasing in their economic size and decreasing in their distance[3].

The dependent variable of the gravity model is the intensity of the internationalization flow from country *i* to country *j* (FLOW_INTENSITY), measured by the number of firms established in country *i* which choose to enter country *j* as a first country of entry. Internationalization flows between pairs of countries are assumed to depend upon a set of destination-specific variables that affect the attractiveness of country *j*, distance measures and bilateral "linkages" between the two countries. A listing of the variables used in the empirical analysis along with their definitions and data source is provided in Table II.

Distance effects are estimated as a parameter in the gravity equation. The model incorporates geographical and cultural distance between host and home country as explanatory variables. We consider four different measures of geographical distance: DIST refers to the latitude and longitude of the most populated cities, DIST_CAPITAL refers to the latitude and longitude of capital cities, DIST_WEIGHTED is a weighted (by the share of country population) measure of the distances of the most populated cities. To account for the importance of differences in time zones in affecting business transactions (Stein and Duade, 2007), we also include the variable TIME ZONE, which measures the time difference in hours between the capital cities of countries *i* and *j*. This variable ranges from 0 to 12.

While most of scholarly works have found a persistence negative effect of distance on bilateral trade flows[4], it is quite likely that this effect is not fully explained by transportation costs alone. It could well be that what really matters is a broad concept of distance, which also includes socio-cultural distance. The similarity of the socio-cultural environment between two countries has been identified to be a critical dimension in explaining trade flows; it can have a profound impact on market access, on consumption patterns and on how business is conducted (Kogut and Singh, 1988; Fletcher and Bohn,

Dependent variable	
Flow intensity$_{ij}$	Number of firms established in country *i* which choose to enter country *j* as a first country of entry
Independent variables	
GDP$_i$	GDP of country *i* in 2011 (logarithm). Source: World Economic Outlook, IMF
GDP$_j$	GDP of country *j* in 2011 (logarithm). Source: World Economic Outlook, IMF
Patents$_i$	Total number of patent applications in country *i* until the year 2011 (logarithm). Source: Thomson Innovation database, Thomson Reuters
Patents$_j$	Total number of patent applications in country *j* until the year 2011 (logarithm). Source: Thomson Innovation database, Thomson Reuters
DIST$_{ij}$	The variable refers to the latitude and longitude of the most populated cities. Source: CEPII database
DIST_CAPITAL$_{ij}$	The variable refers to the latitude and longitude of capital cities. Source: CEPII database
DIST_WEIGHTED$_{ij}$	The variable is a weighted (by the share of country population) measure of the distances of the most populated cities. Source: CEPII database
Time zone$_{ij}$	Time difference in hours between the capital cities of countries *i* and *j*. This variable ranges from 0 to 12. Source: CEPII database
Common lang (0, 1)	Dummy variable which takes value 1 if country *i* and country *j* share the same language. Source: CEPII database
Colony (0, 1)	Dummy variable which takes value 1 if country *i* and country *j* have ever had a colonial relationship. Source: CEPII database
Common legal (0, 1)	Dummy variable which takes value 1 if country *i* and country *j* share the same legal origin. Source: CEPII database
IPR protection$_j$	The Index of Patent Rights Park (2008) for country *j* ranges from 0 to 5. It is the un-weighted sum of the figures for five different aspects of protection of patent rights (extent of coverage, membership of international treaties, duration of protection, absence of restrictions on rights and statutory enforcement provisions). Source: Park, 2008
Investor protection$_j$	The investor protection index for country *j* ranges from 0 to 10, with higher values indicating more investor protection. The index considers the transparency of related-party transactions, the liability for self-dealing and the shareholders' ability to sue officers and directors for misconduct. Source: Doing Business Report 2013, World Bank
Cost enforcement$_j$	Average costs (court costs, enforcement costs and attorney fees) involved in resolving a commercial dispute in country *j*. Source: Doing Business Report 2013, World Bank
VC amount$_j$	Amount of capital invested in VC deals in country *j* in year 2011 (logarithm). Source: Venture Source, Down Jones
Cost export$_i$	Average cost to complete the procedures to export the goods for country *i* (logarithm). The cost includes costs for documents, administrative fees for customs clearance and inspections, customs broker fees, port-related charges and inland transport costs. Source: Doing Business Report 2013, World Bank
FDI$_J$	FDI stock for country *j* in year 2011 (logarithm). Source: Unctadstat database, UNCTAD
Export$_j$	Total exports for country *j* in year 2011 (logarithm). Source: International Trade Statistics report, WTO

Table II.
Definition of variables used in the empirical analysis

1998). We account for the role of socio-cultural distance by using a vector of linkage variables identifying country pairs with a common language (COMMON LANG), a common legal origin (COMMON LEGAL) and a past colonial link (COLONY).

To validate *H1* and *H2*, we include in the model two variables capturing the strength of the legal and regulatory framework in the host country:

(1) the investors protection index, which measures the strength of shareholder protections against directors' misuse of corporate assets (INVESTOR PROTECTION); and

(2) the cost of contract enforcement (COST ENFORCEMENT), which measures the costs (court costs, enforcement costs and attorney fees) involved in resolving a commercial dispute.

H3 is tested using the amount of capital invested in VC deals in country *j* in year 2011 (VC AMOUNT), whereas the innovation capacity of the host country (*H4*) is proxied by the total number of patent applications till the year 2011, extracted from Thomson Innovation database through a search of kind codes. The model specification also controls for patent applications in the home country. We assess the degree of protection of IPR (*H5*) by employing the Index of Patent Rights provided by Park (2008). This index ranges from 0 to 5 and is the un-weighted sum of the figures for five different aspects of protection of patent rights (extent of coverage, membership of international treaties, duration of protection, absence of restrictions on rights and statutory enforcement provisions).

We substitute the masses of the law of gravity in the gravity model with the market size for country *i* and *j*, measured by the level of GDP. The size of the target market is generally regarded as a main driver of the decision of firms to start operating in a foreign country. Large foreign markets allow firms to realize economies of scale in production/sales and offer a greater potential for growth and profit. Because large markets tend to attract global competition, firms that are excluded from these markets are competitively disadvantaged (Porter, 1980). Moreover, firms can use larger markets as a base to export to smaller markets in the region (Krugman, 1980). It has been generally found a positive relationship between investment attraction and the market size/potential of the host country (Blonigen and Piger, 2011; Buckley *et al.*, 2007; De Beule and Duanmu, 2012).

Finally, a set of control variables are included in the model. We take into account the average cost to export for the home country because a high cost to complete the procedures to export might hinder the international orientation of a financially constrained start-up (COST EXPORT). We also check for the competitive conditions in the host country environment looking at the total amount of FDIs and of exports (EXPORT). We include country dummies (both for country *i* and *j*) in all specifications to control for unobservable differences between countries (e.g. macroeconomic and political stability).

Econometric results

Table III presents estimation results for the gravity model. The table reports either OLS (Models 1-3) and Poisson estimates (Models 4 and 5). Santos Silva and Tenreyro (2006) show that in the presence of heteroskedasticity, the OLS estimator can provide inconsistent estimates. To address this problem, they recommend a Poisson pseudo

Variables	OLS			POISSON	
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)
GDP_i	−0.659*** (0.193)	−0.266 (0.196)	−0.432* (0.230)	−0.026 (0.027)	−0.057** (0.028)
GDP_j	−0.261 (0.205)	0.261 (0.237)	−0.318 (0.260)	−0.004 (0.030)	−0.128*** (0.035)
$Patents_i$	1.373*** (0.166)	1.295*** (0.191)	1.285*** (0.208)	0.184*** (0.018)	0.158*** (0.021)
$Patents_j$	1.580*** (0.187)	1.452*** (0.209)	0.752** (0.350)	0.269*** (0.026)	0.118*** (0.038)
$DIST_{ij}$	−0.616** (0.270)	−0.668** (0.308)	−0.681* (0.365)	−0.120*** (0.028)	−0.080* (0.044)
Common lang		1.383 (0.859)	0.451 (0.835)	0.194 (0.104)	0.112 (0.095)
Colony		5.340*** (0.791)	4.829*** (0.792)	0.695*** (0.072)	0.546*** (0.085)
Common legal		5.989*** (0.897)	7.040*** (0.916)	0.629*** (0.088)	0.690*** (0.087)
IPR $protection_j$			3.295** (1.634)		0.499** (0.216)
VC $amount_j$			0.516** (0.222)		0.101*** (0.030)
Investor $protection_j$			0.823** (0.388)		0.117** (0.055)
Cost $enforcement_j$			−0.184* (0.110)		−0.007 (0.013)
Cost $export_i$			−3.509** (1.672)		−0.236* (0.144)
FDI_j			−1.622* (0.884)		−0.245** (0.122)
$Export_j$			0.796 (0.867)		0.183 (0.117)
Country dummies i	yes	yes	yes	yes	yes
Country dummies j	yes	yes	yes	yes	yes
Constant	−13.875** (5.963)	−24.952*** (5.991)	4.878 (16.445)	−3.309*** (0.803)	−1.313 (1.986)
Observations	310	310	310	310	310
R-squared	0.444	0.734	0.796		
Pseudo *R*-squared				0.6039	0.6259

Notes: The dependent variable is FLOW $INTENSITY_{ij}$. Standard errors are in parenthesis. Country dummies (*i* and *j*) are not reported to save space. ***Significant at the 1% level; **significant at the 5% level; *significant at the 10% level

Table III.
Gravity model to test the factors influencing the internationalization flows of high-tech start-ups. OLS and Poisson estimates

maximum likelihood estimator as a robust alternative. The Poisson regressions yield similar results than the benchmark OLS estimates, with very few exceptions.

Results confirm that the geographic distance between two countries is negatively correlated with the intensity of internationalization flows between them. This effect, which holds in all model specifications, is in line with the general evidence that distance still matters, despite developments in transportation and information and communication technology have led to an increasingly integrated, less distant world (Brock *et al.*, 2011). The socio-cultural distance between pairs of countries is instead proxied by the linkage variables. We find that sharing a common legal framework and having a past colonial relationship positively influence the intensity of internationalization flows from the home country to the host country, while sharing a common language does not display a significant effect.

Models 3 and 5 of Table III test the hypotheses described in Section 2. We control for the competitive conditions in the host country (FDI and exports) and for the cost to export in the home country. Some interesting findings emerge when considering the dimensions related to the strength of the legal and regulatory framework in the host country. Countries characterized by a high degree of investors' protection tend to attract a larger number of foreign companies. The effect is positive and significant in all model specifications at the 10 per cent level of statistical significance. The cost of contract enforcement in the host country has a negative, although weekly significant, explanatory power on the intensity of internationalization flows. The variable loses statistical significance in the Poisson specification.

The variables related to the strength of IPR protection and the innovation capacity in the host country are positive and significant at 10 and 1 per cent levels, respectively. Entrepreneurs do not seem to be interested in moving to countries characterized by low levels of innovation capacity or IPR protection, which could prevent them from either acquiring technological capacities or other location-specific technological advantages and appropriating the value generated from their investment in innovation. Finally, a significant and positive effect on the intensity of internationalization flows between pairs of countries is observed for the amount of VC financing, thus confirming *H3*.

To test the robustness of the results we have also run the model using alternative geographical distance measures (see Table AI in the Appendix). The distance effect persists if distance is measured in terms of latitude and longitude of capital cities, while it loses statistical significance (even though negative as expected) if it is measured in terms of time zone or weighted distance (by the share of country population) of the most populated cities. Overall results hold when the three different distance measures are employed.

Concluding remarks

The paper contributes to the international business literature in two ways. First, it provides a comprehensive visualization of the current patterns of internationalization of high-tech start-ups. USA, UK and China seem to be the most attractive countries for internationally oriented start-ups, whereas many European countries are not able to be as competitive. Second, the study examines the relationship between internationalization patterns of high-tech start-ups and attractiveness of host countries. Based on a database of 429 internationalized high-tech start-ups targeting 76 countries and operating in the ICT and electronics sectors, the paper finds that internationalization flows of high-tech start-ups are motivated by the sourcing of host country locational advantages, identified by the strength

of the legal and regulatory framework, the availability of VC financing, the innovation potential and the strength of IPR protection.

Our results have clear implications for policy-makers. A deeper understanding of the conditions under which foreign innovative firms are likely to enter the domestic market is crucial for policy-makers who intend to attract technology-based firms from all over the world. Currently, in most public policy agendas, the main objective is to foster the creation and growth of domestic entrepreneurship, whereas fewer efforts are directed toward attracting foreign entrepreneurs and start-ups. The extent of the diffusion of internationalized high-tech start-ups largely depends on whether enabling conditions are in place. The pace at which small high-tech firms expand internationally might be constrained by the absence or limited presence of adequate policies in hosting countries. This situation calls for new challenges to policy-makers that have to introduce appropriate regulations/incentive schemes or simply to adapt extant regulations to new demands from the market and to changes in technology.

The overall picture obtained from the empirical analysis has highlighted that high-tech start-ups are attracted by those countries able to provide a legal and regulatory framework which guarantees a high level of trust and confidence to new entrants. Indeed, an adequate level of investors' protection and the presence of lean procedures to resolve commercial disputes are found to provide foreign investors a safer environment to invest in. In addition, a strong protection of IPR in the host country increases the confidence of foreign innovators, who are less concerned with the possibility that competitors appropriate the value generated from their investments in innovation.

Other major drivers that influence the attractiveness of a host country for high-tech start-ups are the availability of VC financing and the level of a country's innovation capacity. The evidence of the positive role played by VC in strengthening the entrepreneurial activity in a country has led many governments to mobilize VC and to sustain public/private VC partnerships. Investments in R&D are extremely relevant because a dynamic and advanced innovation system allows not only for the creation of domestic high-tech companies but also for the attraction of innovative companies from other countries.

To conclude, policy-makers aiming at creating a favorable environment for internationally oriented high-tech start-ups should consider three main guidelines in their agendas:

(1) creating a clear legal and regulatory environment to provide foreign investors trust and confidence in the host market;

(2) mobilizing private capital to fuel into VC funds to match the internal demand but also to attract the foreign demand; and

(3) investing in R&D to increase the country's innovation capacity to attract foreign technology-based companies.

Valuable insights could be derived from a close examination of the distinctive contexts and of the related policies that have to be implemented to facilitate the attraction of high-tech start-ups. In this sense, a cross-country comparison of the instruments, programs and laws that are actually in place or an examination of the effects that more or less restrictive policies might have on the direction of internationalization flows is rich in potential for future research.

There are some clear limitations in the present work which indicate the necessity of future research. A first limitation concerns the country level focus of the analysis. Countries may present a significant variability within regions or cities of the conditions to attract high-tech start-ups. The concentration of top-level universities, networks of entrepreneurs, technology or VC investors in a particular area, and the presence of specific regulations at regional or city level, could push high-tech start-ups toward a particular area of the country. Narrowing the focus of the analysis to the regional/city levels will open an avenue for future research.

A second limitation concerns the choice of the dimensions explored in our analysis, which might be incomplete. Future research could extend the exploration of the determinants that affect the intensity of the internationalization flows of high-tech start-ups by including further elements. The industry structure, the competitive arena, the state of the distribution channels in the host country are assumed to account for many of the variations in internationalization patterns but remain issues that deserve further exploration.

Another limitation of the study is its cross-sectional nature. Longitudinal studies might shed further light on firms' internationalization patterns and trajectories. In that sense, events that took place in different periods of time in each of the countries studied could be controlled for. Finally, sector differences within high-tech start-ups have not been considered. Due to the small sample size, we could not carry out more detailed analyses based on a disaggregated technological breakdown of surveyed companies. Richer insights could be achieved by examining specific factors for each sector or even by extending the analysis to other high-tech sectors (e.g. biotech, pharmaceuticals and chemicals).

Notes

1. The "eclectic paradigm" developed by Dunning (1977) combines ownership-specific (O), location-specific (L) and internalization (I) advantages. Ownership advantages are firm-specific competitive advantages, resources or capabilities, location advantages refer to the specific institutional and economic endowments of host countries, internalization advantages refer to the firm's ability to manage and coordinate foreign business activities.
2. CrunchBase is operated by TechCrunch, which is located in the Silicon Valley (California), and is one of the most popular Internet blogs on technological innovations. The dataset is quite new and it shows a good potential for research purposes. The dataset can be found at www.crunchbase.com/
3. Gravity equations have been applied to explain other types of relationships between countries, such as trade in services (Ceglowski, 2006), knowledge flows through patent citations (Peri, 2005), internationalization of inventive activities (Picci, 2010) and immigration flows (Lewer and Van den Berg, 2008).
4. Performing a meta-analysis on 103 papers applying the gravity model, Disdier and Head (2008) show that distance negatively influences bilateral trade flows. The authors thus challenge the idea that distance is becoming less relevant with globalization and with advances in information and communication technologies.

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Appendix

Table AI.
Gravity model to test the factors influencing the internationalization flows of high-tech start-ups (OLS estimates)

VARIABLES	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
GDP_i	−0.274 (0.197)	−0.434* (0.231)	−0.300 (0.193)	−0.447* (0.234)	−0.290 (0.195)	−0.383 (0.256)
GDP_j	0.252 (0.237)	−0.332 (0.261)	0.233 (0.236)	−0.366 (0.261)	0.258 (0.252)	−0.309 (0.278)
$Patents_i$	1.297*** (0.194)	1.290*** (0.213)	1.280*** (0.205)	1.291*** (0.233)	1.296*** (0.210)	1.357*** (0.257)
$Patents_j$	1.459*** (0.211)	0.766** (0.349)	1.460*** (0.219)	0.819** (0.344)	1.486*** (0.233)	0.773** (0.344)
$Dist\_capital_{ij}$	−0.633* (0.330)	−0.662* (0.382)				
$Dist\_weighted_{ij}$			−0.416 (0.397)	−0.575 (0.482)		
$Time\ zone_{ij}$					−0.147 (0.131)	−0.269 (0.176)
Common lang	1.366 (0.861)	0.424 (0.835)	1.311 (0.856)	0.364 (0.828)	1.047 (0.867)	−0.001 (0.842)
Colony	5.255*** (0.794)	4.789*** (0.792)	5.013*** (0.767)	4.653*** (0.782)	5.245*** (0.875)	5.123*** (0.953)
Common legal	6.066*** (0.894)	7.092*** (0.909)	6.310*** (0.878)	7.235*** (0.893)	6.378*** (0.847)	7.326*** (0.868)
$IPR\ PROTECTION_j$		3.420** (1.625)		3.871** (1.573)		3.804** (1.537)
$VC\ amount_j$		0.519** (0.223)		0.529** (0.229)		0.493** (0.225)
$Investor\ protection_j$		0.835** (0.392)		0.860** (0.402)		0.845** (0.403)
$Cost\ enforcement_j$		−0.185* (0.110)		−0.192* (0.114)		−0.212* (0.116)
$Cost\ export_i$		−3.496** (1.671)		−3.317** (1.682)		−2.861 (1.746)
FDI_j		−1.684* (0.877)		−1.945** (0.845)		−1.734** (0.821)
$Export_j$		0.786 (0.873)		0.756 (0.894)		0.939 (0.938)
Country dummies i	yes	yes	yes	yes	yes	yes
Country dummies j	yes	yes	yes	yes	yes	yes
Constant	−25.136*** (5.935)	4.887 (16.517)	−26.214*** (5.773)	4.656 (16.791)	−29.709*** (7.421)	−7.406 (21.347)
Observations	310	310	310	310	310	310
R-squared	0.733	0.796	0.730	0.794	0.730	0.796

Notes: The dependent variable is $FLOW\ INTENSITY_{ij}$. Standard errors are in parenthesis; Country dummies (*i* and *j*) are not reported to save space. *** Significant at the 1% level; ** significant at the 5% level; * significant at the 10% level; Robustness check for different measures of the geographic distance

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