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Human capital intensity in technology-based firms located in Portugal: Does foreign ownership matter?

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ABSTRACT

This paper contributes to the scarce empirical literature on the impact of foreign ownership on human capital intensity. New evidence is provided, based on a comprehensive, large-scale survey of technology-based firms located in Portugal. The key findings are that: (1) foreign ownership *directly* (and significantly) impacts a firm's *general* human capital (education); (2) foreign ownership *indirectly* (and significantly) impacts a firm's *specific* human capital (skills); (3) the total impact of foreign ownership on a firm's human capital intensity is higher for education- (general) than for skills- (specific) related human capital intensity. Giving the critical importance of both FDI and human capital development for an 'intermediate' economy like Portugal (lagging behind in terms of human capital stock, and seeming to have lost part of its attractiveness as an FDI location), the paper discusses related policy implications. It is believed that our results and conclusions may be useful for other countries facing similar challenges.

1. Introduction

Human capital and foreign direct investment (FDI) are widely seen as key engines of economic growth and development (Romer, 1986; Lucas, 1988; Grossman and Helpman, 1991; Dunning, 1993; Mah, 2010; Teixeira and Fortuna, 2010; Ahmed et al., 2011).

Human capital represents the knowledge and skills that individuals bring to an organization (Dimov and Shepherd, 2005). It can be acquired and developed through both education ('general' human capital) and professional experience/skill ('specific' human capital), contributing to both the explicit and tacit knowledge of the firm.

While there is considerable literature focusing on either FDI or human capital in isolation, the specific link between the two has been less researched, particularly at the level of the firm. The issue has further interest given a potential two-way causality between human capital and FDI. Human capital has been recognised as an important FDI determinant (Noorbakhsh et al., 2001; Mengistu and Adhikary, 2011). In turn, foreign-owned companies might be relevant contributors to human capital formation, as they affect both the demand and supply of skilled labour (Slaughter, 2002; Bellak, 2004; Krammer, 2010; Belderbos et al., 2013). Most extant work focuses on the first direction of impact. Studies highlighting the impact of FDI on human capital formation are scarce, rather exploratory (typically opinions and conceptual literature reviews) and mainly based on developing countries. The most comprehensive collection of papers, resulting from a technical meeting on FDI, human capital and education in developing countries, can be found in OECD (2001).

Even though there are very comprehensive and useful literature reviews (e.g. Blomström and Kokko, 2003; Rasiah, 2005; Majeed and Ahmad, 2008), empirical studies are very scarce. An exception is Narula and Marin (2003), a thorough empirical study comparing foreign-owned versus domestic firms in Argentina as regards the quantity and quality of human capital they employ, further linking that to technological spillovers. The present paper contributes to this scarce empirical literature on the relationship between human capital and FDI by investigating the relevance of foreign ownership for the human capital intensity of technology-based firms (TBFs) located in Portugal.

TBFs gained increased attention from governments and scholars owing to their expected highly innovative performance and growth (Czarnitzki and Delanote, 2013), being recognized as responsible for many innovations that can potentially form the basis of a country's future economic and employment growth (Storey and Tether, 1998; Ganotakis, 2012).

Governments increasingly spend huge sums of money to attract research and development (R&D) intensive FDI, with the expectation of creating high quality jobs, further R&D investments, and promoting innovation in various fields (Gelübcke, 2013). Despite the recognition of the importance of TBFs, and albeit a few high quality empirical studies address the role of human capital on

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the performance of such firms (Colombo and Grilli, 2005, 2010; Ganotakis and Love, 2012), to the best of our knowledge no published empirical contributions exist relating TBFs' human capital intensity and FDI.

This paper focuses on an under-researched empirical setting, Portugal, for which no similar study exists. Moreover, the themes of FDI and human capital development are particularly relevant to this 'peripheral' (Benito and Narula, 2008) or 'intermediate' (Molero, 1995) European economy, marked by convergence difficulties *vis-à-vis* the European Union, and with a considerable human capital and technological disadvantage *vis-à-vis* developed countries in general (Soukiazis and Antunes, 2013). Additionally, Portugal embraced recently a proactive FDI attraction policy, recognizing the potential role foreign multinationals could have in upgrading Portugal's industrial fabric and in the accumulation of competences. Therefore, the theme underlying this paper is a critical one, not only for the Portuguese economy, but also for other countries with similar challenges.[1]

Given the well documented relevance of human capital for organizations' innovative and economic performance (Unger et al., 2011; Frank and Obloj, 2013; Santarelli and Tran, 2013), especially those characterized by high levels of knowledge-intensity (Bosma et al., 2004), such as TBFs, this paper's main research question is: *Does foreign ownership matter for the ('general' and 'specific') human capital intensity of TBFs located in Portugal?*

The remainder of the paper is structured as follows. Section 2 reviews extant literature on human capital and FDI, highlighting their connection with economic growth and development, and puts forward the hypotheses tested in the paper. Section 3 presents the data, providing descriptive statistics on respondent TBFs located in Portugal, specifically concerning their human capital traits and foreign ownership structure. The following section explains the empirical methodology, presents the econometric models estimated, and discusses the results obtained. The final section concludes and derives policy implications.

2. Human capital, FDI and technology: literature review and hypotheses development

2.1. Some considerations on the key concepts: human capital and foreign ownership

Since the late 1980s, human capital, in particular in its dimension of educational attainment, became increasingly associated with economic performance and international competitiveness (e.g. Aldcroft, 1992; van Hemert and Nijkamp, 2010). Human capital is currently defined by the OECD as the knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personal, social and economic well-being (Keeley, 2007). This concept is, however, not recent. Schultz (1961: 2), one of the founders of the Chicago School of human capital analysis, argued that "[b]y investing in themselves [through education in schools, colleges or apprenticeships, or by on the job experience] people can enlarge the range of choice available to them." With the emergence of the so-called 'endogenous growth theories', an important role – "the engine of growth" (Ehrlich, 1990) – has been assigned to human capital. The development of both the Lucas (1988) approach (inspired by the work of Becker) and the work of Nelson–Phelps (1966) converge in a positive effect of educational attainment on workers' productivity workers, hence on firms' and countries' growth.

Nowadays, most economists and policy-makers consider human capital, in its distinct attributes (formal education, experience, skills), a key productive asset, highly complementary with technological capital.

At the level of firms, the link between organizational human capital and performance is usually understood in the context of the resource-based view of the firm (Penrose, 1959), which associates superior performance to the possession of resources that are valuable, rare, inimitable, and non-substitutable (Rumelt, 1984; Barney, 1991). Although the basic principle of human capital theory is that the greater is the individual's human capital, the better the performance at a particular task (Becker, 1964), the nature of this proposition needs to be changed in a firm's setting in order to account for the interaction among its collaborators in the context of a particular organizational activity (Spender, 1996). It is useful here to consider the distinction between 'general' and 'specific' human capital. Following Becker (1964) and Acemoglu and Pischke (1999), 'specific' human capital is the one that can be used within the context of a specific job or a specific firm, while 'general' human capital can be used across jobs, firms and industries. In the relevant empirical literature, education levels are taken as good indicators of some form of general human capital, whereas working in a job can lead to the accumulation of specific human capital (Kriechel and Pfann, 2005). Thus, human capital intensity can be proxied by the proportion of firms' employees that possess post-secondary education ('general' human capital intensity) or that perform engineering related tasks ('specific' human capital intensity).

The vast majority of the empirical works on human capital involve country level analyses, generally yielding positive results (e.g., Barro and Lee, 1993; Hanushek, 2013), focusing on issues of economic growth (Wößmann, 2003; Teixeira and Fortuna, 2010) or rate-of-return analysis (Sianesi and van Reenen, 2003; Folloni and Vittadini, 2010). Empirical studies on human capital at firm or establishment level are in much inferior number than those related to more aggregate analyses (Teixeira, 2002; Mendes et al., 2012). Notwithstanding, in extant literature on firms and human capital there is a wide consensus that human capital leads to growth or increased performance of business ventures (Unger et al., 2011).

FDI is nowadays a very topical issue and a particular focus of policy in many countries owing to its sheer scale and importance, as well as to its relevance to policy-makers as it is seen as a fast-track panacea for growth and development (Hanson, 2001; Young, 2004; Young and Tavares, 2004; Girma et al., 2009; Rosell-Martinez and Sanchez-Sellero, 2012). Most countries (developed and developing) scramble to attract FDI projects (Oxelheim and Ghauri, 2003), based on the common wisdom, or the "stylised fact" that multinationals bring positive externalities ("spillovers") to the domestic economy, stimulating development, growth, employment (quantity and skill upgrading/human capital development), wages, exports, technological and managerial innovation, productivity, domestic entrepreneurship and other impacts. Regarding the latter impacts one may highlight demonstration, agglomeration, competition and linkage effects. Demonstration effects occur when domestic firms observe the behaviour and practices of foreign MNEs and emulate them, and in so doing enhance their efficiency (Wang and Blomström, 1992; Bengoa and Sanchez-Robles, 2003; Zhang, 2001; Glass and Saggi, 2002). Agglomeration effects reflect

[1] The so-called 'intermediate' economies (Molero, 1995; Pearce and Papanastassiou, 1999; Fontes, 2001; Bell and Marin, 2004) present considerable human capital and technological disadvantages compared to more developed countries. The attraction of inward FDI may be a promising strategy for narrowing down this human capital (and innovation) gap. In Table A1 (in Appendix), we present a sample of these 'intermediate' economies; these include the BRICS (Brazil, Russia, India, China and South Africa), Argentina and Chile (in Latin America), Turkey, and the so-called 'moderate innovators' from the EU (Czech Republic, Greece, Hungary, Italy, Lithuania, Malta, Portugal, Slovakia, Spain). The bulk of these 'intermediate' economies have been recently classified by Castellacci and Archibugi (2008) and Stöllinger (2013) in the 'followers' or 'imitation' clubs, respectively, as they present a considerable innovation gap *vis-à-vis* the economies in the more advanced groups, often not performing their own R&D but being quite capable of adopting foreign technologies.

the fact that when foreign MNEs and domestic firms co-locate in close proximity, localisation externalities may happen, arising from greater access to knowledge, to a pool of talented workforce, efficiencies due to saving in transport and/or transaction costs for products, services, people and ideas (Harris, 2009). The competition effect is related to spillovers generated by the presence of foreign-owned firms, as such presence leads to increased competition in the host country – thus, in order to remain competitive, domestic companies need to operate more efficiently, eventually adopting new technologies earlier than if they did not face such increased competition (Wang and Blomström, 1992; Glass and Saggi, 2002). Finally, linkage effects occur when foreign MNEs are clients (backward linkages) or suppliers (forward linkages) of domestic firms, hence influencing positively the latter. When foreign MNEs are clients of domestic firms, they create extra demand for the goods or services these domestic companies supply, what may foster the entry and development of domestic suppliers and final goods producing firms (Rodríguez-Clare, 1996; Markusen and Venables, 1999). They may also influence their practices, and so the efficiency of local companies, for instance when foreign MNEs offer technical support or assistance to domestic firms. The same positive influence may occur when foreign MNEs are suppliers to domestic firms, if the former provide training or technical support to their domestic clients.

There is a vast literature on spillovers and on the potential impact of multinationals (Rodríguez-Clare, 1996; Blomström and Kokko, 1998; Markusen and Venables, 1999; Liu, 2008; for reviews, see Görg and Strobl, 2001; Görg and Greenaway, 2004; Tavares and Young, 2005; Meyer and Sinani, 2009). However, and even if this is the most common view, a growing body of literature questions the magnitude of these effects, or even if they are positive (e.g. Haddad and Harrison, 1993; Aitken and Harrison, 1999; Kathuria, 2000; Castellani and Zanfei, 2003). Also debatable is the economic efficiency (opportunity cost) of the sizeable incentives given by countries through their proactive FDI attraction policies (Hanson, 2001; Oxelheim and Ghauri, 2003; Young, 2004).

Bearing in mind the complexity of issues regarding the impact of FDI on host countries and the fact that human capital is considered a key factor for countries' and firms' performances, it is of undeniable relevance to assess the extent to which FDI impacts a country's human capital endowment. This will be done by undertaking a micro level analysis (by this we mean an analysis based on detailed firm-level data) comparing the human capital intensity of foreign and domestic technology-based firms located in Portugal. This approach is the most appropriate, given the growing consensus that FDI-impact issues are better researched at micro (firm) level rather than at macro (country) level (Görg and Strobl, 2001).

2.2. Hypotheses to be tested

Extant theoretical and empirical research has shown that, compared to domestic-owned firms, foreign-owned firms (that is, affiliates of foreign MNEs) present systematically higher productivity levels (Yudaeva et al., 2003; Temouri et al., 2008; Criscuolo and Martin, 2009; Criscuolo et al., 2010; Hanousek et al., 2012; Gelübcke, 2013), are more innovative (Hitt et al., 1997; Sadowski and Sadowski-Rasters, 2006; Malchow-Møller et al., 2013), more efficient (Higón and Antolín, 2012), present superior financial performance (Azzam et al., 2013), and pay higher wages (Bernard et al., 2009; Egger and Kreickemeier, 2013). These performance gaps are, according to some authors (Bellak, 2004; Temouri et al., 2008), more evident in high tech sectors and several studies suggest (e.g., Driffield and Taylor, 1999; Oulton, 2000; Görg et al., 2007) that are related to the fact that foreign firms use high human capital-intensive factors of production. The associated evidence is particularly solid when referring to 'intermediate' economies, such as Turkey (Cecchini and Lai-Tong, 2008), Russia (Yudaeva et al., 2003), Hungary (Bruno et al., 2012), Mexico (Feenstra and Hanson, 1997) or Argentina (Narula and Marin, 2003). In this latter case, Narula and Marin (2003) demonstrated that foreign-owned firms hire more qualified workers and have a more skilled workforce than their local counterparts – corroborating that foreign ownership/FDI matters in terms of human capital intensity.

The FDI-human capital relationship is complex and our knowledge in this vein is still sketchy. Slaughter (2002) notes that foreign MNEs can raise both the demand and the supply of skilled labour. On the one hand, MNEs tend to be technologically intensive firms (Slaughter, 2002), hence demanding skilled staff to work along their knowledge-specific assets. This knowledge intensity tends to raise host country demand for skills. Foreign MNEs can also help increasing the supply of skilled labour by sponsoring education programmes, by formal training of their workforce (done inside or outside the firm), and by informal, on-the-job training (Slaughter, 2002). These initiatives can be an important source of technical and managerial skills for the workers (that can eventually spill over, especially if labour mobility to domestic firms occurs, or if entrepreneurial workers set up their own companies).

Indeed, foreign MNEs often introduce superior management skills and advanced technologies developed in their home base (Caves, 2007), which enable them to establish a competitive advantage in their foreign operations (Belderbos et al., 2008) by exploiting such superior intangible assets (Hymer, 1960/1976). The wage gap often encountered in comparisons between foreign-owned and domestic firms (Bellak, 2004) is likely to reflect a human capital gap (Oulton, 2000). This human capital gap might be justified, according to Malchow-Møller et al. (2013), by two main theories: (i) heterogeneous workers or (ii) heterogeneous learning. According to the first theory, foreign MNEs simply employ ex ante 'better' workers in terms of observable and/or unobservable characteristics due to a complementarity between technology and worker skills (Yeaple, 2005), between skilled managers and skilled workers or among skilled workers themselves (Manasse and Turrini, 2001). The second theory states that, because in foreign firms workers receive better training (Görg et al., 2007) or are engaged in more useful (professional) experience (on the job learning) (Markusen, 2001; Glass and Saggi, 2002), they increase their human capital stock, become more productive and thus receive higher wages. These two theoretical explanations support that foreign-owned firms tend to present higher human capital intensity than domestic firms.

The stimulus provided by foreign MNEs, their demand patterns, their competitive pressure, and potential better practices in human resource development, would, ideally, spur a virtuous circle between foreign-owned and domestic firms, 'raising the bar' of qualification. Such an impact may occur via vertical or horizontal linkages (Feenstra and Hanson, 1997; Markusen and Venables, 1997; Slaughter, 2002). Concerning vertical linkages, if foreign MNEs demand high standards to suppliers and subcontractors, the latter will have to adjust to these requirements, often having to hire highly skilled/qualified staff. This increase in the demand for skilled labour may happen also through horizontal linkages, notably via demonstration effects and competitive pressure on firms in the same industry, 'raising the bar' again for all industry players.

These explanations are in line with findings that, at the country/region level, FDI inflows led to a shift in labour demand in favour of higher skills (Driffield and Taylor, 1999; Tomohara and Yokota, 2011; Bruno et al., 2012). It is important to note that in the case that foreign-owned affiliates serve mainly as export platforms (Ekholm et al., 2007) or are part of an asset-seeking strategy (Narula and Zanfei, 2005) in complex internationalization strategies (Helpman, 2006), the superior production technology from the parent and thus the human capital gaps are irrelevant (Gelübcke, 2013).

Notwithstanding this last remark, we argue that on balance the other arguments are stronger, particularly in the case of 'intermediate' economies, leading us to hypothesize that:

Hypothesis 1. Foreign-owned TBFs present higher human capital intensity than their domestically owned counterparts.

Another crucial relationship, that has relevance to understand better the FDI-human capital link, is the FDI-technology/R&D intensity nexus.

R&D efforts encompass the deployment of a set of well-organised processes of knowledge creation, production, diffusion, and application (Wang, 2010), contributing to innovation in several domains of society, most notably in businesses (Higón et al., 2011). The involvement of a firm in R&D activities implies the improvement of routines and processes in which innovation is assimilated and firms' stock of knowledge is increased (Sánchez-Sellero et al., 2013), thus improving its absorptive capacity (Mowery et al., 1996; Castellani and Zanfei, 2003; Sánchez-Sellero et al., 2013).

The observed complementarity between FDI-R&D intensity-human capital at the country level (Wang and Wong, 2012) is also witnessed at the firm level. Indeed, there is a vast literature highlighting the central role of MNEs as producers and disseminators of knowledge and technological innovations (Teece, 1977; Cantwell, 1989; Narula, 2003; Ebersberger and Herstad, 2012; Dachs et al., 2013). Moreover, several empirical studies show that foreign firms are clearly distinguishable (from domestic firms) in terms of their high R&D reliance and R&D intensity (Markusen, 1995; Higón and Antolín, 2012; Belderbos et al., 2013). For instance, using data for 4780 firms from Community Innovation Survey (CIS), Sadowski and Sadowski-Rasters (2006) show that foreign ownership is an important factor in explaining inter-firm differences affecting innovativeness in Dutch manufacturing. Also, and relatively to 'intermediate' economies, most notably Italy and Spain, Castellani and Zanfei (2003) and Sánchez-Sellero et al. (2013), respectively, found that foreign firms have a higher propensity than domestic firms to get involved in R&D and to generate new knowledge and product innovations. Moreover, a recent study from the European Commission's Directorate-General for Research and Innovation (Dachs et al., 2013), evidences that foreign-owned firms already account for important shares of total business R&D in some European 'intermediate' economies: 20–25% Spain; between 30% and 50% in Hungary and Portugal, and more than 50% in the Czech Republic and Malta.

It is further recognized that foreign multinationals are in a position to obtain higher returns from their innovation efforts relative to domestic firms, for they possess firm-specific advantages, notably a greater capacity to innovate (Criscuolo et al., 2010) and a stronger appropriability regime (Hurmelinna-Laukkanen et al., 2012) that compensate for the costs induced by internationalizing (part of) their R&D activities (Denk et al., 2012). Foreign-owned firms bear an important liability (of foreignness) associated to their potential disadvantage *vis-à-vis* domestic firms regarding local knowledge, reputational hazards or institutional links (Hymer, 1960/1976; Che and Wang, 2013). This liability of foreignness might, though, be less prevalent in a setting as Portugal, where the majority of FDI comes from other European countries, which share similar institutional frames (Dachs et al., 2013).

Deep-rooted in the capability theory of the firm (Teece et al., 1997), the studies following the perspective on home-base augmenting FDI in R&D (Dunning and Narula, 1995), which focus on R&D activities aimed at monitoring or acquiring competitive advantages that are complementary to those already possessed by the firm, have shown that foreign-owned firms located in developed or intermediate economies have been able to build up advanced technological capabilities in order to take up responsibility for product development (Pearce and Papanastassiou, 1999) and, when located in highly developed economies, to absorb superior technology provided by companies and institutions in host countries (Driffield and Love, 2003). Using a sample of 77 innovative firms located in China, Teixeira and Shu (2012) demonstrated that FDI impacts positively on human capital through R&D activities.

In this line of argumentation, and given that human capital exhibits a strongly positive relationship with R&D efforts (Wang, 2010), we conjecture that, for both 'intermediate' and more developed economies, foreign ownership will have a larger impact, the larger R&D efforts will be.

Hypothesis 2. The impact of foreign ownership on TBFs' human capital intensity is higher the more intensive are TBFs' R&D efforts.

Studies analyzing collaboration among MNEs and universities are limited in number (Teixeira and Shu, 2012). As mentioned earlier, a distinctive characteristic of foreign-owned firms is their high R&D intensity. According to the absorptive capacity argument (Cohen and Levinthal, 1989), it would be expected that firms presenting high internal R&D capabilities would also be more likely to increase the effective utilization of external know-how (Arora and Gambardella, 1990; Laursen and Salter, 2004), and to engage in technology- and knowledge-sourcing strategies (Cassiman and Veugelers, 2006; Criscuolo et al., 2010), particularly with universities. Joint sourcing strategies and R&D intensity require highly prepared human resources (Schuelke-Leech, 2013), characterised by high levels of general and specific human capital (which subsequently drive these firms' productivity performance).

The relative high R&D intensity of foreign-owned firms and the subsequent easier access to superior technology creates additional possibilities for learning internally and building on existing strengths (Bellak, 2004; Higón and Antolín, 2012), increasing in this way the quality and quantity of their human capital. Moreover, due to its geographical diversification and reliance on more open sourcing strategies, foreign-owned firms tend to more successfully tap into local knowledge bases than domestic firms (Bellak, 2004; Sánchez-Sellero et al., 2013). Indeed, using a sample of UK firms that responded to the Community Innovation Survey (CIS), Laursen and Salter (2004) demonstrated that firms that use many external sources of knowledge in their innovations also tend to use more knowledge drawn from universities. These authors concluded that the more 'open' the search strategy of the firm, the more university research is used intensively. Such open sourcing strategies, being associated with more sophisticated, complex production technologies (Gelübcke, 2013), and enabling learning from external sources of knowledge, notably universities, promote and demand improvements in workers skills – thus tend to be associated to high levels of human capital intensity (Fukugawa, 2013).

The limited evidence that exists on the differences between foreign and domestic firms regarding collaborations with universities (and other knowledge institutions) does not suggest a clear cut pattern. For instance, van Beers et al. (2008) contend, based on data from CIS, that foreign firms located in Netherlands are less likely to co-operate with domestic public knowledge institutions than domestic firms, while in Finland no significant differences were identified. In contrast, evidence gathered by Machikita et al. (2010), respecting 620 firms located in Southeast Asian countries, shows that foreign-owned firms depend to a larger extent (compared to domestic firms) on cooperation with local universities.

Another aspect that is likely to explain why foreign-owned firms tend to rely to a larger extent (than domestic firms) on university collaborations relates to the fact that these collaborations are more common in basic than in applied research (Link et al., 2002; van Beers et al., 2008).

Technological knowledge developed at universities tends to be in the embryonic stage (Jensen and Thursby, 2001), requiring a close communication between firms' co-workers and academic

inventors in order to identify practical applications of the invention (Mansfield, 1995). This implies active face-to-face communication and transfer of tacit knowledge (Ebersberger and Herstad, 2012), more likely to occur when there is geographical proximity between firms and universities and similarly endowed human resources in the two organizations. At the level of the firms, this requires individuals with adequate/high task specific human capital (e.g., engineers) (Gibbons and Waldman, 2004; Ebersberger and Herstad, 2012).

The combination of these two aspects – basic research and high degree of tacitness of the knowledge involved – characterizing the relations between universities and foreign-owned firms results that university-foreign-owned firm collaborations are associated to higher levels of human capital intensity than those contacts involving domestic firms.

Hypothesis 3. The impact of foreign ownership on TBFs' human capital intensity is higher the more frequent are TBFs' contacts with Universities.

3. Methodology

3.1. Data

This analysis is based on data gathered through a questionnaire survey. A specifically designed, customized survey was the most appropriate (and only) way to collect the needed data, as there are no secondary sources or datasets that would provide the necessary data on TBFs and the relevant characteristics under analysis. Surveys, like other data gathering methodologies, have several limitations. In particular, studies based on surveys administered at a single point in time and answered by a single respondent can suffer from common method bias (Podsakoff and Organ, 1986; Ganotakis and Love, 2012), and indeed from memory and knowledge gaps of respondents. In order to minimize the inherent limitations imposed by the data collection method, for this research we: (i) did not use any question that would involve Likert scales (thus, avoiding respondents' perception bias, and 'social desirability' bias); (ii) used only questions that involved accounting and economic/statistical data, e.g. number of employees, turnover, exports, R&D values; plus other objective data (year in which the company was founded and % of foreign capital). The use of such non-perceptual/non-subjective variables minimized drastically the potential limitations of the methodology employed. The firms surveyed were drawn from the Markelink (a credible private information supplier) 2004 list, which comprises firms located in Portugal that declared and publicised R&D activities.

This was the best possible list of companies publicly available, in order to obtain a credible list of TBFs located in Portugal. There are two very reputed and comprehensive alternatives, notably the company lists used by the Community Innovation Survey (CIS) and *Observatório para a Ciência e Ensino Superior* (OCES) survey, but these are not publicly disclosed due to statistical secrecy. The list of companies used, Markelink, includes 703 companies, representing 85% of CIS III 'innovative' firms and encompassing a much higher number of firms than those considered 'innovative' by the last OCES survey – hence, it can be considered a representative list. It is important to note that, similarly to CIS and OCES, the Markelink list encompasses firms from all industries located within the Portuguese territory (including Azores and Madeira), and, differently from CIS, covers all size classes.

The questionnaire was sent in November–December 2004 to all firms listed in the Markelink list (703) plus 4 firms that we knew (through the on-line OCES' list of Portuguese firms with the largest R&D expenditures in 2001) that performed R&D activities. By mid-December, 425 complete valid replies were received, an effective response rate of almost 61%. This is a surprisingly high response rate for a non-compulsory survey. As Harzing (1997) noted, non-compulsory industrial surveys are typically plagued by low response rates. For instance, the CIS III questionnaire, compulsory, yielded a response rate of 45.8% in the case of Portugal (Bóia, 2003) and of 41.7% in the U.K. (Stockdale, 2002).[2] Therefore, the dataset gathered through this survey compares better in this regard, and can be considered remarkably comprehensive and representative of the relevant population of firms.

3.2. Variables and descriptive statistics

3.2.1. Dependent variable

Human capital is increasingly recognized as having several sources that are linked not only to formal education and training but also to culture, family background, social context and – to a significant extent – innate and non-cognitive abilities and skills (Folloni and Vittadini, 2010; World Economic Forum, 2013). Thus, measuring human capital is very complex and almost impossible task. The several proxies that have been put forward in the literature only manage to capture, in a limited way, a given dimension of it (Slottje, 2010).

Since we are interested in explaining the 'specific' and 'general' human capital intensity of TBFs, our two alternative dependent variables are the proportion of 'top skilled' ('specific' human capital) and 'top educated' ('general' human capital) workers in total employment.

Recall that 'general' human capital is not directly related to a certain job (Becker, 1962), being often proxied by the years of schooling (Rauch and Rijsdijk, 2013). In the line of several empirical studies at firm level (e.g., Kottaridi and Stengos, 2010; Rauch and Rijsdijk, 2013), we proxied 'general' human capital by (formal) education/schooling.

Although skills and education are treated in countless studies as synonymous (e.g., Harris and Helfat, 1997), they are distinct (though interrelated) concepts. Skills can be acquired through education and (formal) training but also (and mainly) through the course of people's activities at work (i.e., learning-by-doing). Rosen (1986) and Bell and Marin (2004) point to the fact that most specific job skills are learned from performing the work activities themselves. Formal schooling complements these skills, both by providing a body of general knowledge and principles (Teixeira, 2005; Teixeira and Wei, 2012).

In order to capture both components of human capital we test human capital intensity by using these two alternative (though interrelated) ways of measuring it. This is reflected in the alternative model specifications presented later (Table 3).

Firms were asked about the number of total workers and the number of workers with an engineering degree, which tend to represent a more firm-industry specific human capital component (Becker, 1964; Acemoglu and Pischke, 1999) and the number of workers with 12 or more years of schooling (post-secondary school), a more general component of human capital (Becker, 1962). Then we computed two widely used ratios for proxying the human capital intensity variable:

(i) the number of 'top skilled' workers over total employment, being top skills measured by the number of engineers (Wood

[2] Using a formula for computing the size of the sample, in random samples, based on a pessimistic scenario (Vicente et al., 1996), a sample size of 425 observations (in a population of 697 firms – the difference between the 707 surveyed and 10 that we found to be out of business) would lead, for a confidence level of 95%, to a precision of approximately 0.03.

Table 1
Across industry variation of human capital intensity and foreign ownership.

Industry	Human capital intensity		% foreign owned TBFs in the industry
	% engineers	% workers with 12 or more years of formal education	
Agriculture, fishery and extractive industry	19.3	22.7	20.0
Food, drink and tobacco	5.6	20.0	26.1
Textiles	3.5	10.0	5.3
Wood, paper and printing	4.9	15.3	25.0
Chemicals and plastics	9.7	26.9	32.7
Non-metallic minerals	5.3	12.6	11.1
Basic metals and fabric. metal products	5.4	16.4	24.1
Machinery	8.7	17.0	10.8
Electrical	21.9	31.3	19.4
Transport and other manufacturing	8.7	20.5	20.8
Utilities and construction	11.3	22.5	8.3
Retail and wholesale	10.8	47.7	23.7
Computing, R&D and firm services	39.2	54.2	5.7
Other services	23.6	27.2	18.2
Average: all industries	15.2	27.2	14.7

and Ridao-Cano, 1999; Noorbakhsh et al., 2001; Bell and Marin, 2004; Teixeira and Shu, 2012); and

(ii) the number of 'top educated' workers over total employment, with top educated represented as the number of workers with twelve or more years of formal education (Teixeira, 2002; Wößmann, 2003; Kottaridi and Stengos, 2010; Rauch and Rijsdijk, 2013).

All variables reported are three-year averages (2001–2003). The respondent sample presents high skill intensity (14.2% on average *cf.* Table 2). Almost half of the firms stated that the proportion of engineers in their total employment was greater than 5% (23% said that engineers represented more than 20% of total employment). By Portuguese standards these TBFs are highly human capital intensive firms. For instance, considering data for a similar period (2001–2003) from INE/PORDATA,[3] referring the percentage of workers with tertiary degree (engineers and others) was 10.3%.

Similarly to the skill intensity indicator, education intensity, which is measured by the percentage of employees with 12 years of schooling or more ('top educated'), also reflects the high human capital endowments of the firms covered in this study. Approximately 84% of TBFs pointed out that 'top educated' workers represented more than 5% of their total workforce, with almost half of TBFs indicating that this figure exceeded 20%. For the respondent TBFs the mean of the education intensity indicator is 26.3% (*cf.* Table 2). For Portugal as whole, and according to INE/PORDATA, the percentage of employed individuals with post-secondary education (which includes individuals that have more than 10 years of formal schooling) reached in 2001–2003, 22.9% of total employment.

3.2.2. Independent variables

Our 'strategic' variable, 'foreign ownership', is a dummy variable which takes the value 1 in the case 50% or more of its equity is foreign-owned and 0 otherwise. The cut-off point of 50% was chosen due to two main reasons: firstly, and without further specific information, it is the least controversial way of considering that a firm is controlled/owned by a certain type of investor, foreign or domestic; as such, it is widely used in the literature (Bellak, 2004; De Backer and Sleuwaegen, 2005), more often than the minimum threshold of 10% of capital adopted by the more controversial OECD Statistical Benchmark Definition for Foreign Direct Investment (OECD, 1999); secondly, only 3% of the companies in the sample had a minority participation of the foreign investor. Hence, we decided to consider majority ownership as the most accurate evidence of being a national or a foreign-owned company. In order to validate the option taken, all models were replicated with a minimum FDI threshold of 10%, which led to similar results. Around 15% (*cf.* Table 2) state that foreign entities owned above 50% of the surveyed firms' capital. It should be noted that a considerable percentage of TBFs (82%) are nationally owned.

The models estimated consider, apart from the main determinants (foreign ownership, R&D intensity and University contacts), three other regressors (here used as controls): size, age, and export intensity.

Substantial literature on multinationals (mostly surveyed in Bellak, 2004; and previously mentioned in this paper's literature review) shows evidence of performance gaps between 'domestic-owned' and 'foreign-owned' firms. The revealed performance differences have been partly attributed to ownership, but also to firm characteristics such as size (Nickell, 1996), age, R&D intensity (Buckley and Casson, 1976; Markusen, 1995), export intensity (Cohen, 1973) and other innovatory-related activities (Mowery and Sampat, 2004). Thus, the models estimated and reported in this paper take into account these supplementary explanatory factors, defined and measured as follows.

The measure of R&D intensity is the ratio of firm R&D expenditure divided by firm sales. This variable is similar to that used by Mohnen and Hoareau (2003), Laursen and Salter (2004), or Gallié and Legros (2012). University contacts, in the line of Ebersberger and Herstad (2012), Teixeira and Shu (2012), and Teixeira and Wei (2012) were measured by the logarithm of the average number of contacts that firms established with universities in the three-year period (2001–2003). It is important to note that the survey explicitly defines contacts with universities as involving active participation and exposure of one's own knowledge (Eurostat, 2006).

Regarding the 'controls', Size is proxied by the number of workers (in logarithmic form), Age is measured by the number of years in business (also in logs), and export intensity is proxied by the ratio of exports to total sales (Ganotakis and Love, 2012).

In addition to the five explanatory variables discussed, 13 industry controls are included to control for different TBFs' skill and education intensities across industries.

Tables 1 and 2 contain detailed descriptive statistics regarding our sample. Table 1 focuses on the surveyed firms' human capital intensity and foreign ownership, providing statistics disaggregated by industry – where considerable differences in human capital

[3] In http://www.pordata.pt/Portugal/Trabalhadores+por+conta+de+outrem+total+e+por+nivel+de+escolaridade+completo-1386 (accessed October 2013).

Table 2
Descriptive statistics and correlation matrix.

	Mean	SD	Min	Max	1	2	3	4	5	6	7	8	9
(1) Skill intensity	0.142	0.200	0	1.00	1	0.134*	−0.032	−0.399*	−0.310*	0.368*	−0.232*	0.188*	0.005
(2) Education intensity	0.263	0.253	0	1.00		1.000	0.058	−0.371*	−0.238*	0.212*	−0.308*	0.109*	−0.023
(3) Foreign owned	0.153	0.361	0	1.00			1.000	0.194*	0.052	−0.097***	0.095**	0.327*	0.685*
(4) Firm size (log)	4.305	1.479	0	8.79				1.000	0.341*	−0.307*	0.369*	−0.018	0.128**
(5) Firm age (log)	3.125	0.789	0	5.19					1.000	−0.211*	0.065	−0.097***	0.090***
(6) R&D intensity	0.051	0.126	0	1.00						1.000	−0.175*	0.177*	−0.047
(7) Export intensity	0.265	0.341	0	1.00							1.000	−0.017	0.068
(8) Foreign × R&D	0.004	0.029	0	0.50								1.000	0.273*
(9) Foreign × contacts with universities	0.090	0.309	0	2.30									1.000

* Significant at 1%.
** Significant at 5%.
*** Significant at 10%.

Table 3
Determinants of the human capital intensity of TBFs located in Portugal.

	Dependent variable: skill intensity						Dependent variable: education intensity					
	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
	Coef.	*p*-Value	Coef.	*p*-Value	Coef.	*p*-Value	Coef.	*p*-Value	Coef.	*p*-Value	Coef.	*p*-Value
Foreign	0.036	0.134	0.013	0.617	−0.013	0.699	0.081	0.014	0.072	0.039	0.113	0.014
Size (log)	−0.022	0.002	−0.022	0.001	−0.022	0.002	−0.033	0.001	−0.033	0.001	−0.034	0.001
Age (log)	−0.025	0.031	−0.023	0.044	−0.024	0.036	−0.022	0.156	−0.022	0.169	−0.020	0.209
R&D intensity	0.190	0.009	0.156	0.033	0.152	0.037	0.016	0.874	0.004	0.970	0.010	0.920
Export intensity	0.000	0.457	0.000	0.440	0.000	0.448	−0.001	0.191	−0.001	0.194	−0.001	0.200
Foreign × R&D			0.809	0.008	0.773	0.012			0.286	0.502	0.347	0.416
Foreign × university contacts					0.054	0.081					−0.076	0.140
Constant	0.356	0.000	0.351	0.000	0.356	0.000	0.672	0.000	0.670	0.000	0.662	0.000
Foreign ownership estimated impact on TBFs human capital intensity[a]	0.036		0.054		0.060		0.081		0.087		0.084	
N	379		379		379		379		379		379	
F-statistic	13.476	0.000	13.351	0.000	12.728	0.000	8.296	0.000	7.871	0.000	7.516	0.000
Adjusted R^2	0.372		0.382		0.383		0.258		0.257		0.257	

Note: OLS estimations; all models have (13) industry controls. Values in grey shade are statistically significant at 1–5%.
[a] Equation: $\frac{\partial HC}{\partial Foreign} = \beta_1 + \beta_2\,(\text{R\&D int}) + \beta_3\,(\text{UnivCont})$.

intensity and foreign ownership incidence across industries can be observed. Table 2 provides descriptive statistics for all variables used in the model, and presents the respective correlation matrix.

The majority of the TBFs surveyed (68%) employ between 10 and 250 workers, being 74 (workers) the mean value for the sample. TBFs with more than 250 workers represent 21% of the total. A large percentage of TBFs are in business for a reasonable number of years (23 years, on average). 57% of the total sample claimed to be in business for over twenty years. Only 13% might be considered as start-ups (age below 10 years).[4]

Overall, TBFs represented in this sample are characterized by a reasonably high R&D intensity – on average, 5.1% of their sales are devoted to R&D activities.[5] Recalling that the CIS III survey for Portugal concluded that the total expenditure in R&D activities (both intramural and extramural) by firms amounted to 0.8% of their total turnover (Bóia, 2003), we might claim that our sample includes high-technology and knowledge intensive firms. Around thirty firms (6.8% of the total) present truly remarkable average R&D intensities, above 20%. A few of these are firms whose business is totally centred in performing R&D activities.

Regarding markets served, the bulk of TBFs are inward oriented (exporting on average 26.5% of their total sales). Indeed, within the period covered in this study (2001–2003), almost two-thirds (63%) of the firms surveyed export less than 20% of their total sales. For Portugal as a whole, the average proportion of exports in total Gross Domestic Product in the period 2001–2003 amounts to 30.7% (INE, 2003).

The correlation matrix shows that, without controlling for other variables, skill and education intensity are negatively and significantly linearly related to size, age and export intensity, and positively (and significantly) linearly related to skill intensity. Thus, smaller, younger, export-led and technology-intensive firms tend to be more strongly associated with high levels of human capital intensity. In contrast, the ownership structure fails to be linearly statistically associated with human capital variables.

4. Model specification and results

4.1. Econometric model specification

In order to test whether foreign ownership matters for explaining establishments' human capital intensity, the following empirical models are estimated for 2001–2003 (average values):

$$h_i = \alpha^1 + \beta_1^1 f_i + \beta_2^1 X_i + \varepsilon_i \quad (1)$$

[4] Startup is a rather vague concept, generally meaning a new business venture in its earliest stage of development. Usually its operationalization is made based on the age in business, ranging from 3 to 5 years up to 15 years. Given this wide variation, we opted for Almeida et al.'s (2003) definition, which considers start-ups those firms with 10 or less years in business.

[5] It is rather peculiar that in spite of being listed as a R&D performer, almost 20% of the respondent TBFs, when asked about the average amount spent in R&D activities in the three-year period of 2001–2003, declared having registered in their accounts no value for this item. Some of these firms recognized, however, to have performed R&D activities in the period, but did not reflect these expenses in their accounts. Some of these respondents are affiliates of other firms, and stated that R&D expenses were exclusively registered in their parent firms' accounts.

$$h_i = \alpha^2 + \beta_1^2 f_i + \beta_2^2 (f * R\&D)_i + \beta_4^2 \mathbf{X}_i + \nu_i \quad (2)$$

$$h_i = \alpha^3 + \beta_1^3 f_i + \beta_2^3 (f \times R\&D)_i + \beta_3^3 (f * Univ)_i + \beta_4^3 \mathbf{X}_i + \omega_i \quad (3)$$

where h_i denotes TBF's i human capital intensity, that is, the proportion of engineers (or workers with twelve or more years of formal education) in total employment. f_i is the dummy variable for foreign-owned TBFs. **X** denotes a vector of other variables representing characteristics of the firm (size, age, R&D intensity; export intensity; industry), likely to influence its human capital intensity. ε_i, ν_i, ω_i are error terms following the standard assumptions.

Our attention in this investigation is focused on the β_1, β_2, and β_3 coefficients, trying to assess whether the impact of foreign ownership and human capital intensity are statistically related and which effects are more relevant – the direct effect (β_1), or the indirect ones through the interaction with R&D intensity (β_2), or through the interaction with the frequency of university contacts (β_3).

Although most of the literature (see Bellak, 2004) focuses on the direct impact of foreign ownership, we here try to highlight the relevance of its indirect impact, notably through technology competencies, translated into R&D intensity and propensity for drawing on external sources of information for innovation, such as universities. These latter interactions were particularly emphasized by the literature on innovation (Laursen and Salter, 2004; Mowery and Sampat, 2004), which stress the leverage effect that R&D and university contacts' intensity have on firms' human capital traits. In this sense, we would expect that the impact of foreign ownership on TBFs human capital intensity is higher "... the more intensive are TBFs R&D efforts" (Hypothesis 2) and "... the more frequent are TBFs contacts with Universities" (Hypothesis 3), that is $\hat{\beta}_2$ and $\hat{\beta}_3$ positive and statistically significant.

4.2. Results

Hypothesis 1 is supported, as foreign ownership has a positive and significant impact on TBFs' human capital intensity. It is interesting to note that foreign ownership directly impacts on the education intensity of TBFs, whereas in TBFs' skill intensity the relevant impact is the indirect one, through R&D efforts. This seems to give reason to both the literature on multinationals, which emphasizes mainly the positive effects that MNEss brings to countries' *general* levels of human capital, and the literature on innovation that highlights the mediating role of R&D on firms/industry *specific* human capital upgrading. This further highlights the importance of the "two faces of foreign ownership" – foreign ownership's (indirect) impact on human capital intensity is closely related to the generation of new knowledge within the firm (Cohen and Levinthal, 1989), and the ability to seek for external sources of information and knowledge for innovation activities (Laursen and Salter, 2004, 2013; Costa and Teixeira, 2005).

In this case, and as expected from Hypotheses 2 and 3, the impact of foreign ownership on TBFs' human capital intensity is higher "the more intensive are TBFs R&D efforts" and "the more frequent are TBFs contacts with Universities". Our results confirm the importance of controlling for R&D intensity and university contacts when trying to explain the firms' human capital intensity.

Concerning R&D intensity *per se*, the results show that R&D efforts are significant in explaining TBFs' *specific* human capital (skills) intensity, but not *general* human capital (education) intensity.

Regarding the control variables, size proved to be negatively signed and significant in all models estimated (for both human capital proxies). This means that smaller TBFs tend to be more intensive in human capital. As regards the variable age, it turned out that younger firms tend to be more human capital intensive, although in this case the results hold only for the models with human capital intensity measured through the variable 'skill intensity'. These two results are not surprising as, after all, we are dealing only with TBFs. Literature on this type of firms (Bartel and Lichtenberg, 1987) usually highlights that smaller and younger firms tend to be more intensive in (mainly *specific*) human capital.

Export intensity fails to be a significant determinant of human capital intensity, regardless the proxy for human capital intensity. Very often (and now thinking specifically of the Portuguese case), firms that are focused on exporting most of their output do not develop high value-added activities (Tavares and Young, 2002), therefore do not display a considerable human capital intensity.

Overall, and summarizing the results obtained, three main outcomes of our empirical study should be strongly emphasized:

1) foreign ownership *directly* (and significantly) impacts on firms *general* human capital;
2) foreign ownership *indirectly* (and significantly) impacts on firms *specific* human capital;
3) the total impact of foreign ownership on firms' human capital intensity is higher for education- (general) than for skills- (specific) related human capital intensity. We estimate that, all other factors remaining constant, 1 percentage point (pp) increase in foreign ownership tends to lead to 3.6–6.0 pp increase in TBFs' skill intensity and to 8.1–8.4 pp increase in TBFs' education intensity.

5. Conclusions and policy implications

5.1. Concluding remarks

This paper aimed at contributing to the relatively scarce empirical literature studying the impact of FDI on human capital intensity. Our approach was to establish whether foreign ownership was a significant determinant of the human capital intensity in TBFs. We used the empirical setting of Portugal, a country that has been encouraging FDI inflows and at the same time a country with a recognized deficit in qualifications, and with some of the poorest education indicators in Europe and in the developed world. Portugal's sluggish economic growth, prevalence of low value-added activities, challenges as a FDI host economy, and relatively low stock of human capital make this study timely, by tackling these critical issues for the country's development, and hopefully arriving to results that may be relevant for other peripheral, intermediate countries with similar challenges.

Using brand new evidence gathered through a purposefully designed and representative large-scale survey of TBFs located in Portugal (with a sample of 475 firms, 61% response rate), we found that foreign ownership was positively related to the human capital intensity of TBFs – directly, and indirectly, when foreign ownership was considered jointly with R&D intensity and the frequency of contacts with Universities. Three key results were obtained. Firstly, foreign ownership *directly* (and significantly) impacts on firms *general* human capital (measured by the proxy related to education "proportion of workers with more than 12 years of studies in the total workforce"); secondly, foreign ownership *indirectly* (and significantly) impacts on firms *specific* human capital, the latter measured by the proportion of engineers in the total labour force – a conventional proxy for "top skills"; thirdly, the total impact of foreign ownership on firms' human capital intensity is higher for education- (general) than for skills- (specific) related human capital intensity.

Two interaction terms were considered: one, relating foreign ownership to R&D; the other, connecting foreign ownership to the frequency of university contacts. When the dependent variable (human capital intensity) was measured by the "top skills" indicator, these interaction terms were significant. In particular, the

significance of the interaction term foreign ownership jointly with R&D should be emphasized, meaning that the joint interaction of foreign ownership and R&D intensity is a strong predictor of high human capital intensity. The results provide broad support to the three hypotheses when human capital refers to skill intensity (specific human capital) and also support a clear positive direct impact of foreign ownership on general human capital.

5.2. Policy implications

These findings have, in our opinion, relevant policy implications, both for policies aimed at attracting (and maintaining) FDI, and to broader (more macro), horizontal policies (like those related to education and training of human resources).

First, foreign ownership matters. Foreign subsidiaries operating in Portugal (and, probably in countries with similar level of development) are, generally speaking, better endowed in terms of human capital. Hence, for a country needing badly to catch up in terms of qualification indicators, with sluggish growth, a difficult external image, and that has lost its traditional labour cost advantage, our results seem to suggest that FDI should be supported. However, not all types of multinational operations. Since we are dealing only with TBFs, i.e. the most innovative firms in the country, it must be concluded that FDI-related policy ought to be discerning and emphasize the quest for higher value-added MNE activities, in a way that is compatible with the endogenous resources and capabilities that the country can realistically offer. This means adopting a selective, targeted and sophisticated approach, and a clear strategy on what kind of firm is desirable. Proactive chase for high value-added investors will, nevertheless, fall apart if it is not coordinated with other policy measures of broader nature. For instance, altering the supply of tertiary (and even secondary and technical) education courses in line with the strategy delineated (e.g. Ireland increased dramatically the number of courses offered to engineers, particularly in electronics, in line with its fine-tuned industrial targeting; Costa Rica attracted Intel, more due to its commitment to changing secondary education curricula to emphasise electronics and English).

A balanced and more systemic approach is needed, involving a more coordinated implementation of measures, and, above all, an emphasis on the quality of operations, in order to attract sustainable MNE operations.

Notwithstanding, FDI-related policies are unlikely to be enough. In terms of the usual investment in education and training, it is urgent that a better allocation of resources is achieved, as Portugal *per capita* spending on education (the "input" measure) is relatively high, but the output indicators are simply not in tune with the relatively high spending – so, investing better, and not necessarily more, as a priority.

This paper's results, are, in sum, in line with general expectations, but are specifically interesting given the direct and indirect impact of foreign ownership according to the human capital measure. It seems, thus, that FDI is acting in the 'right' way – impacting directly and positively on general human capital, which, in terms of spillover potential (positive externalities) to the rest of the economy, is more important as these general qualifications are easily transferable across companies and sectors. Therefore, foreign multinationals operating in Portugal seem to be helping the development process.

In a nutshell, given the well-established importance of human capital as an engine for economic growth of, especially, 'lagging' economies (Tsamadias and Prontzas, 2012; Zivin and Neidell, 2013), and the relevant impact of FDI in fostering host-country's human capital (suggested by the results of the present paper), a consistent and well communicated policy strategy should be promoted, acting in order to shape the skill mix towards more engineering/technical graduates, and acting also more on knowledge infrastructure policies and on linkages between foreign and domestic agents.

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Appendix A.

See Table A1.

Table A1
Human capital, innovation and FDI in a sample of 'intermediate economies'.

	Country	Human capital index – education (rank out of 122 countries)[a]	Innovation capacity (rank out of 122 countries)[a]	Value of greenfield FDI projects, 2003–2011, in % (average) of GDP[b]	FDI inflows in % of gross capital formation, 2000–2012 (average)[b]	GDP per capita 2012, in PPC (2005 USD)[a]
Africa	South Africa	92	30	2.4	9.3	9860
Asia (East)	China	58	27	3.6	6.8	7958
Asia (South)	India	63	37	4.0	5.1	3341
Asia (West)	Turkey	77	41	1.8	8.5	13,737
Europe (moderate innovators[c])	Czech Rep.	36	24	3.5	19.3	23,763
	Greece	47	103	0.9	4.0	20,922
	Hungary	33	84	5.4	22.9	17,033
	Italy	40	28	0.5	5.6	26,328
	Lithuania	23	36	5.5	15.3	18,776
	Malta	24	43	4.2	45.3	23,204
	Portugal	**37**	**38**	**2.3**	**13.7**	**20,962**
	Slovakia	21	49	7.5	30.0	24,320
	Spain	31	26	1.4	12.9	26,545
Europe (transition economies)	Russia Fed.	41	57	3.3	12.7	15,177
Latin America	Argentina	56	80	2.5	11.8	11,658
	Brazil	88	33	2.7	15.6	10,264
	Chile	49	56	6.8	31.8	15,848

Sources: (a) World Economic Forum (2013), Human Capital Report, in http://reports.weforum.org/human-capital-index-2013/ (accessed December 2013); (b) own computations based on data by UNCTAD, in http://unctad.org/en/pages/DIAE/World%20Investment%20Report/Annex-Tables.aspx (accessed December 2013); (c) EC (2013), Innovation Union Scoreboard 2013.
Note: Grey cells identify the BRICS countries; a.a.g.r. – annual average growth rate. Bold values mean to highlight the case of Portugal.

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