From Offshoring to Globalization of Human Capital and Innovation

Abstract

Using 2005 and 2006 data from multi year Offshoring Research Network (ORN) project, this paper presents and analyzes U.S. firms' offshoring practices and strategies for accessing talent and locating innovation activities offshore. Although "taking out costs" continues to be an important driver of firm offshoring decisions, participating companies are increasingly and surprisingly offshoring innovation and knowledge creation activities that conventional wisdom suggests are a core competence of the firm. The empirical results show that offshoring of innovation activities are partially explained by the emerging shortage of high skilled technical talent in the U.S., which drives the need to access talent globally and that cost considerations are not a significant driver of offshoring innovation activities.

Keywords: offshoring, innovation, labor cost, global talent.

INTRODUCTION

Outsourcing of manufacturing applications is already well understood (e.g. Dunning, 1993; Lee, 1986; Vernon, 1966), however the offshoring of white collar jobs – whilst pioneered by a few companies in the 1980s - is a relatively undiffused practice (Amiti and Wei, 2005). This paper seeks to explain two puzzling empirical observations from the Offshoring Research Network (ORN) project which is tracking the evolution of offshoring practices by U.S. firms over time. First, it is widely accepted that the primary driver for offshoring IT centers, IT applications and business processes was to realize cost savings from labor arbitrage (see e.g. Khan and Islam, 2006). The ORN data clearly supports the importance of labor arbitrage as a driver for offshoring certain functions (especially rule based, "follow the book" codified tasks). Surprisingly, however, the data also suggests that U.S. firms are entering a new stage of offshoring involving the sourcing offshore of higher skilled technical, engineering and scientific talent (Lewin and Peeters, 2006a, 2006b). This new trend, according to several authors (Dossani and Kenney, 2006; Levy, 2005; Doh, 2005) is enabled by advances in information technologies and web based coordination capabilities that allow companies to utilize highly skilled talent at offshore locations around the world. At the same time, however, according to Farrell et al. (2006) and Mehta et al. (2006) organizational structures and processes necessary for coordinating business units and activities, managing knowledge, selecting locations and managing talent offshore represent major managerial challenges that counteract these trends.

The empirical results presented in this paper confirm that while cost savings remain the most important strategic driver behind offshoring decisions, "access to qualified personnel" has emerged as the second most important strategic driver and that "availability of talent" and “expertise” are the key factors for selecting a particular offshoring location. ORN data suggests that offshoring of product development (engineering, product and process innovation, R&D, software development, etc.) work has been rapidly accelerating since the late 1990s. This finding is consistent with other research by Henley (2006) and Levy (2005) that European and U.S. companies are increasingly offshoring higher value added knowledge intensive activities and are restructuring and reorganizing their innovation processes worldwide. This trend is facilitated by the ability of companies to dis-intermediate and modularize knowledge creating processes (Sako, 2002; Takeishi, 2002) as well as by the perceived unlimited availability of highly qualified engineers and scientists at offshore locations. Of the firms responding to the 2006 ORN survey, almost 50% of those who are currently offshoring had at least one project involving product development work offshore. Moreover, 26% of all offshore implementations in the sample involved product development, the same proportion as for offshoring information technology and administrative activities (26%), and higher than contact centers (16%) and procurement (5%).

In order to begin to understand these puzzling observations the paper empirically investigates two main questions:

1. Why are firms seeking to access higher skilled talent through offshoring?
2. What determines the firm’s decision to offshore product development (innovation) work?

Consistent with internationalization research, firm strategy to search for and access talent globally, is another manifestation of firms internationalizing their operations by seeking assets or capabilities outside of their national boundaries (Wesson 1993, Caves 1998). Offshoring can be seen as another variant of firm foreign direct investment (FDI) or of engaging in joint ventures offshore or partnering with a third party service providers to build firm specific, location specific or internalization advantages (Dunning 1980). Dunning (1993) has identified Market-seeking, resource-seeking, efficiency-seeking, and strategic asset-seeking, as motives for developing foreign operations. Within this framework seeking and accessing talent globally is not a novel strategy. It is another example for seeking resources (i.e., knowledge seeking), perhaps driven by efficiency seeking (i.e, cost reduction). Indeed historically companies such as Texas Instruments, Motorola, and GE have established technology centers in India and China in the early 1980s to secure a strategic advantage such as securing favorable political treatment (Delios and Henisz, 2003).

In this paper we argue that talent is a different type of asset and that the search for talent globally is emerging as a new phenomenon. Companies are not just diversifying their sources for talent, but are entering an era where they must compete for talent (see Economist special report October 6, 2006). Consistent with the resource based view of the firm unobservable and inimitable organizational knowledge and processes are sources of firm competitive advantage and account for much of the variation in firm performance (Wernefeldt, 1984; Barney 1991). Unlike physical assets talent is not an asset that is tradable in the market. Talent is intangible and is embodied in individuals, groups and social networks. Talent is an integral element of the knowledge base of the firm and consists of a wide range of highly specialized technical skills and knowledge. The realization that an absence of specific skill or talent is critical for proceeding with a project often only becomes evident during the process of undertaking specific projects, especially in the case of product innovation or development. In comparison to typical physical assets, talent is characterized by a different kind of obsolescence. It can be highly mobile and must be renewed on an ongoing basis through various HR strategies such as training and retraining.

Furthermore, the dynamics of the supply of engineering and science talent are changing. In addition to the effect of the ageing of the population, for reasons that are not well understood, fewer young people select to enter careers in science and engineering. It is beyond the scope of this paper to review the many factors that affect this change in preferences for careers in engineering and science except to note that this trend affects all the industrialized countries (US, EU, and Japan). At the same time, Asian countries such as India and China and countries in Eastern Europe and in Latin America are recognized as pools of highly qualified engineering and science talent. If companies are realizing, as the Economist Special Report (October 2006) argues, that they are facing a race for talent because of a growing shortage of talent globally, then the phenomenon under investigation is about companies competing for talent globally and not about seeking engineering and science resources in low cost countries (e.g. Belderbos, 2005; Khanna and Palepu, 2004).

We investigate two potential explanations for why firms seek to access talent through offshoring. The first relates to the possible shortage of adequately qualified engineers in the U.S. which becomes transparent in 2003 when the annual H1B visa quota was cut from 195,000 to 65,000. Consistent with Oliver (1991) we assume that companies strategically react to consequences of misalignments between the institutional structure and their macro environment in which they are embedded. In the present case, the cause of the misalignment is the decline in graduations of U.S. nationals (and permanent residents) with advanced degrees in science and engineering.

Following Oliver (1991) we do not expect that all firms perceive the shortage of talent at the same time or adjust to it the same way. Some companies recognize the emerging talent shortage earlier and decide to take action by, for example, sourcing the talent they need through offshoring technical work. Others may resign themselves to the situation, hire less qualified workers or voice (Hirschman, 1970) their concerns and demand political resolution through their industry associations or lobbying networks which indeed did enact the annual H1B quota for highly skilled talent to work in the U.S. However, agreeing to and implementing structural changes in the configuration of national institutional structures that would increase the attractiveness of careers in science and engineering (e.g. reforming the teaching of mathematics and science in the K-12 educational system) are very complex to resolve and very bureaucratic to implement and therefore require much time[1]. In addition, some firms can be expected to escape the institutional constraints of their country (Witt and Lewin 2007) and respond to emerging talent shortage by globalizing their innovation activities. Firms differ in the strategies they use to guide decisions making at various levels in the firm when facing the same economic environment (Nelson, 1991). However, we argue, that as the talent shortage increases and the practice of globalizing innovation through offshoring diffuses through the population and increasingly becomes institutionalized (Di Maggio and Powell, 19083), the number of companies locating innovation activities and sourcing talent offshore can be expected to increase.

The second reason that is often given for why companies hire qualified workers offshore is cost. The cost of engineers and scientist in countries such as China and India is so advantageous that labor cost must be the primary reason for offshoring innovation type work. According to this

[1] For a report on policy proposals intended to increase the supply of engineers and scientists in the U.S. and a discussion of the consequences of a continued shortage of engineering and science talent in the U.S. see “Rising Above the gathering Storm: Energizing and employing America for a Brighter Economic Future” (2005).

line of reasoning offshoring of innovation-centered activities will follow the pattern of offshoring manufacturing to low cost countries (Gereffi, 2005). In this paper, we argue that accessing global talent pools and reducing costs are *two separate and different strategies* driving offshoring decisions by companies. Accessing talent is linked to companies' growth objectives, especially for companies whose growth depends on product development centered innovation, while cost savings is associated with companies seeking to replace high cost workers (mostly lower skilled) with lower cost workers.

Past experience, however can also affect firm decisions to offshore product development activities. In this paper we investigate another important hypothesis concerning the role of companies' past experience. Previous research has shown that a firm's experience with offshoring is built over time, through a learning by doing process (Lewin and Peeters, 2006; Maskel et al., 2006). Since product development is a more complex and strategic activity compared to other functions offshored, it is likely that companies will need to first acquire some experience with offshoring more routine tasks before they experiment with offshoring high value added technological work. Moreover, at various stages of learning by doing and building experience, the drivers behind offshoring product development are likely to evolve as companies progressively discover new opportunities offered by offshoring such as accessing talent globally and by speeding up time to market of new and improved products and processes.

The research reported on in this paper is part of a larger project presented in the next section of the paper. Following description of some methodological details, we describe the data and sample and discuss a few key trends in the evolution of offshoring practices by U.S. companies.

In the two sections that follow, we frame and discuss the research questions on global search for talent through offshoring and on the determinants of offshoring product development activities. We review the relevant evidence on these issues, develop hypotheses and models to estimate empirically, and present the regressions results. The discussion section interprets the empirical findings in the broader context of growing globalization of human capital, and presents some concluding remarks.

THE OFFSHORING RESEARCH NETWORK (ORN) PROJECT

Methodology

This research uses data collected in the context of the Offshoring Research Network (ORN) project. ORN was launched in 2004 at Duke University Center for International Business Education and Research (CIBER), Fuqua School of Business[2]. In 2004 and 2005 ORN focused on surveying the offshoring practices of U.S. based companies. In 2006, the online survey was extended to involve research partners from EU universities[3] who recruit companies to participate in the survey as well as conduct case studies. At the core of the ORN project is the contextual commonality of the survey, the centralized online administration of the survey (in native business language of a country where necessary) each year. The core survey enables tracking the evolution of offshoring practices involving seven main areas: the functions offshored, choice of offshore location and rationale of this choice, type of service delivery model used (captive, third

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[2] As of 2006 the ORN lead corporate sponsor is Booz Allen Hamilton the global management consulting firm. The 2004 and 2005 surveys were supported by the Duke CIBER and Archstone Consulting LLC.

[3] Partner Universities include Copenhagen Business School (covering Scandinavia countries), Wissenschaftliche Hochschule fur Unternehmensfuhrung (Germany), RSM Erasmus University (Netherlands), IESE (Spain), Manchester Business School (UK), and Solvay Business School (Belgium).

party, hybrid), strategic drivers of offshoring, perceived risks, performance metrics, and future offshoring plans (18-36 months out).

A unique feature of the ORN survey is its focus on surveying the specific offshore implementations and not on companies' general experience with offshoring. In practice it means that every specific function that a company (sometimes involving multiple respondents from same company) has offshored in a particular location is identified by the year it was launched and is treated as a separate observation. This survey design results in a very fine-grained database that enables an analysis of offshoring dynamics across various administrative and technical functions located in a wide range of countries or regions of the world, across industries and across type of delivery model (captive or third party or hybrid). The ORN project does not survey outsourcing of manufacturing applications since this phenomenon is already well understood (e.g. Dunning, 1993; Lee, 1986; Vernon, 1966). Finally, the ORN database includes both companies that do already offshore as well as companies that have considered offshoring but have not yet initiated the offshoring of any applications.

Sample

The present paper uses data from the 2005 and 2006 ORN annual surveys of U.S. companies. The database comprises 253 companies and 890 different offshore implementations. 62% percent of these companies are currently offshoring at least one business function, 16% have plans for offshore projects that have not been implemented yet, and 22% do not have any plans to start offshoring. Launch dates of offshore implementations by currently offshoring companies range from 1990 to 2006. As shown in Table 1, the sample comprises both large and small companies operating in various industries. Median company employment is 1750 employees and the average company employment is 22691 employees.

Insert Table 1 about here

Growth and diffusion of offshoring

Over the 1990-2006 period covered in the database, the growth in adoption of offshoring is marked by two periods of particularly fast growth. The first period covers 1998 to 2000 when many companies, were in the process of preparing for Y2K, and for one reason or another discovered (mainly in India) the large pool of low cost qualified programmers and software engineers. The second period follows the burst of the dot.com bubble in 2001 and continues through 2003. This period parallels the economic recession when companies were faced with decreased or no pricing power and therefore were intensifying their search for new ways to reduce costs and maintain margins. During this entire time period (beginning with the early adopters in 1990) the growth of offshoring follows the classic exponential growth diffusion pattern (e.g. Bass, 1980; Rogers, 1962) while also diffusing across many more functions and locations.

The analysis of the ORN survey classifies offshore implementations into five main functional categories: Administrative (finance and accounting, human resources, legal services, marketing and sales, and other back office activities), Contact Centers (call centers, help desks, and technical support), IT (Information Technology related activities), Procurement, and Product Development (R&D, product design, and engineering services). IT applications were among the earliest ones to be offshored and therefore account for the higher share of implementations in the sample (26%). This may also be a direct consequence of the very good service and quality reputation of India, which continues to be the most preferred offshore location (specifically as regards IT, see Henley, 2006). More surprising is the finding that 26% of offshore implementations involve product development activities. This suggests that companies are offshoring innovative activities that constitute the core of a firm differentiation and value creation strategy that are expected to remain under direct control. Administrative activities also represent a large share of surveyed implementations (26%). Despite the large coverage in the press and popular media, contact centers represent only 16% of current offshore implementations (See Table 2).

Insert Table 2 about here

India, largely because of its highly educated university graduates in engineering, IT and management, English as the common language for daily and business transactions, and its legal structure that mirrors the UK, not surprisingly positioned itself as a credible preferred offshore location. However, as companies gained experience with offshoring more diversified functions and increasingly sophisticated tasks, they have also discovered new locations where to source talent offshore. ORN survey findings show that 74% of companies with only 1 offshore implementation are located in India. Of companies with 5 or more offshore implementations, only 34% of these implementations are located in India. As Table 2 shows, India continues to be the preferred offshoring location across all types of applications, but other countries or regions (e.g., China, Philippines and Latin America) appear to have developed certain location-specific advantages such as tax preferences and availability of highly qualified talent that are attracting U.S. companies.

ACCESSING TALENT AND OFFSHORING OF PRODUCT DEVELOPMENT WORK

It is generally accepted that offshoring enables firms to reduce costs, and the ORN survey results confirm that view (see Table 3). However, "access to qualified personnel" has emerged as the second most important strategic driver. On a five point Likert scale it is rated important or very important for 77% of offshore implementations surveyed. Similarly, the survey reveals that availability of sufficient talent pools and adequate expertise are also emerged as very important reasons for why U.S. firms select particular offshore locations.

Insert Table 3 about here

As shown in Figure 1, access to qualified personnel as a strategic driver remains relatively stable for most functions; however, for product development offshore implementations it is much more important and increasing over time. It is clear that for implementations started in 2003 or later, access to qualified personnel emerges as a key driver for 92% of cases of product development offshoring, significantly higher than the 70% obtained for other functions.

Insert Figure 1 about here

The two central research questions of this paper are

1. Why are firms seeking to access higher skilled talent through offshoring?
2. What determines the firm's decision to offshore product development (innovation) work?

We have seen that over the past 5 to 10 years, U.S. companies have been increasingly offshoring product development and IT activities that require skilled employees trained in science and engineering fields. Over the same period, policy debates over the growing shortage of workers with scientific degrees have been increasing in frequency and intensity in the U.S., and in other countries (Cohen and Zaidi, 2002). The rise in the frequency of companies that cite accessing global pools of qualified personnel and expertise as strategic drivers for offshoring product development applications and for selecting certain country locations are indicative of companies recognizing the growing shortage of technical talent in the United States. In this context, the introduction of the H1B visa quota can be understood as a response by policy makers to the lobbying by companies for relief from the growing engineering and science talent shortage. All else equal, hiring foreign talent on H1B temporary visas is preferred to the complexities associated with offshoring. In 2003, for internal political reasons, the H1B quota is cut back from 195,000 to 65,000. As illustrated in Figure 2, the number of Master and PhD graduates has been declining steadily starting in 1995, very likely creating an increasing gap between supply and demand for engineers and scientists which becomes transparent when the H1B visa quota is cut back in 2003.

Insert Figure 2 about here

Hypotheses 1a and 1b suggest that the 2003 change in the H1B visa policy is the event that reveals a shortage that has been building since 1995 and serves to trigger greater offshoring of product development as a way of accessing needed highly talented human capital. Therefore, the H1B visa policy companies explains why companies are driven offshore to access qualified personnel and increases the probability to offshore product development projects.

> *Hypothesis 1a. The 2003 cut back in H1B visa quota positively impacted companies' actions to seek access to talent through offshoring, especially for product development activities.*

Hypothesis 1b. The 2003 cut back in H1B visa quota positively impacted companies' actions to offshore product development activities.

We have noted that reducing costs is a very important strategic driver of offshoring decisions. It is therefore plausible to argue that the global search for talent is simply another way for companies to exploit labor arbitrage opportunities (i.e. replacing high cost engineers and scientists with lower cost equivalent workers at offshore locations). If this were the case, then cost savings objectives should mediate the global search for talent and the higher the potential cost savings the more intense will be the search for low cost qualified personnel (see also Farrell *et al*., 2006, for a similar analysis). However, if companies perceive that they have to compete for talent (the talent shortage explanation prevails), then cost considerations should not be related to the need to access qualified personnel (i.e. labor cost savings and access to talent are independent from one another). In particular, product development projects consist of activities that require specific skills and are close to companies' core business. Therefore, we do not expect cost savings considerations to be important strategic drivers of the offshoring of product development activities. Hypothesis 2b suggests that companies that focus on cost advantages of offshoring are less likely to offshore product development work, and a negative or not significant correlation between labor cost savings and access to qualified personnel.

Hypothesis 2a. The importance of cost savings as a strategic driver of offshoring has no impact on "access to qualified personnel".

Hypothesis 2b. The importance of cost savings as a strategic driver of offshoring negatively impacts the launch of product development implementations offshore.

Access to qualified personnel (see Figure 1) is arguably a more important strategic driver of product development offshore decisions than (experience with) other types of offshore implementations. If companies undertaking R&D, Engineering and product design in the US are cannot find scientists and engineers they will rate talent as an important driver to move these activities offshore. Hypothesis 3 therefore suggests that the need to access qualified personnel positively impacts the probability of offshoring product development activities more than other types of offshoring.

Hypothesis 3. The importance of accessing qualified personnel as a strategic driver of offshoring positively impacts the launch of product development implementations offshore.

Consistent with the literature on internationalization and FDIs, other factors may increase the need for companies to source talent globally and the establishment of product development activities offshore, that is companies' growth strategies and speed to market. Companies' growth strategies may involve expansion of existing businesses and entering new markets. For technology dependent companies, in particular, exploiting new market opportunities often requires access to engineers and scientists capable of developing new products and technologies or adapting exiting ones. In a context of a tight domestic labor market for engineers and scientists, growth opportunities of companies could be negatively affected by difficulties to find adequately skilled and qualified workers (see for instance CNNMoney.com of 1/4/2007 for recent company testimonies on that matter). Companies may therefore lower their growth expectations, or realize that offshoring could be an important enabler of their growth and expansion strategies and initiate global sourcing strategies for locating talent globally. We therefore expect a positive correlation between growth strategy and access to talent as two important strategic drivers of offshoring, and between growth strategy and product development activities.

The pressure to increase speed to market with new and improved products faster than competition may also affect companies' strategies to offshore product development activities and seek talent. Speed to market can be improved by having access to flexible pool of qualified engineers necessary for responding to changes in demand and for exploiting market and technological opportunities, as well as by new organizational arrangements that enable development around the clock (most product development teams typically work dayshift in the U.S.). Deploying teams of qualified engineers offshore has been shown to provide flexibility to scale product development efforts up or down as needed, and allow companies to manage product development processes using a follow the sun schedule (for examples of small companies offshoring product development driven by speed to market see Buchanan, 2006). DeDuCo in Belgium and Case Consult in Germany (Rangan and Schumacher, 2006) provide evidence of a similar trend in Europe. In contrast to more administrative or customer facing activities where cost reductions, process efficiency, and scale are likely to be the most important drivers of offshoring, we expect "speed to market" to be positively related to the offshoring of product development activities:

Previous research has shown that companies adopt offshoring following a learning-by-doing process where they start with simpler rule based codified activities and progressively experiment with more sophisticated activities such as product development (Lewin and Peeters, 2006a and 2006b). Learning and experience may relate to actual activities offshored, and also to a firm's total experience with offshoring and outsourcing. The learning may involve how to overcome crucial coordination and knowledge flow challenges central to innovative activities. Total experience may also indicate an overall positive attitude toward offshoring within the firm, and therefore increases the probability of offshoring riskier and more complex functions related to product development. The effect of experience on product development offshoring may also depend on the type of past experience. Offshoring product development functions can depend on how many PD functions the company has already offshored (same-domain experience), and/or on experience with offshoring other non product development activities (outside-domain experience). In general, we expect same-domain (product development) past experience to have more impact than outside-domain (non product development) past experience. The effect of non product development offshoring past experience is expected not to significantly impact the probability of product development offshoring.

Finally, an important aspect of offshoring strategies is the model chosen to undertake activities outside the domestic boundaries. The mode of entry in an international market has been extensively discussed in the literature (REF), and the ORN survey includes questions about alternatives models, captive, outsourced to various service providers (local, same nationality, international) or joint venture. However the majority of companies offshoring product development activities tend to adopt captive model. The high percentage of product development offshore implementations (26%) in the sample has already been highlighted earlier. In addition, Figure 3 shows that product development has become the second most often offshored function, with 36% of companies in the sample having at least one offshore implementation involved in product development activities.

Insert Figure 3 about here

Empirical validation

In order to test the hypotheses, we built two models: the first explaining the importance of "access to qualified personnel" as a strategic driver underlying offshore implementations and the second estimating the probability of offshoring product development projects. Both are function of the various elements highlighted in the hypotheses and a series of control variables that account for firm size, industry, and location of offshore implementations. The estimated equations are as follows:

$$\text{AQP} = a + b\ \text{H1B} + c\ \text{LABOR COST} + d\ \text{GROWTH} + e\ \text{Size} + f\ \text{Tech Ind} + g\ \text{CountryD} + \varepsilon \qquad \text{(Eq.1)}$$

$$Prob(\text{PD}) = a' + b'\ \text{H1B} + c'\ \text{LABOR COST} + d'\ \text{AQP} + e'\ \text{SPEED} + f'\ \text{CAPTIVE} + g'\ \text{PD PAST EXP} + h'\ \text{Non-PD PAST EXP} + i'\ \text{Size} + j'\ \text{Tech Ind} + \nu \qquad \text{(Eq.2)}$$

The annual H1B visa quota is a dummy that represents the 2003 cut back in. Its coefficient is expected to be positive and significant (Hypotheses 1a and 1b). The coefficient of LABOR COST (the importance given to labor costs savings as a strategic driver of offshoring) is expected to be negative or not statistically significant (Hypotheses 2a and 2b). AQP represents accessing qualified personnel and its coefficient in Eq.2 is expected to be positive (Hypothesis 3). GROWTH reflects the extent to which firms consider their offshore implementations as a way to accomplish their business expansion plans and SPEED reflect the importance of increasing speed to market in the decisions to offshore. The coefficients of these variables are also expected to be positive and statistically significant. ε is the error term and *a* is the constant intercept. A detailed explanation of the construction of the variables is provided in Table 4. *a* and *a'* are the constant terms and ε and ν the error terms[4].

Insert Table 4 about here

Equation 1 is estimated as an ordered logit model that explains the importance of "access to qualified personnel" as a strategic driver underlying offshore implementations as a function of the various elements discussed in the hypotheses and raised in the previous section, like growth strategy and speed to market, and including a series of control variables that account for firm size, industry, and location of offshore implementations.

Equation 2 is estimated as a binary logit model where the dependent variable reflects the type of function offshored, whether product development (R&D, engineering, or product design) or not. Due to apparent endogeneity issues between accessing qualified personnel and offshoring product development activities, the models have been first tested for endogeneity with the Hausmann test, which did not indicate strong endogeneity[5]. We used both 2 stage Least Square and separate models. The latter presented better estimations.

Results

[4] The sample is restricted to post 1998 observations due to the high variability and low frequencies prior to 1998.
[5] Results are available from the authors upon request.

As Figure 1 has shown, product development offshore implementations behave differently from other implementations in terms of importance of global access to talent. Since the H1B visa policy mainly concerns engineers and scientists, we expect the H1B variable to have a stronger impact on product development implementations, which require more highly trained skilled workers and may be more sensitive to shortage of talent than other implementations. Equation 1 is therefore estimated for the whole sample and also separately for product development and non-product development offshore implementations. Furthermore, because of very high variability and few observations in the early years of offshoring covered in the database, estimations are restricted to offshore implementations launched after 1998.

Estimations results for Equation 1 are reported in Table 5. The first column shows estimated coefficients for all offshore implementations launched between 1998 and 2006; columns 2 and 3 give estimations results for product development implementations only; column 4 provides results for non-product development implementations.

Insert Table 5 about here

Hypothesis 1 on the change in H1B visa policy in 2003, revealing a shortage of technical talent in the U.S. and leading firms to increasingly seek qualified engineers and scientists offshore, is empirically verified for product development functions. Not surprisingly given the type of workers the H1B visa covers, this variable has no significant impact on the importance of accessing qualified personnel through offshoring for the whole sample and for non-product development implementations. Other skill areas may also experience shortage of talent, but in this paper we are analyzing the case of shortage of technically trained (engineering and science) personnel for R&D and other product development and engineering activities (see Disher, et al., 2006, on shortage of talent in financial services industry).

Hypothesis 2 is also supported. The negative and significant coefficient of the cost variable in all estimations (at different levels of significance) clarifies the role of labor arbitrage opportunities in explaining offshoring of technical and administrative work and global search for talent. The analyses indicate that offshoring to reduce labor costs and offshoring to access qualified personnel are two different strategies that companies do not confound. Cost savings opportunities are certainly an important driver for many offshore implementations, but when firms need to support their innovation centered strategies in the face of scarce talent, cost considerations are less important relative to accessing talent anywhere.

The coefficient of the growth strategy variable is positive and significant in all estimations. This confirms the strategic importance companies ascribe to offshoring as a mean to sustain their growth, (i.e. they recognize that offshoring of innovation activities is a way for them to access the talent they need any place in the world). It also supports the claim that companies for whom offshoring is an important element of their growth strategy also tend to assign greater importance to the need of accessing qualified personnel offshore.

A comparison of the percentage of variance explained by the model estimated for all functions, product development and non product development activities suggests that the effect of changes in H1B, growth and labor cost saving strategies on the importance of accessing qualified personnel is much stronger for offshoring innovative implementations (63-65% according to

McKelvey and Zavoina's R^2) compared to all functions or non product development ones. This result clearly indicates that some of the variables explaining access to talent offshore tend to be specific to innovative activities and support the appropriateness of discriminating between product development and non product development activities, which is further investigated in the analyses that follow.

Table 6 reports the results of the estimates of Equation 2 on offshoring product development activities in relation to the hypotheses to be tested and other relevant variables, such as speed to market, offshoring service delivery model and experience. Column 1 shows the results for the model including strategic drivers (access to qualified personnel, cost of labor, and speed to market) and other variables (captive, size and technical industry dummy). Column 2 reports the estimate of Equation 2 that includes strategic drivers, past experience with PD and non PD activities, and controls.

Column 1 shows that hypothesis 1b on the role of H1B visa cut back is not supported, hypothesis 2b on labor cost as not being significant as a driver to offshore product development activities is not supported, but it shows a significant negative sign indicating that offshoring to reduce labor cost has a negative effect on the probability to offshore PD activities. Hypothesis 3 on the importance to access to qualified personnel as a driver to offshore PD activities is supported. We also see support for our case that speed to market increases the probability of offshoring product development activities. The dummy for captive model of offshoring is strongly significant. This result supports the argument that innovative activities require a higher degree of coordination and governance structure that facilitates knowledge flow and integration, and reduces the risk of

IP leakage, all of which is made easier in fully owned subsidiaries compared to outsourcing. The company size and technical industries control variables are also significant.

These results are maintained in Column 2 where past experience in product development and non product development activities are also included. In this case, however, cost of labor is no longer significant, as we initially argued in hypothesis 2b. In terms of past experience we expected past activities in product development to affect the probability of offshoring this kind of activities, but we find no significance, whilst past experience with non product development activities shows a significant negative effect on the probability of offshoring product development activities. Size and technical industries control variables are still significant.

In order to disentangle the role of learning and past experience on the probability of offshoring product development activities we included firms' past experience with PD activities and non PD activities only in our models. We expected that, due to the idiosyncratic nature of innovation related activities, firms are more likely to offshore product development activities if they have already offshored PD projects in the past. Once other explanatory variables are not included in the model, consistent with the importance of cumulative learning and idiosyncratic knowledge developed in implementing and managing product development activities offshore, past experience in offshoring PD has a positive effect on offshoring same domain activities (Column 3), whereas firm past experience with non PD activities does not seem to have a significant impact, at conventional levels, on the probability of offshoring PD activities (Column 4), but when the two experience variables are included in the same model (Column 5) experience with non innovative domains reduces the probability of starting offshoring of innovative activities.

DISCUSSION: TOWARDS GLOBALIZATION OF HUMAN CAPITAL

The empirical analyses presented in this paper support our argument that the shortage of technical talent in the US that became starkly apparent to companies when, in 2003, the H1B visa quota was drastically decreased, impacted the ability of many companies to execute their growth opportunities that were dependent on product development capabilities. In order to adapt to this significant change in their environment, companies entered a global search for talent that led them to offshore product development activities to countries and cities where they could find sufficient pools of qualified personnel and expertise. In the early 1990s very few companies were able to recognize the new growth opportunities offered by offshoring or the role of offshoring in solving their problems of sourcing the requisite talent for growing and expanding their business. It is not surprising that companies need to gain some experience with the new practice of offshoring before fully understanding the strategic value that offshoring can deliver, beyond labor arbitrage. In addition to the desire to grow, accelerating speed to market of new and improved products is another factor that leads firms to progressively experiment with the offshoring of product development activities. The results from our models support our argument that accessing global talent pools and reducing costs are two separate and different strategies driving offshoring decisions by companies. Accessing talent is linked to companies' growth objectives, especially for companies whose growth depends on product development centered innovation, while cost savings is associated with companies seeking to replace high cost workers (mostly lower skilled) with lower cost workers. Cost savings, and labor arbitrages in particular, are certainly important contingencies driving the growth in adoption of offshoring practices that the ORN study documents. Nevertheless, the pattern of offshoring activities by American companies that emerge from the ORN study does not fit the traditional story of companies simply trading low level workers of non-core functions in the United-States with unskilled labor offshore. First, offshoring concerns increasingly core and technical activities performed by highly-trained workers (university graduates from science and engineering schools in particular). Second, less than one out of ten offshore implementations of technical activities has resulted in job losses in the United-States. Offshoring of product and process centered innovations have enabled companies large and small to increase the level of resources dedicated to their innovation efforts, without laying off their domestic engineering and R&D staffs. In other words, in the face of a global race for talent, when it comes to accessing talent and offshoring product development work necessary for a firm to maintain its growth, increase its speed to market and competitive advantage, cost is not the key variable. Many other elements are likely to come into play and this paper shows that access to talent is definitely a key element.

What we have found in this paper has to be placed in the context of the broader phenomenon of increased globalization of human capital (Friedman, 2005; Florida, 2006). Several factors underlie this evolution. Push factors originate from industrial economies where companies have traditionally sourced technically qualified workers but now find themselves sourcing human capital from low cost countries. Pull factors originate from emerging economies who recognize the globalization of human capital as an opportunity to foster their economic growth and proactively make national investments in the education and training of their human capital and in infrastructure (telecommunications, transportation and energy) needed to attract offshoring jobs.

In addition, a series of mitigating factors act as facilitators or inhibitors of the globalization of human capital. Figure 4 depicts these various dynamics.

Insert Figure 4 about here

In this paper, we have mainly focused on the developing shortage of technical talent in the U.S. Though the other factors would certainly deserve closer attention as well, an extensive discussion of all of the dynamics outlined in Figure 4 is beyond the scope of this paper. We wish to emphasize that the key issue is to appreciate that all the elements described in Figure 4 contribute to a new reality that companies increasingly must to go where talent is located. In the industrial economy, workers used to migrate from less developed regions towards more industrialized regions to seek jobs. In the knowledge IT-enabled economy, entire segments of companies' value chains are relocated to where the required human capital is located as a necessary condition for executing certain business function and processes. In one sense offshoring is nothing more than the mechanism through which companies achieve such reorganizations.

CONCLUSIONS

Offshoring of administrative and technical work, including innovation-related activities, is still in the early adopter stage. However, in this paper we provide empirical support to the argument offered by the Economist (October , 2006) in a special feature report of the impending global race for science and engineering talent is triggered by the event of drastically cutting back the H1B visa quota from 195,000 to 65,000 visas annually. However, competing for science and engineering talent is unlike seeking markets or production platforms through FDI. Talent is different from other assets because it is highly mobile and because of high obsolescence.

Accessing and managing talent in globally dispersed locations requires new recruiting an retention strategies as well as new organizational forms for managing, sharing, and exploiting knowledge. In addition, the widely held assumption that China and India combined offer unlimited supply of talents needs to be reexamined. There is a shortage of high quality (A and B level) science and engineering graduates in India and in China, low levels of English language competency is a recognized barrier to offshoring innovation work. It is clear that understanding the dynamics of offshoring innovation, the implication for firm strategy and for national competitive advantage is still in its early phases.

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TABLES TO INSERT IN TEXT

TABLE 1
Sample descriptive statistics

	% of companies	# implementations
Offshoring status		
• Currently offshoring	62%	760
• Not offshoring but plans	16%	130
• No plans to offshore	22%	
Firm size (# employees)		
• 1 to 500	41%	234
• 501 to 2000	10%	69
• 2001 and more	49%	610
Industry		
• Business/IT services	15%	106
• FMCG	3%	30
• Financial services	16%	161
• Health/Biotech/Pharma	6%	42
• Manufacturing	13%	141
• Other services	17%	136
• Professional services	2%	12
• Software & Programming	5%	50
• Technology	21%	268

TABLE 2
Distribution of offshore implementations across functions and locations (2006)

Functions	% of total (N)	Locations	% of total (N)
IT	**26% (227)**	India	42% (367)
Product Development	**26% (231)**	China	11% (98)
• Engineering Services	11%	Latin America	8% (74)
• R&D	10%	Philippines	8% (72)
• Product Design	5%	Western Europe	6% (55)
Administrative	**26% (228)**	Other Asia	6% (55)
• Finance & Accounting	12%	Eastern Europe	6% (52)
• Human Resources	5%	Canada	5% (40)
• Marketing & Sales	4%	Mexico	4% (35)
• Other back office	4%	Other locations	4% (32)
• Legal Services	1%		
Contact Centers	**16% (146)**		
Procurement	**5% (48)**		

TABLE 3
Strategic Drivers of Offshore Implementations (% 4 or 5 on 5 point Likert scale)

	Currently offshoring companies	Companies with offshoring plans for near future
Labor cost savings	90%	92%
Access to qualified personnel	77%	61%
Other cost savings	73%	65%
Growth strategy	73%	61%
Part of larger global strategy	67%	45%
Competitive pressures	66%	48%
Improving service levels	51%	56%
Adopting an industry practice	47%	21%
Business process redesign	46%	66%
Increasing speed to market	46%	39%
Differentiation strategy	30%	23%
Enhancing system redundancy	28%	22%
Access to new markets	21%	14%

TABLE 4
Construction of Variables

Variables	Construction
Dependent	
AQP (*Model 1*)	Linear additive transformation of 1-5 score attributed to “Access to qualified personnel” as a strategic driver of offshore implementations*
PD (*Model 2*)	Dummy = 1 for product development implementations, 0 for other offshore implementations
Explanatory	
H1B (*Model 1 & 2*)	Dummy = 1 for offshore implementations launched in or after 2003, 0 before 2003
GROWTH (*Model 1*)	Linear additive transformation of 1-5 score attributed to “Growth strategy” as a strategic driver of offshore implementations
LABOR COST (*Model 1 & 2*)	Linear additive transformation of 1-5 score attributed to “Labor cost savings” as a strategic driver of offshore implementations
SPEED (*Model 2*)	Linear additive transformation of 1-5 score attributed to “Speed to market” as a strategic driver of offshore implementations
AQP (*Model 2*)	Linear additive transformation of 1-5 score attributed to “Access to qualified personnel” as a strategic driver of offshore implementations
EXP TOT (*Model 2*)	Total number of offshore implementations of the company in 2006.
PD PAST EXP (*Model 2*)	Number of existing product development offshore implementations of the company in year (t-1).
Non-PD PAST EXP (*Model 2*)	Number of existing non-product development offshore implementations of the company in year (t-1).
CAPTIVE (*Model 2*)	Dummy = 1 for captive implementations, 0 otherwise
Control	
Size (*Model 1 & 2*)	Log of number of employees of the company

Tech Ind (*Model 1 & 2*)	Dummy = 1 for Health/Biotech/Pharma, Manufacturing, Software & Programming, Technology, 0 otherwise
CountryD (*Model 1*)	10 dummy variables for the location of the offshore implementation: "Canada", "China", "Eastern Europe", "India", "Latin America", "Mexico", "Other Asia", "Philippines", "Western Europe", "All Others"

**E.g. A score of 4 out of 5 point Likert scale would be transformed as 1+2+3+4= 10*

TABLE 5
Estimation Results Model 1

	Dependent variable = AQP			
	All functions	**Product Development**	**Product Development**	**Non-Product Development**
H1B	0.29	3.09***	2.88***	-0.21
	[*0.153*]	[*0.000*]	[*0.000*]	[*0.377*]
LABOR COST	-0.08***		-0.13*	-0.07*
	[*0.009*]		[*0.088*]	[*0.061*]
GROWTH	0.14***		0.21***	0.14***
	[*0.000*]		[*0.005*]	[*0.000*]
<u>Controls</u>				
Size	0.11***	0.43***	0.44***	0.07*
	[*0.000*]	[*0.000*]	[*0.000*]	[*0.059*]
Tech Industry	0.00	1.10**	0.82	-0.18
	[*0.994*]	[*0.024*]	[*0.104*]	[*0.439*]
CountryD	*Included*	*Included*	*Included*	*Included*
Observations	400	99	96	304
Pseudo R2	0.065	0.309	0.344	0.053
McKelvey and Zavoina's R2	0.167	0.628	0.650	0.138

The four β coefficients are not reported here for parsimonious presentation of the results, but are available from the authors.
*P-values into brackets. Signification levels: *** = 1%, ** = 5%, * = 10%.*

TABLE 6
Estimation Results Model 2

	Dependent variable = PD				
	1	**2**	**3**	**4**	**5**
H1B	0.12 [*0.669*]	0.17 *[0.564]*			
LABOR COST	-0.07* [*0.051*]	-0.07 *[0.066]*			
AQP	0.10*** [*0.007*]	0.10** *[0.004]*			
SPEED	0.11*** [*0.000*]	0.11** *[0.000]*			
CAPTIVE	0.78*** [*0.004*]	0.80** *[0.004]*			
PD PAST EXP		0.10 *[0.299]*	016** [*0.021*]		0.19*** [*0.007*]
Non-PD PAST EXP		-0.17** *[0.010]*		-0.07 [*0.187*]	-0.1* [*0.071*]
<u>Controls</u>					
Size	-0.17*** [*0.000*]	-0.15** *[0.000]*	-0.17*** [*0.000*]	-0.14*** [*0.000*]	-0.15*** [*0.000*]
Tech Industry	0.51* [*0.052*]	0.54* *[0.050]*	0.40* [*0.094*]	0.54** [*0.022*]	0.43* [*0.073*]
Constant	-1.48** [*0.037*]	-1.60* *[0.024]*	-0.10 [*0.717*]	-0.18 [*0.529*]	-0.13 [*0.452*]
Observations	396	396	437	437	437
Pseudo R2	0.136	0.156	0.061	0.055	0.069
McKelvey and Zavoina's R2	0.229	0.267	0.100	0.092	0.120

*P-values into brackets. Signification levels : *** = 1%, ** = 5%, * = 10%.*

FIGURES TO INSERT IN TEXT

FIGURE 1
Access to qualified personnel as a strategic driver of offshoring
(1999-2006, %4-5 on 5 point Likert scale)

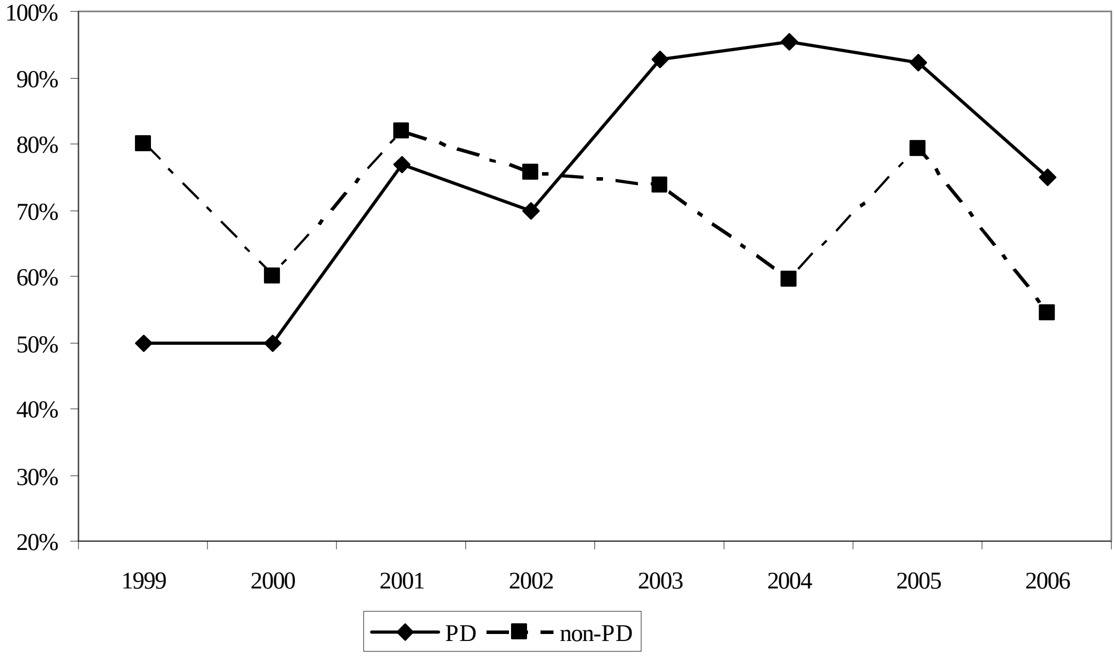
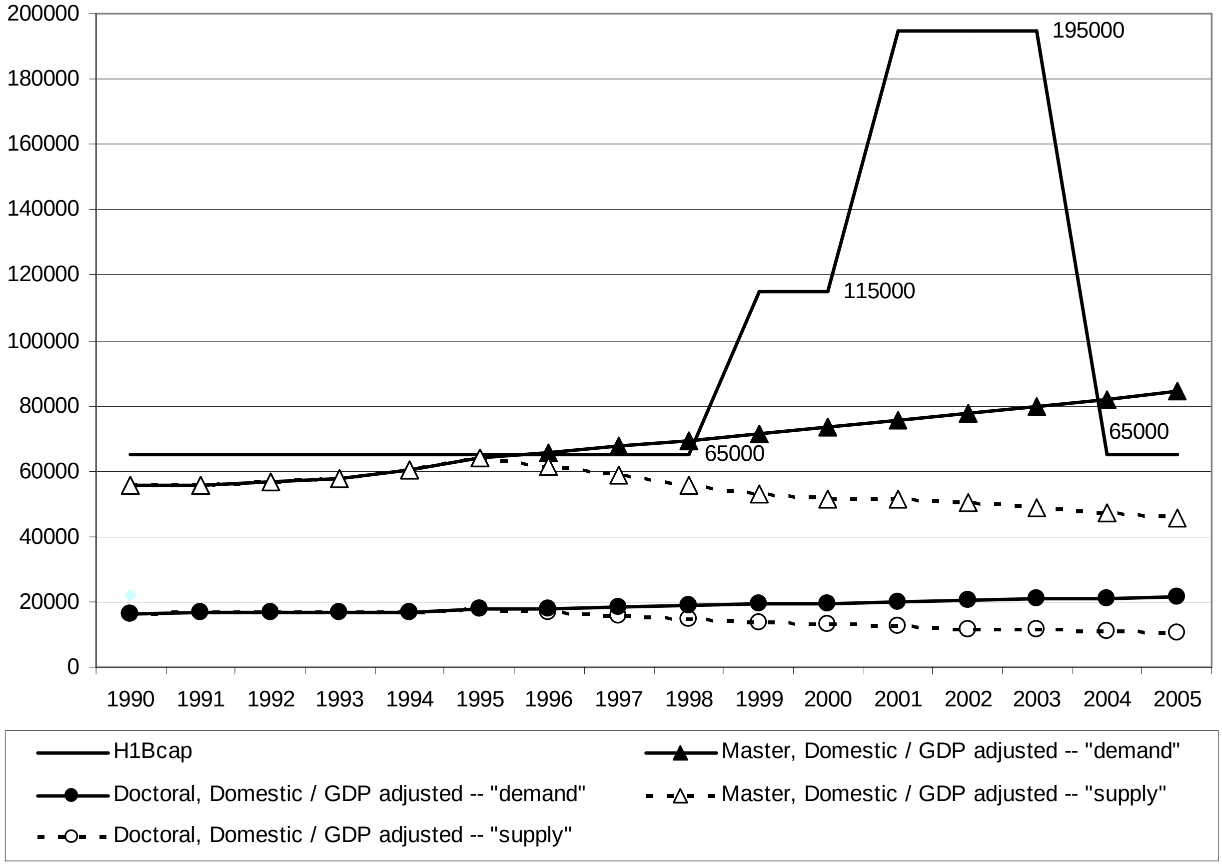


FIGURE 2
Shortage of technical talents in the U.S. and change in visa policy[6]



Data on Master and PhD degrees in sciences and engineering come from the U.S. National Science Foundation. They are adjusted for U.S. GDP. Data for H1B visa quota come from the U.S. Citizenship and Immigration Services.

[6] Raw data on Master and PhD degrees in science and engineering show a growing trend up to 1995. After 1995, the number of new graduates every year became constant. In order to draw Figure 2, 1995 was used as a breakpoint. The demand of graduates is computed using the 1990-1995 GDP growth rate, assuming the demand will grow at same constant rate over the period 1996-2005. The supply of graduates is simply the number of graduates adjusted for U.S. GDP growth between 1990 and t. Supply data were not available after 2003 and were therefore estimated using the GDP adjusted growth rate in number of graduates between 1995 and 2003, assuming this growth rate remains constant over 2003-2006.

FIGURE 3
Cumulative percentage of firms initiating offshoring of functional category (1990-2006)

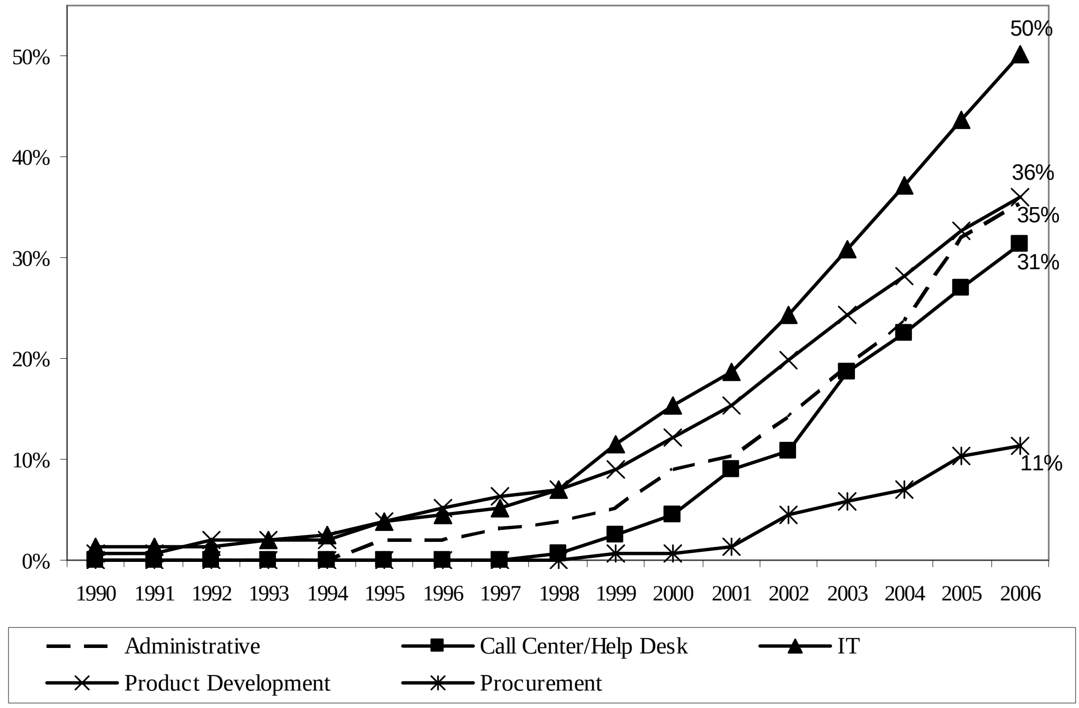
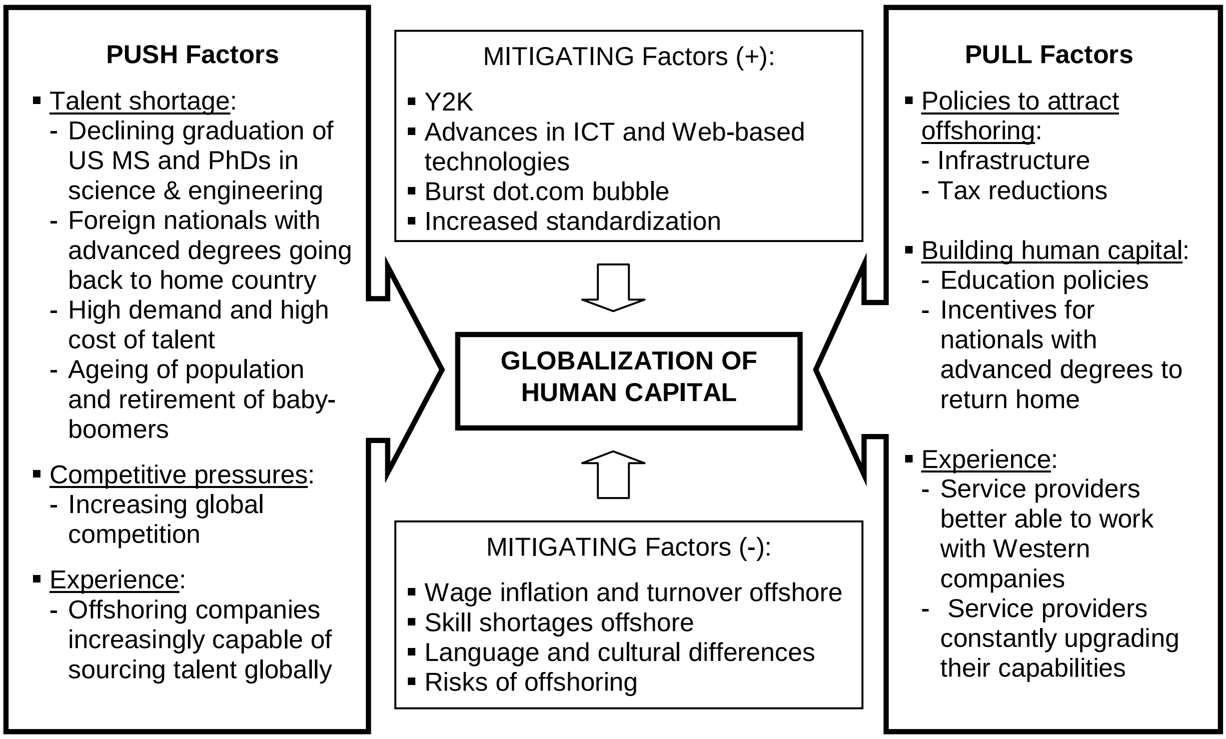


FIGURE 4
Factors underlying the globalization of human capital



APPENDIX A: Correlation coefficients between explanatory variables

Table A1
Correlation coefficients among explanatory variables in Model 1

	2003D	GROWTH	LABOR COST	Size
2003D	1.00			
GROWTH	-0.09	1.00		
LABOR COST	-0.11	0.14	1.00	
Size	-0.02	-0.01	0.16	1.00

Table A2
Correlation coefficients among explanatory variables in Model 2

		1	2	3	4	5	6	7	8	9	10
1	EXP TOT	1.00									
2	PD PAST EXP	0.44	1.00								
3	Non-PD PAST EXP	0.43	0.23	1.00							
4	AQP	0.16	-0.04	0.07	1.00						
5	SPEED	0.15	0.04	0.02	0.10	1.00					
6	LABOR COST	-0.15	-0.26	-0.04	-0.08	-0.10	1.00				
7	2003D	-0.06	0.21	0.17	0.04	-0.01	-0.11	1.00			
8	CAPTIVE	0.26	0.11	0.09	0.00	-0.05	-0.03	-0.13	1.00		
9	Size	0.56	0.19	0.30	0.13	-0.01	0.07	-0.02	0.10	1.00	
10	Tech Industry	0.28	0.24	0.13	0.02	-0.10	0.02	0.01	0.18	0.11	1.00