Bodyshopping versus Offshoring among Indian Software and Information Technology Firms

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Abstract

Investigations of offshore outsourcing of information systems have presented little evidence on developing country software and information technology (IT) industries. This study probes how Indian software and IT suppliers trade off work in India versus bodyshopping of employees. Worldwide clients view these practices as full offshoring versus on-shore temporary hiring from an Indian firm, but these practices are probed from suppliers' perspective. Suppliers' characteristics are theorized to affect their use of bodyshopping versus in-India work. A Reserve Bank of India survey of every Indian software and IT firm elicited suppliers' use of bodyshopping to serve clients abroad. Consistent with theoretical rationales, suppliers that were larger, incorporated, public, and owned foreign subsidiaries most frequently provided bodyshopping among their international services. Bodyshopping was used frequently for IT purchasing and systems maintenance and infrequently for business process applications, and was infrequent to nations where bodyshopped labor costs were high. The evidence expands knowledge of the vibrant entrepreneurial IT industry in India and how it serves client firms abroad.

1 Introduction

The software and information technology (IT) industry has been the most prominently mentioned example of offshoring from U.S. clients, with concern about high-skill job losses especially to suppliers in India, resulting in a burgeoning research literature. A range of studies have examined why U.S. firms have offshored IT and software development, the nature of their experiences, and the processes by which offshoring is managed. Relatively few studies, however, have examined the supplier firms to which work is offshored. These international suppliers are equally important in the connected global economy that is now yielding offshoring. Global suppliers deserve equal, if not substantially more, research attention in future, as the phenomenon of offshoring provides a means to enhance theoretical understanding of firm-level business strategy decisions and their outcomes (Doh, 2005).

The present study analyzes information systems (software and IT) provision from the perspective of Indian suppliers. It probes what factors influence Indian suppliers to undertake work in India versus "bodyshopping" as a service delivery strategy. Thereby, some of the motivation for the strategies of suppliers, who operate as important players on the supply side of the global economy, can be understood.

In particular, Indian suppliers' international provision of personnel, known as bodyshopping (Xiang, 2007), is compared to Indian suppliers' international provision of work performed in India, *i.e.*, clients' full offshoring of activities to Indian suppliers. Indian suppliers have been at the center of the world's attention in the information technology industry. The two forms of their service provision must reflect strategic concerns including production and transaction costs.

A comparison of these two service provision strategies adopted by Indian suppliers is possible using a 2003 survey by the Reserve Bank of India. The first survey to analyze supplier

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practices in meeting international outsourcing demands in services, the Reserve Bank of India survey matches the bodyshopping and in-India sales revenues of each Indian IT firm with characteristics of the firm and of its international and business segment markets. Hence, the present study examines apparent strategic determinants of key means of international software and IT service provision, from the perspective of suppliers in a primary country to which outsourcing has occurred.

2 Relation to Prior Literature

A large and steadily growing literature in information technology, strategic management, and economics analyzes behavior and principles of outsourcing. Most of this literature takes a client-side perspective, considering client-specific determinants of or policies for outsourcing. Analyzing clients' decisions and experiences, for example, Lacity and Willcocks (1998) derive from extensive case study and interview data best practices for outsourcing decisions and contracts: make selective outsourcing decisions, involve executives and IT personnel in decisions, invite internal as well as external bids, use short-term contracts, and write detailed fee-for-service contracts. A small minority of the literature analyzes vendors, considering what makes them successful at providing IT or other services for clients (cf., Levina and Ross, 2003), or at relationships between vendors and clients (cf., Kern and Willcocks, 2002). The present study adds new subject matter to the relatively understudied vendor side of outsourcing relationships.

In the early 2000s, international outsourcing, sometimes termed offshoring, triggered heated political discussion in the U.S. and elsewhere. In response, in addition to aggregate policy issues,[1]

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[1] The publicly perceived negative wage impacts of offshoring have been observed among less-skilled workers (Geishecker and Görg, 2008). Another effect of offshoring is that, at least in the U.S. and the United Kingdom, it has contributed to a rise in skill levels of remaining employees (Feenstra and Hanson, 1996;

many researchers analyzed businesses' offshoring processes and outcomes. Aron and Singh (2005), for example, conclude that clients should limit offshoring to lower-value activities largely independent of core business knowledge, and to easily codifiable tasks with clear quality measures; that hold-up by vendors should be avoided through close supervision and continuation of alternate means of service provision; and that clients should weigh the risks of alternative sourcing locations and ownership structures.

In contrast to such direct business lessons, the offshoring literature has made relatively little progress to analyze determinants of the amount and mode of international IT sourcing from specific supplier nations. One of the exceptions is Qu and Brocklehurst's (2003) analysis of what it might take for China to become a major source country in international IT. They conclude in part that Chinese government should encourage exports by large Chinese software companies, firms should set up marketing and sales forces abroad, an industry association should provide free and reliable information to potential foreign clients, and government should advertise overseas to improve China's reputation and knowledge about China. Nonetheless, offshoring studies such as this do not consider the balance analyzed here between offshoring of work versus workers.

Hijzen, Görg, and Hine, 2005). Overreaction to the apparent effects of offshoring might be counterproductive: in response to public outcry about offshoring, several researchers have raised concerns that misplaced policies might result from factually incorrect public impressions (Baily and Lawrence, 2004; Bhagwati, Panagariya, and Srinivasan, 2004). Lessons can also be learned from studies of earlier aggregate outsourcing activity, for example Autor's (2003) analysis showing that 20% of the rise in U.S. outsourcing from 1973 to 1995 can be explained by a court interpretation that made dismissals more difficult in 46 U.S. states, contributing 500,000 additional outsourced workers in 2000, as well as by unionism.

International flows of work are paralleled by worker flows.[2] Part of the international migration literature focuses on high-skill migrants, who have made a major contribution to nations' economic well-being (Hunter, Oswald, and Charlton, 2009) and have typically counteracted labor shortage (Salt, 1992). This is certainly true for information technology, which in the U.S. among other nations constituted the bulk of international skilled worker flows in the early 2000s.[3]

The high-skilled migration literature primarily analyzes nationwide trends and policies, or the experiences of high-skilled migrants, especially IT workers specifically. Banerjee (2006, 2008) and Chakravartty (2006) document continuing pressures on Indian IT workers in the U.S. to find ongoing work lest they lose their visa status, as well as how rules of the visa system contribute to these and other pressures of the work. Xiang (2007) documents the experiences of skilled international migrant workers more generally. Particularly given such pressures on migrant IT workers and developing countries' need to grow local industries, it seems important to analyze not just worker experiences, but also determinants of the work versus worker flow tradeoff.

Research on the Indian IT industry specifically has analyzed sources of India's competitive advantage in IT and the nature of the Indian IT industry. Bhatnagar and Madon (1997), Arora *et. al.* (2001), and Athreye (2005a, 2005b) document key information about the Indian software industry, including its history, causes of its growth, leading firms, and challenges including labor constraints. Abraham, Ahlawat, and Ahlawat (1998) report on a survey of U.S. software developers regarding

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[2] Job displacement results to some extent from international skilled labor flows (Blanchflower and Shadforth, 2009), but this negative impact is usually perceived to be less than the benefits.

[3] For example in the U.S. in October 1999 through February 2000, 42,563 out of 81,262 approved H1-B visa petitions were for workers in computer-related applications (Cornelius, Epenshade, and Salehyan, 2001, p. 406).

Indian providers' quality and productivity, and catalogue potential improvements to support continued growth of Indian IT firms.

D'Costa (2002) suggests that Indian IT suppliers should develop higher-technology, higher-value work in part through greater work with Indian clients. Bhatnagar and Madon (1997, p. 278), among others, point out the potential and need for high-valued exports of work done in India rather than mere bodyshopping. Although the literature on Indian IT documents an apparent increase in work performed in India in lieu of bodyshopping (Kumar and Joseph, 2005, p. 97; Upadhya, 2009, pp. 3-4), research on Indian IT has not considered how the traits of Indian IT suppliers relate in practice to viable strategies for their work versus worker flow tradeoff.

3 Forms of International Outsourcing and Their Determinants

Indian suppliers provide three types of software outsourcing (Arora *et al.*, 2001). First, onsite consultancy at clients' premises, or "bodyshopping," involves software professionals who act as temporary employees of clients; for international clients, bodyshopping keeps work within their home nations and premises. Second, software and technology development contract work in contrast is almost entirely in India. Third, the mixed case involves work both onsite at the client's premises and in India, typically with an initial team that specifies the project inside the client firm and with the bulk of development following in India.

In all these cases, international interactions yield complexities dealt with by suppliers. Initial visits by software professionals to clients, to help aid project formulation, are carried out even for work done within India by so-called "offshore" (to the client) development centers. International offices of the Indian suppliers often host staff who interact with nearby clients, regardless of the type of outsourcing. Long-term contracts between development centers and specific clients allow

them to carry out successive projects, and physically separate secure locations sometimes are used to protect client information.

The attention by Indian suppliers to project formulation, fruitful relationships, and protection of confidential information and intellectual property, all reflect themes apparent in outsourcing research (D'Costa, 2002). Bodyshopping versus in-India sourcing likewise are affected by concerns of international supplier-client interactions, and research on these topics yields means to understand when bodyshopping versus in-India sourcing might be expected.

Suppliers decide how much bodyshopping they are willing and prepared to provide, but of course cannot set actual demand. Clients' demand determines how much bodyshopping is actually realized. The realized demand depends on characteristics including a supplier's size and legitimacy and the needs of specific business segments and geographic markets. Probing the determinants of realized amounts of bodyshopping thus exposes strategies that work in practice to yield operative bodyshopping businesses.

3.1 The Indian Software and IT Industry

The Indian software and IT industry began with the presence of foreign companies like *IBM* and *ICL* investing in India. Some local companies like *Tata Consultancy Services* and *Patni Computer Systems* also started exporting software abroad. When the Foreign Exchange Regulation Act of 1973 (FERA) restricted multinational corporations' ownership of Indian firms to 40 per cent, *IBM* pulled out in 1977 (Heeks, 1996). Many ex-IBM Indian employees created their own companies and began exporting extensively. The resulting pool of entrepreneurs and firms has been transforming the Indian economy.

With liberalization in the 1990s, the Indian software and information technology industry prospered. The industry grew on average over 37.5 per cent per year between 1995 and 2000 (Athreye, 2005a), accounted for over 28 per cent of India's GDP growth from 2000 to 2002

(Athreye, 2005b), and had domestic sales revenues of $2.5 billion in 2001-2002. Indian software industry exports accounted for 72 per cent of total Indian software industry sales between 2000 and 2001, and grew from $105 million in 1989 to $9.9 billion in 2002 (Athreye, 2005b).

India's pre-eminence in the IT industry has several supporting factors. An educational emphasis on engineering positioned India to respond to the global shortage of information technology talent with a highly educated workforce (Arora *et. al.*, 2001; Chappell, 2001; Ramamurti, 2001). English speaking software developers are readily available, since English is much used in Indian schools and businesses (Kapur and Ramamurti, 2001).

Wages for experienced developers were, at the start of the 2000s, a fourth of those in the U.S. (Chappell, 2001), and telecommunications costs were lower than in the U.S. and Europe, allowing companies to save up to 50 per cent by shifting work to India (Anonymous, 2001). The time difference between North American and India enables firms to create a 24-hour workday to respond to customers (Sarkar and Sawy, 2003). Institutional changes in India have made India an attractive destination for foreign firms and encouraged Indian firms to seek overseas markets (Majumdar, 2007). Finally, the customer-orientation of software and information technology firms has created a reputation for quality (Ramamurti, 2001), causing prior customers to return (Koh *et al.*, 2004) and companies around the world to look to India for IT development, products, and services.

Despite challenges including "access to finance, access to new technology, credibility and other elements of the client-developer relationships, marketing and marketing costs, level of available skills and training, the threat of protectionism, managerial attitudes, and a weak domestic market" (Heeks, 1996, p. 127), India is considered a major global player in the software and IT industry (Commander, 2005; Anonymous, 2003). Yet little is known about how Indian software and IT suppliers behave. This study is one of the first to evaluate micro-level strategy among Indian software and IT suppliers emerging as key players in the global arena.

3.2 Bodyshopping versus Offshoring

How should Indian software and IT suppliers' characteristics affect their use of bodyshopping versus in-India sourcing? The use of bodyshopping is expected to depend on each supplier's size, apparent legitimacy instantiated as its incorporation and public company status, international exposure in terms of overseas subsidiaries and employees, business market segmentation, and geographic market segmentation.

3.2.1 Size

Larger suppliers have more frequent exposure to potential clients through marketing and provision of information at trade shows and other venues. They tend to gain the greatest accumulated experience working with clients through past activities, and, hence, the greatest word-of-mouth spread of information. They are most likely to have personnel and offices in other nations, and are most likely to have the tools and specialized staff, such as legal and contract personnel, that facilitate communication with overseas clients. Moreover larger suppliers have greater opportunities to develop procedures and organizational mechanisms to manage relationships fruitfully with clients, to specify the details of projects to be carried out, to establish appropriate contracts, and to build effective repeat relationships.

In addition, the larger suppliers will have created bigger stocks of in-house knowledge and capabilities than smaller suppliers (Penrose, 1959). These are akin to the firm infrastructure defined by Porter (1986), and include transaction cost-reducing capabilities. These cost reductions all apply generally to in-India sourcing and to bodyshopping, making larger Indian IT suppliers more likely than smaller suppliers to provide in-India services as well as bodyshopping services.

However, one cost difference pertains especially to bodyshopping: because employees work at the client site with limited potential for continual monitoring and education by the Indian suppliers, bodyshopping raises special recruitment and training needs. In fact, in a personal

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interview, a senior executive of a very large IT company suggested that the recruitment and training costs accounted for a third of all costs that the company incurred.

For example, *Infosys Technologies,* one of India's largest companies, actually set up an *Infosys University* to train and educate fifteen thousand new employees per annum. The scale that such operations require, especially given that the global service operations procedures are completely standardized, imply that only large suppliers can put together the necessary infrastructures to create cadres of employees who can be deployed overseas. Hence, the following hypothesis follows:

H1: The provision of bodyshopping services, relative to in-India supply, will positively relate to supplier size.

3.2.2 Incorporation Status

Incorporation and public company status of suppliers provide positive signals to potential clients. Suppliers must pass institutional and regulatory tests to acquire incorporation and public company status. These tests require greater displayed levels of skill and competencies, as captured in financial investment and performance statistics.

Public limited company status refers to widely held and incorporated companies. These are similar to "open" corporations (Fama and Jensen, 1983). Investors of public limited companies are protected by limited liability (Micklethwait and Wooldridge, 2003), an important consideration when bodyshopping is engaged in, with owners' only liability to companies' creditors for the money they have invested in the firm (Hansmann, 1996; Stiglitz, 2006). Acquiring public company status confers legitimacy, attracting foreign clients. The institutional status is a marketing device used as a signaling mechanism by the relevant suppliers.

The increased legitimacy associated with incorporation and public company status is expected to make a supplier more trustworthy as a potential employer with whom employees may sign long-term contracts to be resources used for bodyshopping activities overseas. These traits help validate a supplier that is, after all, dealing in humans for both marketing and production. Enhanced

certainty for employees creates enhanced certainty for clients, who can be more sure to obtain quality personnel who remain effective for the duration of projects. Hence, incorporation and especially public company status may increase a supplier's provision of bodyshopping, and thereby reduce within-India supply activity as a percentage of the supplier's sales.

Additionally, incorporated companies, especially larger ones with public company status, are typically formally structured. The competent personnel and committees in such companies are more likely to examine problems and challenges in depth. These activities can better identify and address policies regarding personnel sent abroad. While delegation of decision making across organizational levels could cause slower response times (Micklethwait and Wooldridge, 2003), there are advantages of deeper and more formal analysis which will make the decision process robust and final decision quality better. This ability to put heads together permits incorporated and especially public companies to develop capabilities and competencies in not only the specific IT tasks the companies deal with, but also processes and safeguards related to sending personnel internationally. Hence incorporated suppliers and especially public company suppliers tend to be more able to deal with bodyshopping and more attractive to employees and clients as providers of bodyshopping, increasing their provision of bodyshopping, and hence also reducing their within-India supply activity as a percentage of sales.

Unincorporated firms are partnerships and proprietorships. They comprise small firms, often start-ups, each owned by an individual, group, or family that has unlimited liability, per the Indian Companies Act of 1956. Unincorporated firms often have difficulty raising capital. However, because the owners are the decision-makers, there is no agency problem in unincorporated firms (Fama and Jensen, 1983). Unincorporated firms tend to be risk-taking (Durand and Vargas, 2003), small and focused units with flat hierarchies, few decision-makers and little bureaucracy (Fernández and Nieto, 2006). Their flexible orientation, however, inhibits growth that would encompass a

greater range of skills, since the benefits of not incorporating are lost through growth. Unincorporated firms therefore face greater challenges to develop bodyshopping competencies than do incorporated firms. Instead, their comparative advantage tends to be in IT skills that are relevant to specific local projects. Unincorporated firms therefore tend to receive relatively few contracts for bodyshopping and instead tend to carry out work within India for their clients worldwide.

Hence, the following hypotheses follow:

H2: The provision of bodyshopping services will be more frequent for incorporated suppliers, relative to unincorporated suppliers, and still more frequent for public company suppliers.

H3: The provision of in-India supply will be more frequent for unincorporated suppliers.

3.2.3 Overseas Office

The bodyshopping business greatly benefits from an overseas base of operations, in order to streamline sales and visa procedures, as well as coordinate housing and other needs in the foreign countries. This makes it easier for suppliers with existing overseas operations to carry out bodyshopping, and makes it especially likely that suppliers that do substantial amounts of bodyshopping will set up overseas subsidiaries. In equilibrium, therefore,

H4: The provision of bodyshopping services, relative to in-India supply, will be more frequent for suppliers with subsidiaries overseas.

This hypothesis does not speak to the direction of causality, though both directions seem relevant, since it cannot be assessed using data presently available to the authors.

3.2.4 Geographic Segmentation

Production costs in IT vary substantially across nations, largely because of differences in labor costs. The cost of in-India sourcing is the same regardless of the location of clients, but the labor cost of bodyshopping varies. Available labor cost figures, albeit imperfect, suggest that the US

and UK have the highest costs for bodyshopping, followed by continental Europe and Australia, with most of Asia and Latin America having relatively low costs (cf. Niederman, 2004, p. 72; Desai, 2005, pp. 38 and 70).[4] Hence production costs tend to make bodyshopping most prevalent to Asia and Latin America, less prevalent to Europe as a whole and to Australia and New Zealand, and least prevalent to the U.S.

These world regions also involve travel- and language-related variations in costs. Travel-related costs in the early 2000s were arguably lower than the effects of having few speakers of a host country's language, but nonetheless lower travel costs might have encouraged sales somewhat more within Asia than to more distant regions. Linguistic costs favor services to English-speaking nations. English is the second most commonly spoken language in India, after Hindi. These transaction costs hinder bodyshopping to non-English oriented countries. They have little effect on in-India supply, because bodyshopping requires that all employees travel to the host nation and work in the host nation's language, whereas in-India supply requires that relatively few people in the supplier and client businesses interact, sometimes in person, using some common language (Desai, 2005, p. 34).

These influences can be summarized as a contingent hypothesis, i.e., one whose outcomes depend on the relative tradeoffs between costs:

> *H5: If labor costs predominate, bodyshopping, relative to in-India sourcing, should be most frequent to Asia and Latin America, less frequent to Europe and to Australia and New Zealand, and least frequent to the U.S. If language costs predominate, bodyshopping should be most frequent to the U.S. and to Australia and New Zealand, moderately frequent to Europe, and least frequent to Asia. Travel costs, to the extent that they matter, tend to discourage bodyshopping outside Asia.*

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[4] Bodyshopping to the U.S. has relied on H-1B visas, which require that imported workers be paid the prevailing wage for a job.

Geographic differences in bodyshopping therefore provide a way to probe the relative importance of labor, language, and travel costs.

3.2.5 Business Market Segmentation

Nachum and Zaheer (2005) point out the importance of inter-segment and inter-industry differences, finding that the cost of distant operations differentially affects investment. They find indeed that the quest for knowledge and efficiency matter most in information-intensive industries, the predominant clients of IT suppliers. Which IT industry segments, though, would experience more bodyshopping relative to in-India supply?

Business markets that more often require close personal activity and interchange, especially where activities fit with large efforts in a client firm, demand an on-site presence. This increases the propensity for bodyshopping, particularly if most of the work involves use of equipment or local information that cannot usually be managed over the Internet. Hence hardware-related services such as equipment purchasing, equipment and systems maintenance, and training should have a high on-site presence of outsourced employees at the client's location. In contrast, software and business process applications, which typically can be carried out at a distance – with hosted software tools and off-site personnel who handle tasks such as human resource tracking, finance, and accounting – should have relatively little need for, and use of, personnel within the client organization. Therefore,

> *H6: The provision of bodyshopping services, relative to in-India supply, will be more frequent for suppliers providing services related to equipment and systems purchasing and maintenance and client employee training, but less frequent for suppliers providing software and business process services.*

4 Empirical Analysis

4.1 Survey and Sample

A survey by the Reserve Bank of India analyzed exports, during April 2002 to March 2003, of Indian software and information technology (IT) supplying firms. The purpose of the survey was to collect export-related data that would inform national policy on the industry. The sample consisted of the entire population of software and IT suppliers. The response rate was nearly 100 per cent, as response from all the suppliers in the sector was mandatory. Data on revenues and exports pertain to *all* transactions during the time period covered. Data collected are proprietary and were obtained in an anonymized form that allows no further matching of information; we exploit here the complete set of available information on the suppliers. No variables other than those used are available for analysis.

The size distribution of suppliers in the sample appears in Table 1, and matches with characteristics noted in other studies, as apparent from firm characteristics noted in the two panels of the Table. The Table reports, for each of ten revenue categories, the number of suppliers, cumulative number with at least the specified revenue, and cumulative share of total revenue. Four suppliers with revenues of at least 10 billion rupees were responsible for more than half of industry total revenues, 27 suppliers had revenues above one billion rupees, and the vast bulk of supplier numbers was composed of smaller suppliers with revenues typically below 1 million rupees. The high concentration and skew distribution of suppliers sizes in the Indian software and IT industry have been emphasized in studies by Arora *et al.* (2001) and Athreye (2005a), both of which used data from an industry trade association directory which may involve a somewhat different industry definition.

4.2 Variables

To analyze the distinction between bodyshopping versus in-India supply, the dependent variable outcome is the proportion of suppliers' sales revenues arising from each of these two forms of exports versus from in-country sales. Table 2 makes this distinction clear by listing the three types of sales, which for each firm are fractions that sum to 1, $S_1 + S_2 + S_3 = 1$. In-country sales S_3 composed on average only 5.6 per cent of suppliers' sales, so almost all revenues arose from exports. In fact, as Table 2 indicates, only 0.9% of suppliers sold only within India, and 80.5% of suppliers reported zero in-country sales.

Since S_3 is completely determined by S_1 and S_2, and given the minor role of sales within India, analyses here focus on the two forms of export sales. We analyze the prevalence of *bodyshopping*, which is work done outside India by Indian employees of an Indian firm, either on supplier-managed projects or through human resource provision practices, and of *cross-border sales*, which is work done in India and supplied to another country, sometimes involving brief personnel visits outside India.

All variables used are listed and defined in Table 3. Explanatory variables fall into several categories. Supplier characteristics include size, as measured by the natural logarithm of revenues; the supplier's status as a public incorporated company, private incorporated company, or unincorporated firm; whether a supplier had a subsidiary unit outside India; and a control for the ratio of overseas employee expenses to sales. Overseas employees are primarily marketing staff posted to overseas locations, and are not staff members who provide services. In a bodyshopping context, the staff members who provide services travel to and fro, and are, fundamentally, peripatetic staff.

Geographic market variables specify the fraction of the supplier's sales revenues originating from each of eight world regions: the United States, Europe, East Asia, West Asia, South Asia,

Australia and New Zealand, Latin America, and other residual world regions. Business market variables are dummy variables equal to one if the firm participated in a specific business segment or zero otherwise, and firms often reported participation in multiple business segments.

Business markets were classified into twelve types in the Reserve Bank survey data. The classifications are described in Table 4, and span a broad range of software and IT activities. These include hardware, software, and services. For software, they distinguish customized programs developed to satisfy customer-specific needs versus packaged software sold to multiple buyers. Business process outsourcing pertains to methods and tools for managing and operating business processes electronically.

4.3 Descriptive Statistics

Descriptive statistics are provided in Table 3 for all variables. Bodyshopping of personnel to other nations contributed 8.8 per cent of the average supplier's revenues, as indicated by the mean of 0.088 in the Table's first row. In-India cross-border sales were the dominant source of software and IT revenues, at 85.6 per cent of revenues for the average supplier. In-country domestic sales constituted the remaining 5.6 per cent of average revenues. In-India cross-border sales alone, with no bodyshopping and no in-country sales, were reported by most firms.

Overseas employee expenses totaled 19.7 per cent of sales. This was substantially larger than the bodyshopping revenue fraction, consistent with the fact that in the late 1990s one person-year of bodyshopped work from an Indian supplier was billed at roughly three times the price of one person-year of work done in India (Arora *et al.*, 2001, p. 1275). Sales to the United States were the main source of revenues, contributing 66.4 per cent of the average supplier's revenues, followed by European sales at 14.5 per cent of revenues, while the remainder of the world contributed less than a fifth of revenues. Domestic sales of these suppliers were trivial.

The statistics in Table 3 also elucidate the nature of suppliers. Subsidiaries outside India were possessed by an impressive 15.3 per cent of suppliers. This suggests that suppliers used overseas offices to aid sales transactions with clients, a strategy that Carmel and Nicholson (2005, p. 46) conclude is both effective and commonplace in the U.S. and the United Kingdom among Indian IT suppliers. Public corporations constituted only 12.2 per cent of the suppliers, whereas 82.3 per cent were private corporations and the rest were unincorporated suppliers, reflecting the entrepreneurial nature of the industry.

Industry participation is apparent from the business segment dummy means in Table 3. The industry dummy means sum to 1.88 across the industry categories, implying that on average suppliers participated in 1.88 of the twelve business segments described in Table 4. Customized programs were produced by 50 per cent of suppliers, systems design was carried out by 38 per cent of suppliers, and business process applications by 24 per cent of suppliers. The remaining categories were less prevalent, with 20 per cent of suppliers for IT purchasing, 12 per cent for data processing, 12 per cent for systems maintenance, 9 per cent for packaged software, 6 per cent for web hosting, and under 2 per cent for each of IT robustness, IT maintenance, and IT facilities. An "other" software and IT category also pertained to 17 per cent of suppliers.

The low activity in packaged software is consistent with the previous finding that packaged software and products constituted only 8.8 per cent of software development and software services export revenues in the late 1990s (Arora *et al.*, 2001, p. 1272). Indeed most software projects outsourced to India have been characterized as technically undemanding and small (Arora *et al.*, 2001, pp. 1273-1274), a fact that contributes to D'Costa's (2002) concern that the low wage and skill levels of the work offer little opportunity for growth of long-term advantage among Indian firms.

A correlation matrix between all variables is available in appendix Table A1.

4.4 Estimation using Two-Limit Tobit Models

Hypotheses were tested using two-limit Tobit models, which account for the constraints on the dependent variables. Each dependent variable is a fraction and hence is constrained to be at least zero and at most one, but each represents a latent variable since the pressures to pursue cross-border sales or bodyshopping in fact differ among the subsets of suppliers whose dependent variable is identically zero or one. The large proportion of observations at each limit would yield biased and inconsistent estimates using OLS regression (Maddala, 1983, p. 2). Econometricians have proposed the "Tobit" model (Tobin, 1958), which does not suffer from these biases, to analyze such limited dependent variables. We therefore use a Tobit specification with both left and right censoring.

If y_i denotes the observed extent of bodyshopping or offshoring for firm i, the form of the simple Tobit model is:

$$y_i = \begin{cases} y_i^* & \text{if } y_i^* > 0 \\ 0 & \text{if } y_i^* \le 0, \end{cases} \tag{1}$$

where y_i^* is a linear function of explanatory variables that influence bodyshopping or offshoring. If $\mathbf{x}_i$ is a Jx1 vector of these explanatory variables, then y_i^* is given by:

$$y_i^* = \beta'\mathbf{x}_i + \varepsilon_i, \tag{2}$$

where β is a Jx1 parameter vector of regression coefficients and ε_i is an independently distributed normal random disturbance with mean zero and variance σ^2. Amemiya (1973) has proved the consistency and asymptotic normality of the maximum likelihood estimator for the Tobit model. Olsen (1978) has shown that the maximum likelihood estimator is unique and yields a global maximum. Since the dependent variable in the present context also has an upper bound of 1, we modify expression (1) as follows:

$$y_i = \begin{cases} 1 & \text{if } y_i^* \geq 1 \\ y_i^* & \text{if } 0 < y_i^* < 1 \\ 0 & \text{if } y_i^* \leq 0. \end{cases} \tag{3}$$

This is often referred to as a 'two-limit' Tobit model (Maddala, 1983, p. 161), and shares the basic Tobit model's properties of consistency, asymptotic normality, and uniqueness. The log-likelihood function is:

$$\text{Ln } L = \sum_0 \ln \text{Prob}(y_i^* \leq 0) + \sum_1 \ln \text{Prob}(y_i^* \geq 1) + \sum_i \ln \text{Prob}(y_i^*), \tag{4}$$

where $\sum_0$, $\sum_1$, and $\sum_i$ denote summation over firms with $y_i = 0$, $y_i = 1$, and $0 < y_i < 1$ respectively. The log-likelihood is therefore partitioned based on the limit and non-limit observations. Using expression (2), the log-likelihood in (4) becomes:

$$\text{Ln } L = \sum_0 \ln \Phi(-\beta' \mathbf{x}_i / \sigma) + \sum_1 \ln(1 - \Phi(1 - \beta' \mathbf{x}_i / \sigma)) + \sum_i \ln(\sigma^{-1} \phi((y_i - \beta' \mathbf{x}_i) / \sigma)), \tag{5}$$

where $\Phi(\cdot)$ and $\phi(\cdot)$ are, respectively, the distribution and density function of the standard normal. Concavity of the log-likelihood function in (5) follows easily from the simple Tobit model (Pratt, 1981). A maximum likelihood estimation procedure (Nelson, 1976) is used to estimate the parameter set (β, σ) on the basis of the observations for y and $\mathbf{x}$ in our sample of firms (see Nakamura and Nakamura, 1983).

4.5 Causality and Interpretation

The estimated coefficients do not necessarily have a causal interpretation, because relationships between some variables are likely to have evolved over time. For example if larger firms choose to offer bodyshopping services, and then the firms and their investors decide that bodyshopping operates most effectively at a large scale, size may lead to bodyshopping which in turn increases size in a dynamic process that plays out until equilibrium is reached. The appropriate

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interpretation of the estimates, then, is that they reflect outcomes at or approaching equilibria which reflect viable business models.

5 Results

5.1 Tobit Regressions of Firm-Level Determinants of Bodyshopping and In-India Supply

Maximum likelihood estimates of $\boldsymbol{\beta}$ from equations (2) and (3) assess, in Table 5, how different sets of supplier-level determinants $\mathbf{x}_i$ relate to bodyshopping (y_i in models A1-A3) and in-India cross-border supply (y_i in models B1-B3).[5] In consonance with the production and transaction cost rationales of Hypothesis 1, larger suppliers were more likely to provide bodyshopping services. Conversely, larger suppliers were less likely to provide in-India cross-border supply.

These results are indicated by the positive and significant estimates in Models A1-A3 and by the negative and significant estimates in Models B1-B3. Specifically the coefficient estimates imply that, among "affected" suppliers, i.e., suppliers with bodyshopping fractions greater than zero and less than one, a doubling of supplier size yielded roughly a 5.4 to 6.0 per cent of sales increase in bodyshopping, with a roughly corresponding decrease in in-India cross-border supply.[6]

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[5] The estimates also implicitly assess supplier-level determinants of supply to India, the omitted case for the dependent variable. As an example, consider the effect of size in Models A1 and B1. At any supplier size, the total of bodyshopping, plus in-India (cross-border) supply, plus supply to India, is 100%. Hence the implicit estimated coefficient of size for supply to India is $-((0.086)+(-0.095))=0.009$, implying a slight (but statistically insignificant) increase in supply to India with firm size.

[6] A doubling of firm size increases the logarithmic size variable by $\ln 2 \approx 0.693$.

Firms with 0 or 1 bodyshopping have the latent variable y_i^* correspondingly altered, and hence are partially affected if y_i^* increases and crosses the threshold values of 0 or 1, to gain a positive or maximum expected fraction of bodyshopping. Decreases in y_i^* have analogous effects. The tendency for the largest suppliers to bodyshop is robust to the alternative model specifications, which add overseas sales variables and remove the private and public company status variables, and continue to hold in later model specifications.

5.2 Size, Corporate Status, and Overseas Activities

In consonance with the rationales of Hypotheses 2 and 3, incorporated suppliers, especially public companies, were more likely to bodyshop than unincorporated suppliers, which is the base case left out for comparison purposes in the model. The estimates in Models A1 and B1 imply, among affected suppliers, that public corporations had 43 per cent of sales greater bodyshopping relative to unincorporated suppliers, and 47 per cent of sales less in-India cross-border supply. The magnitude of the coefficients diminishes once geographic sales variables are included in Models A2 and B2, and the estimates become statistically insignificant, although they continue to suggest possible benefits of incorporation. The public company variable has somewhat smaller coefficient estimates in Models A3 and B3, when overseas subsidiaries and the overseas employee ratio are added as regressors.

In consonance with the rationales of Hypothesis 4, suppliers with subsidiaries overseas were more likely to bodyshop. The estimates in Models A3 and B3 imply among affected suppliers 18 per cent of sales more bodyshopping and 32 per cent of sales less in-India cross-border supply if the suppliers have subsidiaries overseas, with the difference of 13.7 per cent attributed to additional in-country sales. The overseas employee ratio variable has statistically insignificant and near-zero coefficient estimates. Since larger suppliers more often have overseas subsidiaries (the correlation is 0.28), the overseas subsidiary variable is somewhat related to size, but both variables remain

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statistically significant despite the relationship.[7] Bodyshopping may sometimes have driven establishment of overseas subsidiaries, and no claim is made that the relationship to bodyshopping is entirely causal.

5.3 Sales Regions and Business Activities

As anticipated in Hypothesis 5, international differences exist in the relative use of bodyshopping compared to in-India cross-border supply. In-India cross-border supply is estimated to have been substantially less prevalent among suppliers selling to the U.S. compared to those selling to Europe, and enormously less prevalent than in the Asian regions. Among affected suppliers, those selling entirely to the U.S. are estimated in model A2 to have bodyshopped on average 22 per cent of sales less than those selling entirely to Australia and New Zealand, 30 per cent of sales less than those selling entirely to Europe, 57 per cent of sales less than those selling entirely to East Asia, and 76 per cent of sales less than those selling entirely to West Asia.

The evidence suggests that the predominant costs affecting bodyshopping decisions are travel costs, or perhaps labor costs, but not language costs. Travel costs are closely related to the

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[7] In sensitivity analyses in which the overseas employee ratio was transformed, using instead log(1+overseas employee ratio) or log(1+log(1+overseas employee ratio)) to obtain a less-skew distribution, the transformed overseas employee ratio has greater statistical significance than the subsidiary overseas dummy variable. Substituting the double-log transformation in model A3, the estimated coefficient of log size falls to 0.061 (p<.01), the estimated coefficient of overseas subsidiary changes to 0.143 and is statistically insignificant, and the estimated coefficient of log(1+log(1+overseas employee ratio)) is 1.293 (p<.001). This suggests that somewhat more of the apparent relationship of firm size to bodyshopping than is apparent in Table 5 might in fact be due to prior overseas presence of the firm, depending on the unknown true functional form, although it is not known whether overseas presence drove bodyshopping or *vice versa*.

estimated degree of bodyshopping, as clients in regions nearest to India apparently use the most bodyshopping whereas more distant clients use less bodyshopping. Although decisions driven primarily by airline costs would be puzzling, other impediments to travel may be closely correlated. Labor cost differences also match fairly closely with the estimated variations in bodyshopping, but with the exception of low bodyshopping to Latin America and exceptionally high bodyshopping to South Asia. Ignoring these exceptions, one interpretation is that Indian employees working overseas may be paid wages that correlate with indigenous overseas employees' wages, driving up costs of bodyshopping and therefore reducing bodyshopping to clients in countries with high wages. Linguistic differences clearly do not explain these regional differences.

Differences in bodyshopping by business segment are explored in Table 6, which adds the business activity dummies to models A2-A3 and B2-B3. Most other variables' estimates remain similar, with the estimated coefficients of log size somewhat smaller, and of public and private incorporation somewhat larger. The coefficient estimates for subsidiaries overseas are much smaller after accounting for business segments, suggesting that bodyshopping is driven not so much by overseas subsidiaries but more directly by business segments' needs.

As Hypothesis 6 anticipates, the Table suggests that bodyshopping increases with the need for close physical contact in each business segment. The hands-on-equipment IT purchasing and systems maintenance segments have coefficient estimates in Models A4-A5 that are statistically significant and imply among affected suppliers 32 per cent of sales more bodyshopping for suppliers of IT purchasing services and 25 per cent of sales more bodyshopping for suppliers of systems maintenance services, *ceteris paribus*. The internetworking-intensive business process segment has statistically significant negative coefficient estimates, implying among affected suppliers 21 per cent of sales less bodyshopping. Development activities that require no on-site presence but often require close interaction with clients, packaged software, customized programs, data processing, web

hosting, and other software and IT, all have coefficient estimates near zero (with reasonably small standard errors). The remaining industry segments, IT maintenance, IT robustness, and IT facilities, have small sample sizes of 9-16 suppliers each and are correlated with other business activities, causing large standard errors so that little can be said about them. Hence, the available evidence suggests that the need or lack of need for on-site activity appears to drive the degree of bodyshopping in different industry segments.[8]

6 Discussion and Conclusion

The objective of this study was to begin to disentangle determinants of bodyshopping versus in-India supply as means of Indian IT outsourcing to non-Indian clients. To do so, novel Reserve Bank of India survey data on the complete set of Indian IT supplying firms were analyzed, using two-limit Tobit models of the determinants of these two forms of IT provision. The findings

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[8] The business segment coefficients reported here are marginal effects conditional on suppliers' participation in all other business segments. Since suppliers often participate in multiple, somewhat correlated, business segments, one might also ask about the total effects of being in a business segment controlling only for non-business segment variables but not for other business segments. In variants of model A5 in which only one business segment is included at a time, the estimates reveal even stronger inter-segment differences than those reported in Table 6. The point estimates for IT purchasing and systems maintenance increase to 0.382 and 0.389 respectively, and the estimate for business process decreases to -0.229. Other estimates remain closer to zero, although the estimated coefficient for IT systems design increases to 0.225 ($p<.01$) and that for customized programs increases to 0.141 ($p<.10$). The corresponding standard errors all are slightly (up to one tenth) smaller than those reported in Table 6. Hence using total effects of business segments as the metric, business segment differences in bodyshopping are even slightly starker than when using marginal effects as the metric.

showed strong strategic roles of supplier size, legal status, and overseas investments, as well as the differing needs of alternative business activities and world regions.

6.1 Contributions

This study has, apparently for the first time, investigated the determinants of bodyshopping versus in-India supply as means of Indian IT outsourcing to non-Indian clients. This is important because it elucidates how the preeminent Indian IT sector serves information systems and technology needs of businesses worldwide. International IT provision by Indian suppliers has been widely recognized as important, but there have been few investigations of the Indian IT sector.

IT outsourcing's nature depends, seemingly, on key transaction and production cost differences. The hypothesized roles of these costs have universally been confirmed by our empirical analyses of the complete Indian software and IT sector in 2002-2003. In addition the evidence reveals important geographic and industry-specific differences in the relative use of bodyshopping versus in-India cross-border supply and in the sizes of suppliers contracted to supply these services.

Strategic imperatives seem to help drive decision making of Indian IT suppliers and their clients. Large supplier size, and the credibility that comes from incorporation and public listing, apparently enhance suppliers' ability to serve as bodyshopping providers. In contrast, for many applications, especially more technology-intensive applications, small suppliers apparently manage to capture substantial overseas business without any need to rely on bodyshopping.

Suppliers that provide bodyshopping services are well served by setting up overseas subsidiaries to handle visa procedures, housing, and other personnel-related matters in addition to streamlining contacts with potential clients. The evidence shows a statistically significant 19 per cent increase in bodyshopping, as a percentage of revenues, associated with having an overseas subsidiary. This use of overseas subsidiaries is *negatively* associated with in-India work supplied to

international clients, with a 32 per cent decrease in in-India cross-border sales associated with having an overseas subsidiary.

Business segment differences put IT purchasing and systems maintenance services highest in the proclivity to use bodyshopping, suggesting a strategic imperative that management of hardware often requires activity physically located in the client firm. Software creation, data processing, and web hosting had intermediate amounts of bodyshopping. Business process outsourcing, which typically can be performed readily at a distance, was associated with the lowest use of bodyshopping. Although many authors have derided India's substantial reliance on bodyshopping, a rejection of cross-national employee flows may apply best to segments such as software, for which work might be carried out in India and products shipped electronically, and less well to business segments that require hands-on activity inside client firms.

Geographic locations of sales yield noteworthy differences in the use of bodyshopping. The U.S., with the highest cost for bodyshopped employees, evidenced a very low propensity for consuming services involving bodyshopping, while Europe, Australia, and New Zealand, with more moderate costs, had a moderate propensity for bodyshopping, and Asian regions with the lowest bodyshopping costs had the greatest propensity for receiving bodyshopping.

6.2 Practical Implications

Patterns observed here among Indian suppliers provide a checklist of indicators about apparently appropriate business practices. Provision of software and IT services to foreign clients is practical even for tiny businesses, but provision of bodyshopping services seems typically to demand a larger scale of operation. Likewise, legitimacy through public listing and incorporation is not crucial for IT services sales to foreign clients, but is substantially more important for suppliers that provide bodyshopping services. And similarly, having a subsidiary abroad was least important for

suppliers providing cross-border sales to foreign clients. Finally, bodyshopping is less often desirable relative to in-India services for clients in countries with high labor costs.

The explosive growth of the Indian IT industry has become a model for similar attempts to establish new information-intensive industries in China and other nations. The example provided by India involves entrepreneurial firms geared from the start toward international markets, in many ways fitting the profile of born-global firms studied for example by Knight and Cavusgil (2004) and Zahra (2005). Attempts to replicate the global business success of the Indian IT market should consider, as part of their decision making, the strategic factors influencing international provision of personnel versus in-country production for export.

6.3 Limitations and Future Research

The core strategic factors considered here have necessarily been limited to data for April 2002 to March 2003 made available, in anonymized form, by the Reserve Bank of India. Although the data have the advantage of being a near-complete census, they lack the range of variables needed for more replete research. Because the data pertain solely to IT suppliers not clients, this study has assessed the opposite side of the supplier-client relationship from what has typically been studied.

Moreover, to probe further regarding issues of bodyshopping, additional data would be helpful regarding not only client firms but also means of contact and interaction with international clients; specific personnel practices related to bodyshopping; organizational culture and psychology; employee policies, earnings, and hiring; and the more specific types of software and IT that firms provide.

Moreover, these practices would best be analyzed dynamically, through panel data collected annually or more frequently over a period of years. Panel data would facilitate analysis of *changes* in suppliers to provide more or less bodyshopping relative to in-India supply, as well as how firm entry,

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exit, and acquisition affect the composition of the total provision of bodyshopping and of in-India supply. Panel data would also allow more thorough statistical controls.

Surveys by researchers or by government agencies, in India and in other nations, can make great strides in our ability to analyze forces driving the bodyshopping phenomenon and associated corporate and national strategies. These need to be paired with more qualitative studies, such as extensions of the anthropological work by Xiang (2007), that investigate supplier-client interactions and how they can be made to work effectively regardless of the distance from clients. The more the provision of information systems can be made to work well across boundaries of distance, language, and culture, the more potential there is for indigenous software and IT sectors that do not need to send their talent abroad.

Appendix

Correlations between variables are documented in Table 7.

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Table 1. Distribution of suppliers by size of sales

Revenue category	Number of suppliers	Cumulative number of suppliers	Cumulative share of total sales
Rupees 10 billion or more (More than 10 billion)	4	4	51.342
Rupees 1 billion or more (1 to 10 billion)	23	27	80.364
Rupees 500 million or more (500 million to 1 billion)	14	41	85.414
Rupees 250 million or more (250 to 500 million)	27	68	90.096
Rupees 100 million or more (100 million to 350 million)	47	115	93.682
Rupees 50 million or more (50 million to 100 million)	71	186	96.244
Rupees 10 million or more (10 million to 50 million)	247	433	99.075
Rupees 5 million or more (5 million to 10 million)	155	588	99.654
Rupees 1million or more (1 million to 5 million)	221	809	99.984
Less than Rupees 1 million (Up to 1 million)	67	876	100.00

Table 2. Dependent variable outcomes

Type of sales	Mean fraction of sales	Fraction of suppliers with:	
		no sales of this type	only sales of this type
S_1 = Bodyshopping, i.e., Out-of-India work sold cross-border	0.088	0.790	0.027
S_2 = Within-India work sold cross-border	0.856	0.039	0.708
S_3 = Within-India work sold in India	0.056	0.805	0.009

Table 3. Variables and descriptive statistics

Variable name	Definition	Mean	Standard deviation
BODYSHOPPING RATIO	Proportion of sales arising from the presence of natural persons sent abroad to provide a service on own behalf or on behalf of employer.	0.088	0.226
IN-INDIA CROSS-BORDER SALES RATIO	Proportion of sales from cross-border supply when services supplied in another country without supplier or consumer moving overseas	0.856	0.281
LOG SIZE	Natural log of revenues in rupees crores	0.302	2.037
PUBLIC COMPANY	Dummy variable = 1 if supplier is a public limited company; 0 otherwise	0.122	0.327
PRIVATE COMPANY	Dummy variable = 1 if supplier is a private limited company; 0 otherwise	0.823	0.381
UNINCORPORATED	Dummy variable = 1 if supplier is an unincorporated entity; 0 otherwise	0.055	0.228
US SALES	Proportion of total sales from the United States and Canada	0.664	0.429
EUROPE SALES	Proportion of total sales from Western, Central and Eastern Europe	0.145	0.313
EAST ASIA SALES	Proportion of total sales from East Asia	0.064	0.216
WEST ASIA SALES	Proportion of total sales from West Asia	0.021	0.124
SOUTH ASIA SALES	Proportion of total sales from South Asia	0.004	0.035
ANZ SALES	Proportion of total sales from Australia and New Zealand	0.008	0.068
LATIN AMERICA SALES	Proportion of total sales from Latin America	0.003	0.043
OTHER REGION SALES	Proportion of total sales from other countries not covered above, excluding India	0.062	0.216
SUBSIDIARY OVERSEAS	Dummy variable = 1 if supplier has a unit overseas; 0 otherwise	0.153	0.360
OVERSEAS EMPLOYEE RATIO	Ratio of overseas employee expenses (excluding bodyshopped employees) to sales	0.197	5.155
IT PURCHASING	1 if supplier serves segment 1 of Table 4, else 0	0.200	0.400
IT MAINTENANCE	1 if supplier serves segment 2 of Table 4, else 0	0.010	0.101
IT ROBUSTNESS	1 if supplier serves segment 3 of Table 4, else 0	0.018	0.134
IT SYSTEMS DESIGN	1 if supplier serves segment 4 of Table 4, else 0	0.382	0.486
CUSTOMIZED PROGRAMS	1 if supplier serves segment 5 of Table 4, else 0	0.454	0.498
SYSTEMS MAINTENANCE	1 if supplier serves segment 6 of Table 4, else 0	0.116	0.321
DATA PROCESSING	1 if supplier serves segment 7 of Table 4, else 0	0.120	0.325
WEB HOSTING	1 if supplier serves segment 8 of Table 4, else 0	0.061	0.239
IT FACILITIES	1 if supplier serves segment 9 of Table 4, else 0	0.010	0.101
PACKAGED SOFTWARE	1 if supplier serves segment 10 of Table 4, else 0	0.092	0.290
BUSINESS PROCESS	1 if supplier serves segment 11 of Table 4, else 0	0.240	0.427
OTHER SOFTWARE & IT	1 if supplier serves segment 12 of Table 4, else 0	0.174	0.379

Table 4. Business activities

Serial number	Business activity as stated in the survey instrument administered to suppliers	Variable name
1	Hardware and software consultancy and implementation services	*IT PURCHASING*
2	Maintenance and repair of computers and other peripheral equipment	*IT MAINTENANCE*
3	Disaster recovery services, provision of advice, and assistance on matters related to the management of computer resources	*IT ROBUSTNESS*
4	Analysis, design and programming of ready to use systems, including web page development and design, and technical consultancy related to software	*IT SYSTEMS DESIGN*
5	Development, production, supply and documentation of customized software, including operating systems made on order for specific users	*CUSTOMIZED PROGRAMS*
6	Systems maintenance and other support services such as training provided as part of consultancy	*SYSTEMS MAINTENANCE*
7	Data processing services such as data entry, tabulation, and processing on a timesharing basis	*DATA PROCESSING*
8	Web page hosting services, for instance the provision of server space on the internet to host clients' web pages	*WEB HOSTING*
9	Computer facilities management	*IT FACILITIES*
10	Non-physical exports of high value packaged software products	*PACKAGED SOFTWARE*
11	Exports pertaining to information technology enabled services (ITES) and business process outsourcing (BPO)	*BUSINESS PROCESS*
12	Other software & IT exports	*OTHER SOFTWARE & IT*

Table 5. Bodyshopping and in-India cross-border supply related to supplier size, type, and geographic sales region – two limit Tobit models

	Bodyshopping			In India cross-border supply		
Variable name	Model A1	Model A2	Model A3	Model B1	Model B2	Model B3
LOG SIZE	0.086***	0.087***	0.078***	-0.095***	-0.098***	-0.083***
	(0.020)	(0.019)	(0.019)	(0.017)	(0.017)	(0.017)
PUBLIC COMPANY	0.434*	0.311	0.247	-0.473**	-0.355*	-0.257
	(0.224)	(0.217)	(0.219)	(0.193)	(0.189)	(0.189)
PRIVATE COMPANY	0.261	0.196	0.194	-0.185	-0.134	-0.133
	(0.201)	(0.195)	(0.194)	(0.172)	(0.169)	(0.167)
US SALES		0.011	0.071		0.038	-0.053
		(0.259)	(0.262)		(0.225)	(0.225)
EUROPE SALES		0.316	0.349		-0.233	-0.274
		(0.274)	(0.276)		(0.239)	(0.238)
EAST ASIA SALES		0.580**	0.610**		-0.477*	-0.511**
		(0.294)	(0.296)		(0.260)	(0.258)
WEST ASIA SALES		0.774**	0.802**		-0.712**	-0.742**
		(0.362)	(0.364)		(0.331)	(0.329)
SOUTH ASIA SALES		2.432***	2.458***		-2.384***	-2.392***
		(0.894)	(0.895)		(0.855)	(0.850)
ANZ SALES		0.228	0.330		-0.477	-0.605
		(0.658)	(0.651)		(0.514)	(0.508)
LATIN AMERICA SALES		-0.770	-0.755		-0.290	-0.163
		(1.557)	(1.491)		(0.838)	(0.811)
OTHER REGION SALES		0.610**	0.614**		-0.619**	-0.633**
		(0.294)	(0.297)		(0.259)	(0.258)
SUBSIDIARY OVERSEAS			0.182*			-0.319***
			(0.102)			(0.092)
OVERSEAS EMPLOYEE RATIO			0.003			-0.001
			(0.005)			(0.005)
Constant	-0.990***	-1.063***	-1.129***	1.700***	1.744***	1.844***
	(0.209)	(0.328)	(0.332)	(0.174)	(0.281)	(0.281)
Log Likelihood	-478.608	-456.802	-454.925	-590.999	-565.727	-559.613
N	876	876	876	876	876	876
LR χ^2	33.482	77.093	80.847	56.201	106.745	118.973

* $p < 0.10$, ** $p < 0.05$, and *** $p < 0.01$; standard errors in parentheses.

Table 6. Bodyshopping and in-India cross-border supply related to supplier size and type, geographic sales region, and business segments – two limit Tobit models

Variable name	Bodyshopping		In India cross-border supply	
	Model A4	Model A5	Model B4	Model B5
LOG SIZE	0.075***	0.072***	-0.088***	-0.077***
	(0.020)	(0.020)	(0.017)	(0.018)
PUBLIC COMPANY	0.397*	0.370*	-0.413**	-0.337*
	(0.218)	(0.220)	(0.187)	(0.188)
PRIVATE COMPANY	0.245	0.244	-0.169	-0.162
	(0.196)	(0.196)	(0.168)	(0.166)
US SALES	0.051	0.071	0.001	-0.061
	(0.262)	(0.264)	(0.224)	(0.223)
EUROPE SALES	0.346	0.356	-0.254	-0.280
	(0.276)	(0.277)	(0.238)	(0.236)
EAST ASIA SALES	0.511*	0.523*	-0.422	-0.452*
	(0.294)	(0.295)	(0.257)	(0.256)
WEST ASIA SALES	0.585	0.598	-0.565*	-0.593*
	(0.363)	(0.364)	(0.329)	(0.328)
SOUTH ASIA SALES	2.347***	2.368***	-2.250***	-2.286***
	(0.902)	(0.903)	(0.867)	(0.864)
ANZ SALES	0.310	0.348	-0.560	-0.670
	(0.629)	(0.629)	(0.508)	(0.505)
LATIN AMERICA SALES	-1.448	-1.387	0.098	0.108
	(1.684)	(1.662)	(0.870)	(0.835)
OTHER REGION SALES	0.551*	0.547*	-0.570**	-0.591**
	(0.294)	(0.297)	(0.256)	(0.256)
IT PURCHASING	0.322***	0.316***	-0.353***	-0.346***
	(0.089)	(0.089)	(0.081)	(0.081)
IT MAINTENANCE	-0.155	-0.147	0.040	0.035
	(0.337)	(0.337)	(0.310)	(0.308)
IT ROBUSTNESS	-0.072	-0.081	0.076	0.107
	(0.256)	(0.256)	(0.244)	(0.242)
IT SYSTEMS DESIGN	0.088	0.086	-0.108	-0.099
	(0.083)	(0.083)	(0.075)	(0.075)
CUSTOMIZED PROGRAMS	0.011	0.013	0.060	0.061
	(0.079)	(0.079)	(0.072)	(0.071)
SYSTEMS MAINTENANCE	0.249**	0.246**	-0.152	-0.134
	(0.114)	(0.115)	(0.107)	(0.107)
DATA PROCESSING	0.026	0.028	-0.022	-0.030
	(0.119)	(0.119)	(0.107)	(0.106)
WEB HOSTING	0.026	0.016	-0.021	0.011
	(0.158)	(0.159)	(0.145)	(0.146)
IT FACILITIES	-0.125	-0.124	0.233	0.230
	(0.318)	(0.318)	(0.307)	(0.306)
PACKAGED SOFTWARE	0.052	0.049	-0.065	-0.048
	(0.123)	(0.123)	(0.112)	(0.111)
BUSINESS PROCESS	-0.215**	-0.208**	0.199**	0.182**

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	(0.098)	(0.099)	(0.086)	(0.086)
OTHER SOFTWARE & IT	-0.034	-0.030	0.003	0.003
	(0.103)	(0.103)	(0.092)	(0.091)
SUBSIDIARY OVERSEAS		0.066		-0.240***
		(0.103)		(0.092)
OVERSEAS EMPLOYEE RATIO		0.002		0.001
		(0.005)		(0.005)
Constant	-1.207***	-1.229***	1.852***	1.912***
	(0.340)	(0.342)	(0.286)	(0.286)
Log Likelihood	-437.094	-436.755	-545.666	-542.237
N	876	876	876	876
LR χ^2	116.510	117.188	146.867	153.725

* $p < 0.10$, ** $p < 0.05$, and *** $p < 0.01$; standard errors in parentheses.

Table 7. Correlations of Variables Used in the Paper

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
1	1																										
2	-.750	1																									
3	.099	-.181	1																								
4	.076	-.142	.197	1																							
5	-.034	.090	-.106	-.804	1																						
6	-.169	.182	-.041	-.068	.009	1																					
7	.039	-.042	.069	.036	-.005	-.587	1																				
8	.086	-.086	.027	.028	-.017	-.385	-.093	1																			
9	.110	-.110	-.013	.076	-.054	-.236	-.040	-.017	1																		
10	.168	-.160	.028	.049	-.028	-.097	-.026	-.009	.113	1																	
11	.024	-.035	-.017	.006	-.034	-.120	-.021	-.008	-.005	.025	1																
12	-.012	-.022	-.033	.063	-.045	-.080	-.007	-.013	-.009	.000	.000	1															
13	.112	-.120	-.070	.003	.031	-.366	-.104	-.055	-.040	.019	-.026	-.007	1														
14	.096	-.213	.279	.307	-.227	-.208	.078	.077	.064	.053	-.026	.099	.090	1													
15	.066	-.049	.024	.094	-.075	-.054	-.015	-.009	-.006	-.002	-.003	.000	.147	.084	1												
16	.191	-.214	.116	.062	-.049	-.067	-.016	.048	.086	.065	-.034	.040	.032	.153	.071	1											
17	.051	-.063	.085	.066	-.042	-.092	.047	.042	-.002	-.012	-.005	-.006	.040	.083	-.002	.176	1										
18	.090	-.118	.180	.093	-.060	-.070	.001	.033	.045	.192	.026	.122	.018	.179	.000	.230	.240	1									
19	.060	-.069	-.083	.008	-.029	-.073	.049	.055	.012	.015	-.046	.000	.060	.090	-.026	.200	-.010	.138	1								
20	.046	-.012	-.022	.013	-.019	-.053	.000	.085	.013	-.010	.045	.003	.028	.064	-.030	.152	.066	.098	.249	1							
21	.158	-.145	.136	.066	-.051	-.097	.008	.065	.110	.040	.039	.108	.018	.182	-.010	.282	.104	.243	.300	.276	1						
22	-.023	.022	-.055	-.030	.033	.065	-.027	-.044	.002	-.009	.062	-.007	-.039	-.049	-.012	.000	-.003	.081	-.001	-.047	.085	1					
23	.014	-.027	-.077	.052	-.071	-.007	-.005	-.034	-.008	.013	.121	.058	.020	.092	-.007	.089	.069	.251	.214	.086	.162	.069	1				
24	.041	-.033	.077	.031	-.042	-.051	.001	.018	.119	-.012	.012	-.006	-.023	.083	-.002	.176	.214	.240	.106	.066	.210	-.003	.117	1			
25	.045	-.042	-.084	.056	-.054	-.092	.003	.097	.036	.002	.055	.091	.016	.094	-.010	.077	-.033	.104	.114	.089	.167	.040	.184	.085	1		
26	-.074	.058	.071	.134	-.104	.060	.033	-.085	-.037	.018	-.014	-.033	-.036	-.016	-.019	-.033	-.031	.103	-.156	-.174	-.029	.180	.026	-.004	-.032	1	
27	.019	-.036	.140	.009	-.013	.000	-.004	-.020	.007	.043	-.017	-.028	-.018	.023	-.015	-.071	.013	-.018	-.199	-.255	-.072	-.076	.023	-.017	-.032	-.116	1

Key to variables: *1 Bodyshopping ratio, 2 In-India cross-border sales ratio, 3 Log size, 4 Public company, 5 Private company, 6 U.S. sales, 7 Europe sales, 8 East Asia sales, 9 West Asia sales, 10 South Asia sales, 11 ANZ sales, 12 Latin America sales, 13 Other region sales, 14 Subsidiary overseas, 15 Overseas employee ratio, 16 IT purchasing, 17 IT maintenance, 18 IT robustness, 19 IT systems design, 20 Customized programs, 21 Systems maintenance, 22 Data processing, 23 Web hosting, 24 IT facilities, 25 Packaged software, 26 Business process, 27 Other software & IT*