

The Indian Business Process Outsourcing Industry: An Evaluation of Firm-Level Performance

Arti Grover^a

Abstract: The impact of outsourcing on the productivity of the buyer has been widely researched, however, little investigation has been done to explore the factors that explain the productivity of the supplier in an outsourcing relationship. In the absence of any theory of a service provider firm or more popularly called a Business Process Outsourcing (BPO) firm, we use the representation of an intermediate good firm of an endogenous growth model. In particular, we combine suitable elements from the model of an intermediate good firm in Aghion et al (1999) endogenous growth theory, Arora and Asundi (1999) representation of Information Technology outsourcing firms in India and Antràs (2005) internalization theory to bring out the factors that affect a service provider's performance. By applying these models, we are able to support an econometric model of firm performance comprising of non-conventional productivity determinants like number of clients, information security certification and quality certifications. Our empirical results indicate that in the year 2002-03, prior experience, number of locations, number of clients and funding from a venture capitalist had a positive influence on a third party vendor's performance while information security certifications negatively affected the supplier's performance.

Keywords: Productivity, Outsourcing, Third party vendor

JEL Classification: F14, L22, L23 and L60

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^a Delhi School of Economics, University of Delhi, Delhi, India – 110007, ph: 91-11-27666705 agrover@princeton.edu, artigrover@gmail.com

Section 1: Introduction

Companies in high wage nations are increasingly viewing offshoring of services as a strategic and essential element of their business strategy. Offshoring enhances the overall productivity of the sourcing firm by lowering its costs of production, providing access to high quality resources not available internally and releasing internal resources¹. The impact of offshoring on the productivity of the buyer has been widely researched², however, little investigation has gone into the factors that explain the productivity of the supplier in an outsourcing relationship. A major stumbling block in such an evaluation is the complete absence of any theory relating to the service provider firm. In this paper, we borrow relevant features of a firm, which resembles that of a typical service provider firm from different strands of literature. This helps us formulate an econometric model of a representative Business Process Outsourcing³ (BPO) or Information technology enabled services (ITES) firm to quantitatively evaluate the factors that explains its performance in India.

Going by the Heckscher-Ohlin prediction on factor price equalization (FPE), it is not difficult to imagine that international production sharing for pure cost arbitrage reasons is bound to fall overtime. For example, India, a labor abundant country has relatively lower wages vis-à-vis the U.S. and thus is a potential ground for producing labor intensive stages for a variety of final goods. Offshoring or trade in intermediate goods and services has decreased the relative wage gap between India and the US. It is then natural for a supplier in India to raise its prices, lest its profits and operating margins will take a plunge. However, if the prices are indexed to wages, then the volume of offshoring business will fall for cost arbitrage reasons. In India, where the BPO industry is more than a decade old, is witnessing such problems. In the last five years, the industry experienced an average 20 % per annum wages inflation and a resulting 15 % decline in average revenue per hour. Even large Indian BPO firms like Wipro Spectramind, experienced a fall in its operating margins from 23% in 2003-04 to 14% in 2005-06 even though the firm expanded from 9300 to 16087 employees during the same period. Wage inflation, high attrition, sluggish growth of outsourcing business, Indian currency appreciation and competition from other Asian and East European countries have made high margins unsustainable for Indian outsourcing firms. Thus, the only way a service provider can save its business from dipping is by raising its productivity.

Unfortunately, there has not been any research that focuses on the variables impacting the performance of a supplier in an outsourcing relationship. From a macro perspective, it is important

¹ E-Serve, Citibank's back-office, processes are claimed to be 15-20% more efficient than Citibank's internal processes.

² See for example, Amiti, and Wei (2006), Görg and Hanley (2005), Egger and Egger (2006), Calabrese and Erbetta.(2004)

³ The wide range of services offered by the Indian BPO industry can be classified into four main categories – Customer Care/Interaction, Finance, Accounting and Payment, Human Resources and Content Development. These lines are broadly defined in Appendix A.1

to analyze the factors determining the productivity of a BPO service provider for two reasons. First, a BPO vendor's performance is a key to the expansion of the global outsourcing industry. Second, in many countries, like India, BPO industry makes a crucial contribution to the host economy through trade. In 2005-06, the ITES and the Information Technology (IT) sectors together contributed to 20% of aggregate exports and 4.8% of GDP. The Indian BPO industry has come a long way since 1996 when American Express established its first captive offshore operations. Export revenue and employment growth in the BPO industry have been phenomenal, ranging between 40–70% and 35–60% respectively. 90% of the revenue in this industry comes from exports. Table 1 details the revenue, employment and export growth in this sector from 2001-02 to 2005-06.

At a micro level, an understanding of the BPO industry is important from the standpoint of the buyer as well as the service provider. From the view point of the buyer, offshoring of labor intensive fragments to a low wage nation raises its productivity by lowering its cost of production and also allowing it to concentrate on its core activities (See for example Görg and Hanley, 2005 and Egger and Egger, 2006). An increase in the efficiency of the supplier will therefore act as an additional source of productivity to the buyer. This can happen only if the factors determining the performance of the supplier are known. From the perspective of the supplier, it is crucial to know how a change in one variable filters through the organization to affect the bottom-line performance especially so when rising wages forces the operating margins to head southwards. A supplier must optimally choose to allocate its resources among potential areas like infrastructure, quality certifications, business continuity planning (BCP), employee training and re-skilling, expanding service line/process offerings, marketing front-ends and personnel to consolidate its position in the industry. In this paper, we intend to evaluate how some of these variables relate to the performance of a BPO firm, as measured by its revenue per employee.

A well performing service provider can critically contribute to the success of a sourcing firm's offshoring strategy. It is therefore surprising to find that there still exists no theory that explains the performance of a service provider. To formulate an empirical specification in the absence of any theory on BPO firms, we exploit the existing literature where the representation of a firm closely resembles a typical BPO firm. We combine suitable elements from the representation of a firm in the Aghion et al (1999) endogenous growth model, Arora and Asundi (1999) assessment of the impact of adoption of ISO (International Standard for Organizations) quality norms on IT outsourcing firms in India and Antràs (2005) internalization theory to formulate the factors that can potentially affect a service provider's performance.

Aghion et al (1999) develop an endogenous growth model, where the pace of technology adoption by an intermediate good supplier determines its profitability. Like the input suppliers of the Aghion et al model, a BPO firm also provides slightly differentiated services and needs to

continuously upgrade its technology to maintain competitive edge. The pace of technology adoption and hence the profitability of a firm in their model is determined by the degree competition, the structure of operational costs and the source of funding for these firms. We integrate these variables to build our econometric model of BPO firm performance. Another dimension peculiar to BPO and software industry is the pressure to adopt certain quality norms. Arora and Asundi (1999) empirically evaluate the impact of investment in quality (signaled through ISO certification) on the performance of 95 software outsourcing firms in India between 1992-93 and 1996-97. Clearly, software outsourcing firms are similar to the BPO firms in the sense that both supply inputs to a sourcing firm on a contractual basis. In fact, the development of the two types of outsourcing industry has also been similar. Software industry in India started with low-tech jobs, which over a period of time evolved to high end software solution provider. In the same manner, the BPO industry in India started with captive call centers and has now advanced to include risk analytics and other knowledge based processes. We argue that besides ISO certification, there are other variables that have an effect similar to investment in quality. These include investment in information security certifications, number of locations/offices and the degree of specialization. Lastly, we take advantage of the existing internalization literature in the vertical production transfer context. Antràs (2005) differentiates between an affiliated supplier and an unaffiliated supplier and proves that the input of a high-tech good is produced offshore by an affiliated supplier, that is, a captive unit. This combined with the fact that high-tech goods create more technology spillovers suggests that a captive center should perform better vis-à-vis a third party vendor (TPV).

While detailing the above theoretical models to outline the dynamics of a BPO firm, we focus on the non-conventional factors like the number of clients, certifications relating to information security and quality and source of funding, that establishes its performance. The reason for such a unique treatment of the ITES sector can be explained by looking at its structure and development in India. One, a BPO firm is not a self contained organization; it tailors its products to meet the specifications of its client firm and hence fits in between the value chain of its clients. Two, there is still a lot of flux in the BPO industry, for example, there are new trends observed every year which make or mar many firms in this industry. The year 2006 saw many firms exiting the industry due to high labor turnover rates and the pressure to raise wages. The year 2006 therefore saw managers of the new entrants and the remaining firms devoting themselves to designing strategies to sustain their human capital. In the previous year, the discussion on BPO industry was mainly concerned with mergers and acquisitions. Recently in 2007, we witnessed a greater emphasis on quality and information security certifications for selling business to the prospective clients. Since this industry is clearly unusual, we identify a parsimonious econometric model in which conventional factors like energy consumption, capital expenditure, rent or the wage level are better left out.

The specification of our econometric model is based on the available literature on the theory of a supplier and preliminary analysis of aggregate and firm level data. Our estimation of BPO firm performance indicates that in the year 2002-03, prior experience, number of locations, funding from venture capitalists and the number of clients positively affects a firm's performance while investment on information security certification, which is a mandate from the client, does not benefit the supplier firm, at least in the short run. Further, we find that our empirical results are robust and invariant to the choice of estimation technique.

The paper beyond this point is organized in the following manner. In section 2 we review the relevant theoretical models and their applicability to the firms in the Indian BPO industry. These models bring out the variables that affect the performance of an outsourcing service provider. Section 3 gives the details of the data sources. Section 4 builds the intuition of our econometric model through preliminary analysis of data. Section 5 gives the empirical specification of the model and Section 6 presents and discusses the empirical results. The final section concludes the paper.

Section 2: Features of the BPO Industry and Related Models

Outsourcing of labor intensive services makes wage inflation in the host country inevitable. Therefore to prevent its margins from falling, the service providers need to incessantly raise its performance. To the best of our knowledge, there has been no theoretical research on the performance of BPO service provider firms. Thus, the basic problem in measuring a BPO service provider's performance is the complete absence of theoretical literature on outsourcing service providers. In the absence of any theory relating to a BPO service provider, we use the representation of a firm from a wide variety of available models that come close to the operations of a BPO firm. It is interesting to note that each of the three theoretical models that form the backbone of our analysis belong to three distinct area of economic research. We bring out the similarities between the intermediate good supplier firm in the Aghion et al (1999) endogenous growth model and a BPO supplier. We apply the insight developed by Arora and Asundi (1999) to analyze the impact of quality certification on the performance of IT firms in India on our BPO firm model. Finally we throw some light on the relative performance of an unaffiliated supplier vis-à-vis an affiliated supplier using the Antràs (2005) internalization theory. We shall now review each of these models more formally and discuss how they fit in the context of a BPO industry.

Section 2.1: Intermediate Good Supplier in the Endogenous Growth Model and the BPO Firm

We borrow the dynamics of an intermediate good supplier, which has characteristics of a typical BPO firm, from Aghion et al (1999) endogenous growth model. Our use of Aghion et al model is justified for many reasons. One, in the Aghion et al model, a final good is produced using a variety of intermediate inputs, as is typical of a sourcing firm.

$$y = \int_0^N A_i x_i^\alpha di,$$

Where x_i denotes the amount of intermediate good n required to produce final good y and A_i is the productivity parameter which measures the quality of x_i and $0 < \alpha < 1$ is the elasticity of substitution across inputs.

The BPO service provider supplies slightly differentiated inputs as does an intermediate good producer of the Aghion et al model. For example, suppliers of offshored services provide services like customer care, finance and accounting, payroll services, human resource or content development⁴. Within each category, there are many differentiated services, for example, customer care service can be provided through online chat, telephone calls or emails interaction. These are differentiated services and a sourcing firm can use one or all of these services to produce the final good.

Two, the intermediate good supplier of the Aghion et al model is under constant pressure to adopt the leading edge technology else its margins drop with the age of the firm's vintage.

In the Aghion et al model, the net flow of profit for a profit maximizing supplier, $\pi_{i,\tau}$, of vintage τ at date t is given by:

$$\pi_{i,\tau} = \Psi(\underline{w}, g, u) e^{gt}$$

Where \underline{w} is the steady state wage rate adjusted for firm productivity, g is the steady state growth rate of all costs (which includes, variable costs, that is, wages and fixed cost of buying the technology as well as fixed operating or maintenance cost) borne by the firm and $u = (t - \tau)$ is the age of the firm technology. For sufficiently large u , $\Psi(\underline{w}, g, u) < 0$, that is, if the age of the supplier's technology is very large, production entails a loss. Profits decline if the age of the firm technology rises, that is, $\Psi_u < 0$. It is therefore critical for the supplier to periodically upgrade its technology in order to earn positive profits.

A BPO differentiates itself by either putting in new technology or applying existing technology in a new way to improve a process. It is imperative for the service provider to update its technology and tailor its products to the demands of its clients in order to survive in the outsourcing

⁴ These services are defined in appendix A.1

industry. Buyers of BPO services shop for the lowest quality adjusted price which puts the service provider firm under constant pressure to maintain competitive edge and strive for service excellence by rapid adoption of leading edge technology. In this context, the BPO industry has developed a concept of Business Process Management, popularly referred by its acronym, BPM. With continually increasing emphasis on improving business process efficiencies, there is a growing trend towards the use of technology to automate and streamline business functions⁵.

Three, the pace of technology adoption by an intermediate good supplier in the Aghion et al model is found to depend on the degree of competition in the industry, the source of finance for the intermediate good firm and on factors affecting its cost of operations. These factors thus determine the supplier firm's profitability.

Aghion et al broaden their analysis by including the non-profit maximizing firms which are financed from outside. The manager of such a firm cares about his private benefit and the firm's solvency while minimizing the technology adoption effort. The objective function of the firm is given by:

$$U_o = \int_0^{\infty} B_t e^{-\gamma t} dt - \sum_{j \geq 1} C e^{-\gamma(t_1 + \dots + T_j)}$$

Where B_t is the private benefits of control at date t, equals $B > 0$ if the firm has financially survived and zero otherwise, γ is the subjective discount rate and C is the cost of technology adoption and T_j is the time interval between the $(j - 1)$ th and the j th technological adoption. Assuming that the private benefit, B, from remaining solvent is large and non-profit maximizing firms are sufficiently impatient, then the objective has an inverted U-shape (unlike the downward sloping function of a profit maximizing supplier), initially increasing and then decreasing in T and finally taking negative values, see figure 1. There is a maximum \tilde{T} such that the benefits exactly equal the cost of technology adoption. At this time, \tilde{T} , (see figure 1), the firm finds it optimal to upgrade its technology. After adoption, the firm starts with the same maximization problem as on date 0. Thus, the firm adopts technology after every \tilde{T} period. The pace of technology adoption and hence productivity for a profit maximizing self-financed firm is expected to be higher vis-à-vis a firm backed by outside finance when the level of competition is low. Non-profit maximizing firms of Aghion et al model are analogous to the BPO firms financed by a venture capitalist. If competition is

⁵ BPM combines expertise in process management and implementation technologies (such as EAI, BI, DW and BPMS) to deliver a solution oriented towards business delivery. Leading players are developing platform-based BPO solutions to offer industry standard process methodologies focused on key/priority horizontal/vertical markets (e.g., healthcare administration, Finance and Accounting BPO for telecommunications, financial services and manufacturing verticals). In this sense, a BPO firm may find resemblance to an intermediate good producer of the endogenous growth models.

low, a BPO firm backed by a VC is likely to delay its technology adoption as much as possible till its profits begin to fall.

When competition in the industry rises, N rises and therefore $\Psi(w, g, u)$ falls. This tends to decrease the pace of technological upgradation for profit maximizing or self financed suppliers. Thus, competition lowers the pace of technological adoption for self financed suppliers, which is a usual Schumpeterian result⁶. Per contra, competition positively affects the technology adoption rate of a supplier backed by external finance. As $\Psi(w, g, u)$ falls, the pace of technology adoption increases because the firm solvency becomes more critical when competition is high. In figure 1, the time gap between subsequent adoption of technology falls from \tilde{T} to $\tilde{\tilde{T}}$ indicating that an increase in competition increases the pace of technological adoption for firms funded from outside.

From the perspective of a BPO firm operational cost variables resonate in factors like attrition rate, seat utilization and maintenance costs of a BPO firm. BPO business is highly capital intensive and requires huge fixed operating costs, for instance, investment in office space costs about \$10,000-15,000 per seat in the Indian BPO industry, while costs relating to technology, redundancy and communications, dialer running⁷, maintenance and bandwidth are also substantial. The next crucial variable which affects the pace of technology adoption and supplier productivity is the source of finance. In the Aghion et al model, an increase in competition enhances the pace of technological adoption of firms funded from outside finance by threatening their sustainability in times of fierce competition. This tends to increase the overall productivity of the firm. A BPO service provider, funded by a venture capitalist (VC), behaves in a manner similar to the Aghion et al non-profit maximizing intermediate good producers.

Predictions of the model for the BPO Industry

In the Indian BPO space, Venture Capitalist funds such as Oak Hill, General Atlantic Partners, Westbridge Capital, Warburg Pincus, among others have been very active and have invested more than US\$ 300 million from 2001 to 2003. In the first stage of BPO development in India, when competition was low, firms backed by VC did not perform well. Examples include firms like Tracmail, Epicenter Technologies and Infowavz which have now touched the stage of insolvency while Transworks and FirstRing have already closed down. As is true of the externally financed intermediate good suppliers in the Aghion et al model, the initial development of the Indian BPO industry faced lower incentives for technology adoption for firms funded by VC. This is obvious from their poor performance. However, in the past decade, competition in the Indian BPO industry

⁶ Schumpeter (1942) suggested that more competition implies a lower probability of winning the market, which naturally discourages individual firms' R&D efforts.

has grown tremendously and therefore by the Aghion et al model we would expect higher pace of technology adoption and performance for VC backed BPO firms⁸. We will test this in the empirical section of the paper.

In the Aghion et al model, it is easy to see that a high fixed (and variable) cost of operation⁹ decreases the pace of technology adoption and hence firm performance. This is primarily the reason to expect low performance in firms with high proportion of voice based process. On the cost side, firms with a high proportion of voice processes have high fixed costs of operation (like dialer running and maintenance, bandwidth costs) as well as high employee wages¹⁰ and related expenses, while on the revenue side, voice processes are among the ones with lowest billing rates. Voice processes typically require low entry-level skill which induces higher competition and thus drives down prices¹¹. For instance, Wipro BPO, Spectramind blames its poor performance in the past to a high proportion of voice processes and there had been a clear mandate to reduce this proportion from 84% in 2005 to 60% in a span of 18 months for improving its margins.

Aghion et al model also implies that high (variable) labor cost, lowers the pace of technology adoption and hence firm performance. This is intuitive because increasing labor cost lowers not only the expected profit from adopting a new technology, but it also increases the cost of adopting the technology. In the Indian BPO industry, high employee attrition¹² rates averaging about 40%, (In 2002, the attrition rate in Wipro BPO was 120%) are additional costs, over and above the wage inflation of 15-20% per annum. Attrition^{13,14} is a big drain on the revenues of BPO firms. It costs a company \$1000 to train an agent. GENPACT, the largest Indian third party vendor, spends about

⁷ The dialer running and maintenance alone costs \$1.5 per person per hour.

⁸ Examples include the top BPO firms in India like World Network Services (WNS) backed by Warburg Pincus, and 24/7 Customer supported by Sequoia Capital.

⁹ The cost of operation varies within a country as well and hence one location may be preferred to the other depending on parameters like – people (Number, Quality, Education System), Infrastructure (Power, Telecom, STPI, Physical, Roads, Airports), Financial (Cost of Living, Real Estate Prices) and Catalysts (Government Support, Supporting Industries, Social & Political Stability, Competing Companies, Development of City, Weather). KPMG-NASSCOM (2004) and NeoIT (2004) have carried out a study of state and city location attractiveness for BPO in India.

¹⁰ Average salary for a voice based employee 12-15% higher than their non-voice counterpart because of odd working hours and stress.

¹¹ These firms demonstrate the standard Schumpeterian result (for example see Aghion and Howitt, 1992) that high competition lowers the pace of technology upgradation and hence lowers firm level performance perhaps because they attract less venture capitalist interests.

¹² The average age of employee in the Indian BPO industry is 24 years and this is the age of a number of changes in personal life – marriage, higher education. Other factors that contribute to attrition in the Indian ITES could be badly behaved bosses, boredom, odd working hours – night shifts, pay packets, quality of the work environment, lack of growth prospects.

¹³ The fact that attrition rate in the Indian BPO industry is high does not mean that there is a lack of talent per say but the problem is that such service lines are characterized by high labor turnover. For example, the labor turnover rate in the American call center industry is about 100-120% vis-à-vis a 50% attrition rate in the Indian call center industry.

¹⁴ The average attrition rate in the IT sector is about 10-15% which is much lower than the BPO sector. The increasing attrition rate is indicative of the yawning gap between demand and supply. Although India produces 2 million college graduates a year, the services industry has a shortage of seasoned professionals. As of March, 2004, the number of people working in the BPO sector in India was around 245,500 which according to NASSCOM-McKinsey (2005) is expected to

\$10 million and over 1.5 million man hours per annum on training and it takes at least three months for a new employee to reach an optimum productivity level. To combat high attrition, GENPACT maintains a buffer of 15% employees on bench which further increases labor costs and lowers firm performance¹⁵. High bonuses, salary hike, incentives, door-to-door transportation services and offsite team events are some of the strategies to fight attrition which have additionally pushed up the average labor cost of the industry and pulled down the margins. It is worth noticing that voice-based processes, which are characterized by high levels of stress and odd working hours¹⁶, are again at a disadvantage due to high attrition rate. Attrition in voice based processes averages between 50-55% as against an average of 30-35% for non-voice work. As cost of labor rises in India, voice-based BPO firms may be unsustainable in future if higher rates of attrition persist.

To combat the problem arising from high labor and operational costs, firms try to maximize “shift utilization” (that is, 3 eight hour shifts) from their fixed investment of \$ 10,000-\$ 15,000 per seat in office space. However, reality is far from ideal. Shift utilization of Indian call centers is about 1.5-2 shifts principally because 80% of the call center business in India comes from the US, which implies that most of these seats are vacant for 16 hours. To increase seat utilization, BPO firms actively look for clients across the US, that is, from the east coast to the west coast, as well as in UK and Australia. To increase seat utilization, call centers handle their voice-based services during business hours and use non-business hours to answer queries through e-mail. This may also enable a healthy balance of voice and non-voice processes and thereby help evade the problems typical of a voice based process.

Now, suppose that in the Aghion et al model, we have a total of M exogenous buyers (final good producers). Each intermediate good producer can supply to a mutually exclusive set of $m < M$ buyers. If a profit-maximizing supplier firm has higher number of clients then the model suggests that its market share is higher and therefore its profitability is also higher. In such a case, the pace of technology adoption for the supplier would be higher because there is a greater incentive to adopt new technology. In the BPO industry, a small client base implies greater dependence on a few clients which lowers the service provider’s bargaining power. Working with multiple customers also provides the vendor with the opportunity to learn and develop best practices of each of its client and share them across their organization to improve quality and reduce costs for all its customers. For

grow to 1.1 million by 2008. Clearly, a sustainable strategy to continue being the world’s most attractive outsourcing destination calls for a deeper focus on raising the number and standards of graduates in India

¹⁵ The impact of attrition depends critically on the service line in question. CRIS INFAC (2006) quantifies the impact of attrition on operating margins for three different categories of service lines – voice based, Transaction Processing and Knowledge Process Outsourcing (KPO). The study finds that drop in operating margins is much steeper at higher levels of attrition for all three service lines with KPO being the most sensitive of all three. The reason maybe found in skill intensity of KPO services where employees undergo much more extensive and expensive training before they become productive.

¹⁶Besides, it is easier to lure trained customer service representatives who outnumber agents working on services such as banking or insurance related processes

example¹⁷, in 2002-03, 61% of IBM-Daksh's total revenue came from one client and as this figure reduced¹⁸ to 32% in 2003-04, its revenue per employee increased from \$9000 per annum to \$12000 per annum, a 33% improvement in firm performance in one year.

Section 2.2: Firms in the Software Outsourcing Industry and the BPO Firm

As discussed in the previous section, it is critical for the firm to have larger number of clients to minimize risk and increase the pace of technology adoption. How should firms attract more clients? Quality certifications and Information security certifications is one way to place the “foot on the door” and signal potential customers. The modeling of software outsourcing firms in Arora and Asundi (1999) comes very close to a representative BPO firm because there are many commonalities between IT outsourcing firms and BPO firms. Arora and Asundi analyze the impact of adoption of ISO standard for quality on the performance of the Software outsourcing firms in India. An investment in ISO quality certification has two effects. One, it raises the quality of the output of the software firm which directly increases its billing rate. This is termed as the “quality effect”. Two, implementing ISO quality certification is an indication of higher quality and thus attracts higher number of clients through the “signaling effect”. This raises the size of the firm. A rise in the billing rate and an increase in its employee size naturally raise the BPO firm's profit. Besides quality certifications, we propose that other factors like – quality certifications, information security certifications, number of locations and the degree of specialization¹⁹ can also impact a BPO firm's performance through similar quality and signaling effect charted by Arora and Asundi.

A simpler version of the Arora and Asundi (1999) model specifies the profit of a firm, π , as a function of its price, p , as well as the number of employees, N . Price, p , and employee size, N , are a function of the investment ζ on quality level, θ . Quality certification signals for the level of quality attained.

$$\pi = [p(\zeta(\theta)) - w]N(\zeta(\theta)) \quad (1)$$

Where w is the wage rate.

¹⁷ Wipro Spectramind had a similar status, with heavy reliance on a single client that accounted for as much as 44 percent of its revenue in 2002-03.

¹⁸ Attracting clients depends on a number of characteristics of a third party vendor. Clients with high end work would prefer to offshore to a specialist rather than a generalist. Similarly, clients are also looking for data security without which it is difficult to entrust high end work or confidential information to the third party vendor. Above all, clients also want quality standards to be met in the output they receive from the vendor. Location and the number of locations of a TPV and the ensuing infrastructure of the place is another factor that affects the number of clients and hence the productivity of the third party BPO firm. Thus, in a model, number of client determination should ideally be endogenous, which is what we shall do in our econometric model.

¹⁹ Higher levels of specialization and customization can probably beat competition in this industry through more value added work and therefore higher billing rates, that is they have both the signaling effect and the quality effect.

From the above equation one can examine the two channels through which quality certification can impact a firm's profit or performance, namely, the quality and signaling effect.

$$\frac{\partial \pi}{\partial \xi} = \underbrace{\left[\frac{\partial p(\xi(\theta))}{\partial \xi} \right] N(\xi(\theta))}_{\text{Quality Effect}} + \underbrace{[p(\xi(\theta)) - w] \frac{\partial N(\xi(\theta))}{\partial \xi}}_{\text{Signaling Effect}}$$

In the above equation, the “quality” effect is the increase in the price $p(\xi(\theta))$ due to rise in investment in quality, ξ and the “signaling” effect is the increase in firms size $N(\xi(\theta))$ due to an increase in ξ .

An increase in investment on quality increases the firm's profit via the quality and signaling effect.

Predictions of the model for the BPO Industry

Over the years, concerns over quality control used by Indian BPO vendors have rapidly increased. In an increasingly competitive economy, customers demand and expect highest levels of quality. Indian vendors have adopted industry standards such as SEI-CMM (Software Engineering Institute developed the Capability Maturity Model), ISO (International Organization for Standardization), TQM (Total Quality Management), six sigma, COPC (Customer Operations Performance Centre), eSCM (E-Sourcing Capability Model) for continuous quality process enhancement. The importance of quality and information security certifications for the outsourcing industry is reflected in the fact that eighty three per cent of the third party vendors surveyed in Ernst & Young (2004) invest significantly on an ongoing basis in obtaining these certifications. The implementation of quality certification defines, standardizes, documents and measures key variables that impact processes and hence should theoretically improve firm performance. Arora and Asundi (1999) make an empirical evaluation of the impact of investment in ISO certification on performance of the Indian IT outsourcing firms

There are three other variables which play a similar “signaling” role in attracting clients. An increase in the number of plants/locations may further attract customers who worry about a fall back option in case of business disruption. Given the current security situation around the world, clients want their suppliers to formulate a proper Business Continuity Plan, that is, an alternative delivery service center in cases of high seasonal demand or any disruption in the main center. For a vendor, compliance with client policies on business continuity is crucial and mandatory. Recognizing this requirement, over 90% of the firms in Ernst & Young Survey (2004) respondents have a BCP in place. Having an alternative plant/service center signals clients about the seriousness of a BPO firm for business and hence attracts more contracts of the same client or more clients and hence increases firm size.

We assert a similar kind of signaling effect for information security certifications as they ensure end-user privacy and maintain client confidentiality. It is mandatory for BPO firms to have information security certification and they do not have a choice on the certification issue. Many Indian BPO firms are aware of and are opting for international security standards such as ISO-17799 or BS7799, COBIT (Control Objectives for Information and related Technology) and ITSM (IT Service Management).

Besides certifications, quality of a product can also be measured by the degree of specialization of a firm. Then, by equation (1), the profit maximizing price will be determined by whether a firm is a niche player or not. In the Indian BPO space, firms do not have one pricing rule. Pricing model range from the traditional time-based calculation to more value based mechanisms. Complex management fee models are emerging and they depend on factors like – full time equivalent, time based, volume or seat-based, fixed fee or fixed plus variable fee and gain share. Niche players use output based approach for billing, that is, they charge on the basis of the solutions they provide. A solution incorporates domain knowledge, technology and processes. This stops commoditization of high end service because not every call center can offer a solution and hence introduces high entry barriers. Per contra, broad based service providers usually cater to low-end processes and typically charge clients based on the number of seats per hour used for the client's job. This is the input method and is usually employed in pricing standard services.

Standardized services like transcription services and voice processes have lowest billing rates and hence the lowest margins among BPO businesses. BPO firms are slowly realizing the importance of specializing in niche services and therefore strategically graduating to more value-added businesses like transactions processing, human resource (HR) and consulting to get better margins²⁰. For example, Wipro Spectramind has moved away from the low-end customer servicing business to specific business verticals such as travel, insurance and healthcare. Similarly, Technovate is also following the same suit and now focuses on the travel and hospitality industry. Even relatively small players like Trinity Focus are keen on being pure-play specialists and entering verticals like mortgage and banking industry. The basic reason for this make over in the entire industry relates to the large client firms. Most sourcing firms have specific requirements and are seeking an expertise treatment of their problem. Therefore, it is uninteresting for a domain specialist to outsource to a broad-based service provider. This is a change from first generation outsourcing work where general and low-end work was transferred to India. The need of time has changed and to sustain itself in the longer run, a TPV must specialize and develop a particular area of expertise.

²⁰ For example, Progeon, Infosys' \$4.4-million BPO Company is consciously trying to minimize its dependence on voice-based BPO.

Section 2.3: Affiliated/Unaffiliated Suppliers in the Internalization Theory and the BPO Firm

Antràs (2005) model helps us argue that the performance of an affiliated supplier of a multinational, which is also called a captive, is expected to be higher vis-à-vis an unaffiliated supplier, or TPV. Consumer preferences are such that a unique producer, i , of good y faces the following isoelastic demand function:

$$y = \lambda p^{-\frac{1}{1-\alpha}}$$

Where p is the price of the good and λ is a given parameter known to the producer.

Final goods are freely assembled using two intermediate inputs – the high tech input and the low tech input with the assumption that only the low-tech input can be offshored to a low wage nation. The production function of the final good is given by:

$$y = \left(\frac{x_h}{1-z} \right)^{1-z} \left(\frac{x_l}{z} \right)^z$$

Where x_h and x_l are the high-tech and low-tech inputs respectively, assembled to produce the final good y and z is the intensity of low tech input in y . The south lacks the capability to produce high-tech input such as R&D. Thus, the high-tech input is always produced in the north while the low-tech good can be offshored to a low wage country (south) through intra-firm transfer or external contract. In both the organizational modes, the final good producer has to part with a fraction of his revenue. As suggested in Hart and Moore (1990), the bargaining power of the final good producer is higher in an intra-firm relationship vis-à-vis an outsourcing contract because the subsidiary manager can be fired and a proportion of the output can be appropriated. If ϕ is the proportion of revenue accruing to the final good producer in an outsourcing relationship, then the sourcing firm's share in revenue in a vertically integrated relationship with a subsidiary is given by:

$$\bar{\phi} = \delta^\alpha + \phi(1 - \delta^\alpha) > \phi$$

Where δ is the proportion of output the final good producer can obtain by firing the manager of the subsidiary.

In an outsourcing relationship, the final good producer maximizes his profits, given as:

$$\pi = \phi(p \cdot y) - w^N x_h$$

The profit maximizing price of good y is given by:

$$p = \frac{(w^N)^{1-z} (w^S)^z}{\alpha \phi^{1-z} (1-\phi)^z}$$

Where w^b is the wage rate in country b , $b \in \{N, S\}$ for north and south respectively and $w^N > w^S$.

Since the two types of suppliers, unaffiliated and affiliated, differ only with respect to the bargaining power, the expression for the profit maximizing price in an integrated relationship remains as above with ϕ replaced by $\bar{\phi} > \phi$.

From the price expression, it can be inferred that when ζ is low, that is, when the final good is high-tech, then a lower bargaining power of final good producer, introduces higher distortion in price. This implies that, if production of the final good is relatively intensive in the high-tech input, then the relationship specific investment by the supplier is relatively small vis-à-vis the final good producer. Then, property rights theory dictates that the residual rights of control be assigned to the agent contributing more to the value of the relationship, which, in the case when ζ is low, is the final good producer. Thus, VFDI shall be chosen for a high-tech good while outsourcing is preferred for low-tech goods.

Technology adoption and productivity is known to be higher in high-tech industries. Denny, Bernstein, Fuss, Nakamura & Waverman (1992) compute productivity growth rates for high-tech industries from mid-1960s to the mid-1980s. They find that although the aggregate slowdown was common across the United States, Japan and Canada, high-tech industries either did not exhibit any slowdown or the slowdown was not as pronounced as in other industries. Technology spillovers²¹ as well as technology adoption rates are expected to be higher for firms linked with the high-tech firm. Therefore, we can expect the supplier of the input of a high-tech good to have higher rates of technology adoption vis-à-vis that of a low-tech good. Combining this result with Antràs (2005), we can conclude that the pace of technological spillovers and technology adoption is higher for captives and therefore by the Aghion et al (1999) model the performance of a captive is expected to be higher vis-à-vis a TPV.

Predictions of the model for the BPO Industry

The genesis and the initial growth of the Indian BPO industry can be attributed to multinationals like American Express and General Electric, who established their captive BPO outfits in 1990s. Captives have remained dominant in the Indian BPO industry since then. In conformity with the prediction of the above model, we observe that the revenue of captives have remarkably increased from \$710m in 2000-01 to \$ 4600m in 2005-06, with their share in total export revenue rising from 43% to 64% during the same period. TPV also registered significant growth during this period, however, not as phenomenal as the captives. See figure 2.

²¹ High-tech industries are important sources of R&D spillovers. For U.S. high-tech industries, Bernstein & Nadiri (1988) estimated the social rate of return at between two and ten times the private rate of return. These high social rates of return imply that high-tech industries are potentially an important source of productivity gains especially for producers linked to them in the production chain.

A captive unit is expected to have higher productivity as it has the ability to amass large amount of capital, make new investments²², and attract better talent. Captives are usually large and in the BPO industry it matters a lot to attain a critical mass to exploit the economies of scale and make further investment for expansion. Only a large²³ vendor with an innate ability to work in the domestic market may perhaps outperform a multinational captive. Captive units also have an advantage over TPV when it comes to attracting talent because they come with an established brand name and offer 20-25% higher pay package than a TPV. With higher wage, firms get higher worker stability and hence lower attrition rates^{24,25}.

The Indian BPO industry has also witnessed captive centers of the international BPO players like Convergys, Accenture, and Sitel who have tremendous experience in handling back office operations of other firms. These firms have a chance of performing better than the domestic vendors not just because they are captive centers per say, or have past experience but also because experience has helped them grow their size above a critical level, accumulate capital and other resources. Per contra, many Indian BPO service providers are still struggling to grow their manpower above one thousand employees and are in real trouble for lack of funds. We consider the example of Convergys Corp to get a quick look on how fast a global BPO can grow in the Indian BPO industry. In November 2001, Convergys, a \$1.3 billion firm with 45000 employees and 46 facilities worldwide, entered the Indian BPO industry. In just 18 months after its entry in India, Convergys employed 4,464 employees in its Indian operations, a growth rate of 40 employees per week. Global third-party BPO majors like these are a biggest threat to India's domestic outfits like Progeon, Wipro, and Datamatics etc. Even though some of the Indian BPO firms are on a high growth path and are operating in their domestic market, it is difficult to match the financial power these firms possess and use it to drive down prices. Besides, Indian BPO firms do not offer any special advantage that the Indian operations of these global BPO players cannot offer. In 70% of the bids for large contracts, Indian BPO firms already compete with multinational BPO firms.

In this regard, it is important to mention that some Indian BPO industry players come with prior experience either in outsourcing of IT services or other Indian businesses and hence may stand well to compete with these global BPO firms. For example, BPO offshoots of IT firms like Infosys is thriving as Progeon, Wipro's BPO arm is called Wipro Spectramind and so on. Similarly, Hiranani

²² The quantum of new investment in the BPO industry increased approximately by \$300 m to about \$800 m by the end of 2002. Looking at the Indian BPO industry, new investments by both captive units as well as third party players have attracted an equal share.

²³ This is because size determines the ability to amass capital, attract venture capitalists, entice customers, and service a diverse set of verticals.

²⁴ The employee attrition in captive firms is close to 35%, while for third-party players it is above 40%.

²⁵ A captive unit provides a limited opportunity for career growth and promotions in a less developed country (LDC) like India, as top positions in the corporate ladder usually remain occupied by the parent firm's nationals. Thus, in the long run,

Group launched Zenta, Kalyani Group also has a BPO arm called the Epicenter Technologies. Can prior experience be helpful in outdoing other outsourcing service provider firms? We can speculate that prior experience in outsourcing may particularly be helpful for BPO firms²⁶. From the client's perspective, there is a close fit between IT and ITES or BPO service offerings and hence the reason for many IT firms to foray into this area. Existing customer relationships and client base offers the foremost advantage for IT firms to set up a BPO arm. Besides, IT outsourcing firms are familiar with the overseas market, have a better perception of the outsourcing business model and are known globally for delivering quality output. IT outsourcing firms have an understanding of the processes and practices of outsourcing businesses and vertical domain knowledge in the overseas markets which can be extremely useful in offering BPO services^{27,28}. We will test the significance of prior experience in affecting firm performance in section 5.

Section 3: Description of Data

There are various sources of firm level data for the Indian ITES sector. However, all of these sources, except NASSCOM (National Association for Software and Services Companies, the apex body for managing the IT and ITES sectors in India), provide information for at most 20-30 domestic third party firms. CMIE (Centre for Monitoring Indian Economy) database on ITES sector provides financials for 29 companies listed in the stock exchange but most of these firms are BPO arms of IT firms. Moreover, these 29 firms constitute only 17% of the aggregate income accruing to the domestic vendors of this industry. Further, CMIE database has data on conventional productivity determinants like rents and leasing, capital intensity, energy consumption, wage level, legal form of business and number of owners etc but variables relating to voice versus non-voice processes or number of clients which are special for gauging firm level performance of a BPO unit are not available for these firms. CRIS INFAC (A Standard & Poor's Company) gives profiles of 53 domestic and international third party as well as captive BPO firms. The profile includes variables like the year of inception, promoters, quality certifications, specialization, and the number of offices,

either a transition of the captive to a TPV – like GE to GENPACT –or a high attrition rate at middle management levels is inevitable.

²⁶ For examples of Indian IT firms with BPO offshoots, see Appendix A.2.

²⁷ Even though there are obvious synergies for bundling BPO with traditional IT outsourcing, one needs to understand the differences between the two and the additional challenges posed by the BPO front. One key challenge for offering BPO service is to plan for its business continuity as IT is project based while BPO is a continuous process. Moreover, the BPO market can be tapped primarily in English speaking regions which is unlike IT services that is not much dependent on the market language. Thus, the business model for a BPO is unlike IT, as it requires different kind of skill sets and depth of domain knowledge for delivery. Moreover, the BPO model throws up a whole new set of HR challenges which these IT firms planning to offer BPO services will need to address.

their locations, clients, revenue and manpower. However, the problem with this database is that all variables are not available for each of the firms listed. Dataquest India, an institution known for twenty five years for its credible and useful information on the Indian IT and ITES sector surveys 7 global BPO firms, 23 domestic third party BPO firms and 10 captive BPO firms for the year 2003-04 and top 25 BPO firms (Captive and TPV) for 2005-06. A business communication magazine, *Voice&data*, surveys top 22 domestic third party BPO firms for the year 2002-03 and provides variables like revenue, manpower, number of clients, contribution by top client, company's prior experience, quality certifications, number of locations. For preliminary data analysis, we use all these sources of data along with other sources like NASSCOM and *Business world* (An important business magazine). For our econometric exercise we primarily used *Voice&data*, Dataquest India and NASSCOM in conjunction with each other. For some of the firms, the number of quality certifications, number of locations and number of clients were missing. We complemented this data from CRISINFAC database. Finally, we carried out a consistency check for revenue and manpower figures available from *Voice&data* with other sources like CRIS INFAC, Dataquest and NASSCOM to ensure that the data we use is accurate and credible.

We were unable to construct a panel from these data sources even though we have revenue and manpower for different points in time. This is because we are missing key independent variables. For example, quality certification of a firm is reported "as of" the year it is being surveyed and not the year when the certification was actually implemented. A time series of number of clients is also not available. Even if we had the series available, variables like number of quality certification or venture capitalist funding do not change significantly from one year to another and hence their effect on firm level performance cannot be seen within a span of one or two years. We are tightly constrained by data availability and manage to build a parsimonious econometric model with a single cross-section of 22 domestic third party BPO firms for the year 2002-03.

Section 4: The Indian BPO Industry: Preliminary Data Analysis

A large proportion of firms in the Indian BPO industry are small and not listed on the stock exchange and hence accounting data on profit and loss is not available. Arora and Asundi (1999) believe that in a fairly competitive industry, firm performance must be reflected in its economic outcomes and hence they relate firm performance to its revenue and employee strength. Knowledge@Wharton (2005) research also suggests that the performance of outsourcing majors in

²⁸ Besides the above factors there are still more that may impact the productivity of a TPV. These could be in the form of mergers and acquisitions (e.g. Tracmail), the number and nature of alliances formed by a BPO firm with other firms (eg. Msource with Accenture).

India is best indicated by revenue per full-time employee (FTE). Higher revenue per FTE²⁹ reflects higher billing rates which can be demanded when processes are specifically tailored to the needs of the clients thereby reflecting greater customer centricity on the part of the service provider firm. A high degree of customization of products locks in the customer for long and enhances future growth prospects of the BPO firm. Athreye (2005) makes an empirical study of the increase in average and aggregate productivity growth in the Indian Software outsourcing industry. In her model too, productivity is measured by revenue per employee. Other papers, like Yeaple (2003) uses revenue per employee as a measure of firm productivity while Idson, and Oi, (1999); Bernard and Jensen, (1999); and Bernard, Jensen, and Schott, (2003) use a similar measure, that is, value added per worker. We therefore resort to using revenue per employee as a measure of firm level performance.

Outsourcing industry in India constitutes both the IT and ITES sectors. However, we prefer not to combine the IT outsourcing firms with BPO firms in our study for three reasons. One, in terms of export revenue, the IT outsourcing industry in India is about three times the size of its ITES counterpart (See table 2). The distribution of revenue among firms is also similar in the two industries, that is, top 20-30 firms contribute to about 70-80% of total revenue. Therefore, the combined data for say, top 30 firms in each outsourcing sector would be biased in favor of IT outsourcing firms. Two, IT Outsourcing in India started in 1980s while ITES is merely a decade old set-up reflecting the fact that the two industries are at different stages of maturity. Therefore the set of factors which affect the two industries are different. For example, attrition rate is a much bigger problem in the BPO sector vis-à-vis the IT sector. Three, academic research specifically focused on BPO is somewhat neglected compared to IT outsourcing, for example, Dibbern et al. (2004) in their literature review highlight that 'current outsourcing research appears to be heavily tied to IS' and similarly, Rouse and Corbitt (2004) comment on the absence of academic publications on BPO. Four, the work content and skills required for IT and BPO jobs are different. IT is usually project based while BPO is process driven.

It is believed that the revenue mix of the processes serviced by the BPO firms often impact their performance. The reason may be traced in the dispersion in per hour billing rates for various service lines as well as their future growth prospects. If we look at the key verticals³⁰ in the BPO industry, we can infer that finance and payment services are probably the most promising ones. See table 3a for a comparison of billing rates across key verticals and table 3b for Revenue per employee by key verticals. Customer care industry, which includes both voice as well as non-voice processes

²⁹ Other productivity measures like output per employee is not relevant for the BPO industry as the processes or service lines composition of firms differ and so does their billing rates. Therefore one cannot compare for example the output per worker of a firm with predominantly customer care services vis-à-vis a firm with large proportion of finance or payment services.

³⁰ Definition for each of the verticals enlisted in the table is given in the Appendix A.1.

has experienced invariably low revenue per employee primarily because of low billing rates, however, its growth has been the highest. See figure 3.

Applying a combination of the three models discussed in section 2, we believe that the performance of a BPO firm is influenced by a host of factors which affect employee cost, cost of buying new technology, organizational and management structure and quality certifications. We classify these factors into six distinct categories – Source of Funding, operational cost variables, operational risk variables, signaling variables, organizational form and Experience related variables. The variables corresponding to each of these categories is enlisted in table 4. To get a raw measure of correlation between the firm performance and the above listed variables, we first need to examine the distribution of the revenue per employee series. Histogram plot of this series suggests a non-normal distribution which is statistically confirmed by the Jarque-Bera statistic with p-value of 0.46. Therefore, we need to use non-parametric measures of correlation coefficient, that is, Spearman's R and Kendall's Tau for continuous variables and the Fischer's exact test for categorical variables. Table 4 gives the results obtained.

Looking at these correlation coefficients we infer that the factors linked with the cost of operation, like – the proportion of voice processes, attrition rate, seat utilization and employee satisfaction as well as experience related factors are most important in determining a BPO firm's performance. Other factors like VC funding, the number of clients, implementation of a special kind of quality certificate, namely, COPC are also expected to have positive influence on a vendor's profitability. We compare the performance of a TPV vis-à-vis a captive and our intuition from Antras (2005) model seems justified. Fischer's exact test gives a p-value of 0.07 indicating that direct governance by the parent firm has a positive and significant influence on the supplier's performance³¹. However, since we do not have more information on captives in India, we cannot accommodate it into our econometric model. We build an intuitive econometric model based on the above results and of course the theoretical models discussed in section 2.

We use data revealed in the first BPO survey by Voice&data, with 22 observations in combination with NASSCOM and Dataquest India. We need to convince ourselves that the study is important even though the number of observations is not high. We also would like to point out that the probability of a selection error creeping in our model is negligible as these 22 firms are the top performers of the BPO industry in the year 2002-03 and the sample is therefore homogeneous.

³¹ Besides these variables there are other factors which cannot be included in a quantitative analysis, for example, a number of small innovative cost cutting techniques are also being encouraged and implemented. For instance, ICICI OneSource, an Indian BPO firm with revenue over \$100 m, is taking advantage of its growing scale by centralizing all vital support services such as HR, finance and IT in Mumbai and Bangalore. Hero-ITES, another Indian BPO firm, hires telecom equipment as it is cheaper to use rented equipment in the long run when technologies are evolving dynamically.

To evaluate the importance of our study, we look at the percent contribution to revenue and employment by the top 22 firms in the year 2002-03 chosen for our study. Table 5a is indicative of the fact that even though the firms included in our study comprise of just 7.7% of the total number of BPO firms in 2002-03, its contribution to employment is nearly double in per cent terms and more than double in aggregate revenue of the Indian BPO industry. The set 22 of firms considered in our econometric exercise belong to the third party vendor group; therefore, in table 5b we look at the number of firms and revenue figures³² for third party vendors only. We find that even though these 22 firms are just 16% of total TPV firms in 2002-03, they contribute to a massive 72% of revenues in the same group.

However, since our sample includes the top performing firms in the industry, we would expect that the average revenue, employment as well as the experience and age of the firms to be higher vis-à-vis the rest of the third party vendors of the BPO industry.

Section 5: Empirical Specification

The factors gleaned from the above preliminary data analysis provides the background and perspective for a more formal analysis of firm level performance of a TPV. Aghion et al (1999) model implies that a BPO firm's performance should depend on whether a firm is self-financed or gets funding from outside and also on the level of competition in the industry. The model also suggests that a high cost of operation critically lowers the pace of technology adoption vis-à-vis other firms and hence lowers the firm's performance. Equation (1) from Arora and Asundi (1999) model proposes that ISO quality certification is a signal of higher quality and helps in raising the billing rates as well as the number clients. Besides quality certifications, other variables like information security certification, number of locations and degree of specialization also have signaling effect on potential customers. These theoretical models help us formulate an empirical model of firm performance in the following equation:

$$\pi = \alpha + \beta_1 VC + \beta_2 \text{Operational Cost Variables} + \beta_3 y + \beta_4 \text{Signaling Variables} + \beta_5 \text{Experience factor} + \xi \quad (2a)$$

Where π is the measure of firm performance, given by revenue per employee, Operational cost variables, signaling variables, experience related factors are enlisted in table 4 and y is the number of clients. ξ is the i.i.d. error term corresponding to equation (2a). Theory suggests that we should expect β_1 to be positive if the level of competition is high in the industry (Aghion et al, 1999), as is

³² Employment figures segregated to the level of captives and TPV categories is not available.

the case in the year 2002-03 and $\beta_3, \beta_4 > 0$ from Arora and Asundi (1999) model, $\beta_5 > 0$ because, with experience, firms learn from their mistakes and perform better, while $\beta_2 < 0$, because higher operational costs vis-à-vis other firms implies higher price and therefore lower market share (Aghion et al, 1999).

In our model, we also want to test that our estimation result holds good even if one of the independent variables is endogenously determined with firm productivity. We do so by assuming that the variable – the number of clients, is determined endogenously with the firm level performance. This assumption is based on the fact that the number of clients is influenced by the billing rates of the supplier which in turn is manifested in the revenue per employee of the firm. We now specify the other equation of the model to test that our results are invariant to the estimation procedure. We hypothesize that the variable – the number of clients, is endogenous, that is, determined in the following equation.

$$y = v + \gamma_1 \text{Signaling Variables} + \gamma_2 \pi + \varepsilon \quad (2b)$$

Where ε is i.i.d. error term corresponding to equation (2b). Arora and Asundi (1999) theory suggests that we should expect $\gamma_1 > 0$ while $\gamma_2 > \text{or} < 0$ depending on whether billing rate is higher due to higher cost of the BPO firm or due to greater degree of specialization.

After testing for endogeneity of the variable – the number of clients, using the Wu-Hausman procedure, we re-estimate equation (2a) using the two stage least square methodology and compare the coefficient estimates with the results obtained in OLS estimation.

Section 6: Econometric Results

We run basic OLS regression of firm performance, as measured by revenue per employee, on a set of independent variables³³. The OLS estimation result with significant variables is depicted in table 6, column 1 and 2. We find that prior experience, number of locations, venture capitalist funded firms and a high number of clients positively impacts firm level performance at 10% level of significance. The impact of implementing information security certification is counterintuitive and it seems to slow down BPO performance. This is probably because most firms in our sample is young while it takes time to establish reputation as an information security certified firm in order to attract potential clients and influence firm performance.

³³ See Appendix A.4 for definition of each variable.

The number of quality certifications and a special type of quality certification, namely, COPC, are found to be insignificant in the regression equation. This is unlike Arora and Asundi (1999) model where quality certification is found to be crucial in raising a software outsourcing firm's performance. As in the Arora and Asundi (1999) model, the "quality effect" of quality certification does not hold true for the BPO industry because price is already fixed in the contract. The insignificance of the coefficient relating to quality should, however, not lead us to make a hasty conclusion that quality certifications are not even working as a marketing tool to attract clients³⁴. Our results should not be taken to mean that it is not useful to get quality certifications in the BPO industry. It should be noted that the above cited theoretical models are long run equilibrium models while the data we have is a cross-section of one particular year where the median age of firms is only two years. We need to understand that it takes some time to prove a record of quality and hence signal potential customers³⁵. Therefore, if we do not observe the positive impact of quality or information security certifications, then, it does not mean that the model's prediction about their impact on firm performance is incorrect. It takes time to signal clients and attract them once the certification has been attained. Therefore, we need a more detailed study like the Arora and Asundi (1999) over a longer period of time to assess the impact of quality certifications on the BPO industry as well.

To check for the validity of OLS regression results, we need to first test for the normality of residuals as well as the presence of heteroskedasticity. We carry out the Jarque-Bera test for normality to validate our hypothesis test results for significance. The residuals are normally distributed with probability 0.97 as depicted in figure 4. For testing heteroskedasticity in residuals, we carry out the White's test. The result is displayed in table 7. Looking at the p-values, we cannot reject the null hypothesis of no heteroskedasticity.

Econometric results looks good, however, we need to check for the robustness of our OLS results to alternative estimation technique. Our economic intuition makes a case that the variable – the number of clients that a third party BPO firm can attract is influenced by billing rates³⁶ because like all consumers, the clients of the BPO service provider are also sensitive to the price of the offshored service. It may be noted that billing rates of a TPV may be higher vis-à-vis other firms either due to higher degree of specialization or due to higher costs. Therefore, we are suspicious of a simultaneous equation system whereby the number of clients is determined endogenously with the firm performance.

³⁴ We regressed the number of clients on quality and did not find the coefficient to be significant. The impact of quality certification may not be visible in on the variable – the number of clients, because, high quality of work may get rewarded by the same client providing repeat business or larger and more complicated work.

³⁵ As Arora and Asundi (1999) put it, "the actual quality of service may depend not only on whether the firm is certified but for how long it has been certified".

To check whether firm performance affects the number of clients, we regress the number of clients on a set of variables like prior experience, number of years of experience as well as the BPO firm performance, π . The results obtained are shown in table 8, columns (1) and (2). We see that the p-value for firm performance is 0.27. At this point we retain our hypothesis of simultaneity and go on to check for endogeneity using the Wu-Hausman test. The first step of Wu-Hausman test is to regress the “suspicious” variable, that is, the number of clients on a set of instruments available. The result of this regression is tabulated in columns (3) and (4) of table 8. With this regression, we can get the fitted values of the variable – the number of clients and call it `clients_fitted`. In the second step of Wu-Hausman test, we regress firm performance on the set of independent variables we used in our first OLS (table 6, columns 1 and 2) regression along with the variable `client_fitted`. We then test for the significance of the variable `client_fitted`. The regression output of the second step is tabulated in columns (3) and (4) of table 6. We find that the variable `client_fitted` is significant at 10% level of significance. This confirms that the variable – the number of clients, is indeed endogenous and that our OLS result of firm level performance is biased and inconsistent. We therefore need to re-estimate the model using the two stage least squares procedure.

To find an instrument corresponding to the variable – the number of clients, our best bet is the variable number of years of experience. This variable has a high correlation with the variable – the number of clients (0.80) and relatively lower correlation with the dependent variable, that is, the firm level performance (0.3). Thus, number of years of experience of a BPO firm is an appropriate instrument for estimating firm performance through two stage least square (2SLS) technique. The regression output obtained from 2SLS technique is tabulated in column (5) and (6) of table 6. These results clearly indicate that prior experience, number of locations, number of clients and funding from venture capitalist have a positive impact on an Indian third party BPO firm’s performance. On the other hand, investment on information security certifications negatively affects the firm’s performance, at least in the short run. Clients place increasing importance on the data security measures undertaken by a vendor, particularly if the outsourced process requires the vendor to have access to the client’s account numbers, pass codes or pin numbers. Implementing information security certification increase the sales cycle time as clients prefer to physically examine the vendor’s site, check their references and conduct network checks in order to ensure that the necessary security measures are in place. Given the nature of the process that is outsourced, a BPO firm must comply with information security certifications required by the client. Even though this may trap the supplier’s resources in the short-run, it helps in getting more work from existing clients as well as it entices more clients with similar processes in the long-run.

³⁶ Since revenue per employee is also an indicator of a firm’s billing rate, it a good proxy for billing rates.

Now we compare the point estimates and the significance of the independent variables of our OLS results relative to the 2SLS methodology, that is, compare table 6, column (1) and (2) with column (5) and (6) respectively. We find that the point estimates of the variables do not change much as we graduate from OLS to 2SLS technique. Moreover, as is expected of a good instrument variable estimation, the 2SLS estimates are lower than OLS estimates. This indicates that the instrument used is not correlated with the stochastic error term. Hence the choice of instrument is good. It is also useful to assess the strength of the relationship between the instruments and the potentially endogenous regressors. Econometric literature, for example, Staiger and Stock (1997), suggests that when the partial correlation between the instruments and the endogenous variable is low, instrumental-variables regression is biased in the direction of the OLS estimator. Staiger and Stock recommend that the F-statistics (or equivalently the p-values) from the first-stage regression (of 2SLS) be reported in applied work. The F-statistic tests the hypothesis that the instruments should be excluded from the first-stage regressions (i.e., the relevance of the instruments). The idea here is that when the F-statistic is small (the thumb rule is, less than 10, or the corresponding p-value is large), the instrumental variable estimates and the associated confidence interval are unreliable. The F-statistic from first stage OLS (of the 2SLS methodology) for our regression of number of clients on the set of instruments is 13.59, which is greater than 10. Therefore, we can conclude that our instrument is not weak and the significance tests based on normal approximation are valid. Significance tests in 2SLS estimation results, column (6) of table 6, indicate that all variables remain significant at 10% level of significance as in the OLS case. Thus, in the process of testing for endogeneity and re-estimating firm performance using an alternative estimation method, namely the 2SLS technique, we have also ensured that our results are invariant to alternative estimation procedures.

Section 7: Conclusions

Our paper focuses on determining the factors that impact the performance levels of a BPO service provider. We argue that a BPO service provider is different from other firms even within the service industry and hence we propose to evaluate firm level performance using factors typical to the BPO industry like venture capital funding, information security certification, quality certification, number of clients, number of locations, prior experience.

Using a data set on 22 domestic third party firms from Indian BPO industry for the year 2002-03, we build an econometric model that evaluates the factors which influence firm performance. We hypothesize and test if the variable – the number of clients of a BPO firm, is determined simultaneously with the BPO firm's performance. The Wu-Hausman test for endogeneity

is found to be positive and therefore we re-estimate our model using a two stage least square procedure. Our empirical model indicates that prior experience, number of locations of a service provider, venture capitalist funding and the number of clients positively impact a domestic third party firm's performance, while information security certifications tend to dampen its performance levels. Moreover, our conclusion is invariant to the choice of estimation technique as the point estimate and significance of variables do not change much as we graduate from OLS to the 2SLS procedure.

We understand that with the limited data available in hand, our results are not completely representative of the firms in the BPO industry. However, given that there is no perspective available to the theory of the supplier firm in an outsourcing relationship even an imperfect beginning seems justified. Future research should focus on arranging for detailed firm surveys to highlight the trends in the BPO industry and extrapolate firm performance parameters, changes in human resource requirements, skill-upgrading and contractual problems from the supplier's viewpoint.

References

- Aghion, P., Howitt, P., "A model of growth through creative destruction", *Econometrica*, 1992, pp. 60, 323-351
- Aghion, P; Dewatripont M and Rey, P., "Competition, Financial Discipline and Growth," *The Review of Economic Studies*, 66 (4), 1999, pp. 825-852.
- Amiti, M. and S. Wei, "Service Offshoring and Productivity: Evidence from the United States", NBER Working Paper, No. 11926, 2006.
- Antràs, P., "Incomplete Contracts and the Product Cycle," *American Economic Review*, 2005, pp. 1077-1091
- Arora, A. and J. Asundi, "Quality Certification and the Economics of Contract Software Development: A Study of the Indian Software Industry", *NBER Working Paper No. w7260*, 1999
- Athreye, S. , "Evolution of productivity in outsourced services: Empirical evidence from the Indian software sector", Paper presented at the Druid Tenth Anniversary Summer Conference on "Dynamics Of Industry And Innovation: Organizations, Networks And Systems Copenhagen, Denmark, June 27-29, 2005
- Bernard, A., and J. Jensen, "Exporters, Skill Upgrading, and the Wage Gap," *Journal of International Economics*, 1997, pp. 3-33.
- Bernard, A., B. Jensen, and P. Schott, "Falling Trade Costs, Heterogeneous Firms, and Industry Dynamics," mimeo, March 2003.

Bernstein J. I. and M. I. Nadiri. "Interindustry R&D Spillovers, Rates of Return, and Production in High-Tech Industries." *American Economic Review Papers and Proceedings*, 1988, pp. 429-34.

Calabrese, G. and F. Erbetta, "Outsourcing and Firm Performance: Evidence from Italian Automotive Suppliers", *13th Annual IPSERA Conference*, 2004.

CRIS INFAC, It Enabled Services Annual Review, 2006

Dataquest, <http://www.dqindia.com/content/dqtop202k4/giants/2004/104072101.asp> last accessed on 2 Feb, 2007

Dataquest, http://www.dqindia.com/content/DQTop20_2006/SASnBPO06/2006/106082803.asp, last accessed on 3 Feb, 2007

Denny, M., J. Bernstein, M. Fuss, S. Nakamura and L. Waverman. "Productivity in Manufacturing Industries, Canada, Japan, and the United States, 1953-1986: Was the 'Productivity Slowdown' Reversed?" *Canadian Journal of Economics*, 25(3), 1992, pp. 584-603.

Dibbern, J., Goles, T., Hirschheim, R. and Jayatilaka, B. (2004). Information Systems Outsourcing: A survey and analysis of the literature, *The Data Base for Advances in Information Systems* 35(4): 6–102.

Egger, H. and P. Egger, "International Outsourcing and the Productivity of Low-skilled Labour in the EU", *Economic Inquiry*, 44(1), 2006.

Ernst and Young Survey, Offshore Outsourcing Survey: Indian Third Party BPO Vendors, 2004

Grossman, S. and O. Hart, "The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration," *Journal of Political Economy*, (1986): 691-719

Görg, H. and A. Hanley, "International Outsourcing and Productivity: Evidence from the Irish Electronics Industry", *North American Journal of Economics and Finance*, 16(2), 2005.

Hart, O. and Moore, J., "Property Rights and the Nature of the Firm," *Journal of Political Economy*, (1990): 1119-1158.

Hausman, Jerry A., "Specification Tests in Econometrics," *Econometrica*, 46, 1978, pp.1251–1272.

Howitt, P., "Endogenous Growth and Cross-Country Income Differences, *The American Economic Review*, Vol. 90 (4), 2000, pp. 829-846

Idson, T., and W. Oi, "Workers are More Productive in Large Firms," *American Economic Review Papers and Proceedings* 89, May 1999, pp. 104-108.

Knowledge@Wharton, "How Some BPO Providers Seek To Build and Protect Their Turf", January 14, 2005

KPMG-NASSCOM Study 2004, "Choosing a location for offshore operations in India," 17 Jun, 2004

NASSCOM-McKinsey Study, 2005, 15 Dec, 2005

NeoIT, "India: Comparison of Locations", Vol 2 (11), November, 2004

Rouse, A.C. and Corbitt, B. (2004). IT Supported Business Process Outsourcing (BPO): The good, the bad and the ugly, Proceedings of Eighth Pacific Asia Conference on Information Systems (Shanghai, China, July 2004) 8–11.

Schumpeter, J. A. Capitalism, socialism and democracy. New York, New York: Harper and Brothers, 1942.

Douglas Staiger & James H. Stock, “Instrumental Variables Regression with Weak Instruments,” *Econometrica*, 65(3), pp 557-586, 1997

Voice&data, <http://www.voicendata.com/content/bporbit/annualsurvey/> last accessed on 10 Oct 2006

Yeaple, S.R, “Firm Heterogeneity, International Trade, and Wages”, *Journal of International Economics*, Vol 65 (1), pp 1-20, 2005

Figures and Tables

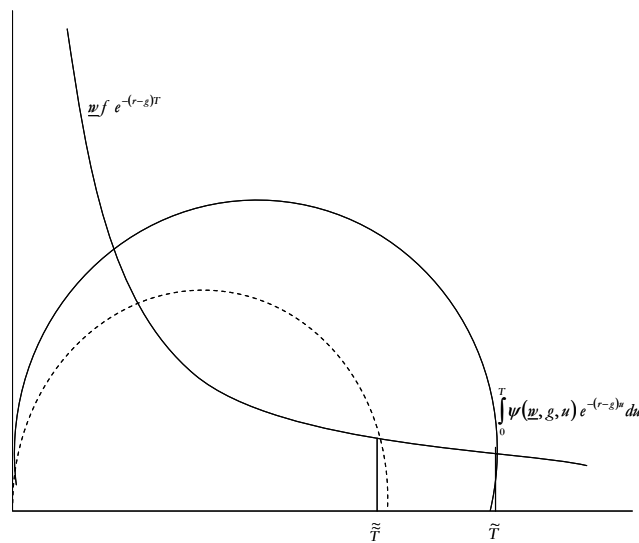


Figure 1: Impact of increase in Competition on a non-profit maximizing firm

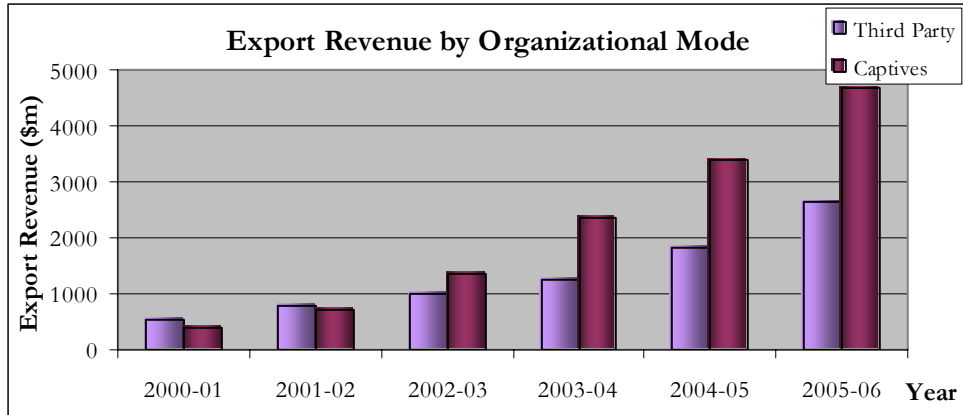


Figure 2: Contribution to Export by captives versus third party BPO Firms
Source: NASSCOM

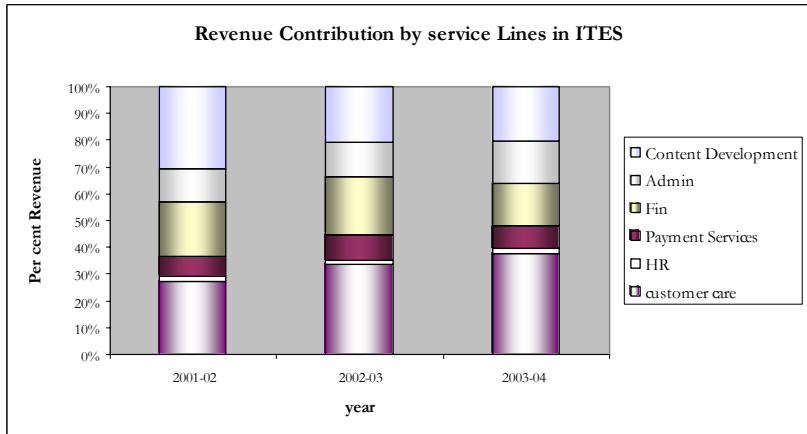


Figure 3: Per cent contribution to Revenue by key verticals
Source: NASSCOM

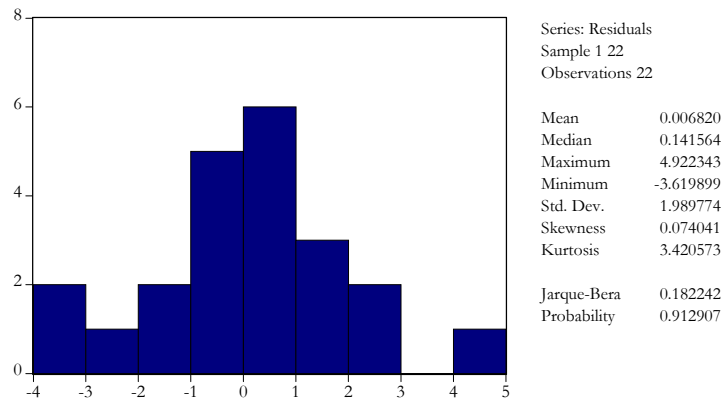


Figure 4: Testing for normality of residuals

	2001-02	2002-03	2003-04	2004-05	2005-06
Revenue (\$bn)	1.6	2.7	3.9	5.8	8.1
Export (\$bn)	1.	2.5	3.6	5.2	7.3
Employment (000)	106	171	245	348	470

Table 1: Revenue, Export and Employment generated by the Indian BPO industry

Source: NASSCOM

Year	ITES (%)	IT Services (%)
1999-2000	14	86
2000-2001	14.5	85.5
2001-2002	19	81
2002-2003	24	76
2003-2004	23	77
2004-2005	30	70

Table 2: Relative Revenue contribution by the IT and ITES sector

Source: NASSCOM

Vertical	Billing rate (\$/hr)
Customer Care	10-14
Finance, Administration and Payment Services	12-15
Human Resources	15-17
KPO based services	25-35

Table 3a: A comparison of billing rates across key verticals for FY 2003-04

Source NASSCOM

<i>Revenue per employee in \$ 000</i>				
Service Line	2001-02	2002-03	2003-04	2004-05
Aggregate	15.09	15.79	15.92	16.67
Customer Care	13.33	12.50	12.50	13.11
Payment Services	15.71	19.17	20.48	
Finance	20.00	21.18	20.37	
Administration	13.21	12.50	13.50	
Human Resources	20.00	21.43	16.67	16.50
Content Development	11.54	10.63	10.78	
KPO	19.44	18.00	12.39	11.08

Table 3b: Revenue by key verticals of the Indian BPO industry

Source: NASSCOM

Variable	Year	RPE Data source	Var. Data Source	N. Obs	Corr Coeff	p-value	Sig at 20%
Source of Funding							
VC funded*	2002-03	V&D	V&D	22	FE	0.1	Yes
Operational Cost Variables							
Voice versus non-voice	2002-03	BW, V&D	BW, V&D	15	SR	0.04	Yes
					KT	0.00	Yes
Attrition rate	2003-04	Dataquest	CRIS INFAC	19	SR	0.03	Yes
					KT	0.01	Yes
Seat Utilization	2003-04	Dataquest	CRIS INFAC	23	SR	0.13	Yes
					KT	0.15	Yes
Employee satisfaction survey	2003-04	Dataquest	E-SAT 2004	11	SR	0.03	Yes
					KT	0.01	Yes
Operational Risk Variables							
% Contribution by top client	2002-03	V&D	V&D	13	SR	0.42	No
					KT	0.37	No
Number of clients	2002-03	V&D	V&D	22	SR	0.23	No
					KT	0.20	Yes
Signaling Variables							
COPC implemented*	2003-04	Dataquest	V&D, CRIS INFAC	29	FE	0.09	Yes

Quality certifications	2003-04	Dataquest	V&D, CRIS INFAC	29	SR	0.25	No
					KT	0.20	Yes
Information security Certification*	2003-04	Dataquest	V&D, CRIS INFAC	29	FE	0.38	No
Number of locations	2002-03	V&D	V&D	22	SR	0.52	No
					KT	0.44	No
Broad-based versus Niche firms*	2002-03	V&D	V&D	15	FE	0.57	No
Organizational Form							
Third Party versus Captives*	2003-04	Dataquest	Dataquest	19	FE	0.07	Yes
Domestic versus global TPV*	2003-04	Dataquest	Dataquest	17	FE	0.23	No
Experience Related Variables							
Prior experience*	2002-03	V&D	Company profiles, reports	22	FE	0.20	Yes
Years of experience	2002-03	V&D	V&D	22	SR	0.17	Yes
					KT	0.14	Yes

RPE: Revenue per employee
 BW: Business World
 V&D: Voice and Data
 FE: Fisher's exact test
 SR: Spearman's R
 KT: Kendall's Tau

Table 4: Correlation coefficient of various factors with firm level performance³⁷³⁸

*These are dummy variables with value 1 for the first variable

	Revenue (\$mn)	Employment	Number of firms
Our sample of top 22 firms	709	36508	22
All BPO firms	2700	171000	285
% contribution due to our sample of top 22 firms	26.3	21.3	7.7

Table 5a: Per cent contribution to revenue and employment in the Indian BPO Industry in 2002-03

Source: NASSCOM

³⁷ Information for variables seat utilization, information security certifications, COPC, number of quality certifications is as of the year we have data on, and not the year when the certification was implemented.

³⁸ For a note on measuring variables of interest, see Appendix, A.4.

	Revenue (\$mn)	Number of firms
Our sample of top 22 firms	709	22
All BPO firms	980	135
% contribution due to our sample of top 22 firms	72.4	16.3

Table 5b: Per cent contribution to revenue in the third party group in 2002-03

Source: NASSCOM

	OLS		Wu-Hausman, step 2		2SLS	
	(1)	(2)	(3)	(4)	(5)	(6)
Variable	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.
Prior Experience	3.058	0.012	2.963	0.009	2.963	0.017
Number of Locations	0.726	0.022	0.567	0.058	0.566	0.087
Venture Capitalist	2.162	0.027	2.048	0.024	2.047	0.041
Information Sec.	-2.263	0.043	-2.227	0.033	-2.226	0.053
Number of Clients	0.101	0.084	-0.079	0.449	0.162	0.025
Client_fitted			0.241	0.057		
R-squared	0.41		0.53		0.37	
Adjusted R-squared	0.27		0.39		0.22	

Table 6: OLS, W-Hausman and two stage least square estimation of firm level performance

Instrument list for 2SLS: Prior Experience Number of Locations Venture Capitalist Funded, Information Security certification, Number of years of Experience

F-statistic	0.410	Probability	0.881
Obs*R-squared	3.742	Probability	0.809

Table 7: White Heteroskedasticity Test

	OLS		Wu-Hausman, step 1	
	(1)	(2)	(3)	(4)
Variable	Coefficient	Prob.	Coefficient	Prob.
Constant	5.860	0.045	5.161	0.338
Prior Experience	4.828	0.073	0.778	0.790
Number of Locations			0.208	0.821
Venture Capitalist			-3.344	0.254
Information Sec.			2.536	0.304
Number of years of exp.	2.301	0.000	2.098	0.000
Firm level Performance	-0.566	0.277		
R-squared	0.66		0.70	
Adjusted R-squared	0.60		0.60	

Table 8: OLS estimation for number of clients and Wu-Hausman test, step 1

Appendix

A.1: Description of key verticals in the Indian BPO Industry

Customer Care: Call centers, telesales and telemarketing, web sales, help desks, clerical support, data entry, word processing, mass emailing, contact centers, IT and technical support help desks electronic- customer relationship management (CRM), collections, market research, customer phone support warranty registration, catalogue sales, order fulfillment, up-selling and cross-selling and CRM.

Payment Services: Credit card and debit card services, check processing services, loan processing, electronic data interchange

Finance & Accounting: Accounting and accountancy services, billing and payment services, banking processing, sales ledger, general nominal ledger accounting, financial reporting, customer supplier processing, document management, legal services, transaction processing, equity research support, accounts receivable, accounts payable, cost accounting, payroll and commissions, stock market research, mortgage processing, credit charge and card processing and check processing.

Administration: Tax processing, claims processing, asset management, document management, legal and medical transcription and translation.

Human Resources: Personnel Administration, hiring and recruiting, training and education, records and benefits payment administration, payroll services, health benefits administration, pension fund administration, retention and labor relations.

Content Development: Engineering and design services, automation programming, digitization, animation, network management, biotech research, application development and maintenance, web and multimedia content development and e-commerce.

A.2: Examples of BPO firms which are offshoots of IT firms

IT Firm	BPO Outfit
TCS	Intelenet Global
Wipro	Wipro Spectramind
HCL Technologies	HCL BPO
Satyam	Nipuna
Mphasis BFL	Msource
Hinduja TMT	Hinduja TMT
Polaris	Optimus
NIIT	NIIT Smartserve
Hughes Software Systems	Hughes BPO Services

A.3: Venture Capitalists looking to invest in India

Venture Capitalist Fund	Asset under management (\$ mn)
Mayfield	2000
Greylock	2200
Sequoia Capital	n.a.
New Enterprise Associates	6000
JP Morgan Partners	23000
Austin Ventures	2400
Venrock Associates	n.a.
Bessemer Venture Partners	2000
Draper Fisher Jurvetson	3000
Alta Partners	1000
Menlo Ventures	2700

Caryle Group	17500
Oak Investment Partners	4200

n.a: Not Available

Source: CRIS INFAC

A.4: Measuring variables of interest:

- *Firm level performance* – Revenue per employee
- *Voice versus non-voice processes* – Proportion of total revenue of a firm that is solely contributed by voice process
- *Attrition rate* – Percentage of current workforce that leaves within a year
- *Seat Utilization* – Number of times a particular office space can be used for 8 hour shifts during a day
- *Contribution by top client* – Percentage of revenue that comes from that one client who contributes the highest in the firm’s revenue
- *Employee Satisfaction Score* – Reported from Dataquest. Calculation based on 11 parameters, like – employee size, Per cent of last salary hike, cost to company, company culture, etc. and it is weighted and indexed on a score of 100. See http://www.dqindia.com/content/top_stories/2005/205111001.asp for details.
- *Information security certifications* – Number of certifications implemented for information security to comply with the mandate of the customer.
- *Quality certifications* – Number of certifications, like six sigma, ISO implemented for quality control

Besides the above continuous variables, we have the following dummy variables:

- *Captive versus third party* – If a production sharing arrangement occurs through a subsidiary in the host country rather than an unaffiliated party or outside contractor, then the set up is called captive, else a third party. In our case, we consider only those firms as captive centers that service their parent firms only. The third party provider is assigned a value 1 and a captive is assigned a value 0

- *Domestic versus international TPV* – A third party service provider whose headquarter is in a foreign country (in our case, any country besides India), is called an international TPV. The domestic third party vendor is assigned a value 1 while the international TPV is assigned a value 0

- *Prior experience of outsourcing in IT* – when the firm has prior experience, the variable assumes a value 1 else 0

- *VC funding* – If the firm is supported by venture capitalists in the year 2002-03, then, the variable takes a value 1, else 0

- *Niche versus broad-based firms* – if a firm is broad-based, then variable is assigned a value 1, else 0

- *COPC certification* – the variable is given a value 1 if the firm has implemented COPC as given in the CRIS-INFAC report and Voice&data