

Augmenting IFS provision via BPO

chapter 5

1. How does an IFC produce IFS?

As argued in preceding chapters, the provision of IFS differs from the production of conventional goods and services. It involves strong economies of agglomeration. This is partly because of the network externalities that shape liquid markets and complex inter-personal and inter-firm relationships. In addition, financial regime governance is an intrinsic, inextricable, 'un-detachable' part of the financial product/service, leading to IFS provision being focused in a few IFCs whose governance regimes have achieved global acceptability.

Spectacular progress in IT and in the costs of transportation of goods has helped to disperse the production of goods and services around the world – often within the umbrella of a single MNC. Such dispersion has occurred because firms wish to be nearer to sources of cheaper/better labour, large consumer markets, sources of key raw materials, or inputs such as water, access to infrastructure, or simply a more tax advantageous location.

Paradoxically, the concentration of global IFS provided from London and New York has increased even as the dispersion of production of goods has taken place in the last 30 years. Today, the provision of global IFS is more concentrated than (say) global automobile production and assembly. The latter is decentralised around the world through a production chain that involves fragmentation of component manufacture and synthesis in assembly. The most intense concentration of auto production in the world – in Detroit – is far less important in determining the contours of global car production when compared with the role that just three GFCs now play in shaping the contours, setting the standards, providing

the instruments and trading platforms, doing the deals, and generally innovating for global finance.

A lot is made of the 'death of distance' (Cairncross, 1997) resulting from new technologies. But, that has not yet affected the primacy of IFCs, or of national financial centres within large economies. The web of human networks, inter-personal relationships, and information flows (about clients, products and markets) that make a national or international financial centre what it is, has eluded functioning over a distance; despite facilities such as e-mail and video-conferencing. For example, despite the enormous growth of financial trading across India with the use of ICT since 1990, the fact is that Mumbai remains the financial capital of the country. That is just as true for London, New York and Singapore as GFCs serving the world well beyond the needs of their own national or regional economies.

The addendum to this argument is that – if the history of IFCs over three centuries is any guide – all globally significant economies have no option but to turn their *national* financial centres into IFCs, as their integration with the global economy widens and deepens. That process occurs by design or default. It cannot be avoided. That is because every globally significant economy has to have a central node connecting its financial system with the global financial system. The question for such economies (particularly for China and India – now the world's two largest emerging economies) is whether the nascent capacities of their financial centres (*i.e.*, Mumbai and Shanghai) as IFCs will remain limited to serving only their own economies (like Paris, Frankfurt and Tokyo) or whether they will grow into export-oriented GFCs, serving the IFS needs of their regions and the world, and making a handsome living from service export revenues by doing so.

The bulk of the *value* of financial services production (particularly IFS) lies in creative thinking and complex decision making. It involves a combination of: fine judgment and client/market knowledge shared across networks of professionals across financial firms. It has close access to exchanges, regulators (especially at policy-making levels), and sophisticated legal, accounting, and tax expertise.

The process of creating and producing new financial services involves: (a) a small number of hours of high value human capital in financial, legal and accounting firms as well as in regulatory agencies; supported by (b) a large number of hours of lower-priced labour, handling the more routine tasks of recording, confirming, booking and correcting the trading involved in two-way financial transactions. These routine tasks need to be performed meticulously in real time.

The former involves creative thinking and complex decision making. As in the case of Silicon Valley or Bangalore – or Stanford, Harvard, Oxford and Cambridge – those processes are critically dependent on specialised human capital with specific domain knowledge interacting in a geographic cluster. For IFS such clusters are found in Wall Street or the City of London. Physical proximity in one location enables people to bounce all kinds of ideas off each other and to develop/refine them into tradable IFS transactions on an ‘eye-ball to eye-ball’ basis. Finance involves more than processing data through mathematical formulae. It involves human knowledge, requiring fine judgment when faced with different shades of grey, or when tailoring or matching client demands and needs (whether clients are users of finance or investors) to sets of circumstances that keep changing, and involve different combinations of risks that are evolving or mutating continuously.

An IFC is a place where a set of humans can converse, compete and trade in the confines of the ‘financial world’, interpreted in the broadest sense of that term. Decision-making and innovation in IFCs takes place through ceaseless communications among financial analysts, tax specialists,

accountants, fund managers, speculators, arbitrageurs, investors, exchange managers, regulators, and treasurers from the financial and non-financial worlds. The nuances of these conversations, the millimetric raising of eyebrows or pursing of lips, and the non-verbal body language so crucial in understanding human reactions in negotiations, are not yet as amenable to subtle interpretation at a distance or on a screen. Phone calls, e-mails and video-conferencing are no substitutes for a chat over coffee or agreement on a deal structure over a game of golf or at a recreation club.

The endless stream of conversations at an IFC is fertile raw material for creative intellectual leaps and imaginative connections through lateral thought. The mind of the successful financial engineer can creatively link three apparently unrelated conversations with clients/colleagues during the previous week, into a set of financial transactions that meet the different needs of three counterparties, while leaving a tidy profit on the table. Spotting such deals requires a regular flow of top quality conversations in an environment that encourages them.

But the ingredients of creativity, imagination, and ingenuity notwithstanding, another phenomenon that has been at work in the world of global finance is an ever-increasing flow of high quality data about firms and countries from an increasing variety of sources, coupled with rapid analysis and global dissemination of this data, through the electronic medium. In principle, a speculator or investor (holidaying in Albania) could be far removed from an IFC (in London) while looking at data on a laptop, engaging in analytical thinking, deciding to buy, sell or hedge a position or security, and placing the trade order with a broker/agent to execute immediately. When trading is driven by cold analytical data processing and remote decision-making, such activity could indeed move out of London and New York to Mumbai, even when the hub of conversations is not in Mumbai. That migration might be driven by nothing other than better service standards, better execution capability at a better price, better

communications, a more convenient time-zone, and lower overall costs in servicing that customer's account.

In some ways, quantitatively oriented finance companies find it easiest to leave the hub of conversations and move to venues with lower-cost labour, since their trades are driven by computerised data processing and not conversations amongst humans. But even in this field, London and New York have crucial advantages. Securities markets are extremely effective at consuming publicly available data and rapidly incorporating it into the price of a contract (owing to speculators all over the world who take educated risks based on this data). Obtaining an edge in decision making, requires human judgment in planning the trading strategies which are implemented in computerised analytical and trading systems. Such judgment is concentrated in the human capital hubs of IFCs.

2. An outsourcing approach to IFS provision and IFC development: Possibilities, opportunities and pitfalls

An alternative approach to developing IFC capabilities involves deploying 'sub-contracting' or 'outsourcing'. The success of such an approach depends on the potential for breaking up the 'stack' of IFS into different layers, and sifting out those tasks that require discretionary judgment, as opposed to those that can be driven by a well-defined process manual.

Close examination of IFS provision reveals numerous sub-systems for which process manuals can be codified, specific activities can be outsourced, and the technical performance of a sub-system can be objectively measured. These sub-systems can be outsourced – using protocols now well established – from any IFC in the world to India (not necessarily just to Mumbai but to any city that provides global IT support services). Understanding the role that BPO can play in IFS production, then, reduces the policy-making conundrum to four questions:

1. What can be done by way of IFS provision that is based on computer systems

consuming electronic information and requiring analysis that could be done by human capital in Mumbai, Bangalore, Hyderabad, Chennai, Pune, *etc.*?

2. What is the potential for outsourcing IFS sub-tasks to Mumbai from other IFCs?
3. What does India need to do to succeed with an outsourcing strategy involving Mumbai or any IT-enabled Indian city immediately in global IFS provision?
4. How can an outsourcing strategy be used to lead to full-scale IFC development in a short span of time? Or would an outsourcing strategy result in deferring emergence of a fully-fledged IFC by compromising its development because of implicit or explicit non-competition arrangements between clients and service-providers?

In answering these questions, it has to be noted that India is already providing ICT software systems development/maintenance and management support to global financial firms, operating in almost all extant IFCs, for 'back-office' operations. Increasingly, higher value processes are being outsourced to India such as the financial analysis of companies, stock market research, credit rating research, *etc.* using the same standards, models and practices that are used by major global securities brokerages, related investment banks, as well as the world's principal credit rating agencies. Hard statistics about the scale of employment in Mumbai, of BPO jobs requiring finance domain knowledge, is hard to come by. Some news stories suggest a significant scale of employment that is undertaking increasingly complex functions. A Bloomberg column by Mark Gilbert records significant movement up the value chain with more complex tasks being done in India.¹ This is being done within the ambit of major Indian IT service providers as well as the captive IT processing centres owned and operated by major global LCFIs such as Citibank, Deutsche Bank, HSBC, ING, some global insurance companies and many others.

¹See <http://tinyurl.com/yzpbqf> on the web.

The question for Indian policy-makers and financial firms interested in developing IFS-provision linkages through sub-contracting/outsourcing is not whether the BPO models and systems already in place (between global financial firms and Indian IT service providers) can creep up the value chain. Of course they can; and they will. But will that result in developing full-fledged IFC capabilities in Mumbai? Probably not: unless Indian financial firms (rather than IT firms) organise themselves into being sub-contractors, service providers or partners to global financial firms. That would need to be done under contractual arrangements that enabled them to graduate into providing IFS services on a fully-fledged basis seamlessly through natural progression. It may require an entirely different approach to outsourcing and different relationships with extant global IFS providers through the three GFCs.

In looking at that possibility, policy-makers and financial leaders in India need to understand why global financial firms (viz. Merrill Lynch, Goldman Sachs, J.P. Morgan Chase, Barclays, Natwest, etc.) – that entered India as joint-venture partners with Indian firms (particularly in investment banking and securities markets) – are now arranging amicable separations from their Indian partners, and preferring to ‘go-it-alone’. These joint-ventures, on the face of it, offered one possible structure and venue for the Indian partners eventually to develop their own IFS provision capabilities for the Indian market and beyond. What was the crux of the concern that led these global financial firms to abandon those partnerships and retain their own brand identities within organisational and institutional structures that they controlled on their own rather than in partnership?

In the view of HPEC, some of whose members are CEOs of the Indian partners of global firms, these global firms probably felt that: (a) the Indian market was too large and globally significant for them to share the returns from it in perpetuity with partners they were forced to ‘marry’ to enter India; and (b) their Indian partners had the innate ability to compete with them in global

markets (if they were permitted to) on level terms and with a distinct cost advantage.

Under those circumstances a continued relationship that did not offer the possibility of complete absorption of the Indian firm by its global partner would only result in continuation of the forced ‘marriage’ being of more net benefit to the Indian partner (in terms of access to learning and increasing competitiveness) than to the foreign one. Those conclusions have an important implication: *i.e.*, that: (a) established global financial firms already acknowledge both the significance of the Indian market in global terms, and (b) the innate capability of Indian financial firms to compete in it. Indeed the faith of these global firms in Indian financial firms appears to exceed that of India’s policy-makers and regulators.

3. A BPO opportunity: Asset management in Mumbai based on algorithmic trading

An increasing proportion of the trading strategies of major global financial firms can be classified as ‘algorithmic trading’. Such trading involves the translation of public information into mathematical models that compute orders that are placed automatically on the market for execution. There is, of course, a continuum in two dimensions. To what extent does a human get involved in decisions? And, to what extent is order placement automated? In both dimensions, there are shades of grey.

- **The decision-making dimension:** In the decision-making dimension, different trading houses have varying levels of automation. Some firms build complete IT systems that analyse information and make decisions. Some firms build sophisticated models that analyse data and interact with humans. But the final decision is taken by the human.
- **The order-placement dimension:** Similarly, there are shades of grey on the extent of automation for order placement. Some firms build systems where sophisticated quantitative information processing drives the thought process, but the actual order placement is done

Box 5.1: *Algorithmic Trading (AT) and Direct Market Access (DMA)*

From the late 1980s onwards the phenomenon of algorithmic trading (AT) has become increasingly prominent in international financial transactions. At first such trading was viewed as an exotic side show. But it now occupies centre-stage: to a point where 80% of the NYSE turnover now comes from AT. In the case of the Chicago Board Options Exchange (CBOE) the proportion of business accounted for by algorithmic trading is even higher.

AT represents a fusion of human traders and computers where the role of the human input shifts away from executing trades to instructing the computer on how to place buy/sell trades. Computers excel at repetitive work; *i.e.*, at the task of processing vast amounts of information using pre-defined rules. AT consists of providing electronic market exchange feeds and news feeds into a computer simultaneously. The computer is controlled by a human decision-maker. But it processes all the data it receives in real-time and places buy/sell orders on the exchanges it is connected to and receives price information from. The connection between the AT system to the exchange is through Direct Market Access (DMA).

The sophistication of the algorithms in use is limited only by human imagination and by mathematical modelling capacity. At their simplest, algorithms can scan the spot market and the futures market simultaneously, looking for violations of the cost-of-carry mathematical model. If a situation is found in which the futures price exceeds the fair price, the computer immediately swings into action buying the spot and selling the future. This is an equilibrating response, one that brings the spot price and the futures price back into alignment. Computers are inherently superior, when compared with humans, at relentlessly scanning the prices of a vast range of contracts on a large number of futures and spot markets and at responding to a mispricing within milliseconds. A market with computers watching for mispricing, and undertaking the arbitrage transactions needed to eliminate it, is much more efficient than a market where this task is done in a labour-intensive way.

In London and New York, hundreds of the best mathematical minds in the financial industry are continually at work analysing historical data and the performance of extant AT systems. They are constantly improving the models and the thought process that drives such trading. There is a continuous process of analysis of past performance, learning, and innovation leading to building better and better AT systems all the time.

AT systems are not just liquidity consumers – placing orders into an existing order book. Computerised algorithms can also place limit orders. Algorithms are able to patiently place and revise thousands of orders, even when only a few turn into trades, in a way that would exhaust human traders. Through this, AT systems tend to drive up the number of orders processed by an exchange per trade matched at the exchange. In return, these

orders give greater liquidity and greater resilience of liquidity.

Contrary to popular perception, the computers involved in AT do not continuously make rapid trades or run amok without any human supervision. On the contrary AT systems are intensely monitored and controlled by humans and exchanges. As an example, in doing cash-and-carry arbitrage, the role of the human is that of choosing which traded products to monitor, setting the cost-of-carry parameters to be applied when comparing the spot and the futures prices, handling special situations such as close of market or futures expiration dates, and applying a manual override when the system misbehaves.

In the options market, “auto-quote” systems are particularly important, given the large number of listed option products. As an example, on the NSE, there are 9,000 different traded options. It is impossible for humans to monitor all these products. Computers excel at interacting with a human manager, computing a fair price for every traded option, and performing market-making functions on the options market. The human manager with such an auto-quote system infuses liquidity into a vast array of options, and runs an options book. The overall risk of the book is then laid off using the futures market using delta-hedging or other dynamic trading schemes.

In India today, the absence of such sophisticated systems is a key factor explaining the poor liquidity of the options market, since human traders are simply unable to produce liquidity in all 9,000 traded options.

For the last quarter century, a debate has taken place world-wide about the relative efficiency of the exchange as a way of organising financial trading; as opposed to the over-the-counter (OTC) market. In some areas, OTC markets have been unusually successful, such as in the currency forwards market. In recent years, the rise of algorithmic trading has re-emphasised the importance of the exchange as a venue. OTC trading is extremely labour intensive; it involves humans talking to one another, which is expensive and time-consuming. Minutes if not hours are taken by humans to do what computers can do in milliseconds. In addition, humans are more error-prone. It is therefore simply impossible to obtain the cost efficiency, enhanced liquidity, and enhanced rationality that comes from plugging an algorithmic trading into an OTC market. This is one of the reasons for the significant gains in market share of exchange-traded derivatives, and particularly the growth of currency futures, in the last five years.

The prospect of fully automated computerised trading systems without human intervention raises fears on the part of many mathematically unsophisticated people, who worry about a Frankenstein that can run amok and destabilise the market. It is often claimed that the October 1987

Box 5.1: *continued..*

crash in the US was caused by such trading systems. The Committee debated these issues at length and agreed on the following positions: (1) Just as an individual human trader can make mistakes and lose money, one computerised trading strategy can make mistakes and lose money; as with thinking about human traders, this is not a policy problem as long as there are a large number of market participants with no one market participant possessing market power (2) Whether human or computerised, all trading strategies are subject to position limits and margin requirements. (3) Shifting from human traders to algorithms changes nothing in terms of compliance with the risk management system; the computer is only a highly efficient clerk responding to the rules programmed into it by humans..

The October 1987 crash was indeed related to relatively primitive systems (by today's standards) at the NYSE being unable to cope with the sheer number of sell orders coming in over computer networks outside established price parameters incorporated into the models at the time (Kleidon and Whaley, 1992). But that was in 1987 – almost 20 years ago – when we did not know what we know now. Computer systems have become perhaps 1000 times to 4000 times more powerful between 1987 and 2007. With modern computer systems,

it is now possible to handle enormous spikes in the order flow and incorporate into AT models much greater variations in prices caused by one-way herd instincts.

In that sense 1987 provided a profound learning experience that was on the whole positive for the lessons it taught. Despite the fears and spectre of doom that it raised, in the aftermath of 1987, AT has only become more important all over the world. It does not seem to have induced any new problems although AT driven volumes are hundreds of times larger now than they were then. The evocative mental image of one Frankenstein computer running amok and destroying the foundation of global finance is as fictional as it is inaccurate. The reality is the opposite when hundreds of different AT systems, all with different trading preferences, parameters and ideas, are competing with each other and trading with each other in the global finance market place. No one trading system is disproportionately important. The biases of one AT system are likely to be offset by the counter-biases of others. So even if a few AT systems suffer losses, others make gains (as is always the case when there is a buyer and seller whether human or not). Therefore they do not affect the market as a whole.

Indeed, the argument is now made in

international finance circles that the algorithms are a force in favour of liquidity and stability. Their absence causes illiquidity and instability because the algorithms work ceaselessly to analyse information, trade and thus supply liquidity, while humans often back away irrationally from placing orders at times of market stress when emotions come into play. Human traders are more likely to suffer fear and panic; whereas computerised AT systems are relatively free of such human failings; they are able to objectively analyse information, and continue on with their work of making markets efficient even in times of market stress.

From an Indian policy perspective, the key argument that the HPEC would emphasise is that AT based on DMA provides a unique opportunity for India. Whether we like it or not, all IFCs now have prolific AT. It provides an extremely remunerative entree into the global IFS business where India can play an important role, even without making progress on local problems of financial or urban governance or capital account convertibility. Hence, it is particularly important for India to work on converting Mumbai into an internationally respected centre where the world's best financial engineers and computer engineers – who build and manage AT systems – are to be found.

by humans. Other firms build systems where the IT system interfaces directly with exchanges and orders are placed by the machine.

All this appears exotic in the present Indian context, where algorithmic trading using Direct Market Access (DMA) is banned with the exception of just one (DMA–NSE) trading strategy: one-shot futures arbitrage through cash-and-carry or reverse cash-and-carry. NSE staff read the computer programs of the trading house to verify that this is the only strategy that is being used before permission to trade is given. This policy framework eliminates the possibility of developing proprietary trading strategies for algorithmic trading. Such an approach is out of touch with global reality. There is no other country where regulatory staff read the computer programs written by algorithmic trading firms. Roughly 80% of the order flow into the NYSE now comes

through DMA, so India might be losing half or more of potential order flow by erecting regulatory barriers to DMA. Such barriers are costly for India given the unique role of algorithms in improving market efficiency, and fostering liquidity at moments when human traders are thrown off balance.

In terms of contractual structures, what is often seen in established IFCs is such work being housed in a specialised asset management firm. Assets thus managed might flow in from a hedge fund, or from large institutional investors like pension funds, insurance companies, banks or mutual funds. But this is not the only possibility. Most large international banks have a quantitative arbitrage group either housed within the bank as an affiliate or as a 100% captive subsidiary.

From an IFC/IFS provision perspective, India can host quantitatively oriented firms that analyse vast data feeds with decision-making by computers. This re-

quires high quality skilled labour in econometrics, quantitative finance, advanced mathematics, and computer science. Access to top-end staff of this nature, at present, is best obtained in a GFC like London or New York. However, it would be possible for India to compete in this space based on low-cost but high quality human capital.

There are two possibilities open to India for exploiting this opportunity (in which India could excel) regardless of capital controls:

- As long as capital controls remain, such firms would be restricted to managing foreign assets, consuming information feeds from outside the country and sending orders back into financial markets outside the country. Some firms have established operations in India, with a structure involving tax domicile in a tax-haven, raising funds in a number of IFCs, and undertaking actual operations in India.
- When India removes capital controls, this business will be transformed owing to: (a) opportunities for obtaining assets for management within the country and (b) opportunities for sending orders back into Indian financial markets. This would benefit India in three ways: these finance firms would be more viable; Indian assets would be managed more professionally; and Indian markets would obtain global order flow.

Consuming public information and sending orders back into exchanges is a highly competitive business. Every trader and every financial firm has the identical information set. Yet some firms believe they can obtain an edge by faster and superior processing of information. A large number of high IQ people, along with a very large mass of capital sourced from banks and hedge funds, strive to obtain supernormal returns through such strategies. Algorithmic trading is therefore a highly competitive field. There are two possible sources of competitive advantage. The first is original ideas in how to process the information available and imagine which trades would be profitable: this is shaped by high-end intellectual capacity in modern financial

economics. The second is labour cost of the highly sophisticated human capital inputs that account for the bulk of this business.

4. IFS subcomponents amenable to outsourcing

The essence of an IFC is the web of human relationships and information flows which lead to the best possible decision making when faced with complex problems where judgment is required. This is the defining feature of GFCs like London and New York. It might be the most difficult characteristic for Mumbai to replicate without the acquisition of more knowledge and experience. That will take time, as well as openness to importing sophisticated human capital with the kind of experience and expertise that India does not, at present, possess.

However, computer and communications technologies are now making it possible to break down the production process of specific IFS into sub-tasks, which are then done at locations around the world. Consequently, an increasing number of IFS sub-tasks are being performed outside established IFCs. These include customer call centres and direct selling, accounting, back office processing, software development, systems administration, data processing, research, *etc.*

What makes outsourcing possible is codifying the task that has to be performed in a process manual defining how it will be performed. A global financial firm operating in an IFC has a financial incentive to identify tasks that can be outsourced at a lower cost. Firms in Mumbai are well placed to bid for and win such contracts given the low prices of labour with adequate skills and finance domain knowledge. This process is already underway. Some sub-tasks of IFS are simple and require no domain knowledge. These can be easily performed at low-cost BPO centres like Jodhpur or Chandigarh. Other sub-components of IFS production require greater domain knowledge in finance. It is in performing these tasks that Mumbai has an edge that overcomes the labour cost advantage of Jodhpur or Chandigarh.

There is a direct relationship between increasing sophistication in Indian finance,

Table 5.1: What is happening in Indian finance through BPO?

Value chain	Business process	Technology
Research	Equity research Credit research	Capabilities in building research tools and portals
Execution	Trade allocation	Capabilities in delivering global execution platform
Settlement	Settlement instructions Cash operations Cash management Electronic payments	Experience in different messaging protocols, infrastructure and converters
Risk management	Risk modelling and management	Creating and supporting information systems for risk management
Data management	Data setup	Experience in data quality and practices, including analysis of market data
Reconciliation	Reconciliation	Nostro reconciliation. Position reconciliation
Fund processing	Manage payables/receivables	Development and maintenance of fund processing applications
Corporate actions		Development and maintenance of corporate processing applications

Source: Infosys Technologies

and India's ability to win IFS outsourcing contracts requiring higher value addition. As Indian finance acquires greater sophistication in risk management and trading derivatives, it will create a larger pool of qualified human capital in these fields. That will result in more risk management tasks being outsourced to India. The disadvantage of outsourcing, from a strategic perspective, lies in low price realisations. Once an IFS sub-task has been codified, and the initial cost-saving allure of out-sourcing has subsided, the outsourcing contract will be opened up to competitive bidding. This will result in a price close to long-run average cost. Prices will be cut to the bone through global competition. India will get high billing rates in comparison with Indian per capita income. But the much larger revenues and value-addition generated in an IFC will remain elusive.

5. Making progress along two paths: IFC Evolution and BPO

The key feature of the evolutionary opening up for an IFC and the BPO path – whether for outsourcing or quantitative fund management – is that they both rely on

highly skilled labour with finance domain knowledge. That requires a large number of postgraduates – masters and doctorates – in economics, mathematics, finance and computer science. All four are areas in which Indian output of high quality graduates is woefully inadequate. While India's labour force is internationally acclaimed, there are important gaps in education that need to be redressed.

Specifically, formal education in economics and finance is inadequate. At present, there is no programme in India offering a *Master of Science in Finance* or a *Master of Science in Computational Finance*. These two degrees are of crucial importance in the labour market for analytical finance jobs. On the international landscape, top universities in the US and EU that have a strong economics department *and* a strong mathematics department produce doctoral students in quantitative finance who enter the top end of the financial labour force. That has not yet happened in India where there is no world-class university that has a good mathematics department *and* a good economics department together in the same place.

IGIDR, IIT Mumbai, and some of the other free-standing quantitatively, mathematically orientated research institutes

around India could be built up into such institutions. But they would need to have: (a) leadership vision; (b) complete independence of operation that is not circumscribed by their funding sources; (c) an adequately funded corpus to attract and retain the best faculty at globally competitive wages; (d) incentives to develop cutting edge research programmes in financial derivatives and develop state-of-the-art trading strategy algorithms; (e) the right global partnership arrangements with the best institutions in the area of quantitative finance from abroad such as Wharton, Chicago, Stern, and LBS, for example. This turnaround in otherwise moribund institutions could be achieved quite easily and swiftly if the political and administrative will needed for the purpose were exercised. The Indian (and global) financial sector would fund and support such institutions enthusiastically; if for no other reason than because they would be the principal beneficiaries of their human and research outputs.

There is a considerable flow of knowledge across three financial domains: domestic finance, outsourcing, and quantitative fund management. All three draw upon a common labour force. The learning-by-doing that takes place in these areas is pertinent for all.² Hence, increasing the sophistication of domestic finance would improve the quality of the financial labour force. It will engage in learning-by-doing in response to demand for more sophisticated skills. For example, despite the profound weaknesses of graduate education in finance, India has one of the world's most respected equity derivatives markets. This came about through learning-by-doing assisted by NSE's mandatory certification program.

In the quantitative fund management arena, which is a specific area of opportunity for India, the goal should be to create an ecosystem of a hundred operational firms applying such an approach, located in Mumbai. This would lead to a fluid

labour market with relevant skills, and a set of employees able to network with each other. The development of skills would be further facilitated if SEBI restrictions on DMA were eliminated to put India on par with other countries. Skills development by local firms engaged in quantitative trading would improve the viability of Mumbai as a venue where such activities could be located. Electronic trading and DMA are easily implemented in the equity spot and derivatives markets, and commodity futures exchanges. Reforms in the debt and currency markets that lead to successful electronic exchange platforms will help augment the scope and knowledge with quantitative trading firms.

In sum, there are two things that India should do to foster an agenda of using high-value outsourcing as a means of preparing IFC capabilities on a fast-track. First, it should attach great priority to the development of an elite, high-skill labour force with masters and doctoral programmes in economics, mathematics, quantitative finance, and computer sciences. Second, it should adopt regulatory attitudes and policies that induce and encourage, rather than inhibit and discourage, sophistication in domestic finance. That would automatically increase the pool of qualified labour with relevant domain knowledge. One specific control which particularly needs to be removed, as part of a quest for sophisticated finance, is the ban on DMA.

6. Conclusion

The expansion of BPO in India is a positive development that can be exploited to advantage in strengthening symbiotically the attempt to create an IFC in Mumbai. Some kinds of BPO, involving low skills, are irrelevant for that purpose. Owing to cost factors, these are not already performed in Mumbai but in other low-cost centres across the country. However, an impressive array of tasks that requires finance domain knowledge has already come to India. These tasks are performed in Mumbai where specialised domain knowledge exists. A synergistic feedback loop now results in Indian finance creating specialised human capital; it attracts

²Many research articles, such as Lucas (1993), have emphasised the role of learning by doing in the context of a competitive and globalised economy, rather than formal education, as being of decisive importance in the process of economic development.

BPO to Mumbai and further enhances the quality of human capital. A two-way flow of highly skilled people between domestic finance employers, and BPO employers, is already taking place.

High-skill BPO work done in Mumbai enhances its prospects of becoming an IFC. It gives Mumbai prominence in the minds of senior decision-makers in global financial firms. That strengthens India's ability to attract such firms into other IFS activities in Mumbai. It enhances the development of greater skills and induces a more international outlook on the part of Indian staff, whose knowledge of global capital market opportunities would otherwise be more limited.

With telecom reforms there are no impediments to the growth of BPO other than rising labour costs and labour skill shortages. Through finance-related BPO, the skills of the financial labour force in Mumbai are being deepened. But further development of BPO hinges on two factors.

- *First*, India needs to create an elite labour force in quantitative finance. That is lacking in Mumbai at present. London and Mumbai have a similar number of individuals – roughly one million – engaged in providing financial services. But the knowledge of London's labour force (augmented by easy immigration in filling skills that are domestically in short supply) is vastly superior.
- *Second*, a programme of financial sector reform, leading to greater sophistication of domestic finance, would enhance further the quality of skills through on-the-job learning. India's success in creating an equity derivatives market has led to a large labour force that can do equity derivatives arbitrage. India's lack of a liquid and efficient bond market for sovereign, sub-sovereign, supranational and corporate issues, has led to the lack of a labour force that can arbitrage the yield curve.

While the continued development of BPO in finance is a positive feature that is supportive of the development of an IFC in Mumbai, winning high-value BPO contracts in financial services does not necessarily result in creating an IFC. The real value in IFS production lies in areas where creativity and judgment are required. India's sights need to be set higher than relying on more BPO revenues. These are infinitesimal compared to the revenues that could be derived from creating a successful IFC. That requires a policy approach quite different from Mumbai being promoted as a host for higher value-added BPO.

The only sub-component of the overall IFS universe, where distance is not an insuperable impediment to capturing full value from such services, is algorithmic trading. It is an area in which India could participate immediately in the global IFS marketplace with a pure BPO model, even if India makes no progress on regulatory difficulties of the local market or on capital controls. The universe of algorithmic traders comprises firms that consume vast quantitative data feeds, analyse them through algorithms, and automatically place buy-sell orders on the world's exchanges. This activity is the least firmly anchored in existing IFCs, since the conduct of such business does not require the human interactions that can only be found at an IFC.

Hence, DMA is an area in which India can make early progress in attracting global financial firms to establish operations. India's growth in this area will be assisted by DMA operations in existing financial exchanges that trade in equities and commodities. It will facilitate progress in bringing currency and fixed income trading to these exchanges as well. A key goal should be to have about hundred international DMA firms operating in Mumbai. That can commence even with capital controls, though deriving the full benefits for India would require their removal.