SPECIALIZATION AND NEIGHBORHOOD EFFECTS IN IT OUTSOURCING FIRMS IN INDIA

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Abstract. We examine how firm productivity, product and client specialization, and neighborhood spillovers shape firms' exporting decisions in the information technology (IT) industry. We study a new firm-level dataset on IT outsourcing firms in India and present three main findings. First, while almost all firms export, more productive firms have larger sales and export greater volumes to a larger number of destination markets. Second, more productive firms offer a smaller range of services and cater to fewer client industries. Moreover, product and client specialization are associated with higher export revenues independently of the direct effect of productivity. Finally, we find strong evidence of neighborhood effects in exporting. Firms are more likely to export to a given country the greater the number of other outsourcing firms in the same city, who also sell to that market. This effect is more pronounced in the products and client industries specific to the firm, and is not attributable to the attractiveness of the destination market or to characteristics specific to the location of the firm. These results speak strongly to the presence of information or labor market spillovers in trade in services.

1. Introduction

Offshoring of information technology (IT) services and business process outsourcing (BPO) are revolutionizing international trade in services.[1] According to a recent McKinsey report, India contributed about two-thirds of global IT outsourcing and about a half of global BPO offshoring in 2004, making India the single largest destination for foreign companies to locate IT-producing affiliates or purchase IT services at arms-length. In addition, IT outsourcing by Indian firms accounted for $36 billion, or nearly 5% of India's GDP in 2005, and is forecasted to contribute 17% to India's projected growth to 2010.[2]

In this paper we study a new firm-level dataset on IT outsourcing firms in India, and examine how firm productivity, product and client specialization, and neighborhood spillovers shape the global trade in services. Importantly, the data makes it possible to analyze not only firm-level exports, but also the variety of services that firms offer, the client industries they service, and the countries to which they export. In addition, information on the city location of each firm allows us to investigate how neighborhood spillovers affect exporting decisions. Since this dataset is an industry census we believe our results capture important features of global trade in IT services.

We present three main findings. First, almost all firms export their IT services abroad. However, more productive firms have larger domestic sales and export greater volumes to a larger number of destination markets. Second, more productive firms specialize in a few services and cater to fewer client industries. Moreover, product and client specialization are associated with higher export revenues above and beyond the direct effect of productivity. Finally, we find strong evidence of neighborhood effects in exporting. Firms are more likely to export to a given country the greater the number of other outsourcing firms in the same city who also sell to that market. This effect is more pronounced in the products and client industries specific to the firm, and speaks strongly to the presence of information or labor market spillovers in trade in services. Importantly, this neighborhood effect is not attributed to the attractiveness of the destination market or

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[1] For brevity, in the remainder of the paper we will refer to both IT and BPO services as "IT". BPO includes call centers, data entry firms and other back-office operations.
[2] Information from a special report on India in *The Economist*.

to characteristics specific to the location of the firm (e.g. city-level productivity). All of our results condition on firm characteristics such as firm size, capital and labor intensity.

A multitude of recent studies have documented that only a small fraction of all plants and firms export their products abroad, and that exporters are characterized by higher productivity and larger size.[3] In addition, more productive exporters have been shown to export greater volumes and sell to a larger number of countries.[4] These studies have largely focused on the manufacturing sector, and their results have been rationalized in the Melitz (2003) framework with heterogeneous firms and fixed costs of exporting. In that framework only firms with productivity above a certain threshold become exporters, and more productive firms have higher domestic and foreign revenues.

This paper presents one of the first empirical analyses of export behavior in the services sector.[5] International trade in services has been largely stalled by prohibitively high costs of exporting, as in the proverbial case of haircuts. In the case of IT services in India, however, both technological progress and substantial improvements in telecommunications infrastructure have diminished the variable costs of exporting to ignorable levels. While service firms still need to incur fixed costs of entry into exporting (such as establishing a network of clients and contacts), these are arguably much lower than the development and maintenance of distribution networks for manufactured goods. Similarly, the fixed costs of setting up an IT firm – acquiring computer equipment and finding qualified employees – are considerably lower than setting up and equipping a manufacturing plant. Studying the performance and export behavior of IT firms thus presents an opportunity to understand how stylized facts about the manufacturing industry translate to the service sector.

The first set of results we present in Section 3 suggest that the same economic forces that shape the manufacturing industry also describe the IT sector, given the cost structure differences described above. We show that 97% of all firms in our data export their IT services abroad. In comparison, only about 15% of all manufacturing firms and

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[3] See, for example, Bernard and Jensen (1999) and a literature review in Bernard, Jensen and Schott (2005).
[4] See Bernard, Jensen, and Schott (2005) for evidence for the U.S., and Eaton, Kortum, and Kramarz (2004a,b) for evidence for France.
[5] Bernard, Jensen, and Schott (2005) compare the export behavior of firms in the manufacturing, wholesale and retail, and services sector. Our paper differs in that we focus on the IT industry where trading costs are particularly low.

1% of all services firms in the U.S. exported in 2000 (Bernard, Jensen, and Schott, 2005). However, as with the literature on the manufacturing industry, we also find that more productive Indian IT firms have larger sales and export greater volumes. We interpret these results as support for the Melitz (2003) framework with heterogeneous firms applied to a context with low fixed trade costs and an associated low productivity cut-off for exporting. We find further support for this interpretation in firms' trading-partner intensity. While more productive IT firms sell their services to a greater number of countries, the frequency distribution of firms with a given number of export partners is considerably flatter compared to the very skewed graphs presented in Eaton, Kortum, and Kramarz (2004a,b) for French manufacturing firms and the results for the U.S. in Bernard, Jensen, and Schott (2005).

In section 4 we examine the product mix and client industry structure of Indian IT firms. Our data provides information on the variety of services that firms offer among 47 different products, which we group into 6 service categories in robustness checks. We also observe the client industries that firms service; the number of client types varies from 1 to 18. Although the distribution of both product and client intensity is rather flat in the data, we find strong evidence that more productive firms specialize in fewer services and cater to fewer client industries. Moreover, product and client specialization are associated with higher export revenues independent of the direct effect of productivity. We emphasize that these results do not document the direction of causality between specialization and export performance, but provide instead useful indications as to the production and export decisions firms face.

These results contribute to recent work on multi-product firms in international trade. Bernard, Jensen, and Schott (2005) find that two thirds of all U.S. firms are multi-product, and firms that sell 10 products or more account for 26% of U.S. employment and 94% of all U.S. exports.[6] They also show that employment and exports are positively correlated with the number of products traded. Bernard, Redding, and Schott (2005) further document that multi-product firms have higher labor and multi-factor productivity, show greater skill intensity, and are more likely to export. While we also find that larger IT firms and firms with more skilled labor offer a wider variety of

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[6] These statistics are for 2000.

services, the relationship between product mix, productivity, and exports speak to important differences between trade in the IT sector and other industries.

Bernard, Redding, and Schott (2005) and Nocke and Yeaple (2006) both develop a generalized theoretical framework in which firms optimally choose their product mix so as to maximize their profits. In the first model firms differ in their capabilities, products vary in their attributes, and firms match with products depending on the interaction of firm and product characteristics. Bernard, Redding, and Schott (2005) point out that while managerial techniques and organizational know-how may be deployed across different products, there may also be capacity constraints on managerial talent which make it more profitable for firms to specialize. Non-complementarities between products may also provide incentives for specialization if one product cannibalizes the sales of another close substitute. In contrast, if there are important fixed costs to expanding the range of products offered, product variety would be increasing in firm productivity. Similarly, Nocke and Yeaple (2006) study firms which experience diminishing returns to the managerial span of control. In particular, the more product lines a firm manages, the less well it manages each one. They posit fixed costs to the adoption of each new product, and find that firms with more organizational capability will offer more products and have higher revenues, but also exhibit higher marginal costs.

In the context of these two models our results on specialization in Indian IT firms suggest that managerial talent may be an important constraint in the provision of IT services. Our results are consistent with managerial talent experiencing decreasing returns with respect to product scope, but increasing returns with respect to production scale.[7] In addition, we surmise that other factors specific to the IT service industry increase firms' incentives to specialize. Given the nature of IT outsourcing, product customization is plausibly integral to the provision of a high quality products, and matching with clients. Product and client specialization likely facilitate building a reputation, marketing strategy and establishing new business contacts. In addition, non-complementarities in production, such as differing labor requirements for software programming, computer training centers and back-office operations, might make

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[7] See Bernard, Redding and Schott (2005) for a review of theoretical studies on managerial control in the industrial organizations and management strategy literature.

specialization more attractive. Finally, because IT firms in India are relatively young, they may need to first establish themselves in one product category before expanding to other related services. The combination of all these factors could explain why more productive firms offer fewer services to fewer industries, as well as why product and client-type specialization is associated with higher exports.

In section 5 we pursue this logic and examine a little explored aspect of firms' exporting behavior: interdependencies among firms and the potential for spillover effects. To our knowledge this is the first paper to explore firm-level neighborhood effects in an international trade framework. In particular, we use information on the city location of IT firms in India to construct firm-specific measures of the activities of other firms in the same city. We focus on the choice of destination market and study export participation in the 25 most common destinations. We find that a firm is more likely to export to a given country, the greater the number of other firms located in the same city who sell to that country. Importantly, this effect is robust to a variety of specifications with destination, city and year fixed effects and their interactions. This ensures that the estimated neighborhood effect is not driven by trends in the profitability of the destination markets, the overall productivity level or other characteristics specific to the firm's location.

We examine alternative measures of the neighborhood effect to understand the source of spillovers. We first show that the neighborhood effect at the city level is not capturing an India-wide effect. Moreover, the neighborhood spillover effect is more pronounced when firms' neighbors specialize in the same products or cater to the same client industries. The evidence for client-specific spillovers suggests that firms may exchange information about potential clients who are looking to obtain different services from a firm in the same city. On the other hand, the results for service-specific spillovers suggest that clients in the destination market may exchange information about specialized firms they trade with.

Service-specific spillovers, however, may also arise because of technological spillovers through the labor market. A special survey in *The Economist* reports that employee retention rates are extremely low, in the order of 50% in BPO firms. While we are unable to distinguish between these alternative stories, we present evidence that the spillover effects are larger for firms located in smaller cities. Smaller cities (as measured

by fewer IT firms) likely have poorer infrastructure, making informational spillovers especially important to the exporting decision. Finally, more productive firms and skilled-labor intensive firms respond more to their neighbors' activities, suggesting that they are more successful at pursuing profitable export opportunities or technological improvements they learn about from their neighbors.

The rest of the paper is organized as follows. Section 2 describes the dataset and section 3 focuses on the relationship between firm productivity and export volume. In the next section, we explore client and product specialization, and in section 5, we examine neighborhood spillovers in IT outsourcing. The last section concludes.

2. Indian IT firms

In this paper, we use a new firm-level dataset on the IT industry in India compiled by the National Association of Software and Service Companies (NASSCOM). The data are presented as a directory of IT firms published in 1995, 1999-2000, 2002 and 2003. While the directory was also published in 1992 and 1998, the variables collected were in a substantially different format that does not allow comparison with other years. The data were collected through a survey of NASSCOM member firms, which account for 90-95% of industry revenue in each year (Mehta, 1998, 1999; Karnik, 2002).

The directories contain information on the location of each firm's headquarters, total revenue and exports, subscribed capital, and the number of employees broken down into software employees and other employees. Since IT firms are exempt from income taxes, they have no incentive to deflate sales and exports volumes. Using this information, we construct three measures of productivity: 1) total labor productivity defined as revenue divided by total employees, 2) production labor productivity calculated as revenue divided by non-software employees,[8] and 3) total factor productivity measured by taking the residuals from a regression of (log) revenue on the number of software employees, other employees and subscribed capital with year fixed effects. We run most of our specifications with all three measures of productivity for completeness, with only minor differences in the results. Figure 1 presents the number of

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[8] Note that while this definition of production labor productivity is relevant for manufacturing firms, it is less clearly relevant for IT firms where skilled (i.e. software) employees include the computer programmers who write software.

firms in each year with non-missing data and Table 1 provides the average employment, capital, sales, exports and productivity in each year of our data.

The directories from 1995, 1999 and 2002 also provide detailed information on products these firms offer and industries they serve. We compile a comprehensive list of 47 services provided by IT and BPO firms from the slightly differing lists in each directory. Some of the more common products include web technology, internet and intranet, system integration and networking, and software product development. Given the large number of categories that may overlap, we also define six larger categories of service groups: software, hardware, internet services, training services, business process outsourcing, and multimedia (including computer graphics, animation and computer games). We also compile a list of 18 different industries to which IT firms cater. The most common client industries include financial services (such as banking, insurance, and payroll), manufacturing and retail, and web applications and online information services.

Finally, all four directories provide information on the markets to which these firms export. Some firms list specific country markets, other firms list regions to which they export (such as Middle East), while still others list a combination of countries and regions. In order to ensure comparability, when studying the number of countries to which a firm exports, we exclude all firms which list at least one region. At the same time, we create a comprehensive list of 29 regions of the world (such as Southeastern Asia or Northern South America) from the CIA World Factbook and mapped both country markets and region markets to these 29 regions. Using this classification, we can study all firms that list any export markets. Note that while we have a list of export destinations and total exports for each firm, we do not know the breakdown of exports across destinations.

3. Firm productivity and IT outsourcing

Recent firm-level studies have documented that only a small fraction of all plants and firms export, and that exporters are characterized by higher productivity and larger size. In addition, more productive exporters have been shown to export greater volumes and sell to a larger number of countries. These results have provided strong support for the influential Melitz (2003) model of international trade with heterogeneous firms and

fixed costs of production and exporting. In that framework only firms with productivity above a certain threshold become exporters. In addition, more productive firms employ more labor and have higher domestic and foreign revenues.

The prior empirical literature has mostly focused on manufacturing firms, primarily because of the limited international flow of services. In the context of the Melitz model this can be attributed to prohibitively high fixed costs of exporting, leaving no firm productive enough to export its services abroad. Because of the rapid technological progress, however, IT services today are characterized by much lower fixed costs of exporting and ignorable variable costs compared to other services or manufacturing. Below we show that the stylized facts about the production and export behavior of manufacturing firms carry over to the IT sector precisely the way that differences in the cost structure of the two industries would predict.

We begin by examining how (the log of) firm sales and total exports correlate with commonly studied firm characteristics. As the first two columns in Table 2 show, more productive IT firms raise higher total sales. In addition, larger firms (as measured by total employment), firms with higher capital to labor ratio, and firms using skilled labor more intensively also receive higher revenues. Similarly, larger, more productive firms using more capital and skilled labor have higher exports to the world (Columns 3 to 5). These effects are highly economically significant and robust to using alternative measures of productivity.[9] For example, a one-standard deviation increase in a firm's total labor productivity is associated with 47% higher total sales and 43% more exports.[10] Finally, as the Melitz model would predict, we find that the share of exports in total sales does not co-move with productivity or firm size because domestic and foreign sales exhibit the same elasticity with respect to productivity.

An extension of the Melitz (2003) model in Helpman, Melitz and Rubinstein (2006) predicts that more productive firms will be able to export to a greater number of countries. Two recent papers have found support for this prediction using firm-level data

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[9] Since total factor productivity (TFP) is obtained as a Solow residual from a regression of (log) sales on capital, skilled and unskilled labor, we do not use the TFP measure in the total sales regressions in Table 2.

[10] Comparative statics using estimates from Columns 1 and 3 in Table 2. The positive association between export revenues, and firm size and productivity persists when we include firm fixed effects and identify all effects from the within-firm variation over time.

for the U.S. and French manufacturing sector.[11] Moreover, these studies have documented a very skewed frequency distribution of firms with respect to their number of trade partners.

Table 3 presents summary statistics for the trading-partner intensity of Indian IT firms, for year 2002. The first striking fact which stands out is that 99% of all firms export their services. (The figure drops marginally to 96% in the whole panel.) This compares to about 15% of all manufacturing firms and 1% of all service firms in the U.S,. exporting in 2000 (Bernard, Jensen, and Schott, 2005). A second notable feature of the Indian IT industry is the significantly flatter frequency distribution of trade partners compared to findings for the manufacturing industry in the prior literature. While a fifth of all firms sell to exactly one foreign market and 45% sell to 2-4 markets, another 29% sell to 5-10 markets and 5% export to more than 10 countries. A similar pattern emerges when we look at the number of regional markets IT firms penetrate.[12]

We next examine how trade partner intensity changes with firm characteristics. The results in Table 4 (columns 1-6) suggest that larger and more productive firms export to a greater number of markets, as measured by either the number of countries or regions serviced. In the last three columns of the table we study the intensive margin of exports and consider (the log of) average exports per market (i.e. total firm-level exports to the world divided by the number of country markets reported).[13] We find that larger and more productive firms also export more per market. In fact, comparing these results to the results for total exports in Table 2 suggests that almost all of the effects of firm size and productivity come from the intensive margin of exports. This finding is consistent with the relatively flat distribution of partner intensity discussed above. Finally, firms which use skilled labor intensively also sell more to more markets.

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[11] See Eaton, Kortum, and Kramarz (2004a,b) on French manufacturing firms and Bernard, Jensen, and Schott (2005) on U.S. firms.
[12] The numbers for country trade partners exclude firms that list both country and region markets. See the previous section for the definition and construction of the regional markets data.
[13] Since we do not observe the breakdown of firms' total exports by destination we cannot study bilateral exports or link them to characteristics of the target market.

4. Specialization in client industries and services

A rare feature of our dataset is that we observe the types of services firms offer and the client industries they serve. This allows us to explore the linkages between firm scope, productivity, size, and exports. Below we show that more productive Indian IT firms specialize in fewer services, cater to fewer client industries, and earn higher export revenues because of specialization. We then discuss what these results imply for economies of scope and scale in the IT sector and relate our findings to the prior literature.

4.1 Specialization in services provided

Table 5 gives summary statistics for the distribution of the number of services firms offer (first three columns). The distribution is stunningly flat in the service range between 1 and 10 products; roughly 6%-7% of all firms fall in each category. Another 19% of all firms offer 11 to 14 different services. The frequency of firms drops sharply beyond 14 products, with less than 10% of all firms offering 15 or more services.[14] The distribution of the frequency of firms active in different service groups (columns 4-6) looks considerably different, and has an inverted U-shape. About 10% of all firms offer only 1 group of services, and another 10% sell in 5 or 6 service groups (6 is the maximum). The fraction of firms active in 3, 4, and 5 service groups is 16%, 34%, and 24%, respectively. Because of the close similarities between some of the individual services firms report among the 47 possible services, we believe the service groups we have constructed may better indicate firms' capacity for product scope.

In Table 6 we study which firms manage a larger product range. Larger firms and firms using skilled labor more intensively offer a wider variety of services. At the same time, more productive firms and firms with a higher capital to labor ratio specialize in fewer services. These results are highly economically and statistically significant and robust to different measures of productivity and product range. Our findings suggest that an improvement in TFP of one standard deviation is associated with 0.7 fewer services (0.17 fewer service groups) provided. For comparison, the median number of services (service groups) offered is 7 (3).

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[14] Note that about 6% of the firms in the sample do not report what services they offer.

Our results are robust to a number of different specification checks. We find very similar magnitudes and levels of significance for all firm characteristics when we restrict the sample to exporters only or to firms which are active in the 'software' service group. The results also persist when we include city fixed effects to account for the possibility that service specialization is determined by characteristics of the city and not specific to each firm (results not reported).

4.2 Specialization in client industries

The last three columns of table 5 give summary statistics for the distribution of the number of client industries that firms report. In 2002 about 13% of all IT firms in our sample cater exclusively to one client industry. Roughly 11% target two client industries, and a similar share sell to 3 or 4 client types, respectively. The distribution remains relatively flat for firms servicing 5-10 industries, and under 6% sell to 11 client sectors or more.[15]

Table 7 examines how the number of client industries varies with firm characteristics. In the first three columns of Panel A we regress client variety on firm size, productivity, and factor intensities. We find that larger firms and firms with more skilled labor cater to a greater number of industries. However, client range decreases with firm productivity, although this effect is only significant with 2 of the 3 productivity measures we use. Once we control for firm fixed effects the coefficient on firm productivity remains of the same sign and significance, but firm size and factor intensities are almost always imprecisely estimated (results not reported).

One possible interpretation of the above results is that more productive firms cater to a few really large client industries. Recall that the 18 possible target sectors vary from very specific client types (such as 'airline reservation systems and railways') to rather broad categories (such as 'manufacturing industries, retail industries, trading and distribution' or 'apparel industry and textiles'). If a broad group is equivalent to a large number of specific client types, the results above may be driven by systematic downward bias.

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[15] Note that about 6% of the firms in the sample do not report their client type.

We take two approaches to address this concern. We first examine whether firms reporting selling to some of the very broad client categories systematically report a lower number of client types. As Table 8 shows, this is not the case. First, for each of the 18 possible client industries we report the number of firms which list this industry as one of its clients in Column 3. While a very large number of firms report selling to 'manufacturing industries, retail industries, trading and distribution' (1,017 firms in the panel), just as many cater to 'banking and insurance, financial accounting, payroll and stock exchange' (1,050) and 'web applications and online information services' (972), two much more specific client categories. Second, Column 4 reports the range of the number of client industries serviced by firms who sell to a given client type. For any client industry firms report serving a total of 1 to 16 client groups, with the exception of 'lease and hire purchases', serviced by only 21 firms with a corresponding range of 2 to 12.

Finally, the rest of Table 8 shows the mean, standard deviation, and skewness of the distribution of the number of client industries reported by firms selling to the client type in that row. The bottom last row shows the corresponding statistics for all 18 client sectors, weighted by the number of firms servicing that sector. Finally, the last column shows the t-statistics from a two-sided F-test of the equivalence of the sector's mean number of client industries to the weighted average. Thirteen of the 18 client sectors exhibit a mean different from the cross-sector average. However, some of the sectors, in which firms on average report the lowest number of total client industries, are among the most narrowly defined. For example, average client range is lowest for firms selling to 'banking and insurance, financial accounting, payroll and stock exchange' and 'web applications and online information services'. At the same time 'apparel industry and textiles' suppliers have one of the largest average number of client types. These three sets of summary statistics suggest that it is unlikely for firms selling to broader client industries to be reporting a lower number of total client types.

We also take an alternative approach and test how correcting for the broadness of the reported client industry affects our results. We match the 18 client industries in our dataset to 4-digit SIC codes, and record the number of 4-digit SIC codes corresponding to each of the client types we observe. We assume that firms which sell to one of our 18

industries sell to all matching 4-digit SIC industries. We then construct a new measure of client industry range by counting the number of 4-digit SIC codes firms service. As the last three columns of Table 7 Panel A show, our results are robust to this specification. In unreported regressions we have confirmed that excluding the 'manufacturing industries, retail industries, trading and distribution' client category from the analysis all together leaves our results unchanged.

Finally, we test how the services firms choose to offer determine their client industries. In the first three columns of Panel B of Table 7 we include service group fixed effects. While firm size and skilled labor intensity continue to matter for client range, productivity no longer enters significantly. This suggests that firms first decide what services they are best positioned to offer, and this determines which client industries the firms will supply. Alternatively, this result may imply that firms optimally choose a bundle of services and clients, and that more productive firms specialize in fewer such bundles. However, as the last three columns of Panel B show, among firms who report offering software (the most common service group provided) there still is a significant and negative correlation between productivity and client range.

4.3 Specialization and exporting

We next examine the incentives for firms to specialize in fewer services and cater to fewer client industries. In particular, we study whether more narrowly specialized firms earn more export revenues.

Table 9 presents the results from regressing (the log of) firms' total exports on measures of firm specialization, controlling for firm size, productivity, and factor usage. As the first three columns show, we find limited evidence that the range of client industries serviced affects export performance. However, we find a strong and robust negative association between exports and the number of service groups firms sell to (middle three columns). Our results remain unchanged when we include both specialization measures in the same regression (last three columns). Moreover, accounting for specialization does not affect the estimated impact of other firm characteristics: larger, more productive firms that use capital and skilled labor more intensively continue to export more. We obtain similar results when we look at the

association between these measures of specialization, productivity and total firm sales (results not reported). This suggests that while specialization is associated with higher productivity, it provides an additional stimulus to exporting that is independent of the overall effect of productivity.

4.4 What does specialization say about IT firms in India?

Our analysis of Indian IT firms suggests that larger firms (in terms of employment) and firms using skilled labor more intensively offer a wider variety of products to a bigger range of clients and sell more abroad. In contrast, more productive firms have higher sales, but they specialize in products and clients. This implies that firms experience decreasing returns with respect to scope but increasing returns with respect to scale. We consider three alternative explanations for this result.

One possible interpretation is limitations to managerial talent and span of control. A large literature in contract theory has studied the causes and consequences of increasing managers' span of control, commonly finding that efficiency falls as managers add more tasks. Nevertheless, in a recent study on U.S. multi-product firms Bernard, Redding, and Schott (2005) find that multi-product firms have higher labor and multi-factor productivity. They present a theoretical framework in which productivity has an ambiguous effect on product scope. In particular, they point out that while managerial techniques and organizational know-how may be deployed across different products, there may also be capacity constraints on managerial talent which make it more profitable for firms to specialize. In contrast, if there are important fixed costs to expanding the range of services offered, product variety would be increasing in firm productivity. Nocke and Yeaple (2006) similarly study firms which experience diminishing returns to managerial span of control. In particular, the more product lines a firm manages, the less well it manages each one. They posit fixed costs to the adoption of each new product, and find that firms with more organizational capability will offer more products and have higher revenues, but also exhibit higher marginal costs.

We believe the fixed costs of product expansion are relatively small in the IT industry, while managerial talent is limited. As a recent survey of the Indian IT industry in *The Economist* points out, there is insufficient qualified labor to meet the demand for

IT services. The combination of these factors may explain why Indian IT firms appear to exhibit decreasing economies to scope. While our data does not allow us to test this explanation, we believe the differences in cost structure between the IT sector and manufacturing, combined with the differences in the market for skilled labor in the U.S. and India, can explain why our findings differ from those in Bernard, Redding, and Schott (2005).

A second reason why more specialized IT firms may be more productive rests on the presumption that product customization is integral to the IT sector. Foreign firms which choose to outsource a specific task to an IT firm in India require the development and provision of a service customized to their specific needs. For example, the software needed by a bank is very different from that utilized by a retailer, which in turn differs from the support that a publishing house may require. Firms servicing fewer client types may be able to improve the technology they use to address the needs of each customer, be more productive, and increase the quality of the service they offer. At the same time, different services may require different skill sets; compare for example software development, graphics design and back office operations. Firms may therefore have bigger incentives (and fewer capacity constraints) to invest in improving the quality of their products when they are active in fewer service groups. This argument may not apply readily to the specialization we observe in the range of services as opposed to service groups because services in the same service group may require very similar skill sets and technological investments.

Finally, specializing in services and client types may be associated with higher productivity and export levels because this facilitates the matching of buyers and suppliers. In particular, specializing in a given product or client type may help firms develop a reputation for expertise which will attract future customers. Similarly, there may be informational, technological or labor market frictions which allow firms to learn from one another about potential export opportunities and production technologies. Firms may be better positioned to maintain and benefit from such a network of "neighbors" if they specialize in fewer products and clients. Below we focus on this explanation and examine the interdependencies among Indian IT firms.

5. Neighborhood effects in IT outsourcing

Due to the unusual nature of our dataset, we can examine how the decision to export to certain destinations is associated with export activities of neighboring firms. For many of the firms in our dataset, we observe both the location of the firm headquarters and the list of markets to which the firm exports.[16] Since there are a large number of countries that import IT services from India, we focus on the 25 most common export markets. This aspect of a firm's exporting decisions has been little studied in the literature mainly due to the lack of sufficient data. In the next three sections, we first show that whether a firm exports to a particular destination is positively correlated with the number of neighboring firms that export to that destination. We also explore how the spillovers vary with firm and city characteristics. Finally, we discuss possible mechanisms for these neighborhood spillovers.

5.1 Neighborhood effects in export market choice

To study this question, we create a dataset with 25 observations for each firm-year in our sample, one for each of 25 possible export markets. Our main outcome of interest is a binary variable indicating whether or not the firm exports to that country in that year. Table 10, Panel A presents the results from regressing this binary variable on the number of other firms in the city that export to that particular country using a linear probability model.[17] In our main specification (columns 1-3), we include firm, year and destination fixed effects, with standard errors clustered at the city level. As the results show, the exporting decisions of neighboring firms are positively correlated with the probability of exporting to a given country. Larger firms are more likely to export to any country, but productivity and factor intensities are insignificant. This is probably due to the insufficient variation in these variables across time, since we control for firm fixed effects. In Column 4, we interact our firm and year fixed effects and find similar results. In this specification, the spillover effect is identified only by the variation across destinations.

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[16] We also observe the location of branches across India, but assume that exporting decisions will be made at the firm headquarters.

[17] Our results are robust to using a conditional logit model instead.

In columns 5-8 we estimate these regressions again, but include a binary measure of whether any firm in the same city exports to that market in order to explore nonlinearities in the spillover effect. We find a large correlation between having any exporting neighbors and export decisions; the impact of an additional exporting neighbor is much smaller. We also consider the concern that our results are driven by outlying nations that provide an export market for many IT firms in India, such as the United States and the United Kingdom. Dropping these export markets does not alter our results (results not shown). Our results are robust to including firm-destination fixed effects, exploiting only the variation across years within a firm-destination pair.

There is a concern that some countries may have a high demand for a service in which one Indian city may have specialized. For example, if Delhi specializes in graphics and multimedia for which Japan has a high demand, we might find many firms in Delhi exporting to Japan. Our specification above would lead us to erroneously interpret this as a spillover effect. Our results are robust to including destination-firm fixed effects, identifying the spillover effect only from the variation over time. Moreover, we obtain very similar results when we use all the variation in the number of firms that export to a given country in a year, when we use just the variation across destinations and when we use just the variation across time.[18]

In Panel B, we control for the number of firms in all other cities in India that export to a given country in order to account for the general profitability of exporting to certain destinations. Our results persist when we include both the number of exporting neighbors and the number of exporting firms across India. Both coefficients are significant, but the correlation with the number of neighboring exporters is larger in magnitude. Our results are also robust to using the (log) volume of neighboring firm exports as a measure of the spillover effects. Since we do not have data on what share of the firms' total exports are sent to each of the markets listed, we use both the total exports of these firms and the average exports per market. Both measures of neighborhood activity are positively correlated with the decision to export to a particular country (results not shown).

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[18] Our results are also robust to the inclusion of destination-city fixed effects (results not shown), using just the variation in a destination-city pair across time.

5.2 Specialization and neighborhood effects

We next study how these neighborhood effects interact with product and client specialization to investigate possible mechanisms through which the spillovers operate. We first calculate the number of exporting firms (that sell to a particular market) that specialize in the same products or cater to the same client industries. In all specifications, we include both destination-year and city-year fixed effects, with standard errors clustered at the city level. This ensures that our results are not driven by trends in city characteristics (such as productivity) or trends in destination profitability.[19]

As the results in Table 11 show, these different measures of neighborhood activities provide some insight into the spillovers. In Columns 1 and 2, we show that the number of other exporters who serve the same client industries in the same city is positively correlated with the probability of exporting to a particular country. At the same time, the number of other exporters not catering to the same client industries is negatively related to the probability of exporting. In Columns 3 and 4, we show that the same pattern obtains for neighbors in the same service groups. Finally, the last column shows that exporting neighbors that both provide the same services and cater to the same client industries significantly increase the probability of exporting to that country. This evidence suggests that some of the benefits from specialization we found above may be coming from spillover effects that are greater between firms in the same product and client industry categories.

5.3 Firm characteristics and neighborhood effects

We next examine whether these neighborhood effects vary with firm or city characteristics, using destination and firm-year fixed effects. In Column 1 of Table 12, we find that spillover effects are greater for firms located in smaller cities (as proxied by the number of IT firms in the city). One explanation for this result is that smaller cities are less likely to have trade shows and other infrastructure that would facilitate making business contacts. In Column 2 and 3, we find that more productive firms and firms with more software employees benefit more from neighborhood spillovers, perhaps because

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[19] The results are robust to a variety of different sets of fixed effects, such as firm-year and destination fixed effects or year and city-destination fixed effects.

they are better positioned to pursue profitable export opportunities or adopt technological improvements.

5.4 Possible mechanisms for these neighborhood effects

There are many potential mechanisms through which these neighborhood effects might operate. First, information may flow between IT firms about the profitability of exporting to a particular destination or even specific clients in that market, perhaps through labor turnover. Similarly, technological know-how specific to a particular market could flow between firms in a city. Second, information may flow between buyers in destination markets about where in India to purchase IT services, i.e. the spillovers may work through the reputation of a particular city.

Unfortunately, our data and many of our results described above cannot cleanly distinguish between these two mechanisms. Greater spillovers between firms that specialize in the same products could derive from larger information flows between firms that provide the same services, either because more workers may move between such firms or because the knowledge can be utilized more effectively at a similar firm. However, this feature of the spillovers may also come from clients in market countries sharing information about where in India to go for a particular IT service. Similarly, spillovers between firms in the same client industries could arise from neighboring firms sharing information about particular clients or from information flows within a client industry in the export market. The greater spillovers for more productive firms could arise from more productive firms utilizing the spillovers more effectively or clients sharing information about the productivity of certain firms in India.

Our results regarding how neighborhood effects vary with city size suggest that some informational or technological spillovers must occur between IT firms. Spillovers across clients should, if anything, be increasing in the number of firms in a city, especially if they operate through the reputation of a city as an IT center. Yet the interaction between neighborhood effects and the number of firms in a city is negative, implying that neighborhood effects are greater when there are fewer firms in a city. The literature on spillovers across firms also posits that some spillovers work through the movement of skilled workers across firms. We find that spillovers are larger for firms

that hire more software employees, but do not differ for firms that hire more non-software employees, implying that some spillovers work through turnover in skilled labor.

In sum, we find evidence of neighborhood effects in exporting across IT firms in Indian cities. A firm is more likely to export to a particular destination the more neighboring firms export to that same destination. Interacting these effects with firm and city characteristics allows us to confirm that some of these spillovers must be operating through informational spillovers between IT firms, either through spying, imitation or interfirm movement of software professionals. We cannot reject that some of our evidence for neighborhood effects may be driven by client-side information flows.

6. Conclusion

In this paper, we have analyzed a new firm-level dataset on IT outsourcing firms in India that includes some rarely gathered information on firms' product range, client industries and export markets. We first used this data to confirm stylized facts regarding how export behavior correlates with firm characteristics that have been well-established, both theoretically and empirically, for the manufacturing industry. The first contribution of our paper is to illustrate how these facts carry over to the service sector, despite differences in the cost structure. We showed that more productive firms have larger sales and export volumes and that they export to a greater number of foreign markets.

Next, we used this dataset to show that more productive firms also specialize in fewer services and cater to fewer client industries. Moreover, specialization is associated with higher export revenues independently of the direct effect of productivity. This new result is the second contribution of our paper. This conclusion contradicts the theoretical and empirical results in the recently-developed literature on multi-product firms. We believe that in the Indian IT industry, the fixed costs of expanding the range of products offered are small, but the limits to managerial talent that prevent adding more products are significant. In addition, factors specific to the IT sector, such as the value of product customization, may provide further incentives for specialization. The last explanation we posit is that specializing in services and client types may increase spillovers from other

firms, either because firms can benefit from the reputation of their city as an IT center or because firms learn more from other firms in the same fields.

We next examined the potential for neighborhood effects in exporting decisions across firms. We found that the probability that a firm exports to a particular market is increasing in the number of firms in the same city that export to that country. This is the third contribution of our paper. We showed that these spillovers are greater from neighboring firms that specialize in the same products and client industries. We also found that these spillovers are greater in smaller cities (as measured by the number of firms), for more productive firms and for firms that hire more software professionals. While we cannot rule out that these effects operate through the sharing of information between clients on the reputation of Indian cities, our results suggest that at least some of the spillovers operate through informational or technological spillovers between neighboring IT firms.

In this paper, we document several stylized facts about the Indian IT sector. One important caveat is that none of our results indicate a direction of causality. Instead, we establish some stylized facts about export performance of firms in the service industry and offer some explanation for these new facts. While we cannot infer a causal link between specialization and export performance, we find an intriguing correlation that contrasts findings in the prior literature, and a strong association between export participation and the export behavior of neighboring firms even controlling for firm, year and destination effects.

References

Bernard, Andrew, Jensen, Bradford, and Schott, Peter (2005). "Importers, Exporters and Multinationals: A Portait of Firms in the U.S. that Trade Goods."

Bernard, Andrew, Redding, Stephen, and Schott, Peter (2005). "Multi-Product Firms and the Dynamics of Product Mix."

"Can India Fly? A Special Report." *The Economist* June 3rd-9th 2006.

CIA World Factbook, https://www.cia.gov/cia/publications/factbook/index.html.

Eaton, Jonathan, Kortum, Samuel, and Kramarz, Francis (2004a). "An Anatomy of International Trade: Evidence from French Firms." *New York University mimeo.*

Eaton, Jonathan, Kortum, Samuel, and Kramarz, Francis (2004b). "Dissecting Trade: Firms, Industries, and Export Destinations." NBER Working Paper 10344.

Helpman, Elhanan, Melitz, Marc, and Rubinstein, Ariel (2006). "Trading Partners and Trading Volumes." *Harvard University mimeo.*

Karnik, Kiran, ed. 2002. Indian IT Software and Services Directory 2002. National Association of Software and Service Companies, New Delhi.

Mehta, Dewang, ed. 1998. Indian Software Directory 1998. National Association of Software and Service Companies, New Delhi.

Mehta, Dewang, ed. 1999. Indian IT Software and Services Directory 1999-2000. National Association of Software and Service Companies, New Delhi.

Melitz, Marc (2003). "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity." *Econometrica* 71(6), 1695-1725.

Nocke, Volker and Yeaple, Stephen (2006). "Endogenizing Firm Scope: Multiproduct Firms in International Trade." *University of Pennsylvania mimeo*.

Figure 1: Number of Firms

Legend:
- All
- With Factor and Revenue Data
- With Factor, Revenue and Export Data
- With Factor, Revenue and Country Markets Data
- With Factor, Revenue and Region Markets Data

X-axis: Year of Data (1995, 1999, 2002, 2003)
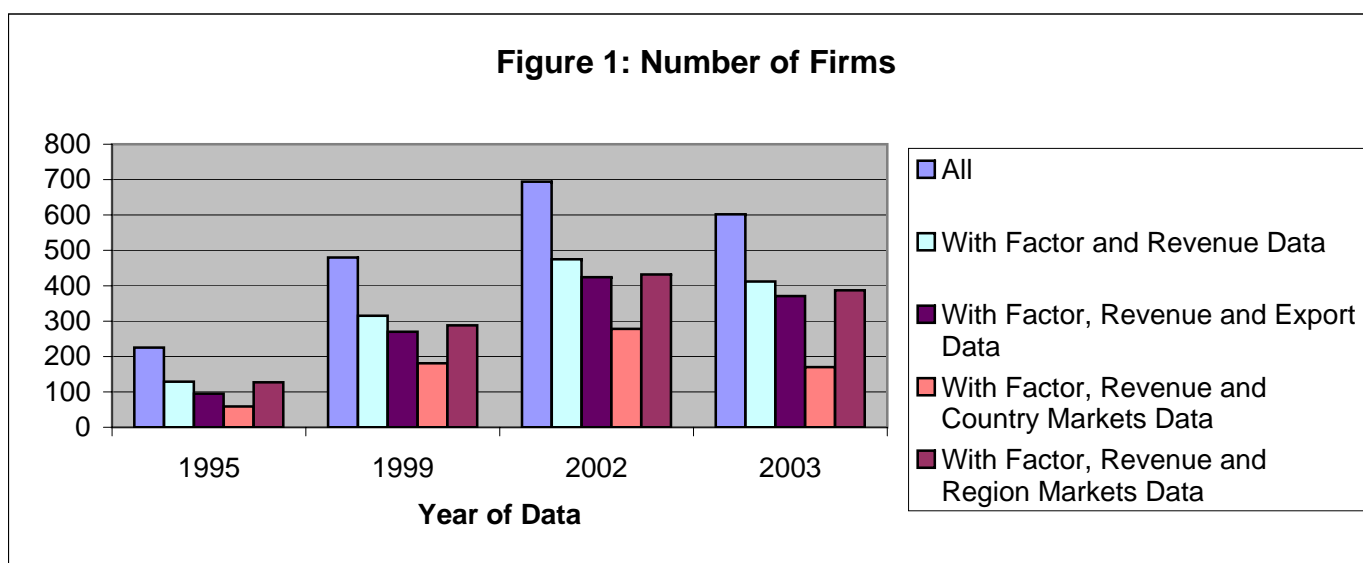
Table 1: Data Overview

Variable	Average in Year			
	1995	1999	2002	2003
Number of firms	129	310	465	395
Software employees	149	185	255	323
Other employees	71	95	86	115
Subscribed Capital (in millions of Rupees)	48.98	55.46	83.31	90.02
Total sales (in millions of Rupees)	145.89	306.67	349.78	517.72
Total exports (in millions of Rupees)	138.37	296.93	291.22	490.95
Total labor productivity	0.83	0.69	1.30	1.29
Production labor productivity	4.41	4.79	7.56	8.11
Total factor productivity[1]	0.00	0.00	0.00	0.00

1 The average total factor productivity in each year is 0 since it is calculated from the residual of a regression with year fixed effects.

Table 2. IT Firm Sales, Exports, and Productivity

Total Labor Prod = Total Sales / Total Employment
Production Labor Prod = Total Sales / (Total Employment - Software Engineers)
TFP Prod = Solow residual from regression of (Log) Total Sales on (Log) Capital, (Log) Skilled Labor, and (Log) Other Labor

Dependent variable:	(Log) Total Sales		(Log) Total Exports			Share of Exports in Revenue		
Productivity measure:	Total Labor Prod	Production Labor Prod	Total Labor Prod	Production Labor Prod	TFP Prod	Total Labor Prod	Production Labor Prod	TFP Prod
Productivity	**0.169**	**0.048**	**0.157**	**0.046**	**0.945**	**-0.003**	**0.000**	**-0.074**
	(17.88)*	**(18.84)***	**(13.41)***	**(14.55)***	**(38.48)***	**(-0.49)**	**(-0.32)**	**(4.46)***
(Log) Total Labor	1.167	0.094	1.172	1.094	1.167	-0.009	-0.010	-0.012
	(58.19)***	(4.04)***	(45.28)***	(41)***	(62.71)***	(-0.77)	(-0.79)	(-0.92)
Capital / Total Labor	0.042	0.845	0.037	0.147	0.253	0.002	0.001	0.002
	(2.74)***	(6.78)***	(1.68)*	(3.01)***	(7.39)***	(0.23)	(0.06)	(0.08)
Skilled Labor / Total Labor	1.540	1.087	2.467	1.729	2.499	0.371	0.394	0.386
	(13.18)***	(52.33)***	(15.5)***	(10.29)***	(22.13)***	(4.94)***	(4.81)***	(5.07)***
Year fixed effects	Y	Y	Y	Y	Y	Y	Y	Y
R-squared	0.7570	0.7622	0.6828	0.6964	0.8437	0.0249	0.0260	0.0427
# observations	1,331	1,299	1,161	1,134	1,133	1,161	1,134	1,133

Table 3. Export and Regional Markets: Summary Statistics

All data are from 2002.
 # Country markets : number of countries firm reports as export partners
 # Regional markets : number of regions firm reports to export to

# Country markets	Freq	Percent	# Regional markets	Freq	Percent
0	5	1.29%	0	5	0.83%
1	76	19.64%	1	87	14.38%
2	72	18.60%	2	86	14.21%
3	62	16.02%	3	68	11.24%
4	40	10.34%	4	71	11.74%
5	33	8.53%	5-7	113	18.68%
6	37	9.56%	8-10	110	18.18%
7-10	41	10.59%	11-15	44	7.27%
11-15	14	3.62%	16-20	14	2.31%
>15	7	1.81%	>20	7	1.16%
Total	387	100.00%		605	100.00%

Table 4. Export Markets and Productivity

 # Country markets : number of countries firm reports as export partners
 # Regional markets : number of regions firm reports to export to, excluding countries listed above
Total Labor Prod, Production Labor Prod and TFP Prod defined as in Table 1
Avg exports per market = Total exports / # Country markets

Dependent Variable:	# Country Markets			# Regional Markets			Avg Exports per Market		
Productivity measure:	Total Labor Prod	Production Labor Prod	TFP Prod	Total Labor Prod	Production Labor Prod	TFP Prod	Total Labor Prod	Production Labor Prod	TFP Prod
Productivity	**0.473**	**0.000**	**0.404**	**0.177**	**0.049**	**0.481**	**0.749**	**0.077**	**0.956**
	(2.7)*	**(-0.02)**	**(2.58)**	**(3.15)***	**(2.89)***	**(3.52)***	**(14.17)***	**(10.26)***	**(22.82)***
(Log) Total Labor	0.975	1.045	1.058	1.208	1.118	1.212	0.860	0.777	0.930
	(7.5)***	(7.41)***	(7.87)***	(11.48)***	(9.86)***	(11.26)***	(21.98)***	(17.5)***	(27.69)***
Capital / Total Labor	-0.189	-0.163	-0.126	0.095	-0.166	-0.056	0.060	0.102	0.222
	(-0.78)	(-0.66)	(-0.51)	(1.01)	(-0.78)	(-0.27)	(0.85)	(1.35)	(3.71)***
Skilled Labor / Total Labor	1.029	1.375	1.365	3.147	2.533	3.321	1.947	1.231	2.518
	(1.46)	(1.68)*	(1.89)*	(5.03)***	(3.65)***	(5.22)***	(8.89)***	(4.63)***	(13.59)***
Year fixed effects	Y	Y	Y	Y	Y	Y	Y	Y	Y
R-squared	0.1033	0.0960	0.1047	0.1379	0.1376	0.1400	0.5942	0.5386	0.7086
# observations	689	671	670	1,235	1,208	1,207	620	605	604

Table 5. Client Industries and Services Provided: Summary Statistics

All data are from 2002.
 # Services : number of services firm provides, 0-47
 # Service groups : number of services firm provides by group, 0-6
 # Client industries : number of client industries firm sells to, 0-18

# Services	Freq	Percent	# Service groups	Freq	Percent	# Client industries	Freq	Percent
0	39	5.62%	0	50	7.20%	0	42	6.05%
1	43	6.20%	1	69	9.94%	1	88	12.68%
2	46	6.63%	2	109	15.71%	2	78	11.24%
3	46	6.63%	3	234	33.72%	3	67	9.65%
4	45	6.48%	4	164	23.63%	4	79	11.38%
5-7	128	18.44%	5	65	9.37%	5-7	185	26.66%
8-10	147	21.18%	6	3	0.43%	8-10	116	16.71%
11-14	131	18.88%				11-13	22	3.17%
>14	69	9.94%				>14	17	2.45%
Total	694	100.00%	Total	694	100.00%	Total	694	100.00%

Table 6. Specialization in Services Provided

 # Service groups : number of services firm provides by group, 0-6
 # Services : number of services firm provides, 0-47
Total Labor Prod, Production Labor Prod and TFP Prod defined as in Table 1

Dependent Variable:	# Services			# Service Groups		
Productivity measure:	Total Labor Prod	Production Labor Prod	TFP Prod	Total Labor Prod	Production Labor Prod	TFP Prod
Productivity	**-0.165**	**-0.072**	**-0.704**	**-0.031**	**-0.017**	**-0.166**
	(-2.35)**	**(-4.85)*****	**(-5.29)*****	**(-1.6)**	**(-4.15)*****	**(-4.69)*****
(Log) Total Labor	1.026	1.103	1.026	0.141	0.163	0.147
	(9.76)***	(10.22)***	(9.66)***	(4.96)***	(5.59)***	(5.13)***
Capital / Total Labor	-0.181	-0.220	-0.239	-0.073	-0.073	-0.077
	(-2.66)***	(-1.96)*	(-2.12)**	(-3.96)***	(-2.39)**	(-2.53)**
Skilled Labor / Total Labor	1.540	2.750	1.772	0.068	0.354	0.126
	(2.49)**	(4.14)***	(2.86)***	(0.42)	(2.01)**	(0.77)
Year fixed effects	Y	Y	Y	Y	Y	Y
R-squared	0.1510	0.1622	0.1663	0.1485	0.1537	0.1584
# observations	920	905	904	939	922	921

Table 7. Specialization in Client Industries

 # Client industries : number of client industries firm sells to, 0-19
Total Labor Prod, Production Labor Prod and TFP Prod defined as in Table 1
Dependent variable : number of client industries

Panel A

Productivity measure:	Total Labor Prod	Production Labor Prod	TFP Prod	Weighted by 4-digit SIC industries		
				Total Labor Prod	Production Labor Prod	TFP Prod
Productivity	**-0.081**	**-0.038**	**-0.316**	**-1.161**	**-1.780**	**-13.615**
	(-1.57)	**(-3.5)*** **	**(-3.21)*** **	**(-0.43)**	**(-2.44)** **	**(-1.88)* **
(Log) Total Labor	0.581	0.626	0.583	33.595	37.328	34.144
	(7.52)***	(7.88)***	(7.43)***	(5.93)***	(6.27)***	(5.86)***
Capital / Total Labor	-0.116	-0.116	-0.126	-10.843	-8.166	-9.612
	(-2.33)**	(-1.39)	(-1.51)	(-2.51)**	(-1.23)	(-1.45)
Skilled Labor / Total Labor	1.223	1.933	1.398	117.149	159.127	128.786
	(2.7)***	(3.96)***	(3.05)***	(3.54)***	(4.44)***	(3.82)***
Year fixed effects	Y	Y	Y	Y	Y	Y
R-squared	0.0857	0.0938	0.0918	0.4297	0.4322	0.4313
# observations	920	905	904	1,332	1,300	1,299

Panel B

Productivity measure:	Total Labor Prod	Production Labor Prod	TFP Prod	Only Software Firms		
				Total Labor Prod	Production Labor Prod	TFP Prod
Productivity	**-0.037**	**-0.013**	**-0.065**	**-0.077**	**-0.037**	**-0.269**
	(-0.83)	**(-1.39)**	**(-0.75)**	**(-1.48)**	**(-3.19)*** **	**(-2.6)*** **
(Log) Total Labor	0.421	0.435	0.415	0.563	0.613	0.570
	(6.23)***	(6.2)***	(6.01)***	(6.92)***	(7.32)***	(6.9)***
Capital / Total Labor	-0.022	-0.021	-0.024	-0.113	-0.080	-0.120
	(-0.5)	(-0.29)	(-0.33)	(-0.68)	(-0.48)	(-0.73)
Skilled Labor / Total Labor	1.106	1.421	1.216	1.060	1.668	1.193
	(2.77)***	(3.28)***	(2.99)***	(2.15)**	(3.16)***	(2.4)**
Service group fixed effects	Y	Y	Y	N	N	N
Year fixed effects	Y	Y	Y	Y	Y	Y
R-squared	0.3245	0.3224	0.3217	0.0818	0.0910	0.0871
# observations	920	905	904	835	825	824

Table 8: Distribution of Number of Client Industries

 # Client industries : number of client industries firm sells to, 0-16

Client Industry ID	Client Industry	Number of firms	Number of Client Industries				
			Range	Mean	Standard Deviation	Skewness	T-stat
1	Education / Training / Entertainment	491	1-16	6.662	3.434	0.417	0.45
2	Engineering / Construction	560	1-16	6.896	3.312	0.418	0.42
3	Oil / Petroleum	201	1-16	8.433	3.296	0.372	0.00
4	Defence	240	1-16	8.104	3.355	0.410	0.00
5	Health / Medical	619	1-16	7.055	3.112	0.509	0.05
6	Electronics / Design automations / Robotics	248	1-16	7.089	3.716	0.458	0.15
7	Transportation / Ports / Telecommunications	808	1-16	6.312	3.287	0.466	0.00
8	Apparel industry / Textiles	177	1-16	8.316	3.590	0.286	0.00
9	Printing & publishing / Advertising	252	1-16	7.349	3.577	0.351	0.01
10	Travel, hotel & leisure industries	383	1-16	7.916	3.125	0.374	0.00
11	Banking & insurance / Financial accounting / Payroll / Stock exchange	1050	1-16	5.891	3.111	0.667	0.00
12	Public administration / Office automation / Electronic government	588	1-16	7.078	3.135	0.463	0.04
14	Manufacturing industries / Retail industries / Trading & distribution	1017	1-16	6.145	3.018	0.670	0.00
15	Lease & hire purchase	21	2-12	6.476	2.522	0.211	0.68
16	Web applciations / Online information services	972	1-16	5.920	3.126	0.694	0.00
17	Electronic commerce	87	1-16	6.839	3.382	0.373	0.87
18	Lobrary management systems	266	1-16	8.372	3.064	0.381	0.00
19	Airline reservation system / Railways	221	1-16	8.778	3.398	0.071	0.00
	Weighted average:			6.780	3.326	0.494	

Table 9. Exports and the Specialization in Client Industries and Services

 # Client industries : number of client industries firm sells to, 0-19
 # Service groups : number of services firm provides by group, 0-6
Total Labor Prod, Production Labor Prod and TFP Prod defined as in Table 1
Dependent variable : (log) total firm exports

Productivity measure:	Client Industry Specialization			Services Specialization			Client Industry & Services Specialization		
	Total Labor Prod	Production Labor Prod	TFP Prod	Total Labor Prod	Production Labor Prod	TFP Prod	Total Labor Prod	Production Labor Prod	TFP Prod
# Client Industries	**-0.025**	**-0.018**	**-0.008**				**0.004**	**0.007**	**0.006**
	(-1.95)*	**(-1.39)**	**(-0.89)**				**(0.28)**	**(0.44)**	**(0.52)**
# Service Groups				**-0.144**	**-0.121**	**-0.068**	**-0.150**	**-0.131**	**-0.075**
				(-4.17)*	**(-3.43)***	**(-2.63)***	**(-3.71)***	**(-3.18)***	**(-2.48)**
Productivity	**0.249**	**0.050**	**0.958**	**0.250**	**0.049**	**0.944**	**0.248**	**0.049**	**0.950**
	(12.56)*	**(11.8)***	**(30.26)***	**(12.69)***	**(11.63)***	**(30.63)***	**(12.61)***	**(11.59)***	**(29.96)***
(Log) Total Labor	1.219	1.143	1.184	1.224	1.151	1.190	1.223	1.148	1.187
	(38.74)***	(34.57)***	(49.76)***	(40.14)***	(35.86)***	(51.66)***	(39.16)***	(34.9)***	(49.99)***
Capital / Total Labor	0.031	0.160	0.295	0.024	0.162	0.290	0.023	0.156	0.291
	(1.41)	(2.33)**	(5.87)***	(1.11)	(2.37)**	(5.84)***	(1.08)	(2.3)**	(5.83)***
Skilled Labor / Total Labor	2.793	2.099	2.651	2.727	2.096	2.700	2.781	2.111	2.650
	(14.33)***	(9.89)***	(18.24)***	(14.62)***	(10.25)***	(19.4)***	(14.38)***	(10.01)***	(18.29)***
Year fixed effects	Y	Y	Y	Y	Y	Y	Y	Y	y
R-squared	0.7106	0.7061	0.8408	0.7155	0.7091	0.8439	0.7156	0.7099	0.8421
# observations	790	777	776	808	794	793	790	777	776

Table 10. Neighborhood Effects in Exporting

Any Exporting Neighbors : whether any firms in i*'s city export to country* c*, excluding firm i*
Number of Exporters Neighbors: number of firms in i*'s city exporting to country* c*, excluding firm i*
Number of Exporters Neighbors in Rest of India: number of firms in other cities exporting to country c
Total Labor Prod, Production Labor Prod and TFP Prod defined as in Table 1
Sample limited to the 25 most common export destinations (countries) for Indian firms
Dependent variable : indicator for whether firm i exports to country c

Panel A.

Productivity measure:	Total Labor Prod	Production Labor Prod	TFP Prod		Total Labor Prod	Production Labor Prod	TFP Prod	
Any Exporting Neighbors					**0.033** (5.42)***	**0.032** (5.32)***	**0.032** (5.31)***	**0.033** (6.04)***
Number of Exporting Neighbors	**0.002** (4.66)***	**0.002** (4.14)***	**0.002** (4.16)***	**0.003** (6.77)***	**0.002** (4.67)***	**0.002** (4.12)***	**0.002** (4.15)***	**0.002** (6.93)***
Productivity	0.003 (4.58)***	0.001 (2.05)**	0.001 (0.24)		0.003 (4.52)***	0.001 (2.04)**	0.001 (0.23)	
(Log) Total Labor	0.051 (4.45)***	0.047 (3.95)***	0.047 (3.8)***		0.051 (4.43)***	0.047 (3.92)***	0.047 (3.76)***	
Capital / Total Labor	0.000 (-0.24)	-0.004 (-0.25)	0.000 (0)		0.000 (-0.19)	-0.004 (-0.24)	0.000 (0.01)	
Skilled Labor / Total Labor	0.014 (0.48)	0.001 (0.04)	0.013 (0.47)		0.014 (0.49)	0.001 (0.04)	0.013 (0.47)	
Year fixed effects	Y	Y	Y	N	Y	Y	Y	N
Destination fixed effects	Y	Y	Y	Y	Y	Y	Y	Y
Other fixed effects	Firm	Firm	Firm	Firm-Year	Firm	Firm	Firm	Firm-Year
Clustered by	City	City	City	City	City	City	City	City
R-squared	0.3847	0.3841	0.3839	0.4029	0.3856	0.3849	0.3847	0.4037
# observations	29,325	28,650	28,625	52,225	29,325	28,650	28,625	52,225

Table 10. Neighborhood Effects in Exporting

Any Exporting Neighbors : whether any firms in i's city export to country c, excluding firm i
Number of Exporters Neighbors: number of firms in i's city exporting to country c, excluding firm i
Number of Exporters Neighbors in Rest of India: number of firms in other cities exporting to country c
Total Labor Prod, Production Labor Prod and TFP Prod defined as in Table 1
Sample limited to the 25 most common export destinations (countries) for Indian firms
Dependent variable : indicator for whether firm i exports to country c

Panel B.

Productivity measure:	Total Labor Prod	Production Labor Prod	TFP Prod	
Number of Exporting Neighbors	0.00140 (3.51)***	0.00133 (2.96)***	0.00134 (2.99)***	0.00133 (3.95)***
Number of Exporting Firms In Rest of India	0.00098 (8.21)***	0.00096 (8.18)***	0.00096 (8.18)***	0.00079 (6.92)***
Productivity	0.003 (4.55)***	0.001 (2.15)**	0.001 (0.28)	
(Log) Total Labor	0.051 (4.55)***	0.047 (3.99)***	0.047 (3.85)***	
Capital / Total Labor	0.000 (-0.29)	-0.005 (-0.33)	-0.001 (-0.06)	
Skilled Labor / Total Labor	0.013 (0.48)	0.000 (-0.01)	0.012 (0.45)	
Year fixed effects	Y	Y	Y	N
Destination fixed effects	Y	Y	Y	Y
Other fixed effects	Firm	Firm	Firm	Firm-Year
Clustered by	City	City	City	City
R-squared	0.3910	0.3901	0.3899	0.4075
# observations	29,325	28,650	28,625	52,225

Table 11. Other Measures of Neighborhood Effects

 # Other Exporters : number of firms in i*'s city exporting to country* c*, excluding firm i*
Total Labor Prod, Production Labor Prod and TFP Prod defined as in Table 1
Sample limited to the 25 most common export destinations (countries) for Indian firms
Dependent variable : indicator for whether firm i exports to country c

	(1)	(2)	(3)	(4)	(5)
# Other Exporters in Client Industries	0.020 (9.45)***	0.012 (9.62)***			
# Other Exporters NOT in Client Industries		-0.017 (-13.02)***			
# Other Exporters in Service Groups			0.019 (9.34)***	0.009 (8.74)***	
# Other Exporters NOT in Service Groups				-0.018 (-11.56)***	
# Other Exporters in Service Groups and Client Industry					0.019 (9.36)***
City-year fixed effects	Y	Y	Y	Y	Y
Destination-year fixed effects	Y	Y	Y	Y	Y
Clustered by	City	City	City	City	City
pseudo R-squared	0.4479	0.5034	0.4474	0.5109	0.4365
# observations	36,850	36,850	36,850	36,850	36,850

Table 12. Neighborhood Effects, Firm and City Characteristics

 # Other Exporters : number of firms in i*'s city exporting to country* c*, excluding firm i*
Exports by Other Exporters : total exports of all firms in i*'s city who export to country c,*
  excluding firm i
 # Firms in City : total number of IT firms in i*'s city*
Total Labor Prod, Production Labor Prod and TFP Prod defined as in Table 1
Sample limited to the 25 most common export destinations (countries) for Indian firms
Dependent variable : indicator for whether firm i exports to country c

Neighborhood effect measure:	# Other Exporters		
Neighborhood Effect	0.009	0.002	-0.001
	(7.12)***	(4.15)***	(-0.95)
Neighborhood Effect	-0.000064		
x Number of Firms in City	(-5.15)***		
Neighborhood Effect		0.000177	
x Productivity		(5.84)***	
Neighborhood Effect			0.001
x (Log) Skilled Labor			(4.57)***
Neighborhood Effect			0.000
x (Log) Other Labor			(1.25)
Destination fixed effects	Y	Y	Y
Firm-Year fixed effects	Y	Y	Y
Clustered by	City	City	City
pseudo R-squared	0.4050	0.4036	0.4029
# observations	52,225	33,225	47,350