Labor Productivity and Cost in Indian and Chinese Software Firms

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Abstract

It is widely believed that one of the most important factors responsible for the rapid growth and export success of the Indian software industry was the abundance of skillful technically educated workers who received low wages. However, the equally large and fast growing Chinese software industry also had an apparently similar factor of production. In this study we use survey data from firms in the two industries to analyze labor skill, productivity, and cost. We conclude that Indian software firms had more labor skill but not greater productivity overall than their Chinese counterparts, but that Indian software services firms might have had a labor productivity advantage over Chinese software services firms; the opposite might have been true for software products firms. We infer that Indian firms had superior management. Unit labor costs for the two countries' firms are not significantly different.

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The Indian software industry is large and fast-growing, driven mainly by the export of software services. The Chinese software industry is equally large and fast growing but its revenue comes mainly from the domestic market. We seek to understand some of the features of the Indian and Chinese software industries that might explain their fast growth, and to find key differences between Indian and Chinese software firms. One of the frequently offered explanations for the rapid growth and export success of the Indian software industry is the large pool of educated workers in India who were paid low wages when reckoned in US dollar terms. In this paper we study the labor factor of production both in the Indian and Chinese software industries, analyzing labor skill, productivity, wages, and cost. We also include the firm's management in the analysis. Our objective is to determine the extent to which Indian software firms differ from their Chinese counterparts in these dimensions of labor and management.

To conduct the analysis we make use findings from existing studies, and we analyze quantitatively firm-level survey data collected for this purpose. The software industry can be broken up into customized services providers and products companies (systems software, applications platforms, and packaged software products). We obtained data from both types of firms using by personal interviews among 179 software firms in India and China. The survey was conducted for the International Finance Corporation by the Confederation of Indian Industry in India and Renmin University in China. Both the Indian and Chinese samples represent roughly the services versus products lines of business in their industries. Both country samples' median firm size was larger than that of their industry. The median Indian software firm had \$6.5 million in revenue and employed 225 people in 2002 (the averages were \$35.9 million and 1,215, respectively), and the median Chinese firm had \$1.9 million in revenue in that year and employed 80 people (the averages were \$6.5 million and 161, respectively). The median export intensity among the Indian firms in the sample was 90.5 percent (the average was 71.0 percent) while the figure for the Chinese firms was 0 percent (the average was 12.7 percent). The appendix gives further details about the samples.

A. LABOR AND MANAGEMENT SKILL

The skills that a firm's workers and its managers contribute to the performance of the firm are especially important in a skill-intensive business such as software. It is widely believed that one of the most important factors responsible for the rapid growth and export success of the Indian software industry was the abundance of skillful technically educated workers who received low wages (e.g., Ramamurti & Kapur 2001). Because of its importance, this belief warrants close analysis. We analyzed labor and management in Chinese and Indian software firms to give us insights into the features of these firms that relate to their differential performance in export markets. To do so we investigated the qualifications of the workforce and the way in which labor was deployed in the firm, and we analyzed the productivity of labor in the firm.

Education, Experience, and Occupations of the Workforce

To understand the skill composition of a firm's workforce, we analyzed the education embodied in its workers and managers, the experience they brought to the firm, and the occupations into which they were deployed.

The workforces of Indian software firms were more highly skilled than the workforces of Chinese software firms; the main difference was that Indian software firms employed more professionals who were more highly educated.

In a simple bivariate comparison, Indian software firms exceeded their Chinese counterparts on most education and experience indicators of the skill of labor and management. Indian software firms had higher entry level qualifications for professionals, and more Indian professionals had post graduate educations. It required a post graduate degree to be newly employed in an Indian software firm, and nearly 40 percent of all professionals in the firm had achieved this level of education. In contrast, a first university degree, or a lesser diploma, was sufficient for professional employment in the median Chinese software firm, and between one-quarter and one-third of all professionals had a post graduate degree. (Table 1)

More Indian professionals had education from abroad (although the numbers were small for both countries), and more had work experience abroad whereas hardly any Chinese professionals had foreign work experience. (The predominance of export business among Indian software firms that was and still is to some extent conducted by Indian employees relocating temporarily to their western client's workplace was surely a major source of this experience; we don't know to what extent professionals' work experience abroad preceded or caused export success.)

Indian software firms employed relatively more professionals than Chinese software firms; they accounted for 69 percent in the median firm in India (the average figure was 59 percent). In the typical Chinese software firm, professional employment was much less at 29 percent of the workforce (the average was 35 percent).

For managers also, Indian software firms embodied more education, more education abroad, and vastly more experience abroad (some of the Indian mangers with work experience abroad might have been no-resident Indians who returned to India). These are all statistically significant bivariate comparisons.

Beyond bivariate comparisons, a more rigorous test of the workforce skill differences between Chinese and Indian firms can be achieved with a partial analysis. Accounting for all of the skill features at the same time, which ones shine through to distinguish one country's software firms from the other's? Because the notable difference between the growth and development of Chinese and Indian software firms is their export success, these partial differences are inevitably associated with export performance. In this further analysis, we ask which skill features retain their distinguishing power when other factors that might separate the two countries' software firms – technology factors and international linkages – are also included. (The analysis consists of estimating a logistic regression equation in which the country of the firm is the dependent variable and a range of labor, management, and other variables that potentially distinguish the two countries' firms are entered, such as technology inputs and outputs and international linkages.)

This strong partial test of workforce skill differences between Chinese and Indian software firms shows that it was professional labor that mattered the most. What Indian software firms had that Chinese software firms did not have was more and better professional labor. The Indian firms required higher educational qualifications for entry, had higher educational attainment among professionals altogether, and assembled a professional workforce that was larger in comparison to the size of the firm's total workforce. This outcome is a tribute to Indian software firm managers, who themselves were more educated than their Chinese counterparts, but it was not the qualifications of management that mattered ultimately but rather how they managed the workforce. We will see further evidence of this next.

B. LABOR PRODUCTIVITY AND VALUE ADDED BY LABOR

The productivity of labor and the value added by labor are two related ways to assess the firm's internal performance that should be related to its product market performance. These indicators are ingredients of labor cost and therefore unit total cost. It is a long leap from labor productivity or value added to competitiveness, but it is a critical component that motivates our investigation into these aspects of the firm's performance.

Labor productivity is a crude measure. It is simply output per worker, and is therefore affected by several forces simultaneously. Measured labor productivity can increase if the skill of labor increases, if more capital and other complementary inputs are employed, if managers utilize labor more efficiently, or in the long run if firms grow and scale economies can be exploited.

Value added is another imperfect measure. Value added by labor refers to the contribution of labor to the value of output produced. It is measured by subtracting from revenue the costs of all purchased inputs such as raw materials, components, supplies, and equipment. This measure varies with the labor intensity of production – industries whose inputs are mostly cost of goods sold such as retail stores typically have low value added by labor, and industries whose inputs are mostly labor such as consulting firms typically have high value added by labor.

Labor Productivity in the Software Industries as a Whole

We can determine labor productivity very roughly for the Chinese and Indian software industries as a whole simply by dividing each industry's total sales revenue by its total employment in each country. The calculation is very rough both because the two countries' industries are not the same and because of concerns about data comparability both on the sales revenue and employment side. Nevertheless, it is a preliminary indicator.

From revenue and employment data for the two countries' industries for 2004, we find that labor productivity for the Indian software and services industry was $22,117 per worker (the figure includes business process outsourcing; it matches closely the figure from NASSCOM that average revenue productivity for the Indian software and services industry was $23,000 per person in fiscal year 2004). The corresponding labor productivity figure for the Chinese software industry was less: $15,897 per worker. This result, which shows an Indian advantage, could be the result of several differences between the industries, including differences in the price level for outputs that would favor the Indian figure. Most Indian firms are exporters and receive western prices whereas most Chinese revenue is earned from the domestic market where prices surely are somewhat lower for similar products; however, on the other hand Indian software exports were in the past mostly low-value entry-level services that commanded only low prices. The aggregate country difference need not imply that individual Indian software firms are better performers or more competitive than their Chinese counterparts. For a more micro view we explore the firm-level data from our survey. (See Arora & Athreye 2002, Arora & Gambardella 2005, and Contractor, Hsu, & Kundu 2005 for discussion of labor productivity in Indian software).

Labor Productivity and Value Added at the Firm Level

We calculated labor productivity simply as output per worker (sales revenue in US dollars divided by total employment). Value added by labor, defined as revenue minus cost of non-labor purchased inputs, we calculated as net profit plus labor cost (both measured in US dollars).[1]

These calculations reflect translations of rupee- and renminbi-denominated sales revenue figures into US dollars, which we did using market exchange rates that prevailed at the date of the figures (year 2002). If either exchange rate is a disequilibrium exchange rate, the dollar figure is distorted. The Indian rupee was a flexible (but managed) exchange rate after the economic reforms of 1991, but the Chinese renminbi was pegged to the dollar in 1995. The real effective exchange rate, which considers countries' price inflation rates as well as the market exchange rate, gives a truer picture of a currency's effect on the export competitiveness of the firms in the country. Over the time period from the early 1990s to 2002, the rupee real exchange rate depreciated and then appreciated and was about the same at the end of the period as it was at the beginning – nominal depreciation was roughly offset by price inflation. In the case of China during this period, the renminbi real exchange rate weakend,

[1] Value Added = Revenue – Purchased Inputs, and Profit = Revenue – Purchased Inputs – Labor Cost, so also Value Added = Profit + Labor Cost

then strengthened, and was roughly constant toward the end of the period, ending up about the same or slightly appreciated from where it started. [2] (The date of the exchange rate translation in this study precedes the concern about undervaluation of the renminbi.) While we cannot judge if either currency was under- or over-valued, we can infer that neither country gained or lost trade competitiveness due to its exchange rate during the time period of software industry growth that we study.

The picture that emerges is mixed. Chinese firms in our sample had higher labor productivity but Indian firms had higher value added (although the latter difference was not statistically significant). Variation among firms in the Chinese industry was greater. (Table 2)

However, the two countries' industries are not strictly homogeneous or identical in their lines of business (and we have samples that are not strictly representative of their industries in all respects). For example, most Indian firms are software services firms whereas more than half the Chinese firms are mainly software products firms, and these two types of firms have different production technologies and face different markets. Most Indian software services are exported to Western markets whereas most Chinese software is sold domestically. Software services firms are more labor intensive than software products firms, and relatively more Indian firms are software services firms. This means that Indian software firms are more likely to have higher value added by labor than Chinese firms because the Indian firms use fewer purchased inputs (labor costs accounted for 53 percent of total costs among Indian firms in our sample whereas labor costs were 40 percent of total costs for the Chinese firms). Therefore we need to describe labor productivity and value added by labor for software services versus software products firms separately.

Differences in the labor productivity and value added by labor in Chinese and Indian software firms were probably due to the services versus products difference in their lines of business. Indian software services firms probably had higher labor productivity and value added by labor than Chinese software services firms, but Chinese software products firms probably outperformed their Indian counterparts.

The result of the separate services-products analysis is that the median Indian software services firms had somewhat higher value added by labor and labor productivity than its median Chinese counterpart, although the sample sizes are small for this disaggregation and the difference for value added was not statistically significant. Conversely Chinese software products firms showed somewhat higher labor productivity and value added by labor than their Indian counterparts (this finding is also suggestive only due to small sample size and lack of statistical significance for value added). (Table 4.5b).

Why do Indian software services firms appear to achieve better labor productivity and value added results than their Chinese counterparts? The answer depends on the features of a firm's inputs and management that determine its labor productivity. Both labor productivity and value added by labor should vary with the skill of labor, the amount of complementary inputs such as capital and technology, with the efficiency of management in utilizing labor, capital, and technology, and possibly with the size of the firm if scale economies are present. More skilled workers means that each worker produces more output, and more capital employed and more technology mean that output is greater without greater labor input. Management that more efficiently combines inputs means that more output is achieved with the same amounts of inputs. If scale economies are available, output increases faster than inputs as firms grow.

For the firms in our sample, we find most of these results. In a multiple regression analysis (details are given in the notes to Table 3), firms with more labor skill achieved both higher labor productivity

[2] The India data come from the Reserve Bank of India and use wholesale prices and export weights. The China data and conclusions are reported in Tyers, Bu, & Bain (2006) and in Wang (2005). Each country's real effective exchange rate is export or trade weighted and does not refer to its exchanger rate against the US dollar alone.

and higher value added by labor (we indicated labor skill by a single summary indicator, which was labor cost per employee [3]). Firms with more use of capital (indicated by the firm's capital-labor ratio) also achieved both higher labor productivity and higher value added by labor. However, technology input (indicated by R&D spending) did not contribute This result is not unexpected because Chinese software firms spent more on R&D than Indian firms, but we believe most of that spending was adaptive rather than innovative and therefore would not lead to greater productivity. (This belief is bolstered both by the type of business that many Chinese software firms practiced, which was adapting western software platforms or packages to the different needs of Chinese businesses and Chinese language, and by data that show that few Chinese patents were awarded outside China and few fell into the innovative category.) The size of the firm (indicated either in terms of revenue or total employment) was marginally significantly related to value added but not to labor productivity. In this analysis we accounted for the firm's line of business so that the effects of labor skill and the capital-labor ratio are independent and separate from the services versus products business of the firm. (Table 3 shows these results, with the non-significant variables omitted.)

Software firms were more productive if they had more labor skill and more capital intensity, whether they were services or products firms. In addition, we infer that Indian software firms achieved both higher productivity and value added in part because of greater management efficiency.

In the analysis that explains labor productivity and value added differences among software firms, we included a country dummy variable. The effect of the firm's country shows through significantly for value added by labor. Indian software firms had higher labor productivity and value added by labor after other determinants were accounted for. Of course, country of location cannot determine value added; rather, the country variable picks up unmeasured contributors to value added that vary systematically by country. The prime candidate is the efficiency of management in utilizing inputs. (Other candidates are other inputs not measured or included in this analysis, excepting technology and scale economies that we have considered, but because software production relies mostly on labor and equipment, we doubt other inputs can be influential.) We infer that the management of Indian software firms, in particular software services firms, was more efficient than Chinese management in utilizing labor and capital (other studies assert superior Indian management, such as Tschang 2003 and Yang, Ghauri, & Sonmez 2005). We pursue the ways in management affected the performance of Indian and Chinese software firms below.

While we can only infer management efficiency from this analysis, we can document the amounts of labor skill and capital that software firms in India and China possessed. Separating software services from software products firms, we find that Indian software services firms had significantly more skilled labor (using the summary labor cost per worker indicator). This finding mirrors the one reached earlier in this section using different indicators of labor skill (education, experience, and occupational distribution). In addition, Indian software services firms were slightly but not significantly more capital intensive, and their firm size was much larger (although firm size is not important to labor productivity). However, among software products firms, Chinese firms had an edge over Indian firms in labor skill.[4] (Table 4.) These differences in the resources of the firms in the two countries match up with the differences in labor productivity and value added by labor that we observed.

[3] Labor cost per employee reflects both the occupational distribution of the workforce and the wage rates paid to workers in each occupation. To be a valid measure of labor skill in a cross-country sample, we want similar wage rates in the two countries' industries, and in our sample we find this to be true (see the section on wages, below). When converted to US dollars at market exchange rates, the entry level median monthly wage for professionals, which is the largest single occupation, was $315 in India and $330 in China. This difference was not statistically significant, but if anything its use understates the Indian firms' labor skill.

[4] To compare capital-labor ratios across countries, we require a similar cost of capital, and for software firms we refer mainly to equipment. Because China had a low-cost hardware manufacturing industry to supply equipment to Chinese software firms, but Indian software firms made more use of imported equipment, we expect the calculated capital-labor ratio understates the Chinese figure.

From the detailed analysis of labor and management skill, productivity, and value added in the software firms in our sample, we conclude that:

Indian software firms compared to Chinese had more labor and management skill, and these capabilities contributed to somewhat higher labor productivity and value added by labor in Indian software services firms. However, this is not true for Chinese software products firms that had some advantage in labor skill compared to their Indian counterparts and in turn higher productivity.

This conclusion accords with the observed growth and development of the two countries' industries. It was software services that dominated the Indian industry but software products that were equally important to the Chinese industry.

If the conclusion implies a negative outcome for Chinese software services firms, there is an additional piece of evidence that extends this conclusion. If differences in labor skill between the two countries' firms are accounted for, and if also other differences between the firms are accounted for – we included quality certifications and international linkages – in a multivariate logistic regression analysis that distinguishes between Chinese and Indian software firms, then the firms that had higher labor productivity were Chinese firms. What is the meaning of this finding? Given the labor skill in the firm and given its capital, given its services versus products main line of business, and given the quality certifications and international linkages of the firm, the Chinese software firm had higher labor productivity and value added by labor than its Indian counterpart. This finding implies that some of the Indian labor and management advantage consisted of superior quality certifications and international linkages; once measured and included in the analysis, higher labor productivity was no longer a feature of Indian firms.

C. WAGES AND UNIT COST

One of the several ways in which companies can compete in export markets is on the basis of price. Surely Indian software companies did so in the past in the US market for customized software services. Making very rough calculations from aggregate market wage rates and illustrative firm-level labor productivity from 2002, it appears that wages in Indian software firms were only about 20 percent of their US competitors while labor productivity in the Indian firms was about 50 percent less, thus yielding a unit labor cost that was much lower than that achieved by US firms (the data were extracted from Ghemawat 2004). Indian software firms possessed absolute advantage at the very least, and were able to do software development work at lower prices than US software firms.

Our interest in this study is to compare Indian with Chinese software firms. We suggested above that Indian software services firms have higher labor productivity and value added by labor than their Chinese counterparts, and that this was due to greater labor skill employed in the Indian firms. The reverse might be true for software products firms, with an advantage to Chinese firms. However, the more important feature for price competitiveness is cost, not only productivity.

Unit labor cost depends labor productivity and on wage rates. In our sample, there were no significant differences between Indian and Chinese software firms in entry-level wage rates paid either to professionals or skilled workers, although the medians and means were higher for Chinese firms. These two occupations accounted for a large majority of the total workforce in the firms. (To be meaningful, wage rate comparisons should refer to workers who are homogeneous with respect to occupation and experience.) The overall average labor cost per worker, which represents both wage rates and the distribution of occupations, was higher for Indian firms, though again the difference was not statistically significant. (Labor cost per worker for the firm also reflects benefits and other non-wage costs attributed to labor.) This result is as expected because Indian software firms employed more professionals compared to Chinese firms, and professionals were paid more than skilled workers.

Because Indian software firms overall had lower labor productivity than Chinese firms but did not pay significantly lower wages but instead used more higher-paid professionals, the outcome is that Indian software firms did not have a unit labor cost advantage over Chinese software firms. We calculated a unit labor cost of $0.40 for Indian firms and $0.31 for Chinese firms from our survey data. (The Indian figure means, for example, that Indian software firms spent $0.40 on labor for every dollar of output produced and sold.) (See Table 5.)

Software services production is more labor skill intensive than software products production (which is more capital intensive), and accordingly the unit labor cost of software services is higher than it is for software products. For both China and Indian combined, the figures from our sample are $0.42 for software services and $0.30 for software products. Within countries, this was also true: Indian software services unit labor cost was higher than Indian software products unit labor cost, and similarly for China (due to small sample size for Chinese software services, this result can only be suggestive). Most importantly, the unit labor cost of Indian software services appeared not to be lower than the unit labor cost of Chinese software services.

Indian software services firms did not achieve export success over Chinese firms on the basis of lower labor cost.

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Table 1. Labor and Management Skill Features of Chinese and Indian Software Firms

Finding: ***The typical Indian software firm is distinguished from the typical Chinese software firm by having a higher entry level educational qualification for professional employees, more professionals with post graduate education, and by employing more professionals.***

Professionals	China	India
Entry level qualification ***(median firm)***	***Dipl or 1st univ. degree***	***Post grad degree***
Post graduate education ***(mean percent with)***	***28.5***	***39.4***
Education abroad (mean percent with)	2.7	5.5
Work experience abroad (mean percent with)	*1.4*	*26.0*
Share of total employment ***(median percent)***	***29.2***	***69.1***

Finding: ***Indian software firm managers have more education and experience abroad than Chinese software firm managers, but these differences are not significant distinctions between the two countries' firms when other labor skill factors are considered.***

Managers	China	India
Post graduate education (mean percent with)	42.7	55.6
Top manager completed post graduate education (mean percent)	88.1	99.2
Education abroad (mean percent with)	5.8	11.7
Work experience abroad (mean percent with)	*2.4*	*36.0*
Years of experience of top manger in the industry (mean) – n.s.	17.2	18.4
Share of total employment (median percent) – n.s.	10.0	8.7
Skilled labor		
Share of total employment (median percent) – n.s.	33.0	21.8
Unskilled labor and support staff (median percent) – n.s.	23.9	19.9

Notes:
All variables are statistically significant bivariate differences between Chinese and Indian software firms at the 0.05 level or better unless indicated otherwise by "n.s." Sample sizes are 112 for India and 59 for China.
Variables in ***bold italics*** distinguish between Chinese and Indian software companies when many other features of the firm are accounted for; variables in *italics* distinguish between Chinese and Indian software companies when other skill factors only are accounted for. The methodology for these two analyses was logistic regression analysis where the dependent variable is binary with value = 1 for China and value = 0 for India.
For occupational distribution, means for each country are in the same direction as medians except for skilled labor for which the Indian mean is 32.4 and the Chinese mean is 31.4.

Source: IFC Survey

Table 2. Labor Productivity and Value Added by Labor for Chinese and Indian Software Firms

a. All Software Firms in the Sample (US dollars per worker in 2002)

All Software Firms	China	India
Labor productivity		
median	29,625	25,557
Mean	45,383	31,381
standard deviation	48,339	26,095
Value added		
median	11,796	13,873
Mean	18,035	18,498
standard deviation	21,796	19,144

b. Software Services versus Products Firms (median US dollars per worker in 2002)

	China	India
Software Services		
Labor productivity	10,000	24,138
Value added	11,761	14,431
Software Products		
Labor productivity	32,400	26,189
Value added	11,796	9,956

Source: IFC Survey
Note: Differences are statistically significant for labor productivity but not for value added; sub-sample size for Chinese software services is only 13; other sub-samples are larger, ranging from 32 to 99.

Table 3. Explaining Labor Productivity and Value Added by Labor in Software Firms:

	Effects of potential labor productivity and value added determinants			
Outcome explained:	**Labor skill**	**Capital-labor ratio**	**Software services versus products**	**Country**
Labor productivity	Positive and significant but small; elasticity is <0.1	Positive and significant and substantial; elasticity = 0.5	No significant partial effect	No significant partial effect; Indian firms may be lower
Value added by labor	Positive and significant but small; elasticity is <0.1	Positive and significant and substantial; elasticity = 0.8	No significant partial effect	Indian firms are higher

Notes:
The findings are based on multiple regression analyses of IFC survey data; in the first equation (first row) the dependent variable is labor productivity and in the second equation (second row) the dependent variable is value added by labor. Explanatory variables included those shown in the columns of the table and two non-significant variables not shown, which were firm size and R&D spending as a percent of revenue to represent technology inputs.
These four variables explain 64 percent of the variation in labor productivity and 74 percent of the variation in value added by labor among software firms in our sample. The sample size is 149 for labor productivity and 145 for value added.
Labor productivity is output per worker; value added by labor is revenue minus costs of purchased inputs.
Labor skill is labor cost per worker; capital-labor ratio is value of capital per worker.

Table 4. Differences between Chinese and Indian Software Firms in Determinants of Labor Productivity and Value Added in 2002

Feature	China	India
Software services		
Labor skill:		
Labor cost per worker (median US dollars)	6,374	8,867
Capital-labor ratio (median value per worker)	8,400	9,369
Firm size		
Revenue (median US dollars)	1,200,000	6,615,000
Number of employees	110	225
Software products		
Labor skill		
Labor cost per worker (median US dollars)	8,844	6,328
Capital-labor ratio (median value per worker)	4,347	10,807
Firm size		
Revenue (median US dollars)	1,982,400	5,339,226
Number of employees	68	150

Notes:
Differences for firm size indicators are highly statistically significant, but differences for capital-labor ratio and labor cost per worker are only marginally significant
Sample size for China software services is small at 13 firms
Source: IFC Survey

Table. 5. Wages and Unit Cost in Indian and Chinese Software Firms

Wage and Cost Measure A. Differences between countries	**China**	**India**
Entry-level wage rate (monthly, median, USD)		
Professionals	$330	$315
Skilled workers	$240	$168
Benefit rate (percent of wage rate)		
Professionals	25%	15%
Skilled workers	25%	16%
Labor cost per worker (annual, median, USD)	$8,082	$8,400
Labor productivity (value of annual output per worker, median, USD)	$29,625	$25,567
Value added by labor per worker (annual, median, USD)	$11,796	$13,873
Unit labor cost (dollars spent on labor per dollar of output, median)	$0.31	$0.40

Wage and Cost Measure B. Differences by line of business	**Services**	**Products**
Entry-level wage rate (monthly, median, USD)		
Professionals	$315	$315
Skilled workers	$168	$210
Benefit rate (percent of wage rate)		
Professionals	15%	20%
Skilled workers	15%	21%
Labor cost per worker (annual, median, USD)	$8,820	$7,333
Labor productivity (value of annual output per worker, median, USD)	$24,051	$31,070
Value added by labor per worker (annual, median, USD)	$14,431	$11,236
Unit labor cost (dollars spent on labor per dollar of output, median)	$0.42	$0.30

C. Differences by country and by line of business	**China**	**India**
Unit labor cost (dollars spent on labor per dollar of output, median)	$0.35	$0.42
Software services	$0.31	$0.27
Software products		

Notes:

Labor cost per worker is calculated as total labor cost as reported by the company divided by total employment, and it reflects the occupational distribution of the workforce as well as wages, benefits, and other costs attributed to labor.

None of the inter-country differences is statistically significant except for labor productivity (0.01 level, and benefits rate for professionals (0.05 level). Standard deviations of wage rates are quite high. Two of the differences between services versus products firms are statistically significant: labor productivity (0.01 level) and unit labor cost (0.50) level.

Sample sizes range from 32 to 99 except for Chinese software services in Panel C, which is only 13.

APPENDIX: Characteristics of the Indian and Chinese Software Firm Samples

The total sample size was 179 firms. The Indian sample of 119 firms was drawn from membership lists of five industry associations and a trade publication's annual review of the industry; the response rate was 62 percent, and it included most of the top 50 companies. The Chinese sample of 60 firms was drawn randomly from a central government statistical report to which we added firms based on local interviewers' knowledge of the industry; the response rate was 30 percent. Questionnaires were completed by personal interviews from January-March 2004

A large majority of the Indian firms in the sample were mainly software services firms while a majority of the Chinese firms were mainly software products firms, as was true in their respective industries.

Table A1. Main Lines of Business and Production Processes of Sampled Firms
(% distribution)

	China	**India**
SOFTWARE		
Line of business		
Software services	21.7	75.6
Software packaged products	58.3	15.1
Embedded software	20.0	9.2
Production process		
Programming, maintenance, testing	75.0	89.9
Design, engineering	78.3	77.3
Systems integration	50.0	63.9
Consulting	36.7	60.5

Source: IFC Survey
Note: Figures for production process sum to more than 100 because of multiple responses.

The median Indian software firm in the sample was larger than the median Chinese firm, both in terms of sales revenue and employment. The average firm sizes were greater than the median due to oversampling of large firms. Few of the Chinese software firms in the sample had significant export business (only 18 percent of them have exports as great as 10 percent of their total sales), but most of the Indian software firms in our sample were exporters; for 89 percent of them, exports account for 10 percent or more of their sales revenue. This pattern replicates the difference in the export performance of the two countries' industries. More than three-quarters of Indian software firms in the sample were majority-owned by private domestic owners; majority foreign ownership accounted for 21 percent of the Indian software firms; state ownership was insignificant. More Chinese firms than Indian firms were majority foreign-owned, and only a small share of firms in the sample were state-owned, which is smaller than the industry figure of approximately 30 percent.

Table A2. Characteristics of Firms in the Sample

	China		**India**	
Variable	median	mean	median	mean
Sales revenue per year ($)	$1,891,000	$6,462,000	$6,451,000	$35,927,000
Employment (number)	80	161	225	1,215
Age of firm (years)	5	6	11	12
Export intensity (% of sales)	0	12.7	90.5	71.0
Majority ownership (% distribution)	(percent distribution)		(percent distribution)	
Private domestic	65		78	
Foreign	32		21	
Government	5		<1	

Source: IFC Survey