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ICT SERVICES AND PRICE-RESPONSIVENESS OF INDIAN INDUSTRY: SIMULATION USING A VIO MODEL

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ABSTRACT

ICT is considered as a general purpose technology and as an important element of factor input that has great implications not only for advanced economies but also for developing countries in their industrial development. There is a vast body of literature that provides discussion and empirical evidence on the role ICT as a technology has played in the case of advanced countries. However, empirical studies highlighting the effect of adoption of ICT services are scarce. In case of India, ICT services industry is considered to be a key industry and a catalyst of growth and development of other domestic industries. Nonetheless, the adoption and dissemination of these services among domestic industries remain restricted mainly due to higher prices of IT services. As the previous literature has pointed out, technological developments and innovations in ICT producing industries worldwide led to a fall in relative prices of these goods and services while the quality of the same improved. The falling prices of ICT capital, for instance, are supposed to benefit the ICT services industry by reducing its cost structure, since ICT capital is assumed to consist of a larger share of the ICT services industry's capital structure. This paper analyzes the potential benefits of a decrease in relative prices of ICT services to other industries of the economy. A variable input output (VIO) model, which evaluates price-responsiveness of the economy, is utilized for this purpose. The dataset consists of Indian Input Output Transaction Table (IOTT) for 2003-04 and 2006-07. Simulation results based on hypothetical scenarios indicate increase in production of the Indian economy as a result of 1 percent and 10 percent reduction in capital cost of the Indian ICT services. The results, in particular the comparison between 2003-04 and 2006-07, also shed light on the structural change that the Indian economy faced during the period. While the study emphasizes larger implications of ICT services as an intermediate input, it recommends broader rationalization of the duty structure and deregulation of ICT related goods and services as a part of competition policy.

JEL CLASSIFICATION & KEYWORDS

■ C67 ■ L16 ■ L86 ■ ICT SERVICES ■ INDIAN INDUSTRY ■ VARIABLE INPUT OUTPUT MODEL ■ STRUCTURAL CHANGE

INTRODUCTION

The Indian services sector grew exponentially in the 1990s and 2000s, and accounts for the largest share of Indian GDP (around 52 percent). In particular the importance of ICT services has increased in the last decade, as is reflected in the two-digit growth rate of these services in the past couple of decades. Indian ICT services, led by 'Computer & related activities' and 'Communication' industries, in real values are growing by two digits in recent years, with an average annual growth rate of 25.4 percent and 25.7 percent between 1999-2000 and 2007-2008, respectively at 1999-2000 prices. One of the reasons for the expansion of Indian ICT services sector lies in its export-intensive nature. In particular, exports of software and IT services witnessed double digit growth in the past decade. Software and IT services exports in 2010-11 are estimated at USD 59 billion as compared to USD 50 billion in 2009-10, an 18 percent growth in dollar terms (Department of Information Technology (DIT), 2011, p. 13). This suggests the growing importance of ICT related services in the Indian economy. ICT services, being an important aspect of the broader information and communications technology, can influence the economic performance of other industries through intermediate demand and final demand. On the other hand, the high costs of input materials and utilities, for instance, erodes the profit margin and labor cost advantage of the Indian industry in general, and affects its international competitiveness in particular. ICT capital and complimentary ICT services can make the Indian industry competitive by affecting its efficiency and production. In particular, falling relative prices of ICT goods due to technological developments in the ICT producing sector globally make these goods and services more attractive than others. Liberalization of import of these goods and services and rationalization of domestic duty structure would assist in dissemination of ICT at a higher speed. It is, therefore, necessary to understand the influence of ICT services industry's evolution and its effect on the Indian economy in an inter-industry setting.

The remaining paper is organized as follows. Section 2 discusses empirical literature followed by the price change of Indian ICT services in the recent past. The data and methodology is discussed in Section 3. This is followed by a discussion of empirical results in Section 4. The concluding remarks are given in Section 5.

Literature review

The empirical evidence on separate analysis of the impact of ICT services in an inter-industry setting is mainly limited to advanced and newly industrialized economies. Klein (2003) in his work estimated the impact of IT services, as an important intermediate input used in the production process, on the productivity of the U.S.'s automotive industry using various I-O tables. The findings of that study indicate a positive influence of IT services as an intermediate input on the automotive industry. In another study on the impact of IT at the industry-level, Gill et al. (1997) found a positive influence of IT capital and labor on the productivity of U.S. industries. In particular, the findings from their study reveal positive output elasticities with respect to IT equipment for two-thirds of the industries analyzed. However, this paper particularly deals with Indian ICT services, focusing upon price decreases of these services due to capital costs reduction and resulting effect on the output of other industries.

In order to estimate the impact of the IT industry (which consists of more than one industry) on other industries of

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the Korean economy, Kim and Oh (2004) utilized a VIO model, which was originally developed by Liew and Liew (1988). The benefit of this model is that it allows for assessing the impact of cost/price change while using the conventional I-O framework. However, the Kim and Oh (2004) study analyzed the effect of 1 percent reduction in capital costs of the Korean IT industry on the output of other industries and found less satisfactory results. Out of the 31 industries at the aggregate level, only 3 industries, including the IT industry itself, show positive increases in production (substitution effect) due to a fall in the prices of IT goods and services. On the other hand, the total effect (combining substitution and income effect) of the same indicate as many as 18 and 13 industries increased production in 1995 and 1998, respectively. In another similar study, Kim (2008) estimated the impact of a fall in prices in the Korean IT industry through technological innovations on the output elasticities of other industries using VIO model. The results of that study also show a less satisfactory impact – about one-tenths, i.e. 3 out of 31 industries, were positively affected – of the Korean IT industry on other industries between 1995 and 2000. The aforementioned studies on the Korean economy define IT industry in a broader way that encompasses hardware commodities such as electric appliances, video/audio & communication devices, computer & office devices, and software services such as communications, broadcasting, and computer services. In another study, Heng and Thangavelu (2006, pp. 16-21) estimated the elasticity of industrial GDP to falling prices of information goods and services for the Singaporean economy, by estimating the ratio of expenditure on information input to nominal GDP of the industry. Their results find most of the industries benefiting from the price decrease, with the industries experiencing the largest impact doing so as a result of 10 percent decrease in the prices of information input include 'information sector', 'electrical appliances and equipments', and 'business services' among others.

As far as the inter-connectedness of industries is concerned, the I-O framework provides a foundation to analyze the effect of price changes of an industry or a set of industries. Under the I-O framework of interconnectedness of industries, Leontief's IO price model (both demand-pull and cost-push) provides the basis to evaluate the effect of price increase or decrease in any particular industry or group of industries (Miller & Blair, 2009, pp. 41-46). Using the extended models of Leontief's IO price model, some studies analyzed the effect of exogenous price change on the price level of other industries (see, for instance, Bazzazan & Batey, 2003; Tunali & Aydogus, 2007). However, the extended models of price change rely on the fixed technical coefficient assumption of Leontief's production function.

In order to evaluate the impact of changing ICT services prices not only on the price structure of other industries, but also on their production as a result of increasing demand for ICT services, an extended model of price change in the form of VIO model is useful. Based on I-O characteristics of interconnectedness of industries, this model assists in tracing the effect on production of price change by treating primary input costs exogenous and variable. In other words, a VIO model, based on profit maximization and cost saving behavior of firms, utilizes the price transmission system of I-O framework and provides insights into production change of other industries which respond to price changes in a certain industry. Since ICT services are increasingly playing an important part in economic activities of various industries, this study tries to evaluate the effect of these services industries and their potential to influence other industries.

As a result of technological improvements and innovations worldwide, the prices of ICT goods and services in real terms are decreasing. The effect of price cuts of ICT services is highly relevant for the Indian industry as a whole, since Indian industries are suffering from high input material and utility costs and a resulting small operating surplus. Although many of the Indian industries have competitive labor costs compared to other emerging and developing countries, high input material costs put Indian industries at a competitive disadvantage since they cannot exploit economies of scale with higher material costs and a lower operating surplus. According to the International Yearbook of Industrial Statistics 2007, only ten Indian industries at three/four-digit level enjoy an operating surplus of 20 percent or more (UNIDO, 2007). Hence, the falling ICT services prices will reduce the burden of input and material costs by increasing demand for these services and substituting for other inputs. This depends on the price and output elasticity of various industries to changing ICT services prices. The VIO model is appropriate for this analysis since it is based on the principle of profit maximization and cost saving behavior of firms.

Price change of Indian ICT services

Since the focus of this paper is to estimate the price-responsiveness of the Indian industry by simulating price decreases in the ICT services industry, this section explains the rationale behind the price decrease simulations.

The Government of India had signed the IT Agreement (ITA) of the World Trade Organization (WTO) in early 1997, which set the target that 'concomitant' to phasing out the duties on the finished products as identified in the ITA list, duties on input raw material, including that on dual usage items, would also be phased out to nil prior to the terminal year i.e., 2005 (Department of Information Technology (DIT), 2006). The products covered under the ITA list broadly include computer hardware and peripherals, telecommunications equipment, computer software, semiconductor manufacturing equipment, analytical instruments, and semiconductors and other electronic components. It was only in 2005 that the government permitted imports of non-IT inputs, raw material and dual-usage items at nil customs duty under end-use-certification (Department of Information Technology (DIT), 2006). In the budget of 2006-07, additional customs duty of 6-7 percent levied on computers was withdrawn (Ministry of Finance, 2006). As a consequence, customs duty on 217 tariff lines covered under the ITA-1 of WTO became zero percent, and all goods required in the manufacture of ITA-1 items were exempted from customs duty subject to actual user condition (Department of Information Technology (DIT), 2011). Thus, customs duty on specified raw materials and inputs used for manufacture of electronic components became zero percent. In addition, customs duty on specified capital goods used for manufacture of electronic goods is also zero percent. In general, the peak rate of basic duties on imported items was also reduced to 12.5 percent in 2006-07 from 15 percent in 2005-06.

As a result of this deregulation of import tariffs on ICT related products by the Indian government following the WTO ITA, the cost of imports of ICT related products was reduced and became available at undistorted world market prices. As a consequence, the exogenous technological innovations and progress in information and communications technology worldwide became available at a world market price through imports of ICT related products, both as a final product and as an intermediate input. In addition, this trade liberalization also put competitive pressure on the domestic ICT

manufacturing industry to compete with the imported products. Overall, it put downward pressure on ICT products such as computers and peripherals, telecommunications equipment, and other electronic items.

To promote the domestic usage of ICT related products including packaged software, the government also rationalized the excise duty regime for these products. The domestic ICT products industry that was under pressure due to constant lowering of customs duties, was adversely affected when computers were exempted from excise duty of 8 percent in the budget of 2004-05 without reducing excise duty on accessories used as inputs and subassemblies. This led to overflow of central excise duties and disruption of business (Department of Information Technology (DIT), 2006). However, this adverse duty structure was addressed in the budget of 2006-07 with the introduction of a 12 percent excise duty on computers (Ministry of Finance, 2006). Due to the reduction in customs duty and rationalization of excise tariffs on ICT products over the years, the local grey market for computers has been adversely affected, the proportion of which came down to 37 percent in 2005-06 as compared to over 60 percent in 2003-04 (Department of Information Technology (DIT), 2006). This led to increase output of the organized computers industry and reduce the gap between computers offered at a price by the organized industry against that by the grey market.

To boost the domestic telecom electronics and equipment manufacturing industry, the government also exempted infrastructure telecom equipment from customs duties and made the import of all capital goods for manufacturing telecom equipment and the manufacturing of telecom equipment itself license free (Department of Information Technology (DIT), 2010). Hence, the lowering of first the customs duties and subsequently in 2001-02 the excise duties has enabled the organized sector to offer mobile products, for instance, to consumers at the same price as that of the grey market.

As a result of deregulation of import duties and rationalization of the excise duty structure related to a broad range of ICT products, the domestic ICT manufacturing industry came under competitive pressure. The availability of imported ICT goods at a fair market price put downward pressure on the prices of these products in the Indian market. In addition, the rapid technological innovations related to ICT, especially from the advanced economies, also made the ICT products relatively cheaper and affordable. Hence, domestic prices of ICT capital goods decreased in the recent past partly due to deregulation of imports and resulting competitive pressure on the domestic ICT manufacturing industry. One of the industries that are supposed to intensively use ICT capital goods and benefit from a downward pressure on the prices of ICT capital goods is the ICT services industry.

Hence, this paper estimates the effect of the fall in the prices of ICT services by simulating a decrease in the capital costs of the ICT services industry, that include both the 'Computer & related activities' and 'Communication' services industries. However, due to high costs of human resources in the ICT services industry, particularly in 'Computer & related activities' industry, the capital costs advantage is assumed to be adversely affected. Nonetheless, the partial effect of decreases in ICT capital costs is simulated based on two different scenarios. The first scenario does not consider relative prices of other commodities, whereas the second scenario does. The deregulation of imports of ICT products and increasing competitive pressure on the domestic ICT manufacturing industry provides speedy technological dissemination and a healthy and fair market price structure for these commodities. The ICT services, in particular 'Computer & related activities' services, which are growing mainly due to their high exports will become relatively cheaper in the domestic market as a result of decrease in their ICT capital costs. The usage of ICT services is assumed to reduce intermediate input costs and increase competitiveness in various industries, resulting in a higher production and operating surplus. Hence, the analysis focuses on the effect of price changes in ICT services on production in other Indian industries.

The comparison between 'Computer & related activities' and 'Communication' industries indicate that the latter is bigger in size in real terms. However, when compared at current prices, the industrial GDP of 'Computer & related activities' exceeds that of 'Communication' from the year 2002-2003. This indicates that the price of 'Computer & related activities' services is growing faster than that of 'Communication' services. The implicit price indices of both the industries during 1999-2000 and 2007-2008 and their comparison with the implicit national GDP (at factor cost) price index are reported in Figure 1. As is shown in Figure 1, the implicit annual price indices of 'Computer & related activities', 'Communication', and national GDP (at factor cost) at the base of 1999-2000[1] are compared against each other for the given period. The comparison indicates that the annual price of 'Computer & related activities' services increased during the period a little over that of the national average. On the other hand, the implicit price index of 'Communication' falls substantially below the national average. This observation suggests the prices of 'Communication' services are more competitive than that of 'Computer & related activities' services.

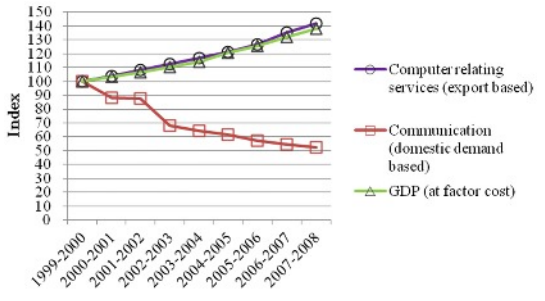
In an inflationary economy such as India, the prices of goods and services produced in that economy tend to rise as is indicated by the price index of 'Computer & related activities'. The high prices of 'Computer & related activities' compared to 'Communication' services in India needs to be seen mainly in light of its export-intensive nature. Due to high exports in the 'Computer & related activities' industry, the labor costs in this industry are very high compared to other industries. Besides, these services involve skilled labor that adds up to their high primary input cost. As far as the domestic market is concerned, the industry does not enjoy economies of scale because the market is not yet fully matured and requires product differentiation to successfully cater to the domestic needs.

As a result, 'Computer & related activities' services entail high prices, which hinder the adoption of these services among other industries and mitigate benefits of technological advancements in ICT. Moreover, the introduction of 'Computer & related' services additionally requires firms to invest in their human capital and organizational structure, which increases the actual cost of these services. In contrast, 'Communication' services have a huge domestic market that allows them to enjoy economies of scale. In addition, the introduction of telecommunication services requires less additional costs. Hence, the fall in 'Communication' services prices is due to intense competition in the industry to capture the fast growing domestic demand for communication services as well as the benefits of scale economies. However, as explained earlier, due to the liberalized imports of ICT

[1] These implicit price indices (deflators) are derived by using the ratio of GDP at current prices and at 1999-2000 prices for corresponding sectors.

products and intense competition in the ICT manufacturing industry, 'Computer & related activities' are also assumed to be affected positively, making them more affordable than before.

Figure 1: Comparison of Price change through Implicit GDP Deflators (at 1999-2000 prices)



Source: Author's compilation based on the data from Central Statistics Office (CSO) (2008) and (2009)

Since ICT services are assumed to play an important role as intermediate inputs, this analysis focuses upon the price responsiveness of other industries of the economy on hypothetical falling prices of ICT services. This whole process is captured only for ICT usage in the domestic market because exports are treated as a part of total final demand in the I-O analysis, the component which is treated as exogenous. In addition, cost competitiveness is one of the advantages ICT services exports have enjoyed in the past where price competitiveness in the international market initially increased the exports of ICT services. The higher income elasticity of ICT services in the international market brought increased demand for cost competitive ICT services from India, leading to increases in its prices as a feedback effect. However, in the analysis of domestic market scenarios, one of the limitations is that such feedback effect is not observed.

Data and methodology

Data

The dataset used for the analysis relies on Input Output Transaction Tables (IOTTs) of the Indian economy for 2003-04 and 2006-2007[2]. Further, for the analytical purpose the 130X130 commodities matrix of the IOTTs are aggregated into 45 commodities for both the years. The aggregation is based on Indian industrial classification. Those industries which do not fall into any aggregation are treated as is. 'Computer & related activities' and 'Communication' industries are also not aggregated and treated separately as they are the main industries of interest. The deflators of 2006-2007 are derived from implicit GDP deflators as well as Wholesale Price Index (WPI) for the same period.

Methodology

Since the analysis requires information on the detailed inter-industrial structure of the economy, the methodology relies on I-O framework of the Indian economy. A VIO model, an extension and modified model of existing "Leontief Price Model (Cost-push)", is used to analyze how falling relative prices of ICT services stimulate production of other industries of the economy. The main advantage of the VIO model is that it is a price-responsive model based on a firm's profit maximization theory (C. J. Liew & C. K. Liew, 1988, p. 65). Under the conventional Leontief's input-output model, industrial outputs are determined by final demand and input-output ratios are assumed to be fixed, that is, there is zero elasticity of substitution between inputs in the production function. However, under the VIO model, industrial outputs are not only determined by final demand but also by the primary input prices, and thus, technical coefficients are made endogenous to input prices (C. J. Liew & C. K. Liew, 1988, p. 65). Hence, the VIO model permits the prediction of changes in production in other industries due to the changes in input cost of a certain specific industry.

Under the Leontief's price model (Cost push), price equation of the input side is determined by

$$\tilde{p} = (I - A^{'})^{-1} v_c \quad \text{for} \quad v_c = v_j / x_j$$

where prices of all commodities $\tilde{p}$ are determined by the exogenous values (costs) of primary inputs v_c (Miller & Blair, 2009, p. 44). On the other hand, output is determined by the output side equation:

$$x = (I - A)^{-1} f$$

where output of all commodities is determined by the final demand in terms of change in household consumption, government expenditure, private investment and net exports. The above equations indicate that the Leontief's price equation is independent of its output equation, i.e. a dichotomy exists between the two equations due to the assumption of fixed technical coefficient, α_{ij}, of the matrix A (C. J. Liew & C. K. Liew, 1988, pp. 65-67). Hence, the conventional I-O price model does not allow tracing any change in the outputs of other industries to the change of primary input costs in a specific industry. On the other hand, the VIO model does so by allowing technical coefficients to respond to changing relative prices due to change in primary input costs of a certain industry. Following Kim and Oh (2004), the theoretical background of the VIO model is explained as follows.

Model

The VIO model is originally derived by transforming a Cobb Douglass' production function into a log-linear one and by including intermediate inputs and primary inputs on the RHS of the model. The primary inputs such as employee pay, business surplus, depreciation of fixed capital, and indirect tax form value added items of the I-O table.

$$\ln x_j = \alpha_{0j} + \sum_i \alpha_{ij} \ln x_{ij} + \sum_k \beta_{kj} \ln L_{kj} \qquad (1)$$

where x_j is the output of industry j, x_{ij} is the commodity (intermediate input) of industry *i* purchased by industry *j*, L_{kj} is the amount of primary inputs *k* (labor and capital) employed in industry j as value added, and $\sum_i \alpha_{ij} + \sum_k \beta_{kj} = 1$ satisfies the condition of linear homogeneity.

$$p_j x_j - \sum_i p_i x_{ij} - \sum_k w_{kj} L_{kj} = 0 \qquad (2)$$

where p_j is the commodity price of industry *j*, p_j is the commodity price of industry *i*, w_{kj} is the unit price of primary production factors *k* purchased by industry *j*.

Based on the equation [1] as a constraint condition and profit equation of [2], Langrangian function of profit maximization model is derived as:

$$Max \prod = \sum_j (p_j x_j - \sum_i p_i x_{ij} - \sum_k w_{kj} L_{kj}) +$$
$$\sum_j \lambda (\ln x_j - \alpha_{oj} - \sum_i \alpha_{ij} \ln x_{ij} - \sum_k \beta_{kj} \ln L_{kj})$$

[2] For the year 2003-04, the 'Commodity-by-Commodity' matrix is used, which is made available by the Central Statistics Office (CSO), Government of India. The 2006-07 IOTT consists of 'Absorption' and 'Make' matrices. These matrices are used to construct 'Commodity-by-Commodity' matrix for 2006-07, which is utilized for the analysis.

From the first order condition, the optimal levels of intermediate inputs x_{ij} and primary inputs L_{kj} to be applied are derived as follows.

$$x_{ij} = \alpha_{ij} p_j x_j / p_i, L_{kj} = \beta_{kj} p_j x_j / w_{kj} \quad (3)$$

These optimal levels of intermediate inputs and primary inputs in equation [3] are substituted in equation [1] in order to obtain a following price function.

$$\ln p = (I - A^{'})^{-1} \left[\sum_k \beta_k \ln w_k \right] \quad (4)$$

where p is the price of commodities, β_k is the value added coefficient indicating primary input (k) usage of various commodities, and w_k is the price of primary input (k).

This equation indicates that the price (p) is determined by the price of primary input k (w_k). Here, the price of commodities affected by the change (increase/decrease) in primary input costs will affect the output, since the change in relative price ratios will influence the technical coefficient in matrix A, which in turn will change the output of other industries (x). Hence, there does not exist the dichotomy between the input and output equations under the VIO model.

In addition, the application of x_{ij} in equation [3] into the basic I-O identity will yield $x_i = \sum_j x_{ij} + F_i$, where x_{ij} indicates optimal level of intermediate inputs applied through the change in production method $(p_j/p_i)\alpha_{ij}$ which is in turn affected by change in relative prices of commodities. This procedure transforms a production equality on output side into the matrix form, as:

$$x = (I - h)^{-1} F, \; h = \alpha_{ij} \left(\frac{p_j}{p_i} \right) = p^{-1} A p \quad (5)$$

where p is a diagonal matrix, and h is a newly derived technical coefficient matrix.

The change in output under the VIO model is measured by differentiating[3] the equation [5], as:

$$\mathrm{d}x = (I - h)^{-1} \mathrm{d}h x + (I - h)^{-1} \mathrm{d}F \quad (6)$$

This equation estimates price-responsiveness in terms of output elasticities of total industries to changes in the cost (w_k) of primary inputs of a certain industry, an exogenous variable in the price equation. The RHS of the above equation consists of two terms. The first term, $(I - h)^{-1}\mathrm{d}hx$, is an input substitution effect[4] through changes of production techniques (that is, technical coefficients) and the latter term, $(I - h)^{-1}\mathrm{d}F$, is an income effect through changes of final demand. If there is no price change in commodities of a certain industry influencing matrix h, the equation for change in output ($\mathrm{d}x$) will become $\mathrm{d}x = (I - A)^{-1}\mathrm{d}F$. It is nothing but the conventional Leontief's I-O model, showing that the change in output is determined only by final demand.

Since the analysis focuses on intermediate demand change due to change in prices in a certain industry, the second term $\mathrm{d}F$ (= 0), which is an income effect, is not considered in the analysis. In other words, the changes in output of all industries resulting from the decrease in the costs of primary production factor (w_k) in 'Computer & related activities' and 'Communication' industries are derived using the VIO model.

In order to evaluate the effect of capital cost reductions in the 'Computer & related activities' and 'Communication' industries on the production of other industries of the economy, two hypothetical scenarios are created. Based on these scenarios of price change, an impact of decreasing prices of ICT services is simulated on all the industries of the economy. To begin with, it is assumed that the 'Computer & related activities' and 'Communication' industries each experience 1 percent reduction in capital cost due to technological development in these industries as is the case in Kim and Oh (2004, p. 185) for the Korean IT industry. Although the primary production factors include capital and labor which form value added items in the I-O table, only the cost of capital input is assumed to be reduced due to technological developments and innovations in ICT, producing a net decrease by 1 percent in the cost of primary inputs in 'Computer & related activities' and 'Communication' industries that represent ICT services under the I-O framework. The change in output is derived for 2003-04 and 2006-07 using IOTTs of the two periods. The first scenario underscores that the exogenous change in primary input costs in the ICT services industry leads to change in its own prices as well as that of other industries. Hence, this price transmission affects the output of other industries including the ICT services industry itself.

The analysis of price change effect is further extended beyond the first scenario of 1 percent reduction in capital cost by factoring in real situations of price changes in the Indian economy during the period of the study. Since the Indian economy has been on an inflationary path during 2003-04 and 2006-07, it is necessary to factor in this inflation while assuming price decreases of ICT services and their effect on other industries. Hence, a new hypothetical scenario is developed considering the real price changes of various industries of the economy in the year 2006-07 at 2003-04 constant prices. After deflating the value added items of each industry that reflects the relative prices of various commodities based on their 2006-07 prices, the simulation is tested based on a hypothetical price decrease of 'Computer & related activities' and 'Communication' services. The details of the hypothetical scenarios to be analyzed are summarized in Table 1.

The scenarios of price change in 'Computer & related activities' and 'Communication' industries given in Table 1 are tested by using equations [4], [5] and [6]. While Scenario 1 assists in understanding the effect of price decreases of ICT services, it does so by normalizing the prices of other commodities. In order to incorporate the relative prices of other industries including the ICT services industry, value added items of all the industries are deflated by their 2006-07[5] prices and a baseline scenario is developed as is shown in Table 1. Once the relative prices are factored in, Scenario 2 is developed to simulate 10 percent decrease in primary input costs of the ICT services industry. The difference in the results of Scenario 2 and that of the baseline scenario is measured to derive the change in output of other industries due to decreases in the prices of ICT services.

These scenarios are important to understand how affordable ICT services can affect outputs of other industries through the price transmission system and interconnectedness of industries under the I-O framework. For instance, Scenario 1 considers the responsiveness of other industries to ICT

[3] For the details of differentiation, please refer to Kim and Oh (2004, p. 184).

[4] The substitution effect explains change in production by the ratio changes of production techniques whereas Hick's substitution effect refers to the replacement of factors with a fixed output, hence, they are not in accord with each other (Kim & Oh, 2004, p. 184).

[5] The price index based on 2006-07 prices for all the 45 industries is provided in the annex.

Table 1: Price-change Scenarios of ICT services

Scenario No	Name	Description	Change in the prices
Scenario 1	1% capital cost reduction of ICT services industry	Due to a fall in the capital cost of ICT services industry, the relative prices of ICT services decrease.	For ICT services: $dlnp = \left(I - A^{'}\right)^{-1} \beta_k * (1 - 0.01)$ For other industries: $dlnp = \left(I - A^{'}\right)^{-1} \beta_k * 1$
Baseline	Gross Value Added (GVA) is deflated as per the 2006-07 prices	Due to a fall in the total primary inputs costs as per the 2006-07 deflators, the relative prices of commodities change.	For ICT services: $dlnp = \left(I - A^{'}\right)^{-1} \beta_k * \left(\frac{1}{1.16}\right)$ For other industries: $dlnp = \left(I - A^{'}\right)^{-1} \beta_k * \left(\frac{1}{P_{06/07}}\right)$ where $P_{06/07}$ is 2006-07 price of corresponding industry
Scenario 2	10% capital cost reduction of ICT services industry	10% decrease in the total primary inputs cost (through GVA) affects the relative prices of the ICT services industry vis-à-vis other industries for 2006-07.	For ICT services: $dlnp = \left(I - A^{'}\right)^{-1} \beta_k * \left(\frac{1}{1.16 * (1 + 0.1)}\right)$ For other industries: $dlnp = \left(I - A^{'}\right)^{-1} \beta_k * \left(\frac{1}{P_{06/07}}\right)$

Source: Author

services becoming more affordable than their current price level. Equally, Scenarios 2 finds out the change in output of other industries when the magnitude of affordability of ICT services increases with the fall in primary input costs by 10 percent.

Empirical results

The substitution effect of ICT price change on the Indian economy

The results of the change in production of various industries, due to a fall in relative prices of the 'Computer & related activities' and 'Communication' services industries based on the aforementioned scenarios are given in Table 2 and Table 3. This change in output is a result of substitution effect, that is, change in the coefficient of production techniques resulting from increasing demand for ICT services – represented by 'Computer & related activities' and 'Communication' services industries – as an intermediate input due to a fall in its prices against other intermediate inputs. The values indicate substitution effect by the change in production (output) of other industries in percentage for scenario 1 and in percentage point for scenario 2 for both the periods.

As is seen from the results of Table 2, the industries which have potential to benefit the most due to falling prices of computer and related services include 'Business services', 'Miscellaneous manufacturing', 'Ships and boats', 'Computer & related activities', and 'Banking' among others for 2003-04 and 2006-07. The 'Business services' industry holds the largest potential for an increase in output at 0.08 percent and 0.12 percent, respectively for both the years due to cheaper 'Computer & related activities' services. This is followed by 'Miscellaneous manufacturing' with 0.05 percent and 0.06 percent increase in output, respectively for both the years. All other industries also changed their production method by increasing application ratios of computer and related services, leading to an increase in output, except for 'Ownership of dwellings' and 'Public administration'. The results of the simulation indicate that all the industries (other than few exceptions) are price-sensitive, resulting in more demand for computer and related services with the fall in relative prices of these services. This substitution by changing intermediate input application ratios (and, thus the production technique) produces increases in output.

Further, as is shown in Table 2, the industries which could benefit the most due to decreases in the 'Communication' industry's prices include 'Mining & quarrying', 'Ships and boats', 'Communication', 'Miscellaneous manufacturing', and 'Basic Metals Alloys & Metals Products' among others. The 'Mining & quarrying' industry poses the largest gains by 0.13 percent and 0.15 percent increase in output in 2003-04 and 2006-07, respectively. This is followed by the 'Ships and boats' industry with 0.09 percent and 0.13 percent increase in production, respectively for both the years. In addition, industries such as 'Business services' and 'Electrical machinery' also pose to gain from a decrease in the prices of communication services. Similar to the case of 'Computer & related activities', other industries also benefited from the communication price fall, with the exception of 'Ownership of dwellings' and 'Public administration'. These results provide inferences as to how price decreases in ICT services can induce industries to change their production techniques by substituting ICT services for other inputs and thus reduce costs. This in turn will increase the production of the industries as per their output elasticity to changing prices. The results of Scenario 2 are presented in Table 3. The industries reported in the table are in descending order, starting from the industry with the highest value of percentage point change in output due to a 10 percent reduction in the capital costs of 'Computer & related activities' and 'Communication' industries.

From the results of Scenario 2 as are reported in Table 3, it is found that a decrease in the commodity prices of the 'Computer & related activities' services industry in relative terms, in addition to the price changes as per 2006-07 prices of various commodities, leads to increases in the production of other industries. The industries which benefited the most from the 10 percent decrease in the primary inputs costs of 'Computer & related activities' industry include 'Business services', 'Ships and boats', 'Miscellaneous manufacturing', 'Mining and quarrying', 'Banking', 'Computer & related activities', and 'Communication' among others. These findings substantiate the results of Scenario 1 related to the 'Computer & related activities' industry. The first seven industries in Scenario 1 and Scenario 2 are the same ones with, nonetheless, a slight difference in their rankings and a higher magnitude of output change in the case of Scenario 2. All other industries also gained from the decreasing prices

Table 2: Results of Scenario 1

No	The case of 'Computer & related activities' industry	Change in Production (%) for 2003-04	Change in Production (%) for 2006-07	The case of 'Communication' industry	Change in Production (%) for 2003-04	Change in Production (%) for 2006-07
1	Agriculture	0.0023 (39)	0.0037 (40)	Agriculture	0.0060 (36)	0.0069 (36)
2	Forestry and logging	0.0043 (34)	0.0070 (33)	Forestry and logging	0.0130 (31)	0.0177 (29)
3	Fishing	0.0004 (43)	0.0009 (43)	Fishing	0.0017 (41)	0.0021 (41)
4	Mining & quarrying	0.0258 (5)	0.0367 (6)	Mining & quarrying	0.1328 (1)	0.1490 (1)
5	Food Products	0.0018 (42)	0.0033 (41)	Food Products	0.0032 (38)	0.0043 (39)
6	Beverages Tobacco & Tobacco Products	0.0020 (41)	0.0027 (42)	Beverages Tobacco & Tobacco Products	0.0026 (39)	0.0028 (40)
7	Textiles	0.0023 (38)	0.0040 (39)	Textiles	0.0061 (35)	0.0071 (35)
8	Wood & Wood Products	0.0099 (19)	0.0162 (16)	Wood & Wood Products	0.0339 (16)	0.0473 (11)
9	Paper & Paper Products	0.0151 (11)	0.0225 (9)	Paper & Paper Products	0.0418 (11)	0.0519 (10)
10	Leather & Leather Products	0.0022 (40)	0.0045 (38)	Leather & Leather Products	0.0068 (33)	0.0106 (32)
11	Rubber & Plastic Products	0.0080 (23)	0.0122 (19)	Rubber & Plastic Products	0.0358 (13)	0.0442 (14)
12	Petroleum products	0.0083 (22)	0.0114 (23)	Petroleum products	0.0430 (10)	0.0463 (12)
13	Coal tar products	0.0115 (18)	0.0222 (10)	Coal tar products	0.0442 (8)	0.0696 (6)
14	Chemicals & Chemical Products	0.0089 (21)	0.0144 (18)	Chemicals & Chemical Products	0.0313 (18)	0.0408 (17)
15	Non-Mettallic Mineral Products	0.0061 (26)	0.0112 (24)	Non-Mettallic Mineral Products	0.0226 (23)	0.0330 (20)
16	Basic Metals Alloys & Metals Products	0.0132 (15)	0.0194 (13)	Basic Metals Alloys & Metals Products	0.0629 (6)	0.0775 (5)
17	Non-Electrical Machinery & Parts	0.0060 (28)	0.0083 (30)	Non-Electrical Machinery & Parts	0.0265 (22)	0.0307 (22)
18	Electrical Machinery	0.0152 (10)	0.0175 (15)	Electrical Machinery	0.0765 (3)	0.0643 (8)
19	Ships and boats	0.0304 (4)	0.0475 (3)	Ships and boats	0.0888 (2)	0.1292 (2)
20	Transport Equipment & Parts	0.0093 (20)	0.0108 (25)	Transport Equipment & Parts	0.0160 (28)	0.0146 (31)
21	Watches and clocks	0.0032 (36)	0.0051 (37)	Watches and clocks	0.0024 (40)	0.0046 (38)
22	Medical, precision & optical instruments	0.0049 (32)	0.0102 (26)	Medical, precision & optical instruments	0.0141 (30)	0.0233 (26)
23	Gems & jewellery	0.0033 (35)	0.0053 (36)	Gems & jewellery	0.0359 (12)	0.0451 (13)
24	Aircraft & spacecraft	0.0128 (16)	0.0156 (17)	Aircraft & spacecraft	0.0298 (19)	0.0276 (23)
25	Miscellaneous manufacturing	0.0465 (2)	0.0627 (2)	Miscellaneous manufacturing	0.0743 (5)	0.0919 (4)
26	Construction	0.0046 (33)	0.0067 (34)	Construction	0.0063 (34)	0.0087 (34)
27	Electricity, gas & water supply	0.0140 (14)	0.0201 (12)	Electricity, gas & water supply	0.0549 (7)	0.0611 (9)
28	Transport	0.0059 (29)	0.0082 (31)	Transport	0.0196 (25)	0.0238 (25)
29	Storage and warehousing	0.0060 (27)	0.0087 (28)	Storage and warehousing	0.0271 (21)	0.0316 (21)
30	Communication	0.0226 (7)	0.0325 (7)	Communication	0.0761 (4)	0.1250 (3)
31	Trade	0.0053 (30)	0.0077 (32)	Trade	0.0189 (26)	0.0219 (27)
32	Hotels and restaurants	0.0199 (8)	0.0246 (8)	Hotels and restaurants	0.0105 (32)	0.0097 (33)
33	Banking	0.0256 (6)	0.0410 (5)	Banking	0.0343 (15)	0.0433 (15)
34	Insurance	0.0144 (12)	0.0206 (11)	Insurance	0.0344 (14)	0.0421 (16)
35	Ownership of dwellings	0.0000 (44)	0.0000 (44)	Ownership of dwellings	0.0000 (44)	0.0000 (44)
36	Education and research	0.0053 (31)	0.0085 (29)	Education and research	0.0002 (43)	0.0003 (43)
37	Medical and health	0.0116 (17)	0.0118 (20)	Medical and health	0.0010 (42)	0.0012 (42)
38	Business services	0.0822 (1)	0.1216 (1)	Business services	0.0436 (9)	0.0653 (7)
39	Computer & related activities	0.0450 (3)	0.0436 (4)	Computer & related activities	0.0051 (37)	0.0063 (37)
40	Legal services	0.0172 (9)	0.0176 (14)	Legal services	0.0331 (17)	0.0403 (18)
41	Real estate activities	0.0140 (13)	0.0097 (27)	Real estate activities	0.0197 (24)	0.0153 (30)
42	Renting of machinery & equipment	0.0076 (24)	0.0114 (22)	Renting of machinery & equipment	0.0272 (20)	0.0361 (19)
43	O.com, social&personal services	0.0072 (25)	0.0115 (21)	O.com, social&personal services	0.0187 (27)	0.0268 (24)
44	Other services	0.0030 (37)	0.0060 (35)	Other services	0.0149 (29)	0.0216 (28)
45	Public administration	0.0000 (45)	0.0000 (45)	Public administration	0.0000 (45)	0.0000 (45)

Source: Author's calculations

of computer and related services, given the effect of each other's price of 2006-07 on each other.

'Communication' services also affected outputs of other industries positively given the decrease in their prices as per Scenario 2. As is observed from the results in Table 3, industries which are positively affected the most include 'Mining and quarrying', 'Ships and boats', 'Communication', 'Miscellaneous manufacturing', 'Basic Metals Alloys & Metals Products', 'Coal tar products', and 'Electricity, gas & water supply' among others. These results also corroborate the findings of Scenario 1 related to the 'Communication' industry, given the similar ranking of the first few industries. The results of the simulations, in particular some of the industries that seem to benefit the most, for instance, 'Business services', 'Banking', 'Computer & related activities', 'Communication', 'Electrical machinery', and 'Petroleum products', are comparable with the case of Singapore (Heng & Thangavelu, 2006) and to some extent South Korea (Kim & Oh, 2004). All the findings from the two scenarios substantiate the view that the falling relative prices of ICT services, through 'Computer & related activities' and 'Communication' industries, affect other industries of the economy positively.

Tracing structural change

This sub-section sheds light on the overall structural change to be observed due to the substitution effect of ICT services. The industries are categorized into three main sectors; namely, primary, manufacturing, and service sectors. The

Table 3: Results of Scenario 2

No	The case of 'Computer & related activities' industry	Change in Production (percentage point) for 2006-07	The case of 'Communication' industry	Change in Production (percentage point) for 2006-07
1	Business services	1.500	Mining & quarrying	3.856
2	Ships and boats	0.960	Ships and boats	3.392
3	Miscellaneous manufacturing	0.812	Communication	1.859
4	Mining & quarrying	0.730	Miscellaneous manufacturing	1.742
5	Banking	0.523	Basic Metals Alloys & Metals Products	1.720
6	Computer & related activities	0.503	Coal tar products	1.635
7	Communication	0.415	Electricity ,gas & water supply	1.382
8	Coal tar products	0.384	Business services	1.311
9	Basic Metals Alloys & Metals Products	0.332	Electrical Machinery	1.035
10	Electricity, gas & water supply	0.328	Wood & Wood Products	1.006
11	Paper & Paper Products	0.317	Petroleum products	1.003
12	Hotels and restaurants	0.290	Paper & Paper Products	0.991
13	Insurance	0.279	Chemicals & Chemical Products	0.928
14	Legal services	0.273	Banking	0.911
15	Wood & Wood Products	0.258	Rubber & Plastic Products	0.907
16	Chemicals & Chemical Products	0.239	Legal services	0.877
17	Aircraft & spacecraft	0.233	Insurance	0.835
18	Electrical Machinery	0.229	Gems & jewellery	0.769
19	Petroleum products	0.194	Storage and warehousing	0.764
20	Rubber & Plastic Products	0.192	Renting of machinery & equipment	0.745
21	Non-Mettallic Mineral Products	0.180	Non-Mettallic Mineral Products	0.704
22	Renting of machinery & equipment	0.175	Non-Electrical Machinery & Parts	0.673
23	O.com, social & personal services	0.162	Aircraft & spacecraft	0.596
24	Storage and warehousing	0.161	Other services	0.546
25	Medical, precision & optical instruments	0.151	O.com, social & personal services	0.527
26	Real estate activities	0.140	Transport	0.514
27	Non-Electrical Machinery & Parts	0.138	Trade	0.478
28	Transport Equipment & Parts	0.138	Medical, precision & optical instruments	0.470
29	Medical and health	0.135	Forestry and logging	0.390
30	transport	0.128	Real estate activities	0.288
31	Trade	0.122	Transport Equipment & Parts	0.283
32	Forestry and logging	0.112	Leather & Leather Products	0.203
33	Other services	0.112	Hotels and restaurants	0.172
34	Education and research	0.097	Construction	0.171
35	Construction	0.087	Agriculture	0.135
36	Gems & jewellery	0.075	Textiles	0.122
37	Watches and clocks	0.061	Computer & related activities	0.119
38	Leather & Leather Products	0.060	Watches and clocks	0.088
39	Agriculture	0.054	Food Products	0.082
40	Textiles	0.048	Beverages Tobacco & Tobacco Products	0.054
41	Food Products	0.046	Fishing	0.038
42	Beverages Tobacco & Tobacco Products	0.037	Medical and health	0.019
43	Fishing	0.013	Education and research	0.005
44	Ownership of dwellings	0.000	Ownership of dwellings	0.000
45	Public administration	0.000	Public administration	0.000

Source: Author's calculations

primary sector includes industries from No. 1 'Agriculture' to No. 4 'Mining & quarrying'. The manufacturing sector is comprised of industries from No. 5 'Food products' to No. 26 'Construction'. The service sector is comprised of industries from No. 27 'Electricity, gas & water supply' to No. 45 'Public administration', by omitting No. 30 'Communication' and No. 39 'Computer & related activities' industries. These two industries are treated separately for tracing their change between 2003-04 and 2006-07.

The details of structural change are reported in Table 4, which deals with the original output values and proportions of the aforementioned sectors in the total economy for 2003-04 and 2006-07 together with the changed values and proportions based on the estimates of substitution effect.

As can be seen from Table 4, a 1 percent reduction in capital cost in 'Computer & related activities' industry increases its own industrial proportion from 1.5080 percent to 1.5085 percent and from 2.0511 percent to 2.0517 percent in 2003-04 and 2006-07, respectively. It is also observed that the proportion of service sector increased for both the years. The proportions of primary and manufacturing sectors shrunk during both the periods; however, the output value for the same increased. This indicates that the effect of 'Computer & related activities' industry is positive on all the sectors, resulting in increased proportion of the service sector in the overall Indian economy.

In the case of 'Communication' industry, it is observed that the share of its own industry increased from 1.1176 percent to 1.1182 percent and from 1.2329 percent to 1.2341 percent in 2003-04 and 2006-07, respectively due to a 1 percent reduction in its capital costs. The proportion of manufacturing sector also increased

Table 4: Structural Change in Indian Economy as a result of adoption of ICT services

		Original		Computer & related activities		Communication	
Year	Sector	Output	%	Changed Output	%	Changed Output	%
2003-04	Primary	85 119 252	16.6067	85 123 038	16.6060	85 1134 347	16.6058
	Manufacturing	217 125 947	42.3610	217 142 487	42.3606	217 186 524	42.3631
	Service	196 857 728	38.4067	196 877 208	38.4072	196 895 598	38.4052
	Computer and related activities	7 729 416	1.5080	7 732 893	1.5085	7 729 810	1.5077
	Communication	5 728 229	1.1176	5 729 526	1.1177	5 732 587	1.1182
	Total	512 560 572	100	512 605 151	100	512 678 867	100
2006-07	Primary	113 222 737	14.3179	113 231 099	14.3172	113 248 809	14.3171
	Manufacturing	371 258 730	46.9487	371 300 722	46.9481	371 382 603	46.9509
	Service	280 325 293	35.4494	280 363 655	35.4498	280 387 826	35.4472
	Computer and related activities	16 219 429	2.0511	16 226 495	2.0517	16 220 458	2.0506
	Communication	9 749673	1.2329	9 752 839	1.2332	9 761 859	1.2341
	Total	790 775 863	100	790 874 810	100	791 001 555	100

Source: Author's calculations

during both the periods, while that of primary and service sectors decreased marginally. Nevertheless, the output value increased for all the sectors, indicating positive effect of 'Communication' services during the both the periods. In particular, it is found that the structural change takes place in favor of the manufacturing sector. Hence, the estimates showed that the ICT services industry, including 'Computer & related activities' and 'Communication' industries, exerted positive effect on all the sectors of the Indian economy. The structural change that these industries may bring favored service and manufacturing sector, respectively.

However, a statistical assessment is required to support the aforementioned findings that the changing production techniques by substituting ICT services resulted in increased production for the Indian economy. For that purpose, a paired observations t-test has been applied. The paired observations t-test makes an overall assessment of the input substitution effect by comparing the rate of production change for 2003-04 and 2006-07, for 'Computer & related activities' and 'Communication' industry separately. The hypothesis is set up as follows:

H_0: $\mu_{comp} = 0$; $\mu_{commu} = 0$

H_α: $\mu_{comp} \neq 0$; $\mu_{commu} \neq 0$

where μ_{comp} is the mean difference of rate of production change between 2003-04 and 2006-07 of all the industries in the dataset, caused by input substitution of 'Computer & related activities' services; μ_{commu} is the mean difference of rate of production change caused by input substitution of 'Communication' services.

The null hypothesis of equality of mean difference for both the industries, 'Computer & related activities' and 'Communication', is rejected at 1 percent critical level of significance (with *p* value to be 0.0000). The *t* value for both the industries also underlined positive effect of ICT price reduction on the overall Indian economy between 2003-04 and 2006-07. Although the mean difference is small, it asserts positive effect of ICT services as intermediate input.

Table 5: Paired observations t-test results

Variable	Observations	Mean	Std. Dev.	*t* value	Pr(|T| > |t|)
μ_{comp}	45	.0049333	.006854	4.84	0.0000
μ_{comm}	45	.0072267	.0106789	4.96	0.0000

Source: Author's calculations

Conclusion

This paper sought to analyze the price effect of ICT services on other industries of the economy. Using a VIO model, the effect of falling relative prices of ICT services, hypothetically observed in two different scenarios, is evaluated. The first simulation, based on the related previous literature, assessed the effect of a 1 percent decrease in the capital costs in the ICT services industry on the production of other industries. The subsequent scenario 2 is the extension of the analysis in the 1st scenario, in which the effect of falling prices of ICT services is observed after factoring in 2006-07 prices of other industries based on their implicit GDP deflators. This modification allowed for estimating price effects of ICT services not only in isolation but also considering relative price change of other commodities as per the real economic situation of 2006-07. The falling prices of ICT products are assumed to be the result of innovations and technological developments in ICT producing industries worldwide. In particular, the liberalization of ICT products through deregulation of import duties and rationalization of excise duty structure by the Indian government led to reduce the distortions in domestic prices of ICT products and to increase its dissemination. The VIO model, used to empirically analyze the effect of price change, is an extension of Leontief's I-O price model.

A percent reduction in the capital costs of 'Computer & related activities' services industry resulted in an increase in the output of most of the other Indian industries due to falling relative prices of these services as intermediate inputs. Not only services industries such as 'Business services' and 'Banking', but also manufacturing industries such as 'Miscellaneous manufacturing' and 'Ships and boats' hold the potential to gain from the price decrease. In addition, price reductions in 'Communication' services also exerted a positive influence on other industries. In the case of communication services, manufacturing industries such as 'Ships and boats' and 'Miscellaneous manufacturing', as well as 'Mining and quarrying' and the 'Communication' industry itself benefited the most. As has been shown by the simulation results of Scenario 2, the percentage points of output change are positive and showing higher values compared to Scenario 1. These findings emphasized the positive effect of ICT services as intermediate inputs on the Indian industry as a whole, given exogenous decreases in the relative prices of these services. Moreover, the adoption of ICT services can bring about structural change favoring manufacturing and service sectors of the economy with the

increase in production and proportion of these sectors in the total economy.

In a nutshell, the role of ICT services as a competitive supplier of intermediate inputs and the resulting positive effect of adoption of these services on the Indian economy would be larger, given the decrease in its relative prices. Two important policy implications can be made from the findings. First, the introduction of ICT services at an affordable price can reduce the burden of intermediate input costs in many industries as a result of substitution effect, suggesting that the usage of ICT services help other industries to grow and become competitive. The implication is that ICT services are important for industrial development, and hence should be made available by improving ICT infrastructure as well as its diffusion across the country. In addition, the competition policy through liberalization and deregulation of goods and services help reduce distortions in the market and access technological developments at a fair market price. Second, the human resource development should be the priority area, for the Indian labor force to utilize ICT goods and services, and adapt to changing ICT technologies.

References

Bazzazan, F., & Batey, P. W. J. (2003). The Development and Empirical Testing of Extended Input-Output Price Models. Economic System Research, 15(1), 69-86.

Central Statistics Office (CSO). (2008). National Accounts Statistics 2008. Retrieved from http://mospi.nic.in/Mospi_New/upload/nas2008.htm.

Central Statistics Office (CSO). (2009). National Accounts Statistics 2009. Retrieved from http://mospi.nic.in/Mospi_New/upload/nas_2009.htm.

Department of Information Technology (DIT). (2006). Eleventh Five Year Plan - Information Technology Sector 2007-12. Retrieved from http://planningcommission.nic.in/aboutus/committee/wrkgrp11/wg11_IT.pdf.

Department of Information Technology (DIT). (2010). Report of Task Force to suggest measures to simulate the growth of IT, ITES and Electronics Hardware manufacturing industry in India. Retrieved from http://deity.gov.in/sites/upload_files/dit/files/Task_Force_Report-new_21211(2).pdf.

Department of Information Technology (DIT). (2011). Information Technology Annual Report 2010-11. Retrieved from http://deity.gov.in/content/annual-plans-reports.

Gill, G., Young, K., Pastore, D., Dumagan, J., & Turk, I. (1997). Economy-Wide and Industry-Level Impact of Information Technology. Working papers series, ESA/OPD 97-3. Retrieved from http://ssrn.com/abstract=15544 or http://dx.doi.org/10.2139/ssrn.15544

Heng, T. M., & Thangavelu, S. M. (2006). Singapore Information Sector: A Study Using Input-Output Table. SCAPE Working Paper Series, 2006/15, 1-24. Retrieved from http://www.fas.nus.edu.sg/ecs/pub/wp-scape/0615.pdf

Kim, H. G. (2008). The Effect of IT Innovation on Industrial Output Elasticities. Hitotsubashi Journal of Economics, 49(1), 11-22.

Kim, H. G., & Oh, J. H. (2004). The role of IT on the Korean economy under IMF control. Journal of Policy Modeling, 26, 181-190.

Klein, L. R. (2003). The use of the input-output tables to estimate the productivity of IT. Journal of Policy Modeling, 25, 471-475.

Liew, C. J., & Liew, C. K. (1988). A Comparative Study of Household Interactive Variable Input-Output (HIVIO) Model and the Conventional Input-Output Models. Journal of Urban Economics, 24, 64-84.

Liew, C. K., & Liew, C. J. (1988). Measuring the Effect of Cost Variation on Industrial Outputs. Journal of Regional Science, 28(4), 563-578.

Miller, R. E., & Blair, P. D. (2009). Input-Output Analysis: Foundations and Extensions (Second ed.). New York: Cambridge University Press.

Ministry of Finance. (2006). Union Budget 2006-2007, Customs and Central Excise Notifications. Retrieved from http://indiabudget.nic.in/ub2006-07/cen/exnotecus.pdf.

Tunali, E., & Aydogus, O. (2007). The Effect of Energy Price Increases on Industrial Prices and General Price Level: A Comparative-static Analysis for Selected EU Countries and Turkey within the Open-Static Leontief Model. Paper presented at the XVI. International Input-Output Conference, 2-6 July, 2007.

UNIDO. (2007). INTERNATIONAL YEARBOOK OF INDUSTRIAL STATISTICS 2007. Glos, UK: Edward Elgar Publishing Limited.

Annex

Price Index based on 2006-07 prices (Base 2003-04=100)	
Industry	**Value**
Agriculture	119.31
Forestry and logging	113.31
Fishing	116.71
Mining & quarrying	134.42
Food Products	109.48
Beverages Tobacco & Tobacco Products	118.43
Textiles	100.53
Wood & Wood Products	114.99
Paper & Paper Products	110.04
Leather & Leather Products	108.58
Rubber & Plastic Products	109.78
Petroleum products	117.27
Coal tar products	184.07
Chemicals & Chemical Products	109.42
Non-Mettallic Mineral Products	129.27
Basic Metals Alloys & Metals Products	139.03
Non-Electrical Machinery & Parts	119.86
Electrical Machinery	114.77
Ships and boats	114.38
Transport Equipment & Parts	110.18
Watches and clocks	114.38
Medical, precision & optical instruments	114.38
Gems & jewellery	114.38
Aircraft & spacecraft	114.38
Miscellaneous manufacturing	114.38
Construction	135.07
Electricity ,gas & water supply	104.17
Transport	111.58
Storage and warehousing	117.30
Communication	84.53
Trade	124.99
Hotels and restaurants	122.47
Banking	88.90
Insurance	86.12
Ownership of dwellings	116.63
Education and research	108.60
Medical and health	115.39
Business services	115.36
Computer & related activities	115.81
Legal services	115.61
Real estate activities	115.59
Renting of machinery & equipment	115.52
O.com, social & personal services	115.70
Other services	112.69
Public administration	116.26
National GDP (at factor cost)	115.88
Source: Author's calculations	