ECONOMIC INTEGRATION, IT INTENSITY
AND THE AGGREGATE ECONOMIC IMPACTS OF IT SERVICES OFFSHORING

Yen-Chun Chou and Robert J. Kauffman
W. P. Carey School of Business, Arizona State University, Tempe AZ 85287
{yen-chun.chou, rkauffman}@asu.edu

Abstract. This study examines the economic contributions of offshore IT outsourcing (or IT offshoring for short) by using an extended Cobb-Douglas production function, and a panel data set from 20 OECD countries over the 2000 to 2006 period. Our analysis indicates that IT offshoring has made a positive and significant contribution to national productivity. Previous research on IT offshoring has relied on case studies and practitioners’ perceptions. In addition, our analysis supports the idea of economic integration. Thus, it sheds some light on the debate about whether IT offshoring is harmful or beneficial to a national economy [4]. We also investigate total factor productivity and the moderating effect of IT intensity on the degree and impacts of IT offshoring. We apply feasible generalized least squares and the Durbin-Wu-Hausman endogeneity test to handle context-specific estimation issues. The results suggest that to reap greater value from IT offshoring, developed countries need to establish IT capabilities by investing in IT capital.

Keywords: Economic integration, IT intensity, IT offshoring, IT services, outsourcing, service science.

1. INTRODUCTION

Offshore information technology (IT) outsourcing is the use of IT services provided by external and affiliated providers in the foreign country [40, 41]. We will refer to this as IT offshoring. The OECD IT Outlook [41] has reported that imports of IT services in most OECD countries increased by 9% per year during the 1996 to 2004 period. Recently, the World Trade Organization (WTO) expanded the General Agreement on Trade in Services (GATS) for the offshoring of computer and information services, and other business services. Among all the types of services, the liberalization of trade in IT services – an important industry and national-level issue in the emerging service science arena – has reached the widest agreement among members. In addition, as the trend toward business process outsourcing (BPO) continues, demand for international IT services, especially those involved in supporting outsourced business processes, will increase.

Research related to IT offshoring has focused on make-or-buy decisions, non-contractible aspects of service offshoring, and the key determinants of successful practices (e.g., [14, 31]). Relatively little attention, however, has been focused on the economic value of IT offshoring. Studies relevant to IT offshoring performance have relied on case analyses and practitioners’ perceptions (e.g., [26, 29]). They have discussed the benefits and drawbacks of IT offshoring and its expected rapid growth. To our knowledge though, no research has examined the economic impact of IT offshoring on economic performance, such as productivity.

This study examines the value of IT offshoring, using data from 20 OECD countries. Offshore outsourcing is not new in terms of material inputs. Firms outsource the less efficient parts of their production activities to contractors abroad, and import material inputs by engaging in international trade. What is novel is that this trade is now in services: before, services were seen as non-tradable [2].

In the context of IT offshoring, the potential negative impacts on wages and employment have led to opposition. Furthermore, the concerns about service quality also stopped some firms from offering outsourcing services abroad, like Lehman Brothers’ termination of internal IT help desk services [25]. Contrary to the conventional thinking, Bunyaratavej et al. [13] found that firms prefer to invest in countries whose salary levels are close to the host country’s to guarantee human capital and service quality. Other concerns include loss of the basis for developing new business process and application knowledge, and pushing IT services industry capitalization overseas [5].

On the positive side, IT offshoring may lead to higher productivity. Prescott [28] has proposed economic integration to explain how development can spread beyond leading countries through different channels such as IT offshoring, and how it will bring an increase in productivity due to efficiency gains and new demand for goods. While developed countries improve production efficiency via access to low-cost IT professionals, developing countries enhance their economy base via access to advanced technology and knowledge. Growing economies in developing countries will bring further demand for goods, especially luxury goods, provided by developed countries. Due to
Building on the offshore services outsourcing literature, we will investigate the economic effects of IT offshoring using production economics. Economists have employed production functions to study the impacts of offshore material and services outsourcing in the manufacturing industries, and have been modeling the impacts through total factor productivity, the portion of output not explained by the amounts of inputs used in production, such as efficiency and quality improvements [16]. We examine the effects of the intensity of IT offshoring at the country level based on the share of imported IT services as intermediate inputs [2, 20]. We theorize that the intensity of IT offshoring will shift the technology parameter of the underlying production function, and thus improve productivity. The technology parameter, indicating quality improvements and efficiency gains of the production function, is a representation of total factor productivity. IT offshoring brings efficiency gains by shifting the less efficient parts of their IT functions to foreign vendors. Firms in the home country, as a result, not only achieve new cost efficiencies, but also obtain operational efficiencies by restructuring their business processes and labor inputs. As foreign partners gain experience, their service quality will improve. IT offshoring also brings quality improvements to the home country [45].

Both Abraham and Taylor [1] and Olsen [40] argued that impacts of services outsourcing, either onshore or offshore, depend on contextual characteristics and the different types of services involved. To date, research in services offshore outsourcing has looked at the aggregate impacts of services as a whole and has established evidence from manufacturing industries within a country. We will investigate the economic impacts of IT offshoring separately. Our findings support the positive contributions of IT offshoring on productivity at the country level. In addition, rapid developments in IT have enabled greater electronic cross-border delivery of services. We investigate how a country’s IT intensity influences its value acquired from IT offshoring. Our results suggest the existence of systematic differences among countries regarding the intensity and benefits from IT offshoring. We find high IT intensity countries use more imported IT services as intermediate inputs, and also acquire more value from IT offshoring.

Our analysis uses country-level panel data. Dewan and Kraemer [17] described the benefits of this approach. First, productivity issues are more relevant at economy-level. At lower levels, profitability may be more meaningful than productivity. Second, our analysis is based on total national inputs and outputs, rather than just a subset. Research at lower levels of analysis imposes additional questions on whether contributions of IT offshoring are consistent across firms and industries within the country, and whether these contributions are generalized in the international context. Last, an analysis based on a cross-section of countries opens the possibility to deal with issues uniquely addressed in the international context.

Next, §2 reviews related literature. §3 develops theory on how the intensity of IT offshoring impacts productivity. §4 presents our empirical model. §5 describes the data and construction of variables. §6 presents our empirical findings. Finally, §7 discusses our contributions and shares our conclusions.

2. LITERATURE

2.1. Outsourcing Decision-Making

The theoretical literature on the decision to produce in-house or outsource through market contracts can be broadly categorized as either strategy-oriented or economics-oriented [32]. From the strategy perspective, researchers generally refer to resource-based theory. Firms view IT outsourcing as a strategy to help them achieve expected performance [31]. For example, by outsourcing IT functions to vendors with expertise and capabilities to keep up with IT advances, firms maintain business IT alignment without taking the risk of obsolescence [26].

As for the economic perspective, production economics and transaction cost economics are the main theories. Firms organize business activities either in the market or in the hierarchy form, depending upon the tradeoff between production and transaction costs [23]. Firms acquire value by outsourcing IT functions to vendors with production cost advantages [3]. On the other hand, while enjoying the production cost advantages, firms also bear transaction costs involving vendor search and contracting costs, transition costs, and managing costs [7]. Transaction costs may cancel out potential savings from outsourcing. There is empirical support for production cost advantages [24]. IT outsourcing is value-enhancing only when production cost advantages from the vendors outweigh the relevant transaction costs.

2.2. IT Offshoring

Few studies have focused on the value of IT offshoring. Researchers involved in these studies have mainly relied on case analysis and practitioners’ perceptions, and discussed the benefits and drawbacks [26, 29]. Cost efficiency is viewed as the main driver of the growth of IT offshoring. Escalating transaction costs may cancel out the cost advantages though. And even though cost efficiency may be obtained, firms may not get the expected service quality. They have
evaluated the pros and cons, and concluded that demand for IT offshoring will grow rapidly. They did not address whether or how much IT offshoring will contribute to objective performance measures like productivity.

The few studies on the economic performance of IT offshoring in the IS discipline are due to its recency. Most research on offshore services outsourcing has not distinguished among the different types of services, and only examined their aggregate economic impacts. Abraham and Taylor [1] and Han et al. [24] argued that firms outsource different types of services with different considerations and expect different realized value though. Thus, empirical research on impacts of services outsourcing must look at different types of services. In addition, Olsen [40] concluded that the results on the performance of offshore services outsourcing were mixed and may depend on context-specific characteristics. Inconsistent results also may come from the aggregation of different effects associated with the various types of services. So it will be good to study the economic impacts of IT offshoring separately and examine country-wide characteristics.

3. THEORY DEVELOPMENT

IT capital is recognized as an important factor of production, and the services sector accounts for important portions of the Western economies. This makes it worthwhile to investigate economic relationships between IT offshoring and national outputs.

3.1. The Value of IT Offshoring

There are different channels through which IT offshoring can improve productivity. We theorize the value as cost efficiency, operational efficiency, and quality improvement. First, firms in the home country relocate the less efficient parts of their IT functions to developing countries and acquire cost advantages. The utilization of cheap labor costs in those countries motivates IT offshoring and has been termed global arbitrage [38]. This has transaction costs for vendor management and contracting.

Advances in technology, however, have smoothed the costs involved in coordination and monitoring [41]. In addition, firms learn from experience and establish appropriate managerial strategies for IT offshoring [32]. They assess their IT portfolio for the parts that are suitable for IT offshoring. Then, they evaluate different outsourcing models, such as the exchange-based model for customized software and net-sourcing for standardized services, and they craft contracts that suit their needs. So they can avoid the pitfall of transaction costs, cancelling out the accrued cost advantages.

Besides, by outsourcing IT functions offshore, firms in the home country can forgo the risk of obsolescence [26]. Some services providers have started to develop delivery-based offerings across infrastructure, applications, and business processes. Under this scenario, clients are able to enjoy wider combinations of IT services relevant to their business processes with even cheaper prices.

Second, IT offshoring supports improved operational efficiency by exploiting time differences, restructuring processes and rationalizing labor. With time differences for different parts of the world, software development and data processing now can proceed on a 24 x 7 basis [26]. The popularity of modular design in software development makes this efficiency even more leverable [14]. Proponents of IT offshoring have argued that displaced IT workers will be re-deployed or re-employed. As firms jettison routine IT work, IT workers previously in non-core functions will be reassigned to core business processes or activities requiring intensive quality control and staff involvement [11]. For example, by offshoring the IT help desk, firms have been able shifted their IT staff to projects requiring customization of systems to support business process integration.

Opponents of offshoring assert that firms are replacing their domestic IT workforce with a cheaper one in developing countries [11]. Firms and employees in developed countries need to continuously support innovations to create new jobs, and explore new work skills [6].

Last, IT offshoring encourages quality improvements in the home country. Initially, firms used offshoring to save money. As foreign vendors gain more experience though, their capabilities improve, which further improves quality. Most large Indian software vendors use Six Sigma quality management methods [29]. Also, according to the Software Engineering Institute, about 40% of firms satisfying CMMI Level 5 are located in India [35]. They have learned to meet client requirements and create significant value [45].

These studies show the efficiency gains and quality improvement brought by IT offshoring. We expect the economic impact of IT offshoring on national productivity will be positive for developed countries.

3.2. Economic Integration through IT Offshoring

The economic integration view that we noted earlier explains how reciprocal multinational relationships may lead to productivity increase. Michael Musa [37], Economic Counselor and Director of Research of International Monetary Fund, noted three main channels of economic integration: through trade, factor movements, and communication of economically useful knowledge and technology. We focus on the integration channel through trade in IT offshoring.

Services account for significant portions of the economic activities of Western economies. IT capital is recognized as an important factor in productivity
and has much higher marginal product than other inputs. So instead of looking at services as a whole, we look at trade in IT services separately. We operationally define IT offshoring as the portion of imported IT services represented by intermediate inputs.

IT offshoring will bring an increase in productivity due to efficiency improvement, and additional demand in goods from foreign countries. Firms in developed countries outsource their less efficient IT activities to developing countries and gain an increase in productivity due to efficiency gain. Developing countries get access to foreign knowhow and enhance their economic base. This development spillover will lead to additional imports from developed countries. As a result, demand for outputs in developed countries will increase and stimulate a further increase in productivity. In addition, as foreign vendors gain more experience, they may bring quality improvements to the home countries and even create competition for the local services providers. The competition will stimulate efficiency and increase productivity. We expect that the economic impact of IT offshoring on national productivity will be positive in developed countries.

3.3. IT Intensity and IT Offshoring

IT intensity has been measured as the value of IT capital normalized by output [18, 36]. Both Stiroh [46] and Mittal and Nault [36] used IT intensity to indicate industries’ propensity to invest in IT capital. Given the significant contributions of IT capital to productivity, IT intensity is associated with positive economic performance. Stiroh [46] showed that IT-intensive industries contributed significantly to the productivity resurgence in the U.S. in the late 1990s.

Barthelemy and Geyer [8] argue that institutional differences, such as overall IT development and economic policy, may influence the use of IT offshoring too. They commented that these differences may increase or lower the transaction costs of IT offshoring. We expect that the IT intensity of a country will affect the use of IT offshoring. First, IT offshoring requires coordination and monitoring activities between clients and vendors. Clients in IT-intensive countries have more IT investments in communication, such as the Internet and interorganizational systems (IOS). So they should have lower coordination costs and better monitoring capabilities for IT offshoring [34]. These advantages should increase firm willingness in the developed countries to use IT offshoring. They imply higher returns from IT offshoring for countries with a lot of IT capital since costs are lower.

Second, firms in countries with more IT capital, on average, have higher IT expenses. They will have higher incentives to use IT offshoring for cost reduction [33]. Bharadwaj [10] used physical IT assets as a key determinant of a firm’s IT capabilities. The author defined IT capabilities as a firm’s ability to utilize IT resources to achieve superior performance. Thus firms in countries with more IT capital generally will develop better IT capabilities in terms of technical and managerial IT knowledge. So developed countries with more IT knowledge will be able to better manage and exploit offshore outsourcing.

We measure the use of IT offshoring via share of imported IT services as an intermediate input. Countries with high IT capital levels will have a higher degree of IT offshoring and will acquire more value.

4. A PRODUCTION MODELING FRAMEWORK

Because the impacts of IT offshoring on productivity develop through efficiency and quality enhancement, we will use Cobb-Douglas function as our base model, and extend it to incorporate the impacts of IT offshoring. Feenstra and Hanson [19] argued that offshored services can be viewed as a new type of intermediate input, which can shift the aggregate production function of the host country. Consistent with literature on services offshore outsourcing [22], an appropriate way to model IT offshoring in the production function is to include its impacts on total factor productivity through the technology parameter.

Since prior research suggests that different types of services may lead to different outcomes, it makes sense to look at the intensity of IT offshoring separately, instead of the effects of services as a whole. Similar to how we separate IT capital from overall capital, we incorporate the intensity of offshore outsourcing in materials and other services. In our model, we let $A$ represent the technology parameter of a country. Within $A$, we have $\text{ITOffshoring}$ as the intensity of offshoring of IT services, and $\text{Other Offshoring}$ as the intensity of offshoring for material and other types of services. $A(\text{ITOffshoring}, \text{OtherOffshoring})$ captures this relationship.

Some may question the applicability of the production function at the aggregated-level analysis since it was originally used for firm-level analysis. Yet, by using a log linear and additively separable production function, we are able to satisfy the key conditions that Nataf [39] proposed for the aggregation of production functions from the firm-level to the industry and economy levels. As Dewan and Kraemer [17] and Park et al. [44] used a Cobb-Douglas production function to study impacts of IT capital on national productivity, our model is given by:

$$ \text{Output} = A(\text{ITOffshoring}, \text{OtherOffshoring}) $$

$$ \text{OtherCapital}^{\theta} \text{ITCapital}^{\gamma} \text{Labor}^{\alpha} $$

where Output is the national output level in terms of GDP. $A$ represents the technology parameter as an amplifying effect due to efficiency gains and quality improvements from offshoring. The other variables are
non-IT OtherCapital, ITCapital, Labor and an error term \( \varepsilon \), with \( i \) for country and \( t \) for time. We take the natural log of the model to create its log-additive separable form for estimation:

\[
\ln Output_{it} = \alpha + \beta ITOffshoring_{it} + \gamma OtherOffshoring_{it} + \kappa \ln OtherCapital_{it} + \theta \ln ITCapital_{it} + \omega \ln Labor_{it} + \varepsilon_{it}
\]

### 5. DATA AND VARIABLES

We collected cross-sectional time-series data for 20 OECD countries from 2000 to 2006. \(^3\) Our data set comes from multiple sources, including the OECD, the World Bank, and the United Nations. Table 1 provides a brief description of the sources and our construction procedure. GDP, capital flows, and employee compensation were obtained from the World Bank and are measured in constant 2000 U.S. dollars. We use wages as a proxy for the labor quantity input because employee compensation involves the amount of labor, adjusted for its quality over time.

#### Table 1. Variables and Data Sources

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>DESCRIPTION</th>
<th>SOURCE</th>
</tr>
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<tbody>
<tr>
<td>Output</td>
<td>GDP in 2000 US$</td>
<td>World Bank</td>
</tr>
<tr>
<td>ITCapital</td>
<td>IT capital estimated by PIM, 2000 US$</td>
<td>World Bank</td>
</tr>
<tr>
<td>OtherCapital</td>
<td>Non-IT capital stock, 2000 US$</td>
<td>World Bank</td>
</tr>
<tr>
<td>Labor</td>
<td>Proxied by workers’ remittances and employee wages, 2000 US$</td>
<td>World Bank</td>
</tr>
<tr>
<td>ITOffshoring</td>
<td>Intensity of IT offshoring defined as the share of IT services inputs from import</td>
<td>World Bank, OECD, STAN, U.N. Service Trade Database</td>
</tr>
<tr>
<td>Other Offshoring</td>
<td>Intensity of other types of offshore outsourcing excluding IT services, defined as share of material and non-IT services inputs from import</td>
<td>World Bank, OECD, STAN, U.N. Service Trade Database</td>
</tr>
</tbody>
</table>

An appropriate series of capital stock data was not available in the database, so we used an approximation method due to Kohli \([30]\), and suggested by the OECD’s \([42]\) productivity measurement manual, to estimate initial total capital stock at \( t = 0 \) for country \( i \):

\[
TotalCapital_{i0} = InvFlow_{i0} / (g_i + \delta_i)
\]

In this expression, \( InvFlow_{i0} \) is the initial investment capital flow into country \( i \). The growth rate \( g_i \) of the investment capital flow is calculated with the earliest 10 years of investment data that we had available. We assumed that the depreciation rate \( \delta_i \) is 5%, based on Park et al. \([44]\). Once we obtained the initial capital stock \( TotalCapital_{i0} \), we then were able to compute the subsequent values of the capital stock series using the perpetual inventory method via the following relation with the country subscript suppressed: \( TotalCapital_t = TotalCapital_{t-1} (1- \delta) + InvFlow_{t-1} \). We applied this approach to estimate overall capital stock, as well as the IT capital stock, ITCapital. This permitted us to derive the non-IT capital stock OtherCapital by subtracting the ITCapital from TotalCapital.

We estimate intensity of IT offshoring for each country with a method of Feenstra and Hanson \([19, 20]\) for outsourced material inputs. The intensity of IT offshoring, ITOffshoring, is the share of imported IT services as an intermediate input, calculated as:

\[
ITOffshoring = \left[ \frac{\text{Imports of IT Services}}{\text{Total Non-Energy Inputs Used}} \right]
\]

\[
= \left[ \frac{\text{Imports of IT Services}}{\text{Production + Imports – IT Services Exports}} \right]
\]

The first bracketed term is calculated with data from the OECD Structure Analysis (STAN) Database. We measured the purchase of IT services input by intermediate inputs from “Computer and Related Activities” (ISIC Rev.3 72). \(^4\) For non-energy intermediate inputs, we subtract the energy inputs (ISIC Rev.3 40, 41) from the “Electricity, Gas and Water Supply” category from total intermediate inputs. For the second bracketed term, we obtained imports and exports of IT services from the “Computer and Information Services” category (EBOPS 262) from the U.N. Service Trade Database. \(^5\) We then applied the same method to calculate offshore outsourcing intensity excluding IT services, OtherOffshoring. We obtained imports and exports excluding IT services by subtracting imports and exports of IT services from total imports and exports in goods and services from the World Bank.

#### 6. METHODS AND RESULTS

##### 6.1. Estimation Process

We chose to estimate a fixed effects model, which is favored by the results of a Hausman test that we ran.

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\(^3\) The 20 countries are Austria, Belgium, Czech Rep., Finland, France, Germany, Greece, Hungary, Italy, Japan, Netherlands, Norway, Poland, Portugal, Slovakia, South Korea, Spain, Sweden, U.K., and U.S.

\(^4\) ISIC Rev.3 indicates a United National activity classification industry, similar to Standard Industry Codes (SIC) and the North American Industry Classification Systems (NAICS) in the United States. Rev.3 was last revised in 1989, and was superseded by Rev.4 in August 2008, but most data are coded using Rev.3. See the United National Statistical Division at [unstats.un.org/unsd/cr/registry/isic-4.asp](http://unstats.un.org/unsd/cr/registry/isic-4.asp) for more detailed information and background.

\(^5\) EBOPS indicates “extended balance of payments services.” Category 262 includes computer services (hardware and software related services and data processing services), news agency services (provision of news, photographs, and feature articles to the media), and other information provision services (database services and web search portals).
Wooldridge [47] suggests that unobserved effects can be written as \( y_{it} = x_{it} + c_i + u_{it} \), where \( c_i \) is an individual effect and \( u_{it} \) is an idiosyncratic error. He notes the difference between a random effect and a fixed effect: “In modern econometric parlance, [a] random effect is synonymous with zero correlation between the observed explanatory variables and the individual effect … [a] fixed effect means one is allowing for arbitrary correlation between the unobserved effect \( c_i \) and the observed explanatory variables.”

Our fixed effects model captures unmeasured country-specific effects with country dummies, and allowing the unmeasured effects to be correlated with the observed explanatory variables. We also consider time-specific effects via year dummies, but the Wald test for the set of year dummies was not significant. This result is consistent with Dewan and Kraemer’s [17] specification. It is not surprising since developed countries have passed the rapid growth phase, and annual changes in outputs may not be significant. Thus we only control for country-specific effects.

Because we use cross-sectional time-series data, we test for potential heteroskedasticity across countries and autocorrelation across time. The output variable GDP may vary with country size, and the country’s use of IT offshoring may be correlated across time. Thus, we conducted a likelihood ratio test for panel-level heteroskedasticity. We rejected the null hypothesis that the standard deviations of the error terms are constant across different levels of regressors. We also used the Wooldridge [47] test to detect panel-level autocorrelation. The result indicated that first-order autocorrelation (AR1) exists in our data.

By using a regression model, we assume that the error terms are not correlated with the regressors. Yet this assumption may be violated due to the potential simultaneity between IT capital and output, IT offshoring and output, and other types of offshore outsourcing and output. Thus, we also tested for endogeneity. By using one and two-year lagged values of the variables as instruments, we checked for the endogeneity of IT capital, IT offshoring, and other types of offshore outsourcing. We conducted a Durbin-Wu-Hausman test for endogeneity and Hansen’s J test for exogeneity also [9]. We ran the tests for all three variables jointly and separately. The results suggest that we should not reject the null hypothesis that these variables are exogenous in our data set. This allows us to conclude that our estimates will not be biased due to the correlation between the IT and outsourcing variables and the error terms.

To control for heteroskedasticity and autocorrelation, we use feasible generalized least squares (FGLS) [47]. This method may give biased results if the regressors are not strictly exogenous to the error terms. The current error term has to be uncorrelated with past and current regressors, but also with future regressors. For example, the unexplained part of GDP in this year may be correlated with IT offshoring in the previous year and in the next year. If this is the case, then FGLS may lead to biased estimates.

The previous endogeneity test only guarantees that the model is weakly exogenous, so that the current error term is not correlated with past and current regressors. Because ordinary least squares (OLS) estimates are consistent but less efficient under heteroskedasticity and AR1, one also can estimate the model by OLS with panel-corrected standard errors (PCSE) [48]. We also tried this method, and the results were consistent with those obtained from FGLS estimation. Thus, the assumption of strict exogeneity is not a serious one. PCSE is less efficient in the presence of heteroskedasticity and autocorrelation though, so we will emphasize the FGLS estimation results.

### 6.2. Contributions of IT Offshoring

Table 2 shows the FGLS and PCSE estimations for the economic impacts of IT offshoring at the country level. We focus on the FGLS results. The coefficient for ITOffshoring, the intensity of IT offshoring based on the share of imported IT services as intermediate inputs, is positive and significant. This implies that IT offshoring made significant and positive contributions to national productivity. Thus, economic integration through IT offshoring paid off in the 20 OECD countries during the 2000 to 2006 period. On average, a 1% increase in ITOffshoring (\( \beta = 0.078 \), SE = 0.03, \( p < .05 \)) outsourcing intensity is associated with a 7.8% increase in GDP productivity.

As for the impact of aggregate offshore sourcing, a 1% increase in intensity of OtherOffshoring (\( \gamma = 0.129 \), SE = 0.06, \( p < .05 \)) and ITOffshoring is associated with an 8% increase in productivity at the country level. From the coefficient for intensity of ITOffshoring, we can tell that, within the 8% increase in productivity, over 90% of the increase comes from intensity of ITOffshoring. This high percentage of contributions from ITOffshoring may, however, need further investigation. The intensity of non-IT offshoring, OtherOffshoring, is aggregated from offshore outsourcing of materials and other types of services, and thus may contain some averaging-out effects. For example, Gorg et al. [22] showed that offshore outsourcing of materials has negative impacts on productivity while offshore outsourcing in aggregated services has positive impacts at the plant level of analysis. Thus, the contributions of offshoring that do not involve IT may come from the averaging effects of some types of offshore outsourcing with positive contributions, and some with negative impacts.
samples stratified by high and low IT intensity. The Finland with high IT intensity. just slightly lower than the median. So we classified observations were above the median, and the other 3 were is the middle of the 2 groups. Across 7 years, 4 obser-
vations. To some extent, our results are consistent with previous findings that suggest the contributions of offshoring appears to have positive and significant impacts on national productivity.

6.3. IT Intensity Splits
Barthelemy and Geyer [9] have argued that institutional differences may increase or lower transaction costs and thus influence the use of IT offshoring. Earlier we hypothesize that the degree of IT development of a country will affect the use and the value captured from IT offshoring. We measure IT development as IT intensity and split our sample countries according to their relative IT intensity. Stiroh [46] and Mittal and Nault [36] measured IT intensity as IT capital normalized by outputs. Thus, the measure of IT development also takes the size of a country into account. We ranked the IT intensity of each country for the period of 2000 to 2006 and split the countries based on the median. The high IT intensity group has 11 countries, and the low IT intensity group has 9 countries. Finland is the middle of the 2 groups. Across 7 years, 4 observations were above the median, and the other 3 were just slightly lower than the median. So we classified Finland with high IT intensity.

Table 3 shows the summary statistics for data samples stratified by high and low IT intensity. The high IT intensity group has higher average IT intensity (30.3%) than the low IT intensity group (21.1%). We conducted a t-test for comparing the mean of IT intensity between two groups. The difference is significant at the 0.001 level. In addition, intensity of IT offshoring is higher in the high IT intensity group (0.116%) than in the low IT intensity group (0.093%). A t-test on the means of the intensity of IT offshoring between the two groups is significant at the 0.05 level. Thus, we conclude that high IT intensity countries tend to use more IT offshoring than low IT intensity countries.

Table 4. Estimation Results: IT Intensity Split

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>ESTIMATED COEFFICIENTS: IT INTENSITY SPLITS</th>
<th><strong>(p)</strong></th>
<th><strong>(p)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>OtherCapital</td>
<td>0.523 (0.0370)</td>
<td>0.569 (0.0908)</td>
<td></td>
</tr>
<tr>
<td>ITCapital</td>
<td>0.146 (0.0418)</td>
<td>0.123 (0.0613)</td>
<td></td>
</tr>
<tr>
<td>Labor</td>
<td>0.015 (0.0083)</td>
<td>0.021 (0.0082)</td>
<td></td>
</tr>
<tr>
<td>OtherOffshoring</td>
<td>0.003 (0.0005)</td>
<td>0.001 (0.0009)</td>
<td></td>
</tr>
<tr>
<td>ITOffshoring</td>
<td>0.214 (0.0594)</td>
<td>0.062 (0.0725)</td>
<td></td>
</tr>
</tbody>
</table>

Note: The high IT intensity group has 11 countries (64 obs.) and the low IT intensity group has 9 countries (50 obs.). Signif.: **\(p < 0.05\) and *\(p < 0.1\). Std. errs. are in parentheses.

The result is that IT offshoring has made signifi-

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6 To test the time-invariant IT intensity effect in the fixed effects model, we added an interaction for the IT intensity dummy and the intensity of IT offshoring using the full sample. The result is positive and significant.
cantly greater contributions to productivity in the high IT intensity countries. In other words, those countries with more developed IT infrastructures and capabilities from larger IT investments tend to appropriate more value from IT offshoring.

7. DISCUSSION

We modeled the intensity of IT offshoring as a technological change parameter in the production function. Our results suggest that IT offshoring has made substantial contributions to economic performance of the 20 OECD countries during the period from 2000 to 2006. On average, a 1% increase in intensity for IT offshoring is associated with a 7.8% increase in productivity at the national level. In addition, among the overall contributions of offshore outsourcing, over 90% comes from IT offshoring. We offer two possible explanations for this significant increase in productivity: (1) Firms gain cost and operational efficiencies by relocating less efficient parts of their business processes offshore, and also gain from better labor utilization. (2) As foreign vendors gain experience and capabilities, they also may improve the quality of the original processes. Further work is required to explore the determinants of productivity improvement.

We also looked into how IT intensity influences the use and returns from IT offshoring in the international context. We found that IT development and capabilities of a developed country that are proxied by IT intensity seem to be associated with systematic differences in the way IT offshoring is used. High IT intensity countries tend to use more IT offshoring because they have stronger incentives to reduce costs for their substantial IT investments. These countries value offshoring because they have advantages with IT-relevant knowledge and organizational capabilities and are better able to manage and utilize IT offshoring.

Furthermore, we speculate that IT intensity will also be a critical factor for the provision of the IT services in the developing countries. Bunyaratavej et al. [13] argue that, when choosing the locations of services offshoring, firms favor countries with near parity in terms of infrastructure and educational level due to concerns about service quality. For example, when BPO involves communication through IOS, the IT development capabilities present in a developing country will influence the willingness of firms in developed countries to outsource. Aron et al. [5] pointed out that improvements in Internet access in India reduce BPO risk, and facilitates BPO initiatives.

The positive correlation between IT investments and IT offshoring may also have some implications for the growth pattern of IT offshoring. Researchers expect IT offshoring to follow the growth pattern of offshore outsourcing in manufacturing, involving three stages: start-up, rapid growth, and maturation [45]. Thus, this positive correlation may be able to tell us something about the threshold for the transition from start-up to rapid growth. In the start-up stage, countries accumulate experience and IT-relevant knowledge and capabilities in managing IT offshoring. Over time, as experience accumulates and IT capabilities reach a certain threshold, returns from IT offshoring will substantially improve, and the demand for IT offshoring will increase.

Our work has introduced an innovative way to study the impacts of IT offshoring at a more macro level. In addition, our analysis provides empirical evidence on how international IT trading networks in the form of IT offshoring improve productivity of industrialized countries. This is the idea of economic integration that we discussed earlier. Since IT offshoring is just one realization of economic integration, our analysis provides some preliminary evidence on the effects of global economic integration.

Prior research on performance of IT offshoring used case studies and practitioner interviews. The interpretation of these results has been somewhat limited. Even for the literature on services offshore outsourcing, the empirical analyses are still few and limited to the manufacturing industries of single countries. We provide empirical evidence on economic impacts of IT offshoring, and extend the results to the cross-country context. Aside from its impact on employment, we shed some light on the debate about whether IT offshoring is harmful or beneficial to a national economy.

Our results also provide implications for policymakers. First, our study provides a method for measuring the aggregated impact on the economy from IT offshoring. Second, our analysis supports economic integration and, therefore, provides directions for policy-making. Finally, our IT intensity split analysis further suggests that, to acquire more value from IT offshoring, a country will need to accumulate its IT-relevant knowledge and capabilities.

Looking forward, we believe that offshoring will continue to grow. As IT advances and firms redesign business processes, services platforms like service-oriented architecture (SOA) will gradually mature too. More business activities will be conducted through the Internet. While transaction costs associated with communication and monitoring will decrease rapidly, the “move to the middle hypothesis” will continue to represent the strategic risks associated of inter-firm contracting [5, 15]. We expect offshoring to take the form of stable bilateral relationships with a few vendors, not a market mechanism with a wide collection of service vendors.

This study has limitations. First, we know firm-level data would improve our ability to examine the
economic impacts of IT offshoring. However, firm-level data is hard to collect due to confidential considerations. Park et al. [44] commented that, in the research on IT and productivity, additional attention should be placed on macro-level analysis since the IT productivity paradox originated from the national and industry level, so there is still much to learn.

Second, because our data come from multiple sources, inconsistent measurement methods and potential measurement errors may bias the estimated results. Third, IT offshoring may bring both compositional and structural changes of the production function. For example, as firms within a country outsource their less efficient IT-relevant activities offshore, they are then able to put the resources originally used in the less efficient IT processes into the value-added activities. Thus, productivity improves because the production process becomes more efficient and moves toward the production frontier. On the other hand, the cost efficiency acquired from IT offshoring also may shift the production frontier outward. Although we have captured the overall benefits from IT offshoring, we are unable to distinguish whether the benefits come from the former, the latter, or both. The truth probably involves both, but we cannot differentiate the parts from the compositional and the structural improvements.

Third, IT offshoring is one of the multiple channels for economic integration, and thus its positive impacts support the contributions from economic integration to national productivity. Even so, we are unable to determine whether this increase comes from labor substitution, further demand in labor, or both. In terms of IT-relevant jobs, some people argue that IT professionals will be replaced by lower-paid workers in foreign countries. Association for Computing Machinery (ACM) president, David Patterson [43, p. 26], commented on U.S. Bureau of Labor Statistics: “[D]oes anyone besides me know that U.S. IT employment in 2004 was 17% higher than in 1999 – 5% higher than the bubble in 2000 and showing an 8% growth in the most recent year?” An explanation is that, as firms get their IT routines wired abroad, they will better utilize resources for value-added activities, and create new jobs. Since IT capital is recognized for its contributions to productivity, industries, especially those with low IT intensity, will continue to invest in IT capital. Thus, ongoing IT advances and growing demand for IT-enabled business processes will eventually create more jobs than those that will be lost.

Blinder [12] discussed the nature of the jobs being offshored. His view is consistent with Friedman’s [21]: services that are impersonal and suited for e-delivery with little diminution of quality will be offshored. As offshoring advances, more services will fit this mold. This is different from the conventional distinction between low and high-skilled work. He cautions governments to rethink what educational systems and social policies will prepare the public for the job transition brought by offshoring, and what new jobs will be created that remain in the country.

Finally, due the limit of data availability – the critical constraint for IT impact research in the international context [27]. It normally takes two years for international agencies and governments to assemble the relevant data, so it is not easy to be perfectly up to date. As such our data does not include the most recent economic meltdown. It is possible that the implications of IT offshoring may be different when unexpected and significant economical fluctuations like this occur. This will be an interesting question for follow-up research.

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