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QUALITY OF FOREIGN DIRECT INVESTMENT, KNOWLEDGE SPILLOVERS AND HOST COUNTRY PRODUCTIVITY
A Framework of Analysis

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Abstract

The existing research on knowledge-spillovers from foreign direct investment (FDI) has invariably treated all foreign firms as homogeneous and of equal importance for the development of host countries. However, in actual market situations foreign firms are basically non-homogeneous and of varying qualities as far as the potential for knowledge-spillover are concerned. Foreign firms differ in terms of export-orientation, intensity to undertake local R&D activities, vertical integration, generating demands for local raw materials, and entry modes. Non-inclusion of such quality dimensions of FDI into the spillover analysis is certainly an important limitation of the existing literature. This paper has explored different notion of FDI quality and argued that it should be included in the empirical studies on spillover analysis. This paper has develop an empirical framework for inclusion of quality dimensions in exploring FDI-related spillovers on host country productivity and propose a percentile criterion to distinguish between low and high quality FDI firms in empirical exercises. Since there are several dimensions of FDI quality, the study suggest that the researchers can utilize the principal component analysis (PCA) to build a composite quality index to define low and high quality FDI firms. The empirical exercise on the construction of FDI quality index and related spillover variables for the Indian manufacturing sector shows that there are considerable differences exists between the spillovers variables associated with high and low quality FDI firms. This difference is more pronounced at individual industries level. Unless the differences that are present across foreign firms in terms of quality are brought into the spillover analysis, the obtained results are likely to give misleading conclusions.

Keywords

FDI Quality; Knowledge-Spillover

JEL Classification

F23

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Jaya Prakash Pradhan[*]

1. Introduction

The existence and extent of knowledge spillovers from the presence of foreign subsidiaries in host developing countries is an important subject of enquiry in the literature on international production (see Fan, 2002; Gorg and Greenaway, 2004 for recent surveys). Since foreign affiliates bring in new technologies, both disembodied and embodied forms, skills, marketing expertise and latest management practices from their parents into host countries, these knowledge resources get spillovers to domestic companies through various channels. Domestic firms tend to improve their technologies to meet increased competitive challenges thrown by entry of foreign affiliates and also they can learn from the demonstration of new technologies represented in foreign affiliates. In many instances, domestic firms as local suppliers and customers interacting with foreign firms benefit when the latter provides technical assistance to them. Inter-firm mobility of labour from foreign to domestic companies may act as another channel of knowledge spillover as new skills and training brought by foreign firms diffuse to the domestic sector.

These foreign subsidiaries led knowledge spillovers can play a significant role in the productivity growth of local enterprises in a host economy. A large number of recent empirical studies are thus concerned with this issue and their number is ever growing with modifications in empirical methodology and across countries and time. Although the earlier studies like Caves (1974) on Australian manufacturing industries, Globerman (1979) on Canadian industries, and Blomstrom and Perssion (1983) on Mexican industries found significant presence of knowledge spillovers from foreign enterprises, evidence

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from more recent studies [e.g., Haddad and Harrison (1993) on Morocco, Aitken and Harrison (1999) on Venezeula, Xu (2000) on a group of selected developing countries, Kathuria (2000), and Pradhan (2002) on India] shows that such spillovers are insignificant or even negative. Therefore, the exiting literature presents a mixed set of findings on the existence and nature of knowledge spillovers from FDI in host countries.

Apart from the standard explanation of country- and sector-specific differences, different methodologies and different data sources for these mixed results on FDI led knowledge spillovers, the most important reason offered is the minimum local capability hypothesis. It was argued that local firms must have a minimum level of human and technological strength to absorb spillovers from foreign enterprises. In countries or sectors where local firms are quite capable they tend to benefit from spillovers and where they are too weak in capability they might fail to benefit. Several studies like Kokko (1994) on Mexico, Kokko et al (1996) on Uruguay, and Xu (2000) on a set of developing countries have found empirical evidence for the above explanation.

However, these existing views on mixed findings on the knowledge spillovers are based on an important assumption that all FDI projects/firms are homogeneous and equally important for a recipient country. They were concerned with the quantity of FDI and fail to distinguish between different qualities that are inherent in FDI. This is a serious drawback in previous literature as FDI projects are not of equal quality in actual market situation. Foreign firms might have different market orientation (domestic market-seeking versus export oriented FDI), different local knowledge creation activities (high R&D-intensive versus low R&D-intensive FDI), might generate divergent quantum of local linkages (high and low indigenous raw material dependent FDI), etc. This paper argues that mixed cross-country and sectoral findings on knowledge spillovers might be due to the different quality of FDI being attracted. The contribution of this paper is to suggest an empirical framework to incorporate this quality dimension into knowledge spillovers analysis.

The paper has been structured as follows. Section 2 outlines different perspectives on the quality of FDI and examines their implications for host country development. Sections 3 and 4 discuss various ways to integrate different quality perspectives into the existing empirical frameworks and dwell upon the importance of constructing a composite index of FDI quality. Section 5 concludes the paper.

2. Perspectives on Quality of FDI and Host Country Development

There are several perspectives on the concept of the quality of FDI and the ways they affect development and growth of host countries. Following are the five important perspectives most often emphasized in theoretical and empirical literature:

2.1. Sectoral Perspective on the Quality of FDI

The idea that the sectoral composition of FDI is important for economic growth of less developed countries can be traced back to the structuralist school of thought on economic development. Singer (1950) argued that foreign investment in primary sectors like mining, food and raw materials offer less scope of technical progress in developing countries. In this view, FDI into manufacturing sector and particularly into technology-intensive industries constitute high quality FDI than FDI into extractive or natural resource-based sector. Since developing countries have weak base in high technology-intensive sectors, entry of FDI has the greater potential of vertical inter-firm linkages, diffusion of new knowledge and other spillovers within the host economy (Kumar, 2002). In labour intensive industries, developing countries already have a well-developed production base and FDI tends to crowd out domestic enterprises due to their technological and other intangible assets superiority. As a result, the potential for FDI led spillovers to domestic firms is higher in the technology-intensive sector and lower in the case of matured industries. Dutta (1997), however, could not find support to the hypothesis that sectoral pattern of FDI does matter for economic growth. On the contrary, UNCTAD (2005) found that the growth-enhancing role of FDI in Africa is quite limited due to poor quality of FDI that it attracts. The region has attracted FDI into enclaves of export-oriented primary sectors such as oil and mining and they have limited links to other economic sectors with little knowledge spillovers.

2.2. Localization of Production Perspective on the Quality of FDI

For host country development, it is important that FDI not only comes into technology-intensive sectors, but also large part of their production activities takes place locally. Localization of production in a FDI project includes two things—*(i)* extent of its vertical integration in the host country, and *(ii)* its intensity of using local raw materials and intermediates. Kumar (2002) argued that the extent of knowledge transfer and its diffusion in the host country is proportional to the degree of vertical integration (measured as the proportion of value-added in sales), which in turn captures the extent of localization of production. The importance of localization of production by foreign companies for local technological development has been a recurrent theme in literature on sectoral innovation system. For example, Kumar and Pradhan (2003) and Pradhan

(2002) have shown that foreign firms in Indian pharmaceutical industry had a shallow manufacturing base during 1940s–1960s, largely importing bulk drugs to process them into formulations to sell in the domestic market, and thus generated little knowledge spillovers. In theoretical models of Rodriguez-Clare (1996) and Markusen and Venables (1999) the development of host countries are crucially linked to the increased demand for local inputs from foreign firms. The extent of local purchasing of inputs by foreign firms is important for stimulating local entrepreneurship and improving efficiency in local contractors by assisting them with investment, technology, and quality control. Moran (1998, 2001) provides a number of empirical cases where local suppliers of foreign firms have significantly benefited from vertical knowledge transfer from FDI.

2.3. Technological Perspective on the Quality of FDI

The role of foreign subsidiaries in the technological activity of the host country is an important aspect of the quality of FDI. That is why many host countries including India had technology transfer requirements for the entry of foreign firms (UNCTAD 2004). FDI projects involving technology transfers from parent firms and with a commitment to do local research and development (R&D) activities are only permitted. In this view, the knowledge spillovers work only when foreign affiliates bring new technologies and skills to the host country and may generate significant externalities if they are also engaged in sizeable knowledge creation activities in the host economy. Current research suggests that the R&D of developed country multinationals are increasingly becoming more global in recent years (Cantwell and Janne, 1999; Patel and Vega, 1999; UNCTAD, 2005) and have begun to establish R&D centres in developing countries like India and China. In case of Argentina, Marin and Bell (2006) have found that local technological activities of foreign affiliates have been the main channel of FDI related spillovers during 1990s.

2.4. Market-orientation Perspective on the Quality of FDI

The market-orientation of FDI project is an important parameter of the quality of FDI. Depending upon overall market-orientation, an FDI project can be classified into domestic market-seeking or export-oriented. While domestic market-seeking FDI are primarily inclined to serve the domestic market, the central focus of export-oriented FDI is on regional or global export market (Pradhan, Das and Paul, 2006). In this classification, export-oriented FDI is termed as high quality FDI than domestic market-seeking FDI (Pradhan and Abraham, 2005; Kumar, 2002). This is because the export-oriented FDI have greater potential to generate strong links with local economy compared to domestic market oriented FDI given their motivation to exploit the locational advantages offered by the host county like low-cost labour, raw materials, components, parts, among others for export activities. This not only enhances the scope for knowledge spillovers from export-oriented foreign firms to local suppliers, but also generates information spillovers to purely domestic firms to enter into export market (Aitken et al, 1997). Export-oriented FDI also strengthens the supply capacities of export-oriented sectors in host developing countries (UNCTAD, 2002) by providing new competitive assets. Further, the possibility of 'crowding-out effect' from FDI is relatively less in the case of export-oriented FDI than in the case of domestic market-seeking FDI. Since the latter group of FDI is being motivated to serve the domestic market, they can erode the market share of domestic firms because of their superior assets bundles. On the contrary, export-oriented FDI may encourage downstream domestic investment by increasing demands for intermediate goods and since they primarily focus on external market they are less likely to adversely affect their domestic counterparts.

2.5. Mode of Entry Perspective on the Quality of FDI

Another important component of 'quality of FDI' lies in the modes of entry of foreign firms into a host economy. A foreign investor can enter into a market via acquiring an existing domestic company or establishing a completely new productive unit. The first entry mode is known as brownfield form of FDI and second one is tagged as greenfield foreign investment. The greenfield FDI is generally regarded as high quality FDI as compared to brownfield FDI for several reasons. As compared to brownfield projects, greenfield FDI implies a net addition to the productive capability of a host developing economy with a pro-competitive bias with respect to the domestic market. The scope and extent of technological knowledge transfer may be much higher when a greenfield unit is started than a buyout of an existing unit. Further, greenfield FDI is likely to have a favourable impact on host country employment than brownfield FDI. UNCTAD (2000), however, argued that many differences between the impacts of these two modes of FDI diminish or disappear in the longer term with the possible exception of impact on market structure and competition. The nascent empirical findings on the growth impact of FDI through M&As and greenfield FDI, reveals a mixed picture. Calderón et al (2002) have found that neither type of FDI appears to precede economic growth in either developing or industrial countries. Wang and Wong (2004) have obtained that the greenfield FDI promotes economic growth but not so with M&As, especially when host countries have poor levels of human capital.

The preceding discussion emphasizes the fact that FDI projects are essentially non-homogeneous in generating favourable impact on host economy and there exists several dimensions on which their quality for development may vary. Much of the existing research on the quality of FDI has been centered on examining factors attracting high quality FDI (like export-oriented or R&D-intensive FDI) into host developing countries (e.g., Kumar, 2002) or examining their impact (especially impact of M&As vis-à-vis greenfield FDI) on economic growth of recipient countries (e.g., Wang and Wong, 2004). The literature is yet to integrate the quality dimensions into the conceptual frameworks to analyze the knowledge spillovers from FDI.

3. Integrating FDI Quality into Spillover Analysis

In this section the study proposes a simple method to incorporate quality of FDI into their empirical analysis. Since domestic firms can absorb knowledge spillovers from FDI situated in the same industry and also from FDI located at backward or forward stages of production chain, the discussion has been accordingly divided into horizontal and vertical spillovers analysis.

3.1. Intra-industry (Horizontal) Knowledge Spillovers

Majority of the studies of the previous literature have generally adopted the following generic specification to examine the intra-industry knowledge spillovers due to the presence of FDI:

$$y_{ijt}^{d} = \sum_{k=1}^{m} \beta_k x_{kijt}^{d} + \sum_{\ell=1}^{p} \chi_\ell x_{\ell jt} + \alpha S_{jt} + \varepsilon_{it} \qquad \text{………… (1.1)}$$

$$i = 1.....n;\ j = 1....N;\ t = 1.....T$$

Where y^d is the productivity of domestic firms; x^d is a k vector of exogenous variables related to domestic firms; x is a l vector of exogenous variables related to industries; s is the foreign presence variable; ε is the usual random error term; β_k and χ_l are parameters of the model; i is the ith firm indexed by both time (t) and industry (j). This specification is with respect to the firm-level analysis based on panel dataset. In the case of industry level analysis, the dependent variable shall become the productivity of all the domestic firms in an industry and all independent variables related to the domestic firms are now aggregated at the industry level.

In equation (1.1) the variable S is the share of all foreign firms in the total output of an industry[1]. This way of measuring the presence of foreign firms, however, ignores the quality differentials that exist among foreign firms. Then, the question is how to incorporate quality aspect into the spillover analysis. The simplest approach is to look at

[1] Previous studies have also used share of foreign firms in industry sales and employment to measure the variable foreign presence.

the industry-specific distribution of foreign firms on a particular quality parameter (lets say R&D-intensity) and then classify those foreign firms as high quality FDI, which are situated above the 50th percentile value[2]. Lower quality FDI firms are those with R&D-intensities up to the cut-off value of 50th percentile. This 50th percentile criterion to classify high and low quality FDI firms is simple to understand and implement in empirical exercises.

Table-1 presents the scheme of classifying FDI quality based on percentile criterion for different quality indictors and measuring their presence.

Table-1
Percentile Criterion to Classify High and Low Quality FDI

Perspective on FDI Quality	*Indicators of FDI Quality*	*Percentile criterion*	*Foreign Presence Variable*
Localization of Production Perspective	Value-added as a percentage share of sales (VDINT)	1. High Quality FDI: > 50th percentile VDINT 2. Low quality FDI: ≤ 50th percentile VDINT	S_1 is the output share of high quality FDI firms. S_2 is the output share of low quality FDI firms.
Technological Perspective	R&D-intensity (RDINT)	1. High Quality FDI: > 50th percentile RDINT 2. Low quality FDI: ≤ 50th percentile RDINT	
Market-orientation Perspective	Export Intensity (EXPOINT)	1. High Quality FDI: > 50th percentile EXPOINT 2. Low quality FDI: ≤ 50th percentile EXPOINT	

Following the percentile criterion we have two measures of foreign presence S_1 and S_2 as given below:

$$s_{1j} = \frac{\sum_{\eta} y_{\eta j}^{fH}}{\sum_{i} y_{ij}} \quad ; \quad s_{2j} = \frac{\sum_{\varsigma} y_{\varsigma j}^{fL}}{\sum_{i} y_{ij}} \qquad \ldots \ldots \ldots (1.2)$$

$$j = 1 \ldots\ldots\ldots N$$

Where y^{fH} denotes output of a high quality FDI firm and y^{fL} indicates output of a low quality FDI firm as identified by the percentile criterion. Thus, S_1 and S_2

[2] The 50th percentile value is also known as median value of a distribution and serves as a measure of central tendency or an average.

respectively represent presence of high quality and low quality FDI firms in *j*th industry. Now, replacing S by S_1 and S_2 in equation (1.1) we obtain the empirical framework which takes into account quality aspect of FDI. Thus, the estimable model to examine intra-industry knowledge spillovers from quality of FDI becomes:

$$y_{ijt}^{d} = \sum_{k=1}^{m} \beta_k x_{kijt}^{d} + \sum_{\ell=1}^{p} \chi_\ell x_{\ell jt} + \alpha_1 S_{1jt} + \alpha_2 S_{2jt} + \varepsilon_{it} \qquad \text{... ... (1.3)}$$

$$i = 1.....n;\ j = 1....N;\ t = 1.....T$$

The above-given empirical model can be estimated for each individual indicator of quality of FDI. The signs, significance and fully standardized coefficients of s_1 and s_2 can be used to make inference on the quality aspect of FDI in knowledge spillovers in host economies.

3.1.1. Composite Perspective of FDI Quality

Since there are several indicators of the quality of FDI it becomes difficult to classify an FDI project as high quality than other FDI projects merely with reference to an individual indicator. For example, consider a situation where FDI project A is market-seeking but doing more local R&D than FDI project B which is export-oriented. In this case, in terms of market-orientation criterion, FDI project B is high quality than Project A but the reverse is true in the case of technology creation criterion. Thus, it is important to take into account all the relevant indicators of FDI quality while classifying an FDI project/firm into high quality or low quality FDI. This necessitates that the analysis should construct a composite index of FDI quality for exploring the link between quality and spillovers.

The method of principal component analysis (PCA) can be used to construct the composite index of FDI quality. This method is quite a popular method in social sciences to summarize a large number of inter-related variables (associated with a particular phenomenon) into a smaller number of uncorrelated composite variables (Dunteman, 1989). The set of original variables are first standardized and then are aggregated into the composite variable by providing weights known as 'factor loadings'. These weights are in fact correlation coefficients of the variables with the constructed principal component. The first principal component explains the maximum variance in the set of standardized indicators while the second component explicates the maximum in the residual variance (i.e., variance not explained by the first component) and so on. In many empirical situations, the first principal component may explain a moderate level of variation, let's say it accounts about less than half of the total variation that exists in the original indicator matrix. In that situation, the first principal component alone may not serve as a suitable composite index. Thus, it is essential to further combine different principal components to increase the explanatory power of the composite index. Since we are interested in accounting for 100 per cent variation in the indicator matrix into the composite index, all the principal components may be further aggregated by using eigen values as weights to obtain the composite index. The composite index, thus, can be derived as follows:

$$Composite\ Index\ of\ FDI\ Quality = \frac{\sum_{1}^{q} l_i P_i}{\sum_{1}^{q} l_i} \qquad \text{... ... ... (1.4)}$$

Where P_i and l_i respectively denote the *i*th principal component and its eigen value. Using eigen values as weights in aggregation is justifiable as they provide lower weight to successive factors extracted in accordance with their variance explaining power.

Now obtaining the aggregate FDI quality index for foreign firms at individual industry level, the percentile criterion can be followed to classify high and low quality FDI firms based on the vector of composite FDI quality index.

3.2. Inter-industry (Vertical) Knowledge Spillovers

The literature on inter-industry spillovers focuses on how the productivity of domestic firms in an industry is being affected by the presence of foreign firms in another industry. In the case of forward linkages, domestic firms in industry A utilize the output of foreign firms in industry B as raw materials and inputs. Hence, forward linkage effects are related to domestic firms as customers of foreign firms and the importance of the products of foreign firms as inputs into the production of the output of the domestic firms. For backward linkages, foreign firms in sector B consume the output produce by domestic firms in sector A. In this view, foreign firms are a source of derived demand and domestic firms are suppliers of raw materials to them.

The existing literature utilizes an input-output based measure of inter-industry linkages and specifically the backward linkage foreign presence (BLFP) is constructed as follows:

$$BLFP_{jt} = \sum_{k=1;k\neq j}^{N} s_{jkt} a_{jk} \quad \text{... ... ... (1.5)}$$

Where S_{jkt} is the output share of all foreign firms in *k*th industry; N is the number of total industries; a_{jk} is the input coefficient of *k*th industry taken from the industry-level Input-Output Tables and it represents the proportion of *j*th industry output used as input in *k*th industry.

As in the case of intra-industry spillovers, the construction of backward linkage foreign presence (BLFP) variable in (1.5) treats all foreign enterprises as homogeneous in generating inputs demand for local raw materials. However, foreign enterprises differ in their propensities to generate demand for domestic intermediates and materials. There may be foreign firms disproportionately relying more on imports of raw materials and hence have lower level of backward linkages in the host economy than other foreign firms. Since the existing studies have not utilized the actual spending of foreign firms on sourcing local raw materials, this quality aspect of FDI is still not incorporated into the analysis.

The present study suggests that researchers should look at the distribution of foreign firms on their propensity to use local raw materials in their production process. This propensity can be calculated as the percentage share of spending on local raw materials to total raw material expenses incurred (DRAWINT). Based on the distribution of foreign firms on this indicator at individual industry, high quality FDI firms can be defined by the percentile criterion. Foreign firms with local raw material propensities up to the 50^{th} percentile may be taken as low FDI firms and rest foreign firms can be tagged as high quality FDI as far as the extent of backward linkage generation is concerned. Corresponding to these two categories of FDI, now there are two kinds of BLFPs:

$$BLFP_{1jt} = \sum_{k=1;k\neq j}^{N} s_{jkt}^{H} a_{jk} \; ; \; BLFP_{2jt} = \sum_{k=1;k\neq j}^{N} s_{jkt}^{L} a_{jk} \quad \text{... ... ... (1.6)}$$

Where S^{H}_{jkt} *and* S^{L}_{jkt} respectively denote the output share of high and low quality foreign firms in *k*th industry; $BLFP_1$ and $BLFP_2$ represent backward linkage foreign presence variable for high and low quality FDI.

4. An Empirical Exercise in Constructing FDI Quality Variables

After suggesting modifications to the existing empirical framework to incorporate quality as an aspect of FDI, the study has demonstrated how the individual and composite FDI quality index can be constructed for the knowledge spillovers analysis. The study, however, does not examine the link between FDI quality indicators and productivity of domestic firms and the task is left to researchers dealing with FDI spillover issue.

The study has drawn upon the PROWESS database of the Centre for Monitoring Indian Economy (2005) for the empirical analysis. First, it abstracted firm level financial information on Indian manufacturing firms from the said database. This database covers all companies traded on India's major stock exchanges and a limited number of unlisted companies and provides comprehensive financial information on them. After abstracting data on about 5034 manufacturing companies, these companies are later grouped into 18 major industries utilizing firm level activity description available in the PROWESS. This industrial classification is based on ISIC Rev.3, which is similar to the National Industrial Classification 1998. For classifying foreign firms we have adopted the 10 per cent criterion of foreign ownership. An enterprise is termed as a foreign enterprise if foreign investors own 10 per cent or more of its ordinary shares or voting power. The information on the equity share of foreign promoters is for latest available year for a firm. Surely this is a notable limitation in classifying foreign firms but we don’t have an alternative since the PROWESS furnished latest year information on this variable starting since March 2001. For earlier years, this data includes both foreign direct investors as well as foreign portfolio investors in calculating foreign equity share. Further in certain cases the PROWESS puts zero if foreign ownership data is not available and in that case the study has utilized the available information on foreign business houses operating in India to classify a foreign firm. If a firm is found to be a subsidiary of foreign houses then it is classified as a foreign firm. In the analysis, a total of four industries, namely Office, accounting and computing machinery, Ships and boats, railroad equipment, and transport equipment, n.e.c., Other manufacturing, and Diversified industrial groups were dropped due to limited number of foreign firms in them. Respectively, there are 4, 3, 2 and 3 foreign firms in these industries.

4.1. Industrial Patterns of Critical Percentile Values to Classify High and Low Quality FDI Firms

Utilizing the above mentioned database of foreign firms broken down into 14 major industries the study has classified high and low quality FDI firms based on the 50th percentile criterion. Table-2 presents the estimated 50th percentile values of different FDI quality indicators across industries. These critical values of FDI quality have been obtained from industry-wise distribution of foreign firms on each indicator of FDI quality. The particular quality indicator is a vector of firm-specific unbalanced averages during 1991–2005 for a particular industry.

Table-2 shows that there exist substantial differences among FDI firms in terms of quality and across industries. For each industry, one-half of its total firms have a value larger than the reported 50th percentile value of an indicator and another half falls below it. So treating all foreign firms as homogeneous in quality makes little sense if one is dealing with the knowledge-spillovers from FDI to domestic firms. For example, the 50th percentile value of VDINT is 14 per cent in the case of Food products, beverages and tobacco. This suggest that 31 foreign firms in this industry have local value-addition accounting for more than 14 per cent of their sales whereas the local value-addition activities of another 31 foreign firms fall below 14 per cent of their sales. In this case, the first 31 foreign firms with higher intensity to engage in local value-added activities are likely to have a different impact on local economy than the last 31 foreign firms.

Table-2
Industry-wise 50th percentile values to classify high and low quality FDI firms

NIC Code	*Description*	*50th percentile value*				
		Intra-industry FDI Quality Indicators				*Inter-Industry Quality Indicator*
		VDINT	*RDINT*	*EXPOINT*	*Composite Index*	*DRAWINT*
15	Food products, beverages and tobacco	14.3801 (62)	0 (62)	2.284528 (62)	-.1809795 (62)	99.19001 (60)
17	Textiles, textile products, leather and footwear	18.15854 (36)	0 (36)	50.54094 (36)	-.169989 (36)	89.62704 (35)
20	Wood, pulp, paper, paper products, printing and publishing	18.18182 (13)	0 (13)	.5274292 (13)	-.2535211 (13)	65.55882 (12)
23	Coke, refined petroleum products and nuclear fuel	10.70647 (8)	.0462124 (8)	.2229916 (8)	-.5075033 (8)	65.08763 (8)
24	Chemicals excluding pharmaceuticals	17.49686 (78)	.0994681 (78)	3.503426 (78)	-.0816123 (78)	78.85132 (74)
25	Rubber and plastics products	17.78897 (25)	0 25	7.190496 25	.0837118 25	86.49535 25

contd...

NIC Code	Description	*50th percentile value*				
		Intra-industry FDI Quality Indicators				*Inter-Industry Quality Indicator*
		VDINT	*RDINT*	*EXPOINT*	*Composite Index*	*DRAWINT*
26	Other non-metallic mineral products	22.79402 (20)	0 (20)	5.659491 (20)	-.2326605 (20)	95.97891 (20)
27	Basic metals and fabricated metal products	16.97937 (40)	0 (40)	5.595076 (40)	-.0809635 (40)	86.32971 (40)
29	Machinery and equipment, n.e.c.	24.24617 (69)	.0618032 (69)	7.306516 (69)	-.2224885 (69)	86.89447 (67)
31	Electrical machinery and apparatus, n.e.c.	21.45061 (24)	0 (24)	6.899093 (24)	-.0127191 (24)	81.45389 (23)
32	Radio, TV and communications equipment	23.61684 (21)	0 (21)	8.259376 (21)	-.0754482 (21)	59.24458 (21)
33	Medical, precision and optical instruments	23.58356 (12)	.0609362 (12)	8.881016 (12)	-.2812786 (12)	52.65641 (12)
34	Motor vehicles, trailers and semi-trailers	22.19744 (48)	.257134 (48)	4.450254 (48)	-.1985155 (48)	81.35543 (48)
2423	Pharmaceuticals	22.6396 (50)	.3554798 (50)	5.206902 (50)	-.1542149 (50)	75.21823 (49)

Source: Computation based on Prowess Database (2005), CMIE.

Note: The total number of foreign firms in a particular industry is provided in the parenthesis.
VDINT- Value-added as a percentage share of sales, RDINT- R&D expenses as percentage share of sales and EXPOINT- exports as percentage share of sales, DRAWINT-spending on domestic raw materials as a percentage of total raw material expenses.

Among industries, the critical values for vertically integrated structure of foreign firms shows that these firms in the technology-intensive sectors like Machinery and equipment, n.e.c., Radio, TV and communications equipment, Medical, precision and optical instruments, Pharmaceuticals, Motor vehicles, trailers and semi-trailers, and Electrical machinery and apparatus, n.e.c., have relatively greater degrees of vertical integration in the host economy than low-technology industries such as Wood, pulp, paper, paper products, printing and publishing, Textiles, textile products, leather and footwear, Rubber and plastics products, Basic metals and fabricated metal products, Food products, beverages and tobacco, Coke, refined petroleum products and nuclear fuel. Foreign firms in the above-mentioned high technology industries have a median vertical integration ratio in the range of 21 per cent to 24 per cent whereas in the said low technology industries their median vertical integration falls below 19 per cent. This result suggests that FDI into technology-intensive sectors have higher intensity to get vertically integrated in a host economy than that into low-technology industries. However, there are exceptions to this general picture. Foreign firms in a low technology industry like Other non-metallic mineral products have relatively high degree of vertical integration (around 23 per cent) whereas in a technology-intensive industry like Chemicals they have relatively low level of vertical integration (17.5 per cent).

The quality of FDI in India in terms of local R&D activities is remarkably low. One-half of foreign firms in as many as 8 industries from a total of 14 industries do not do any local R&D activities. These industries include two technology-intensive industries like Radio, TV and communications equipment and Electrical machinery and apparatus, n.e.c., and six low technology-intensive industries like Other non-metallic mineral products, Wood, pulp, paper, paper products, printing and publishing, Textiles, textile products, leather and footwear, Rubber and plastics products, Basic metals and fabricated metal products and Food products, beverages and tobacco. In other six industries where they spent on R&D like Pharmaceuticals, Motor vehicles, trailers and semi-trailers, Chemicals, Machinery and equipment, n.e.c., Medical, precision and optical instruments and Coke, refined petroleum products and nuclear fuel, in terms of sales that spending is insignificant (less than 1 per cent level).

The extent of overall market-orientation of foreign firms varies across industries. Foreign firms in Textiles, textile products, leather and footwear have emerged as high quality FDI firms with a median export of 50 per cent of their sales. They are followed by foreign firms in Medical, precision and optical instruments and Radio, TV and communications equipment with median export intensity of 9 per cent and 8 per cent respectively. In terms of export intensity, low quality foreign firms are concentrated in four industries, namely Motor vehicles, trailers and semi-trailers, Chemicals, Food products, beverages and tobacco, Wood, pulp, paper, paper products, printing and publishing and Coke, refined petroleum products and nuclear fuel, where half of the foreign firms exports less than 5 per cent of their sales.

The composite horizontal quality index has been constructed following equation (1.4). The summary results on industry-wise principal component analysis has been furnished in Appendix Table-A1. It can be seen that the first principal component has an explanatory power in the range of 36 per cent (for industry with NIC code 15) to 67 per cent (for industry with NIC code 33). Obviously using the first principal component alone would have left a significant proportion of variation in the indicator matrix unaccounted. The aggregation presented in equation (1.4) thus helps in checking this drawback. The constructed composite index of FDI quality indicate that foreign firms in industries such as Rubber and plastics products, Electrical machinery and apparatus, n.e.c., Radio, TV and communications equipment, Basic metals and fabricated metal products, Chemicals and Pharmaceuticals are high quality FDI firms by descending order. Coke, refined petroleum products and nuclear fuel, Medical, precision and optical instruments and Wood, pulp, paper, paper products, printing and publishing represents bottoming out of FDI quality by an ascending order.

Among all the indicators of FDI quality, foreign firms' performance on sourcing raw materials and intermediates from downstream domestic suppliers has been significantly very high. There are eight industries such as Food products, beverages and tobacco, Other non-metallic mineral products, Textiles, textile products, leather and footwear, Machinery and equipment, n.e.c., Rubber and plastics products, Basic metals and fabricated metal products, Electrical machinery and apparatus, n.e.c., and Motor vehicles, trailers and semi-trailers where more than 80 per cent of raw materials purchase of foreign firms are from domestic sources. Foreign firms' median expenditure on local inputs in Chemicals and Pharmaceuticals are 79 and 75 per cent respectively. The lowest spending share is about 53 per cent in the case of Medical, precision and optical instruments.

4.2. Industrial Patterns of Constructed Spillover Variables

After identifying high and low quality FDI firms based on percentile critical values reported in Table-2, different horizontal spillover variables were constructed following the equation (1.2). Basically, these spillover variables are percentage share of high quality and low quality FDI firms in an industry sale and are summarized in Table-3. It can be seen that high quality FDI firms, on an average, account for a greater share of industry sales at aggregate manufacturing level than their low quality counterparts on two quality indicators (export-orientation and R&D-intensity) as well as on composite quality index. For example, on export-orientation indicator high quality FDI firms account for about 13.2 per cent of the total manufacturing sales whereas low quality firms just about 7.6 per cent sales share. In the case of vertical integration, the sales share of high quality and low quality FDI firms differ marginally for the total manufacturing sector.

The differences between high and low quality FDI firms in industry sales become more pronounced at individual industries and across quality indicators. In terms of export-orientation, the sales share of high quality FDI firms exceeds that of low quality firms in eight industries (industry codes—27, 15, 34, 20, 24, 31, 26, and 33), equals in two industries (industry codes—29 and 25) and falls behind in four industries (industry codes—2423, 17, 23, and 32). Of the fourteen individual industries, high quality firms had greater share of industry sales than low quality FDI firms in twelve industries, equals in one industry (industry codes—27) and is lower in just one industry (industry codes—33) based on R&D quality indicator. For vertical integration, high quality FDI firms had relatively higher industry sales in seven industries (industry codes—20, 17, 15, 2423, 31, 24, and 29), nearly equal in one industry (industry codes—26) and relatively lower in six industries (industry codes—27, 25, 34, 23, 33, and 32). Taking all the three quality indicators together, relatively higher sales share of high quality FDI can be observed in a total of eight industries (industry codes—23, 15, 17, 20, 31, 29, 24, and 25) and relatively lower shares in remaining six industries (industry codes—34, 33, 27, 2423, 26, and 32).

The above findings, both at aggregate manufacturing and individual industry levels indicate that spillovers variables associated with high and low quality FDI firms are substantially different with respect to industry sales and that spillover analysis must take account of such quality differences.

Table-3
Summary of horizontal FDI quality variables over 1991–2005

Industry Code	*Statistics*	*Industry sales share of foreign firms based on quality indicators (%)*							
		EXPOINT		*RDINT*		*VDINT*		*Based on Composite Perspective*	
		LQ FDI	*HQ FDI*	*LQ FDI*	*HQ FDI*	*LQ FDI*	*HQ FDI*	*LQ FDI*	*HQ FDI*
15	Min	2.6	26.9	1.7	27.9	4.9	24.7	2.5	26.6
	Mean	4.5	34.4	2.5	36.4	7.0	31.8	4.3	34.6
	Max	6.4	43.1	3.2	46.6	10.3	39.3	5.4	44.0
	S.D.	1.2	5.6	0.4	6.3	1.7	4.8	1.0	5.9
17	Min	4.1	1.3	1.2	4.7	0.1	5.8	0.1	5.9
	Mean	5.1	2.7	2.2	5.6	1.2	6.6	1.1	6.7
	Max	7.4	3.6	4.8	6.3	3.0	7.1	2.9	7.2
	S.D.	0.9	0.7	1.1	0.4	0.9	0.4	0.9	0.4
20	Min	1.7	3.2	1.2	3.4	0.3	4.2	0.9	3.9
	Mean	2.3	6.6	2.7	6.2	1.2	7.8	1.6	7.4
	Max	3.1	8.9	4.3	8.2	2.4	9.9	2.7	9.6
	S.D.	0.4	1.7	0.9	1.7	0.7	1.5	0.6	1.6
23	Min	2.3	0.4	0.1	2.8	2.2	0.4	0.1	2.8
	Mean	3.0	0.7	0.1	3.5	3.0	0.7	0.1	3.5
	Max	4.2	1.0	0.2	4.6	4.2	1.1	0.2	4.6
	S.D.	0.6	0.2	0.0	0.5	0.6	0.2	0.0	0.5
24	Min	5.9	12.2	3.8	14.5	7.0	11.4	6.9	9.5
	Mean	7.3	15.7	4.7	18.4	8.5	14.5	9.2	13.8
	Max	9.9	18.8	5.7	21.3	11.0	17.3	12.8	17.1
	S.D.	1.2	2.7	0.6	2.3	1.2	2.3	1.7	3.1
25	Min	5.8	3.6	0.8	8.4	5.3	1.6	4.9	3.3
	Mean	6.9	7.2	2.3	11.7	8.8	5.3	6.1	8.0

contd...

Industry Code	*Statistics*	*Industry sales share of foreign firms based on quality indicators (%)*							
		EXPOINT		*RDINT*		*VDINT*		*Based on Composite Perspective*	
		LQ FDI	*HQ FDI*	*LQ FDI*	*HQ FDI*	*LQ FDI*	*HQ FDI*	*LQ FDI*	*HQ FDI*
	Max	8.5	12.9	3.5	18.5	17.9	7.2	7.6	12.7
	S.D.	0.9	3.5	0.8	3.5	4.1	1.5	0.8	3.0
26	Min	1.1	3.0	0.5	3.7	2.3	1.9	2.3	1.7
	Mean	2.8	4.4	2.7	4.5	3.8	3.3	4.9	2.3
	Max	4.7	5.6	3.9	5.6	4.7	4.9	6.5	2.7
	S.D.	1.2	0.7	0.9	0.7	0.6	1.0	1.1	0.3
27	Min	0.5	2.8	1.8	2.0	2.2	1.6	1.4	2.3
	Mean	1.0	8.8	4.6	5.1	5.9	3.8	5.7	4.1
	Max	2.1	15.4	8.4	9.1	11.6	5.9	10.6	7.0
	S.D.	0.4	3.9	1.8	2.4	2.9	1.4	2.7	1.3
29	Min	8.3	9.9	3.7	14.5	6.1	11.8	5.4	12.8
	Mean	10.7	11.3	5.3	16.7	8.9	13.0	7.3	14.6
	Max	13.3	13.7	6.6	19.4	12.3	15.1	9.1	17.1
	S.D.	1.7	1.0	0.8	1.6	2.0	0.9	1.1	1.2
31	Min	8.4	16.6	2.6	23.1	8.2	17.8	8.2	17.8
	Mean	11.3	22.1	5.3	28.1	9.0	24.4	9.0	24.4
	Max	14.1	31.9	10.9	39.9	10.5	35.0	10.5	35.0
	S.D.	1.8	3.9	2.6	4.7	0.7	4.5	0.7	4.5
32	Min	13.9	2.1	0.3	12.1	15.5	0.7	15.5	0.7
	Mean	16.0	3.2	3.4	15.9	18.0	1.2	18.0	1.2
	Max	21.0	6.5	6.5	18.3	22.1	2.3	22.1	2.3
	S.D.	1.8	1.1	2.2	1.9	2.0	0.5	2.0	0.5
33	Min	6.7	10.0	10.0	5.2	18.0	0.0	11.8	3.8
	Mean	12.5	15.9	17.5	11.0	23.3	5.2	16.2	12.2
	Max	17.2	22.8	24.2	14.5	27.2	9.1	19.9	16.3
	S.D.	2.8	3.2	4.2	2.7	2.9	3.2	2.4	3.6
34	Min	4.8	34.2	3.5	30.9	30.7	7.5	20.1	15.9
	Mean	6.0	37.8	7.6	36.1	35.4	8.3	24.0	19.8
	Max	8.1	41.8	15.0	40.3	40.2	9.1	28.1	24.6
	S.D.	1.2	2.5	4.6	2.6	3.4	0.5	2.5	2.9
2423	Min	9.3	11.5	2.6	18.2	1.3	19.8	10.2	10.6
	Mean	17.5	14.3	7.0	24.9	6.0	25.8	19.5	12.3
	Max	29.8	18.6	11.8	36.7	9.4	39.0	32.6	15.8
	S.D.	6.7	1.9	2.8	5.8	2.6	6.3	7.5	1.4
Total	Min	0.5	0.4	0.1	2.0	0.1	0.0	0.1	0.7
	Mean	7.6	13.2	4.8	16.0	10.0	10.8	9.1	11.8
	Max	29.8	43.1	24.2	46.6	40.2	39.3	32.6	44.0
	S.D.	5.5	11.4	4.5	11.5	9.4	9.9	7.6	9.4

Source: Authors estimation; EXPOINT: Based on Market-orientation Perspective; RDINT: Based on Technological Perspective; VDINT: Based on Localization of Production Perspective; LQ FDI: Low Quality FDI; HQ FDI; High Quality FDI.

5. Concluding Remarks

The existing literature on knowledge spillovers from FDI and host country productivity growth tends to treats all foreign firms as homogeneous and that they all are equally important for knowledge spillovers from FDI to transpire. However, this assumption is at odds with the reality where foreign firms essentially differ in developmental quality for the recipient countries. They differ in terms of export-orientation, intensity to undertake local R&D activities, vertical integration, generating demands for local raw materials and entry modes. This paper has explored different notion of FDI quality and argued that it should be included in empirical studies on spillover analysis.

The paper has conceptualized the quality of FDI in terms of five dimensions and identified suitable indicators. It has introduced the percentile criterion for segregating high quality FDI firms from low quality FDI firms in an industry. This criterion is simple to understand and easy to implement in empirical situation. It has argued for constructing a composite index of FDI quality and suggested the use of principal component analysis (PCA) for this purpose. It has shown required modifications in the existing empirical methodology to take account of quality dimension into the spillover analysis.

The paper undertook an empirical exercise to show the construction of spillover variables taking into account quality differences that exist among foreign firms. This has been shown for Indian manufacturing sector. The results suggest that differences between the spillover variables associated with low and high quality FDI firms are substantial and more pronounced across individual industries. Ignoring such evident differences in the quality of FDI firms, researchers searching for knowledge-spillovers from FDI are likely to encounter biased and inaccurate empirical results. Obviously, the paper has not endeavoured to examine how quality has affected the productivity of domestic sector, which would require dealing with issues in constructing capital stocks for domestic firms/industries, calculating employment figure, etc., which are not available in database used in the paper and we have left this task for concerned researchers to do. Nevertheless, the basic premise of the paper stands clear and undeniable that foreign firms are essentially non-homogeneous in terms of quality to generate knowledge-spillovers and such differences must be brought into spillover analysis.

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Appendix

Table-A1
Summary Results from Industry-wise PCA Analysis

<table>
<tr><th>Industry Code</th><th>Obs.</th><th>Principal Components, Total Variance Explained and Factor Loadings</th></tr>
<tr><td>15</td><td>62</td><td>
A. Eigenvalue and Total Variance Explained
<table>
<tr><th>Component</th><th>Eigenvalue</th><th>Difference</th><th>Proportion</th><th>Cumulative</th></tr>
<tr><td>1</td><td>1.07797</td><td>0.06625</td><td>0.3593</td><td>0.3593</td></tr>
<tr><td>2</td><td>1.01172</td><td>0.10142</td><td>0.3372</td><td>0.6966</td></tr>
<tr><td>3</td><td>0.91030</td><td>.</td><td>0.3034</td><td>1.0000</td></tr>
</table>
B. Factors Loadings
<table>
<tr><th rowspan="2">Variable</th><th colspan="3">Eigenvectors</th></tr>
<tr><th>1</th><th>2</th><th>3</th></tr>
<tr><td>VDINT</td><td>0.62145</td><td>0.49592</td><td>-0.60652</td></tr>
<tr><td>RDINT</td><td>-0.28785</td><td>0.86454</td><td>0.41196</td></tr>
<tr><td>EXPOINT</td><td>0.72866</td><td>-0.08142</td><td>0.68002</td></tr>
</table>
</td></tr>
<tr><td>17</td><td>36</td><td>
A. Eigenvalue and Total Variance Explained
<table>
<tr><th>Component</th><th>Eigenvalue</th><th>Difference</th><th>Proportion</th><th>Cumulative</th></tr>
<tr><td>1</td><td>1.57688</td><td>0.75431</td><td>0.5256</td><td>0.5256</td></tr>
<tr><td>2</td><td>0.82258</td><td>0.22203</td><td>0.2742</td><td>0.7998</td></tr>
<tr><td>3</td><td>0.60054</td><td>.</td><td>0.2002</td><td>1.0000</td></tr>
</table>
B. Factors Loadings
<table>
<tr><th rowspan="2">Variable</th><th colspan="3">Eigenvectors</th></tr>
<tr><th>1</th><th>2</th><th>3</th></tr>
<tr><td>VDINT</td><td>0.57813</td><td>0.57393</td><td>-0.57998</td></tr>
<tr><td>RDINT</td><td>0.63676</td><td>0.12712</td><td>0.76051</td></tr>
<tr><td>EXPOINT</td><td>-0.51020</td><td>0.80898</td><td>0.29196</td></tr>
</table>
</td></tr>
<tr><td>20</td><td>13</td><td>
A. Eigenvalue and Total Variance Explained
<table>
<tr><th>Component</th><th>Eigenvalue</th><th>Difference</th><th>Proportion</th><th>Cumulative</th></tr>
<tr><td>1</td><td>1.25403</td><td>0.15896</td><td>0.4180</td><td>0.4180</td></tr>
<tr><td>2</td><td>1.09507</td><td>0.44417</td><td>0.3650</td><td>0.7830</td></tr>
<tr><td>3</td><td>0.65090</td><td>-</td><td>0.2170</td><td>1.0000</td></tr>
</table>
B. Factors Loadings
<table>
<tr><th rowspan="2">Variable</th><th colspan="3">Eigenvectors</th></tr>
<tr><th>1</th><th>2</th><th>3</th></tr>
<tr><td>VDINT</td><td>0.74459</td><td>0.18199</td><td>-0.64223</td></tr>
<tr><td>RDINT</td><td>0.20392</td><td>0.85411</td><td>0.47845</td></tr>
<tr><td>EXPOINT</td><td>0.63561</td><td>-0.48722</td><td>0.59885</td></tr>
</table>
</td></tr>
<tr><td>23</td><td>8</td><td>
A. Eigenvalue and Total Variance Explained
<table>
<tr><th>Component</th><th>Eigenvalue</th><th>Difference</th><th>Proportion</th><th>Cumulative</th></tr>
<tr><td>1</td><td>1.97620</td><td>1.00296</td><td>0.6587</td><td>0.6587</td></tr>
<tr><td>2</td><td>0.97324</td><td>0.92269</td><td>0.3244</td><td>0.9831</td></tr>
<tr><td>3</td><td>0.05056</td><td>-</td><td>0.0169</td><td>1.0000</td></tr>
</table>
</td></tr>
</table>

Industry Code	Obs.	Principal Components, Total Variance Explained and Factor Loadings

B. Factors Loadings

Variable	Eigenvectors		
	1	2	3
VDINT	0.70192	-0.02721	-0.71173
RDINT	0.29344	0.92157	0.25416
EXPOINT	0.64900	-0.38725	0.65486

Industry Code: 24 — Obs.: 78

A. Eigenvalue and Total Variance Explained

Component	Eigenvalue	Difference	Proportion	Cumulative
1	1.41007	0.40209	0.4700	0.4700
2	1.00797	0.42601	0.3360	0.8060
3	0.58196	.	0.1940	1.0000

B. Factors Loadings

Variable	Eigenvectors		
	1	2	3
VDINT	-0.04501	0.98861	0.14362
RDINT	0.70874	-0.06972	0.70202
EXPOINT	0.70403	0.13339	-0.69753

Industry Code: 25 — Obs.: 25

A. Eigenvalue and Total Variance Explained

Component	Eigenvalue	Difference	Proportion	Cumulative
1	1.18215	0.19554	0.3941	0.3941
2	0.98662	0.15538	0.3289	0.7229
3	0.83123	.	0.2771	1.0000

B. Factors Loadings

Variable	Eigenvectors		
	1	2	3
VDINT	0.69349	0.00316	0.72046
RDINT	-0.50039	0.72157	0.47849
EXPOINT	0.51835	0.69234	-0.50198

Industry Code: 26 — Obs.: 20

A. Eigenvalue and Total Variance Explained

Component	Eigenvalue	Difference	Proportion	Cumulative
1	1.45820	0.46875	0.4861	0.4861
2	0.98945	0.43711	0.3298	0.8159
3	0.55235	.	0.1841	1.0000

B. Factors Loadings

Variable	Eigenvectors		
	1	2	3
VDINT	0.70099	-0.07607	-0.70910
RDINT	0.15758	0.98624	0.04997
EXPOINT	0.69555	-0.14677	0.70333

Industry Code: 27 — Obs.: 40

A. Eigenvalue and Total Variance Explained

Component	Eigenvalue	Difference	Proportion	Cumulative
1	1.36962	0.42950	0.4565	0.4565
2	0.94011	0.24984	0.3134	0.7699

Industry Code	*Obs.*	*Principal Components, Total Variance Explained and Factor Loadings*

Component	Eigenvalue	Difference	Proportion	Cumulative
3	0.69027	.	0.2301	1.0000

B. Factors Loadings

Variable	*Eigenvectors*		
	1	*2*	*3*
VDINT	0.62431	-0.42415	0.65600
RDINT	0.40211	0.89445	0.19563
EXPOINT	-0.66973	0.14165	0.72897

Industry Code: 29, Obs.: 69

A. Eigenvalue and Total Variance Explained

Component	*Eigenvalue*	*Difference*	*Proportion*	*Cumulative*
1	1.28327	0.24124	0.4278	0.4278
2	1.04203	0.36732	0.3473	0.7751
3	0.67471	.	0.2249	1.0000

B. Factors Loadings

Variable	*Eigenvectors*		
	1	*2*	*3*
VDINT	0.73110	0.00716	-0.68224
RDINT	0.46600	0.72512	0.50699
EXPOINT	0.49834	-0.68858	0.52680

Industry Code: 31, Obs.: 24

A. Eigenvalue and Total Variance Explained

Component	*Eigenvalue*	*Difference*	*Proportion*	*Cumulative*
1	1.35304	0.46231	0.4510	0.4510
2	0.89073	0.13451	0.2969	0.7479
3	0.75622	.	0.2521	1.0000

B. Factors Loadings

Variable	*Eigenvectors*		
	1	*2*	*3*
VDINT	0.52577	0.76538	0.37116
RDINT	0.56224	-0.64012	0.52358
EXPOINT	0.63832	-0.06660	-0.76688

Industry Code: 32, Obs.: 21

A. Eigenvalue and Total Variance Explained

Component	*Eigenvalue*	*Difference*	*Proportion*	*Cumulative*
1	1.23714	0.24823	0.4124	0.4124
2	0.98891	0.21496	0.3296	0.7420
3	0.77395	.	0.2580	1.0000

B. Factors Loadings

Variable	*Eigenvectors*		
	1	*2*	*3*
VDINT	0.21662	0.97493	-0.05093
RDINT	-0.68659	0.18922	0.70198
EXPOINT	0.69402	-0.11709	0.71037

Industry Code: 33, Obs.: 12

A. Eigenvalue and Total Variance Explained

Component	*Eigenvalue*	*Difference*	*Proportion*	*Cumulative*
1	2.01951	1.19203	0.6732	0.6732

Industry Code	*Obs.*	*Principal Components, Total Variance Explained and Factor Loadings*				
		2	0.82748	0.67448	0.2758	0.9490
		3	0.15300	.	0.0510	1.0000
		B. Factors Loadings				
		Variable	*Eigenvectors*			
			1	*2*	*3*	
		VDINT	0.66275	0.20069	0.72145	
		RDINT	-0.38803	0.91602	0.10164	
		EXPOINT	0.64047	0.34731	-0.68497	
34	48	***A. Eigenvalue and Total Variance Explained***				
		Component	*Eigenvalue*	*Difference*	*Proportion*	*Cumulative*
		1	1.37244	0.45972	0.4575	0.4575
		2	0.91272	0.19788	0.3042	0.7617
		3	0.71484	.	0.2383	1.0000
		B. Factors Loadings				
		Variable	*Eigenvectors*			
			1	*2*	*3*	
		VDINT	0.65701	-0.08116	-0.74950	
		RDINT	0.57253	-0.59307	0.56610	
		EXPOINT	0.49046	0.80105	0.34318	
2423	50	***A. Eigenvalue and Total Variance Explained***				
		Component	*Eigenvalue*	*Difference*	*Proportion*	*Cumulative*
		1	1.50060	0.49783	0.5002	0.5002
		2	1.00277	0.50613	0.3343	0.8345
		3	0.49664	.	0.1655	1.0000
		B. Factors Loadings				
		Variable	*Eigenvectors*			
			1	*2*	*3*	
		VDINT	-0.70808	-0.00110	0.70613	
		RDINT	0.44743	0.77293	0.44987	
		EXPOINT	0.54629	-0.63449	0.54681	

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