The Comparative Capital Intensities of Joint Venture and Local Firms in Iran

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The controversial nature of the subject of foreign investment in less developed countries (LDC's) in recent years has called for more empirical research to pave the way towards the establishment of a more generally acceptable theoretical framework. One of the issues which has attracted the attention of the development economists is the question of capital intensity of foreign firms versus local firms. It has often been argued that, since foreign firms are accustomed to the use of capital intensive technology and since it is costly for them to adjust their production techniques to the conditions existing in LDC's, foreign firms tend to utilize a relatively capital intensive technology, which is not suitable for the labor-abundant LDC's (Streeten).

In a recent article, Morely and Smith have referred to the importance of environment in which foreign firms are operating. Using Brazil as a case study, they report that multinational firms operating in that country do not use a technology that is appropriate to the low-wage economy. They argue that the government's protectionism has created a "permissive environment." To protect the domestic market from foreign competition in this environment the government has granted different subsidies to foreign firms. Given this situation, foreign firms faced with the lack of competitive market in Brazil have continued to use a relatively capital intensive technology. Thus, according to the authors, the choice of inappropriate technology by multinational

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firms in Brazil is due to mismanaged government policies (Morely and Smith).

Although the above argument points out a major reason for the reluctance of the foreign firms to adapt their technology to the conditions existing in some LDC's, such an argument is not universally valid. In many LDC's the pursuit of export promotion and infant industry protection have led the government authorities to devise economic policies under which local and foreign firms are treated equally.

The case of the Iranian economy before the recent revolution provides one such example in which under the law both Iranian firms and joint venture firms are treated equally. Additionally, the government commitment to industrialization has not put the local firms at a disadvantage to joint venture firms. (MOE) Thus, it is reasonable to assume that under such policies, both local firms and joint venture firms have been subject to the same environment. In other words, we could say that if there was a "permissive Environment" for joint venture firms the same would be true for local firms.

In this paper I investigate the comparative capital intensities of Iranian American Joint Venture Firms (IAJV's) and Iranian Firms (IR's) for the 1971-1976 period. This is a period during which Iran, as the fourth largest oil producer in the world and as a member of OPEC, was experiencing a special set of economic conditions. The relative abundance of capital brought about by the increasing oil revenue in the years following 1971 facilitated the process of industrialization. The rapid industrialization of the country led Iranian entrepreneurs to increase their investment in capital-intensive goods (Tofigh). As the result, the Iranian economy changed from a low-cost to a relatively high-cost labor economy with bottleneck situations with regard to skilled labor (Aminzadeh).

Given the relative shortage of skilled labor in Iran, one could contemplate that firms with superior knowledge in the use of capital intensive technology would engineer their way out of the skilled-labor shortage problem. One could expect these to be joint venture firms, which because of their western trained managers and owners are more apt to use capital intensive technology than their local firms' counterparts.

On the basis of the above argument, in this study it is

hypothesized that:

IAJV firms have been relatively more capital intensive than their IR counterparts. This could be related to skilled labor shortage on the assumption that IAJV firms could move more easily to capital intensive design – substituting capital for labor – than their IR counterparts.

I. The Method of Analysis

Matched pair comparison is used in the analysis. The firms are compared on the basis of the following indexes:

I. Capital Intensity Index $\equiv \delta \equiv \frac{K}{L}$

where:

K = capital, defined as total value of assets at constant price.

L = Labor input.

II. Skilled Labor Intensity Index $\equiv \rho \equiv \frac{W_s}{W_u}$

W_s = total wages paid to skilled labor.

W_u = total wages paid to unskilled labor.

To compare IR firms and IAJV firms the six-year average of the established indexes of both groups of the firms are compared. The comparison is presented in the form of two different hypotheses. To test these hypotheses, since matched pairs are being compared, the Wilcoxon matched-pairs signed-ranks test is proper for this purpose. One sample receives the treatment of joint venture management and control, while the other sample receives local ownership and management control.

The Wilcoxon text gives more weight to pairs that show a large difference than to pairs indicating small differences. In this manner the Wilcoxon test is similar to the t-test, but deals with original data. This test is one of the most powerful non-parametric tests. Even for small samples its power efficiency is about 95 percent of that of the t-test (Seigel).

To conduct the Wilcoxon test, first the difference between each pair, with regard to the variables that are being compared, is computed. Then these differences are ranked on the basis of their absolute values. Next of sum of the ranks of the negative differences is used as the test statistic T.

II. The Limitations of the Study and The Sample Size

A number of writers have argued that comparative analysis is inevitably faced with some measurement problems. Hal B. Lary elaborates on these problems in relation to intersectoral and intercountry comparisons (Lary). Dunning discusses this issue in his empirical study, emphasizing that" ... problems of product heterogeneity and spread could not be entirely resolved" (Dunning). Mason provides an extensive examination of the difficulties in making interfirm comparisons (Mason). From these writings it appears that the measurement problems, in making interfirm comparisons, center around two main questions:

1) How to choose firms for comparison?
2) What kind of data should be used for compaison?

As for the first question, ideally, the two groups of firms should be similar with respect to product heterogeneity and their size. They should also operate in a similar environment and in a similar market structure, differing only in the technology they use. However, the limitation of the sample size in most of the empirical studies calls for some restrictions in choosing the firms for comparison.

Following the most acceptable criteria set by empirical studies, the pairs of firms chosen in this study consist of one IR firm and one IAJV firm having the following characteristics:

1) Operating in the same industry.
2) Producing broadly similar products.
3) Having approximately the same size.

All the data for this study was collected by the author from the individual firms that were operating in the manufacturing sector of Iran during the 1971-1976 period. A total of 11 pairs (22 individual firms) were surveyed. Table 1 shows the industrial sectors of the matched pairs selected in this study.

The second question has to do with organizational and accounting differences between the firms. These differences might lead to bias in the measurement of the capital ratios. Measurement problems could arise because the firms may use different procedures for the valuation of assets and the calculations of depreciation. Identical plants may differ in book values merely because of dif-

Table 1

THE INDUSTRIAL SECTOR OF THE PAIRS USED IN THE STUDY

Pair	Industrial Sector
1	Agriculture Machinery
2	Chemical
3	Detergent
4	Food
5	Mining
6	Motor Vehicle
7	Paper
8	Pharmaceutical
9	Home Appliances
10	Steel Structure
11	Tire

ferent price levels at the time of acquisition. Other measurement problems could be related to the differences in the age of capital and the rate of capital utilization. To minimize these problems the step taken by most researchers is to use the current replacement costs of assets, or alternatively, the insurance valuation of the fixed assets of the firms rather than their book values (Dunning and Mason). In this study the replacement cost of the assets was obtained from the firms that were surveyed.

III. The Testing of the Hypotheses

To compare the capital intensities of IR firms and IAJV firms, as was explained earlier, paired comparison is used as the method of analysis. The comparison is presented in two parts, in the form of hypothesis testing. The null and alternative hypotheses and the results of the tests for each part, at the 1 percent level of significance are:

1) H_O: The capital intensity of IR firms and IAJV firms does not differ.

   H_A: The IAJV firms have a higher capital intensity than IR firms.

Table 2 shows the results of the Wilcoxon matched pairs signed ranks test where:

$$D_k = \frac{\sum_{i=1}^{n} \delta IAJV_{ki}}{n} - \frac{\sum_{i=1}^{n} \delta IR_{ki}}{n}$$

$i = 1 \ldots 6; k = 1 \ldots 11$

$^{\delta}IAJV_{ki} \equiv$ capital intensity of the kth IAJV firm in year i.

$^{\delta}IR_{ki} \equiv$ capital intensity of the kth IR firm in year i.

Table 2

THE WILCOXON TEST FOR THE COMPARISON OF THE CAPITAL INTENSITIES OF IR FIRMS AND IAJV FIRMS

Pair	$\frac{\sum_{i=1}^{n} \delta IAJV_{ki}}{n}$	$\frac{\sum_{i=1}^{n} \delta IR_{ki}}{n}$	D_k	RD	RND
1	3.2434	1.5081	1.7353	10	
2	2.0322	1.8443	0.1879	3	
3	2.3271	1.2542	1.0729	7	
4	4.6041	3.3934	1.2107	8	
5	1.4570	1.1851	0.2719	4	
6	3.0857	1.8532	1.2325	9	
7	1.5442	1.1332	0.4110	6	
8	0.8064	0.8108	-0.0044	1	1
9	1.3629	1.1968	0.1661	2	
10	4.7127	2.8470	1.8657	11	
11	1.2274	0.9179	0.3095	5	$T = \overline{1}$

Source: Calculated from the survey data collected by the author
RD = Rank of absolute vlaue of D_k
RND = Rank of the negative D_k

This gives a T value of 1. Hence the null hypothesis is rejected at the 1 percent level of significance.

2) H_o: The skilled labor intensity of IR firms and IAJV firms does not differ.

H_A: IR firms have higher skilled labor intensity than do IAJV firms.

The above hypothesis is expected because of the conditions of labor supply in Iran. Given the increasing skilled labor shortage in Iran one would expect that IAJV firms could move more easily towards a capital intensive design, engineering their way out of skilled labor shortage problems than could IR firms.

Table 3 shows the results of the Wilcoxon test, where:

$$D_k = \frac{\sum_{i=1}^{n} \rho IR_{ki}}{n} - \frac{\sum_{i=1}^{n} \rho IAJV_{ki}}{n}$$

$i = 1 \ldots 6;\ n = 6;\ k = 1 \ldots 11$

$\rho IR_{ki} \equiv$ Skilled labor intensity of the kth IR firms in the year ith.

$\rho IAJV_{ki} \equiv$ Skilled labor intensity of the kth IAJV firms in the ith year.

This would have a T value of 4. Hence the null hypothesis is rejected at the 1 percent level of significance.

IV. Concluding Remarks

On the basis of the analysis presented in this paper it appears that IAJV firms are more capital intensive but less skilled labor intensive than their IR counterparts.

In a recent article on factor substitution, Solomon and Forsyth reach a similar conclusion as the author of this study. Using Ghana as a case study, the authors report that foreign-owned firms and the firms owned by resident expatriates employ a relatively more capital intensive but a relatively less skilled — labor intensive technology than their local firms counterparts. They explain that the differences in production technique used by foreign firms and

Table 3

THE WILCOXON TEST FOR THE COMPARISON OF THE SKILLED LABOR INTENSITY OF IR AND IAJV FIRMS

Pair	$\frac{\sum_{i=1}^{n} \rho_{IR_{ki}}}{n}$	$\frac{\sum_{i=1}^{n} \rho_{IAJV_{ki}}}{n}$	D_k	RD	RND
1	2.855	1.868	0.987	7	
2	2.138	2.013	0.125	2	
3	3.190	2.163	1.027	8	
4	3.536	1.536	2.000	11	
5	1.850	1.170	0.680	6	
6	3.458	2.003	1.455	9	
7	6.953	7.010	-0.057	1	1
8	2.466	2.193	0.273	4	
9	5.795	6.011	-0.216	3	3
10	4.201	2.616	1.585	10	
11	3.883	3.608	0.275	5	$T = \overline{4}$

Source: Calculated from the survey data collected by the author
RD = Rank of absolute value of D_k
RND = Rank of the negative D_k

local firms should be attributed to differences in "technical expertise" existing between the two groups of firms. Thus they maintain that the higher capital intensities of foreign firms should be viewed as "evidence" of their managerial ability in economizing on the use of the relatively scarce input; that is, skilled labor (Solomon and Forsyth). This would seem to be a reasonable interpretation for Iran which has been suffering from the shortage of entrepreneurial and managerial expertise (Aminzadeh).

The study of Solomon and Forsyth have explained the possible causes of the relative higher capital intensity of foreign-owned firms versus indigenous firms. This study indicates that such explanation could still be valid even when foreign firms appear in the

form of joint venture firms.

The case of the Iranian economy as an oil producing nation provides a further explanation as to the cause of the relative higher capital intensities of foreign firms versus local firms. It further indicates one of the roles that foreign investment could play in resolving an important obstacles to industrialization; that is, the shortage of managerial and technical expertise. Further research in the case of other oil-producing nations is needed to warrant any general conclusion about these countries.

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