APPROPRIATE TECHNOLOGY, *X*-INEFFICIENCY, AND A COMPETITIVE ENVIRONMENT: SOME EVIDENCE FROM PAKISTAN*

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The question of "appropriate" technology for less developed countries has received widespread attention in the last few years. The failure of industrial sector jobs in LDC's to grow as fast as the demand for them has generated high and rising apparent levels of unemployment. Policy makers and researchers have become interested in finding ways of encouraging more labor-intensive technologies. These are valued, not only for the employment that they will encourage, but also for the more favorable income distribution that is likely to result.

Much attention has been focused on measuring the potential flexibility of production technologies and on examining the financial incentives to entrepreneurs in choosing technologies. There is now a mounting body of evidence that indicates that technologies are flexible and that relative factor prices have frequently been inappropriate for reaching the goal of labor-intensive production.[1]

Recently, Wells and Ranis have generated a second hypothesis concerning appropriate technology.[2] They argue that the absence of competition in many markets in LDC's, because of import protection and fewness of domestic producers, may also discourage labor-intensive technology. Protected producers, cushioned from the cost-minimizing rigors of competition, may well "indulge" in capital-intensive production methods. If this argument is correct, it implies that procompetition (and protrade) policies in LDC's may be more beneficial than just the static deadweight loss measures would indicate. Unfortunately, this hypothesis has had only anecdotal and impressionistic support and has not really been tested.

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1. See, for example, I. Little, T. Scitovsky, and A. Scott, *Industry and Trade in Some Developing Countries* (London: Oxford University Press, 1970); and H. J. Bruton, "The Elasticity of Substitution in Developing Countries," Research Memorandum No. 45, Center for Development Economics, Williams College, April 1972.

2. See L. T. Wells, "Economic Man and Engineering Man: Choice in a Low Wage Country," *Public Policy,* XXI (Summer 1973), 319–42; and G. Ranis, "Some Observations on the Economic Framework for Optimum LDC Utilization of Technology," in *Technology, Employment, and Development,* L. J. White, Ed. (Manila: Committee for Asian Manpower Studies, 1975), pp. 58–96.

This paper will have three sections. The first will offer a partial reformulation of the Leibenstein X-inefficiency hypothesis, of which the Wells-Ranis argument is a variant.[3] This formulation will stress the distinction between monopoly and competitive market structures and will shed some light on the controversy between Schwartzman and Leibenstein concerning the relative X-efficiency of the two market structures.[4] The second section will then propose a directly testable hypothesis embodying the Wells-Ranis argument, describe the data and its limitations, and provide the econometric results. The final section will offer some conclusions from this study.

I

The strict theory of profit-maximizing entrepreneurial behavior predicts, of course, that entrepreneurs will always seek out the most efficient technology available. But Leibenstein has argued that firms are unlikely to achieve perfect technical efficiency and that the departure from complete technical efficiency, or X-inefficiency, is likely to be greatest in monopolies or firms with market power, where the strict discipline of competition is absent. Earlier, Scitovsky had recognized that entrepreneurs faced a tradeoff between profits and leisure and that they would choose between them on the basis of an overall utility framework.[5] This too implied that "simple" profit maximization and cost minimization did not provide a complete enough picture.

Let us try to reframe the X-inefficiency argument in the spirit of the Scitovsky analysis. The activities of an enterprise yield both net pecuniary rewards (revenues minus monetary costs, or profits) and net nonpecuniary rewards (prestige and satisfactions of running an enterprise, less the time and effort involved in management). Suppose that we can collapse the net nonpecuniary benefits into a single measure, which will be labeled *NNPB.* With a given output price, a given technology, and a given set of input prices, an entrepreneur faces a tradeoff between profits and *NNPB.*[6] A higher level of effort is required to attain lower costs (e.g., supervise employees

3. See H. Leibenstein, "Allocative Efficiency vs. X-Inefficiency," *American Economic Review,* LVI (June 1966), 392–415.

4. See D. Schwartzman, "Competition and Efficiency: Comment," *Journal of Political Economy,* LXXXI (May/June 1973), 756–64; and H. Leibenstein, "Competition and X-Efficiency: Reply," *Journal of Political Economy,* LXXXI (May/June 1973), 765–77.

5. See T. Scitovsky, "A Note on Profit Maximization and Its Implications," *Review of Economic Studies,* XI (1943), 57–60.

6. Profits should be properly expressed as a rate of return on invested capital.

more closely, think harder about cost-saving methods, and spend more time evaluating information so as to make better decisions) and hence to achieve greater profitability. This higher level of effort means lower *NNPB*. Thus, there is a tradeoff, at any given output price, between profitability and *NNPB*.[7] This tradeoff at a price P_1, can be represented in Figure I by curve T_1. As the output price rises, the profitability-*NNPB* possibility frontier moves outward, as represented by

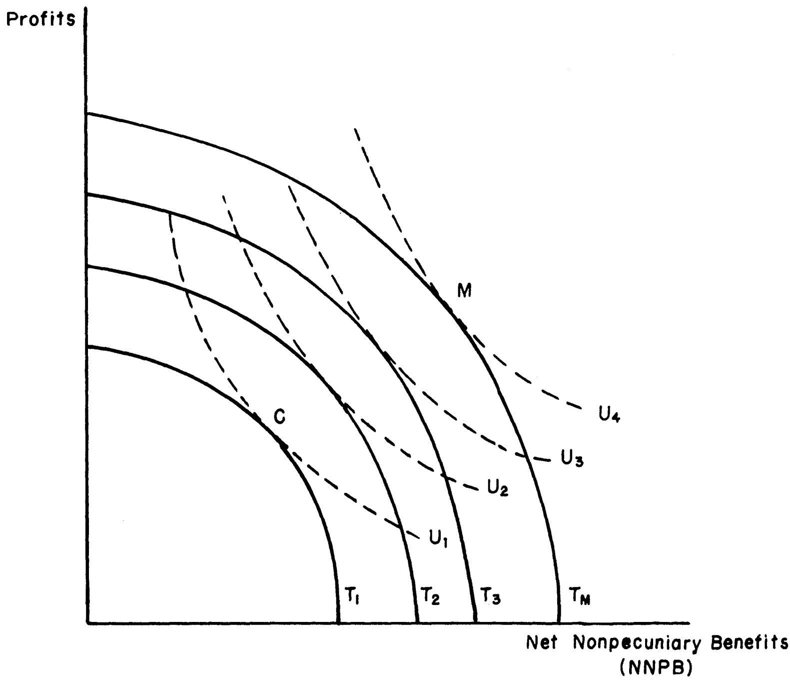

FIGURE I

curves T_2 and T_3. The outermost position that this frontier can reach is that yielded by a monopoly. The monopoly price, however, is somewhat more ambiguous than the usual case where maximum efficiency is assumed. If the entrepreneur's efforts can affect marginal costs, then the desired monopoly price will depend on the level of

7. To the extent that there is satisfaction in a job well done and that profitability is a measure of how well done the job is, there may be a range over which rising *NNPB* and rising profitability are consistent. But at some point, the extra effort to squeeze out extra profits will overtake this satisfaction, and the negative tradeoff will assert itself. It is this range with which we are concerned.

NNPB.[8] We can draw an envelope, though, of all the best possible profitability-*NNPB* points achievable by the monopolist (at different prices). This locus is represented by curve T_M. Note that, if the demand curve for the product changes, the other T curves will not change (since they represent the locus at any given price) but the T_M curve does change (because the marginal revenue schedule has changed). If new technologies become available or if factor prices change, all curves will change. Finally, if one entrepreneur is more competent than another, the better entrepreneur's profitability-*NNPB* locus will lie outside that of the other for any given output price.

The curves described so far represent frontiers of achievable points at different price levels. We can now ask a different question: How will entrepreneurs value the various combinations of profitability and *NNPB*? We can draw a set of indifference curves representing an entrepreneur's utility function. They should have the normal convex shape.[9] These are also represented on Figure I. There will presumably be some minimum level of satisfaction that an entrepreneur will require to remain in the industry. This is represented by curve U_1. Note that there is not a unique "normal" profit level (as is the case in the standard model), but rather a set of profitability-*NNPB* combinations, all of which would be satisfactory enough to keep the entrepreneur in the industry.

To compare the equilibrium outcome of a competitive and monopoly market structure, let us first assume that all entrepreneurs are identical in their competence (i.e., in their ability to tradeoff *NNPB* for profits) and in their utility maps. In that case we can see the outcome on Figure I. The competitive industry will achieve the combination of *NNPB* and profits indicated by point C.[10] The price

8. This has also been recognized by other writers. See M. A. Crew and C. K. Rowley, "On Allocative Efficiency, X-Inefficiency, and the Measurement of Welfare Loss," *Economica*, XXXVIII (N.S.) (May 1971), 199–203; and R. Parish and Y. K. Ng, "Monopoly, X-Efficiency, and the Measurement of Welfare Loss," *Economica*, XXXIX (N.S.) (Aug. 1972), 301–08.

9. If the firm is not run by an individual enterpreneur, but instead decisions are made by a group (who share both the profits and *NNPB*), a single indifference map for the firm is no longer valid. However, we can still use the concept of a community indifference map for this group, as a convenient device in the same way that international trade theory uses it, to indicate the general notion of the firm's owner-managers having a preference trade-off between profits and *NNPB*.

10. Note that there is no necessity for the competitive firms to achieve maximum profits; i.e., a point along the vertical axis. Indifference map U_1 defines the set of combinations that will trigger entry or exit, in the same way that the "competitive level of profits" triggers entry or exit in the usual single dimensional case. Only a corner solution, in which the U_1 curves of enough entrepreneurs (enough to supply the industry) hit the vertical axis without becoming tangent to a T frontier, would yield the maximum profit equilibrium. This would imply a very low marginal value for *NNPB*.

that yields frontier T_1 is the competitive price in this industry, given that entrepreneurs require a combination on U_1 to remain in the industry.[11] At any other price the satisfaction level that could be obtained would be too high or too low, and entrepreneurs would exit or enter the industry. By contrast, the monopolist is able to achieve point M, the highest utility point on frontier T_M.

From Figure I we can see that the monopolist's equilibrium contains higher levels of both profitability and *NNPB* than does the competitive equilibrium. The difference in profitability comes as no surprise. But it is the *NNPB* that primarily concerns us. The equilibrium *NNPB* for the monopolist will always be larger than for the competitive industry as long as the T frontiers are similar in shape and the indifference curves are not badly skewed toward the left (i.e., *NNPB* is not an inferior good for entrepreneurs).

We can now relate this to the X-inefficiency hypothesis. Points along the vertical axis represent the maximum technical efficiency points: an all-out effort by the entrepreneur to get the highest level of monetary profits possible at any given price. The more we move down and to the right along the transformation frontier, the less efficient the enterprise will be. In effect, *NNPB* is a proxy for X-inefficiency. And, as we have seen, the monopolist's equilibrium will be to the right of the competitors'; i.e., the monopolist will be more X-inefficient than the competitor, though even the latter is unlikely to achieve complete technical efficiency. The monopolist, enjoying an expanded transformation frontier (and, by definition, sheltered from entrants who would be satisfied with a U_1 level of utility), can have his quieter life and higher profits too.

If entrepreneurs are not all identical, the model is a bit more complicated, but the same conclusions are likely to stand. First, suppose that entrepreneurs are still equally skillful but that they have different utility maps. The easiest case is if the minimum satisfactory indifference curve for each entrepreneur is still tangent to frontier T_1 (though at different points along T_1). Then the price implied by T_1 will still be the competitive price. The average levels of competitive profits and *NNPB* will be the weighted average of the locus of all the tangency points.[12] Unless the monopolist has an indifference map that

11. If entrepreneurs' notions of the minimum satisfaction level change, the competitive equilibrium point would change. Thus, if the minimum satisfaction level were to rise to that indicated by indifference curve U_2, the new equilibrium point would be on transformation curve T_2, and the price of output would have to rise to some level P_2. Parish and Ng, *op, cit.*, also recognize this point and argue that there is no overall social loss from such a change. The analysis here supports that view.

12. If, for example, T_1 were a perfect quarter-circle of radius X and the entrepreneurs distributed themselves evenly along T_1, the weighted average values of

is more strongly skewed to the left than that of most of the competitive entrepreneurs, his equilibrium value of *NNPB* will exceed that of the average of the competitive industry. Again, he is less efficient.

Suppose, next, that different entrepreneurs have different minimum satisfactory indifference curves that yield tangencies with different transformation frontiers. Some entrepreneurs are attracted into the industry at low prices; others require higher prices. We thus have an upward-sloping supply curve for the industry. The long-run price that clears the market will be the one that yields a transformation locus (say T_2) which attracts enough entrepreneurs to provide the necessary output. Again, the average levels of competitive profits and *NNPB* will be the weighted average of the locus of tangency points to the frontier.[13] And, again, the monopolist is likely to be less efficient.

Finally, if entrepreneurs have different levels of competence, they each have a different set of transformation frontiers. The analysis becomes more complicated, but conceptually, if the monopolist is to achieve a higher level of efficiency than the competitive industry, he would have to be sufficiently more competent than the average for the competitive industry to offset his expanded transformation opportunity and his preferences for *NNPB*. Again, it is likely that the monopolist will be less efficient.

Thus, we have presented a model that allows entrepreneurs to tradeoff profitability and net nonpecuniary benefits. Inefficiency is likely to be strongly associated with the latter benefits. In the context of this model we have demonstrated that the monopolist's wider opportunity locus, combined with a reasonable set of preferences, is likely to lead the monopolist to a less efficient level of production than is attained in the competitive industry. The initial claims by Leibenstein for this proposition are supported by our more complex model.

II

The previous section demonstrated that a monopoly is likely to "indulge" in less efficient production than a competitive industry. Wells and Ranis argue that in less developed countries this ineffi-

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profitability and of *NNPB* would each be $2X/\pi = 0.637X$. By contrast, if all entrepreneurs were identically located at a point half-way around on the quarter circle, the values of profitability and of *NNPB* would each be $X/\sqrt{2} = 0.707X$.

13. For the marginal entrepreneur, the tangency will be with his minimum satisfaction curve. For those entrepreneurs who had been attracted into the industry at lower levels of satisfaction, the tangency is with higher indifference curves.

ciency is likely to take the form of excessive use of capital-intensive equipment and methods. Capital-intensive technologies involve large quantities of shiny new equipment, which convey the aura of being up-to-date and yield high prestige. They may, as Wells argues, bring out the engineering instincts in entrepreneurs. They require less administrative efforts on the part of entrepreneurs, particularly with respect to labor relations, since there are fewer workers to be supervised. In short, capital-intensive equipment in less developed countries embodies a fair amount of nonpecuniary benefits. The entrepreneur enjoying a monopoly or market power position (protected by tariffs or licenses or other barriers to new entry by potential rivals) is likely to tradeoff some potential profits for equipment that is more capital-intensive than cost minimization would dictate. The entrepreneur in a more competitive environment finds his choices are under tighter constraints, and he is likely to choose more labor-intensive methods.

This competitive environment hypothesis can be subjected to econometric tests, if one has data on the relative competitiveness of different industries. Fortunately, these data are available for a cross-section of Pakistani industries.

Let us propose the following testable hypothesis: Suppose that entrepreneurs in Pakistan have a fairly extreme preference for nonpecuniary benefits; if given a completely free choice, they would prefer to use the same technology as that found in developed countries in the same industry, for the reasons given by Wells and Ranis. Specifically, the entrepreneurs would prefer to use the same capital-labor ratio as that found in developed countries. The presence or absence of a competitive environment, though, will influence the freedom of that choice; more competition will tend to force them to use more labor-intensive technologies.

This proposition will be tested using Pakistani and U. S. cross-section data for a sample of thirty-one industries for 1967–1968; it will be assumed that the U. S. capital-labor ratios are those that the Pakistani entrepreneurs are interested in emulating.

Ideally, one would like to test this on data that represent the capital-labor ratios of new factories being built in both countries at roughly the same time. Unfortunately, these kinds of data are not available. Instead, we have the reported values of capital and labor for various industries reported by the *Censuses of Manufacturing Industries* for 1967–1968 for East and West Pakistan and by the *Annual Survey of Manufacturers* for 1968 (reporting 1967 data) for the United States. The ratios for each country will be labeled *PKL* and *USKL*. (More will be said about the limitations of these data below.) The competitive structure of the Pakistani industries is represented by the four-firm concentration ratios for those industries (labeled *PCON*).[14] In addition, the extent of involvement in international trade would be another competitive variable; I have used a dichotomous variable (labeled *EXPORT*) here, which takes the value of 1 if exports took 10 percent or more of any industry's output in 1967–1968 and takes the value 0 otherwise.[15] Finally, I also employed a dichotomous variable (labeled *PROCESS*) to indicate whether an industry was a chemical or process-related industry; these kinds of industries might be more rigid in their capital-labor requirements and less susceptible to labor substitution.

Formally, then, we have

$$PKL = f(USKL, PCON, EXPORT, PROCESS).$$

Since both the Pakistani and U. S. data divide industrial labor into production workers and other workers, we can test this relationship for the ratios of capital to all labor and of capital to each kind of labor. This will allow us also to test, at least partially, another hypothesis proposed by Ranis:[16] Even where the actual manufacturing processes appear to require fixed capital-labor coefficients, auxiliary processes like handling and packaging have flexible technologies that can be either capital-intensive or labor-intensive. Unfortunately, workers in these auxiliary processes are included in the production worker category. But this argument should apply to nonproduction processes generally (e.g., front office, delivery, sales functions). There may well be greater capital-labor flexibility in these processes (e.g., electric typewriters versus manuals, fancy photocopying versus mimeograph, older delivery vehicles versus new ones, requiring sales personnel to use public transportation versus providing them with a personal automobile) than in some manufacturing processes. Thus, we would expect the "competitive" variables (*PCON* and *EXPORT*) to be more

14. See L. J. White, *Industrial Concentration and Economic Power in Pakistan* (Princeton: Princeton University Press, 1975), Ch. 5. Note that the market structure of the U. S. industries is not relevant to the hypothesis: the Pakistani entrepreneurs simply take as their goals whatever capital-labor ratios appear in their counterpart industries in the United States.

15. I chose this to be dichotomous, partly because some industries (e.g., textile finishing) do not have any direct exports (which are all attributed to weaving and spinning), but they are nevertheless directly affected by the competitive pressures of exports and partly because there is likely to be a point at which export involvement becomes an important influence on an industry; 10 percent seemed to be a reasonable guess at this point.

16. See Ranis, *op. cit.;* and G. Ranis, "Industrial Sector Labor Absorption," *Economic Development and Cultural Change,* XXI (April 1973), 387–408.

important when only nonproduction labor is in the capital-labor ratio and the "technology" variable (*USKL* and *PROCESS*) to be more important when only production labor is in the capital-labor ratio. Table I lists the variables used and their natural means.

TABLE I

VARIABLES USED AND THEIR NATURAL MEANS

*PKL*1:	The Pakistani ratio of book value of capital to all labor (in logs); natural mean = Rs. 16,620/man.
*PKL*2:	The Pakistani ratio of book value of capital to production labor (in logs); natural mean = Rs. 23,330/man.
*PKL*3:	The Pakistani ratio of book value of capital to nonproduction labor (in logs); natural mean = Rs. 68,190/man.
*USKL*1:	The U. S. ratio of book value of capital to labor (in logs); natural mean = $20,002/man.
*USKL*2:	The U. S. ratio of book value of capital to production labor (in logs); natural mean = $27,684/man.
*USKL*3:	The U. S. ratio of book value of capital to nonproduction labor (in logs); natural mean = $97,027/man.
PCON:	The Pakistani four-firm concentration ratio (in logs); natural mean = 56.06 percent.
EXPORT:	Dichotomous variable: 1 if exports account for 10 percent or more of an industry's output; 0 otherwise.
PROCESS:	Dichotomous variable: 1 if the industry is a chemical or process industry; 0 otherwise.

There is a likely simultaneous relationship that needs to be mentioned. Other things being equal, a capital-intensive firm in a less developed country is likely to be large. For a given industry size, a capital-intensive industry will have larger and hence fewer firms. Thus, there is a likely subsidiary positive relationship between the Pakistani four-firm concentration ratio and the capital-labor ratio. The total sales size of the industry would be an exogenous explanatory variable in this last relationship and, since sales size is not included in the primary equation, we could use a simultaneous-equations-estimation method for the primary equation. Efforts to do this failed to yield sensible results, however. The main reason seems to be the lack of an actual relationship between the concentration ratio and industry size. The simple correlation coefficient between the two was only −0.05. Accordingly, only simple least squares results are reported.

Other explanatory variables might be considered relevant for these regressions. One possibility would be the level of competitive imports to an industry, since both imports and exports affect the competitive stance of an industry.[17] However, imports were largely licensed and limited during this period and thus could not really serve as a competitive check on domestic firms. The rate of effective protection from all sources (tariffs and quotas) was another possibility, but the available data were for a much smaller sample of industries.[18] Also, recent theoretical work on effective protection has raised considerable doubt as to the predictive power of effective protection measures.[19] Yet another possible variable would be the cost of labor facing each industry. Though wage data for each industry are available, there is no information on skill categories, and hence one cannot tell if wage differences reflect skill differences in the costs of similar kinds of labor.

Finally, imperfections in the data are worth discussing. U. S. and Pakistani industries that have been linked in the cross-section may not be comparable, though I have tried to restrict the sample to industries in which the basic manufacturing processes do seem to be comparable. As mentioned above, the capital-labor figures themselves are far from ideal. Accounting procedures, the valuation of capital, depreciation rules, and the final costs of capital goods, land, and buildings are different in the two countries, and these surely will yield discrepancies. The same holds true for definitions of production and nonproduction labor. Unfortunately, there seems to be no way of correcting for these problems. As in most quantitative work, we are dealing with imperfect data.

A log-linear specification was chosen for the model, so *PKL, USKL, PCON,* and *PSIZE* are in logarithms; *EXPORT* and *PROCESS* are 0, 1 dummy variables. Tables II, III, and IV report the regressions (the numbers in parentheses are t-statistics).

A number of interesting results emerge from the regressions. In Table II the Pakistani capital-labor ratio is positively and significantly related to the U. S. capital-labor ratio. However, in both equations (2-1) and (2-2) the coefficient on *USKL*1, representing the elasticity between the two ratios, is significantly less than 1.0. Thus, as capital-labor ratios rise, there is a tendency for the Pakistani ratio to fall progressively farther below that of its American counterpart.

17. See R. E. Caves and R. W. Jones, *World Trade and Payments* (Boston: Little, Brown, 1973), pp. 206–15.

18. See S. R. Lewis, Jr., and S. E. Guisinger, "Measuring Protection in a Developing Country: The Case of Pakistan," *Journal of Political Economy,* LXXVI (Dec. 1963), 1170–98.

19. See J. N. Bhagwati and T. N. Srinivasan, "The General Equilibrium Theory of Effective Protection and Resource Allocation," *Journal of International Economics,* III (Aug. 1973), 259–81.

TABLE II

REGRESSIONS WITH TOTAL LABOR IN THE CAPITAL–LABOR RATIO

(2–1)	$PKL1 = \underset{(9.53)}{3.25} + \underset{(4.13)}{0.63}\ USKL1$	$R^2 = 0.37$
(2–2)	$PKL1 = \underset{(8.77)}{2.29} + \underset{(3.95)}{0.54}\ USKL1 + \underset{(3.08)}{0.48}\ PCON$	$R^2 = 0.53$
(2–3)	$PKL1 = \underset{(13.38)}{9.00} + \underset{(4.20)}{1.06}\ PROCESS - \underset{(2.53)}{0.67}\ EXPORT$	$R^2 = 0.53$
(2–4)	$PKL1 = \underset{(4.07)}{5.13} + \underset{(1.89)}{0.32}\ USKL1 + \underset{(1.11)}{0.23}\ PCON + \underset{(1.93)}{0.64}\ PROCESS - \underset{(0.90)}{0.30}\ EXPORT$	$R^2 = 0.59$

TABLE III

REGRESSIONS WITH PRODUCTION LABOR IN THE CAPITAL–LABOR RATIO

(3–1)	$PKL2 = \underset{(12.54)}{2.63} + \underset{(6.66)}{0.71}\ USKL2$	$R^2 = 0.60$
(3–2)	$PKL2 = \underset{(10.54)}{1.70} + \underset{(6.85)}{0.65}\ USKL2 + \underset{(3.17)}{0.40}\ PCON$	$R^2 = 0.71$
(3–3)	$PKL2 = \underset{(11.89)}{9.24} + \underset{(4.62)}{1.19}\ PROCESS - \underset{(2.21)}{0.59}\ EXPORT$	$R^2 = 0.55$
(3–4)	$PKL2 = \underset{(5.19)}{2.70} + \underset{(3.87)}{0.56}\ USKL2 + \underset{(1.75)}{0.33}\ PCON + \underset{(0.65)}{0.22}\ PROCESS - \underset{(0.21)}{0.06}\ EXPORT$	$R^2 = 0.71$

TABLE IV

REGRESSIONS WITH NONPRODUCTION LABOR IN THE CAPITAL–LABOR RATIO

(4–1)	$PKL3 = 7.81 + 0.26\ USKL3$ (2.44) (1.41)	$R^2 = 0.06$
(4–2)	$PKL3 = 6.00 + 0.22\ USKL3 + 0.59\ PCON$ (4.27) (1.39) (3.25)	$R^2 = 0.32$
(4–3)	$PKL3 = 12.35 + 0.57\ PROCESS - 0.65\ EXPORT$ (3.58) (1.80) (1.98)	$R^2 = 0.26$
(4–4)	$PKL3 = 7.06 + 0.18\ USKL3 + 0.42\ PCON + 0.30\ PROCESS - 0.24\ EXPORT$ (2.51) (1.08) (1.66) (0.87) (0.61)	$R^2 = 0.35$

Second, the *X*-inefficiency hypothesis, as proposed here, does seem to be supported. Pakistani industries with higher concentration (and presumably greater monopoly power) have significantly higher capital-labor ratios, and this effect is quantitatively important. Thus, firms with market power do seem to be "indulging" in more capital-intensive methods than are firms facing more competition. The presence or absence of a competitive environment does matter.

A similar story is told by using instead the *PROCESS* and *EXPORT* variables in equation (2-3). The process industries have higher capital-labor ratios, while industries that face significant export competition have lower capital-labor ratios. However, when we try to include all of the possible explanatory variables in equation (2-4), the problem of multicollinearity appears (the simple correlation coefficient between *USKL*1 and *PROCESS* is 0.53; between *PCON* and *EXPORT*, −0.64): coefficients and significance tests become unreliable, while the overall level of explanatory power does not increase very much. We are thus left with the conclusion that some combination of a technology variable (*USKL*1 or *PROCESS*) and a competitive environment variable (*PCON* or *EXPORT*) can explain over half of the variance in Pakistani capital-labor ratios. Given the extreme form in which we have framed the hypothesis (some Pakistani entrepreneurs may be less inclined to emulate the U. S. pattern than we have assumed) and given the imperfections in the data noted above, this is a quite satisfactory level of explanation for a cross-section regression.

Equally interesting is a comparison of the results in Tables III and IV. The ratio of capital to production labor is much better explained by the technology variables than is the ratio of capital to nonproduction labor, while the competitive environment variables, especially *PCON* in (3-2) and (4-2), have a larger quantitative impact on the latter ratio. Chow tests on equations (3-2) and (4-2) and on equations (3-3) and (4-3) lead us to reject the hypothesis that the two ratios behave similarly. Thus, we appear to have support for the hypothesis that the use of nonproduction labor is more flexible, less prone to fixed proportions, and more susceptible to the influences of competition. Note that these differences between production labor and nonproduction labor make eminent sense in the context of the model proposed here, while they are not obvious consequences of the subsidiary relationship between concentration and capital intensity mentioned above. Thus, the basic model, rather than the subsidiary relationship, does seem to offer the best explanation for these results.

III

The results of this paper are encouraging. Though there clearly are major similarities in the kinds of technologies used in Pakistani and American industries, these similarities are not absolute. There is room for some flexibility, and a competitive environment, whether created from internal or external sources, does appear to encourage this flexibility in socially worthwhile directions in Pakistan and likely in other LDC's as well, i.e., in labor-intensive directions. This especially appears to be true for labor involved in activities away from the production floor.

The conclusion that follows from the quantitative study in this paper, as well as the anecdotal evidence of other writings, is that the potential for technological flexibility does appear to be present and that therefore policies that affect incentives and that can potentially affect entrepreneurial behavior are indeed important. These include policies affecting relative prices, but, as this paper has shown, they also include policies affecting the general competitive environment. Even in LDC's competition matters.

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