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FIRM AND MARKET SIZE, FACTOR PRODUCTIVITY AND INDUSTRIAL CONCENTRATION IN MEXICO

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INTRODUCTION

The industrial sector of the Mexican economy is highly concentrated. The distribution of employment and output by firm size for 1970 shows that small firms, (less than 5 workers) which make up 63% of the industrial firms, produce only 2.4% of the industrial output (see Table 1). On the other hand, a small number of large firms (250 workers or more) which constituted only 1.7% of the total number of firms produced almost 54% of the industrial output and gave employment to about 42% of the labor force in that sector.

There are several indices that measure the degree of industrial concentration. Among them are the Gini coefficient, the Herfindahal index, the number of firms that together produce 80% of an industry's output, and the number of firms that together give employment to 80% of an industry's labor force. The Gini and the Herfindahal indices of industrial concentration are shown for Mexico in Table 2, using the data of the 1965 and 1970 Industrial Census at the two digit level. As with the Gini coefficient, when the Herfindahal index approaches one, inequality increases. In Table 2 it can be observed that the degree of concentration varies considerably among industries and that the level of concentration has not noticeably changed between those two years.

In section I, part A of this paper, we study the causes that determine the minimum optimum firm size, a concept which we later on relate to industrial concentration. We then test several of the hypothesis that have been advanced in the literature regarding the causes of industrial concentration. In particular, we make empirical estimates concerning the importance of the absolute and relative optimum firm size (Section 1B); the absolute and relative capital requirements of

Table 1

Mexico: Number, Employment and Value of Output of Industrial Firms by Size Class

1970

Size of Firm (Number of workers)		Proportion of Total Number of Firms %		Proportion of Total Employment %		Proportion of Total Output %
0 - 5		62.86		7.2		2.4
6 - 15		17.56		6.6		3.4
16 - 25		5.33		4.4		3.3
26 - 50		5.66		8.5		6.5
51 - 75		2.54		6.5		5.7
76 - 100		1.46		5.4		5.1
101 - 175		1.95		10.9		10.9
176 - 250		0.93		8.2		9.0
251 - 350	1.71	0.59	42.3	7.3	53.7	8.1
351 - 500		0.46		8.0		9.8
501 - 750		0.32		8.1		10.7
751 -		0.34		18.9		25.1
Total		100		100		100

Source: Manuel Gollas, "Reflexiones sobre la concentración económica y el crecimiento de las empresas", El Trimestre Económico, No. 166, Vol. XLII (2), Mexico, April-June, 1976, pp. 457-485.

Table 2

Mexico: Indices of Industrial Concentration According to Employment

1965 - 1970

Industry	1965				1970			
	Herfindahl (1)	Gini (2)	Number of Firms (3)	Concentration Rank (4)	Herfindahl (5)	Gini (6)	Number of Firms	Concentration Rank
11 Coal and graphite	0.730	0.557	18	24	0.345	0.615	14	22
12 Metallic mines	0.306	0.757	333	8	0.322	0.734	323	8
14 Gravel and Sand mines	0.171	0.601	218	23	0.167	0.598	265	23
15 Non-metallic minerals	0.165	0.661	219	20	0.159	0.672	215	18
20 Food Products	0.145	0.709	22 187	13	0.144	0.720	23 764	10
21 Beverages	0.192	0.811	1 487	1	0.233	0.822	1 263	1
22 Tobacco	0.722	0.772	30	3	0.419	0.662	52	19
23 Textiles	0.170	0.685	2 721	16	0.171	0.692	2 579	17
24 Clothing and Shoes	0.126	0.694	6 234	15	0.125	0.718	6 743	11
25 Wood Products	0.198	0.782	749	2	0.210	0.758	490	6
26 Furniture	0.125	0.669	1 265	18	0.129	0.654	3 107	20
27 Paper	0.185	0.710	444	11	0.196	0.705	517	15
28 Printing	0.120	0.699	2 730	14	0.124	0.705	3 323	15
29 Leather	0.140	0.647	769	22	0.153	0.641	792	21
30 Rubber	0.140	0.770	1 036	6	0.156	0.768	1 403	4
31 Chemicals	0.157	0.709	2 175	12	0.171	0.712	2 511	13
32 Petro-Chemicals	0.332	0.682	49	17	0.180	0.708	80	14
33 Non-Metallic Products	0.148	0.758	3 912	7	0.163	0.763	4 704	5
34 Steel and Iron	0.455	0.665	187	19	0.470	0.726	322	9
35 Metal Products	0.140	0.774	4 337	5	0.145	0.773	5 021	3
36 Machinery and Tools	0.128	0.734	2 043	9	0.134	0.736	1 754	7
37 Electrical Products	0.225	0.728	777	10	0.220	0.704	949	16
38 Automobile and Transport	0.333	0.776	435	4	0.361	0.802	695	2
39 Various Manufacturing	0.139	0.661	1 801	21	0.133	0.714	1 410	12

Source: Manuel Gollas, "Reflexiones sobre la concentración económica y el crecimiento de las empresas", El Trimestre Económico, No. 166, Vol. XLII (2), Mexico, April-June, 1976, pp.457-485.

firms (Section IC); and the industry's size and its growth rate (Section ID).

In Section II, we explore the nature of the relationships between industrial concentration, factor productivity and the capital intensity of production. Finally, in Section III, we study the effects of some of the factors that determine the size of firms in terms of the number of employees.

I. THE DETERMINANTS OF THE DEGREE OF INDUSTRIAL CONCENTRATION

The notion of a minimum optimum firm size is frequently used to explain the degree of industrial concentration. In the literature on industrial concentration (Stigler 1958, Savings 1961, Weiss 1964, Comanor and Wilson 1967, and Scherer 1973) the minimum optimum or most efficient firm size is that which has the minimum average cost of production. Most empirical studies which estimate a minimum optimum firm size assume that the long run average cost of production has an L shape. The minimum optimum size of firm is then defined as that size after which the long run average cost curve is horizontal. Firms smaller than the minimum optimum exhibit increasing economies of scale as they increase in size, and firms larger than the minimum exhibit constant economies of scale.

The optimum firm size may be an important factor in determining the degree of industrial concentration since in many instances it is not possible to attain an efficient scale of production without firms so large than concentration is inevitable (Bain 1959). Moreover, the minimum optimum size is often so large that it constitutes an important barrier of entry for new firms, thus increasing the degree of concentration.

In Part A of this section we investigate the factors that determine the minimum optimum size of firm for an industry. In Part B, we examine the ways in which that minimum optimum size of firm and its capital requirements determine the degree of concentration. The relationships between a relative measure of minimum optimum firm size and the degree of industrial concentration is studied in Section C. Finally, in Section D, we examine the effects on the degree of concentration of the industry's absolute size, its rate of growth, and its capital intensiveness.

A. Factors That Determine the Optimum Firm Size

Among the factors that determine the optimum firm size as defined above we may mention (1) the industry's size, (2) the industry's rate of growth, and (3) the capital intensity of the production process.

(1) The industry's size is a factor that determines the minimum optimum firm size because in a large industry a firm may take advantage of all the economies of production that are available. According to this argument, the minimum optimum firm size will be larger, the greater the size of the industry. We measure the variable size of industry as the total value of output for that industry in a given year.

(2) It may be argued that the minimum optimum firm size tends to be large in industries experiencing rapid rates of growth. This is because it is easier to establish a large firm in an industry which is growing than in one which is not. We measure the growth variable as the rate of growth for each industry's output between 1965 and 1970.

(3) In Mexico, capital intensive methods of production are generally used by large firms because the set of distorted relative factor prices

which they face, (brought about by protectionist policies) stimulates the use of capital intensive techniques. It maybe argued, that because of this the minimum optimum firm size would be larger in highly capital intensive industries than in the more labor intensive ones. We measured the capital intensity of production for each industry with two variables: the capital-labor ratio, and the value of fuels and lubricants per worker.

In this section of our paper, we test by a simple regression analysis, the importance that variables (1), (2) and (3) above have in determining the minimum optimum firm size in an industry.

The minimum optimum firm size is estimated by the survivor technique used for the U.S. by Stigler (1958), Weiss (1964), Savings (1961) and by Gollas (1978) for Mexico. According to this technique, the minimum optimum size is the average firm of the class that has gained the most in the industry's market during a certain period of time. We estimated the minimum optimum size according to this technique using the data of the Mexican Industrial Census for 1965 and 1970 at the four digit level. For a more detailed explanation of the use of this technique and its application to the Mexican data, see Gollas (1978.

The specification of the regression equation that best fitted our data is of the multiplicative form which is linear in the logarithms. This specification has the advantage that the estimated coefficients are elasticities with a clear economic interpretation. The estimated regression is:

$$\ln M_1^i = 2.35 + \underset{(0.23)}{0.50} \ln S_i + \underset{(0.65)}{1.63} \ln \Delta Q_i + \underset{(0.48)}{0.84} \ln \left(\frac{K}{L}\right)_i - \underset{(0.50)}{0.33} \ln \left(\frac{F}{L}\right)_i$$

$R^2 = 0.31$ $F = 5.15$ Number of Industries = 50

where

i = industries

M_1 = Minimum optimum firm size estimated by the survivor technique.

S = value of output (industry size)

ΔQ = rate of growth of output between 1965 and 1970

$\frac{K}{L}$ = capital-labor ratio

$\frac{F}{L}$ = value of fuels and lubricants-labor ratio

The estimated regression coefficients have the expected sign and are also statistically significant with the exception of the coefficient of the value of fuel and lubricants per worker. The independent variables explain about 30% of the variance of the minimum optimum firm size.

Since the coefficents of our regression are elasticities, they measure the minimum optimum firm size's degree of responsiveness to changes in the independent variables. For example, an industry that grows at a rate 10% faster than another, will have a 16% larger minimum optimum firm size. Or, an industry that has a capital-labor ratio 10% larger than another will have a 8.4% larger minimum optimum firm size. A similar interpretation may be given to the variable that measured the industry's size.

Our results support the assertion that the minimum optimum firm size for an industry will be larger as the industry increases its size, its rate of growth, or its capital intensity. Now that we have explored the factors that determine the minimum optimum firm size, we study how that firm size and its capital requirements affect industrial concentration.

B. The Minimum Optimum Firm Size and its Absolute Capital Requirements As Determinants of the Degree of Industrial Concentration.

The degree of output or employment concentration in an industry is often explained by consideration of the minimum optimum firm size and its absolute capital requirements. The minimum optimum firm size is a factor that determines the degree of industrial concentration because it constitutes an important barrier of entry into the industry. Because of these considerations it is maintained that the degree of concentration and the minimum optimum firm size are positively related: the larger the minimum optimum firm size the higher the degree of concentration and vice versa.

Another factor which may also be a determinant of the degree of industrial concentration is the absolute capital requirements of the firm of minimum optimum size (Comanor and Wilson 1967, Guth 1971). The absolute capital requirements increase the barriers of entry of new firms preventing competition and thus increasing concentration. For this reason it is often maintained that the degree of output or employment concentration and the absolute capital requirements of the optimum firm size are positively related.

In this section of our paper we test the hypothesis that there is a positive relationship between the degree of industrial concentration and (1) the minimum optimum firm size and (2) the capital requirements of the minimum optimum firm size.

Concentration in an industry is measured by three indices: the Gini coefficient in terms of employment (C_1), the number of the largest firms that together produce 80% of the industry's output (C_2) and, by the number of the largest firms that give employment to 80% of the labor force (C_3). The indices C_2 and C_3 measure concentration inversely: the smaller their value the larger the degree of concentration and vice versa.

The minimum optimum firm size is obtained by first calculating the average firm size, in terms of the value of output,for the largest firms which account for 50% of the total output of a given industry. Then, this average firm size is divided by the total industry output to obtain the minimum optimum firm size. When estimated in this way, the minimum optimum firm size is given as a percentage of the industry's output. The estimation of the minimum optimum firm size follows closely the method employed by Comanor and Wilson (1967) and Guth (1971).

The absolute capital requirements variable is estimated by multiplying the average size of the firms that produce 50% of the industry's total output by the ratio of that industry's total investment (assets) to total output. The absolute capital requirement estimates are given in thousands of Mexican pesos.

Regression equations which are linear in the logarithms were fitted to our data. The results are shown in Table 3. All the coefficients have the expected sign and are statistically significant. In all regressions, roughly 50% of the variance in concentration is explained by the minimum optimum firm size and by its absolute capital requirements. In regressions (2) and (3) the coefficients have, as expected, a negative sign, since the concentration indices C_2 and C_3 measure inversely the degree of

Table 3

Multiple Regression Equations Explaining Concentration [a]

1970

Independent Variables and Other Statistics	Regressions [b]		
	C_1	C_2	C_3
	(1)	(2)	(3)
M_2	0.127 (0.021)	-0.85 (0.076)	-0.80 (0.084)
KR	0.73 (0.012)	-0.18 (0.043)	-0.20 (0.048)
R^2	0.43	0.57	0.51
F	74	131	105
Number of Industries	201	201	201

a/ The index of concentration C_1 refers to the Gini coefficient in terms of employment, C_2 to the number of firms that produce 80% of the industry's output, C_3 to the number of firms that give employment to 80% of the labor force in the industry. See text for definition and units of measurement of the minimum optimum firm size (M_2) and its capital requirements (KR).

b/ The standard errors are in parenthesis.

concentration. Because the estimated coefficients are elasticities, our results suggest that, for example, according to regression (2), an increase of 10% in the minimum optimum firm size would increase concentration by 8.5% and an increase of 10% in the absolute capital requirements would increase concentration by 1.8%. Similar interpretations may be made for the other regressions.

Our empirical results support the view that an increase in the minimum optimum firm size, or in the absolute capital requirements of that minimum optimum firm size, will increase the degree of concentration in an industry and vice versa.

C. The Relative Minimum Optimum Firm Size and The Degree of Industrial Concentration

The nature of the relationship between the degree of concentration and the optimum firm size may be further explored through the notion of a relative, as opposed to an absolute, optimum firm size. According to this view, the important explanatory variable of a change in concentration is the change in the optimum firm size relative to industry size. That is, the estimation of a relative minimum optimum size is obtained by first calculating a minimum optimum size and then weighing this figure by the industry's size. We made these calculations as follows:

The minimum optimum firm size, as opposed to plant size used by Weiss (1963), involves the estimation of the size of the "mid point" firm, i.e. the firm at the mid point of the output array. The "mid point" firm size was estimated in the following manner. The sum of the value added of all employment size classes was calculated in order to find the class containing the "mid point" firm. The employment size of the "mid point" firm was then estimated by interpolation. The "mid point" firm, this time in terms of value added, was calculated by multiplying its number of employees by the value added per employee in that size class. Once the "mid point" firm size was estimated we weighed it by the industry size. The change in the optimum firm size relative to industry size was calculated as follows:

$$\Delta M_3^i = \frac{\text{1970 "mid point" firm size}}{\text{1970 industry size}} \Bigg/ \frac{\text{1965 "mid point" firm size}}{\text{1965 industry size}}$$

where both, the mid point size and the industry size, are measured in terms of the value added in each industry i.

The change in concentration between 1965 and 1970 was measured by the change in the value of the Gini coefficient (ΔC_1^i) for each industry i.

A linear in the logarithm regression equation was estimated relating the rate of change in concentration and the mid point firm size relative to industry size. We obtained the following results.

$$\ln C_1^i = 1.03 + \underset{(0.051)}{0.312} \ln \Delta M_3^i$$

$R^2 = 0.17$ $F = 37.0$ Number of Industries = 185

Our findings support the view that the degree of concentration in an industry and the relative optimum firm size are positively related: an increase in the relative minimum optimum size increases the level of concentration and vice versa.

D. <u>The Industry Size, Its Rate of Growth, and Its Capital Intensity as Barriers to Entry Causing Industrial Concentration</u>

The causes of output or employment concentration in an industry may be investigated by studying the relationships between concentration and (1) the industry's absolute size, (2) its rate of growth and (3) its capital intensity.

It is often argued that when the size of an industry is large there are more opportunities for new firms to enter the industry and thus concentration is reduced. Furthermore, it is also thought that in rapidly growing industries, one is likely to find a low degree of concentration since, as new markets open, the opportunities for new firms to enter the industry increase. However, one may also argue that the opposite outcome is likely to occur: the larger the industry's size and the higher its rate of growth, the more likely that large well established firms would grow still more thus increasing the degree of concentration. In other words, large, rapidly growing industries make it easy for large firms to take advantage of economies of scale, thus growing still further and thus increasing the degree of concentration.

The degree of capital intensity in an industry is one of the factors that determines its degree of concentration. It may be argued that in a high capital intensive industry there are substantial indivisibilities in capital equipment that stimulate the growth of large firms, thus increasing concentration. This tendency is further reinforced when one considers that in Mexico small and new firms often cannot take advantage of credit facilities, preferential import rights, etc. given to large firms. Under these circumstances, only the expansion of large, well established firms, is stimulated, and hence concentration is increased.

In this section, we test empirically (a) the direction and the intensity of the effect that industry's size and its growth rate have on the degree of industrial concentration and (b) the hypothesis that capital intensity in production and concentration are inversely related.

The variables used to measure an industry's size are the value of its assets or its total number of workers. The increase in an industry's size was measured by the growth rate of its output between 1965 and 1970. The value of the capital-labor ratio is the variable that measures the degree of capital intensity in each industry. Output concentration (C_2) was measured by the number of the largest firms that together produced 80% of an industry's output in 1970. Employment concentration (C_3) was measured by the number of the largest firms that together provided employment to 80% of the labor force in each industry for that year. Both C_2 and C_3 measure concentration inversely: the larger their value the smaller the degree of concentration and vice versa.

The linear in the logarithms regressions estimated by ordinary least squares are

$$\ln C_2^i = 1.72 + \underset{(0.055)}{0.56} \ln A_i - \underset{(0.107)}{1.28} \ln \left(\frac{K}{L}\right)_i - \underset{(0.138)}{0.073} \ln \Delta Q_i \tag{1}$$

$R^2 = 0.47$ F = 62 Number of industries 183

$$\ln C_3^i = 2.46 + \underset{(0.069)}{0.50} \ln L_i - \underset{(0.098)}{0.74} \ln \left(\frac{K}{L}\right)_i - \underset{(0.156)}{0.039} \ln \Delta Q_i \tag{2}$$

$R^2 = 0.37$ F = 33 Number of industries 176

where

i = industries

C = index of output or employment concentration

A = value of an industry's total assets (industry size)

L = size of the labor force (industry size)

$\left(\frac{K}{L}\right)$ = capital-labor ratio

ΔQ = rate of output growth

Regression (1) indicates that 47% of the total variation in output concentration is explained by changes in the independent variables, while in regression (2) the explained variation of employment concentration is 37%.

The signs of the coefficients that measure the industry's absolute size (total value of assets or total number of workers) are positive and statistically significant in both regressions. Our results bring support to the view that in large industries one expects to find a low degree of output or employment concentration. For example, since the estimated coefficients are elasticities, regression (1) suggests that an industry which is 10% larger than another (in terms of the total value of its assets) would be 5.6% less concentrated. We may also interpret regression (2) to suggest that an industry that employs 10% more workers than another, would be 5% less concentrated in terms of employment.

The negative sign of the coefficient that measures the degree of capital intensity is significant in both regressions. This suggests that a high degree of output and employment concentration may be expected in high capital intensive industries. The value of the elasticity of output concentration with respect to the capital labor ratio is, however, larger than the one of employment concentration with respect to the capital labor ratio. Thus, an increase of 10% in the degree of capital intensity would probably bring about a 12.8% increase in output concentration and a 7.4% increase in employment concentration. In other words, an increase in the capital intensity of an industry would proportionately, increase output concentration more than employment concentration.

Since the coefficients of the industry's rate of growth are not statistically significant in either regression, we cannot say much about the relationship between concentration and the industry's rate of growth. We will, however, attempt to investigate this relationship further in the remaining pages of this section.

It is often maintained that fast growth encourages new entrants into the industry because of the prospect of higher profits and because the barriers to entry may seem less difficult in a growing industry. It is for these reasons that an industry's growth and its level of concentration are negatively related. Some empirical studies (Nelson 1960, Sheperd 1964, Sawyer 1971) support this view, although some contrary evidence (Kamerschen 1968) rejects it.

The hypothesis that there is an inverse relationship between an industry's growth rate and its level of concentration is tested using the rate of change of an industry's output as the growth variable, and the rate of growth in the number of firms in the industry as the barrier to entry variable. If the barriers to entry are low, we would expect a rapid increase in the number of firms in the industry and vice versa. The variables that measure the changes of concentration are the rates of change of C_2 and C_3 whose value, as explained above, measure concentration inversely.

The estimated linear and linear in the logarithms regression equations are shown in Table 4. The estimated coefficients are negative for the rate of growth of output and positive for the rate of growth of the number of firms. All coefficients are statistically significant and in all regressions the changes in the independent variables explain at lease 35% of the variation in the rate of growth of concentration.

Our results bring evidence to support the view that the barriers of entry into an industry are important for explaining the degree of industrial concentration. For example, according to equation (3), Table 4, if the rate of growth of the number of firms in an industry is 10% higher than in another (i.e. the entry barriers are not as

Table 4

Multiple Regression Equations Relating Changes in the Level of Concentration, the Growth of Output, and the Rate of Growth of the Number of Firms in an Industry.[a/]

Independent Variables	ΔQ	ΔNF	R^2	F	Number of Industries
(1) ΔC_2	-0.080 (0.029)	0.75 (0.070)	0.38	56	190
(2) ΔC_3	-0.091 (0.030)	0.98 (0.073	0.49	91	192

	ln Q	ln NF	R^2	F	Number of Industries
(3) ln ΔC_2	-0.13 (0.070)	0.76 (0.081)	0.35	49	190
(4) ln ΔC_3	-0.19 (0.062)	0.94 (0.073)	0.49	91	192

[a/] ΔC_2 and ΔC_3 are rates of change of the indeces of output and employment concentration as defined in the text. ΔQ and ΔNF refer to the rates of change of output and the number of firms in the industry between 1965 and 1970.

The upper panel shows regressions in linear form and the lower panel in linear logarithmic form. Standard errors are in parenthesis.

strong) one expects the rate of change in concentration to be 7.6% lower. The rapid entry of new firms into an industry decreases the growth of concentration.

On the other hand, the sign and magnitude of the coefficient of ΔQ suggests that concentration is more likely to increase in rapidly growing industries. For example, according to regression (3) Table 4, an industry whose output grows 10% faster than that of another would have a rate of growth of output concentration 1.9% higher and, according to equation (2), a 1.3% higher rate of growth of employment concentration. Our findings then, do not support the view that diseconomies of scale and other bottlenecks adversely affect a large firm's ability to grow (Penrose 1959, Baumol 1962) or that "the growth of the industrial markets makes feasible a greater explotation of the division of labor along both industry and functional lines, and leads to lower concentration levels" (Nelson 1960, p. 641). The direct association found in the industrial sector of Mexico between growth and concentration may be explained if one considers that large firms in rapidly growing industries are better able than the small ones to gain monopoly power and thus increase the degree of concentration.

We next investigate the nature of the relationship between the increases in the number of new entrants and the industry's growth rate. We also investigate the relationship between cencentration and increases in the number of new entrants when the latter is the only explanatory variable in the regression equation (contrast this formulation with the regressions of Table 4).

The estimated regression between the rate of growth of output (ΔQ) and the rate of growth of the number of new entrants (ΔNF) and the regression between the rate of growth of new entrants (ΔNF) and the rate of growth of concentration (ΔC_2) are as follows:

$$\ln \Delta NF = 0.45 + \underset{(0.035)}{0.37} \ln \Delta Q \qquad (1)$$

$R^2 = 0.36 \quad F = 109 \quad$ Number of industries 200

$$\Delta C_2 = 0.29 + \underset{(0.067)}{0.71} \Delta NF \qquad (2)$$

$R^2 = 0.38 \quad F = 113 \quad$ Number of industries 185

$$\ln \Delta Q = 1.26 + \underset{(0.056)}{1.98} \ln \Delta NF \qquad (3)$$

$R^2 = 0.86 \quad F = 237 \quad$ Number of industries 200

Our estimated coefficients suggest (regression 1) that there is a positive relationship between increases in the number of new entrants and the rate of growth of an industry's output. Our estimates also indicate (regression 2) that there is a negative relationship between increases in the number of new entrants and an industry's concentration (recall that C_2 measures concentration inversely).

These results suggest that an increase in the rate of growth of an industry's output would decrease concentration through the effect which that increase has on the growth of the number of firms. This outcome may at first seem inconsistent with the results shown in Table 4, which indicate that a rapid rate of output growth would increase not decrease concentration. These seemingly contradictory results may be explained, and even reconciled, if we take into account the following considerations.

Although increases in the growth rate of Mexico's industrial output have stimulated the entrance of new firms thus reducing concentration, it has also been the case that the largest proportion of total output increases have come from the largest firms and this has increased concentration. This is why equations where the rate of industry output and the rate of growth of the number of new firms are included (Table 4) show that an increase in the rate of output growth increases concentration while ,simultaneously, encouraging the entry of new firms thus reducing concentration.

II. CONCENTRATION AND FACTOR PRODUCTIVITY

It is often argued that in most of the less developed countries capital is scarce and labor is abundant. Given this level of factor endowment a high degree of efficiency is attained when the productivity of capital is high. The relevant issue, from the point of view of concentration policies, is to determine whether small firms use less capital and less of other scarce resources than do the large ones to produce a given level of output. Most of the available evidence suggests that small firms tend to use less capital per unit of output than do the large ones (Ranis 1962, Marsden 1969, Meheta 1969, Todd 1971, Berry 1972). However, some contrary evidence shows that the productivity of both labor and capital, increases with firm size (Dhar and Lydall 1961, Boon 1964, Sanderasa 1966, 1969, Cardwell 1978). Moreover, since, in general, labor productivity (output-labor ratio) tends to be higher for large firms than for small and medium size ones, and since an industry with few large firms is usually one with a high degree of concentration, it follows that labor productivity increases with concentration. If we accept the argument that small firms are more efficient in the intensive use of the scarce capital (low capital-output ratios), and also make extensive use of the abundant labor (low capital-labor ratio), then it is meaningful to reduce the level of concentration, i.e. to increase the number of small and medium size firms in the economy.

The point of view that small and medium size firms use more labor intensive techniques (low capital-labor ratio) than the large ones, is supported by most of the empirical evidence (Dhar and Lydall 1961, Ranis 1961, Shetty 1963, Marsden 1966, Berry 1972, Ditullio 1972). The reasons usually given to explain the use of labor-intensive techniques by small and medium size firms are as follows: Small and medium size firms face a more competitive environment than do large size firms and are thus forced to choose a technology more in accordance with the factor abundance in the economy. In other words, small firms are confronted with a set of relative factor prices closer to the real scarcity prices than the set faced by the large ones. Large firms, on the other hand, tend to be less labor intensive and to pay high wages due to the presence of powerful unions and because wage legislation is more effective in large firms than in small ones. It has been found by Garberino (1950), Weiss (1966) and Phlips (1971), that large firms in highly concentrated industries pay higher salaries than firms in less concentrated ones.

Another factor for the capital intensiveness of large firms is that subsidized credit and other capital subsidies such as preferential fiscal treatment, as well as facilities to import capital are available mostly to them.

In accordance with the foregoing argument, wages tend to be low (high) and capital costs high (low) for small (large) size firms, and hence they tend to use labor (capital) intensive techniques. If it is true that small firms use labor-intensive techniques, not because they operate on a small scale, but because they face a less distorted set of relative factor prices than the large ones, it can be argued that policies to increase employment should not encourage the creation of more small size firms (reduce concentration) but should work to eliminate the factor price distortions that give rise to dual factor markets. If these policies are successful, firms of all sizes will adopt more labor-inensive technologies.

In this section we make tentative estimations of the relationships between the degree of concentration in the industrial sector of Mexico and (a) employment growth (b) labor productivity, (c) the level of wages, and (d) the capital intensity of production.

The estimated linear in the logarithm regressions are shown in Table 5. The degree of concentration is measured, as above, by C_2 and C_3. C_2 is the number of the largest firms that together produce 80% of the industry's output; C_3 is the number of the largest firms that together give employment to 80% of the labor force; both measure inversely the degree of concentration. Since it has been found that in Mexico an industry with a high degree of concentration is likely to be one with a

Table 5

Regressions Relating Measures of Factor Productivity, Capital Intensity and Concentration[a/]

1970

Independent Variables	C_2	ΔC_2	$\left(\frac{K}{L}\right)$	$\Delta\left(\frac{K}{L}\right)$	R^2	F	Number of Industries
(1) ΔL		0.28 (0.019)			0.54	237	96
(2) $\frac{Q}{L}$	-0.23 (0.040)				0.26	33	96
(3) W	-0.18 (0.029)				0.29	38	96
(4) $\frac{K}{L}$	-0.35 (0.048)				0.37	53	91
(5) C_2			-1.07 (0.147)		0.37	53	91
(6) C_3			-1.04 (0.153)		0.34	46	91
(7) C_2				-0.62 (0.131)	0.19	22	96
(8) C_3				-0.77 (0.135)	0.26	32	96

[a/] All regressions are linear in the logarithmic form. The standard errors are in parenthesis.

small number of large firms (Gollas 1978), in this paper we refer to a highly concentrated industry as one with few large firms. The other variables used in the regressions have the usual connotation: for each industry, Q is value added, L is the number of workers, W refers to wages, and K to total value of assets.

Equation (1) indicates an inverse relationship between the degree of concentration and the industry's employment growth. The statistically significant coefficient (elasticity) suggests that a 2.8% increase in the rate of employment growth may be expected if the rate of concentration growth decreases by 10%. Moreover, the value of R^2 indicates that more than 50% of the variation in the employment growth rate may be explained by the growth of industrial concentration.

According to equations (2), (3) and (4), as concentration increases, the productivity of labor, the industrial wages, and the capital intensity of production will also increase. The estimated coefficients suggest that, for example, if an industry is 10% more concentrated than another, it would (a) pay wages that are 1.8% higher, (b) use a 3.5% more capital intensive technology and (c) its labor would be 2.3% more productive.

The depressing effect that an increase in the rate of concentration has on the rate of employment (equation 1) probably occurs because the same increase in concentration also increases the level of wages (equation 3), thus reducing the rate of employment. In other words, the increase in the price of labor caused by an increase in concentration reduces the rate of employment growth.

However, the direction of causation between concentration and the degree of capital intensity used in production may be reversed. That is, it may be argued that high capital intensive techniques stimulate concentration, and not that an increase in concentration induces high capital intensive techniques as suggested by equation (4), Table 5. Equations (5), (6), (7), and (8) indicate that a high degree of concentration may be expected if the level, or the rate of change of capital intensity of production increases.

To sum up. Our empirical estimates support the view that industries made up of small firms (low degree of concentration) tend, as opposed to industries made up of large firms, to (a) have larger employment growth rates, (b) have lower labor productivity, (c) pay lower wages, and (d) use more labor intensive technology in production.

III THE DETERMINANTS OF FIRM EMPLOYMENT SIZE

The factors that determine the size of firm in terms of its number of employees may be studied using the notion of the minimum optimum size of firm estimated by the survivor technique. As explained in Section I (A) above, the determination of the minimum optimum firm size for each industry by the survivor technique consists in calculating the average firm size for the class that has gained most in the market during a certain period of time.

The same technique may be applied to determine the optimum firm size ,now in terms of employment, of the class which has had the greatest increase in employment during a certain time period.

After the firm size whose employment growth has been fastest has been determined, we may inquire about the factors that contribute to determining its size. Among these factors, we may mention (1) the size of its industry's labor market, (2) its industry's output growth rate, and (3) its industry's capital intensity of production. The mechanism through which these factors affect the employment size of firms is as follows:

(1) If a firm operates in an industry that employs a large number of workers, it is likely that in that particular labor market the price of labor would be sufficiently low as to make it attractive for firms to use labor intensive techniques. We test the hypothesis that the size of firm in terms of number of employees will be large if the labor market in which the firm operates is also large.

(2) A rapidly growing industry makes it possible for firms to take advantage of the economies of scale in production, thus stimulating the firm's growth. We test the hypothesis that there is a positive relationship between the employment size of the firm with the highest rate of employment growth, and the industry rate of output growth.

(3) The effect of the degree of capital intensity in production on the employment size of the firm which has experienced the largest rate of employment growth is more difficult to determine. In some instances, large employment size firms are found in low capital intensive industries, but they are also frequently found in high capital intensive industries. We test whether it is more likely to find large employment size firms in high or in low capital intensive industries.

The size of the labor market in each industry is measured by the total number of workers for 1965 and 1970. The rate of each industry's growth is measured by the rate of output growth. The capital intensity of production is measured by two variables: the capital-labor ratio and the value of fuels and lubricants per worker.

We fitted our data to a linear in the logarithm regression equation and obtained the following results:

$$\ln (FS)_i = -2.8 \underset{(0.15)}{+0.52} \ln L_i + \underset{(0.47)}{0.83} \ln \Delta Q_i + \underset{(0.25)}{0.47} \ln \frac{K}{L}_i \underset{(0.32)}{- 0.17} \ln \left(\frac{F}{L}\right)_i$$

$R^2 = 0.25$ $F = 4.1$ Number of industries = 55

where

i = industries

FS = average firm size of the class that proportionately generated more employment between 1965 and 1970.

L = size of the labor market

ΔQ = rate of growth of output between 1965 and 1970.

$\frac{K}{L}$ = capital-labor ratio

$\frac{F}{L}$ = value of fuels and lubricants per worker

The coefficients of the variables that measure the size of the labor market and the industry's rate of growth have the expected signs and are statistically significant. The coefficient of fuels and lubricants is not statistically significant. Our estimates suggest that one is likely to find that the firm which generates proportionately more employment is larger, in terms of the number of employees, in industries with relatively large labor markets and relatively rapidly growing output. For example, the employment size of the firm that generates proportionately more employment is likely to be 8.3% larger in an industry that grew 10% faster than another.

The positive coefficient of the capital labor ratio suggests that the employment size of the firm that generates proportionately more employment is likely to be larger in the more capital intensive industries. This outcome is not unreasonable if one takes into consideration that in Mexico a number of economic policies (capital import facilities, capital subsidies, credit facilities, tax exemptions among others) have traditionally encouraged the rapid growth of large firms along capital intensive techniques of production. This high capital intensive path has been followed quite independently of the technological requirements of production and of the country's relative factor endowments. The protectionist policies which have encouraged the rapid growth of large firms have had a dual effect on industrial employment. On the one hand, the observed increases in the capital labor ratio of large industrial firms in Mexico imply, by definition, that large firms employ less labor per unit of capital, however, simultaneously because of the protectionist policies mentioned above, their output has grown fast enough to more than offset the depressing effect of capitalization on employment. It is not surprising then, to find that the employment size of the firm that generates proportionately more employment is relatively larger in the more capital intensive industries.

Our findings suggest that more attention should be paid to the employment generating capacity of large high capital intensive industries. It is not at all obvious that the creation of a large number of small labor intensive firms is the only or best way to increase total employment.

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