INDUSTRY INFLUENCE ON FIRMS' INVESTMENT IN WORKING CAPITAL: THEORY AND EVIDENCE

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I. INTRODUCTION

The factors affecting the level of firms' investment in working capital is a topic of interest to students of corporate financial management. The topic, however, has received little attention in the finance literature despite the well-known fact that nonfinancial corporations have a substantial proportion of their total assets tied up in short-lived assets.

In the next section of this paper we re-examine the concept of net working capital. In section III we seek to analyze firms' investment in working capital with respect to three exogenous variables: technology, managerial efficiency and sales. A simple proposition regarding investment in working capital is then formulated. This proposition leads to a testable hypothesis spelled out in section IV. We show that within an industry the ratios of firms' investment in working capital to sales should be similar but they should differ among industries.

After performing a series of statistical tests on 1,181 firms grouped into 36 industries with 19 years of annual data (the sample is described in section V) we could not reject the null hypothesis stated above. We conclude that there is a significant industry effect on firms' investment in working capital. Our empirical results are also consistent with the notion that there exist industry norms within industries to which firms adhere when setting their working-capital investment policies.

In testing our hypothesis we use a methodology based on cluster analysis. This technique attempts to capture the simultaneous behavior of the ratio of working capital-to-sales among industries (cross-sectional analysis) and over time (time-series analysis). The methodology and the tests are described in section VI. Our empirical findings are reported in section VII. Concluding remarks make up the last section.

II. WHAT IS WORKING CAPITAL?

Working capital has been traditionally defined as the difference between current assets and current liabilities and referred to as Net Working Capital (NWC). Current assets are essentially made up of cash and short-term marketable securities (C), accounts receivable (AR) and inventories (INV). Current liabilities are short-term borrowings (STB), accounts payable (AP) and short-term net accruals (NA). Hence we can write:[1]

$$NWC = (C + AR + INV) - (STB + AP + NA) \qquad (1)$$

The grouping of these short-term items to provide a measure of a firm's investment in working capital is usually justified by the fact that they are all closely related to the firm's operating cycle, that is, the process of procurement, production and sales.

This traditional concept of working capital can be criticized on the ground that some of the components of NWC are not closely related to the firm's operating cycle and should not, therefore, be considered a part of the firm's investment in working capital.

Specifically, items such as cash and marketable securities (C) as well as overdrafts and notes payable to banks (STB) should be viewed as decision variables

which are purely financial in nature and, as such, not directly related to a firm's investment in its current operations. For example, an increase in long-term borrowing to finance capital investment may temporarily raise the firm's cash position and artificially inflate its NWC.

If we rearrange equation (1) in the following manner:

$$NWC = \Big[(AR + INV) - (AP + NA)\Big] + \Big[C - STB\Big] \qquad (2)$$

then the four items within the first set of brackets are directly related to the firm's operating cycle whereas the two items within the second set of brackets are essentially the outcome of purely financial decisions.

The difference between the sum of accounts receivable (AR) and inventories (INV) and the sum of accounts payable (AP) and net accruals (NA) can be isolated and referred to as the firm's Working Capital Requirement (WCR). The difference between cash and marketable securities (C) and short term borrowing (STB) - the two items related to the firm's financial decisions - is referred to as the firm's Net Liquid Balance (NLB). Hence, equation (2) can be written as:

$$NWC = WCR + NLB \qquad (3.1)$$

or

$$WCR = NWC - NLB \qquad (3.2)$$

According to this approach, a firm's investment in working capital is better measured by Working Capital Requirement (WCR), the difference between the traditional concept of Net Working Capital (NWC) and what we call Net Liquid Balance (NLB). A firm's Net Working Capital will equal its Working Capital Requirement only if the firm's Net Liquid Balance is zero, that is, if its cash holdings equal its short term borrowing.

To determine if there exists a significant difference between these two measures of firm's investment in working capital we perform our tests alternatively with working capital measured as NWC and WCR.

III. DETERMINANTS OF THE LEVEL OF A FIRM'S INVESTMENT IN WORKING CAPITAL

In this section we identify at least three basic variables which affect a firm's investment in working capital, defined as WCR. These are: (1) the firm's technology, (2) the degree of managerial efficiency, and (3) the level of sales.

By the firm's technology we mean the nature of the product it sells and the process it employs to manufacture (or deliver) its output. Typically, a manufacturer of industrial equipment would need a higher WCR to sustain the same level of sales as a chain of grocery stores. This is simply due to the nature of each firm's operating cycle. To achieve a level of sales equal to that of the manufacturer of industrial equipment, the chain of grocery stores will carry a relatively lower level of inventories and will probably hold a very small amount of accounts receivable since its business is mostly conducted on a cash basis. For certain companies, WCR may even be negative. In this case, the firm's operating cycle becomes a permanent source of financing. Such firms will be encountered mostly in the retail and service sectors of the economy. They will usually carry small inventories and collect the proceeds of their sales before they pay their suppliers on products of small added value.

Despite the constraints imposed by a firm's operating cycle on its investment in working capital, different levels of WCR are still possible for firms with similar technologies and equal levels of sales. This can occur as a result of differences among firms in their degree of managerial efficiency. For example, an increase in the efficiency with which a firm manages its operating cycle can, to some extent, reduce that firm's investment in working capital as a result of, say, tighter control over inventories and receivables. That is, by raising the firm's inventory turnover and/or shortening the firm's average collection period and/or lengthening the firm's average payment period (if at all possible), management can, ceteris paribus, reduce the firm's WCR. Of course, firms which would be able to achieve a reduction in WCR through increased managerial efficiency, given technology and sales, are those which are currently operating below their industry norms.

Given technology and managerial efficiency, the level of sales is the major determinant of a firm's WCR. In sectors where WCR is positive, increase sales will call for additional investment in working capital, assuming that technology and the degree of managerial efficiency remain the same. This relationship can be formalized as follows. Ignoring net accruals, WCR (assumed positive) is given by:

$$WCR = \left[INV + AR - AP \right] > 0 \qquad (4.1)$$

Dividing and pultiplying the right-hand side of (4.1) by the level of sales (S) we get:

$$WCR = \left[\frac{INV}{S} + \frac{AR}{S} - \frac{AP}{S} \right] \cdot S \qquad (4.2)$$

The three ratios within brackets are measures of the degree of managerial efficiency. The first ratio (INV/S) is the reciprocal of the firm's inventory turnover, the second (AR/S) is the firm's average collection period and the third (AP/S) is its average payment period.[2] When the level of sales varies these ratios will remain constant if the degree of managerial efficiency is the same. For example, a 10 percent rise in sales should call for a 10 percent increase in WCR given that inventory turnover, average collection period and average payment period do not change. This sales effect can be demonstrated as follows. Assuming a given degree of managerial efficiency and taking the derivative of (4.2) with respect to sales we get:

$$\frac{\partial WCR}{\partial S} = \left[\frac{INV}{S} + \frac{AR}{S} - \frac{AP}{S} \right] > 0 \qquad (4.3)$$

since

$$\frac{\partial}{\partial S} \left(\frac{INV}{S} \right) = 0; \quad \frac{\partial}{\partial S} \left(\frac{AR}{S} \right) = 0 \text{ and } \frac{\partial}{\partial S} \left(\frac{AP}{S} \right) = 0$$

given a fixed degree of managerial efficiency.

Hence if WCR is positive, a proportionate change in sales will call for an equal proportionate change in WCR in the same direction.

Another important but often overlooked aspect of the relationship between working capital and sales is inflation. When the price level rises so will the firm's sales although the number of units sold may not have significantly changed. Inflated sales figures will require additional investment in working capital if the degree of managerial efficiency does not change, although, again, quantities

produced and sold may not have varied appreciably.[3]

IV. INFERRING A TESTABLE HYPOTHESIS

In order to test our proposition according to which given technology and the degree of managerial efficiency, investment in working capital is directly related to sales we rewrite (4.2) as:

$$\left(\frac{WCR}{S}\right)_i = \left(\frac{INV}{S}\right)_i + \left(\frac{AR}{S}\right)_i - \left(\frac{AP}{S}\right)_i \tag{5.1}$$

which can be restated in a more general form as:

$$\left(\frac{WCR}{S}\right)_i = f\ (\text{Managerial Efficiency} | \text{Technology}) \tag{5.2}$$

In words, the ratio of working capital-to-sales of the i-th firm is a function of its degree of managerial efficincy given the firm's technology.

In order to test this proposition an additional assumption is made: firms within an industry have similar degrees of managerial efficiency and same technology. This assumption is justified as follows. In reasonably competitive markets, we should not expect to observe wide differences in the degree of managerial efficiency among firms within an industry. Consider, for example, accounts receivable. A firm may not be able to significantly reduce its investment in receivables by, say, imposing stricter terms of trade to its customers. These may simply switch to the competition. Hence, "optimal" industry norms will develop to which most firms are expected to adhere. Also, technology can be reasonably assumed to be the same across firms within an industry and different across industries. This is consistent with the standard assumption in the financial literature of constant business or operating risk within an industry.

If the degree of managerial efficiency and the technology are assumed the same for firms making up an industry then the calculated ratios of WC-to-sales of firms within an industry, should not differ significantly. The industries' mean ratios of WC-to-sales should, however, be significantly different from one another. Our null hypothesis, then, can be stated as follows: the ratios of WC-to-sales are similar within industry groups but the industry mean-value of these ratios differ. Introducing the following notation:

$$\left(\frac{WC}{S}\right)^t_{k,i} \equiv \text{ratio of WC-to-sales for firm i in industry k in year t.}$$

$$\left(\frac{WC}{S}\right)^t_{k} \equiv \frac{1}{n}\sum_{i=1}^{n}\left(\frac{WC}{S}\right)^t_{k,i} = \text{mean of the ratios } \left(\frac{WC}{S}\right) \text{ in year t for the n-firms making up the k-th industry.}$$

Our null hypothesis can be formally expressed as:

$$H_o : \left(\frac{WC}{S}\right)^t_k - \left(\frac{WC}{S}\right)^t_\ell \neq 0 \qquad k \neq \ell \tag{6}$$

where k and ℓ are two different industry groupings.

As we will see in section VI, one way of testing our hypothesis is simply to verify if there is greater variance in ratios of WC-to-sales among industry groups than within industry groups.

In measuring the ratio of WC-to-sales we should note that this ratio has a stock variable in its numerator (WC) and a flow variable in its denominator (Sales). When calculating WC we took the arithmetic average of either NWC or WCR. Since these ratios are computed annually (see Section V), working capital over year t is measured as:

$$\overline{WC}_t = \frac{WC_t + WC_{t-1}}{2} \tag{7}$$

Where WC_t is either NWC_t or WCR_t. Consequently, the ratio of Working Capital-to-Sales over year t is calculated as $\overline{WC}_t/S_t$ where S_t are Net Sales over year t.

V. SAMPLE PROPERTIES

The sample consists of 1,181 firms grouped into 36 industries with data taken from the COMPUSTAT INDUSTRIAL TAPE. Industries reference numbers, name, corresponding SIC codes and the number of firms in each industry are given in Table 1. Annual data for most firms begin in 1960 and end in 1979, a total of 20 observations per variable.

In order to form our 36 industry groups we proceed as follows. We first eliminated all companies that had less than 15 consecutive years of data available on the tape and then grouped the remaining companies according to their two-digit SIC codes. This initial grouping procedure revealed that industry groups thus formed appeared heterogeneous and very large. This led us to splitting them up into 36 smaller groups of four-digit codes which are relatively more homogeneous than the initial grouping based on two-digit SIC codes. All industry groups containing less than 15 companies were eliminated from the sample. All firms belonging to the financial sector of the economy were also eliminated. We were left with 36 industry gourps which contained a total of 1,181 companies. The largest industry group has 87 companies and the smallest 15 companies.

Net Working Capital (NWC) was computed as the difference between Current Assets (CA = item #4 in COMPUSTAT TAPE) and Current Liabilities (CL = item #5 in COMPUSTAT TAPE), Working Capital Requirement (WCR) was computed as NWC minus Cash and marketable securities (C = item #1 in COMPUSTAT TAPE) plus short term debt (STB = item #34 in COMPUSTAT TAPE). Finally average NWC and average WCR were calculated as indicated in equation (7) in the previous section. Because

an average is taken we lose an observation, that is, we end up with a maximum of only 19 ratios of average working capital to sales (item #12 in COMPUSTAT TAPE) for each of the 1,181 firms in our sample.

VI. METHODOLOGICAL ISSUES AND STATISTICAL TESTS

As we pointed out earlier, we have calculated the ratios of working capital to sales with WC measured either as NWC or WCR. We did find that when WCR is used instead of NWC our statistical results are slightly superior but the difference, however, is not statistically significant. The discussion that follows and the empirical results reported in the next section are based on firms' investment in working capital defined as working capital requirement (WCR).

For each of the 1,181 companies in a sample and for every one of the 19 years of available data the ratio of WCR-to-sales was calculated according to (7). As a preliminary test we examined the behavior of these ratios, for each year, within each of the 36 industry groups and found that the intra-industry distributions of the ratios of WCR-to-sales can be approximated closely with normal distributions. Hence, parametric tests can be applied to analyze the properties of our sample data.

The next step is to test for significant differences in the mean ratios of WCR-to-sales among the 36 industry groups. Three tests were performed at this stage: (1) a one-way analysis of variance, (2) a pairwise analysis involving a multiple comparison test,[4] and (3) an intertemporal cluster analysis. Each of these techniques is now briefly described.

In performing a one-way analysis of variance our objective is to determine if industry groups conform to our null hypothesis stated in (6). If the variability of the sample mean ratios of WCR-to-sales across the 36 industry groups is

significantly greater than that within industry groups then we cannot reject our null hypothesis: there exists a significant industry effect on firms' investment in working capital.

The preceding test has a major drawback. It does not identify the particular industries with mean ratios of WCR-to-sales that differ significantly from the other industries in the sample. With 36 industry classes we have 630 possible industry pairs. A pairwise analysis involving multiple comparison tests will indicate the extent of inter-industry differences, an effect which is not captured by performing a direct one-way analysis of variance.

The preceding two tests have two common shortcomings. First, they are performed for a given year and hence say nothing about the intertemporal behavior of inter-industry differences. Does the structure of inter-industry differences in investment in working capital change over time? Second, the pairwise test does not tell us if there are distinct clusters such that industries within these clusters are all similar but significant differences still existing between these clusters both at a moment in time (cross-sectional comparison) and over time (time-series comparison). The third test is designed to capture the relative strength of the intertemporal structure of inter-industry differences in investment in working capital.

The method we designed is an adaptation of conventional cluster technique.[5] For each of the 630 industry pairs in our sample we define an Intertemporal Similarity Index:

$$ISI_s = \frac{N}{19}$$

s = the industry pair s, s=1, ..., 630.

N = number of years (0<N<19) for which two paired industries have mean ratios of WCR-to-sales which are significantly similar to each other.

If the ISI is zero then the two industries had different mean ratios over each one of the 19 years covered by our sample. If the ISI equals one then the two industries had the same mean ratios (statistically) over each one of the 19 years covered by our sample. An ISI between zero and one indicates some similarity between mean ratios of the two paired industries with the strength in similarity rising as the ISI approaches one. Hence, the ISI captures the degree of similarity between the mean ratios of WCR-to-sales of two industries over time.[6]

Once ISI are computed, conventional cluster analysis can be applied. Through an iterative process a search is made to find the first two industries in our sample which are temporally most similar (ISI closest to one). Once detected, these two industries are merged together to form a single group or cluster. Since we started with 36 industry classes we are now left with 35 clusters: 34 single-industry clusters and one cluster made up of the two industries that merged first. The procedure is repeated and a search is made to find two of the remaining 35 clusters that are most similar.[7] The process is carried out until all 36 industries merge into a single cluster. An examination of the resulting pattern of merging industries and the value of the ISI at which merging occurs will shed more light on the structure of the sample than either one of the two tests discussed earlier.

VII. EMPIRICAL FINDINGS

In this section we report our statistical results for the three tests discussed in the previous section.

One-way Analysis of Variance. The relevant data are summarized in Table 2 which shows the value of the industry mean ratio of WCR-to-sales for 3 of the 19 years: the first (1961), the middle (1970) and the last year (1979). The value of the industry mean ratio of WCR-to-sales varies from a low of -.031 (Air Transportation) to a high of .3592 (Computing Equipment). When the mean ratios were computed using NWC instead of WCR, no statistically significant difference was found between the two ratios. The last column gives the value of the computed F-ratio. With a sample size of 1,181 companies grouped into 36 distinct industries, the computed F-ratio must be greater than its critical value of 1.43 to be significant at the 5 per cent level. Hence, whenever a computed F-ratio exceeds 1.43 we cannot reject our null hypothesis. The variability of the ratios of WCR-to-sales is greater among industries than within industries implying that there exists a significant industry effect on firm's investment in working capital. This is the case for 3 years reported in Table 2 as well as for the other unreported 16 years of data. The same conclusion was drawn when we analyzed the mean ratios of NWC-to-sales as opposed to WCR-to-sales.

As pointed out in the preceding section, this test does not tell if the sample mean ratio of any given industry differs significantly from that of every other industry in our sample. To achieve this goal one may perform a pairwise analysis as shown below.

Pairwise Analysis. A summary of the pairwise analysis is given in Table 3.

This table is a square matrix of size 36. Each cell in the matrix refers to an industry pair. Rather than report the results for an arbitrary year, an asterisk in a cell indicates that the industry-pair had mean ratios of WCR-to-sales that are significantly different in at least 10 out of the 19 years of available data. Statistical significance is determined by applying the F-ratio test for difference-in-means at the 5 per cent level of significance. A look at Table 3 indicates that out of 630 possible industry-pairs 378 or 60 per cent of the total had mean ratios of WCR-to-sales that differed, that is, 60 per cent of all possible industry-pairs had working-capital investment policies (as reflected by the ratio WCR/S) that were different for at least 10 years between 1960 and 1979. This percentage varies from a maximum of 85 per cent (percentage of industry pairs that had different mean-ratios in at least one year) to a minimum of 22 per cent (percentage of industry pairs that had different mean-ratios in all 19 years of available data).[8] These statistical results do not allow us to reject our hypothesis (6): there exist significant differences in the mean ratios of WCR-to-sales among the industry groups that make up the sample. Over the 19 years covered by the sample there was a significant industry effect on firms' investment in working capital. The evidence is also consistent with the notion that there are industry norms to which firms adhere when setting their working-capital investment policies.

Intertemporal Cluster Analysis. Results for the intertemporal cluster analysis are summarized in Table 4 with the help of what is called a dendrogram. This diagram shows the structure of industry aggregation as the Intertemporal Similarity Index (ISI) goes from one to zero. For example, when the ISI is at the level of one, industries 27 (Electric Services) and 29 (Gas Services) have already clustered. This means that these two industry groups do not have mean ratios of WCR-to-sales that differs significantly (Computed

F-ratios are smaller than the critical value at the 5 per cent level of significance) in any one of the 19 years covered by our sample. Essentially, the Gas Services Industry and the Electrical Services Industry have working capital investment policies, as reflected by their mean ratios of WCR-to-sales, that are similar.

When the ISI is at the level of .84 (meaning that out of 19 years, the clusters contain industries that have similar mean ratios of WCR-to-sales in 16 years and different mean ratios in 3 years) we have 11 clusters. Note that the industries that cluster first tend to be those which belong in the same two-digit SIC code.

What can be said about the statistical significance of the overall dendrogram? That is, can we accept or reject a null hypothesis (6) - mean ratios differ among industries - in light of our results? One way of testing for significance is as follows. The probability of concluding that over a given year two industries have different mean ratios of WCR-to-sales when they actually have the same mean ratios is 5 per cent (Type I error) at the level of significance we have chosen earlier. Also, the probability of concluding that they have different mean ratios when it is indeed the case is 95 per cent (correct decision). Since we have 19 years of data and 19 F-ratios for each industry pair the probability of having similar mean ratios for "x" years (out of 19) is given by a binomial distribution with $N = 19$, $q = .05$ and $p = .95$. Referring to a binomial distribution table we find that there is a 6.7 per cent chance that we reject an observation of 16 or less F-ratios indicating similarity even though it is correct. Recall that when an industry pair has similar mean ratios for 16 out of 19 years then its ISI equals .84. Hence .84 is our critical value for the Intertemporal Similarity Index. In other words, we can state that there is a 6.7 per cent

chance that we are wrong when we claim that our sample data can be viewed as made up of 11 distinct clusters (This is the number of clusters at the level of ISI equal to .84 as shown in Table 4). Considering that the intertemporal cluster analysis we performed is a stringent test (it looks at pairwise similarity over 19 years) this result can be interpreted as further evidence of the existence of a significant and persistent industry effect on firms' in investment in working capital.

VIII. CONCLUSION

The purpose of this paper was to re-examine the concept of working capital, to identify the basic factors affecting firms' investment in working capital and to infer a testable hypothesis regarding working-capital investment. We have argued that the concept of Working Capital Requirement may be preferable to the traditional concept of Net Working Capital when analyzing firms' investment in short-lived assets. After identifying three basic factors affecting firms' investment in working capital (the level of sales, the degree of managerial efficiency and the firm's technology) we have formulated the following proposition: the ratios of WCR-to-sales of firms belonging to the same industry group should be similar but those ratios should differ among industries. Our proposition was tested on a sample of 1,181 firms over a period of 19 years. After applying 3 different statistical tests to our sample data we could not reject the hypothesis that there is greater similarity in ratios of WCR-to-sales within industries than among industries. We can conclude that there exists a significant industry effect on firm's investment in working capital and that this effect persisted over the 19 years covered by the sample data. Our empirical results are also consistent with the notion that there exists industry norms within industry groups to which firms adhere when setting their working-capital investment policies.

FOOTNOTES

1. For a review of the basic concepts underlying the management of firms' working capital see, for example, [4] and [5] .

2. Inventory turnover would be better measured by taking the ratio of cost of goods sold to inventory (both are reported at cost) rather than the ratio of sales (reported at market value) to inventory. Also, average payment period would be better measured by taking the ratio of accounts payable to purchases rather than accounts payable to sales. However, if there are fixed ratios between sales and purchases, the discussion in the text is not modified.

3. See Harrison and Hernandez [1] .

4. See, for example, [3] for an application of these two statistical tests to examine industry influence on firms' financial structure.

5. See, for example, [2] for a clear exposition of clustering analysis and the drawing of summary dendograms. (Dendograms are explained in the next section).

6. In conventional cluster analysis based on cross-sectional and time-series data, the measure of similarity between variables is usually the correlation coefficient.

7. The ISI of a cluster is calculated as the arithmetic average of the ISI's of the industries making up that cluster.

8. The corresponding percentages for the case where ratios were computed using NWC instead of WCR were smaller not not significantly so.

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TABLE 1

DESCRIPTION OF INDUSTRY GROUPS

Industry Reference Number	Industry Name	SIC Codes	Number of firms within industry
1	Nonferrous metals	1000/1021/1031/1041	30
2	Oil & natural gas	1311/1381/1382/2911	73
3	Food	2000	18
4	Beverages	2082/2085/2086	22
5	Textile	2200/2270	31
6	Apparel products	2300	33
7	Wood products & buildings	2400/2450	17
8	Paper	2600/2649/2650	36
9	Publishing	2711/2721/2731	17
10	Chemicals	2800/2810/2820	26
11	Drugs	2830	20
12	Soaps & perfumes	2841/2844	21
13	Rubber products	3000	15
14	Plastic products	3079	16
15	Steel works	3310	36
16	Refining: nonferrous metals	3330/3341/3350	21
17	Hardware	3429/3430/3449/3452/3480 3494/3499	56
18	Machinery & equipment	3510/3520/3531/3533/3536 3540/3550/3558/3560	87
19	Computing equipment	3570/3573	22
20	Electronic components	3651/3652/3661/3662/3670 3679/3699	79
21	Motor vehicles	3711/3713/3714/3716	41
22	Aircraft	3720/3721/3728	19
23	Measurement instruments	3811/3820/3823/3825/3830 3841/3843	36
24	Trucking	4210	17
25	Air transportation	4511	23
26	Telephone	4811	15
27	Electric services	4911	64
28	Natural gas: distribution	4923/4924/4926/4927/4928	42
29	Gas Services	4931/4932	51
30	Wholesale: durables	5012/5030/5040/5050/5063 5064/5065/5070/5080/5093 5099	30
31	Wholesale: nondurables	5120/5140/5199	21
32	Department stores	5311/5331	35
33	Grocery Stores	5411	31
34	Retail: nongrocery stores	5912/5944/5949/5961/5962 5980/5999	30
35	Service*	7311/7349/7370/7391/7392 7393/7394/7399	33
36	Conglomerates	9997	17
	TOTAL		1,181

*Advertising, cleaning, data processing, R&D, management consulting, leasing, etc.....

TABLE 2

MEAN RATIOS OF WORKING CAPITAL REQUIREMENT TO SALES FOR

36 INDUSTRIES OVER 3 YEARS

YEAR	1*	2	3	4	5	6	7	8	9	10	11	12
1961	.1839	.0713	.1300	.3047	.2937	.2637	.2000	.1609	.1987	.1886	.1802	.1134
1970	.1854	.1227	.1459	.2512	.2794	.2794	.2069	.1879	.2405	.2455	.2462	.2284
1979	.2342	.0661	.1363	.1677	.2813	.2813	.2372	.1289	.1633	.1749	.2438	.2276

YEAR	13	14	15	16	17	18	19	20	21	22	23	24
1961	.2624	.1961	.2032	.3082	.2418	.3151	.2432	.2275	.2027	.1630	.2027	.0463
1970	.2935	.2281	.2372	.2984	.2654	.3397	.3592	.3508	.2157	.2777	.2157	.0319
1979	.2283	.2022	.1508	.2179	.2040	.2516	.2492	.2464	.1608	.1517	.1608	.0237

YEAR	25	26	27	28	29	30	31	32	33	34	35	36	F-ratio**
1961	.0103	.0055	.0534	.1176	.0426	.1960	.2250	.1902	.0493	.1889	.1433	.2344	5.404
1970	.0135	.0168	.0426	.0714	.0472	.2669	.1471	.1393	.0445	.1336	.1818	.2196	20.748
1979	-.0301	-.0215	.0536	.0449	.0668	.2097	.1030	.1275	.0249	.1051	.1134	.1451	19.591

* Refer to Table 1 to find the name of each industry.

** F-ratios with (35, 1146) degrees of freedom. The critical value of the F-ratio at the 5 percent (10 percent) level of significance is 1.425 (1.915). The minimum value of the computed F-ratio is 5.404 (1961) and the maximum is 2.4460 (1971).

TABLE 3

PAIRWISE ANALYSIS OF THE INDUSTRIES' MEAN-RATIOS OF WORKING CAPITAL REQUIREMENT TO SALES

An asterisk indicates that the industry pair (i,j) has different mean-ratios for at least 10 out of 19 years at the 5 percent level of significance (F-ratio test).

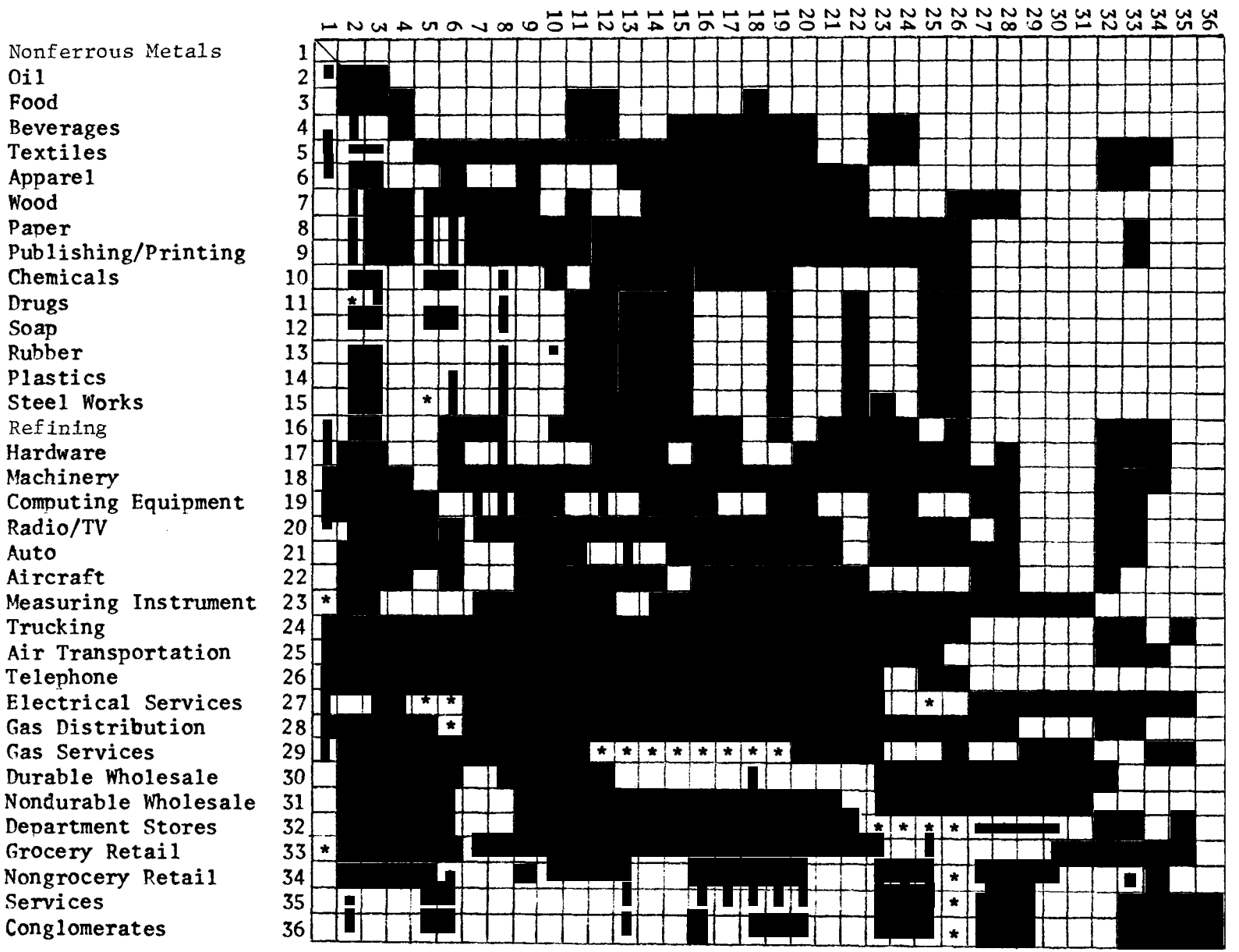
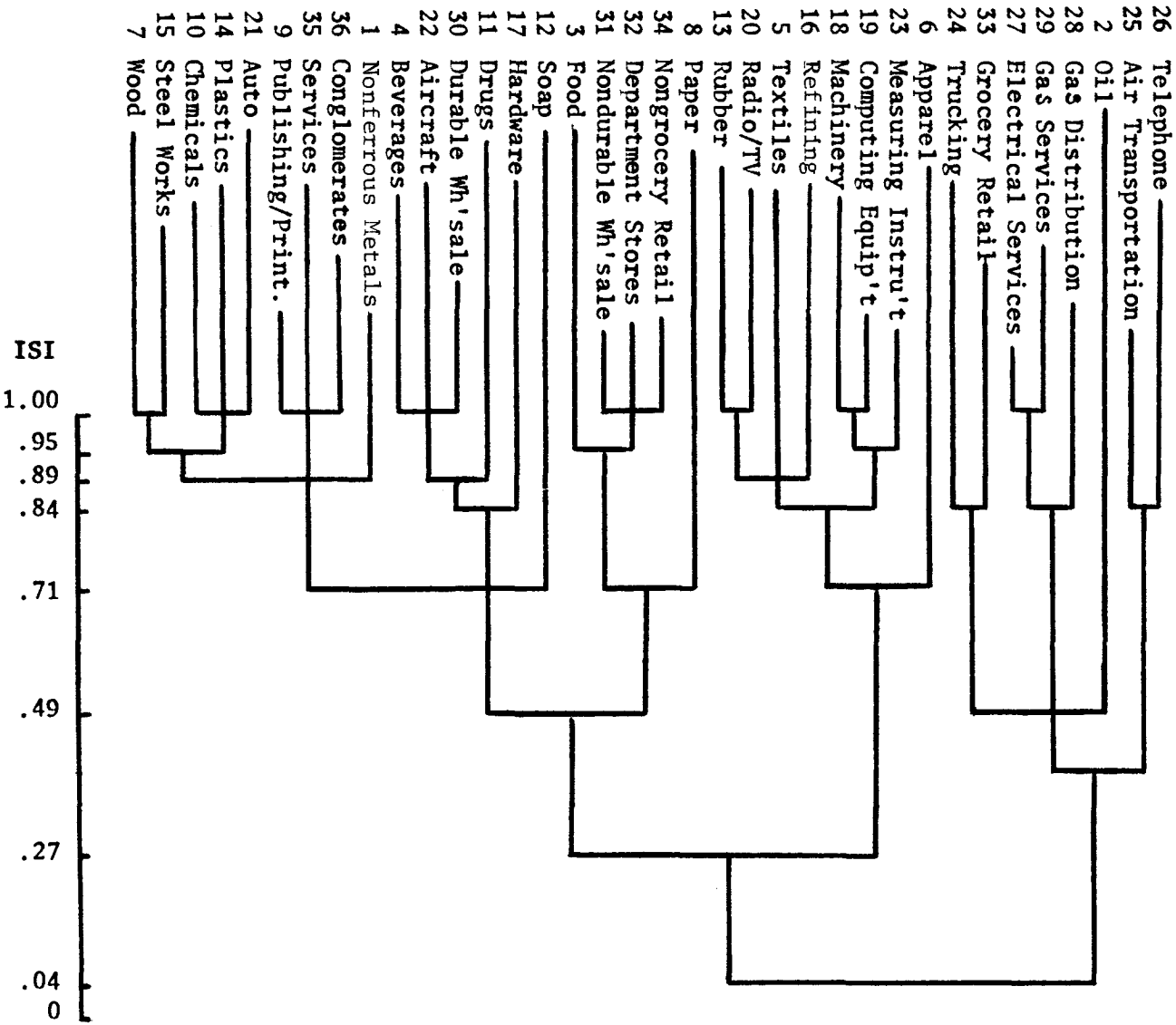


TABLE 4
INTERTEMPORAL CLUSTER ANALYSIS



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