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PRODUCTIVITY: AN EXAMINATION OF UNDERLYING CAUSES
by
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I. INTRODUCTION

One of the most provoking issues discussed today is the problem of productivity decline in the U.S. economy as a whole. It is of great interest because of its fundamental effect on the health of the U.S. economy and on the general well-being of its populace. The mystery of this phenomenon has been vigorously pursued by professionals from all fields of endeavor and has generated hundreds, perhaps thousands, of responses offering possible causes and potential solutions.

One of the first problems encountered is how to define and measure productivity. In previous papers (Zannetos, et al., 1981b, 1982a) we have examined and critiqued much of the research that has been done in the area of measurement of productivity and suggested a framework for such. In doing so we found value-added over salaries and wages to be the measure that best satisfies the criteria of consistency, homogeneity, robustness, and validity. We also have spent some time examining the components of this measure as they change over time in order to decipher certain trends (Zannetos, et al, 1982b). However, while this enables us to more clearly understand what it is that we are discussing, it does not tell us what causes these individual components to change over time. It is this issue that we address in this paper.

Of course, this is not a small task. One almost feels like Diogenes in search of an honest man or someone looking for the proverbial needle in a haystack. Certainly thousands upon thousands of work-hours have been spent trying to solve this mystery. Thus, it would be naive on our part to believe
we could reach a definitive solution. However, we do believe that some significant inroads can still be made, and will be made, if research is directed in the most fruitful directions. It is our contention, as we have stated in the papers previously cited, that research focused at decision-making within the firm where the majority of decisions effecting investments and productivity are made, will yield greater returns.

With this in view it will be useful to our inquiry and exposition to first relate the basic approaches or perspectives that already have been used and examine their contributions and limitations. This we provide in Section II, along with a synthesis of the different perspectives. Then in Section III, we lay out a theoretical framework for examining productivity in a strategic setting and also look at how we might understand productivity decline in the automobile industry using this framework.
II. FOUR PERSPECTIVES IN PRODUCTIVITY RESEARCH

We find that researchers or other professionals have often found themselves examining productivity from four levels or perspectives -- macroeconomic, industry, firm, and individual. While there is a considerable amount of overlap in the literature, one can usually identify these emphases as being particularly pursued or recommended by the writers. The bulk of the interest seems to have resided at the two ends of this continuum -- macroeconomic and individual -- while phenomena at the industry or firm level have received much less attention than they deserve, in our opinion. As we now turn to examine each of these perspectives, we should note that our review is not meant to be exhaustive in its explication but rather it is intended to relate major thrusts and findings encountered in existing literature in the general area of productivity, broadly defined.

A. The Macroeconomic Perspective

Undoubtedly, the most prodigious amount of work has been conducted at the macroeconomic level, especially with the work of economists such as Solow (1956), Denison (1974), Kendrick (1961, 1980), Jorgenson and Griliches (1967) and others. Most have usually employed either the growth accounting methodology or production function approach in attempting to identify major causes of the change in productivity. These approaches have been described in detail in our previous paper (Zannetos, et al., 1981b).

The model employed by studies focusing at the macroeconomic level is basically one which assumes there exists a production function which is based on the state of technological knowledge, and firms attempt to maximize profits by choosing a point on that production function and transforming inputs into outputs accordingly. It is generally assumed that markets are perfectly competitive, technological knowledge is a public good, and full employment
exists in the economy. Accordingly, proportional output growth due to input growth equals the sum of share-weighted proportional input growths, and thus any residual in the equation is said to represent a shift in the production function, i.e. an advance in technological knowledge.

Based upon this, researchers have used extensive data bases to arrive at some common ground concerning potential causes of productivity change. We can present these basic factors in the following graphical form:

These specific items are the ones identified as having the greatest impact on productivity. Of course, the next logical questions are how they affect productivity and how significant they are. Regarding these questions, researchers have performed some calculations using the production function approach to arrive at average annual percentage rates of change in the various sources of growth.

In Table 1 we show contributions by percentage points of each of these factors, as calculated by Kendrick and Denison. Let us now briefly examine
how these factors are determined and how they are hypothesized to affect productivity.

The first seven lines of this table show the components of the average annual percentage rates of change (AAPRC) in total factor productivity (TFP). The AAPRC of TFP (line 7) is determined by the real product per unit of labor (line 5) less the AAPRC of capital/labor substitution (line 6). The AAPRC of real product per unit of labor is calculated by the real gross product less labor input (line 3) and the AAPRC of the capital/labor substitution is the difference between total factor input and labor input. Thus,

$$\text{TFP} = \text{Real Product Per Unit of Labor} - \text{Capital/Labor Substitution}$$

$$= [\text{Real Gross Product} - \text{Labor Input}] - [\text{Total Input} - \text{Labor}]$$

For example, in the period 1973-1978, TFP is calculated as follows:

$$\text{TFP} = [2.4 - 1.3] - [1.6 - 1.3]$$

$$= 1.1 - 0.3$$

$$= 0.8$$

We can see that for the three periods reviewed, the AAPRC of real gross product has been declining. Labor input rose significantly in the second period and fell slightly in the third (1.4 to 1.3), while capital input declined by much more than this in the third period. Therefore, the capital/labor substitution rate of change decreased from 0.7 in the first period to 0.3 in the last. The difference then between the product per unit of labor and this substitution ratio gives TFP. We can see this has decreased from 2.8 to 0.8.

The remainder of the table consists of a breakdown of percentage point contributions to this change in TFP for each of the seven factors. Let us
### TABLE I

**SOURCES OF GROWTH IN REAL GROSS PRODUCT**  
U.S. Domestic Business Economy  
Percentage Points, Selected Subperiods, 1948-1978

<table>
<thead>
<tr>
<th>Sources</th>
<th>Average Annual Percentage Rates of Change</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Real Gross Product</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.9</td>
</tr>
<tr>
<td><strong>Factor Input</strong></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1.1</td>
</tr>
<tr>
<td>Labor</td>
<td>0.4</td>
</tr>
<tr>
<td>Capital</td>
<td>2.8</td>
</tr>
<tr>
<td><strong>Real Product Per Unit of Labor</strong></td>
<td></td>
</tr>
<tr>
<td>Capital/Labor Substitution</td>
<td>3.5</td>
</tr>
<tr>
<td></td>
<td>0.7</td>
</tr>
<tr>
<td><strong>Total Factor Productivity</strong></td>
<td>2.8</td>
</tr>
</tbody>
</table>

**Sources of Total Factor Productivity Growth: (Percentage Point Contribution)**

1. Advances in Knowledge  
   - R&D Stock               0.85            | 0.75          | 0.6        |
   - Informal                0.3            | 0.25          | 0.2        |
   - Rate of Diffusion        0.25          | 0.1          |            |

2. Changes in Labor Quality  
   - Education & Training    0.6            | 0.7          | 0.8        |
   - Health                  0.1            | 0.1          | 0.1        |
   - Age/Sex Composition     -0.1           | -0.4         | -0.2       |

3. Changes in Quality of Land       ---          | -0.1          | -0.2       |

4. Resource Reallocations  
   - Labor                   0.4            | 0.7          | 0.3        |
   - Capital                 0.4            | 0.5          | 0.2        |

5. Volume Changes  
   - Economies of Scale      0.4            | 0.3          | 0.2        |
   - Capacity Utilization     ---           | -0.1         | -0.3       |

   - Services to Business    0.1            | 0.1          | 0.1        |
   - Regulations             -0.1           | -0.2         | -0.4       |

7. Actual/Potential Efficiency, and n.e.c.  
   - Efficiency, and n.e.c.  -0.4           | -0.6         | -0.4       |

n.e.c. = not elsewhere classified

examine each of these contributions, briefly relating how they are measured and how they are alleged to affect productivity.

1. **Advances in Technological Knowledge**

   As we have previously mentioned, advances in technological knowledge are considered to cause the change or shift in the production function. This is the residual in the growth accounting equations, and therefore represents all that is not accounted for elsewhere. While authors tend to fold in other factors here as well, such as managerial efficiency, it is basically considered as consisting of three subcomponents that contribute to technological advance, as noted in Table 1: R&D stock, informal R&D, and the rate of diffusion of innovations.

   Formal R&D is measured by the cumulative stock of real R&D outlays with due allowance for gestation and development time periods, and for the mortality experience of process and product innovations. Then estimates of a social rate of return for R&D are applied to these stock estimates to determine the rate of change. We can see from Table 1 that this contribution has been declining, from 0.85 in 1948-66 to 0.6 in 1973-78.

   The more rapid the diffusion of innovations, the greater will be their effect on productivity in time. Researchers such as Kendrick assume that cost-reducing innovations are generally embodied in new capital goods so that the average age of fixed capital goods is used as a measure of possible changes in the rate of diffusion.

   Informal R&D consists of inventive and innovative activity not captured in formal R&D figures, and includes such things as work of part-time or individual inventors as well as improvements made at the plant level. This, of course, is extremely difficult to measure, and it is generally calculated as the difference between the total component of advances in knowledge (the
residual) and R&D stock plus rate of diffusion.

We should note that these attempts at clarifying or disaggregating the residual are helpful in beginning to ascertain causalities. However, we can see that these disaggregations are accomplished by very rough approximations. While it is essential to understand what the components are, the magnitude and the manner in which they affect productivity is still in elementary stages of enlightenment. Specifically, we need to know what are the causal factors or incentives/disincentives that spawn the different types of innovative activity and why they take the form they do. We also need to understand the differences between process and product innovations in terms of their short and long-run effects on productivity.

2. Change in Labor Quality

We can also see from Table 1 that the contribution of the factor entitled "Change in labor quality" is also significant, and that its contribution decreased in the second period but increased in the third. Labor quality is measured by its three components; education and training, health, and age/sex composition. The contribution of education & training is estimated from census data on earnings differentials of workers with different levels of educational attainment, and from an estimate of the average rate of return on human capital. The concept is fairly straightforward -- as workers receive more education and training, they are allegedly better able to do the same job more efficiently or have the capacity to accomplish more tasks and/or more difficult ones. Similarly, healthier workers should be more productive, at least in terms of number of working days affected by illness or accidents. The changing age/sex composition of the work force may change the quality of labor also, as for example, the increased number of women and youths added to the work force have initially reduced labor quality due to previous lack of experience for many of them. We can see from Table 1 that in the time period
examined there has been an increasing contribution of the education/training component, a stable rate of change in health, and a negative contribution of age/sex composition.

3. **Changes in the Quality of Land and Other Natural Resources**

As land and other resources are depleted, lower quality resources must be utilized, thus requiring more labor/capital effort to extract the same amount of resource. This is especially true in the extractive industries such as petroleum and mining. We can see from Table 1 that this factor has a small but increasingly negative contribution to productivity growth. We should note, however, that the capital-resource interaction perspective taken here is from the view point of productivity. There are other aspects to this relationship. For example, one may look at this as the ability of new technologies (capital) to unlock or make feasible the extraction of existing resources, thereby increasing the available stock of non-renewable resources, and thus increasing social welfare. Productivity then is only one component of social welfare. In this instance, productivity may have declined in that more input is required for the same amount of output, but social welfare may be increased because scarce, non-renewable resources are being made available to the economy.

4. **Resource Reallocation**

This component measures the effect of shifts in labor and capital from uses, firms, industries, and regions with lower rates of return to those with higher rates of return, thereby increasing productivity. Researchers have particularly focused on shifts from farm to non-farm occupations and from non-farm self-employment to employee status as to their effect on productivity. There was indeed a marked shift in these subgroups in the early periods examined in Table 1, and we can see the sizeable effect of this factor. However, we can also see the contribution has declined considerably.
due to a severely diminished number of people remaining in the farm and self-employed groups.

Capital reallocation is measured by the change in capital across all industries, each with varying average rates of return. Such shifts from industries with lower rates of return to those with higher ones, of course, raise the average rates of return and value-added, increasing productivity, ceteris paribus. Table 1 shows that while this factor remained strong in the 1966-1973 period, it has declined significantly since then.

The recognition of such a factor is important in that it begins to address a crucial issue - that of short-run versus long-run equilibrium. The basic macroeconomic model utilized assumes equilibrium, when in fact, the system rarely is in such a state, due to market imperfections. Such imperfections include such variables as market structure, imperfect information, and outright costs of moving. Unfortunately these variables are only cursorily examined by most researchers, yet the implications of their existence is profound in that it suggests the existence of fixities in labor and capital, and therefore the importance of understanding the causes and solutions to such.

5. **Volume Changes**

Changes in the number of units produced affects productivity primarily through economies of scale and changes in the capital utilization rate. Productivity may change due to economies of scale, i.e. to increasing efficiency as the volume of production increases, reflecting increasing specialization and the spreading of overhead costs over increased volume. Denison calculates this factor by first determining the sizes of economies of scale by running regressions comparing output under constant returns to scale to that under increasing returns to scale, and then multiplying this difference by an index of gains from these economies. We can see from Table 1
that this has a positive effect on productivity as we would expect but we can also see that its contribution to productivity growth has been declining over the period examined.

Volume changes are also determined by cyclical phenomena such as changes in intensity of demand, which would in turn affect a firm's or industry's capacity utilization rates. These underutilized assets represent a loss in productivity, and we can see from Table 1 that its negative contribution has been increasing.

6. **Net Government Impact**

While it is often difficult to quantitatively measure the aspect of governmental policies and actions, there is a strong indication that government policies do indeed have a definite effect on productivity. For example, the positive side, government often provides an infrastructure that contributes to productivity, while on the negative side it is argued that the multitude of regulations proliferated by the government restrict or restrain productivity. As to the effect of the latter, some argue that government-mandated investments are undertaken at the expense of more profitable investments that would increase productivity (Kendrick, 1980), while others have suggested that government regulations are biased toward new investments and thus further retard growth (Crandall, 1980). However, most researchers admit that serious measurement problems exist, so that empirical validation of such hypotheses becomes difficult.

7. **An Overview**

In evaluating this approach we can ask three questions: 1) how well does the construct of the model correspond with reality? 2) do results obtained from the model correspond to observed phenomena? and 3) does it have usefulness for decision-makers?
Regarding the first point, the model has in fact come under increasing criticism due to its very idealistic and stylistic assumptions, such as profit-maximizing firms acting as unitary actors, public knowledge of technology, and perfectly competitive markets (see Nelson, 1981). Whether evaluation models should be based on their predictive ability alone or on their resemblance to reality, it is clear that these assumptions have been shown to be unrealistic. While the results obtained may still hold in general, understanding the variations around that general trend may be the most significant avenue of research for opening up previously unknown factors of productivity change. Similarly, the model is deficient in accounting for interaction between various factors analyzed. There is indeed some discussion concerning a few of these relationships but the number and extent of the investigation could be much improved.

For example, researchers have noted the potential interaction between advances in technological knowledge and quality of labor, in that one potentially drives or affects the other. However, there are many such interrelationships between the various factors, often with potentially contradicting effects.

For instance, while volume changes may positively affect productivity, they may also generate greater fixites in both labor and capital, which may in turn negatively affect efficient resource allocation. For example, economics of scale may reduce costs, but the increased size of operations as well as specialization may make it more difficult to change to new means of production. Similarly, there appears to be a logical relationship between capacity utilization and capital investment, the hypothesis being that the greater the utilization rate, the greater the pressure to raise spending on capital (see Grossman, 1977). These are just a few examples but they are indicative of the magnitude of areas which the macroeconomic model slights.
How well has the model identified key trends? We must admit that the model has helped to unveil our understanding of general economic productivity phenomena especially at the national and sector level, but it has not to date been able to successfully explain differences across industries and across firms within an industry. Yet it would appear to us that these differences are indeed critical in our understanding productivity. Why are some firms, who face the same general economic environment, more productive than others? It would seem that an identification of critical success factors of the leader would be more beneficial at this point in time than averages across an industry.

Related to these points is the answer to the third question as to the utility of the approach. By aggregating data and dealing with averages, the richness of variation is hidden from view as are potential answers to underlying causalities. The model has identified key variables or major contributors to productivity growth. Yet it has not identified underlying causal factors as to why these particular phenomena occur. For example, what are the motivating and inhibiting factors behind resource reallocations and how can they be empirically validated?

In conclusion we can say that the work by these economists has greatly expanded our knowledge of productivity, by delineating critical components of change. The model they have used has certainly served to lay a foundation upon which others can build. Its shortcomings then do not necessarily reflect inherent flaws but rather the limitations that can be found in any methodology. Their model has pointed out the forest, but now we need to see the trees, or better yet, the soil and conditions that allow the forest to exist.
3. The Industry Perspective

As we now begin to examine work done at the industry level we must be fair to some of the researchers previously mentioned and note that some have indeed calculated industry indices of productivity. Probably the most complete work has recently been carried out by Gollop and Jorgenson (1980). They laboriously calculated capital and labor inputs, output, and productivity growth figures for fifty-one U.S. industries. However, while the data provide much more detailed information than research at the national level, the figures in themselves do not provide much insight into causal factors.

Some economists have also discussed selected industry comparisons. For example, Thurow (1980) examines levels of industrial productivity in twelve selected industries, and discusses reasons for some of the productivity changes observed. For example, he states that mining has suffered productivity decline due to both changes in resource quality and increased government regulation, while electrical and gas utilities have succumbed to a declining rate of consumption. As to the construction industry, the author calls the decline in productivity a "major mystery," citing problems of measurement and unconvincing hypotheses such as complexity of projects. While this work is designed only to generate some tentative hypotheses, it does begin to focus on underlying causes at the industry level, trying to explain differences among them. While this is a welcomed direction, much more work remains to be done in order to quantify and test these hypotheses.

Some have tried to examine the productivity problem by looking at structural characteristics of various industries. The so-called industrial economic model envisions a world in which
where arrows indicated causality (See Caves, 1977). If we assume that productivity is one component or measure of performance then the paradigm tells us that we can find ultimate sources of change in productivity embodied in a particular industry structure.

Much of the research effort in this area related to productivity issues has focused on the relationship between structure and innovation, mostly utilizing multiple regressions where some measure of productivity is the dependent variable and various potential causes are the independent variables. A good deal of the work was apparently spawned by Joseph Schumpeter's hypothesis (1950) that monopolies were necessary, or at least better able, to carry on the R&D that produces innovations. He argued that since such firms would secure a greater profit, they were better able to bear risks and costs associated with R&D. Galbraith (1956) extended this argument, citing intra-company synergies and volume saving as additional rationales for this phenomenon.

There have been many tests of this hypothesis without definitive results, but, generally speaking, the hypothesis is not supported empirically. Scherer (1965) found that a modest correlation between formal R&D activity and industry concentration existed up to some threshold point, but others (Weiss, 1956; Phillips, 1956) found no correlation. Scherer, in a later article (1965), looked at a number of variables and found that the amount of technological opportunity in an industry was the more significant factor. Scherer (1980) still holds that while there are some advantages to size up to a point, there is a counterbalancing effect in that i) risk decisions are made by managers not by firms; ii) large R&D laboratories may be overorganized; iii) costs and risks are not that great for many innovative products and processes; and iv) most decisions are sequentially made, thus further reducing risk. However, we should point out that these phenomena
should vary across industries with different levels of capital-intensity, across decisions made by firms, and between product and process innovations. To our knowledge the effect of these variations has not been examined.

Rosenberg (1976) looked at relative size of the firm (as measured by market share) as it impacts on innovative activity, and generally confirmed Scherer's findings. He found a significant negative correlation between research intensity, as measured by the percentage of total employment allocated to professional R&D personnel, and the firm's market share. His regression results also show that more important determinants of innovative activity are high technological opportunity, federal subsidies, and past sales growth. There is a problem, however, with direction of causality. Does market share determine R&D spending or vice-versa?

At least one author (Allen, 1969) looked directly at the relationship between productivity and concentration, using labor productivity figures from the Bureau of Labor Statistics, but no significant differences due to varying concentrations across industries were found.

However, when we look at the rate of diffusion of innovations in different industries we do find that there appears to be significant differences among them that are attributable to industry characteristics. Romeo (1977), in looking at the adoption of numerically-controlled machines saw different rates of adoption across industries due to such factors as number and variance of the size distribution of firms within an industry. However, Scherer (1980) notes that there should be two countervailing forces at work here: i) a stimulus effect, whereby more sellers increase the competitive drive to adopt an innovation, and ii) a market-room factor, whereby more sellers decrease the potential profit to be made. The question is which effect will predominate.
We should point out, therefore, that mere regression equations are not sufficient to explain these phenomena. In fact, one could argue a reverse causality exists, i.e. that the amount of R&D expended produces innovations that allow firms to grow, thereby securing monopoly rents and driving out competitors, and thus increasing concentration. Of course, this depends on the nature of the innovation and other barriers to entry.

What is needed, in our opinion, is a more in-depth analysis of the theory and a richer exploration at the industry level in order to understand phenomena more clearly at the firm level. While certainly industry characteristics have a telling effect on the various alternatives available to firms within an industry, there are several mitigating and counterbalancing factors at work. For one thing, industries are not homogeneous entities, with clearly defined boundaries: it is not always so easy to define what is a particular industry, i.e. where one leaves off and another begins. Also, it has been recognized that there are subgroups within industries. For example, in a more recent work, Newman (1978) used the term "strategic groups", in identifying these homogenous subgroups within an industry, demarcating them by common strategies employed by firms within each group. It is also the case that firm conduct affects the industry structure and not merely the other way around, as the paradigm suggests. Indeed, through innovation a firm may essentially create a different industry or at least substantially change the structure of its industry. Actions taken by individual firms therefore must be examined in order to properly understand what phenomena are at work. If we are to understand why and how decisions are made we must therefore, in our opinion, take account of industry structure as it is perceived and changed by these very decision-makers.
C. The Firm Perspective

While much of the literature on productivity implicitly is discussing individual business decisions and decision-making, very few economists have actually focused at this level of analysis in their research. As we have pointed out, the macroeconomic model assumes firms are unitary actors who maximize profits according to output demand and factor input supplies in a perfectly competitive market. Similarly the industrial economics paradigm sees firm conduct as determined by market structure variables. In fact, however, we see significant differences across firms within an industry, in both internal structure and external strategies, and it would appear that understanding these differences would be very beneficial in enlarging our knowledge of productivity.

Most of the literature using this unit of analysis has focused more on profitability per se rather than on productivity, but operating profit is a crucial component of productivity when measured using value-added (See Zannetos, et al, 1982b). Most of the firm-level studies can be further sub-divided into two concerns: i) activities within the firm; and ii) the interaction of the firm with its environment. Let us briefly examine each in turn.

1. Internal Organization

A considerable amount of effort has been expended looking at the inner workings of the firm in order to explain profitability. Indeed, much of the management literature has focused on proper principles of administration for efficient operation, dating back to Gulick and Urwick (1937) and others. Matters such as lines of authority, span of control, and others were posited as rules to which, if organizations would adhere, efficiency would result. However, a more recent strain has surfaced known as the contingency view which
contends that the application of such principles should be contingent upon different environments, technologies, etc. Thus, for example, Woodward(1965) found that organizations structures should vary according to various technological processes.

All of this, of course, assumes the firm is a "rational" actor as posited by the classical macroeconomics model. But there is also a considerable thrust of research that argues that, in fact, the firm is not such a monolithic concern. Barnard (1938), Cyert & March (1963), and others, contended that the firm is made up of individuals with their own goals, and that decisions are, in fact, negotiated between actors. Some have called for a broadening of the productivity model to include such phenomena (Arnold, Evans, and House, 1980), arguing that much of what we find in the residuals from the growth accounting studies may be attributable to matters related to decision-making processes within firms, rather than to technological change.

In our opinion, it is better to consider the organization structure and decision-making processes of the firm as part of its technology. In other words, we cannot look only at the organization or production in calculating a firm's technology. Rather we define the term in a broader sense to include the arrangement or organization of all of the firm's available resources to manage the enterprise as it faces complexities on many fronts. Just as means of production may change over time, so may the means which are critical for the design of an effective organization structure.

We view managers as primarily trying to address economic concerns facing them, and in this sense they are 'rational'. However, the definition of rationality is dependent upon the state of knowledge (or ignorance) of the "experts". It is critical, therefore, that we understand the associative context in which a manager is operating before we can decipher his or her actions.
For example, Hayes & Abernathy (1980) have argued that due to short-term reward structures, managers have become overly risk-averse especially in terms of long-term investments. Similarly, Porter and Zannetos (1978) described the differential effect of single hurdle rates on division managers, who are faced with investment opportunities of different risks, versus single-product company presidents. They hypothesize that the different regulating mechanisms that these decision-makers face determine different attitudes toward risk-taking.

2. External Orientation

This brings us to the second perspective -- that of the relationship of the organization to its environment. This line of inquiry also has some history, but most of the work has been generated in the last ten years or so, particularly in the Strategic Management literature.

The basic model is that decision-makers in firms are the masters of their own fate, and they take into consideration various factors related to their environment (internal & external) and develop goals and strategies accordingly. The classical model was proposed by Andrews (1971) who saw strategies asking four basic questions: i) what can we do (our strengths and weaknesses); ii) what might we do (threats & opportunities in the environment); iii) what do we want to do (our personal values); and iv) what should we do (societal obligations). Based upon the answers to these questions, a match-up is then formulated into a strategy which then is implemented (Christensen, Andrews, & Bower, 1975).

There have been numerous studies trying to determine the critical strategic factors that lead firms to financial success, using case studies, regression analyses, and other techniques in trying to establish and confirm relationships. Most of the case studies view a firm's environment as highly situational, almost unique in itself, so that solutions to problems become
highly idiosyncratic. More recently, however, there have been attempts to establish commonalities among firms or groups of firms. Some have begun to incorporate some of the industrial economics perspective, in analyzing firms & groups of firms within their industrial setting (See Porter, 1980).

A good example of this incorporation is the work of Schendel and Patton (1978). These authors developed a simultaneous equation model for the Brewing industry that looked at three goals (market share, return on equity, and efficiency of production), seven variables outside of the control of management (concentration, industry advertising, industry wage rate and material costs, number of firms, per capita consumption and package sales), and sixteen manager-controllable variables, including acquisitions, average capacity, capacity utilization, capital expenditures, capital/labor ratio, debt, material costs, newness and number of plants, and firm size. They then examined data for three different subgroups within the industry, and found significant differences in the effects of different variables across different goals for each subgroup.

While the large number of variables makes individual effects difficult to isolate, the results of this research are potentially useful in showing that there may be tradeoffs between return on equity (ROE) and efficiency (the way efficiency is measured is not explained in the article). While there is a positive and significant correlation between ROE and efficiency, there are a number of variables that have different effects on the accomplishment of each of these goals. They find the following factors (at the industry level) have one effect on efficiency (given in parentheses) and the opposite effect on ROE: i) market share (-); ii) acquisitions (-); iii) average capacity (+); iv) capacity utilization (+); v) capital expenditures (-); vi) newness of plants (+); vii) number of plants (+); and viii) size (-). They also found
the ratio of capital to labor had a positive effect on efficiency while capital intensity had a negative effect on ROE.

Still others contend that the relationships among critical success factors overrides specific industry characteristics. An example of this can be seen in the PIMS model developed by Strategic Planning Institute (Schoeffler, Buzzell and Heany, 1974). The PIMS model has identified 37 variables which allegedly account for 80% of return on investment (ROI) for over 1200 business units. The main contributions to ROI are: i) market share (+); ii) product quality (+); iii) investment intensity (-); iv) R&D (positive if market share is high, negative if low); and v) size of company (positive if market share is high, negative if low).

One of the problems with such large models is that they become unmanageable at the decision-maker's level. Also, as with all regression analyses, they do not prove causality but rather only correlation, and many of the relationships could have the reverse causality from that posited in the model.

However, the PIMS model helps to confirm that looking at isolated effects of individual factors may be misleading, as we have posited. We must be careful not to overlook mitigating and perhaps confounding elements, as for example, they have found with the interaction of market share and R&D expenditures on the impact on ROI.

These models that test hypotheses at the firm level make some useful inroads into understanding business decisions and the factors that affect and are affected by them. This we believe is a fruitful line of inquiry. However, there is a tendency on the part of a good deal of research along this line to neglect or ignore economic phenomena underlying these decisions. Particularly, many of the variables examined at the macroeconomic level such as inflation and business cycles are overlooked.
D. The Individual Perspective

Finally, research has also been conducted examining productivity at the level of individual action. For purposes of brevity we reproduce a chart by Sutermeister (1976) which provides a good summary of the major (and minor) factors alleged to affect productivity of individuals (Figure 1). As one can see by the innermost circles on the diagram, productivity is viewed as primarily a motivation problem affected by such things as individual psychology and needs, as well as physical and social conditions, consisting of such matters as formal and informal organization structures and leadership. On each one of these subjects there has been a plethora of writings and we do not wish to relate all of them here. Let us state that the effect of many of these factors on motivation is established to varying degrees and, no doubt, individual motivation does play a large role in productivity. However, a comment is in order: to the extent that this knowledge and practice is diffused into organizations, this should not account for the significant differences we see among firms in an industry or among industries. For example, in our previous paper (Zannetos, et al, 1982a) we found productivity peaks of 1959 and 1963 for GM and Ford respectively. It is difficult to believe that such intrafirm factors affecting individual productivity caused this change at the different peaks for each company, when basic practices remained the same for each company over this time and were basically the same for both. We must look elsewhere, we believe, for more meaningful answers.

E. A Synthesis

It should be apparent, therefore, that each of the perspectives, while containing some shortcomings, has contributed to the furtherance of our knowledge of productivity. However, one problem is that whenever a particular perspective is taken, one can become blind to other factors that may be significant in explaining the particular issue at hand.
FIGURE 1

MAJOR FACTORS AFFECTING EMPLOYEES' JOB PERFORMANCE AND PRODUCTIVITY

With this in view we would like to make some general comments about these four perspectives we have presented. First of all, while they view productivity from different vantage points, they all implicitly focus on actions taken by individual firms as the factor that directly affects productivity. In the case of the macroeconomic viewpoint the focus on these decisions is paramount, although the measurement of relations is done at a much more aggregated level. From the industrial economics vantage point, the emphasis is on industry characteristics, but as they ultimately impact on firm decision-making. The individual or psychological perspective influences individual decisions - but as they are affected by the characteristics of firms where these individuals are employed. Lastly, the firm viewpoint is obviously focusing on the firm as the determining factor. This, in itself, should indicate the importance of actions and characteristics of individual firms in any type of analysis of productivity. Yet it is not so often explicitly acknowledged.

Indeed we may consider all these perspectives as dealing with or focusing on different levels of decision-making within firms. In 1965, both Robert Anthony and H. Igor Ansoff provided a trichotomy of business decisions within a firm, which they termed strategic, managerial (or administrative), and operational, where the first type referred to product-market decisions, the second, the structuring of the firms' resources for optimum performance, and the third, more day-to-day decisions.

More recent work has refined this somewhat to reflect more the structural evolution of the modern business enterprise as chronicled by Chandler (1962). Specifically, it is proposed that strategic decisions exist at three hierarchical levels: corporate, business, and functional (Hofer and Schendel, 1978).
Corporate strategy is concerned primarily with the issue of what set of businesses the organization should be in. This may be considered a portfolio decision, looking at various businesses the firm is in and how to balance these to maximize profits and reduce risks. These decisions set the overall direction of the organization, providing the major planning assumptions to be considered.

Business strategy focuses on how to compete in particular industries or product/market segments. Of particular importance are the distinctive competences (what are we good in?) and other competitive advantages that the firm possesses. This level of decisions is also particularly concerned with integrating various functions within the unit, such as manufacturing, R&D, and marketing.

Finally, strategies also exist at the functional level. Each of the various functions, such as the ones we have just mentioned, must be as efficient as possible in order that the corporate and business strategies can be implemented. Of particular concern, then, at this level is the maximization of resource productivity.

As we consider these different levels of decisions it becomes apparent that much of what is considered in the productivity literature, especially that from the macroeconomic and individual perspectives, focuses on functional strategies, to the exclusion of the others. Even the industrial economics perspective views firm behavior as rather deterministic, thus excluding from consideration much of what is termed corporate and business strategies.

While these perspectives do tend to capture efficiencies of the firms, they do not capture whether what the firms are doing is effective. In the same vein, short-run decisions may be measured, but long-run effects overlooked.
We argue that if one is to understand causal factors that contribute to decisions that affect productivity, one must look at the firm, not as one facing only functional decisions, but corporate and business decisions as well. Major causes of productivity decline must be found in strategic decisions made by firms. In Section III we develop in more detail a strategic framework for productivity analysis.
III. A STRATEGIC FRAMEWORK FOR PRODUCTIVITY

A. A Conceptual Model of the Firm

Our previous discussion points to the importance of understanding how firms make critical decisions in order to understand underlying causes of productivity change. In order to accomplish this, it is necessary to have some construct which at least approximates how decisions are made. Admittedly there has been a prodigious amount of research done which has looked at the differences among firms in their decision-making processes (Cyert & March, 1963; Mintzberg, 1976, 1978; Miller & Friesen, 1978) but we would like to consider this at a more fundamental level, stressing commonalities rather than differences or variations on a theme.

We prefer to view this problem from a systems viewpoint, conceptualizing a firm as a transformation mechanism which receives inputs and transforms them into outputs according to certain properties of the firm, i.e. according to the workings of the mechanism. This is particularly useful for our purposes here because it illustrates that a readily available way of evaluating a firm is to compare its output with its inputs, which in its broadest sense, is how we define productivity.

But more importantly we believe this model, while simple, does in fact characterize the essence of all the activities of the firm, from top to bottom, beginning to end. Inputs can be ideas, data, people, or physical materials. In turn, outputs may be ideas, strategies, policies, or products. However, we can return to Hofer and Schendel's framework that suggests that there are, in addition to types of decisions, levels as well, each often requiring different kinds of inputs. In fact, decisions made at one level become, as well as determine, inputs at another level. We can illustrate this
as follows:

This diagram also shows that decisions made not only determine inputs but they also affect how the mechanism itself operates, i.e. how the inputs are transformed. This may be clearest using the example of production. Once a particular means of production is chosen, the firm, at least in the short run, will continue to produce in the same way. We have been using the term "fixities" to describe this type of phenomenon, and in viewing this at this level of abstraction, we can see many types of possible fixities, at all levels of the transformation process. For example, managers can become fixed in their way of operating just as can capital or other labor. However, while each level of decisions affects the others, most writers would agree that the corporate concerns should and usually do dominate and drive the other two (Christensen, Andrew and Bowers, 1975; Hofer and Schendel, 1978). This would then argue that to explain the behavior of firms, we should primarily examine their strategic decisions, the inputs that are taken into account and the mechanisms that are activated in making them.

B. The Capital Investment Decision

Let us illustrate the points presented above, by looking at what many argue is one of the driving causes of productivity growth - capital
investment. We can see in Table 1 (in Section I) that in the last subperiod (1973-78) the rate of growth of labor input remained high relative to the preceding period (from 1.4 to 1.3) while there was a significant decline in the rate of capital formation (from 3.3 to 2.3). Kendrick, in an article in 1980 concludes:

Since increasing amounts of capital per worker, apart from increasing efficiency of capital due to technological progress...raise the productivity of labor, it is clear that a slowing in the growth of capital relative to labor would retard the growth of labor productivity.¹

But what is the cause of this decline? Kendrick, referring to the work of Terborgh (1977) suggests that a major cause is the decline in rates of returns to U.S. corporations. Terborgh found a positive correlation between rates of return and capital investment. During the period 1970-77 adjusted domestic after-tax profits of U.S. non-financial corporations averaged 4.25 per cent of their gross domestic product, compared with a 7.75 per cent average for 1947-69, and changes in the growth of capital relative to labor were correlated with this movement. Kendrick argues that higher profitability provides both a source of funds for investment as well as an incentive to invest in capital. He then goes on to discuss factors that diminished profit rates such as:

1) inflation coupled with managerial slowness to adapt new pricing policies and with dividend declarations by boards of directors based on over-stated book profits (Terborgh, 1977);

ii) use of macroeconomic policies to prevent prices from rising as much as unit costs in certain years (Kendrick, 1980);

iii) a growing proportion of business capital stocks required by government regulations thus lessening investment in "productive" capital (Denison, 1979);
iv) relative increase in prices of structures and equipment (Denison, 1979).

Thus, Kendrick's line of reasoning is as follows:

\[
\text{Various factors} \rightarrow \text{Profitability} \rightarrow \text{Capital Investment} \rightarrow \text{K/L Ratio} \rightarrow \text{PRODUCTIVITY}
\]

where arrows again indicate causality.

We will examine some of the research on these relationships, but before such discussions we would like to make a few comments. Regarding the matter of the effects of the increase in capital investments on labor productivity, Kendrick's statement may be misleading. While on the average and on the aggregate the positive relationship posited by Kendrick may hold, this may not be true at the disaggregate level and cannot often be definitely known ex ante. In effect, managers may not know in advance exactly what the effects of investment in a new process may be. This is always true at the individual project level, and will often be true at the firm level and industry level as well.

Furthermore, we would not expect this relationship to be true ad infinitum, because some maximum point will be reached. The problem of course, is how to determine the location of the maximum point. There is also the additional problem of obsolescence of capital. In sum, while in the aggregate, ex post, the relationship may hold because of averaging ex ante, there is a definite risk concerning both the efficiency and effectiveness of any capital investment.
In fact there has been a prolific amount of research by economists, among others, of the investment decision. Since this is considered of utmost importance to productivity let us examine what some have written. Jorgenson (1971), in an excellent survey article, has pointed out that most econometric models of investment behavior consist of three basic items: determinants of desired capital, the time structure of the investment process, and the replacement mechanism for existing capital. A typical model might look as follows:

\[ A_t = (1 - \lambda) [K_t^* - K_{t-1}] + \delta K_{t-1} \]  

where
- \( A_t \) = gross investment in time \( t \)
- \( K_t^* \) = desired capital in time \( t \)
- \( K_{t-1} \) = actual capital in time \( t-1 \)
- \( \delta \) = rate of replacement of capital
- \((1-\lambda)\) = adjustment mechanism

Equation (1) states that a firm's gross investment is made up of new capital investments (expansion) and replacement of old capital. Firms invest in new capital by reducing the difference between their actual capital stock and some desired level, according to some distributed lag function.

The differences among various models employed are centered around the three basic items just mentioned. As to the replacement mechanism, most researchers employ a geometric distributed lag and the general consensus is that, for manufacturing, the average lag between the determinants of investment and actual expenditures is from one and a half to two years, although this varies among industries, firm, and projects (see Grossman, 1977). Concerning the time structure of investment the modelling of the replacement investment varies somewhat, but it is generally structured as
being proportional to either gross or net capital stock.

However, the greatest differences among models lie in how various researchers deal with the determinants of desired capital, which is by far the most critical to the matter of productivity. Jorgenson, in summarizing the empirical work conducted prior to 1971, groups the determinants into three; the first having to do with demand and the second and third with supply of funds. The three are: 1) capacity utilization, (represented by the ratio of output to capacity), change in output, sales less previous peak of sales, etc.; 2) internal finance, represented by the flow of internal funds, the stock of liquid assets, debt capacity, etc.; and 3) external finance, represented by interest rates of return, stock prices, and the market value of the firm. He concludes that: i) undoubtedly the most important of these is output; ii) the availability of external funds is also important; and iii) internal funds or liquidity is not an important determinant. This would tend to disprove Kendrick's argument for profitability as a source of funds for investment, although the incentive argument may remain.

However, one problem with all of these studies is that they do not investigate a reverse model, i.e. that capital investment may affect profitability. They look at the factors which affect investment and not what results are caused by investment. The argument runs the danger of becoming cyclical, i.e. managers don't invest because rates of return are low, and because they don't invest, returns are lowered.

Moreover, the capital investment decision in itself involves more than is captured in these studies and, in addition, the decision is only one of a panoply of strategic alternatives available to a firm.

Regarding the capital investment decision, those types considered in the literature reviewed by Jorgenson can be considered as falling within the rubric of what Anthony calls managerial decisions. But the "non-routine"
decisions, especially those involving a change in technology are not covered, nor are new product decisions, at least not explicitly. But still the strategic decisions faced by the firms involve more than allocation of resources to purchase new capital, and as such, this calls for looking for additional inputs into the decisions process, i.e. there are more causal factors at work than captured in most explanations offered in these models.

One other point is that two of the variables which researchers have deemed the most important in terms of their effect on productivity are capital investment and technological advance. While there are many factors that affect or cause these variables to change, it is important to note that both of these are primarily determined by strategic decisions made by firms, and, therefore, this should reinforce our argument for the need to focus on strategic considerations as primary determinants of productivity change. Let us then try to capture more carefully strategy decisions, as opposed to managerial or operational ones.

B. The Strategy Decision

While it is beyond the scope of this paper to repeat or review all that has been written on the strategy decision (see Glueck, 1980, for a good overview), it may be helpful to look briefly at how some have viewed it.

One of the early contributors was Ansoff (1965), who proposed using a two-by-two grid, which he felt captured the essence of the strategic alternatives facing firms. We reproduce that grid in Figure 2.

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>OLD</th>
<th>NEW</th>
</tr>
</thead>
<tbody>
<tr>
<td>MISSION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OLD</td>
<td>MARKET PENETRATION</td>
<td>PRODUCT DEVELOPMENT</td>
</tr>
<tr>
<td>NEW</td>
<td>MARKET DEVELOPMENT</td>
<td>DIVERSIFICATION</td>
</tr>
</tbody>
</table>

FIGURE 2
Thus, what he saw as important was what a firm sells and to whom it is sold. In the cases where old products are still the main components of strategy, market share battles might easily predominate, while this would usually not be the case where new products are involved, at least not initially. With old missions, the same general set of customers and means of operation are predominant whereas with new missions new customers are reached. One can see that this approach has a strong marketing orientation.

A more recent contribution is that of Porter (1980), who sees strategies as falling into three generic forms: cost leadership, product differentiation, and focus strategy. The meaning of the first is probably rather obvious in that it involves a firm attempting to continually reduce its costs below that of competition, possibly through process innovation, learning curve effects, and other means. An example of such a strategy can be seen with Texas Instruments, which has consistently reduced costs on its electronic components by selling in volume and benefitting from learning curve effects. Product differentiation focuses more on the sales or revenues side rather than on costs in that the firm seeks to differentiate its products from those of its competitors through means such as advertising, thereby insulating it from price competition. Attempts at this can be seen in expensive advertising battles among cigarette producers. The final category is termed "focus" which basically means a firm selects a particular niche of a market, so that it operates in a specific market segment where it can compete more effectively. An example of a focus strategy can be seen with American motors, which has generally aimed at segments such as 4-wheel drives and jeeps, where it is not forced to compete head-on with Ford, General Motors, or Chrysler.

Porter's framework is extremely useful, especially in emphasizing the importance of competition in formulating strategy. This might appear an obvious consideration, yet even Ansoff's grid does not incorporate this
explicitly. More importantly for our purposes here, there is almost not even a mention of the potential effects of competition on key productivity decisions that we can find in the macroeconomic literature, where most of the work on productivity has been done. But we argue that this is a crucial determining factor in managerial decisions that affect productivity.

1. Goals

Of course, implicit in this discussion is the assumption that goals have been determined. Some consider this conceptually as part of strategy while others consider it as a separate process (see Bowman, 1974, or Richards, 1978), but either way some goals should exist. From a theoretical point of view, managers should seek to maximize the present value of the firm, which is measured by all future expected cash flows discounted at some discount rate.

We find that this is in fact somewhat captured in the productivity measure we have recommended (Zannetos, et al, 1981b). This measure, value-added over payroll and benefits, captures the importance of two main variables -- operating income and depreciation (relative to payroll and benefits). But it is precisely these two variables that measure the annual cash flow of the firms.

At the same time it also indicates a potential weakness in the usage of the measure in that, in any given year, it only captures the cash flow relative to payroll and benefits for that year. There is the potential then for a firm to demonstrate a short-run increase in productivity in any given year, while it may be actually causing a decline in the long-run. It is precisely this type of argument that is made in the article by Hayes and Abernathy (1980) to which we referred earlier. However, as long as the trend is examined, as we have suggested, such potential misapplications will be avoided.
There is also the problem of whether indeed managers do actually seek to maximize the value of the firm. Some have argued that they do not, but rather that managers seek such goals as growth in sales (Baumol, 1967; Marris, 1963) or increasing their own emoluments (Williamson, 1963), while some contend that goals are merely what can be agreed upon (Lindblom, 1959).

However, in considering deviations from value maximization, we believe a more enabling concept is to consider the problem as one of the management of complexity. We consider that managers do indeed seek to maximize the value of the firm, and thus are intendedly rational, but as we have already stated, this rationality is a function of the state of knowledge. Given the factors that an individual can or will consider, he or she may be rational depending upon whether the individual possesses the necessary knowledge as postulated by the experts and applies such knowledge according to the rules (methodology) of the experts. In other words, actions must be considered in light of existing knowledge. For example, as inflation is understood and to the extent that the experts have developed a methodology for handling it, behavior which fails to take account of inflation could be considered 'irrational'.

Why we feel this is enabling is that it does not view the manager as merely a self-seeking individual, but rather as one who is trying to cope with the complexity he or she faces. The job facing the corporation is then one of finding ways of learning to cope with complexity or, if you will, advancing or assimilating the state of knowledge and possibly building beyond.

Having examined the issue of goals, we must now consider the inputs and outputs related to the strategy decision. As we have indicated in our model, it is difficult to look at each of these separately, since the kinds of outputs being considered will determine what kinds of inputs are received, and vice-versa. Thus, it is an iterative process. However, for purposes of exposition let us look first at the kinds or categories of inputs of strategic
decision-making, and then we will examine potential outputs.

2. Inputs

As we have related in Section I, Andrews (1965) posited four categories of such inputs: strengths and weaknesses of the firm, threats and opportunities in the environment, personal values of managers, and societal obligations. These are quite broad, of course, but we do believe they provide a facilitating mechanism that can be used to see the kinds of issues that researchers have examined and those they have ignored or overlooked. We can see, for example, that economists have largely ignored the effect of personal values on decisions, as well as societal expectations, other than questions of economic social welfare. We can also see that Kendrick's arguments of the funds and incentives of profitability can be subsumed under the first two categories, funds being a strength and incentives indicating opportunities.

It is these latter two categories of items that have the greatest impact on strategic decisions. Strengths may include products, patents, brand names, and various functional superiorities such as marketing, R&D (distinctive competence), or reputation. Opportunities are general environmental characteristics where a firm can secure a suitable return. This might include a change in consumer tastes or demand, the departure of competitors, or new technologies for production. Included within this are most, if not all, of the particular industry characteristics in which a firm is competing, as well as general economic and social trends at the industry, national, and international level. As we have pointed out, it also includes competitors and competitive activity and it should also include factors outside the industry, as for example, the relationship between ancillary industries and the firm.
3. Outputs

Surrounded by such information, the firm, through some information-processing mechanism, seeks and receives data from its environment (Aguilar, 1967) and then provides an associative context from which meaning can be determined from the data, and allows it to be transformed into strategy. The variance that we can observe in strategies that are selected by firms can therefore be explained by differences in their internal strengths and weaknesses (and personal values), and in both the amount and types of external data each receives and the particular way in which the data are configured. In other words, on the one hand, some may not receive or perceive the same data, while on the other, the same data are received but what is done with these may often differ.

At any rate, once a generic strategy is chosen, the specific outworking of it must be determined, i.e. how the grand strategy will be applied specifically to the firm in its environment. It then allocates resources to carry out these plans. What are the alternatives? We cannot presume to be all-inclusive in our offerings but we can at least illustrate some of the choices available.

We have already discussed the capital investment decision. But as we have stated, the decision goes beyond one whether or not to invest in capital, extending to questions of the nature, magnitude and timing of such decisions. These are all potentially strategic decisions, which directly impact productivity.

The firm must also make decisions about labor -- for example, how much and what kind, and whether this involves new hiring, training and/or relocation. It must also decide on the percentage items it will purchase versus what it will produce itself; this involves questions of vertical integration. It must also decide if it will allocate resources to R&D and for
what purposes: basic vs. applied research? product vs. process development? It must decide where it will deploy these resources, whether to specific regions of one's native country or in foreign lands.

In essence, each firm chooses a particular configuration of these decisions which comprises its overall strategy. Hopefully these components can be identified at any point in time as well as the relative shifts in the components over time (See Mintzberg, 1978).

We have stated what some authors perceive as the strategic alternatives facing firms. It is difficult however to capture this in a simple model. In spite of the danger of oversimplifying the decision, we would like to enlarge Ansoff's grid to include cost considerations. We can do this by adding a third dimension which we can call process (old and new). Thus, in addition to choosing what market need it is addressing (mission) and what product it is selling, the firm also can choose to invest in new processes. This mainly would refer to production through capital, but we could also conceive it to include labor processes as well.

We reproduce the resulting cube in Figure 3. We will briefly expand on each strategy.

**Strategy 1**

The firm continues to address the same market with the same product and means of production. It seeks to penetrate this market (increase market share) by increasing sales through a market-pull strategy (advertising) or market push (cost reductions though learning curve effects). Capital investment consist of either replacements or expansion. R&D would be minimal or non-existent.
FIGURE 3

OLD

MISSION

NEW

PRODUCT

OLD

NEW

OLD

NEW

NEW product
old process
old mission

NEW product
old process
old mission

old mission
old product
new process

old mission
new product
old process

old mission
new product
new process

new mission
old product
old process

new mission
new product
old process

new mission
new product
new process
Strategy 2

This is the same as (1) with the exception that there is a focus on cost reductions through process innovations as for example, the wide-scale adoption of robots. The firm may either develop these in-house or purchase them. The latter strategy has the advantage of decreasing risks to the firm, but it also means the technology would probably be available to competitors as well.

Strategy 3

Here the firm continues with the same product and means of production but seeks to address a new product-market, i.e. new users for the same basic product. It would generally seek to do this primarily through the marketing function, although production might be involved in small adaptations to different markets.

Strategy 4

In this strategy the firm seeks to not only gain new types of customers but also to produce using different production processes. It may be that cost reductions would allow the new market to be reached although it must be clear we are not talking about merely moving down the present demand curve for the product.

Strategy 5

This is a pure product innovation strategy. The same market need is addressed, and the same technology utilized, but an entirely new product is developed. Whether this is indeed a very likely occurrence in some industries in questionable, in that often new products would require new processes. While strategies previously discussed focused more on pushing sales or reducing costs, this strategy in essence seeks to gain a significant foothold through new products, affording a firm pricing
flexibility at first, and then learning curve effects afterward, giving it an extended advantage over competitors.

Strategy 6
As mentioned, this may be a more likely occurrence in some quarters, since new products may of necessity require new technologies in production. When these two are coupled together, of course, the firm is the most insulated from competition.

Strategy 7
This involves a more diversified approach since both new missions and new products are undertaken by the firm, although the production process is the old one. In this, the firm thus strikes out into new ground and it may do so in different ways, one of which may be acquisition. Whether or not the firm will be successful may depend to a large degree on its ability to manage the new enterprise.

Strategy 8
This is the same as (7) except the production process is new. The same problem are faced as above except more so, since the firm is in totally unfamiliar territory.

D. Application to the U.S. Automobile Industry
Having provided such a framework, let us use this paradigm to examine the U.S. automobile industry. We should state from the outset, that we can only make observations based on data available to us. For example, we can see trends for particular companies over time, but we do not know whether in fact this is the result of specific decisions made or merely occurred somewhat passively or in an ad hoc fashion. Similarly, we can only conjecture why these decisions might have been made, at least until further research is conducted. In other words, we can only look at outputs and what data exists
as potential inputs. Whether in fact they were inputs into a decision, and if so, how they were considered, we do not know at this point.

We can observe some basic components of the U.S. automobile manufacturers' strategies. Some of these include: i) competition in many product classes (e.g. high, low and medium-priced cars) with frequent style changes; ii) high product differentiation; iii) backward vertical integration; iv) price leadership/matching. One could argue that there has been little change strategically since General Motors began its multiple models strategy in the 1920's. The U.S. auto makers have basically pursued strategy (1). There has been little in the way of new products as well as new production processes.

The strategy was relatively successful until the late fifties and early sixties. Since that time, performance has declined. Figure 4 shows trends for some financial performance measures for GM and Ford from 1955 to 1979. We can see that GM peaked in the years 1962 to 1965 for each of the three measures. Ford shows a peak in the 1959-60 period, with some resurgence in 1977, but a decline since then. More telling, however, are productivity trends for the two firms. Figure 5 illustrates an unambiguous declining trend in productivity since 1959 for Ford and 1963 for GM. It is clear that something is amiss and has been for some time. We argue that this is due to a lack of a successful strategy on the part of the U.S. auto makers.

To be sure, the unions have had their effect. In disaggregating value-added, we find that salaries and wages have been a steadily increasing component, relative to operating returns and depreciation. Figure 6 shows that the ratio of operating profits over payroll and benefits have been decreasing since 1962-63 for Ford and GM. This would indicate that rather than increasing value-added, there was a decrease (relative to salaries and wages) and, within that decreased amount, a transfer of wealth from stockholders to labor.
FIGURE 4

Return on Equity, Return on Assets and Return on Sales, 1955 - 1979

(a) GENERAL MOTORS

(b) FORD
FIGURE 5
VALUE-ADDED OVER PAYROLL & BENEFITS
FOR GM & FORD
1955-1979
FIGURE 6
OPERATING PROFITS OVER PAYROLL & BENEFITS FOR GM & FORD 1955-1979
Operating profits did not increase proportionally, we contend, because the U.S. auto makers lost their comparative advantage, and their monopoly rents declined. This is evidenced in Figure 7, where we can see that the real price of new cars (new car price over producer price index) has declined consistently since the peak years of the early sixties. Not only the U.S. Auto firms did not succeed in passing on to the consumer the total increases in salaries and wages, but at the same time the price levels for U.S. cars were such to invite others to enter the U.S. market.

This loss of competitive advantage allowed foreign imports to steadily penetrate the U.S. market during the same period (See Figure 8). The Japanese in particular were pursuing a strategy of approaching product innovation along evolutionary channels and at the same time gearing massive investments for process innovation to match it. For example, they used the technology for the 2-liter engine developed by Chrysler in the 1950s (Wall Street Journal, January 22, 1982) and evolved and perfected it to a state where it became an extremely attractive product. Along with this they strove to move quickly down the learning curve to exploit cost economies. Such a strategy gave them a superior product at lower costs. Of course, the wage scale facing these manufacturers was considerably lower.

Faced with such a situation, gross margins accruing to U.S. manufacturers began to decline (Figure 9). The trend line demonstrated in Figure 9 is remarkable in clearly portraying the sharp decline in margins and also the early date of the genesis of such declines.

As we would suspect, Ford and GM have taken some steps to alleviate this problem as we indicated in our previous paper (Zannetos, et al, 1982b). These are: i) reduction of vertical integration; ii) increase imports from foreign operations; and iii) substitution of capital for labor. However, these steps were taken slowly and were not sufficient in light of the magnitude of the
FIGURE 7
NEW CAR PRICES
OVER PRODUCER PRICE INDEX
1955-1979
FIGURE 8
U.S. MARKET SHARE OF IMPORTS
1955-1979
FIGURE 9
GROSS MARGINS*
FOR GM AND FORD
1955-1979

*Gross margins calculated by: 1 - Cost of Goods Sold / Sales
decline in margins. For example, Ford's imports totalled only 2.67% of its domestic production by 1971 and still only 10.65% by 1980.

All of these substrategies, however, are attempts to reduce costs, while still remaining in a strategy (1) mode. Now there are increasing attempts by these firms to move toward a strategy (2), especially in the usage of robots. But we must question why this action was not taken until at least 15 years after the vital life signs were diminishing.

We also question the validity of this strategy. These firms are now playing a catch-up game to compete with foreign imports on the imports own ground and in their own product-market. It would appear that no long-lasting advantages will accrue to U.S. automobile manufacturers from such a strategy, since the strategic emphasis is on input costs, and foreign manufacturers still enjoy a comparative advantage in terms of wages. We would argue that only product innovation can give a significant lead time advantage for the profitability of U.S. car makers to improve significantly. It is to this issue of innovation that we turn to examine in our next paper.


4. Anthony, R. N., Planning and Control Systems (Boston: Division of Research, Graduate School of Business Administration, Harvard University, 1965).


