The Comparative Structure of Growth in the Major Developed Capitalist Nations

PETER MURRELL
University of Maryland
College Park, Maryland

According to Energy Secretary David Howell, North Sea oil money is already beginning to create an "interesting structural change" in the British economy. He said new British firms servicing the multinational corporations drilling in the North Sea have not been encumbered by traditional labor-management and class conflicts or work rules that inhibit productivity in Britain's older industries and that new businesses have been more receptive to new technology and working relationships [*Washington Post*, May 8, 1980, p. A25].

I. Introduction

For many economists, sustained long-term economic growth is the distinguishing characteristic of the modern era. However, the determinants of long-run growth are not well understood. Denison's examination of recent growth experience has served to emphasize this lack of understanding:

> That I do not know why the record suddenly turned so bad after 1973 must be obvious, because the effects of all the output determinants that I could measure continuously are excluded from the residual. . . .
>
> Seventeen suggested reasons for the slowdown in my residual series were explained. . . . I rejected a few suggestions, expressed skepticism about some, had no opinion about others, and characterized the rest as probably correct and individually able to explain only a small part of the slow-down. No single hypothesis seems to provide a probable explanation of the change after [1973] [7, 122, 145].

Thus the present moment is especially appropriate for an examination of a new theory of economic growth.

In this paper, I test the implications of a theory developed by Mancur Olson [21; 22; 23; 24]. Olson's theory broadens the scope of factors which are identified as affecting growth. The theory focuses on the institutional framework, the social structure, and other

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variables usually assumed to be outside the economists' purview. The theory views these factors as the result of a long historical process in which a society's institutions undergo gradual change. If that historical process affects growth, one could detect its influence by examining a set of countries for which there have been variations in the variables which affect this process. In this paper, I test Olson's theory by analyzing the inter-industrial structure of growth in six nations: United States, United Kingdom, Canada, West Germany, Italy, and Japan. In Section II, I summarize theories relevant to the present study and develop implications for comparative industrial performance. In Section III, the performance of the steel and electronics industries is examined in the light of these implications. Section IV contains the theoretical developments necessary for the formulation of testable hypotheses. In Section V, the tests are described and their results presented.

II. Institutional Sclerosis and Organizational Rigidity[1]

Olson's theory is used to develop a theory of the comparative structure of industry growth. Briefly, the main elements of that theory are as follows [20;21;22;23;24;25]:

1. Common interest groups form slowly. Large and scattered interests may never organize.

2. Developed democracies will gradually accumulate common interest organizations but will never achieve complete or symmetrical organization.

3. Interest groups reduce growth by restricting entry, by lobbying for efficiency-reducing government programs, and by reducing the extent to which free markets foster growth-producing innovations.

4. Countries whose common interest organizations have been emasculated or abolished by war, revolution or foreign occupation should grow relatively quickly after a free and stable legal order is established.

5. Countries that have had freedom of organization for the longest uninterrupted period will suffer most from growth-repressing organizations.[2]

Olson's theory is consistent with a number of theories of organization. These theories imply that, in stable environments, large organizations will develop increasingly rigid behavior patterns [8, 264; 6, 50–3]. Both Olson's and the organizational theories predict that as an industry matures firms within it will become less responsive to innovation and growth. Let us use 'organizational rigidities' to denote industry-specific growth-inhibiting forces. Then one can make the following predictions:

(a) Rigidities will increase with the age of the industry.

(b) Rigidities decrease after a major political upheaval.

To examine differences in rigidities between industries, assume industry A was formed early in the industrialization process, while B was created much later. Rigidities in B will be relatively small in all countries. To predict the level of rigidities in A, assume:

(i) Country X began to industrialize before Y and both experienced equivalent domestic political upheavals.

1. The theory of Section II is developed more fully in [19].
2. In this brief statement of the theory, one must remember that the *ceteris paribus* assumption is being used strongly.

Then the accumulation of rigidities in industry *A* in *X* will be greater than in *Y*. *B*, being newer, is likely to be the same age in both countries. The accumulation of rigidities in *B* will be of the same order in *X* and *Y*. Thus,

$$\text{(Organizational rigidities in } A\text{/Organizational Rigidities in } B) \qquad (1)$$

will be greater in *X* than in *Y*.

Consider an alternative to (i):

(ii) *X* began to industrialize at the same time as *Y* but *Y* recently experienced a domestic political upheaval.

In *Y* the interest groups most likely to have been abolished would have been the most prominent ones. As the oldest organizations would have been most likely to have secured a powerful place under the old regime, they would also have been likely targets of a new regime. Thus, the effects of *Y*'s political upheaval will have centered on older industries. Those effects reduce the ratio (1) in *Y* while leaving this ratio unchanged in *X*. Therefore, assumptions (i) and (ii) lead to the same predictions on the relative size of ratio (1).

To develop tests of the theory one must establish which countries would be classed as *X* and *Y* in applying the theory. Table I contains the relevant information. Columns (1)–(3) focus on the industrialization process. Black has identified phases of the modernization process. During the consolidation of modernizing leadership, there is ". . . an effective and decisive break with the institutions associated with a predominantly agrarian way of life, permitting the transition to an industrial way of life" [5, 71–2]. During economic and social transformation, ". . . virtually the entire industrial plant and communications system as we know them today were built. . . ." [5, 78–9]. Although the beginning years of these phases (columns (1) and (2)) do not necessarily mark the onset of industrialization, those years can be used to predict which countries first began to industrialize.

To avoid reliance on a single source, information is also taken from Kuznets [15]. Column (3) shows the importance of industry in total national product in 1870. Countries with higher figures in column (3) are likely to have begun to industrialize earlier. There is no disagreement between column (3) and columns (1) and (2) in their use as predictors of the order of industrialization. Countries which appear on higher rows of Table I will have begun to industrialize earlier. Column (4) provides the obvious information on the second variable which influences ratio (1): political upheavals. This information shows that if *X* is in the first three rows of Table I and *Y* is in the bottom three rows, then ratio (1) will be higher for *X* than for *Y*. Fortunately, this conclusion is the same as would be reached using information from columns (1) to (3). For the 6 countries, there is no inconsistency between the "political upheaval" and "beginning date of industrialization" variables in their effect on ratio (1).[3]

III. An Application of the Theory: A Tale of Two Industries

As the analysis has proceeded abstractly, an example will help to elucidate the argument. A single example does not constitute a test but it does show that the theory can predict

3. In this paper, it is assumed that defeat in the Second World War had an equivalent effect on the three countries.

Table I. Variables Influencing the Extent of Organizational Rigidities

Country	(1) Beginning Year of Consolidation of Modernizing Leadership	(2) Beginning Year of Economic and Social Transformation	(3) Percentage share of Industry in National Product	(4) Last Major Political Upheaval in 20th Century
U.K.	1649	1832	36	None
U.S.A	1776	1865	31	None
Canada	1791	1867	26	None
Germany	1803	1871	25	1945
Italy	1805	1871	21	1945
Japan	1868	1945	16	1945

Sources: Columns (1) and (2): [5, 91-2]
Colum (3): [15, 88-93] (using linear interpolations)

well-known facts whose interpretation is subject to disagreement. Thus, the diffusion of innovations is examined in two industries: steel and semiconductors. The steel industry is a good example of an "old" industry. In contrast, the semiconductor industry is of recent creation. If the previous section's hypotheses have any validity, then their consequences should be verified for these two industries.[4]

Tilton [26] has analyzed the performance of the semiconductor industries of the U. S., Japan, and Europe. During 1948–68, the United States was the leading innovator with an average diffusion lag for thirteen major innovations of 0.1 years.[5] The corresponding figure for the U. K. was 2.2, for Japan 2.5, and for West Germany 2.7. In this new industry the U. S. and U. K. performed better than Japan or Germany.

Tilton's observations on the nature of growth of the semiconductor industry are also revealing. In that industry, barriers to entry have been low. New firms have made a large contribution to diffusion of the new technology. In 1966, new firms had 65% of U. S. sales, in the U. K. 66%, in Germany 30%, and in Japan 18% [26, 66, 114, 115, 143]. Thus, firms existing before the invention of semiconductors gained a much larger market share in Germany and Japan than in the U. S. and the U. K. The pattern of growth within the industry was consistent with the foregoing theory. The semiconductor industries in the U. S. and the U. K. could perform better than those of Germany and Japan because low barriers to entry implied a significant role for new firms.[6]

Turning to the steel industry, during 1954–1967 percent changes in output per man-hour were 1.9% in the U. S., 2.4% in the U. K., 4% in West Germany, and 11.8% in Japan [14, 17]. Thus, in the "old" industry the U. S. and the U. K. lag behind West Germany and Japan. Further insight is gained by examining diffusion of two major innovations: the

4. Because of lack of information in the sources used for this section, Canada and Italy are omitted from the discussion.

5. A diffusion lag is the time between the world's first application and first application in a specific country (which equals zero in the innovating country).

6. The existence of a protected military sector in the U. S. and the U. K. would have favored the development of semiconductor industries in the U. S. and the U. K. The relatively better performance of the new firms could not be explained by the same reasoning.

basic oxygen furnace (BOF) and continuous casting (CC). The first commercial use of the BOF was in Austria in 1954 [1, 175]. By 1965 16.6% of U. K. steel capacity was BOF, 17.4% for the U. S., 19.2% for the European Coal and Steel Community (of which West Germany was a member), and 55% for Japan [2, 477]. The first commercial CC installation in Germany was in 1950, in the U. K. in 1959, in Japan in 1960, and in the U. S. in 1963 [4, 272]. By 1970 CC capacity was 8.2% in Germany and 1.7% in the U. K. [3, 90], equivalent figures for the U. S. and Japan were not given). Although incomplete, these figures show that the steel industries of the U. K. and the U. S. were slower in adopting innovations than those industries in Japan and Germany.[7]

The diffusion process for the two innovations within the U. S. also was consistent with the theory of Section II. Huettner [13] and Haller [11] give the dates on which U. S. firms adopted the two innovations. Rank correlations between these dates and the age of the firms[8] are −0.11 for BOF (14 firms) and −0.3 for CC (27 firms). Newer firms tended to adopt innovations earlier.

The pattern of technological diffusion in these two industries could be predicted by the theory of Section II. The performance of the U. K. and the U. S. in the new industry relative to the performance of these two countries in the old industry stands in marked contrast to the relative performance of Japan and West Germany in the two industries. In the new industry the U. S. and the U. K. are leaders; in the old industry laggards. In the next section, formal tests of the theory are presented.

IV. Patterns of Industrial Growth

Let us examine two countries: X appears above Y in Table I. Industry A is older than B. Assume, initially, X and Y are growing at the same rate. With identical tastes and production conditions in X and Y, similar industries will grow at the same rate in X and Y. Thus, with organizational rigidities absent:

$$G_A^Y - G_A^X = G_B^Y - G_B^X \tag{2}$$

where G_j^i is the growth rate of industry j in country i.

In Section II it was shown that ratio (1) will be higher for X than for Y. Taking into account the effect of organizational rigidities, one can show that the difference in the growth rate of industry A between countries will be larger than the difference in the growth rate of industry B between countries. Therefore, when organizational rigidities exist:[9]

$$G_A^Y - G_A^X > G_B^Y - G_B^X \tag{3}$$

The next stage in formulating a testable hypothesis is to assume that the countries have different growth rates. Olson's theory predicts that X will grow slower than Y. Therefore, (2) and (3) must be revised. To understand why such a revision is necessary,

7. Huettner [13] and McAdams [16] have criticized the studies from which the information has been taken. However, they have not disputed the basic information.

8. Age of firm was the earliest date mentioned for the firm in Moody's Industrial Manual [17].

9. Formulation (3) is chosen rather than a ratio formulation so that the inequality will be correct for negative growth rates. It is easy to construct realistic assumptions sufficient to derive (3) from (1). Since specifying these assumptions requires lengthy description and it is evident on an intuitive level that (3) follows from (1), the assumptions are not made explicit.

assume organizational rigidities are absent and X is growing at 5% and Y at 10%. Suppose industry C always grows at a country's average rate and the output of industry D always remains contant. Then, when organizational rigidities are absent, $G_D^Y - G_D^X < G_C^Y - G_C^X$. When aggregate growth rates vary between countries, equation (2) will be incorrect even with no organizational rigidities. To provide a suitable null hypothesis, an equation analogous to (2) must be found when X and Y have different growth rates.

Let $g_j^i = G_j^i/G^{-i}$, where G^{-i} is the aggregate growth rate of country i. Then for the example given in the previous paragraph:

$$g_D^Y - g_D^X = g_C^Y - g_C^X \tag{4}$$

Equation (4) will be correct when organizational rigidities are absent but aggregate growth rates differ (assuming identical tastes and production functions in both countries). If organizational rigidities exist and D is newer than C, then, using the logic employed in deriving (3):

$$g_C^Y - g_C^X > g_D^Y - g_D^X. \tag{5}$$

As factors other than organizational rigidities have been ignored, (4) and (5) should have a stochastic term representing these other factors. The presence of such a term is implicit in the following statistical tests.

Tests require a null hypothesis against which a theory can be tested. Usually the null hypothesis is obvious, often derived from some rival theory. For a new hypothesis on the comparative structure of industry growth rates, there is no obvious rival theory. However, Murrell [18] has shown that (4) is the appropriate null hypothesis when standard neoclassical assumptions are applicable. Thus, tests of (4) versus (5) are tests of neoclassical theory versus a theory based on organizational rigidities.

The tests can now be described. For any two countries, denote the country on the higher row of Table I by X and the other Y when applying (4) and (5). The data needed are standardized growth rates and ordinal measures of age for each industry. Then, for any two countries, and every pairwise combination of industries, one can ascertain whether (5) is verified. If organizational rigidities had no effect, one would expect (5) to be verified for one-half of the industry pairs. If organizational rigidities were important, the proportion of times that (5) was verified would be greater than one-half. The test can be repeated for every possible pair of the six countries.

There is a further way in which the theory can be tested. The manufacturing sector contains both heavy and light industry. Heavy industries have higher capital-labor ratios, higher concentration ratios, higher unionization rates and larger factories (in terms of size of workforce).[10] Industries with these characteristics would be more susceptible to organizational rigidities. Higher concentration rates facilitate non-competitive behavior. Higher unionization rates indicate a propensity for formation of common-interest organizations. Larger workforce size leads to an increased likelihood that an employee's social interaction will facilitate the cohesion of group interests. Lastly, larger organizations are more susceptible to the types of organizational rigidities which have been discussed by organizational theorists [8]. Thus, one would predict that heavy industries will reveal stronger effects due to organizational rigidities than light industries.

10. See Pryor [25, 59–60] for a discussion of the characteristics of heavy industries. Pryor [25] and George and Ward [10] show which particular industries are heavy industries.

V. Tests of the Existence of Organizational Rigidities

Before measuring age and growth, one must specify what constitutes an industry. Although the delineation of an industry boundary is somewhat arbitrary, there are standard classifications. As comparable information for six countries was required, the International Standard Industrial Classification (ISIC) was used. Tests were carried out on 29 industries.[11] Indices of industrial production from the *Yearbook of Industrial Statistics* [27] were converted into growth rates. Three sets of growth rates were used. At the 3-digit level, growth rates were calculated for 1969–73 and 1960–69. At the 6-digit level, growth rates were calculated for 1969–73 from measures of commodity production. There were 364 such commodities; the number of commodities within any 3-digit industry varying between industries. By using data from different time periods and at different levels of aggregation, one can have greater confidence that test results, if consistent, reflect the effects of forces described by the above theory.

There does not exist a standard age measure. Three alternative measures were constructed and results calculated for each. Assume that industries were formed first in countries that first developed. Assume also that the lag between the establishment of an industry in two countries will be less than the lag between the beginnings of industrialization in the two countries. Under these assumptions, one can construct age measures using only data from countries that first industrialized. Hoffman [12] has constructed output indices for British industries from 1700 to 1937. It is plausible that the first year for which Hoffman could find information to construct an industry's index is related systematically to the year in which an industry became significant.[12] Given that only an ordinal measure of age is required, one can construct:[13]

> *Age Measure 1—Hoffman (1)* Age is measured by the length of Hoffman's series on industry output.[14]

This first measure may give undue age to an industry which existed early in the industrialization process, but which only rose to prominence later. The second measure does not have this feature:

> *Age Measure 2—Hoffman (2)* Age is measured by the length of time for which industry output was at least 50% of output in 1937.

To avoid relying on one source, U.S. data has also been used. Fabricant [9] has constructed series measuring the growth of U.S. industries from 1899–1937. An industry is judged "newer" the higher its growth rate from 1899–1937. Using growth rates to measure

11. These 29 industries were the ones for which data was available for 3 or more of the countries during 1969–73. The ISIC numbers were 311, 314, 321–4, 331–2, 341, 3411, 342, 351–6, 362, 369, 371, 372, 381–5, 3841, 3843, 390. (The four-digit industries were included because they are sectors of significant size, yet contain significantly different information from that in the 3-digit industry of which they are part.)

12. Of course, the relationship will be subject to much random error.

13. The age measures presented here were also used in [19].

14. There is no exact correspondence between Hoffman's classification and the ISIC classification. However, the two classifications can be broadly reconciled. In deciding which of Hoffman's categories to use for which ISIC industry, it was easy to find one or more of Hoffman's categories which would be classified within the ISIC industry or which completely contained the ISIC industry. Where two or more of Hoffman's categories were relevant the average of the beginning years of the series was used. The correspondences between the classifications can be supplied by the author on request. This footnote applies, *mutatis mutandis,* to the two other age measures.

Table II. Tests Investigating the Presence of Organization Rigidities

(1)	(2)	(3)	(4)	(5)
		Numbers of Pairs of Countries for which		
Age Measure Used	Growth Measures Used	Inequality (5) verified more than ½ times for all industries	Inequality (5) verified more than ½ times for heavy industries	Inequality (5) verified more times for heavy than for all industries
1	3-digit ISIC industries 1960-9	11	11	7
2	3-digit ISIC industries 1960-9	11	10	12
3	3-digit ISIC industries 1960-9	9	9	6
1	3-digit ISIC industries 1969-73	10	12	14
2	3-digit ISIC industries 1969-73	12	14	9
3	3-digit ISIC industries 1969-73	9	9	11
1	6-digit ISIC industries 1969-73	12	12	10
2	6-digit ISIC industries 1969-73	12	12	9
3	6-digit ISIC industries 1969-73	13	12	9

age relies on the observation that, where there has been growth, changes have taken place. The greater these changes, the less time have organizational rigidities had to develop. Thus, one can use:

Age Measure 3—Fabricant The age of the industry is measured by the reciprocal of the growth rate in the U.S. from 1899–1937.

The basic test unit is a comparison of two countries: X appears on a higher row of Table I than Y. For every pair of industries, one age measure is used to ascertain which industry is older.[15] Inequality (5) is then examined for this pair of industries. The proportion of pairs of industries for which (5) is satisfied is found for the pair of countries. If organizational rigidities do not exist, one would expect this proportion to be one-half. If organizational rigidities are important, this proportion will exceed one-half.

15. The age applied to a 6-digit industry was the age of the 3-digit industry in which the 6-digit industry was classified.

Table III. Numbers of Country Pairs for which the Proportion of Times that (5) Was Verified Was Significantly Greater than One-half.

(1) Age Measure Used	(2) Growth Measures Used	(3) Pairs for which the Test Statistic was Significant: All Industries	(4) Pairs for which the Test Statistic was Significant: Heavy Industries
1	3-digit ISIC industries 1960-9	5	5
2	3-digit ISIC industries 1960-9	7	7
3	3-digit ISIC industries 1960-9	5	6
1	3-digit ISIC industries 1969-73	1	4
2	3-digit ISIC industries 1969-73	4	5
3	3-digit ISIC industries 1969-73	0	2
1	6-digit ISIC industries 1969-73	11	9
2	6-digit ISIC industries 1969-73	8	8
3	6-digit ISIC industries 1969-73	8	10

Data for 6 countries has been used, giving 15 different pairs of countries. Columns (3) and (4) of Table II give the number of country pairs for which (5) is verified in more than one-half of the industry comparisons. In column (3), all 29 industries are included. In column (4), 21 heavy industries are included.[16] Column (5) shows the number of country pairs for which the proportion of times that inequality (5) is verified is greater for heavy industries than for all industries. The closer these numbers to 15 (their maximum), the greater the support for the existence of organizational rigidities. (The expected value of these numbers, under the null hypothesis of no rigidities, is 7.5.) Thus, the tests give general support to the existence of organizational rigidities.

In order to judge the meaning of the results, significance tests must be used. For each country pair and for each of the nine data combinations, the proportion of times inequality (5) was verified was compared to one-half. One-sided tests with 95% significance levels were used. The standard error of the proportion of comparisons for which (5) was verified could not be derived from standard formulae because of interdependence between comparisons. The method of calculation of the standard errors is described in [18].

Table III lists the numbers of pairs of countries for which the significance tests

16. The sample of heavy industries was obtained by excluding light industries (311, 314, 322, 323, 324, 331, and 332). This was consistent with Pryor's classification of industries.

supported inequality (5). Each entry in columns (3) and (4) represents the number of significant statistics (out of a total of 15). If the null hypothesis was correct, one would expect each statistic to be significant in 5% of tests. Yet in 15 of the 18 entries in columns (3) and (4), 20% or more of the statistics are significant. The probability of such an event occurring if organizational rigidities were absent would be exceedingly low. The results in Table III give additional support for the theory in that more statistics are significant for the heavy industry comparisons than for the comparisons of all industries.

The test results of this section, and the example of section III, show that observed data patterns in six industrialized countries are consistent with the theory of sections II and IV. The results give support not only to the particular hypotheses formulated here but also general support for Olsons' theory. Thus, the significance of the results goes beyond the fact that they support a theory of comparative intersectoral patterns of growth. The results also support a theory which may be valuable in promoting our understanding of the major influences affecting the comparative economic performances of nations.

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