

**Economic Development And Strikes:  
An Examination Of The Haas And Stack Model**

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**Abstract:** The evidence presented by Haas and Stack (1983) suggests that a parabolic relationship exists between a nation's level of industrialization and the strike activity among its labor force. Their model is tested using data from a different time period. Criticisms of the original model, including problems of heteroskedasticity, autocorrelation and multicollinearity, are addressed here. The findings of this study support only marginally the conclusions reached by Haas and Stack, in that the relationship is confirmed to be curvilinear. (JEL O10)

**Keywords:** industrialization, strike activity.

I appreciate the helpful comments of Ed Greenberg and James McDonald on an earlier version of this paper. Naturally, I am responsible for remaining errors.

## **Economic Development And Strikes: An Examination Of The Haas And Stack Model**

### 1. Introduction

Haas and Stack (1983) propose a model suggesting that the relationship between industrial disputes and economic development follows a "parabolic curve" (p. 56). They argue that the propensity to strike will increase during early periods of economic development, but that strike activity will wither away during late industrialization due to such factors as the separation of business ownership from control and the decline in unionization.

The empirical evidence they present -- in the form of least squares regressions of a polynomial model -- has been criticized due to presumed problems both in the specification of the model and in the statistical techniques used. Cameron (1985) argues that results of the Haas and Stack study may be invalidated due to errors such as misspecification, multicollinearity, and heteroskedasticity. In reply to these criticisms, Stack and Haas (1985) contend *a posteriori* that statistical tests suggest no indication that the validity of their findings are in fact questionable. They do express "caution" in interpreting the results of their study due to the omission of several important control variables which could not be incorporated into the design of the model. Nevertheless, they maintain their position that evidence suggests strike activity tends to decline late in industrialization.

This paper is an attempt to replicate the conclusions of the Haas and Stack paper using data from a different time period. The data for this study are taken from the same sources, where possible, so that the results of this analysis may be compared to those of Haas and Stack. Statistical modifications of the model will be made, and if necessary, alternative testing techniques will be recommended.

### 2. The Propensity to Strike and Economic Development

Strike volume has been studied from a number of different viewpoints. One perspective attributes strike propensity to such economic factors as unemployment, inflation, and real wage changes (Yoder, 1940; Rees, 1952; Farber, 1978). Another is the organizational perspective, which states that strikes are related to such structural factors as the extent of unionization and the degree of centralization and institutionalization in collective bargaining (Britt and Galle, 1972; Snyder, 1975).

In addition to these perspectives, a number of theorists have suggested that a relationship exists between the incidence of strikes and the level of industrial development (Ross and Hartman, 1960; Hibbs, 1976; Korpi and Shalev, 1979). Most theorists agree that the propensity to strike increases during early periods of industrialization. As noted by Haas and Stack (1983), low levels of economic development are characterized by severe social problems, such as eighteen-hour workdays, poverty, and erratic business cycles. These problems tend to fuel the propensity for workers to strike for better working conditions.

However, widespread disagreement exists about the effect of advanced economic development on strike activity. Some theorists expect strike activity to fall in late industrialization, for reasons such as the decline in unionization and the identification of workers with management (Blum, 1964); the separation of ownership from control and the emphasis of growth rather than profit goals (Haas and Stack, 1983); and the creation of new job skills from technology and the increased occupational mobility of workers (Dahrendorf, 1959).

Other theorists (Zeitlin, 1974; Herman, 1981) take exception with this former perspective, arguing that strike volume will escalate in periods of late industrialization, because "economic development produces a shift in power resources favorable to the labor movement and increases the likelihood of working-class mobilization to wrest concessions from employers" (Haas and Stack, 1983, p. 47). That is, higher standards of living allow workers to devote less time trying to survive and more energy to worker reform movements. Moreover, industrialization may actually contribute to the worker's feeling of alienation, raising strike propensity among workers (Haas and Stack, 1983).

### 3. The Methodology of the Haas and Stack Model

To test the relationship between strike volume and economic development, Haas and Stack analyzed data collected from a sample of 71 nations. They noted that although the listing of nations is not technically random, the study may still be considered valid because the sample is "fairly large and seemingly representative of the market economies" (1983, p. 49). Data set for this present study are from 69 nations for which information on the strike volume and the proposed explanatory variables are available for the years 1981-1983. The original Haas and Stack study used data for the years 1976-1978. A different time period is used in this study in an attempt to corroborate the Haas and Stack model.

Eleven nations not present in the Haas and Stack paper have been included in this study, while thirteen have been excluded because strike information was not available.<sup>1</sup> Similar findings and conclusions would substantiate the specification of the Haas and Stack model.

While limitations of the ILO data on strike activity may in fact exist, they do not necessarily invalidate studies which incorporate data from ILO sources.<sup>2</sup> Stack and Haas (1985) note that no evidence exists that substantiate the argument that undeveloped countries cannot (or will not) collect accurate strike information. In addition, Hibbs (1976) shows that strike volume (strike size times duration times frequency, or man-days lost due to industrial disputes) is not affected by differing methods of measurement or calculation. He argues that strike volume is a preferred measure of strike activity because it represents the "net impact of a nation's overall strike profile" (p.1036). Therefore, cross-national comparisons such as this are permitted independent of the various accounting methods which measure a nation's strike activity.

The model Haas and Stack use to test the effect of economic development on strike activity is of the following form:

$$SV = b_1E + b_2E^2 + b_3Z$$

Descriptions of the variables are as follows:

SV = strike volume. This is calculated as the ratio of the total number of man-days lost to the size of the labor force. A three year average was used to reduce the possibility of annual fluctuations.

The data is from the International Labor Organization (1987).

E = level of economic development. This variable is measured by per capita GNP in 1982 (1980 dollars). Haas and Stack justify the use of per capita GNP as the measure of economic development by

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<sup>1</sup> The following presents a list of the nations included in this study. The nations are presented according to their grouping by the International Labor Organization (1987). An asterisk indicates that the nation was not included in the original Haas and Stack analysis. Africa: Burundi, Cameroon, Egypt, Ghana, Kenya, Madagascar\*, Malawi, Mauritius, Morocco, Nigeria\*, Sierra Leone, South Africa, Tunisia, Zambia, Zimbabwe\*. The Americas: Barbados, Canada, Chile\*, Colombia\*, Costa Rica\*, Ecuador, El Salvador, Guatemala, Guyana, Haiti\*, Mexico, Panama, Peru, Suriname\*, Trinidad and Tobago, United States, Venezuela. Asia: Bangladesh, Cyprus, Hong Kong, India, Indonesia, Israel, Japan, Republic of Korea, Malaysia, Pakistan, Philippines, Singapore, Sri Lanka, Thailand. Europe: Austria, Belgium, Denmark, Finland, France, Federal Republic of Germany, Greece\*, Iceland, Ireland, Italy, Malta, Netherlands, Norway, Portugal\*, Spain, Sweden, Switzerland, Turkey, United Kingdom. Oceania: Australia, Fiji, New Zealand, Papua New Guinea.

<sup>2</sup> Critics have suggested that comparisons between nations are inappropriate for two reasons: countries at low levels of development are unskilled in the techniques of measuring strike data (Cameron, 1985), and researchers use improper measures of strike activity--size (strikers per strike), duration (man-days lost per striker), frequency (strikes per 1,000 civilian wage and salary workers) or a combination of the three (Stern, 1978).

stating that per capita GNP is a

readily available predictor of the concentration of capital and decline of small businesses, the expansion of the white-collar sector, and other changes seen as aspects of economic development. These trends tend to accompany the growth of the GNP. (Haas and Stack, 1983, p. 51)

Information on per capita GNP is from the World Bank (1985).

$E^2$  = second-order development term. By introducing the square of the level of economic development, the model tests for the possibility that the relationship between strike volume and economic development is curvilinear. A significant coefficient will suggest a curvilinear relationship. The hypothesis that the volume of strikes will first increase during periods of low economic growth, then decline as the level of development increases, will be supported if the  $E$  and  $E^2$  parameters are respectively positive and negative.

$Z$  = represents the additional variables which will test for the possibility of "spuriousness" that may arise in an industrialization-strikes relationship. The variables draw on the other perspectives of strikes -- the economic, the organizational and one Haas and Stack introduce, the social perspective. These variables are outlined as follows:

**Economic Perspective:** Haas and Stack use the degree of prosperity and the rate of inflation as two factors that affect a nation's strike activity. The degree of prosperity is measured as the average annual growth rate in GDP from 1970 to 1981; the data is from the World Bank (1985). Increasing prosperity is expected to reduce strike volume, since "managers may be more amenable to giving in during upswings in the economic cycle so that they will not lose their . . . share of the booming market through disruptions in production" (Haas and Stack, 1983, p. 48); this parameter is predicted to be negative.

The rate of inflation is calculated as the percentage rate of change in the consumer price index between 1981 and 1982 (the base year is 1980); the data is from the International Labor Organization (1987). Haas and Stack (1983) cite studies which indicate that strike activity is positively affected by the rate of price changes. Thus, the parameter for this variable is expected to be positive.

**Organizational Perspective:** From the organizational perspective on strike activities, a measure of union strength is used as a control variable. The degree of unionization is calculated as a percentage of the number of union members in the labor force; the data is from the Central Intelligence Agency

(1985). Union strength has been shown to affect strike activity (Britte and Galle, 1972). Moreover, "unions promote worker solidarity and provide resources such as strike funds that encourage workers to press their demands more forcefully and steadfastly (Haas and Stack, 1983, p. 48). This variable is expected to be positive.

**Social Perspective:** Haas and Stack introduce three "neglected" variables as controls, arguing that various social aspects may affect worker solidarity, hence contributing to strike volume. The first variable, ethnolinguistic fractionalization, is defined as the probability that different languages will be spoken by two randomly selected persons; the data is from Taylor and Hudson (1972:271-73).

A second social variable, the rate of rural-to-urban migration, may have a bearing on strike behavior because rural migrants may be more inclined to express pro-union sentiments. This variable, taken from the World Bank (1985), is calculated as the difference in the percent of the population that was urban between the years 1970 and 1980.

The degree of the development of the mass-media is also included, since an awareness of one's standard of living relative to someone else's might affect one's desire to strike. This variable is measured by the number of television sets per 1,000 inhabitants in 1983; the data is from the World Bank (1985).

#### 4. Results of the Haas and Stack Model

Because the presence of heteroskedasticity is characteristic of cross-sectional studies such as this one, and as a result of the criticisms raised by Cameron (1985), generalized least squares estimation of the parameters of the model will be used. This is to avoid the inefficiencies of pre-test estimators.<sup>3</sup> Heteroskedasticity is assumed since unexplained variation in strike volume increases as nations become more industrialized.

Although heteroskedasticity does not result in biased or inconsistent least squares estimates of the parameters, the parameters are no longer minimum variance (Kennedy, 1987). Consequently, a t-test

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<sup>3</sup> A pre-test estimator,  $B^*$ , is defined according to the following rule:

$$\begin{aligned} B^* &= b \text{ if } H_0: \text{no heteroskedasticity present} \\ B^* &= B \text{ if } H_1: \text{heteroskedasticity is present} \end{aligned}$$

That is, if no heteroskedasticity is detected,  $b$  (the ordinary least squares estimator) is used; if heteroskedasticity is detected, then  $B$  (the generalized least squares estimator) is used. The efficiencies of pre-test estimators in the case of heteroskedasticity is discussed by Greenberg (1980). When heteroskedasticity is assumed to be present, it is usually prudent to use generalized least squares estimation.

cannot be considered valid, and the test to determine whether a curvilinear relationship exists between strikes volume and economic development will not be substantiated.

To facilitate generalized least squares regression analysis, variables in each model will be weighted by the inverse of the source of heteroskedasticity -- in this case, the size of the labor force.

(Table 1 about here)

The generalized least squares (standardized) estimates of the parameters are presented in Table 1. These results tend to corroborate those presented by Haas and Stack. The estimated parameters for both economic development (E) and  $E^2$  are respectively positive and negative as expected. As suggested by Haas and Stack, the "negative sign of the squared term indicates that strike volume increases through low levels of economic development, peaks out, and then decreases at high levels of development" (1983, p. 54). The turning point of the parabolic curve is estimated to be at a per capita GNP of \$6,916 in 1980 dollars. This corresponds to a level of economic development about half that of countries with high standards of living, which appears to confirm the conclusion made by Haas and Stack.

On the surface, these results seem to authenticate those presented by Haas and Stack -- the effect of economic development on strike propensity is a parabolic relationship. Moreover, the rate of inflation appears to affect positively strike volume independent of the other variables, as shown by Haas and Stack.

However, there are two major differences between the Haas and Stack results and the results presented here. First, the addition of other explanatory variables alters the significance of the polynomial economic development model. The significance of the curvilinear relationship between strike volume and development breaks down when economic and social conditions are considered. Perhaps this is due to the fact that the social conditions outlined above may be irrelevant in explaining strike propensity. If this is true, then the inclusion of these variables will result in inefficient estimates of the least squares parameters; the estimates will be unbiased, but they will not be minimum variance. Thus, tests of hypothesis are inaccurate. Indeed, subsequent regressions of strike volume on ethnolinguistic fractionalization, migration and mass-media development confirmed that these variables are insignificant in explaining a nation's overall strike activity. Economic conditions, on the other hand, do produce strong, independent effects on strike volume.

Second, contrary to the findings of Haas and Stack, the effects of prosperity and ethnolinguistic fractionalization appear to influence significantly strike behavior independent of the level of economic development. The sign on the effects are negative and positive, as reported by Haas and Stack.

#### 5. Discussion of the Haas and Stack Model

The criticism of possible heteroskedasticity suggested by Cameron (1985) was addressed and controlled for in this study. His argument that autocorrelation may be present was not substantiated. The Durbin-Watson statistic for all four models was not significantly different from two.

However, multicollinearity appears to be relatively important in this model (see Cameron, 1985). Table 2 presents the Pearson product-moment correlations between the variables included in this study. A similar table was also presented in the Haas and Stack study.

(Table 2 about here)

If the presence of multicollinearity is significant, then least squares estimates of the parameters may be imprecise; with multicollinearity there is difficulty separating the individual effects of each variable estimated in the model. Lack of precision is further manifested by the fact that parameter estimates may have large sampling variances. The result is that estimates do not appear to be significant and are subsequently dropped from the model, even though  $R^2$ 's and F-values indicate high explanatory power (Judge, et al., 1985).

The presence and degree of multicollinearity are more precisely determined by an examination of the characteristic roots and vectors of the  $X'X$  matrix (Judge, et al., 1985). Collinearity is present when one or more characteristics roots are "small." This measure was developed in detail by Belsley, Kuh, and Welsch (1980), who suggested that a more precise method of defining "small" involves the formation of "condition indices" and a corresponding matrix of cross variances between variables and eigenvalues. The condition index refers to a vector consisting of the square root of the ratio of the largest eigenvalue to each individual eigenvalue. Elements in the cross variance matrix is calculated as the proportion of the variance of each variable associated with each single characteristic root. Collinearity exists when the condition index is large -- around 5-10 for weak dependencies and 30-100 for moderate to strong relationships -- and when the associated row vector in the cross variance matrix contains two or more large values -- usually values greater than 0.50 (Judge, et al., 1985).

Such a test was performed on the Haas and Stack model. Condition indices ranged between 10 and 25 for the four regression models. These results indicate that collinearity is potentially a problem, especially between economic development and its squared term and economic development and mass-media development.

The presence of multicollinearity might explain why unionization does not appear to affect strike activity in the Haas and Stack analysis. Unionization is significantly correlated with all variables except prosperity and inflation in the Haas and Stack paper. Also, mass-media development is highly correlated with the level of economic development and ethnolinguistic fractionalization, which might explain its insignificance in explaining strike activity. Indeed, the presence of significant collinearity among so many explanatory variables suggests that the results of least squares regressions on the model as it now stands will not accurately explain whether economic development is related to strike volume. A more accurate model of the effect of industrialization of strike volume should not include unionization and mass-media development as control variables because of their high measures of multicollinearity.

## 6. Conclusion

The results of this analysis support in part the conclusion that the relationship between strike volume and the level of economic development is curvilinear as argued by Haas and Stack. Strike activity, while increasing as a result of industrialization, does appear to level off at higher levels of industrial development. However, this conclusion was reached only after correcting for the presence of heteroskedasticity and determining the possible presence of multicollinearity in the model. The hypothesized relationship that strike volume and economic development follow a parabolic curve is weakly supported.

In order to determine the exact relationship between strikes and industrialization, a model must be constructed which will more accurately account for the effects and cross-effects of the explanatory variables. This might be resolved by one of two ways. First, although the use of the square of the explanatory variable is one of several variations in depicting a curvilinear functional form, another method is that of the semilog form. The semilog representation involves the transformation of the explanatory variable into a logarithm. For the Haas and Stack, this is represented as the following

$$SV = b_0 + b_1 \log E + b_2 \log Z$$

where  $\log E$  is the log of the level of economic development variable used in the former model representation, and  $\log Z$  represents the log transformation of the control variables. The estimate of the parameter for economic development is expected to be positive; the parameters on the other log-variables are expected to be the same sign as described above.

The log representation of the model is preferable in the sense that the correlation between the  $E$  and  $E^2$  terms is removed. The limitation of the log transformation is that, although the log will pick up the possibility of a curvilinear relationship between industrialization and strike volume, it will not reflect a parabolic one. The reason is that the dependent variable regressed on the log of an explanatory variable approaches an asymptotic value (ie. it will not pick up the bend back down). Consequently, this representation of the Haas and Stack model will not necessarily confirm the hypothesis that strike activity will first increase, then decline, as economic development increases for nations.<sup>4</sup> However, this model will tend to confirm that position in the sense that the relationship between strikes and industrialization is curvilinear and concave.

Second, one could use a system of equations, in which the effects of the control variables can be more precisely laid out by the use of a simultaneous solution. For instance, mass-media might be defined as a function of the level of economic development, as well as another independent variable. Union strength has been found to decline during late industrialization (Blum, 1964). Also, rural-to-urban migration has been linked with the industrialization process (Haas and Stack, 1983). These variables could be defined as dependent, and then solved simultaneously with the Haas and Stack or similar model. Only when these effects, and perhaps others we have not yet defined as influencing strike behavior, are considered will we be able to accurately relate the effect of economic development to a nation's strike volume.

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<sup>4</sup> A variation would be to use a Box-Cox transformation of the variables (See Box and Cox, 1964).

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Table 1. The Effect of Development on Strike Volume: Standardized Regression Coefficients for the Haas-Stack Polynomial Models (N=69)

Regression Model Number	(1)	(2)	(3)	(4)
Economic development (E)	0.889* (1.725)	0.882* (1.829)	0.548 (0.962)	0.811 (1.046)
E <sup>2</sup>	-0.887* (-1.721)	-0.762 (-1.586)	-0.520 (-0.985)	-0.839 (-1.424)
Prosperity	---	-0.239** (-2.105)	-0.216* (-1.875)	-0.222* (-1.854)
Rate of Inflation	---	0.391** (3.503)	0.351** (2.996)	0.374** (3.216)
Union strength	---	---	0.165 (1.096)	0.222 (1.419)
Ethnolinguistic fractionalization	---	---	---	0.320** (2.177)
Rural to urban migration	---	---	---	0.098 (0.824)
Mass media development	---	---	---	0.189 (0.645)
R <sup>2</sup>	.04	.25	.26	.32
D-W Statistic	2.17	2.02	2.01	1.88

t-statistics in parentheses

\* = significant at 10% in two-tailed test

\*\* = significant at 5% in two-tailed test

D-W is the Durbin-Watson test statistic for autocorrelation

Note: Standardized coefficients are presented in order to allow comparison with those reported by Haas and Stack.

Table 2. Pearson Correlation Matrix (N=69)

	SV	ED	PROS	INFL	UN	ETH	MIG	MMD
Strike volume	1.000	0.048	-0.051	0.443	0.305	-0.001	0.046	0.018
Economic development		1.000	0.196	-0.082	0.475	-0.344	-0.083	0.894
Prosperity			1.000	0.069	0.004	-0.107	0.036	0.320
Rate of inflation				1.000	0.213	-0.110	0.050	-0.135
Union strength					1.000	-0.248	0.061	0.403
Ethnolin. Fraction.						1.000	-0.067	-0.376
Rural to urban migration							1.000	-0.070
Mass media development								1.000