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WITH AN ENDOGENOUS
GOVERNMENT SECTOR

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AN ECONOMETRIC MODEL WITH AN
ENDOGENOUS GOVERNMENT SECTOR *

Bruno S. Frey
Friedrich Schneider

Despite rapid advances and considerable successes existing econometric models are of only limited value for forecasting and policy advice. It is impossible to predict what economic consequences follow from e.g. the end of a military intervention (such as in South-East Asia), or large scale natural disasters because in a modern industrial society the effects are largely determined by what action the government undertakes. Though there is considerable intuitive knowledge available of what the government is likely to do under such circumstances, to our knowledge no econometric model formally integrates such information.

With respect to policy advice, an econometric model may serve to derive a set of measures a government may or should follow in order to reach certain goals. However, experienced policy advisers know that some policies will not be acceptable to the government because they negatively affect its popularity and reelection chances. No government will e.g. undertake severe restrictive policies shortly before a major election, because the short run effects on income and employment will be negatively reflected in the election while the beneficial effect on prices will occur only afterwards. Again, present econometric models do not take account of the information existing in this respect.

This paper endeavours to endogenize the government sector in order to improve forecasting and to indicate what policies are likely to be acceptable to the government. At the level of positive theory, a contribution to the integration

of the economic and political sectors is intended. Part I offers a short survey of precursors and part II sketches the general theoretical model which is empirically estimated in part III. Part IV presents some forecasting results.

I. Precursors

In the literature it is possible to find a considerable number of attempts at integrating the economic and political sectors of society. Well known are the early contributions by KALECKI and ÅKERMAN on the "political business cycle" ¹⁾. The development of the Economic Theory of Politics or Public Choice has created renewed interest in the problem; very recently there has been a surge of theoretical and empirical research ²⁾. There exist partial models stressing specific areas of politico-economic interdependence, in particular the inflation-unemployment trade-off ³⁾.

Other models analyze the total interaction restricting themselves to correspondingly simple pictures of the main decision-makers, viz. the government and its bureaucracy. This type of research proceeds from purely analytic formulations, to simulations and - in the present paper - to empirical ("politometric") estimation.

II. The general theoretical model

Society is for the purpose of present analysis divided into "the economy" - represented by a macro-econometric model - and "the polity" with democratic elections in each fourth year. The latter consists of the government which is assumed to have the goal to stay in power, i.e. to win the (next) elections, and to put, if possible, its ideological ideas into practice, and of the government bureaucracy which is assumed to be interested in a continuous expansion of expenditures. These behavioural assumptions are closely related to

those usually made in Public Choice⁴⁾. The interacting links between the economy and the polity are of central interest, here. The popularity function shows how voters react to the current state of economic variables such as inflation, unemployment and per-capita consumption. Such functions have been statistically estimated for various countries. Though there are considerable estimation problems, and there are different variables and functional forms relevant for different nations and periods, there is good evidence that this relationship is meaningful⁵⁾. Instead of monthly popularity series derived from surveys, often actual election results are used (e.g. in Kramer's case) but in both cases the intention is the same. Current popularity ratings are in the present model taken as indicators for the government's future election success.

The interaction equation describing how the polity affects the economy has so far received less attention⁶⁾. They are called "reaction equations" as they essentially describe the government's reaction to changing expectations about the election outcome.

A government which infers from current popularity ratings that it is likely to lose the upcoming election takes actions to improve economic conditions in order to increase its popularity with the voters. It is for simplicity assumed that the government is confident to stay in power if its popularity (POP) is higher than a certain minimum level (POPMIN) determined by structural conditions such as the number of competing parties, coalition possibilities etc. The government chooses those policy instruments with most effect on the economic variables contained in the popularity function. It also takes account of the time profile (lags) in these affects relative to the time period available before the election.

A government confident to win the next elections (i.e. $POP > POPMIN$) is able to pursue policies in accordance with

its "ideology" but which are not (necessarily) popular with the voters. The content of government ideology can be determined through interview methods, content analysis, or derivation of preference functions ⁷⁾.

Bureaucratic influence is reflected in the fact that all government expenditures have cet.par. the tendency to autonomously rise by a certain percentage each year.

Figure I pictures the two economic and political sectors and the popularity and reaction functions connecting them.

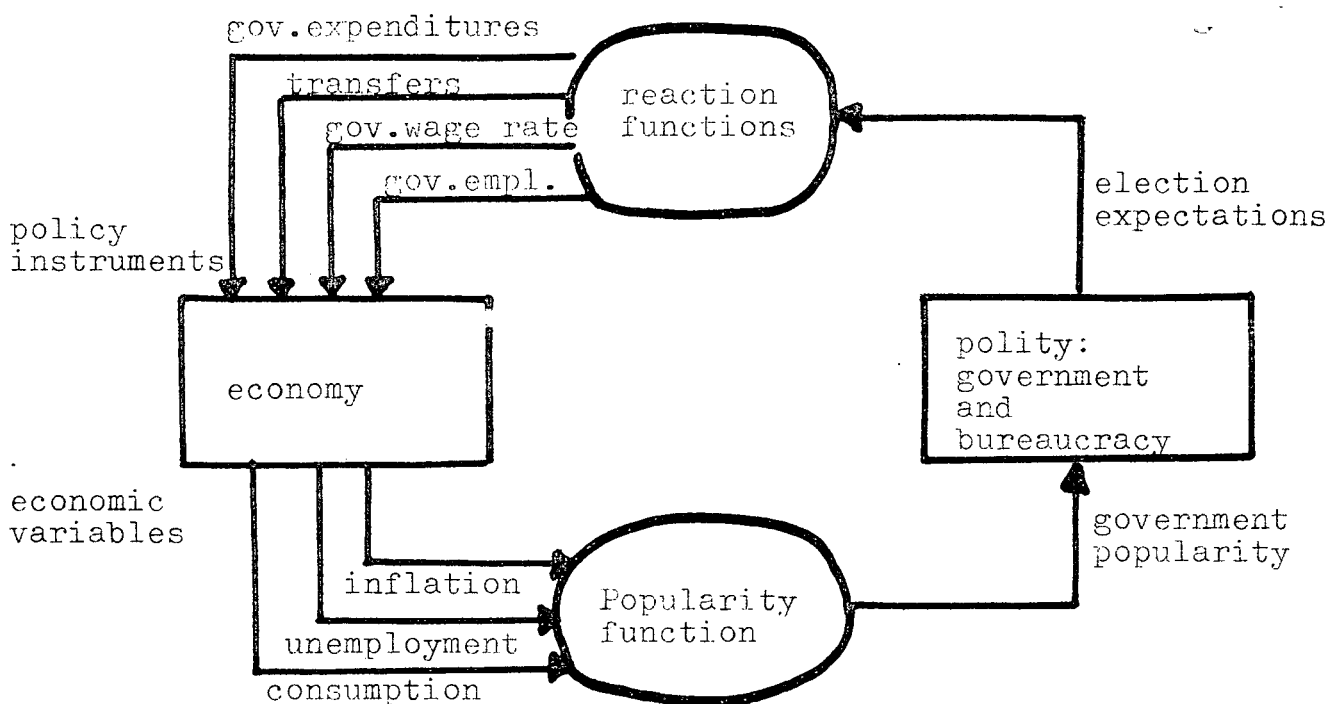


Fig. I

III. Empirical estimation

The theoretical model sketched can be empirically tested. As an example, the case of the Federal Republic of Germany (F.R.G.) is presented for which an econometric model is available ⁸⁾. This model is regularly used for practical policy purposes. It is "purely economic" in so far as it does not contain any theory about government behaviour, but determines government expenditures as a regression on the unweighted average of the last two year's tax income and

on the lagged growth rate of nominal domestic product. Transfers are simple regressed on last year's taxes, and the governmental wage rate is a linear function of the wage rate in the private sector. Public employment, finally, depends on the total number of employees in the economy.

To test the politico-economic model, the following procedure is used:

(a) The popularity function is empirically estimated using yearly figures over the period 1951-1972. Of the many possibilities of formulation the simplest, i.e. a linear relationship is included into the model. It has turned out that the function is quite robust with respect to changes in specification, periods etc.⁹⁾

$$(1) \text{ POP}(t) = 0.77 \text{ POP}(t-1) + 11.30 - \\ (4.4) \qquad \qquad \qquad (4.38) \\ - 117.36 \text{ P}(t) - 10.66 \text{ U}(t) \\ (-2.38) \qquad \qquad (-1.99) \\ + 234.20 \text{ C}(t) \\ (2.84)$$

$$R^2 = 0.71 \quad \text{D.W.} = 2.14$$

The figures below the parameters indicate t-values. Due to the endogenous lagged variable they (as well as the R^2) are biased. Equation (1) conforms to a-priori expectations: A rise in the level of consumer prices (P) and of the rate of unemployment (U) increases, and a rise in real consumption per capita (C) lowers, government popularity (POP).

(b) According to the econometric model, the government has four policy instruments at its disposition:

- (current) government expenditures for goods and services (G)
- government transfers to individuals (TR)
- wage rate of government employees (GW)
- employment in the government sector (GE).

(c) When the government fears not to be reelected ($POP < POPMIN$) it uses those instruments which most effectively increase popularity within the time period available before the election. The instruments are divided into three groups according to whether they affect popularity in the short run (i.e. in the same year), medium run (one year lag) or in the long run (two and three year lag). Taking account of the multiplier analysis as well as of the relative size of parameters in the popularity function (1) the following assignment can be derived:

- If the government realizes in the election year that it must increase its popularity in order to be reelected, the most effective action will be to increase expenditures, transfers and the wage rate of government employees;
- if the same decision has to be taken one year preceding the election year, the largest effect will be reached by raising all four instruments;
- if the government realizes two or three years before the election year that it has to increase popularity in order to be reelected, the most effective action is to raise government expenditures and transfers.

(d) Three types of government "ideology" are determined using information from surveys¹⁰⁾. With descending order of importance, the values are:

- For a "right-wing" government: Price stability; balance of payments equilibrium; surplus (or only small deficit) in the budget.
- For a government of the "center": Price stability; income growth; full employment.
- For a "left-wing" government: Increase of the government sector, full employment, income growth.

In order to reach these goals the following use of policy instruments is appropriate:

- For a "right-wing" government: decrease of expenditures and of transfers, and a reduction of the number of government employees.
- For a government of the "center": Increase of expenditures and of transfers.
- For a "left-wing" government: Increase of expenditures, transfers, of the wage rate and the number of government employees.

According to this typology there was in Germany a "right-wing" government (i.e. entirely formed or dominated by the Christian Democratic Union) 1951-1965; 1966-1969 a government of the "center" (i.e. the "Grand Coalition" between the Christian Democrats and the Social Democratic Party), and 1970-72 a "left-wing" government (i.e. formed or dominated by the Social Democrats).

(e) The information gained in steps (c) and (d) is summarized in a dummy variable (D) which is unity, if the corresponding instrument is strongly used; 0.5 if weakly used; and naught if not used at all. It is assumed that the government uses an instrument more strongly when its popularity is lower than necessary for reelection, than when it is higher (see Table I).

Table 1

Values assigned to Dummy Variable D

		Policy Instrument				
		governm. expend.	governm. transfers	wage rate of governm. employees	number of government employees	
POP	POPMIN	short run	- 1.0	- 1.0	- 1.0	0.0
		medium run	- 1.0	- 1.0	- 1.0	- 1.0
		long run	- 1.0	- 1.0	0.0	0.0
POP	POPMIN	"right-wing" gov.	- 0.5	- 0.5	0.0	- 0.5
		gov. of "center"	0.5	0.5	0.0	0.0
		"left-wing" gov.	0.5	0.5	0.5	0.5

(f) The reaction functions are estimated for the same period as eq. (1). Again, the simplest possible formulation is used.

$$(2) \quad G(t) = \underset{(6.38)}{1.12} G(t-1) + \underset{(2.02)}{0.72} [POP(t-1) - POPMIN] \cdot D(\tau)$$

$$R^2 = 0.82 \quad D.W. = 2.09$$

$$(3) \quad TR(t) = \underset{(6.47)}{1.08} TR(t-1) + \underset{(1.95)}{0.10} [POP(t-1) - POPMIN] \cdot D(\tau)$$

$$R^2 = 0.85 \quad D.W. = 2.14$$

$$(4) \quad GW(t) = \underset{(5.03)}{1.06} GW(t-1) + \underset{(1.92)}{0.023} [POP(t-1) - POPMIN] \cdot D(\tau)$$

$$R^2 = 0.83 \quad D.W. = 2.16$$

$$(5) \quad GE(t) = \underset{(5.89)}{1.04} GE(t-1) + \underset{(1.97)}{0.031} [POP(t-1) - POPMIN] \cdot D(\tau)$$

$$R^2 = 0.84 \quad D.W. = 2.15$$

Due to the lagged endogenous variable, the t-values and the R^2 are biased.

Equation (2) to (5) indicates that there is an autonomous increase of expenditures by 12% p.a., of transfers by 8% p.a., and that government wage rates and employment rise by 6% and 4% p.a., respectively, which is attributable to bureaucratic behaviour. Taking account of Table I, it can e.g. be seen that when the government is forced to take action in order to be reelected ($POP < POPMIN$) it will increase current expenditures for goods and services much more strongly than transfers (the regression coefficient being 0.72 compared to 0.10). The government wage is also increased in the short and medium run, but again much less strongly than transfers. Government employment is only increased if the government experiences insufficient popularity in the year preceding the election year, and the reaction will be of a size similar to the increase of the wage rate, only.

The equations can be correspondingly interpreted for the case of "ideological" action ($POP \geq POPMIN$).

IV. Some forecasting results

Two types of ex-post forecasts have been undertaken: For one year ahead (yearly forecasts) and over a whole election period. In each case the performance of this politico-economic model is compared to Krelle's "pure economic" model.

A. Yearly forecasts

In this case, no prediction for government popularity is necessary because the reaction functions (2) - (5) refer to lagged popularity.

Table II gives the results for the four policy instruments and selected macro-variables.'

Table II

Yearly ex-post predictions, 1957 - 72 (absolute percentage difference from actual values).

variable	model	1957	1958	1959	1960	1961	1962	1963	1964	1965	1970	1971	1972
government expenditures	politico-economic	9.5*	2.4*	2.7	3.2	3.8*	3.5*	1.5*	4.9*	3.7	0.1	0.8*	0.3*
	pure economic	13.8	9.4	2.8	0.1*	8.2	5.0	6.8	6.7	3.3	1.2*	3.6	3.3
government transfers	politico-economic	0.2*	0.1*	0.9*	0.4	3.0	0.5*	1.7*	1.2*	2.5	1.8*	0.4*	1.8
	pure economic	4.0	8.1	4.3	0.5	3.7	6.6	9.6	5.6	2.7	3.8	2.8	2.5
government wage rate	politico-economic	0.2*	4.3*	6.3	0.8	0.8	1.9*	1.5*	1.3*	5.0	0.3	3.8	2.9
	pure economic	1.4	7.3	2.3*	0.1	0.2	3.0	4.7	4.6	3.4*	0.1	2.7*	3.0
government employment	politico-economic	3.0	1.4*	1.7	0.1	3.7	0.6	0.5	0.1	0.5	0.1*	0.3	0.4
	pure economic	2.0*	3.0	1.6	0.6	0.2*	0.5	0.2	0.9	1.2	1.7	0.1	0.7
GNP (nominal)	politico-economic	2.4	2.0	3.1*	1.1	3.0	5.7	1.4	0.2*	1.7	1.3	2.0	1.5*
	pure economic	2.6	2.0	4.3	1.9	3.1	5.1	1.5	1.9	2.4	1.9	0.6*	2.5
unemployment	politico-economic	38.0*	7.3*	10.1*	48.0*	119.0*	158.0*	53.0	5.9*	75.0*	28.0	40.0*	20.0*
	pure economic	50.0	14.0	17.2	54.0	121.0	145.0	48.0*	11.1	79.0	28.0	42.0	28.0
general price index	politico-economic	4.4	2.0	2.8*	0.1	0.1	0.2*	1.4	0.7*	0.1	0.5	1.3	3.4
	pure economic	5.0	2.1	3.5	0.5	0.1	4.2	1.4	1.7	0.3	0.2	0.6	3.8
budget surplus	politico-economic	50.6*	27.1*	24.6	15.2	51.6*	84.2*	63.7*	40.5*	59.2	32.8*	46.4*	36.0
	pure economic	66.9	81.3	17.2*	11.2*	61.7	102.2	96.6	54.9	10.1	42.6	65.2	18.4*

Starred values indicate the cases in which one model yields better forecasts by at least one percentage point.

As can easily be seen from this Table, the politico-economic model here developed yields in most years better ex post predictions than the "pure economic" model. Taking account only of those cases in which one model is by at least one percentage point nearer to the actual value (starred values), there are superior forecasts with respect to government expenditures in 8 years, and worse forecasts in only 3 years; with respect to transfers the relationship is even 8 vs 0; government wage rates are better predicted in 5 vs 3 years; government employment is equally well (or badly) predicted in both models. Not surprisingly, the macro-economic variables are in general also better predicted. The politico-economic model is superior in 3 vs 1 years for the GNP; in 10 vs 1 years for unemployment; in 3 vs 0 years for the price level; and in 8 vs 3 cases for the budget surplus.

B. Forecasts over a whole election period

Table III shows the results for the two four year periods 1958-61 and 1962-65 in which a "right-wing" government was in power, and the three year election period 1970-72 in which there was a "left-wing" government and an election ahead of schedule. Note that in the case of these forecasts government popularity must be predicted. The deviations from true values are shown in the last line.

Table III

Ex-post predictions over an election period, 1952 - 61, 1962 - 65 and 1970 - 72
(absolute percentage difference from actual values).

variable	model	1958	1959	1960	1961	1962	1963	1964	1965	1970	1971	1972
government expenditures	politico-economic	2.4*	4.2*	4.5	2.1*	3.5*	3.4*	1.9*	6.7*	0.1*	1.1	0.2
	pure economic	9.4	6.5	2.8*	4.3	5.0	17.0	13.0	12.5	1.2	1.3	0.2
government transfers	politico-economic	0.1*	0.6*	0.7	2.7*	0.5*	1.3	0.1	2.3*	1.8*	2.2	0.3*
	pure economic	8.1	4.1	0.7	1.0	6.6	1.4	0.3	3.8	3.8	1.1*	1.2
government wage rate	politico-economic	4.3*	1.4*	1.9	0.4*	1.9*	0.6*	0.6*	5.3*	0.3	4.2	1.6*
	pure economic	7.3	2.5	0.8	2.6	3.0	2.5	2.4	0.6	0.4	4.7	5.4
government employment	politico-economic	1.4*	1.3	2.4	0.4	0.6	0.8*	1.1*	2.4*	0.2*	0.2	0.3
	pure economic	3.0	2.1	1.4*	1.0	0.5	1.8	2.4	3.4	1.7	0.2	0.2
GNP (nominal)	politico-economic	2.0	2.9	4.8	7.5*	5.7	0.1*	1.0*	0.1*	1.3	1.3	1.8
	pure economic	2.0	3.2	5.7	8.5	5.1	3.7	5.9	7.7	1.9	2.1	1.6
unemployment	politico-economic	11.6*	7.3*	101.0*	161.0*	158.0*	9.1*	3.6*	2.4*	28.0	42.0	56.0
	pure economic	13.8	14.0	118.0	177.0	145.0	46.0	65.0	99.0	28.0	41.0*	56.0
general price index	politico-economic	2.0	2.8	0.1	3.2	2.3	1.8*	0.3	0.2*	0.5	2.7	1.8
	pure economic	2.1	3.0	0.8	4.1	1.9	3.6	3.6	4.2	0.2	2.2	2.0
budget surplus	politico-economic	27.1*	0.7*	30.6*	72.9	84.2*	28.5	11.5*	84.4	32.8*	55.6	42.3*
	pure economic	81.3	54.2	39.2	66.1*	102.2	4.1*	34.5	60.3*	42.6	52.4*	67.0
popularity		2.6	2.9	3.1	5.4	5.5	0.8	1.9	7.0	0.9	3.0	6.7

Starred values: See Table II

The forecasts derived with the politico-economic model are in most years better than with the orthodox econometric model. Taking again those cases in which one model is better than the other by at least one percentage point it may be noted: for government expenditures the politico-economic model is superior in 8 and worse in 1 year; for transfers the relationship is 7 vs 1; for government wage rates 8 vs 1; and for government employment 5 vs 1. The same favourable picture appears for the macro-economic variables: for GNP 4 vs 0; for unemployment 8 vs 1; for the price index 3 vs 0; and for the budget surplus 7 vs 4.

Table IV finally gives the arithmetic mean value per year of relative percentage differences from the true values over each electoral period. For the policy instruments, it is always lower (and once equal), for the macro-economic variables this average is in nine cases lower and in three cases higher.

Table IV

Mean value per year of relative percentage differences from true values over each electoral period.

variable	model	electoral periods		
		1958 - 61	1962 - 65	1970 - 72
government expenditures	politico-economic	3.3	3.9	0.5
	pure economic	5.8	11.9	1.1
government transfers	politico-economic	1.1	1.1	1.4
	pure economic	3.5	3.0	2.0
government wage rate	politico-economic	2.0	2.1	2.0
	pure economic	3.3	2.1	3.3
government employment	politico-economic	1.8	1.1	0.2
	pure economic	1.9	2.0	0.7
GNP (nominal)	politico-economic	4.3	1.7	2.4
	pure economic	4.8	5.6	2.5
unemployment	politico-economic	70.6	43.1	42.0
	pure economic	80.6	88.7	41.9
general price index	politico-economic	2.0	1.1	1.7
	pure economic	2.5	3.3	1.5
budget surplus	politico-economic	32.4	55.2	43.6
	pure economic	60.4	52.9	54.0

V. Concluding remarks

It may be concluded that the politico-economic model derived yields quite generally superior ex post forecasts than the "pure economic" model. This gives an indication that the endogenisation of the government sector - even in the very simple manner here undertaken - constitutes a useful step towards a more realistic modelling of the economy in a modern society. If the approach here presented is used for policy advice, the government's reaction function must be discarded. An "open" version must be used as it is exactly the intention of policy advice to improve the government's reaction. The model then shows how the popularity and the reelection chances are affected by any proposed policy.

The politico-economic model developed should, of course, only be seen as a very first step. Much further work needs to be done. It is e.g. necessary to introduce additional decision-makers such as the central bank, parliament and interest groups. The structural relations must be extended to allow for federal units and international interdependence. While the influence of electoral periods, on which the present model is concentrated, turns out to be of considerable importance, other aspects of the interaction between economics and politics must be introduced. An interesting new research area seems to open up.

Footnotes

- * We are grateful for helpful comments received when earlier versions of this paper were presented at the Joint Seminar in Mathematical Economics of the University and the Technical University of Munich, at the Institute for Advanced Studies in Vienna and at the University of Basel.
- 1) M. Kalecki, "Political Aspects of Full Employment". Political Quarterly 14 (1943), 322-331.
J. Åkerman, "Political Economic Cycles". Kyklos 1 (1947), 107-117.
 - 2) A survey is given by the present two authors in: "On the modelling of politico-economic interdependence". European Journal of Political Research, forthcoming.
 - 3) W.D. Nordhaus, "The Political Business Cycle". Review of Economic Studies, forthcoming.
D.C. MacRae, "A Political Model of the Business Cycle", unpublished manuscript. The Urban Institute, 1974.
 - 4) See e.g. A. Downs, An Economic Theory of Democracy (New York: Harper, 1957);
A. Wildavsky, The Politics of the Budgetary Process (Boston: Little, 1964);
W.A. Niskanen, Bureaucracy and Representative Government (New York: Aldine, 1971).
 - 5) See the controversy between G.J. Stigler, P.W. McCracken and A.M. Okun in the American Economic Review, Papers and Proceedings (May 1973), 160-177, following G.H. Kramer, "Short-Run Fluctuations in U.S. Voting Behavior, 1896-1964". American Political Science Review 65 (1971), 131-143.
 - 6) One of the few examples is G. Wright, "The Political Economy of New Deal Spending: An Econometric Analysis". Review of Economics and Statistics 56 (1974), 30-38.
 - 7) See A.F. Friedlaender, "Macro-Policy Goals and Revealed Preference". Quarterly Journal of Economics 87, (Feb. 1973), 25-43.
G.C. Rausser and J.W. Freebairn, "Estimation of Policy Preference Functions: An Application to U.S. Beef Import Quotas". Review of Economics and Statistics 56, (Nov. 1974), 437-449.
 - 8) This "Bonner version V model" of approximately 140 equations has kindly been made available to us by W. Krelle. See his book Erfahrungen mit einem ökonomischen Prognosemodell für die Bundesrepublik Deutschland (Meisenheim: Anton Hain, 1974).

- 9) All the estimations are SLS. Simultaneous estimations of the politico-economic model have been undertaken with a smaller econometric model also by Krelle. It turned out that there are insignificant differences between the SLS and simultaneous estimates.
- 10) See B.S. Kirschen, J. Bernard, H. Besters et al., Economic Policy in our Time, Vol. I (Amsterdam: North Holland 1964).