NBER WORKING PAPER SERIES

PLANNING THE CONSUMPTION GOODS MARKET: PRELIMINARY DISEQUILIBRIUM ESTIMATES FOR POLAND, 1955-1980

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Working Paper No. 1076

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
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February 1983

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ABSTRACT

This paper specifies and estimates a four-equation disequilibrium model of the consumption goods market in a centrally planned economy (CPE). The data are from Poland for the period 1955-1980, but the analysis is more general and will be applied to other CPEs as soon as the appropriate data sets are complete. The work reported here is based on previous papers of Portes and Winter and Charemza and Quandt. Portes-Winter applied to each of four CPEs a discrete-switching disequilibrium model with a household demand equation for consumption goods, a planners' supply equation, and a "min" condition stating that the observed quantity transacted is the lesser of the quantities demanded and supplied. Charemza-Quandt considered how an equation for the adjustment of planned quantitites could be integrated into a CPE model with fixed prices and without the usual price adjustment equation. They made plan formation endogenous and permitted the resulting plan variables to enter the equations determining demand and supply. This paper implements the Charemza-Quandt proposal in the Portes-Winter context. It uses a unique new data set of time series for plans for the major macroeconomic variables in Poland and other CPEs. The overall framework is applicable to any large organisation which plans economic variables.

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1. Introduction

This paper specifies and estimates a four-equation disequilibrium model of the consumption goods market in a centrally planned economy (CPE). The data are from Poland for the period 1955-1980, but the analysis is more general and will be applied to other CPEs as soon as the appropriate data sets are complete.

The work reported here is based on the previous papers of Portes and Winter (1980) and Charemza and Quandt (1982), referred to below as P-W and C-Q. The former applied to each of four CPEs a discrete-switching disequilibrium model with a household demand equation for consumption goods, a planners' supply equation, and a "min" condition stating that the observed quantity transacted is the lesser of the quantities demanded and supplied. C-Q considered how an equation for the adjustment of planned quantities could be

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integrated into a CPE model with fixed prices and without the usual price adjustment equation. They made plan formation endogenous and permitted the resulting plan variables to enter the equations determining demand and supply. Depending on the precise specification of the equation determining the plan, the model could adjust towards market clearing in a manner similar to that of disequilibrium models with price adjustment equations.

This paper implements the C-Q proposal in the P-W context. It differs from P-W in several respects: (i) the data are extended beyond 1975, up to 1980; (ii) the main series have been more or less substantially revised, using new information; (iii) a plan-adjustment equation determines the published plan for aggregate consumption by households; (iv) this plan enters the equation for the supply of consumption goods; (v) the variables constructed by P-W to measure deviations from plans for exogenous variables (output, investment, defence expenditure), which proxied the plan series by second-order quadratic trends, now use published plan data. The model here differs from C-Q in having a more general form of plan-adjustment equation than they propose.

The work reported here was possible only because we were able to assemble reliable time series for plans for the major macroeconomic variables in Poland and other CPEs. Using this new and unique data set, our empirical work can now go beyond the question posed by P-W, which concerned the existence of excess demand in the aggregate consumption goods markets of CPEs, to a range of important questions concerning the planning process and macroeconomic disequilibrium: Are the plans in a CPE properly represented as endogenous, determined by stable economic relationships rather than political caprice? How do plans so determined then influence the planners and the economy? Do the planners plan for macroeconomic equilibrium (i.e. does the plan refer to their planned supply or to their intention for the quantity transacted)? Is the disequilibrium macro framework appropriate and useful for the analysis of CPEs (see Portes, 1981a)? There are also interesting theoretical and econometric questions which arise, some of which will provide material for future work. The overall framework is applicable to any large organization which plans economic variables.

2. The Model

Our general model for Poland is taken from P-W with the modifications indicated above. Thus the consumption demand equation is identical to that in P-W, derived directly from the Houthakker-Taylor savings function:

$$CD = \alpha_1 DNFA1 + \alpha_2 DYD + \alpha_3 YD1 + u_1 \qquad (1)$$

where

CD = household desired expenditure on consumption goods and services in the current period

DNFA = household saving, measured as the change in net financial assets of households, NFA, during the period (NFA is the end-of-period net stock of financial assets); DNFA1 was called S1 in P-W

DYD = change in disposable income from the previous to the current period

YD = disposable income

1 suffix denotes a one-period lag operator

$u_1 \sim N(0, \sigma_1^2)$

The work of Houthakker and Taylor suggests the following a priori hypotheses:

$-1 < \alpha_1 < -1/3, \quad 0 < \alpha_2 < 1, \quad \alpha_3 = 1.$

The modified supply equation is

$$CS = \beta_1 C^* + \beta_2 C^*Z + \beta_4 RNFA1 + \beta_5 CZXD + \beta_6 CZXI + \beta_7 DUM + u_2 \quad (2)$$

where

CS = supply of consumption goods and services in current period

C* = announced plan for consumption

(* denotes a plan throughout. The value of a plan variable in period t is the plan for period t, as formulated in period t-1)

NMP = net material product

D = defence expenditure

I = investment expenditure

C*Z = (C*/NMP*)·(NMP-NMP*)

CZXD = [(D/NMP) - (D*/NMP*)]·NMP

CZXI = [(I/NMP) - (I*/NMP*)]·NMP

RNFA = deviation of current NFA from second-order exponential time trend fitted to observed values of NFA

DUM = one for the period 1978-80, zero otherwise

$u_2 \sim N(0, \sigma_2^2)$

A planned supply function of this form is explained, justified and estimated in Portes and Winter (1977, 1980). The hypothesis is that consumption goods supply will be determined by the announced consumption plan and by <u>deviations</u> from plans of output, defence, investment and consumption, as well as deviations from trend of household financial assets. A coefficient β_3 for the lagged values of C*Z was considered in the general model of P-W but the corresponding term dropped out of their estimates for Poland and therefore has been excluded here, while their original numbering of coefficients has been retained to facilitate comparisons. On the other hand, in P-W defence and investment expenditure were aggregated, with a single coefficient β_5. A-priori arguments here suggest $\beta_1 \simeq 1$; β_2 , $\beta_4 > 0$; β_5 , $\beta_6 < 0$. The dummy variable was introduced because it was believed that 1978 marked the beginning of an extraordinary sequence of events, including changes in the planners' behaviour, which led to the crisis of 1980 (Portes, 1981b).

In both the demand and supply equations, we expect a priori that no constant terms should appear. They were tried in initial estimates, however, and we could not reject the hypothesis that they were zero.

The simple disequilibrium model is completed by

$$C = \min\ (CD,\ CS) \qquad (3)$$

where C is the quantity observed.

Now we add the plan-adjustment equation

$$C^* = \delta_1 C^*1 + \delta_2 C1 + \delta_3 C2 + \delta_4 RNFA2 + \gamma(CD-CS) + u_4 \qquad (4)$$

where the suffix 2 denotes a two-period lag and $u_4 \sim N(0,\ \sigma_4^2\ )$.

The plan for the current period is normally determined towards the end of the previous period, and we suppose it is a function of the

† The plan for year t is formulated in the last quarter of year t-1. At that time the planners know NFA2 exactly, since it refers to financial assets at the end of year t-2. They also know part of NFA1 - the first 6 or 8 months, since it refers to financial assets at the end of year t-1.

plan for that period and realized quantities for that and the preceding period, as well as the most recent known value of RNFA.† A final influence on the plan might be excess demand, or CD–CS.

Single-equation models of plan formation involving only previous plans and realizations are discussed by Yeo (1982). Planners' behaviour of this kind is discussed by Gacs and Lacko (1973) and by Kornai (1971). Different schemes yield similar relationships of the form of equation (4) with different interpretations of $(\delta_1, \delta_2, \delta_3)$. We discuss below some of the properties of these coefficients.

Our plan-adjustment equation also supposes that the planners will respond to observed "excess" household liquidity by raising the plan $(\delta_4 > 0)$. We use RNFA1 in the supply function and RNFA2 here because the former is meant to capture behaviour <u>during</u> the current period, when RNFA1 is known, whereas when the plan for period t is determined in period (t-1) only NFA at the end of period (t-2) is known. A similar argument might suggest that C1 does not belong in equation (4), but we suppose the planners have better information on a flow variable towards the end of the period during which it is realized than on a stock to be measured at the end of that period. We did try RNFA1 instead of RNFA2 in equation (4) for some estimates; but although its coefficient was significant and of the correct sign it resulted in considerably poorer estimates of $(\delta_1, \delta_2, \delta_3)$.

A more serious objection to the dating of variables in equation (4) is the use of <u>contemporaneous</u> excess demand, which is clearly unknown when the plan is fixed. This might be justified on a "planners' rational expectations" argument; on the other hand, it might be thought preferable to use lagged excess demand, which would correspond to excess demand in the period during which the plan is formulated. Unfortunately, the model's likelihood function then becomes intractable, unless we suppose that u_4 is identically zero (this is clear by analogy with the analysis in Laffont and Monfort, 1979, and Quandt, 1981). We did try estimating such a model, but it gave some silly results, for reasons which we do not yet understand.

One variant which was simple enough to implement was to suppose that CD and CS enter separately in equation (4) with coefficients γ_1 and γ_2, respectively. When we tried this formulation, we did find $\gamma_1 > 0$, $\gamma_2 < 0$, as expected, and of the same order of magnitude (though surprisingly large); and we often could not reject $\gamma_1 = -\gamma_2$. We therefore report only results for the model as shown above, expecting $\gamma > 0$ a priori. We also tried an asymmetrical formulation where only positive excess demand influences the planners, so the term in equation (4) is γ max (D-S, 0). This did not work well, and the estimates are not reported.

All estimates use annual data for 1955-80 for Poland, although the two-period lag in equation (4) means that we can report estimates of excess demand only for the 24 observations 1957-80. All variables are in constant prices, with the CPI used as deflator. Further information on the data is given in Appendix A.

3. Results

The likelihood function for the model of equations (1) - (4) is derived in Appendix B. It is clear that the model is coherent, because the matrix of coefficients of the endogenous variables is the same whether there is excess demand or excess supply. We used the

Davidon-Fletcher-Powell algorithm to obtain maximum likelihood estimates, with numerical first derivatives. The procedure invariably iterated long enough so that the H matrix provided good convergence to the inverse of the Hessian and therefore good estimates of standard errors.

We report the results of estimation in Tables 1 and 2. The first column of Table 1 gives the original P-W estimates, the second column estimates for the P-W model on the new data (using plans). The third and fourth columns show estimates for two different versions of the model of equations (1) - (4), first with and then without the excess demand term in the plan-adjustment equation. As discussed below, we find the estimates with $\gamma = 0$ to be superior, so Table 2 gives output only from this run. The first column shows for each observation the probability π that demand exceeds supply, as estimated by P-W, and the second gives our estimates of π.

As a first step in the estimation it was decided to estimate the original P-W model with data for plans instead of time trend proxies. Estimation of this model for the new data set using a sample from 1957-1980 did not yield acceptable results; however convergence was obtained when the observations for 1980 were omitted. The results are given in the second column of Table 1. The estimates of the demand equation are quite reasonable, the supply equation less so. In particular the estimates of β_5, and β_6 do not have the expected signs.

Estimation of the new model including the excess demand term in the plan-adjustment equation does produce an estimate of γ which is significant and of reasonable size, and a likelihood ratio test suggests (though not very strongly) that we should reject the

TABLE 1

	P-W 1980	P-W Model Re-estimated	Model of Eqns. (1)-(4)	Model of Eqns. (1)-(4), $\gamma \equiv 0$
a_1	-0.965 (0.085)	-0.630 (0.236)	-0.414 (0.213)	-0.494 (0.222)
a_2	0.970 (0.055)	0.810 (0.136)	0.729 (0.107)	0.747 (0.126)
a_3	1.001 (0.004)	0.998 (0.007)	0.996 (0.006)	1.000 (0.008)
s_1^2	3.721 (1.298)	32.30 (11.15)	29.34 (11.61)	55.030 (6.11)
b_1	1.055 (0.025)	1.028 (0.003)	1.020 (0.008)	1.003 (0.003)
b_2	0.143 (0.562)	1.179 (0.085)	-0.066 (0.237)	0.499 (0.106)
b_4	2.572 (1.212)	0.824 (0.099)	-0.424 (0.189)	-0.269 (0.077)
b_5	-1.718 (0.644)	0.721 (0.044)	-3.332 (2.351)	-5.445 (1.136)
b_6	-	2.514 (0.723)	0.252 (0.175)	0.527 (0.086)
b_7	-	-	-33.141 (11.118)	17.42 (3.55)
s_2^2	15.293 (11.327)	1.247 (0.763)	70.19 (3.30)	2.467 (1.34)
d_1	-	-	-1.962 (0.645)	-0.751 (0.184)
d_2	-	-	2.851 (0.430)	2.035 (0.112)
d_3	-	-	0.223 (0.467)	-0.225 (0.171)
d_4	-	-	2.820 (0.895)	1.214 (0.220)
c	-	-	1.526 (0.624)	-
s_4^2	-	-	46.36 (1.85)	92.67 (38.80)
Log L	-48.56	-65.15	-149.89	-154.85
C	302.7	421.94	448.88	448.88

TABLE 2

	π_t P-W (1980)	π_t Model of Eqns. (1)-(4), $\gamma \equiv 0$
1957	0.00	0.00
1958	0.04	0.00
1959	0.53	0.93
1960	0.03	0.00
1961	0.00	0.81
1962	0.00	0.52
1963	0.00	0.01
1964	0.00	0.00
1965	0.00	0.84
1966	0.00	0.00
1967	0.00	0.00
1968	0.00	0.45
1969	0.00	0.75
1970	0.00	0.00
1971	0.99	0.00
1972	1.00	0.97
1973	0.92	0.00
1974	0.00	0.00
1975	0.00	0.88
1976	-	0.00
1977	-	0.74
1978	-	0.00
1979	-	0.92
1980	-	0.88

Notes to Table 1

1) a_i are estimates of α_i, b_i of β_i , d_i of δ_i , c of γ, s_i^2 of σ_i^2.

2) Asymptotic standard errors in parentheses.

3) $\overline{C}$ is the sample mean value of consumption.

4) b_5 in the estimates for P-W (1980) is the estimated coefficient on a term aggregating investment and defence expenditure, but of the same form as CZXD and CZXI.

5) The estimation in P-W (1980) was carried out over a sample including 1954-1975.

6) Re-estimation of the P-W model in column 2 included 1956-1979. In this re-estimation the defence and investment deviations were entered as separate variables, and not combined as in P-W (1980).

7) The estimates in columns 3 and 4 were carried out over the sample 1957-1980.

Note to Table 2

The values of π_t taken from P-W (1980) are the estimated marginal probabilities that the observation was generated by an excess demand regime, i.e. that $CD_t > CS_t$. The probabilities reported in column 2 of Table 2 (which correspond to the estimates in the last column of Table 1) are the estimated conditional probabilities that the observation was generated by an excess demand regime, i.e. that $CD_t > CS_t$, conditional on the observed C_t. The two estimated π's can nevertheless be compared, since Burkett (1981, p. 161) reports that there is little or no difference between the marginal and conditional probabilities for Poland in the original P-W (1980) model.

restriction $\gamma = 0$. On the other hand, the inclusion of this term affects the estimates of several other coefficients unfavourably (b_2, d_1, d_2, d_3) and gives a less plausible sample separation. Since the rationale for using contemporaneous excess demand in equation (4) is somewhat tenuous (and experiments with separate γ_1 and γ_2 gave no better results and used up yet another degree of freedom), we concluded this informal specification search by choosing the estimates with $\gamma = 0$. Note that the dummy variable for 1978-80 is strongly significant in these estimates, and a run without it was rejected by a likelihood ratio test.

Considering the estimates in the last column of Table 1, we find that all the estimates for equation (1) satisfy the a-priori conditions, as do the estimates for β_1, β_2, β_5, and δ_4. The other coefficients in equation (4) look reasonable enough, and we shall discuss them and the anomalous estimates for β_4 and β_6 below.

The estimated probabilities of excess demand regimes look much more acceptable here than they did in P-W. P-W were themselves skeptical about their π's for Poland (pp. 153, 155). Here, almost half the observations are classified as excess demand, and the pattern is reasonably consistent with a qualitative assessment of events in the Polish economy since the mid-1950s. In particular, the estimates pick up the effects of the investment boom of 1959, the sudden growth of wages in 1971-72, and the strain on the economy from 1975 onwards, which further foreign borrowing could not relieve.

Turning in more detail to the estimates from individual equations and coefficients, there is little further to say about the demand function. The standard errors are somewhat larger than in the original P-W estimates, and the estimate of α_1 is significantly different, but the overall picture is quite satisfactory. The coefficients imply a long-run average savings ratio of 2.3% in an economy growing at 5% p.a.

The plan-adjustment equation is much more interesting. First, the coefficients are on the whole quite well determined. Second, it seems clear that the plan is adjusted upwards when the planners observe that households are holding "excess" liquid assets; indeed, they appear to increase the plan more than commensurately (but see the discussion of b_4 below). Third, the long-run properties of the estimated equation (4) are remarkable.

Recall that RNFA is a series of deviations from trend. Although this is not a linear but rather an exponential trend, so that the mean of RNFA is not zero by construction, it is nevertheless very close to zero (0.7) compared with C. If we therefore disregard RNFA and take the estimates with $\gamma = 0$, we have the simplified equation

$$C^*_t = d_1 C^*_{t-1} + d_2 C_{t-1} + d_3 C_{t-2} \tag{5}$$

What are the implications of a stationary state in which $C_t = \tilde{C}$ for all t? We would have the first-order difference equation

$$C^*_t = d_1 C^*_{t-1} + (d_2 + d_3)\tilde{C} \tag{6}$$

Provided $|d_1| < 1$, which does hold for the estimates with $\gamma = 0$, this converges to

$$C^* = (d_2 + d_3)\tilde{C}/(1-d_1) = 1.034\ \tilde{C} \tag{7}$$

Given the degree of precision of the estimates, this is tolerably close to permitting a stationary state in which the plan is always realized.

Of course, the Polish economy (and aggregate consumption) were in fact growing steadily until the very end of our period. We might then ask what constant growth rate is consistent with exact realization of plans in the estimated version of equation (5)? Taking $C_t = (1+g)C_{t-1}$ and $C_t^* = C_t$ for all t in equation (5) gives us

$$(1+g)^2 C_{t-2} = (d_1+d_2)(1+g)C_{t-2} + d_3 C_{t-2} \qquad (8)$$

The positive root of this quadratic is g = .075, which is close to the observed average growth rate of consumption over the period 1957-1980 of 6.3% ! That is, the observed planners' behaviour does not suggest unrealistic planning. Alternatively, we might say that the consumption planning mechanism was on the whole consistent with the economy's possibilities, and the role of RNFA suggests that when exogenous shocks pushed plans and actual consumption off course, the planners sought to return to this path.

Finally, suppose we did introduce an excess demand term equal to a constant proportion e of consumption into the constant growth economy with exact plan realization of equation (8), but with $\gamma = 1$. In other words, for the moment we visualize a centrally planned economy in which there is excess demand for consumption goods in every period, but in which the planners make planned consumption a positive function of excess demand. This would give us

$$(1+g)^2 C = (d_1+d_2)(1+g)C + d_3 C + eC \qquad (9)$$

It is straightforward to establish how the solution to the quadratic in g will vary with e:

$$\frac{\partial g}{\partial e} = +[(d_1 + d_2)^2 + 4(d_3 + e)]^{-1/2} > 0 \qquad (10)$$

(for the root with $g > 0$)

As excess demand increases so does the consumption plan and so also does actual consumption. Thus the higher excess demand, the higher would be the growth rate of actual consumption required to be consistent with continuous realization of plans (note that this conclusion is not independent of the estimated parameter values, since they determine which root will give $g > 0$, and indeed whether there exists a positive real root).

The estimates of the supply function suggest that consumption is not used as a "buffer" to absorb unanticipated shocks to NMP ($b_2 < 1$ - see P-W for this interpretation). Further, they suggest that consumption goods supply would equal the plan ($b_1 \approx 1$) were it not for the effects of the "deviation" or shock variables, all of which have means approximately equal to zero.

In this equation, b_4 and b_6 take signs opposite to those expected on a-priori grounds. For each, we can provide fairly plausible ex post rationalizations, but more study will be required.

For b_6, we conjecture that there was a structural change around 1972, when the foreign borrowing constraint was relaxed, so that investment no longer crowded out consumption. Indeed, β_6 might well have become positive, if the planners took account of the multiplier effects of shocks to investment and were willing to accommodate them with additional imports of consumption goods. To test this, we tried an additive dummy on the coefficient β_6 itself for the period 1972-80. The coefficient on the dummy was not significant but at least was positive, as expected, and b_6 also became insignificant, but did not switch sign. This gave partial support to our hypothesis.

The surprising but fairly small negative coefficient on RNFA1 in the supply equation must be viewed in the light of the rather large positive coefficient on RNFA2 in the plan-adjustment equation. It may be that the end-year measurement of NFA does not correspond to the data to which the planners actually respond when they plan <u>during</u> (t-1), in equation (4), and when they adjust supply <u>during</u> t, in equation (2). Thus we also find that RNFA1 performs similarly well in equation (4), which is not suprising both because the planners know some of the information going into RNFA1 by the time they set C*, and because the observed positive serial correlation between RNFA1 and RNFA2 is 0.84.

Moreover it should be noted that the stock of financial assets affects supply in two ways - directly, through the RNFA1 term in equation (2) and indirectly through the presence of C* in equation (2) and the presence of RNFA2 in the equation determining C*. Thus the C* entering equation (2) already has in it information on RNFA2, to which the planners may have overreacted in period t-1 in setting the consumption plan. They may then seek to compensate for this overreaction in period t by adjusting actual supply in the opposite direction, based on RNFA1. The total direct and indirect effect of net financial assets on supply can be obtained by substituting the C* from equation (4) into the supply equation, equation (2). The total effect of RNFA upon CS is then given by

$$\frac{\beta_4 RNFA1 + (\beta_1 + \beta_2\Theta)\delta_4 RNFA2}{1 + \gamma}$$

where Θ is (NMP-NMP*)/NMP* . Now consider a constant unit positive RNFA, i.e. a sustained departure of net financial assets from trend.

The supply response will be

$$\frac{\beta_4 + (\beta_1 + \beta_2\Theta)\delta_4}{1 + \gamma}$$

The size of this response of course depends upon Θ, which over the sample period ranged in magnitude between -0.05 and +0.05. The total effect of RNFA upon supply, based on the two versions of the model estimated (with and without the term involving γ), can be summarized as follows:

	$\Theta = -0.05$	$\Theta = 0.05$
Equations (1)-(4) with γ estimated	0.975	0.967
Equations (1)-(4) with $\gamma \equiv 0$	0.918	0.979

This suggests that the planners, in response to a sustained increase in household financial assets, would adjust the supply of consumption goods by an equal amount. The evidence from the performance of RNFA that the planners do seek market clearing thus seems quite strong.

4. Conclusion

We believe we have taken substantial steps towards answering the questions posed in Section 1 and demonstrating the applicability of the C-Q model. Estimation has shown that it is both feasible and informative to use plan data, and to model the regularities in the process of plan construction. The plan for year t, formulated and announced in year t-1, is dependent upon planned and actual consumption and household financial asset behaviour, as known to the planners in year t-1. These announced plans are then embodied in a supply function which reflects, in addition, unforeseen developments in the economy in year t. The role of the financial assets variable suggests that the planners do appear to try to adjust announced plans and actual supply in order to reduce excess demand. The disequilibrium macroeconomic framework, with fixed prices and planned quantities, can be estimated for centrally planned economies and seems to provide insight into their behaviour. The plan-adjustment equation helps in disequilibrium estimation, which was possible even with a relatively small sample.

There are various extensions of the analysis which we shall explore in future work. We should soon have data sets permitting application of the model to three other countries. We shall try further experiments with the model with lagged excess demand in the plan-adjustment equation. We intend also to try a model allowing different coefficients on positive and negative excess demand in equation (4). It may be interesting to run a current-price demand equation with an inflation term, based on a restricted intertemporal linear expenditure system. Finally, the same structure could be applied to other macro variables and markets - e.g., investment or NMP itself.

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Appendix A : Data

The data used in this study have been drawn from a variety of Polish and other sources, all publicly available. The earlier study by Portes and Winter ((P-W (1980)) was based on the data described in Rudcenko (1979). There are some important conceptual differences between the variables used here and those constructed by Rudcenko. In addition some of the series reported by Rudcenko and used in P-W (1980) have been subject to revision by the Polish central statistical agency (GUS).

1. Realized Variables

The series describing actual or realized variables are mainly drawn from the annual statistical yearbook, Rocznik Statystyczny (RS) the concise annual statistical yearbook, Maly Rocznik Statystyczny (MRS), or other publications of the GUS.

i) Real Income (YD): This is the real disposable income of households, after the deduction of taxes and other obligatory payments. It includes not only income flows from the state or socialized sector to households, but income flows within the private sector. In particular it includes an estimate of the net income of private enterprises and an estimate of the income in kind of private agriculture. In this respect it differs fundamentally from the income series reported in Rudcenko (1979, p.447), which included only gross income flows from the socialized sector to households. The income series used in the present study was thought to be the more appropriate for a study of consumer behaviour.

This series has been reported regularly in the RS for the years since 1970. A comparable series can be found for the years from 1961 to 1970 and for 1975 in the yearbook of national income, Rocznik Dochodu Narodowego (RDN), for 1960-1965, 1971 and 1976. These issues of the RDN contain relatively detailed balance sheets of aggregate nominal household income and expenditure. The income figures, after some adjustment because of definitional changes, appear to be comparable to the figures reported in the RS for the years after 1970. We have not yet been able to obtain comparable published income figures for the 1950s. Instead we have applied the percentage changes in the index of "nominal money income of the population" given in Hodoly (1966, p. 149) in order to create an income series from 1950 to 1960. The percentage changes in income given by Hodoly have been compared to similar series given in a variety of other publications and monographs. In general all these sources agree closely on the movement in income in the 1950s. This nominal income series for the years 1950-1980 is then deflated by the published consumer price index to give the series YD.

ii) Real net financial assets (NFA): This variable is equal to the sum of savings deposits and cash held by households, minus the total amount of outstanding loans from the state to households. It is thus financial assets net of the sum owed by households to the state. It is measured as an end-of-year stock. This nominal stock figure is then deflated by the published consumer price index.

This variable is constructed from the series reported in Rudcenko (1979,p. 446-450) and has been updated to 1980 from the data published in the RS and the MRS. We were not able to obtain a consistent series for credits advanced to and repaid by households. Instead we used the series from Rudcenko, which measures credits advanced to the population, which includes credits to individual farmers and non agricultural private enterprise.

iii) Real household consumption of goods and services (C): This series is obtained as the difference between real income, YD, and the annual assets variable is deflated before being differenced to obtain DNFA.

iv) Net material product (NMP): This is net material product, in constant prices. The series is taken from the RS, but re-scaled to give an implicit deflator equal to 1 in 1971, in conformity with the practice in P-W (1980).

v) Investment (I): This is total investment in both the socialized and private sectors, in constant prices. The series is taken from the RS, but re-scaled in the same way as net material product.

vi) Defence (D): This is current defence expenditure, as given in the RS. The figure in the RS is in current prices, and is deflated using the implicit deflator for investment, I. This implicit deflator is calculated as the ratio of current to constant price total investment figures as published in the RS.

vii) Consumer Price Index: This is the price index for goods and services purchased by the population, as published in the RS. The published series has been linked and rescaled so that 1955 = 1.0, in accordance with P-W. (1980).

2. Plan Variables

The annual economic plan for Poland is announced during November or December of the preceding year in the official gazette of the Polish government, Monitor Polski (MP). The plan figure for year t is usually given only as a percentage increase over the (unspecified) actual or realized figure for year t-1. In some cases the level of the planned series for year t is also given, but this is not always the case. The figures in MP have been supplemented and confirmed from the figures given in the planning journal Gospodarka Planowa (GP) and in the United Nations Economic Survey of Europe. In some instances in the 1950s and 1960s additional information was obtained from the Polish monthly statistical bulletin, the Biuletyn Statystyczny (BS), and the United Nations Economic Bulletin for Europe.

i) Planned net material product (NMP*): This series is available in MP, GP and the U. N. sources, given as a percentage increase over the preceding year's actual figure. It has been converted to a planned level by applying this percentage increase to the latest available published figure for the previous year, which is just the series NMP.

ii) Planned investment (I*): This series is available on the same basis as the NMP figures, although planned levels are given for some years. The series I* is generated in the same manner as the series NMP*.

iii) Planned defence expenditure (D*): This series corresponds to budget appropriations for current defence expenditure announced by the government. The series is taken from Alton et al. (1980, p. 32-33).

iv) Planned supply of consumption goods and services: There is no published plan series available which corresponds exactly to our notion of consumption, although a variety of retail sales plan figures are available. We have used here a series for the planned "volume of retail sales" or "retail sales turnover", taken from the United Nations Economic Bulletin for Europe and the Economic Survey of Europe. This corresponds to a fairly complete coverage of retail sales of goods, but not of services. There are some plan figures available for services for the 1970s, but not earlier. We generated planned consumption levels in the following manner: We applied the published planned percentage increases in the "volume of retail trade turnover" to the published series on actual retail sales of goods, RSG. This generated a series of planned levels for retail sales, RSG*. We then regressed our real consumption series, C, on the published actual retail sales of goods RSG. Because our consumption data is somewhat different in origin for the 1950s, 1960s and 1970s, we allowed slope and intercept dummies for each of these periods in the regression relating C and RSG. We then generated C* by substituting RSG* for RSG in this estimated relationship. The alternative and more direct way of generating C* would be to apply the planned percentage increases in RSG directly to the actual level of C in t-1, as if they were the planned percentage increases in C itself. This yielded a very similar series.

References

1. Official Publications

Biuletyn Statystyczny (monthly statistical bulletin)

Gospodarka Planowa (monthly planning journal)

Maly Rocznik Statystyczny (concise statistical yearbook)

Monitor Polski (government gazette)

Rocznik Dochodu Narodowego (yearbook of national income) 1960-65, 1971 and 1976

Rocznik Statystyczny (statistical yearbook)

2. Other

Alton, T. P., E. M. Bass, G. Lazarik and W. Znayenko, 1980, Military expenditures in Eastern Europe, post World War II to 1979 (New York, Research Project on National Income in Eastern Europe, Occasional Paper no. 63)

Hodoly, A., 1966, Problemy spozycia w Polsce (Warsaw, PWE)

Rudcenko, S., 1979, Household money income, expenditure and monetary assets in Czechoslovakia, GDR, Hungary and Poland, 1956-1975, Jahrbuch der Wirtschaft Osteuropas 8, 431-450.

The equations of the model are

$$D_t = z_{1t} + u_{1t} \tag{A.1}$$

$$S_t = \beta_1 Q_t^* + \beta_2 z_{4t} Q_t^* + z_{2t} + u_{2t} \tag{A.2}$$

$$Q_t = \min(D_t, S_t) \tag{A.3}$$

$$Q_t^* = z_{3t} + \gamma_1 D_t + \gamma_2 S_t + u_{3t} \tag{A.4}$$

Where Q_t^* represents plans, z_{1t}, z_{2t}, z_{3t} and z_{4t} contain only parameters and predetermined variables, and u_{1t}, u_{2t}, u_{3t} are distributed as $N(0,\Sigma)$ with scalar covariance matrix. The pdf of D_t, S_t, Q_t^* is immediate from (A.1) to (A.4):

$$f(D_t, S_t, Q_t^*) = \frac{|1 - \gamma_2(\beta_1 + \beta_2 z_{4t})|}{(2\pi)^{3/2}\sigma_1\sigma_2\sigma_3} \exp\left\{ -\frac{1}{2}\left[\frac{(D_t - z_{1t})^2}{\sigma_1^2} + \frac{(S_t - (\beta_1 + \beta_2 z_{4t})Q_t^* - z_{2t})^2}{\sigma_2^2} + \frac{(-\gamma_1 D_t - \gamma_2 S_t + Q_t^* - z_{3t})^2}{\sigma_3^2} \right]\right\} \tag{A.5}$$

The pdf of the observable random variables Q_t, Q_t^* is

$$h(Q_t, Q_t^*) = \int_{Q_t}^{\infty} f(Q_t, S_t, Q_t^*)\,dS_t + \int_{Q_t}^{\infty} f(D_t, Q_t, Q_t^*)\,dD_t \tag{A.6}$$

It is easy to show by completing the square that the integrals in (A.6) can be obtained as

$$\int_{Q_t}^{\infty} f(Q_t, S_t, Q_t^*)\, dS_t = \frac{|1 - \gamma_2(\beta_1+\beta_2 z_{4t})|}{2\pi\sigma_1(\sigma_3^2+\gamma_2^2\sigma_2^2)^{1/2}} \exp\left\{-\frac{1}{2}\left[\frac{(Q_t - z_{1t})^2}{\sigma_1^2} + \frac{B_t - A_t^2}{\omega_1^2}\right]\right\} \times$$

$$\left[1 - \Phi\left(\frac{Q_t - A_t}{\omega_1}\right)\right]$$

$$\int_{Q_t}^{\infty} f(D_t, Q_t, Q_t^*)\, dD_t = \frac{|1 - \gamma_2(\beta_1+\beta_2 z_{4t})|}{2\pi\sigma_2(\sigma_3^2+\gamma_1^2\sigma_1^2)^{1/2}} \exp\left\{-\frac{1}{2}\left[\frac{(Q_t - (\beta_1+\beta_2 z_{4t})Q_t^* - z_{2t})^2}{\sigma_2^2} + \right.\right.$$

$$\left.\left.\frac{E - C^2}{\omega_2^2}\right]\right\}\left[1 - \Phi\left(\frac{Q_t - C_t}{\omega_2}\right)\right]$$

where

$$A_t = \frac{\sigma_3^2(\beta_1 Q_t^* + z_{2t}) - \sigma_2^2\gamma_2(\gamma_1 Q_t - Q_t^* + z_{3t})}{\sigma_3^2 + \gamma_2^2\sigma_2^2}$$

$$B_t = \frac{\sigma_3^2(\beta_1 Q_t^* + z_{2t})^2 + \sigma_2^2(\gamma_1 Q_t - Q_t^* + z_{3t})^2}{\sigma_3^2 + \gamma_2^2\sigma_2^2}$$

$$C_t = \frac{\sigma_3^2 z_{1t} - \sigma_1^2\gamma_1(\gamma_2 Q_t - Q_t^* + z_{3t})}{\sigma_3^2 + \gamma_1^2\sigma_1^2}$$

$$E_t = \frac{\sigma_3^2 z_{1t}^2 + \sigma_1^2(\gamma_2 Q_t - Q_t^* + z_{3t})^2}{\sigma_3^2 + \gamma_1^2\sigma_1^2}$$

$$\omega_1^2 = \frac{\sigma_2^2\sigma_3^2}{\sigma_3^2 + \gamma_2^2\sigma_2^2}$$

$$\omega_2^2 = \frac{\sigma_1^2\sigma_3^2}{\sigma_3^2 + \gamma_1^2\sigma_1^2}$$

and where $\Phi(\ )$ is the standard normal distribution function.

The likelihood is $L = \prod_t h(Q_t, Q_t^*)$

THE DATA

	C	C*	NMP	NMP*
1950	NA	NA	211.581	NA
1951	NA	NA	227.450	NA
1952	NA	NA	241.626	NA
1953	116.034	NA	266.804	NA
1954	132.633	128.236	294.944	NA
1955	149.609	151.501	319.699	NA
1956	171.323	164.717	342.127	342.078
1957	203.576	207.272	378.942	369.839
1958	220.882	222.657	399.889	401.300
1959	240.681	238.736	420.624	424.282
1960	243.876	251.165	439.031	444.599
1961	264.935	261.045	474.788	460.983
1962	273.665	276.921	484.733	508.024
1963	285.716	284.067	518.374	509.939
1964	299.638	299.776	553.285	537.036
1965	319.077	311.137	592.004	582.056
1966	337.055	332.587	634.109	613.909
1967	353.550	355.343	670.290	655.669
1968	376.077	371.197	730.590	702.463
1969	392.337	398.892	751.748	767.120
1970	410.339	415.020	790.891	795.350
1971	441.644	436.180	855.000	833.599
1972	487.337	447.533	945.345	907.155
1973	534.829	533.920	1047.54	1020.03
1974	579.106	583.522	1156.93	1147.06
1975	637.987	636.550	1260.81	1270.31
1976	709.760	742.172	1346.50	1365.46
1977	766.729	787.825	1413.79	1423.25
1978	781.604	845.187	1456.10	1490.13
1979	794.816	803.869	1422.67	1496.87
1980	817.967	840.438	1337.41	1445.44

		I.	I*	D	D*
1950	.	42.9248	NA	NA	NA
1951	.	48.1616	NA	NA	NA
1952	.	57.1758	NA	13.1454	13.4233
1953	.	65.8466	NA	17.6335	19.2438
1954	.	69.7098	67.1635	19.1633	19.5717
1955	.	72.5000	68.5248	22.6345	21.9226
1956	.	75.9339	79.6049	17.4762	17.0378
1957	.	81.8576	80.2622	12.6802	12.7324
1958	.	90.3137	88.7336	13.9606	15.1473
1959	.	105.252	101.061	16.7529	16.3049
1960	.	111.433	111.988	16.6505	17.8090
1961	.	119.546	121.685	17.8582	17.7628
1962	.	131.135	131.022	19.4044	20.6208
1963	.	134.612	142.019	21.9837	23.2949
1964	.	140.965	136.901	23.1223	23.7904
1965	.	154.358	153.088	24.5000	24.9977
1966	.	167.278	163.310	26.5967	27.0597
1967	.	186.208	180.827	27.9526	28.3969
1968	.	202.519	197.008	32.1867	30.8313
1969	.	219.045	220.341	35.3429	35.1080
1970	.	227.931	224.521	37.5135	37.1723
1971	.	244.800	244.342	36.7540	36.6140
1972	.	301.117	268.301	36.7534	37.6451
1973	.	377.438	339.961	40.2510	39.0338
1974	.	461.780	424.240	43.3686	42.2350
1975	.	511.191	489.487	44.9683	44.6537
1976	.	516.304	511.191	43.1006	42.0052
1977	.	532.310	522.499	46.7710	43.8104
1978	.	543.488	504.098	48.0826	47.2855
1979	.	500.550	494.574	50.0382	47.7857
1980	.	438.983	460.506	48.2505	47.3854

	YD	NFA	CPI	INVDEFL
1950	NA	NA	.614110	NA
1951	NA	NA	.673650	NA
1952	109.378	6.01553	.770670	.454042
1953	115.975	5.93440	1.09261	.516063
1954	134.985	7.75880	1.02426	.516613
1955	151.866	9.70200	1.00000	.516911
1956	178.321	15.6311	.990080	.663761
1957	208.047	18.2042	1.04300	.764975
1958	224.929	20.0697	1.07166	.773603
1959	244.932	21.0411	1.08269	.805831
1960	250.038	24.0691	1.10254	.852829
1961	270.914	28.1440	1.11025	.901548
1962	280.009	32.7979	1.13782	.901856
1963	293.662	37.9076	1.14774	.900669
1964	308.548	42.7469	1.16207	.899564
1965	328.519	47.1350	1.17310	.902042
1966	350.704	55.6487	1.18743	.898607
1967	366.518	64.9239	1.20507	.897949
1968	388.348	74.2483	1.22492	.897886
1969	404.764	82.4685	1.24146	.902586
1970	418.363	86.1308	1.25579	.908579
1971	463.212	104.102	1.25469	1.00000
1972	520.719	128.900	1.25469	1.00592
1973	575.597	164.880	1.28986	1.00472
1974	613.882	200.159	1.38137	1.00833
1975	677.105	237.270	1.42282	1.05857
1976	731.565	257.953	1.48545	1.19954
1977	784.873	267.936	1.55821	1.23320
1978	791.948	274.193	1.68445	1.24330
1979	813.121	290.447	1.80232	1.28438
1980	832.127	309.215	1.97133	1.38015

	RNFA
1950	NA
1951	NA
1952	-.816900E-01
1953	-1.35848
1954	-.941850
1955	-.651590
1956	3.34213
1957	3.65546
1958	2.88972
1959	.806010
1960	.296640
1961	.287470
1962	.239180
1963	-.495500E-01
1964	-1.39027
1965	-4.05695
1966	-3.57356
1967	-3.41277
1968	-4.40357
1969	-7.82354
1970	-17.2587
1971	-13.9816
1972	-5.61996
1973	12.0277
1974	26.9220
1975	41.4322
1976	37.1337
1977	19.5856
1978	-4.40511
1979	-21.2824
1980	-38.6910

NOTE: "NA" MEANS DATA NOT AVAILABLE
INVDEFL IS THE IMPLICIT DEFLATOR FOR GROSS INVESTMENT, I
OTHER VARIABLE NAMES ARE AS GIVEN IN THE TEXT