A C T A U N I V E R S I T A T I S L O D Z I E N S I S
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Aleksander Welfe*

MODELLING CONSUMER GOODS MARKETS UNDER DISEQUILIBRIUM AND INFLATION

1. Introduction

The market of consumer goods in a centrally planned economy has been treated for many years as an integral part of a centralized economic system. The market supplies, consumers expenditures were largely determined as an outcome of production process and distribution policies, and also as the result of centralized wage-price policies. In spite of frequently observed shortages of commodities it was assumed that the planned quantitative and wage adjustments ensure the market equilibria. The possibility of functioning of autonomous market mechanisms was typically neglected.

The period of economic crisis in Poland, on the turn of the 1970's, combining deep disequilibria and inflation fully demonstrated the flimsiness of the above assumptions. Thus, a need appeared for a theoretical reflection and for an extensive empirical research. First, the notion of consumer demand had to be extended to cover the new phenomena typical for a state of disequilibrium and to solve the measurement and estimation problems. Secondly, the analysis of market systems had to be developed to include the impact of disequilibria on consumer behaviour and price changes and to cover the inflationary process. The new price and wage policies under economic reforms had also to be taken into account.

*Dr., University of Łódź, Poland.

2. General Characteristics of the Model

The first model of consumer goods market in Poland that explicitely assumed market disequilibria (excess demand and forced savings), and endogenous inflation process was the WA-1 model (see A. W e l f e (1983, 1984d)). It was used not only for empirical verification of theoretical hypotheses concerning the functioning of market mechanism but also to perform regular forecasts (see A. W e l f e (1984a, 1984b)).

The WA-2 model presented below is an extended and reestimated version of the previous one discussed in A. W e l f e (1985). It is a system of simultaneous equations of medium size. The details are presented in Appendix A.

The parameters of the present version of the model have been estimated using OLS and TSLS. The Gauss-Seidel iterative method has been used mostly for simulation and examination of the dynamic properties of the model. F. J. H. D o n and G. G a l l o (1985) used also Newton - type algorithms for solving previous version of the WA-2 model but results did not differ too much. The sample covers the years 1960-1984. Thus-which should be particularly stressed - also the period of economic crisis that took place in Poland. This has significantly affected the specification of the particular equations and especially ruled out the introduction of autoregressive schemes into particular functions. Should they be included, it would be equivalent to the introduction of time trends, and that would make an appropriate representation of future development and especially forecasting turning points impossible. In spite of that, the model is strongly dynamic, due to the fact, that many equations, mostly those of wages and prices, are built and estimated using first differences of variables.

All the regression functions are linear approximations, however, the identities of the model, especially those that enable the transformation from constant to current prices and vice versa, cause that the model itself is non-linear.

The statistical data have been borrowed from publications by the Central Statistical Office. Their documentary sources are included in other papers: A. W e l f e (1984a, 1986a).

2. The Structure of the Model[1]

2.1. Personal Incomes

Wages constitute the main component of personal incomes. By far, the most important of all, are the wages within material production sector of the national economy. We can tell by experience that their changes have a decisive influence on the rate of wage increases in non-productive sectors, and also, indirectly, on the increase of other components of personal income, eg. pensions (see: W. D ę b s k i (1984)). The first group of factors that determine the wages in material product sector is related to the functioning wage regulations, which provide additional benefits or premiae for increased productivity, and quality of products, fulfiling of export plans, etc.

It simply means that an increase in labour productivity stimulates the average wage increase. The second group includes factors which provide an autonomous increase in wages (improvement qualifications and professional skill, growing age, etc.). However, lack of sufficient data caused the use lagged wages as the symptomatic variable. The third factor is the increase in the cost of living. So far, a wage indexation with legal guarantees has never been introduced in Poland. However, its functions have been fulfilled by the pressures brought on by trade unions and public opinion[2].

Thus the equation explaining average wages in material production sectors has the following form[3]: ..

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[1] The final structure of some stochastic equations can slightly differ from those presented in the text. The differences are due to omission of some variables in situations when they proved to be statistically insignificant during the model updating. In some cases it was necessary to eliminate the non-typical observations, or provide to for sample segmentation by means of dummy variables, which, however, we do not discuss in detail.

[2] It is done in the form of open discussion on governmental proposals concerning price rises and introduction of compensations for the poorest groups of the population, and through factory floor negotiations.

[3] In the notations of particular equations we omit the random term, providing it does not lead to misunderstandings. We assume

$$\Delta ZUXP_t = f(\overset{(+)}{\Delta XQN_t}, \quad \overset{(+)}{ZUXP_{t-1}}, \quad \overset{(+)}{\Delta PYZ_t}) \tag{1}$$

where

XQN - labour productivity calculated as net output, constant prices, per employee;

PYZ - cost of living index;

Δ - operator of the first difference.

Average wages in non-productive sectors (ZUOP) became dependent on average wages in material production sectors. This follows the hypothesis, that economic policy is aimed to prevent serious wage disproportions among the above sectors to avoid process of manpower outflow:

$$ZUOP_t = f(\overset{(+)}{ZUXP_t}) \tag{2}$$

There is always a time lag in the process of adjustment of average pension (ZGTP) increase to the increase of average wages in the national economy (ZUP), thus

$$\Delta ZGTP_t = f\left(\sum_{k=0}^{k'} h_k \quad \overset{(+)}{\Delta ZUP_{t-k}}\right) \tag{3}$$

Individual farmers incomes from agricultural production are the next component of personal income. They depend on net agricultural output (XR), and on administred procurement prices paid by socialized trade organizations (PXRS). We have used a two-year average of net agricultural output (XR) to eliminate erratic fluctuations caused by changing weather conditions

$$YBRP_t = f(XR_t \cdot 0.5 + \overset{(+)}{XR_{t-1}} \cdot 0.5, \quad \overset{(+)}{PXRS_t}) \tag{4}$$

The remaining personal incomes include transfers from social funds (excluding pensions), incomes of representatives of free

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for the random factor that $\xi : N(0, \sigma^2)$, and that basic conditions allowing for the application of the least square method are met.

professions (i.e. artists, writers, lawyers, etc.) net incomes of private enterpreneurs, and other incomes. The above incomes bear a definite relation towards the incomes from wages (YZP) and private farmers incomes:

$$YBIIP = f(\overset{(+)}{YZP_t}, \overset{(+)}{YBRP_t}) \tag{5}$$

The total personal incomes are a sum of four specified above components after allowing for the number of employees and pensioneers.

2.2. Consumer demand

Shortages in consumer goods supply, occuring in some years covered by the sample period meant that the demand exceeded the purchased quantities, and thus it was not directly observable (see R. J. B o w d e n (1978)). This made it impossible to estimate the parameteres of demand functions directly, using OLS (see R. C. F a i r, H. H. K e l e j i a n (1974)). Thus the real value of expenditures by the households could not be simply regressed against real personal incomes, and relative prices.

In case the market is balanced the demand (D) - ex post - equals the realized, i. e. purchased quantities (Q), and simultaneously, supply (S). In the opposite case we have excess demand (DE), and the observable quantities equal using the minimum condition:

$$Q_t = \min \{ D_t, S_t \} \tag{6}$$

Defining

$$DE_t = D_t - S_t \tag{7}$$

we can write the equation explaining the transacted quantities in terms of consumers expenditures:

$$Q_t = D_t - DE_t \cdot U_{Dt} \quad \text{for:} \quad U_{Dt} = 1, \text{ if } DE_t \; 0 \qquad U_{Dt} = 0 \text{ otherwise.} \tag{8}$$

A correct specification of the demand and excess demand functions being the components of the equation (8) enables the estimation of structural parameters. Our arguments will proceed as follows. In a state of equilibrium, consumer demand, given real personal income and relative price, represents revealed preferences of the households, and thus corresponds to the conventional understanding of demand. After R. W. C l o w e r (1965), we shall define it as the "notional demand" (DN)

$$DN_t^j = f^{(+)\ (-)}(Y_t, P_j^j/Pt) \tag{9}$$

where

Y - real, personal incomes;

P^j - price index for commodity j;

P - cost of living index.

Let us asume that on the j good market excess demand occured in the t - 1 period. We shall call it the initial excess demand (DEi^j). Thus, after having made purchases in the market j consumers will have remaining funds at their disposal, which they can spend on other goods. It is equivalent to a demand transfer from one market to other markets caused by disequilibrium (see also G. S. M a d d a l a (1983), p. 337-340). However, in case of simultaneous supply shortages occur on many markets, we can expect, that after the demand transfers have taken place, still unsatisfied demand will remain. We shall call it the final excess demand (DE^j). It is the source of postponed demand (DO^j), which, along with notional demand, is the second constituent of effective demand (D) (see A. W e l f e (1984c)). The postponed demand will be understood as a fraction of final excess demand (from previous period) the consumers decide to retain in the next period

$$DO_t^j = \gamma^j DE_{t-1}^j, \tag{10}$$

where

$\gamma^j \in \langle 0.1 \rangle$ - propensity to postpone unsatisfied demand.

It is natural to assume, that the postponed demand will be financed from the accumulated forced savings (FSP). They will be defined as the financial equivalent of total unsatisfied demand in the previous period:

$$FSP_{t-1} = \sum_{1} FSP^{1}_{t-1} = \sum_{1} DE^{1}_{t-1} \cdot P^{1}_{t-1} \qquad (11)$$

Faced with accumulated forced savings, the consumers make in the t period further decisions concerning their use. Part of them may be transformed into voluntary savings. The rest will be used first of all to finance postponed demand (DP^{j}) in the current period

$$FSP_{t-1} = \eta FSP_{t-1} + \varkappa FSP_{t-1} \qquad (12)$$

where

η - coefficient of neutralization of savings,

$\varkappa = 1 - \eta$ - coefficient of activation of accumulated forced savings, $\varkappa \in \langle 0,1 \rangle$.

It can be observed, that in many markets, postponed demand is negligible, or does not occur at all. The situation is especially common with food markets or other non-durable goods ($\gamma^{j} = 0$). As a consequence, total activated forced savings, with given prices unchanged, will not be absorbed in the whole by postponed demand. On the other hand, the likely price increases may reduce the value of accumulated savings. The remainder (BFSP) can be computed from:

$$BFSP_{t} = FSP_{t-1} - \sum_{1} \gamma^{1} \; FSP^{1}_{t-1} \cdot P^{1}_{t} / P^{1}_{t-1} \qquad (13)$$

It is natural to assume that the remainning fund /BFSP/ will be added to current personal income. Thus the effective demand, using linear form, can be written as

$$D^{j}_{t} = \beta^{j}_{o} + \beta^{j}_{1} Y_{t} + \beta^{j}_{2} BFSP_{t}(P_{t} - \beta_{3} P^{j}_{t}/P_{t} + \gamma^{j} FSP^{j}_{t-1}) P^{j}_{t-1} + \xi^{j}_{Nt} \qquad (14)$$

where:

ζ_N^j - random factor.

There are two additional components of effective demand: anticipated demand and transfer demand, already mentioned. The first one expresses consumers' reaction to expected changes in prices, or, if such changes are not present, to expected changes of disequilibrium. The second one is caused by shortages of particular goods and consists of demand flowing out towards other goods available on the market, prices of which are relatively higher (for more details see A. W e l f e (1986b)). If these constituents are ignored, specification errors in function (14) are likely to appear. The main consequence expected would be bias of the estimator of β_3 price-related parameter.

Let us consider the possibility of construction a function explaining final excess demand (DE). To achieve this purpose, we shall convert the definitional identity (7) into a formula relating the actual values of the ratio of demand and supply to those close to the point of equilibrium:

$$DE_t^j = S_t^j\left(\frac{D_t^j}{S_t^j}\left(\frac{D_o^j}{S_o^j}\right) + S_t^j\,\frac{DE_o^j}{S_o^j}\right) \text{ for } DE_t^j > 0 \qquad (15)$$

Should we accept, that in the period t = 0 the demand was satisfied, i.e. $DE_o^j \leqslant 0$, or that unsatisfied demand had "normal" value in the sense of J. K o r n a i (1982) (p. 21 and following), formula (15) would have the following form

$$DE_t^j = S_t^j\left(\frac{D_t^j}{S_t^j} - \frac{D_o^j}{S_o^j}\right) \qquad (16)$$

However, precise values of demand and supply remain unknown. Instead, observable, proxy variables ($\tilde{D}$, $\tilde{S}$) can be difined as being the principal determinants of demand and supply, respectively, or, at least, allowing to form natural limits of potential

values demand and supply. If demand is concerned, personal income may appear, or rather income increased by the total amount of savings, or alternatively, by the total amount of accumulated forces savings. The latter information can be found in other studies, or it can be derived from estimation of savings functions, which we shall deal with below, in Part 3. Market supplies of goods, or sales by socialized trade can be adapted as supply determinants. We propose to establish the value of "normal", unsatisfied demand at the minimum, historically observed level of $\tilde{D}_t/\tilde{S}_t$ ratio then we can write:

$$DE_t^j = \tilde{\alpha}_E \tilde{S}_t^j \left(\frac{\tilde{D}_t^j}{\tilde{S}_t^j} - \min \left\{ \frac{\tilde{D}_t^j}{\tilde{S}_t^j} \right\} \right) \qquad (17)$$

After substituting (14), and (17), in (8), we can estimate the parameters of the equations explaining the transacted quantities, and, at the same time, the parameters of the functions of demand and unsatisfied demand.

2.3. Personal Savings

Total personal saving (ΔGSP) consists of two components: voluntary saving (ΔVSP) resulting from a long - term propensity to save, and of forced saving (ΔFSP)

$$\Delta GSP_t = \Delta VSP + \Delta FSP \qquad (18)$$

To estimate forced savings, we have used a disequilibrium indicator built in accordance with formula (17), where personal income was used as total demand determinant, and total sales of goods and services as supply determinant.

Voluntary personal savings (VSP) contain two elements: savings in cash (OGDP), and savings located in savings banks and loan institutions (OBDP). The former are accumulated and kept as a necessary reserve that enables current purchases, and they constitute a fraction of current personal income (YBP)

$$OGDP_t = f(\overset{(+)}{YBP_t}) \tag{19}$$

Bank savings are accumulated mainly as a form of old age insurance, or in order to buy durables of luxuries. Their increase depends on personal income, and on the ratio of inflation rate (TPYZ) to savings interests rate (O%)

$$\Delta OBDP_t = f(\overset{(+)}{YBP_t}, \quad \overset{(-)}{TPYZ_t / O\%_t}) \tag{20}$$

The equation explaining total voluntary personal saving (ΔVSP) is given by

$$\Delta VSP_t = f(\overset{(+)}{YBP_t}, \quad \overset{(-)}{TPYZ_t/O\%_t}, \quad \overset{(+)}{\Delta YBP_t}) \tag{21}$$

2.4. Supply of Consumer Goods and Services

The volume of market supplies of commodities and of socialized trade stocks is treated exogenously in the WA-2 model. A conversion to current prices is done by means of identities, with use of appropriate deflators, described in the price block (endogenous in the model). Sales by socialized trade sector of the 5 groups of goods are described by equations

$$CHP_t^j = f(\overset{(+)}{SHP_t^j}, \quad \overset{(-)}{\Delta RP_t^j}) \tag{22}$$

where

CHP - sales by socialized trade,
SHP - market supplies of commodities,
RP - socialized trade stocks.

The value of household expenditures (CP) equals the sum of purchases in socialized trade, and from other sources (catering trade, private trade, etc.). The lack of sufficient statistical data is the reason why "transition" equations were used

$$CP_t^j = f(\overset{(+)}{CHP_t^j}) \qquad (23)$$

Foodstuffs are the only exeption, as for this group, purchases from non-socialized trade were modelled separately.

2.5. Prices

We have accepted the equations of producers' prices, using the input-output approach (see W. W e l f e (1981)), as the starting point. The equation has the form of an identity

$$P_j^T = P_{kt}^T A_{kt} + P_{mt}^T A_{mt} + d_t^T \qquad (24)$$

where

$P = [P_j]$ - n x 1 vector of prices,

$A = [a_{ijt}]$ - n x n matrix of material unit costs,

$d = [d_{ij}]$ - n x 1 vector of value added per unit of production.

Subscript, or superscript k denotes domestic output, m stands for import, and T is a transposition operator. However, a direct application of the above formula in practice is frequently difficult. For one thing, we lack detailed information concerning prices and material unit costs of particular products. For another, elements of full cost matrix are available for some years only, most often in current prices. For these reasons we used the reduced form of the above equation system, estimating the unknown coefficients. Of course, a transition to average price indices for appropriate groups of products, was necessary. The list of explanatory variables was reduced to prices of imported commodities and respective components of unit value added. In general we have then, using model symbols and writing the equation (24) for first differences (for more details see A. W e l f e (1985)).

$$P_{jt} = f(\Delta^{(+)} P_{mit}, \quad \Delta^{(+)}(FU_t / XNRL_t), \quad \Delta^{(+)}(AF_t / XNRL_t), \quad \Delta^{(+)}(A_t / XNRL_t)) \tag{25}$$

where

FU - wages bill in material production branches of the socialized sector of economy,

AF - financial accumulation,

A - depreciation,

XNRL - national product (agriculture and forestry excluded).

The above equation system relates prices to both fabrication costs and, through financial accumulation, to the market situation and financial and price policy of the goverment.

3. Properties of the Model in the Light of Simulation Experiments

The inflationary loop is of basic significance for the model WA-2, as it determines its properties to a large extent. Thus, our analysis shall be limited to an examination of the effects the impulse changes of the values of variables, that enter this feedback. In the first simulation we introduced the increase by 10% prices of all non-food commodities. The inflationary feedback, for one thing brough at the same period an increase of incomes from wages by over 7%, and for another, the perturbation introduced has been amplified - from 10% to over 12% for prices of non-food commodities.

Considering the results for next 7 periods we notice that the introduced impulse has a fading character. It is necessary to stress, that the tendency, that existed in Poland in 1970's and 1980's, to compensate price rises with an appropriate increase of average wages in socialized sectors of economy, brings a negligible drop of the real value of total personal incomes - by approx. 0.2 - 1.8% in subsequent periods. It allows to make the following point that the efficiency of the policy aimed at

regaining market equilibrium by means of price rises, depends on the possibility of imposing constraints on wages increases.

The next simulation illustrates the effects of the increase of average wages in socialized economy. The introduced impuls has been amplified from 10% to 12.5% in the first period as a result of the inflationary feedback that simultaneously caused a rise in prices of non-food commodities by about 4%. An analysis of rates of growth for subsequent years is very interesting. It shows, that during the second, third, and fourth periods of the simulation average wages, grow autonomously at an annual rate of aproximately 14%. Thus, they demonstrate a higher dynamics than in the first years the shock has been introduced.

Let as notice that the inflationary spiral, set in motion by an increase of wages, asures a constant growth of real personal incomes at an annual rate of approx. 3-5%.

An important conclusion can be drawn from the simulation experiments we have done. Wages-price mechanisms that have function in the Polish economy, do not assure a prompt automatic suppression of inflation. They contain such a strong pressure for wage increases, that a possible rise in prices is at least compensated, or even a growth of real wages takes place. Thus, regaining of market balance can be achieved only through an active government policy in relation to wages and price shaping. It is necessary to stress, that it is possible to achieve this goal (i.e. regaining of equilibria) with a simultaneous use of many instruments; the effects of such an action, however, are much more complex than those that could be observed in the simulations, carried with an assumption of ceteris paribus.

4. Forecasts of the Development of the Financial and Market Situation up to the Year 1990

The determination of exogenous variable values for the forecasting period is an important task; obviously it has to preserve the consistency of accepted assumptions. To achieve this purpose, we have used the results of simu-

lation analyses carried out on the basis of the W-5[4] model of national economy, as well as the forecast of the development of Polish economy (see W. W e l f e (1985a)). As a result, we have obtained a set of hypotheses that bears a character of "optimistic realism". The following additional assumption are its source.

These assumptions consider the improvement in the situation of foreign trade and better conditions for agriculture. They foresce the increment of the production rate of growth by 3-4% in 1986-1990 (i.e. 1 point less than the labour productivity rate of growth), restraining the decrease of employment in industry and construction; consistently, the increase in supplies to the market of foodstuffs by 3-4%, non-food commodities - by 4-5%. The rate of growth of non-consumer goods prices was assumed at the level of 12-13%.

As a result we obtained diminishing increment of the nominal personal incomes from 15,5% in 1986 to 12,5% in 1990, and wages in industrial sector from 14,6% to 11%. The rate of inflation decreases from 12,4% to 9%. The situation in the market is quite good. Excess demand is decreasing (in all commodity groups) starting from 1988, the most significant for textiles with clotning and footwear. Global balance is expected in turn of 1988/1989 (wide discussion in A. W e l f e (1986a)).

Appendix A

Characteristics of the WA-2 Model

Number of variables (lagged variables excluded)	160
endogenous	142
exogenous (dummy variables excluded)	18
Number of equations	142

[4] The model has been built in the Institute of Econometrics and Statistics, University of Łódź under scientific supervision of professor W. W e l f e (1985b).

stochastic 54
identities 88

Estimation of parameters is based on the 1960-1984 sample.
Year 1982 was used as a base for constant prices.
Endogenous variables are grouped in the following blocks.

A. "Personal incomes" 26
B. "Taxes" 1
C. "Credits" 3
D. "Consumer demand" 27
E. "Personal savings" 7
F. "Other consumer expenditures" 2
G. "Natural consumption" 2
H. "Supply of consumer goods and services" 39
I. "Prices" 35

In blocks D, H, I the following groups of commodities were distinguished: foodstuffs, alcoholic beverages, cigarettes and tobacco, textiles with clothing and footwear, durables, other non-durables, non-material services.

List of exogenous variables:

National income produced in sectors other than agriculture and forestry
Net output of food processing industry
Net output of agriculture
Labour productivity in the whole industry
Labour productivity in food processing industry
Employment in food processing industry
Employment in sectors other than food processing industry
Employment in non-productive sectors of the national economy
Market supplies of foodstuffs
Market supples of alcoholic beverages
Market supplies of non-food commodities
Supply of services
Stocks of inventories of foodstuffs in socialized trade
Stocks of inventories non-food commodities in socialized trade
Number of pensioneers

Price index of imported goods
Price index of non-consumer goods sold in retail trade
Financial accumulation in food processing industry

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Aleksander Welfe

MODELOWANIE RYNKU DÓBR KONSUMPCYJNYCH W WARUNKACH INFLACJI I NIERÓWNOWAGI

Głównym celem skonstruowanego modelu rynku dóbr konsumpcyjnych WA-2 jest wyjaśnienie procesów inflacyjnych oraz zjawiska powstawania popytu niezaspokojonego i oszczędności wymuszonych, które to wystąpiły ze szczególną siłą w drugiej połowie lat siedemdziesiątych i 5 lat osiemdziesiątych.

W tym celu zostało rozszerzone pojęcie efektywnego popytu konsumpcyjnego o dodatkowe poza popytem normalnym składniki: popyt antycypacyjny, popyt odroczony i popyt transferowy. Należało również skonstruować indykatory nierównowagi, które pozwoliły pokonać problem nieobserwowalności zmiennych.

Jednocześnie, zbudowane równania płac przeciętnych i cen dóbr konsumpcyjnych zapewniły endogenizację obydwu wielkości i ich wzajemne powiązanie w formie sprzężenia jednoczesnego (tzw. pętli inflacyjnej).

Model WA-2 umożliwił zatem analizę wpływu różnych polityk płacowo-cenowych na sytuację pieniężno-rynkową i to zarówno w kontekście historycznym, jak i prognoz średniookresowych.