It is a well-documented fact that policy making generally and in agricultural sector in particular is driven by political rather than economic considerations. The policy making process is described by modern economists as an interaction of various subjects like voters, politicians, interest groups in institutional contexts of decision. What is the role of pure positive economic analysis in this process? Economic analysis provides an insight that alters preferences of subjects participating in the policy making process. This insight helps to make "better" decisions, that is the decisions that do not have to be reversed afterwards. Positive policy analysis, therefore, remains an important factor in decision making, probably the most important one.

The general goal of this paper is to provide an overview of the methods used to model the impact of agricultural policies on agricultural sector. Two types of methods have been used extensively: mathematical programming and econometric models. Each of them is suitable for different problems. We compare the methods and state their pros and cons. Past applications of each methodology are provided to stress the differences.

The paper does not aim to be comprehensive review of the existing literature. Rather, its focus is restricted to the policies that are relevant for integration of the Central and East European Countries (CEEC) into the European Union (EU). Integration of the CEEC into the EU brings a series of policy changes both in the EU and the CEEC. Agricultural chapter is one of the most controversial parts of acquis. Therefore, a lot of policy changes is being adopted and expected to adopt in the future. These policy changes need to be evaluated and the best options to be selected by policy makers. Towards this end the impact of various policy decisions has to be considered. The policy paper has ambition to provide basic methodology to assess these changes. This methodology was absent or neglected in the past, which is reflected in the minimal quantity of scientific papers evaluating policy reform impact on the Slovak agriculture due to integration into the EU.

While there are general problems of modelling both in developed and emerging markets, building a model for transitional economy poses several additional challenges. In particular, the data problems are important. In econometric studies, the difficulty in transitional economy is to find a long enough series of consistent and comparable observations in a relatively small number of variables. In mathematical programming, the problem is to find a consistent set of input-output coefficients for farm model or regional model.

The second really pronounced problem of modelling the impacts of agricultural policy in transitional economies (and quite related to the first one) is a permanent structural change. Econometric response functions have obvious advantages: they can extract the maximum amount of information possible out statistical data, and the estimation procedure, too, provides the indicators of the statistical reliability of estimates. However, they also have a significant disadvantage. Since the estimates are valid only over the historically experienced range of variation, they may not be applicable to the analysis of proposed policy changes which involve the significant departure from historical trends. Mathematical programming methods usually can cope with these problems, while remaining less satisfactory than econometric methods with regard to fidelity to historical data and availability of objective measures of reliability for their forecasts (Norton and Schiefer, 1980).

The usual problem to assess the impact of some kind of policy on farm level, local level, national level or international level is to find a reliable methodology and then build the policy instruments into the model and calculate the effects. It has to be assumed that the policy body may be able to influence farm decisions by restricting their decision possibilities or by altering their relative profitability. The farms are otherwise free to make their own choices within the limits of economic and technological constraints. Usually the policy body is faced with the necessity of solving two problems. One is to forecast how farmers would react to various hypothetical policy actions and the other is to select the most appropriate combination of those possible actions. The forecasting problem is sometimes called the positive or descriptive problem and the policy problem is referred to as the normative or prescriptive problem. There are two main methods used to solve the forecasting problems. First one is mathematical programming methods and second is econometric method.
The use of mathematical programming for policy analysis

Specification of the model

To model agricultural policy, five issues need to be considered: (a) empirical specification, (b) economic behaviour, (c) dynamics, (d) policy specification and (e) validation and computation.

Empirical specification deals with selection of firms and data collection. In empirical work, the inclusion of every individual producer is impossible. To simplify this task, empirical studies have attempted to identify homogenous groups or producers. Each group is then treated as an individual producer or a representative farm for each homogenous group (or region) is chosen.

Behavioural specification tackles the issues of what market structure should be considered. On the production side, a perfect competition is most widely used. Some of the studies have considered monopolistic competition or just one monopolist in the market. Also, risk and the incorporated risk aversion are another behavioural feature which can be included in the model. On the other side of the market, the consumer preferences should be specified.

Third, the model might include the dynamic aspect. Most of the agricultural applications of these modelling techniques have covered annual crops, thus developing a one-year static equilibrium-type model. An alternative approach is to use recursive formulation of the problem (Andersen and Stryg, 1976).

After building the model, a policy analyst may implement a policy instrument into the model and then compute the effects. This can be relatively easy in a mathematical programming model. For instance, by incorporating new activities, new constraints, changes in right-hand-side values and factor supply or product demand schedules.

Validation of the model is the last part of the modelling process. The basic validation tests which have been used involve: (a) how well the model solution, when specified with base period data, corresponds to the real situation in that base period, (b) whether the model can feasibly produce the base period demand quantity, (d) the stability of the results with respect to the objectives.

Basic mathematical programming model

McCarl and Spreen (1980) describe a generic (basic) mathematical programming model that policy analysts often use in their work. This model implicitly assumes a sector made up of a large number of participants, each seeking to optimise some objective function. It means that the perfect competition is considered in both product and factor markets. Producers produce many homogenous products and compete for the same factors of production. Each producer has a finite set of production processes, with each representing a particular way of combining n-owned factors (\( y_{ik} \)) with m-purchased factors (\( x_{ik} \)) to obtain one unit of output.

Thus, the producer’s problem may be formulated:

\[
\begin{align*}
\text{Max} & \quad \Pi = \sum_{k=1}^{r} p_{k} q_{k} - \sum_{k=1}^{r} \sum_{i=1}^{m} c_{i} x_{ik} \\
\text{subject to:} & \quad x_{ik} + a_{ik} q_{k} = 0 \\
& \quad (i = 1, 2, ..., m; k = 1, 2, ..., r) \\
& \quad y_{k} + b_{k} k_{k} = 0 \\
& \quad (i = 1, 2, ..., n; k = 1, 2, ..., r) \\
& \quad \sum_{k=1}^{r} y_{k} = y_{j} \\
& \quad (i = 1, 2, ..., n; k = 1, 2, ..., r) \\
& \quad a_{k}, x_{k}, y_{k} \geq 0 \\
& \quad (i = 1, 2, ..., m; j = 1, 2, ..., n; k = 1, 2, ..., r)
\end{align*}
\]

where:

- \( q_{k} \) — the output level of the production process \( k \)th, \((k = 1, 2, ..., r)\)
- \( p_{k} \) — the price of the output \( k \)th, \((k = 1, 2, ..., r)\)
- \( x_{ik} \) — the use of the purchased factor \( i \)th in the production process \( k \)th, \((i = 1, 2, ..., m; k = 1, 2, ..., r)\)
- \( y_{ij} \) — the use of the owned factor \( j \)th in the production process \( k \)th, \((j = 1, 2, ..., n; k = 1, 2, ..., r)\)
- \( y_{j} \) — the quantity of the owned factor \( j \)th available to the producer, \((j = 1, 2, ..., n)\)
- \( a_{ik} \) — the quantity of the purchased factor \( i \)th required by one unit of the production process \( k \)th, \((i = 1, 2, ..., m; k = 1, 2, ..., r)\)
- \( b_{ik} \) — the quantity of the owned factor \( j \)th required by one unit of the production process \( k \)th, \((j = 1, 2, ..., n; k = 1, 2, ..., r)\)
- \( c_{i} \) — the market price per unit of the purchased factor \( i \)th, \((i = 1, 2, ..., m)\)

The values of all necessary parameters and prices given, the problem can be solved easily via linear programming. It will be more instructive, however, to formulate the Lagrangian (L) for this problem.

Mathematically, the conditions of this problem are as follows.

Kuhn-Tucker conditions provide the necessary and sufficient conditions for a constrained maximum at \( q_{k}^{*}, x_{k}^{*}, y_{k}^{*}, x_{ik}^{*}, a_{ik}^{*}, b_{ik}^{*} \). Mathematically, the conditions of this problem are as follows.

Outputs:

\[
\begin{align*}
\frac{\partial L}{\partial q_{k}} &= p_{k} - \sum_{i=1}^{m} \alpha_{ik} a_{ik} - \sum_{i=1}^{m} \alpha_{ik} b_{ik} \leq 0 \\
\frac{\partial L}{\partial q_{k}} &= 0 \\
q_{k}^{*} &\geq 0 \\
(k &= 1, 2, ..., r)
\end{align*}
\]
Purchased factor:

\[ \frac{\partial L}{\partial x_k} = -c_i + x_k^* \leq 0 \quad \text{for} \quad i = 1, 2, \ldots, m; k = 1, 2, \ldots, r \]

(6a)

\[ \frac{\partial L}{\partial x_k} x_k^* = 0 \quad \text{for} \quad i = 1, 2, \ldots, m; k = 1, 2, \ldots, r \]

(6b)

\[ x_k^* > 0 \quad \text{for} \quad i = 1, 2, \ldots, m; k = 1, 2, \ldots, r \]

(6c)

Owned factor:

\[ \frac{\partial L}{\partial y_k^*} = \sigma_k^0 - \mu_i^0 \leq 0 \quad \text{for} \quad j = 1, 2, \ldots, n; k = 1, 2, \ldots, r \]

(7a)

\[ \frac{\partial L}{\partial y_k^*} y_k^* = 0 \quad \text{for} \quad j = 1, 2, \ldots, n; k = 1, 2, \ldots, r \]

(7b)

\[ y_k^* \geq 0 \quad \text{for} \quad j = 1, 2, \ldots, n; k = 1, 2, \ldots, r \]

(7c)

If \( \sigma_k^0 \geq 0 \), then equation (5a) will hold with strict equality, so:

\[ \beta_k = \sum_{i=1}^{m} \alpha_k a_i + \sum_{j=1}^{n} \sigma_k b_j \quad \text{for} \quad k = 1, 2, \ldots, r \]

(9)

Then (9) says that the total return (price) on one unit produced under the production process \( k \) must be equal to the total imputed costs of one unit produced under the production process \( k \). This fairly technical explanation can be interpreted as the well-known marginal condition of profit maximisation: continue to supply a product up to the point where price equals marginal cost. Rewriting (8a) gives

\[ c_i = x_k^0 \quad \text{for} \quad i = 1, 2, \ldots, m \]

(10)

Thus, (10) is analogous to the familiar marginal condition: continue to apply a variable factor up to the point where its price equals the value of its marginal product. Rewriting (7a) gives

\[ \sigma_k^0 = \mu_i^0 \quad \text{for} \quad j = 1, 2, \ldots, n \]

(11)

(11) implicitly states that the marginal value of the owned factor \( j \)th used in process \( k \) must be less than or equal to the marginal value imputed to the owned factor \( /k \).

The above basic model serves to model the farm-level response to change various policy variables. Usually, a representative farm is selected and conclusions are drawn for the whole farming sector in the region or the state. This modelling technique is relatively simple and does not require plenty of data. It also provides useful information on a farm response to policy changes. In the classical or first generation aggregate mathematical programming models for agriculture, the specification was almost entirely oriented to the production side, the demand was simplified to fixed quantities or fixed prices and the representative farm-level data were used for the technological parameters. Usually, a profit maximisation or cost minimisation objective function was used. A representative example for this models is a model of Heady and Egbert (1964). They analysed the interregional competition and the optimum spatial allocation of crop production in the United States. Efficient production patterns are specified by a linear programming model restrained by regional land resources and national demands. The demand was specified as fixed national requirement for specific product. On the other hand, supply prices are endogenous. The objective of the model was cost minimisation. The policy implication is the determination of location and an amount of land which should be withdrawn from production if the nation is to arrive at a long-run solution to its mammoth surplus problem and to lessen the treasury costs of farm subsidies.

While the cost minimisation or the profit maximisation under fixed-price regime is appropriate at the farm or local levels, a complete representation of sector-wide or national behaviour must take into account price endogeneity (or downward sloping demand curves). Such a model of price endogenous optimisation model was applied by Weindlmaier and Tarditi (1976). In their model, the process of price determination and equalising the demand for and the supply of apples and pears among different European production and consumption areas is represented by a spatial price equilibrium model. The objective function was maximisation of the total European social revenue for apples and pears over all regions minus the sums of transportation costs and tariffs. The model incorporates linear price prediction functions for apples and pears in all the regions considered. To evaluate the overall effects of certain policies, they used a concept of economic surplus. The components of economic surplus are a producer’s income, government revenues, and a consumer’s gain. The main conclusions of policy implications are that withdrawals of apples and pears can be considered as a valuable instrument, if only used as temporary measure to stabilise markets. The second conclusion is that an extension of the EEC was advantageous to consumers in newly integrated countries and also led to substantially increasing incomes in the main production areas for apples and pears in Europe. Variations have been made on the basic specification of producers as profit maximizers. For example, Hazell (1971) has introduced the assumption that producers are risk-averse in the farm level model, and Hazell and Scandizzo (1974) have computed a market equilibrium when suppliers are confronted with risk.

Aggregation

An elementary extension of the above model comes from the fact that at an aggregate level the assumptions of exogenously determined prices for all factors and products are no longer tenable. In aggregate models, there is a relationship between prices and quantities. Prices and quantities are jointly determined in the model, i.e. they are both endogenous. Therefore, demand and supply relations should be included. This leads to an aggregate model wherein participants individually behave as small competitive units.
Suppose that the inverse demand relation of the output of the sector exists and is given by

\[ R_k = f(Q, \theta) \]  

(12)

where \( \theta \) is a vector of exogenous factor and \( Q \) is a vector with elements equaling each commodity's total sector output production.

Also, suppose that the inverse supply relation of purchased factors to the sector exists and is given by

\[ r_i = g_i(X, \Gamma) \]  

(13)

where \( \Gamma \) is a vector of exogenous factors and \( X \) is a vector of total sectoral use of purchased factors.

The production level of each activity should be determined by the first order conditions with which an individual producer will select his production level. Let \( Q_k \) be the level of output from the production process \( k \)th by the producer \( i \)th \( (k = 1, 2, ..., r; i = 1, 2, ..., \). Similarly, can be defined \( \lambda_{ik}, \alpha_k, b_k, c_i \). Using this definition, it follows that the sectoral use of the purchased factor \( i \)th and the sector supply of the output \( k \)th output are

\[ x_i = \sum_{k=1}^{r} \sum_{m=1}^{m} \lambda_{ik} \]  

(14)

\[ Q_k = \sum_{i=1}^{m} q_k \]  

(15)

\( (k = 1, 2, ..., r) \).

The aggregate conditions can be constructed from the above microconditions. If we consider the optimal level of output \( O^2 \), we can develop an aggregate equation relating the price analogously to (5a).

\[ f(Q^2, \theta) - \sigma_k^2 \leq 0 \]  

(16)

\( (k = 1, 2, ..., r) \)

where \( \sigma_k^2 \) is the dual variable from (15).

Similarly, an analogous condition of (10) where \( \lambda^2_k \) is the dual variable associated with (14), is

\[ g_i(X^2, \Gamma) \geq \lambda^2_i \]  

(17)

\( (i = 1, 2, ..., m) \).

Furthermore, an individual producer is a price taker equating the aggregate price with the price they receive (pay) when they produce an output (consume a factor). The price at which a producer is willing to sell the output is greater than or equal to the aggregate price and the producer's imputed value of a factor is less than or equal to its aggregate price. Thus, the conditions relating an aggregate and microprices need to be imposed:

\[ \sigma_k^2 \leq \rho_k \]  

(18)

\( (k = 1, 2, ..., r; i = 1, 2, ..., L) \)

Consider the following linear demand and supply curves

\[ P_k = G_k - H_k Q \]  

(20)

\( (k = 1, 2, ..., r) \)

\[ r_i = E_i + F_i X \]  

(21)

\( (i = 1, 2, ..., m) \)

Like Samuelson (1952), who converted the spatial price equilibrium model into linear programming by specifying it as objective maximisation of social pay-off function, it was followed by McCarl and Spreen (1980). The following optimisation model possesses the first-order conditions which are developed above, based upon the aggregation process

\[ Q, G - \frac{1}{2} Q H Q - X E - \frac{1}{2} X F X \]  

(22)

subject to (1)-(4) for all producers and to (14) and (15) for \( (k = 1, 2, ..., r; i = 1, 2, ..., m), (i = 1, 2, ..., L), (j = 1, 2, ..., n) \).

It can be verified by assuming that a commodity \( k \) is produced \( (Q_k > 0) \), then the dual variable from (14) equals the product price from the demand curve, and by further assuming that microunits produce \( (q_u > 0) \), then the equation of price and marginal cost follows as discussed above. Similar arguments could be made for factors. Thus, the formulation implies that microeconomic conditions for production by competitive firms are met.

The objective function no longer represents a producer's profit. Rather the net social benefit is maximised. The net social benefit is consumers' and producers' surpluses, which are diffident as the area between the demand and the supply curves to the left of their intersection (Samuelson, 1952).

In the derivation of the model, it is assumed that the sector is composed of many competitive microunits, none of which can individually influence output or factor prices. Each producer supplies according to the rule: equate the product price to the marginal cost of producing one more unit of that product. Similarly, each producer uses purchased factors according to the rule: equate the factor price to marginal value product.

The competitive behaviour simulating the properties of the model provides a potential powerful tool for policy makers. The model allows a policy analyst to specify the change designed to meet some government objective, and then observe a simulated sectoral response to the policy change.

Application of mathematical programming in policy analysis

Andersen and Stryg (1976) used the recursive programming model for forecasting the regional development in the Danish agricultural production and its structure. All important branches of production were introduced in the model and the development of farm structure was forecasted endogenously with the aid of separate structural activities that allowed a decrease or an increase in the number of farms within each group. The intuition to understand the recursive programming is that there is simulation of farmers' decisions over a sequence of time periods. The model for each sub-period was solved by maximising the objective function with regard to all constraints. The progressive solution to the model, from sub-period to sub-period through the whole
forecast period, was an automatic process as the subsequent
sub-period models were dynamically linked. The model solution of
sub-periods consequently make up the forecast of future
development of numbers of farms, labour use, size of production
and resource use in each individual farm group in each region.

Another type of models is based upon the identification of
representative farms. The aggregate programming consists
of the independent specification of and solution to many models
for particular farms, with a subsequent aggregation of solution
results. A similar model was designed by Thomson and
Buckwell (1979). They divided the population of farms into
relatively homogenous groups for each of which a separate LP
model was created and solved. The results were then
aggregated to the national level. Also, Davey and Weightman
(1971) developed a representative farm approach to estimate a
supply response in the British agriculture for alternative policy
assumptions (one alternative was for the full member of the
EEC, whilst the other assumed that Britain will be outside the
Community). The linear programming technique was used to
compute optimal, profit maximising programmes for a set
of representative farms and the individual farm results are raised
to obtain estimates of the aggregate supply.

Ray and Williams (1999) used representative farm
modelling for the purposes of analysing policy implication, such
as input subsidies and output price supports. The
representative farm results were not aggregated to analyse the
aggregate policy impact as in previous models but the objective
was to compare the impacts of policy on farms placed in
different locations. Similar strategy was used by Majewski et al.
(2000) to assess the impact of Agenda 2000 on farms in some of
the countries which are about to integrate into the EU as well as
for some member states.

All previous models included only one objective function.
Berbel (1989) used the multiple criteria decision making
(MCDM) methodology to model four reference farm types in
Spain. This methodology includes Multi-objective
programming, which is based on the notion of non-dominance.
A non-dominated solution is a point belonging to the feasible
domain which achieves the same or better performance than
any other solution, being better at least for one objective. The
objective is a measurable characteristic of the problem to which
the decision maker assigns a desirable direction of
improvement. The development of an effective set
(non-dominated or trade off curve) gives an important
knowledge of the structure of the conflicts between different
objectives. Once the trade-off curve has been generated, the
second step of the MCDM problem is to define a specific
solution or at least to reduce a size of the effective set into
a smaller one, which is known as compromise programming.

Berbel (1989) provides an application of this approach. He
analysed two behavioural aspects of the farms: first, the cropping
pattern when size varies and behaviour is constant, and second,
changes in the farm plan within a given type when behaviour
varies. The four different behavioural assumptions analysed are
income maximisation, risk minimisation, satisfaction and
compromise. The satisfying behaviour supposes that a
decision-maker is interested in achieving a compromise between the
three objectives: income, risk and leisure for small farms.

Wossink and Renkema (1994) used the micro modelling to
simulate changes in agriculture (MIMOSA) at farm and regional
levels, including a different scenario for the arable farming
region in The Netherlands. Their aim is to investigate and
model future changes in agriculture on the basis of a farm
economics approach. The effects are analysed for different
forms of technical innovation, agricultural price policy and
environmental regulations with respect to farm organisation,
farm income and the environmental quality of production. The
structure of model comprises three main parts: LP module,
continuation module and innovation adoption module. The LP
module assesses the optimal farm organisation, indicating
cropping pattern, cropping technique, regular and causal
labour, etc in response to changes in the external conditions.
The continuation module assesses potential numbers of
adopters of a new innovation used in the innovation adoption
module. The last module simulates the differences in adoption of
a new innovation by adopters.

Econometrics and policy analysis

The second method most widely used for forecasting policy
implication is econometric methodology. Generally, the
econometric methodology is used to solve two problems: a) to
understand and explain the past behaviour of supply or output
and b) to prove validity of economic theories (this is rather
difficult by the use of the mathematical programming method) and b) to
predict the impacts of policy changes on supply or output, i.e. to
estimate the price supply elasticity. Elasticity refers to a speed
and a magnitude of changes in the planned output in response
to anticipated output prices. This modelling may be considered
at different levels, depending on a type of resource use and on
the question a policy-maker is concerned with. It may be at the
aggregate level (country or multi-country level), or at the micro
level (commodity or farm levels).

For the purposes of policy implication analysis of the
agricultural supply, the critical point is estimating the price or
input supply elasticity. When they are estimated, it is relatively
easy to use them for policy analysis. Usually, elasticity of an
independent variable (such as price or input price) estimates
the change of a dependent variable (e.g. output) when the
independent variable changes. Or more definitely, when a
policy maker wants to see the effect of a proposed agricultural
price change, by calculating the price elasticity he or she can
gain an exact calculation of a response of output to every unit of
price change. Here, however, it is very crucial to keep all other
variables unchanged in order to be able to isolate the impact of
change in the desired independent variable on the dependent
variable. Also, an example from today’s real life can be given.
As Central and Eastern European Countries (CEEC) seek to
integrate into the EU, a lot of researchers and policy makers as
well are interested to estimate the effect of this integration on
the agricultural output. This is because the agricultural prices in
CEEC are lower than in the EU. And hence, an increase in
agricultural output due to a rise of prices up to the EU level is
expected. By estimating the price supply elasticity this impact
can be very easily calculated.

Generally speaking, it is observed in the literature (with some
development) that the short-run price elasticities are lower than
long-run ones. The short-run price elasticities usually range from
0 to 0.8 and long-run ones from 0.3 to 1.2 (Rao, 1989;
Peterson, 1979). Now the question is why do we observe this
difference? Peterson (1979) gave an intuitive explanation. He
argued that it is not unreasonable to believe that when prices are
high, most producers expect them to return to a more normal
level in the near future. Hence we would expect producers to be
reluctant to invest heavily in order to increase production for just
a short period. Similarly, when prices are unusually low, the
reasonable expectation will be a return to somewhat more
favourable prices in the near future. In this case we should not
expect producers to disinvest heavily in order to reduce the
output during what is expected to be a relatively short period.
Although some output response to these short-run price
fluctuations can be observed, the response should be small in
comparison to what we might expect to observe when there is
a change in a level of prices which will persist for a longer period.
This is since it becomes more profitable to invest or disinvest in
response to long-run price changes.

What about input price elasticity? The results of Krishna
(1982), and Gunawardana and Oczkowski (1992), among
others, indicate higher input or technology supply elasticities
than price supply elasticities. Therefore, Krishna (1967, 1982)
suggested that a balanced agricultural policy should stress
more a technology policy than price policy. It should also be
preferred in political grounds as food prices do not have to be
raised and on budgetary grounds only farmers use the input
benefit. However, Krishna favours output price supports, be
cause (a) farmers are more familiar and sensitive to them, and
(b) output price supports are more easily coupled with a
price stabilisation than input subsidies.

For estimation of the supply function and hence calculation
of the elasticities certain issues should be faced, such as
variable choice and functional specification. In literature, the
variable price used was a measure of relative prices: prices
paid relative to prices received; output prices relative to input
prices, crop price relatives at or at aggregate level the aggregate
price level relative to input price. A major source of differences
among studies has to do with specification of the supply
function. This includes two aspects. (a) First one is specification
of a function type. The most commonly used function is
Cobb-Douglas specification, which has advantage of constant
elasticity. (b) Second one is considering non-price factors
affecting production such as weather, infrastructure, past
economic environment, and technological change.

General considerations
All these elasticity calculations, however, are subject to Lucas
Critique (Lucas,1976). The central assumption of the theory
of economic policy, applied in the models, was that once the
estimated parameters (for example, price supply elasticities)
are known, they will remain stable under arbitrary changes in
the behaviour of the exogenous variable of policy changes. For
example, suppose a reliable model policy analysis is available,
and one wishes to use it to assess the consequences of
alternative price policy. According to the theory of economic
policy, one then simulates the system under alternative policies and
compares outcomes by some criterion. For such comparison to have any meaning, it is essential that the
structure of parameters do not vary systematically with a choice
of price policy. Or said in a different way, assuming the stability
of parameters under alternative policy rules means to assume
that agents' views on the behaviour of shocks towards the
system are invariant under changes in the true behaviour of
these shocks. Without this extreme assumptions, the kinds of
policy simulations called for by the theory of economic policy
are meaningless. So, if it is given that the structure of an
econometric model consists of optimal decision rules of
economic agents and that optimal decision rules vary
systematically with changes in the structure of series relevant
to a decision maker, it follows that any change in policy will
systematically alter the structure of econometric model.

Conclusions
Econometric response functions have obvious advantages:
they can extract the maximum amount of information out of
statistical data, and the estimation procedure also provides
indicators of the statistical reliability of the estimates. On the
other hand, they have significant disadvantages too. First, as
emphasised by Davey and Weightman (1971), Shumway and
Chang (1977) and Norton and Schiefer (1980), the estimates
are valid only over the historically experienced range of
variation, so they may not be applicable to the analysis of
proposed policy changes which involve a significant departure
from historical trends. Second, econometric models cannot
include inequality constraints such as seasonal land
constraints. Third, econometric models typically do not provide
much complementary information on the movement of
variables of interest. Mathematical programming methods
usually can cope with these problems, while remaining less
satisfactory than econometric methods with regard to fidelity
to historical data and availability of objective measures of
reliability for their forecasts (Norton and Schiefer, 1980). The
data problems of two main approaches to policy analysis are
quite different. In econometric studies, the difficulty is to find a
long enough series of consistent and comparable observations
in a relatively small number of variables. In mathematical
programming the problem is to find a consistent set of
input-output coefficients for farm model or regional model.

Súhrn

Kľúčové slová: analýza politik, ekonometrické metódy, matematické programovanie

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References
ANDERSEN, F. – STRYG, P. 1976. Inter-regional recursive LP mo-
BERBEL, J. 1989. Analysis of protected cropping: an application of
EKOLOGICKÉ SYSTÉMY HOSPODÁRENIA NA PÔDE A VÝROBA BIOPRODUKTOV

FARMING ECOLOGICAL SYSTEMS AND PRODUCTION OF BIOPRODUCTS

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The work analyses the problems of farming ecological systems that are gradually spreading in Slovakia. There are about 65 thousand ha soil involved in the ecological way of farming. Over 98 % of ecological products are exported to West European markets. Ecological agriculture is supported through the grant policy in Slovakia. Ecological technologies are used in an area of about 60 thousand ha. The development conception of ecological agriculture in Slovakia by 2010 supposes this area to be in a range of 100 – 150 thousand ha, which is 4 – 6 % of the total area of agricultural soil.

Key words: bioproducts, economical indexes, development trends

V súvislosti s využitím prírodných zdrojov poľnohospodárstva a s tvorobou ochranného životného prostredia má agrokomplex mnohostrannou funkciu. Ide o tzv. biopolitiku, t.j. vedecky fundované konanie spoločnosti, ktoré zabezpečí zdravý život v udržovanom a chránenom prírodnom prostredí. A práve agrokomplex by sa mal stať garanom riešenia veľkej časti úloh v oblasti životného prostredia.