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RURAL DEVELOPMENT POLICIES MODELLING: COMPUTABLE GENERAL EQUILIBRIUM APPROACH

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ABSTRACT

Although the CGE model is not a new tool in policy impact analysis, it has not yet gained wide popularity in regional applications, such as the analysis of rural economic problems. We have demonstrated in our paper that an inter-regional CGE model can be quite a useful tool for analysing the impacts of changes in global economic conditions and for assessing the inter-regional as well as the inter-sectoral implications of potential policy changes even if computational resources are limited and a full range of regional economic data required by a formal CGE analysis are not available. We have also asserted in our empirical analysis we found out that the rural economy of Latvia, which was used as an example for Central and Eastern European accession countries, has to expect the largest welfare gains from the integration into the EU if Latvia opens its markets gradually and not if the current policy setting is continued or if it conducts a completely liberal market policy.

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1. INTRODUCTION

The changes the rural economy and society experience today are wide ranging and complex. They stem to a large extent from changing socio-economic norms and values in a society as well as from the changes of the global economy, of the market policy and trade rules. These changes affect, however, not only sectoral markets, but local economies and rural areas in general (FERMAN 1999). At the same time rural economies have to meet rising environmental and recreational claims of the society, which fundamentally change both the structure and the level of goods and services demanded from rural economies (DRABENSTOTT and MEEKER 1999).

The European Structural Funds as one of the most important rural development policy planning tools in the EU currently undergo a fundamental re-organisation extending the assistance programs towards Central- and Eastern European countries (VANHOVE 1999). These reforms are deep-going and wide-reaching in their nature and influence the competitiveness of rural economies in Europe in several aspects. They will alter the sectoral structure and the activity levels in rural economies as well as the economic performance of these economies in general. In order to be able to consider these economy-wide impacts of a changing institutional framework in the future rural development planning, it is utmost important to assess these a-priori (JOHNSON and SCOTT 1997).

Although the ongoing reforms of the regional development policy in the EU play a significant role in changing the rules and conditions of rural economies, there is another obvious influence on the spatial dynamics of an economy, namely the decreasing importance of agriculture in rural economies. Almost all rural areas in Europe have experienced a decline in the importance of agriculture during the nineties so that only very few rural areas could now be defined as being dependent on agruculture. As a result, the economic structure of rural economies depends more and more on service activities (LOPEZ-BAZO et al. 1999). The role of rural areas has also been altered, particularly in northern Europe, by an increase in the demand for rural 'consumption' goods, for example for rural leisure goods and for rural tourism (EUROPEAN COMMISSION 1999).

A further cause for the rapidly changing relationships between actors, sectors and regions in a spatial economy are the changes in production technologies as well as the emergence of completely new production technologies. The Information

Technology (IT) branch, one of the most important example of the so called "New Economy" affect economic space and hence rural areas in various ways. The modern tele-commuting technologies e. g. increasingly separate places people live in and work in. This makes it for people more attractive to live rural and to work urban (DRABENSTOTT and MEEKER 1999). One consequence of these changes has been a blurring of the distinctions between rural and urban space and a concomitant change in the nature and the extent of interdependencies that exist between rural and urban areas. From an economic perspective these growing inter-regional interdependencies alter the degree to which income is generated, retained or leaked from a rural or urban economy and the extent to which regions are interdependent (PONS-NOVELL and VILADECANS-MARSAL 1999). The growing inter-regional interdependencies (people live in one region, earn money in another one and spend it in a third one), however, have severe consequences in the regions' socio-economic development and, therefore, have to be considered carefully in regional development planning which requires an *inter-regional* analysis approach (SCHINDLER, ISRAELEVICH, HEWINGS 1997).

The main goal of our study is to demonstrate a quantitative analysis tool for exploring the impacts of these changing global economic conditions of rural economies. Another objective of our study is to assess alternative rural development planning options and to compare them within the framework of the European Structural Funds in selected applicant countries. While there is little doubt among economists about the increasing importance of these Funds in Europe's regional economic development, only few of the studies carried out so far have used an *inter-regional* and *inter-sectoral* framework to analyse policy impacts to rural and to urban regions as well as to various sectors of an economy explicitly[1] (AZIS 1997a). Using the example of Latvia our study makes a contribution to close this research gap in understanding and predicting the causal structure of the fundamental changes regional economies experience today in Europe as well as to assess the impacts of potential changes in European regional policy setting within a framework of an inter-regional general equilibrium.

[1] Some of the few successful attempts to build a computable general equilibrium model for a regional economy are that of KILKENNY (1993), AZIS (1997b) and ANDO and TAKANORI (1997) who managed to built a regional CGE model even for a developing economy - China .

2. METHODS OF REGIONAL ECONOMIC ANALYSIS

Regional economic analysis has been dominated strongly by a model orientation in the past decades (NIJKAMP et al. 1986). Despite a wide variety in the pursued goals, the covered scope and the applied techniques there are some common classes within regional economic models which gain more popularity than the others. Above all, multiplier models (economic base, income-expenditure), commodity flow models (input-output) and models based on activity analysis (linear and non-linear programming) have been applied most commonly in regional analysis in the last decades (MIDMORE and HARRISON-MAYFIELD 1996, ISARD et al. 1998). Taking into account the spatial character of our study, the inter-sectoral and inter-regional interdependencies of economic agents as well as the policy instruments studied we concentrate our attention only to regional economic models being able to consider them.

One approach that models both price and volume changes simultaneously is the Computable General Equilibrium (CGE) model (TAKAYAMA and JUDGE 1976). As the name suggests, CGE models are based on the idea of market clearing (*equilibrium*) and they include the simultaneous study of all markets in an economy (*general*). Like other mathematical models, Computable General Equilibrium models express behavioural relationships among the various sectors and markets of an economy as a set of mathematical equations, which can be solved applying appropriate hard- and software (*computable*)[2] (SCARF and SHOVEN 1984). The fundamental characteristics of a general equilibrium analysis are, therefore, the identification of interdependencies among the goods, factors, assets and markets of an economy as well as of behavioural variables of economic agents, and of market clearing (equilibrium) conditions (GUNNING and KEYZER 1995).

The CGE model is a generalisation of the input-output model in it's origin. However, being based on the same Input-Output table and the same general equilibrium perspectives as the Input-Output model, the CGE model makes considerably fewer limiting assumptions describing economic relationships (KOH, SCHREINER and SHIN

[2] Much of the research associated with CGE models has involved the development of highly sophisticated algorithms suitable for the solution of the necessarily complex models used to represent the interdependencies between markets. CGE models vary today from a closed single region to comprehensive open multi-regional models, from relatively simple forms with only few equations to models as comprehensive as regional social accounting matrix, from linear to non-linear using neo-classical consumption and production functions (SCARF and SHOVEN 1984).

1993). Moreover, in contrast to Input-Output models, CGE models are built on fundamental microeconomic principles and include non-linear feedback mechanisms. This allows to analyse all markets simultaneously and to model complex inter-sectoral and inter-regional interdependencies unrestricted by the constraint of linearity, or by problems involved of modelling different markets separately from each other (SHOVEN and WHALLEY 1992). The CGE model describes various interrelated markets and examines the complex market based interactions between the various sectors and actors incorporating fundamental general equilibrium links between production structures, incomes from various kinds of institutions, and the pattern of demand (consumption). Since it endogenises prices as well as relationships in quantities of demand and supply[3], a mutual determination of market outcomes (prices and quantities) in many interrelated markets or sectors of a region is explicitly emphasised (BANDARA 1991).

Unfortunately for regional development planners, the majority of CGE models that have been built until today have been applied solely at a national scale (TREYZ 1993). There are several reasons explaining this general neglecting of regional details in CGE applications. One reason surely is that regional CGE models require a sample with more data than other comparable modelling approaches. They require numerous parameters, including supply, demand, and substitution elasticities for each sector and each region (MANSUR and WHALLEY 1984). In order to construct a CGE model for a regional economy one needs information about commodity and factor prices, the quantities of traded and non-traded goods and services, the availability of factors of production, behavioural parameters for regional consumption and saving functions, the tax structure, exports and imports, capital flows and factor mobility, which are often not available at a regional level (MANSUR and WHALLEY 1984). Another reason explaining the relative unpopularity of CGE models for regional applications is that the CGE framework is often too expensive and unwieldy applied to small regional economies with only marginal changes in economic structure (ANSELIN 1990). In order to compensate this drawback of a higher complexity, CGE models frequently involve only a limited number of regions and highly aggregated

[3] The production functions are used to represent production links that exist between the various industries or sectors of a region and to indicate the possibility of factor substitution, economies of scale, and productivity increases. Similarly, consumption functions are used to allow the substitution among the goods.

sectors of production[4] Most often they are applied to policy analysis which deal with more macro-oriented questions such as potential changes in prices, wages, and interest rates, because they require less sector specific information (SPENCER 1988). Our study is a stuck in the middle combining theoretical consistency and microeconomic foundation with the application of a general equilibrium on regional economic issues.

3. DATA BASE - AN INTER-REGIONAL SAM

A social accounting matrix gives a complete, consistent and comprehensive picture of how all the various actors in an economy interact at a certain point of time. Like an input-output table, each account in the matrix is represented by both a row and a column where a single entry in the matrix, r_{ij}, represents an expenditure item of account *j* and an income receipt of account *i*. However, whilst an input-output table only includes detailed information on interactions within the production sphere of the economy, a Social Accounting Matrix (SAM) extends the focus to the full circular flow of income around the economy - typically including, in addition to the production accounts, factor, household, government, capital and 'rest of the world' accounts (PYATT and ROUND 1985). Thus the usefulness of such a database can be threefold: (1) as a means of reconciling different but overlapping sources of data within a consistent framework (HEWINGS and MADEN 1995), (2) as a descriptive mechanism for imparting information on the structure of an economy and the relative importance of interactions that take place (PYATT and ROUND 1985), and (3) as a means of parameterising economic models (MANSUR and WHALLEY 1984). The third one will be the driving force for building an inter-regional SAM for Latvia.

Whilst the construction of national SAMs has become a common place, examples of interregional SAMs, especially for transition economies, are still relatively few. ROUND (1985, 1988) as a pioneer among these few examples using a regional SAM of Malaysia illustrated that the design of an inter-regional SAM could be such that the additional data required to capture inter-regional flows is minimal. Following his example we develop an inter-regional SAM for Latvia focusing on inter-regional

[4] CGE models tend to deal with highly aggregated industrial sectors and thus are not really suitable for individual sector analysis. Instead they are mostly associated with efficiency questions and neo-classical welfare analysis. Their size and complexity means that they have huge and detailed data requirements and thus are expensive to maintain and keep up-to-date which further reduces their flexibility (DERVIS et al. 1982).

dependencies. Figure 1 indicates in a schematic form the structure of an inter-regional SAM, designed to focus on rural-urban interdependencies.

Figure 1 shows each region as having its own set of 'domestic' accounts. In the off-diagonal sub-matrices of the SAM, flows between the regions are recorded, whilst the final row and column of the matrix records incomes from and expenditures to the region from the combined exogenous accounts. The design of our SAM distinguishes between transactions within a region which are functional transactions, taking place between different types of accounts, and geographical transactions between regions which are simply transfers, augmenting the account in one region whilst simultaneously depleting the same account in the other. It is important to note with regard to the subsequent closure of the model that the off-diagonal sub-matrices are block diagonal in structure, and that this diagonality is maintained, regardless of the degree of dis-aggregation of accounts in the SAM.

Figure 1: General structure of an inter-regional SAM

The construction of the inter-regional SAM for Latvia was carried out in three stages. First, a SAM was built for whole Latvia. The principal sources of data used during this stage of the construction process were the 'use', 'make' and 'import' matrices from the 1998 Latvian input-output tables, data from the Industrial and Agricultural Census, regional-level data from the annual Census of Employment, regional household composition data from the 1998 population Census and finally household expenditure patterns and income sources from the HOUSEHOLD EXPENDITURE SURVEY (HES). Data from each of these sources, supplemented by additional information when considered more accurate, were integrated to form an estimated SAM for the region consisting of 4 production activities, 4 corresponding commodities, three factors of production, one aggregate household, one government, and one aggregate exogenous account.

The Latvia SAM was split subsequently into two sub-regions representing rural and urban Latvia, respectively. The definition of rural and urban sub-regions in Latvia was driven more by pragmatic than conceptual criteria. Defining rural Latvia as being the whole of the region other than the city of Riga district allowed the relatively straightforward use of statistics collected on a district-level basis, thus mitigating the need for extensive primary survey work. Information of differing employment structures (from the CENSUS OF EMPLOYMENT) was used to split various industry sub-matrices of the regional SAM, while maintaining the overall control totals for Latvia as a whole (COMER and JACKSON 1997).

The final stage of the construction process was the estimation of flows between the sub-regions for which little data or no data were available. For this reason the information of a survey on trading pattern between firms in Latvia which was carried out in 1997 was used. In conjunction with the knowledge about the relative importance of different production sectors in rural and urban Latvia, estimates were made of the flows of commodities between the sub-regions. Implicit within these calculations was the assumption that output levels from sectors in each sub-region were proportional to employment levels. Moreover, no attempt was made to reflect possible differences in technologies and input demand between rural and urban firms within a sector. These are both areas in which future survey work could improve substantially the accuracy of information in the SAM and hence reliability of model result (KILKENNY 1995). The final matrix is shown in aggregate form in **Figure 2.**

Figure 2: Aggregated rural-urban SAM for Latvia, 1998 (Mio Ls)

Figure 2 indicates not only the relative importance of the rural and urban sub-regions of Latvia, but also the significance of different types of flows within and between the areas in the base year of the SAM 1998. Rural Latvian firms are shown to have produced 4 958 Mio Ls output in the base year, urban firms 7 199 Mio Ls. Though rural areas reside two thirds of Latvia's population, only 41 per cent of the total Latvian output is of rural origin. 59 per cent of the countries output is produced by only one third of Latvia's inhabitants - the urban ones.

4. RURAL DEVELOPMENT POLICIES SCENARIOS

The primary purpose of the next two chapters is to demonstrate applicability of an inter-regional general equilibrium model in a practical policy analysis. The full algebraic structure of the model is described in KANCS 2000. In order to provide our study with an empirical example we employ the model for evaluating the impacts of changes in rural development policy in the context of enlargement of the European Union (EU).

Policy scenarios formulation within a model consists of several steps, most important of which are formulation of descriptive form policy measures into a mathematical one; implementing these into functions representing producer/consumer behaviour; and calibrating the model. The first step - transformation of an information describing SAPARD funds utilisation into an algebraic consideration's form of policy instruments is presented in the equations 1 to 4, where PS describes farm gate price (price supply) and S the amount of producer subsidies. We selected out four the most important ones of a pool of SAPARD policy measures for simulating these in the model. These contain following policy instruments: measures for facilitating technical progress within the agriculture, improvement of food product processing and marketing, supporting non-traditional economic activities, and investments into the public infrastructure. Whilst, the first three are sectoral specific policy instruments, represents the fourth measure potentially an equal utilisation of it for all economic agents within a region[5].

(1) $$\Pi(\mathrm{PS}) = \sum_{agr} \beta_{agr}^{S} \mathrm{PS}_{\mathrm{agr}} + \frac{1}{2} \frac{\sum_{agr} \sum_{j} \gamma_{agrj}^{S} \mathrm{PS}_{\mathrm{agr}} \mathrm{PS}_{\mathrm{j}}}{\sum_{agr} \alpha_{agr}^{S} \mathrm{PS}_{\mathrm{agr}}} + \sum_{agr} \tau_{agr}^{S} PS_{agr} t + \tau t$$

(2) $$\Pi(PS,S) = \sum_{fpr} \beta_{fpr}^{S} \left(PS_{fpr} + S_{fpr}\right) + \frac{1}{2} \frac{\sum_{fpr} \sum_{j} \gamma_{fprj}^{S} \left(PS_{fpr} + S_{fpr}\right)\left(PS_{j} + S_{j}\right)}{\sum_{fpr} \alpha_{fpr}^{S} \left(PS_{fpr} + S_{fpr}\right)}$$

(3) $$\Pi(PS,S) = \sum_{srv} \beta_{srv}^{S} \left(PS_{srv} + S_{srv}\right) + \frac{1}{2} \frac{\sum_{srv} \sum_{j} \gamma_{srvj}^{S} \left(PS_{srv} + S_{srv}\right)\left(PS_{j} + S_{j}\right)}{\sum_{srv} \alpha_{srv}^{S} \left(PS_{srv} + S_{srv}\right)}$$

(4) $$\Pi(PS,C) = C\left(\sum_{i} \beta_{i}^{S} \mathrm{PS}_{\mathrm{i}} + \frac{1}{2} \frac{\sum_{i} \sum_{j} \gamma_{ij}^{S} \mathrm{PS}_{\mathrm{i}} \mathrm{PS}_{\mathrm{j}}}{\sum_{i} \alpha_{i}^{S} \mathrm{PS}_{\mathrm{i}}}\right) + d_{cc} C^{2} \sum_{i} \phi_{i}^{S} PS_{i}$$

Source: OWN CALCULATIONS

In a second step we condense all these policy measures into a one profit function. This means we just forward straight single measures into this generalised form of a profit function. The only difference in algebraic notation between a single policy instrument analysis and scenario analysis is in the notation form of producer subsidies. The full mathematical structure of the model and policy scenarios is provided in KANCS 2000. A general structure of a profit function representing the SAPARD funds within a model is presented in the equation 5.

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[5] We introduce alias for identification of production sectors within a model.

(5)
$$\Pi(PS,C)=C\left(\sum_i \beta_i^S \mathrm{PS}_i+\frac{1}{2}\frac{\sum_i\sum_j \gamma_{ij}^S(\mathrm{PS}_i+S_i)(\mathrm{PS}_j+S_j)}{\sum_i \alpha_i^S(\mathrm{PS}_i+S_i)}\right)$$
$$\ldots\ldots\ldots\ldots\ldots\ldots+d_{cc}C^2\sum_i \phi_i^S(PS_i+S_i)+\sum_i \tau_i^S(PS_i+S_i)t+\tau t$$

Furthermore, we develop also two "alternative" policy scenarios - the base run with no changes in the current policy setting and market liberalisation instead of integration, in order to provide an reference for assessing of SAPARD Funds. A scenario of integration into the EU under full application of the EU market regulations is compared to a base run scenario of unchanged continuation of the current rural development policies. In addition, a scenario of complete liberalisation of regional and agricultural policies is a second point of reference with which the EU accession scenario is contrasted (Figure 3).

Figure 3: Alternative rural development policies scenarios for Latvia

Base run: unchanged current policies (BR). The base run serves as a reference assuming that the national rural development and agricultural policies observed for the base year 1998 do not change until 2007. The nominal rates of market protection are defined as the policy induced percentage gaps between output and border prices. These rates are assumed to be those observed for 1998. The changes in border prices between 1998 and 2007 are exogenous and are based on the world market price projections of the OECD (2000). Any other support like direct subsidies, input subsidies and general subsidies are kept at their 1998 levels per unit of output. Assumptions on autonomous technical progress are derived from the European Commission's report (1999). The annual growth rates of technical progress are mainly in the range of 1 to 3 per cent. Retail margins in absolute real values per quantity unit are kept at their base year levels.

Liberalisation scenario: dismantling of market protection (LS). A scenario in which any market protection is dismantled serves as a second point of reference with which the EU accession scenario is compared. In this scenario border protection is completely abolished, i.e. the nominal rates of protection are set to zero value. Also any other regional market support, such as producer subsidies, is cut. This leads to a change in the ratios between the producer output prices for the different commodities. The assumptions on technical progress, retail margins, and population growth of the BR are maintained in the LS.

5. ASSESSING ALTERNATIVE POLICIES SCENARIOS

Though, impacts of policy changes can be evaluated using many criteria in a regional CGE model (SCHINDLER et al. 1997), we apply only three of them in our empirical example, the Gross Regional Product (GRP), the price level in the region and the household income measuring the regional household welfare.

5.1 GROSS REGIONAL PRODUCT

One of the most comprehensive measures of impacts of policy changes provides the Gross Regional Product (GRP) in CGE models. GRP accounts for the quantity of primary factor inputs used and the compensation to each input employed in the production process. It also includes the indirect business tax paid by the industry, the total compensation for labour by the industry including payroll taxes and employee benefits, and gross returns to capital (including profits) before depreciation.

GRP can be accounted in several ways, e.g. the quantity of goods and services produced in a region valued at market prices or income generated within a region. The main destination of regional income are enterprises. The source of enterprise income *(YE)* is gross capital rents:

(6) $YE = PCR \bullet QSCE,$

where *PCR* is capital rent and *QSCE* is the initial stock of enterprise capital.

Enterprise income *(YE)* is redistributed to regional households, the government[6] and the capital account. Because our regional CGE model is only used in a comparative static analysis to marginal changes in the system, enterprise income is distributed to the three entities (regional households, governments and capital account) in fixed shares[7].

The assumed distribution is:

(7a) $YEH = h\ YE,$

(7b) $YEG = g\ YE,$

(7c) $YEC = c\ YE,$

where h, g, and c are shares of gross enterprise income distributed to households, government and capital account.

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[6] The government receives revenues from enterprises in form of corporate income taxation.

[7] While this distribution of income may be realistic to some extent for households and the government, it is fairly unrealistic for the depreciation of capital which is generally based on capital stock rather than capital income.

The model results show that in most of the scenarios the changes in regional welfare, which are measured by GRP, is surprisingly small in the rural economy and at the same time considerably high in the urban region (Figure 4). In all three scenarios the growth rates of the rural economy differ only slightly. The most moderate growth rate is to be expected in the case of market liberalisation, where the annual growth rate was calculated 0.71 per cent. An explanation of this phenomenon provides neo-classical trade theory It tells us that the reduction of a region's market protection will decrease the competitiveness of the regional producers in the short run. In the long run, however, the picture would be quite different. The two model scenarios, the base run and the market liberalisation scenario, show almost equal growth rates for Latvia's rural economy in the first ten years. Rural GDP will grow most rapidly in the case of the EU integration scenario with the GRP growing at about 1.9 percent per year (Figure 4).

Figure 4: Gross regional product of rural and urban Latvia (GRP), Mio Ls

However, these results should be treated with caution. One serious drawback of a GRP as a regional welfare measure is that GRP counts only payments to resources employed in the region irrespective of where resource owners reside. Factor payments flow to resource owners that are located within the region and outside the region. That is the reason why the GRP is not able to measure changes in the welfare of households which reside within the considered region.

5.2 HOUSEHOLD INCOME

Household income is one of the most widely used measure of household welfare[8]. Most of the household income stems from factor (especially labour) payments. Since gross factor payments are subject to government taxes and capital depreciation, the total household earnings are reduced by the applicable deductions that are available for the distribution to the households which own the factors used for the production of goods. Other sources of household income include inter-household transfers, government transfers, and net remittances from outside the region.

We obtain gross household income *(YH)* adding up all these sources of income:

(8) $YH = YLN + PC\ QSCH + YTN + YHE + YHG + YHO,$

[8] Utility measures for individuals and households are the result of preferences expressed through markets. Moving from one market result to another market result presumes a welfare change for households in most, if not all, regions. To measure this change from a policy or program change, welfare must be measurable. Because utility is not directly measurable, alternative measures must be chosen.

where *YLN* is the net labour income, *PC* is the capital rent, *QSCH* is the capital stock owned by households, *YTN* is the net land income, *YHE* is the household enterprise income, *YHG* are the government transfers to households, and *YHO* are the net transfers and remittances to households from outside the region. In contrast to the factor payments the two latter sources mentioned do not depend on regional resource ownership and factor prices - they are exogenous in our model.

Disposable (net) household income *(YHN)* is given by:

(9) $YHN = YH(1 - th)$,

where *th* is the household income tax rate.

Household savings *(SAVH)* is:

(10) $SAVH = mps \cdot INCH$,

where *mps* is the savings rate.

Since our model allows for inter-regional mobility of labour and capital, adjustments need to be made in factor compensations to households to assure that the ownership of resources by households does not change through resource mobility.[9]

Rural household labour income changes with labour migration, labour income *(YL)* for the benchmark (initial) regional households is given by the following equation:

(11) $YL = PL \cdot (QDLE + QDLO) + PLO \cdot (\sqrt{DSL^2} - DSL) \cdot 0.5 - PLR \cdot (\sqrt{DSL^2} - DSL) \cdot 0.5$

where the first term on the right-hand-side is the regional gross labour compensation, the second term identifies out-migration and the compensation received when out-migrating, and the third term identifies in-migration and the compensation received by immigrants.

Household income from capital depends, above all, on household capital ownership and capital rents. Under the assumption of capital mobility, capital resources owned by the regional households are used in-region or out-of-region depending on the proportion of capital out-migration to the initial capital stock. The proportion of capital migration to capital stock is[10]:

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[9] This is one of the major differences between inter-regional and national-scope CGE models. While national models do not need to account explicitly the mobility of resources within the national boundaries to hold original resource ownership constant by household group, regional models, where households own labour, capital and land and receive transfers (inter-household, governments and from outside-the-region) need to make resource adjustments with labour mobility in order to assure that changes in regional gross household income accounting are not the result of unintended changes in the household resource ownership.

[10] We assume for simplicity the same proportion of out-migration of capital applies equally to households and enterprises.

$$(12)\ aDSC = \frac{(\sqrt{DSC^2} - DSC) \cdot 0.5}{\sum_i SQC0_i}$$

Capital compensation to households remaining within the region is given by the following equation:

(13) $YHCR = (1 - a\,DSL)\,(1 - a\,DSC)\,YHC + PCO\;a\,DSL\;QSCH,$

While the first term on the right-hand-side adjusts capital compensation to households *(YHC)* for out-migration of labour *(1 – a DSL)* and out-migration of capital *(1- a DSC),* the second term adds back in the compensation for out-migration of capital but at a higher capital rent because *PCO > PCR.* Compensation for capital in-migration adds to gross regional product (GRP) but is assumed to flow out-of-region as well, because capital ownership resides also out-of-region.

Household income from land depends on land ownership and land rent. All net land income accrues to households in our model:

(14) $YHTN = (1 - tt)\,YT.$

Since a part of labour is migrating out-of-region, a proportion of *YHTN* flows out of region. The proportion of *YHTN* remaining in-region is then:

(15) $YHTNR = (1 - a\,DSL)\,YHTN,$

where the argument is the same as for capital income.

Enterprise income, government transfers and remittances from outside the region accruing to the initial regional households remaining in-region under conditions of labour out-migration is given as:

(16) $YHIR = (1 - a\,DSL)\,(YHE + YHG + YHO).$

Our model results of the rural household income are very similar to those of the GRP. The total impact on consumer welfare, which is measured by the household income, is relatively small (figure 5). In the liberalisation scenario (LS) the rural household income will grow at a yearly rate of 1.6 per cent between 1998 and 2007. A little bit more favourable to rural inhabitants seem to be the base run (BR) and the EU integration (EU) scenarios, where the average growth rate of household income will be about 2 per cent yearly. Negative impacts of the Common Agricultural Policy (CAP) on consumer welfare resulting from price increase for processed food are obviously balanced out by price cuts for agricultural, manufactured and non-tradable goods and services.

Figure 5: Rural and urban household income in Latvia, Mio Ls

However, also these results should be interpreted cautiously. Since, for example, in our model resource ownership and transfer income are held constant by the household with emphasis on changes in unit values of resources and regional mobility of resources (labour and capital), the regional welfare measure of household income does not reflect changes in resource ownership caused e.g. by policy changes.

5.3 REGIONAL PRICE LEVEL

The overall regional price level may be calculated in two alternative ways, either as a weighted index of the composite commodity prices or as regional output prices. We calculated several prices in our model in order to be able to compare the general price level in a region with the outside-the-region price level: the net output price, the commodity output price and the commodity purchase price.

The net output price in our model is the regional output price minus the unit cost of intermediate inputs and the indirect business tax:

$$(17)\ PN_i = PS_i - \sum_j a_{ji} \cdot PD_j - tib_i \cdot PS_i,$$

where *PNi* is commodity i's net price, *PSi* is the composite regional output price, a_{ji} is the amount of the j^{th} commodity per unit output of the t^{th} commodity, *PDj* is the composite purchase price of the j^{th} commodity, and *ibt*; is the indirect business tax per unit value of output. The net output price is the per unit value of output available to compensate for primary factor use. Moreover, the zero profit condition tells us that -assuming constant returns to scale in production - the sum of the marginal value products for all primary factor use equals exactly the commodity net price.

Commodity purchase prices are a composite of regional and import prices:

$$(18)\ PD_i = \frac{PSR_i \cdot QSR_i + PDM0_i \cdot QDM_i}{QSR_i + QDM_i}$$

The composite purchase price *(Pi)* is the unit value for household consumption goods, intermediate inputs, and institutional purchases, where *PDRi* is the regional purchase price and *PDMi* is the import price, *QSRi* is the total amount of commodity regionally produced and consumed and *QDMi* is the total amount of commodity imported.

Commodity output prices are a composite of regional and export prices:

$$(19)\ PS_i = \frac{PSR_i \cdot QSR_i + PSX0_i \cdot QSX_i}{QSR_i + QSX_i}.$$

The composite output price is the weighted unit value of revenue received from regional and export sales.

Since composite commodity prices are endogenous in our inter-regional CGE model, being calculated as a weighted average of the regional and import prices, price growth in the monetary variables for the rural economy may be caused by both quantity changes and/or price changes. The extent to which these changes take actually place is determined by the elasticity of substitution between the goods and services.

Figure 6: Output prices in rural region %

The figure above (figure 6) shows producer prices relative to the base year of 1998 and of the different scenarios for the year 2007. With unchanged agricultural and rural development policies as assumed for the base run (BR) output prices develop between 1998 and 2007 more favourably for the food processing industry, whereas they even decrease for agricultural, manufactures and non-tradable products. Since in the BR nominal protection rates are assumed to stay at their 1998 levels, the regional output prices change between 1998 and 2007 with the same rate as the world market prices. The increase of the producer price for non-tradable goods in the EU scenario obviously stems from the financial support of the European Structural Funds to support rural industries such as rural tourism.

6. CONCLUSION

Although the CGE model is not a new tool in policy impact analysis, it has not yet gained wide popularity in regional applications, such as the analysis of rural economic problems. We have demonstrated in our paper that an inter-regional CGE model can be quite a useful tool for analysing the impacts of changes in global economic conditions and for assessing the inter-regional as well as the inter-sectoral implications of potential policy changes even if computational resources are limited and a full range of regional economic data required by a formal CGE analysis are not available. We have also asserted in our study that a regional CGE model is an impact model permitting analysis of interdependent effects across various parts of an economy rather than a device for statistic testing of economic variables.

In our empirical analysis we found out that the rural economy of Latvia, which was used as an example for Central and Eastern European accession countries, has to expect the largest welfare gains from the integration into the EU if Latvia opens its markets gradually and not if the current policy setting is continued or if it conducts a completely liberal market policy. This argument is supported by the fact that the market protection in the EU is currently relatively high in comparison to Central and Eastern European countries. Since especially agricultural markets are highly protected in the EU, above all rural regions will gain from the integration to the EU. Moreover, since many of the rural regions in the CEE will be eligible for the financial aid foreseen within the EU Structural Funds these rural communities will be strengthened financially as well.

Although we have been able to consider several important features of a rural economy in our inter-regional CGE model, it would be necessary to concentrate further modelling activities in specifying other complex relationships and externalities which rural economies are facing today. Above all, market imperfections, transportation costs, as well as a dynamic rather than a static treatment of an economy should be considered by modellers. If all this is ensured rural development planners will have a very helpful and highly reliable planning tool for the ex-post as well as for the ex-ante evaluation of regional and, especially, of rural development policies.

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Figure 1: General structure of an inter-regional SAM

	Rural					Urban					Total
Rural	Sect.	Exp.	Fact.	Inst.	Cap.	Sect.	Exp.	Fact.	Inst.	Cap.	
Sectors	Rural make			Rural consumption							Total rural output
Imports		Rural-ROW exports					Rural-urban exports				Total rural imports
Factors	Rural value added										Rural. factor reward
Institutions			Rural factor payments								Total rural income
Capital											Rural capital rewards
Urban											
Sectors						Urban make			Urban consumption		Total urban output
Imports		Urban-rural exports					Urban-ROW exports				Total urban imports
Factors						Urban value added					Urban factor rewards
Institutions								Urban factor payments			Total urban income
Capital											Urban capital rewards
Total	Total rural output	Total rural imports	Rural factor payments	Rural expenditure	Rural capital payments	Total urban Output	Total urban exports	Urban factor payments	Urban expenditures	Urban capital payments	

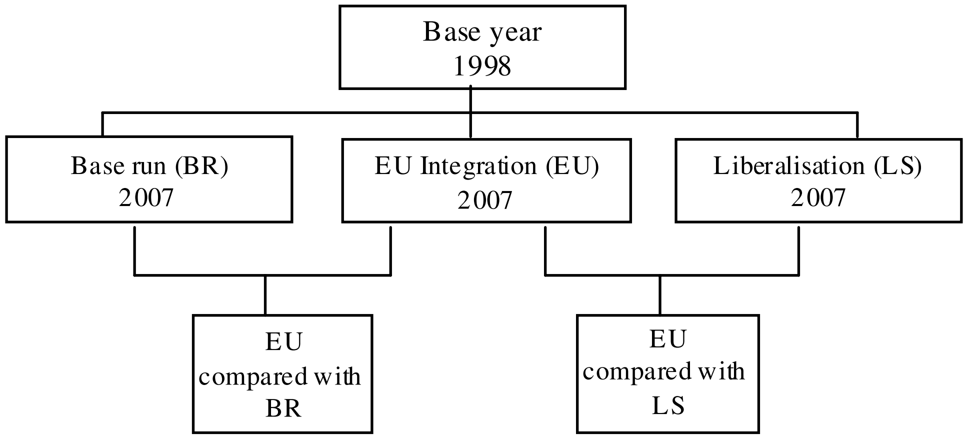
Source: Adjusted from DE JANVRY and SADOULET 1995.

Figure 2: Aggregated rural-urban SAM for Latvia, 1998 (Mio Ls)

	Rural					*Urban*					**Total**
Rural	Sect.	Exp.	Fact.	Inst.	Cap.	Sect.	Exp.	Fact.	Inst.	Cap.	
Sectors	3077	262		957	95	523			44		**4958**
Imports				435	82		180				**697**
Factors	1065			345							**1410**
Institutions	44		1375					526			**1945**
Capital				163			15		14		**192**
Urban											
Sectors	772					4849	407		981	190	**7199**
Imports		180			15				407		**602**
Factors						1738			35		**1773**
Institutions		255	35	45		89		1247		135	**1806**
Capital									325		**325**
Total	**4958**	**697**	**1410**	**1945**	**192**	**7199**	**602**	**1773**	**1806**	**325**	

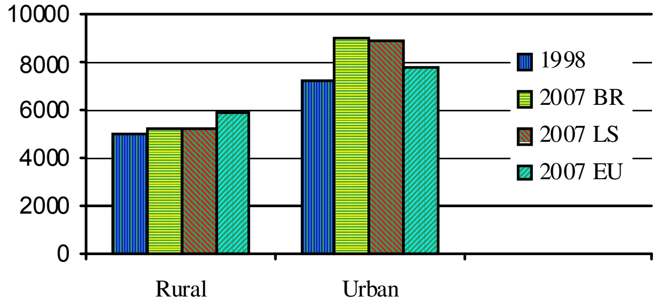
Source: Own calculations, NATIONAL ACCOUNTS OF LATVIA 1998.

Figure 3: Alternative rural development policies scenarios for Latvia



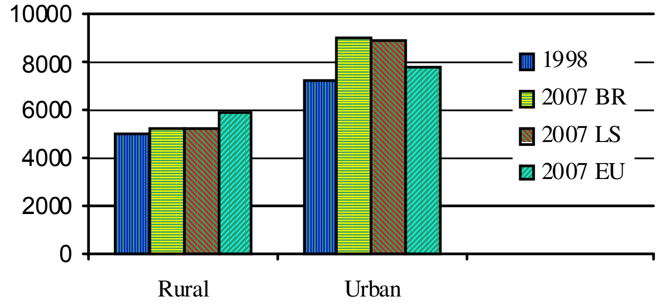
Source: Own calculations

Figure 4: Gross regional product of rural and urban Latvia (GRP), Mio Ls



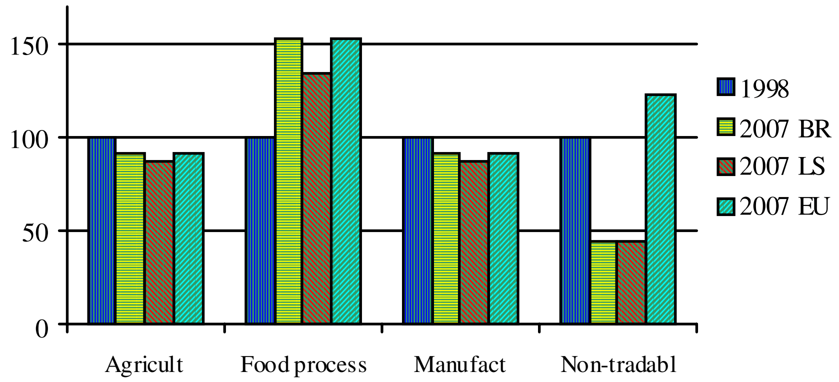
Source: Own calculations

Figure 5: Rural and urban household income in Latvia, Mio Ls



Source: Own calculations

Figure 6: Output prices in rural region %



Source: Own calculations