7 TRENDS IN STRUCTURAL CHANGES AND CONVERGENCE IN EU*

Lucian-Liviu ALBU**

Abstract

Despite the multitude of models created, their predictions are often contradicted by the empirical data, so that investigating macroeconomic structural changes continues to be a challenge to economists. Based on empirical data from countries around the world, our study tries to estimate a generic long-run model for analysing structural changes along with the general process of economic development. Moreover, from such a methodology a specific "EU model" was derived. Among the results, the long-run dynamics of structural changes seems to converge within the EU-27; the remaining problem being how long the convergence period is. This study shows how some more detailed interpretations could be extracted from the simulation of the model by using 3D maps or contour plot in the case of the EU countries.

Keywords: structural changes, non-linear model, asymptotical trajectory, stages of economic development.

JEL Classification: C13, C15, O11, O47.

1. Introduction

The economic theory of development postulates major changes in the structure of national economies, along with the historical growth process. At historical scale, in national economies in a first stage agriculture predominates, in the next stage industry becomes the predominant sector, and in a third stage the services sector becomes the major part of the economy. According to a general rule, during the first stage of development, along with a general increase in income, the demand for agricultural goods is growing, but slower than the income due to a smaller elasticity of income in relation to their demand. On the contrary, in the case of manufactured goods there will be a larger elasticity of income in relation to their demand. Thus, the share of the secondary sector in economy will increase.

* This paper is partially based on an author's study achieved within the National Research Project of Excellence (CEEX 05-D8-18/5.10.2005): "Valorisation of competitive potential of Romania in the field of services", Institute for Economic Forecasting, Romanian Academy, Contracting Authority – IFA Măgurele, Contractor ASE, 2005-2008.
** Research Professor, Institute for Economic Forecasting, e-mail: albul@ipe.ro.

However, in the historical process of development, as the income continues to increase, from a certain moment people begin to consume more services, taking into account that in their case income elasticity in relation to demand is even larger. Consequently, the tertiary sector will develop faster. This general rule is supposed to guide development at historical scale, but based only on empirical facts.

Such a scheme may be sometimes false. Thus, from the income per inhabitant level viewpoint there are underdeveloped countries in which the tertiary sector is predominant as a consequence of an expanded tourism activity, concomitantly with a non-developed secondary sector. This situation implies major risks. For instance, a deep recession in the countries supplying tourists can strongly affect the income from tourism in the destination country. Further, the overall effect will compromise to a large extent the general development process in this country. In the cases when either the primary sector or the secondary sector cannot be strengthened by domestic means, the loan and increasing debt will be the single solutions.

In the present world, the expansion of the tertiary sector coincides with the emergence and fast development of the so-called new economy. Thus, the new economy is often viewed as an economy of services. Many authors consider, as a basis of the spectacular growth of the tertiary sector in the developed countries during the last years, certain activities, such as: scientific research and technological development; design and experimentation; marketing and trade (including external trade); production, putting in stock, processing and transmission of information; improvement of human factor, education, health, and increasing of life quality (including quality of environment, leisure, tourism); financial activity, banking, insurance societies, and capital markets, etc. Only such “services”, on which essentially depends the efficiency even in the so-called material sphere of production, demonstrate today the highest dynamics. They are either integrated together with proper productive activities in the same system or developed as autonomous systems, such as: “banking industry”, “tourism industry”, “information industry”, etc.

2. Theoretical model and empirical evidences

Economic theory usually uses a number of stylised facts of structural changes along with the economic growth process. According to it, a satisfactory theory of structural changes should be able to explain the real evolution illustrated by empirical data. Among the conclusions, three stylised facts are highlighted: the share of the primary sector shows continuing decrease converging in the long run to a small constant value; the share of the secondary sector increases until a maximum value but it decreases further converging in the long run to a constant value; the share of the tertiary sector shows continuing growth converging in the long run to a high value. Consequently, a model of structural changes should be able to simulate such dynamics.

In order to estimate parameters describing the medium- and long-run evolution of the structure of different national economies, usually either econometric models are used or alternatively they should be calibrated to fit reasonably empirical data.

To build a theoretical model, in this case essentially a non-linear model, we consider some limit-values to which the trajectories of the shares of the three sectors are asymptotically converging in the long run, depending on the level of GDP per inhabitant. The basic

hypotheses, plausible from a theoretical viewpoint, should be also in accordance with the empirical data. There are three hypotheses that we used for the model, as follows:

$$na = h = ct., \quad for\ y \to +\infty \tag{1}$$

$$ni = 0, \quad for\ y \to 0 \tag{2}$$

$$ns = d = ct., \quad for\ y \to +\infty \tag{3}$$

where: na, ni and ns are the shares in employment of the primary sector (mainly agriculture), secondary sector (mainly industry), and tertiary sector (services), respectively. Stemming from these hypotheses, the dynamics of the shares of agriculture and services in total employment can be function of GDP per capita, y, expressed by the following two relations:

$$na\,(y) = (A*h*y + m*B) / (A*y + m) \tag{4}$$

$$ns\,(y) = d / (1 + e^{b-c*y}) \tag{5}$$

where: A, h, m, B, d, and c are calibrated parameters (they can also be econometrically estimated); e is the base of natural logarithms. Moreover, considering the complementary relation, na+ni+ns=1, one should write also the dynamics of the share of industry in the total employment:

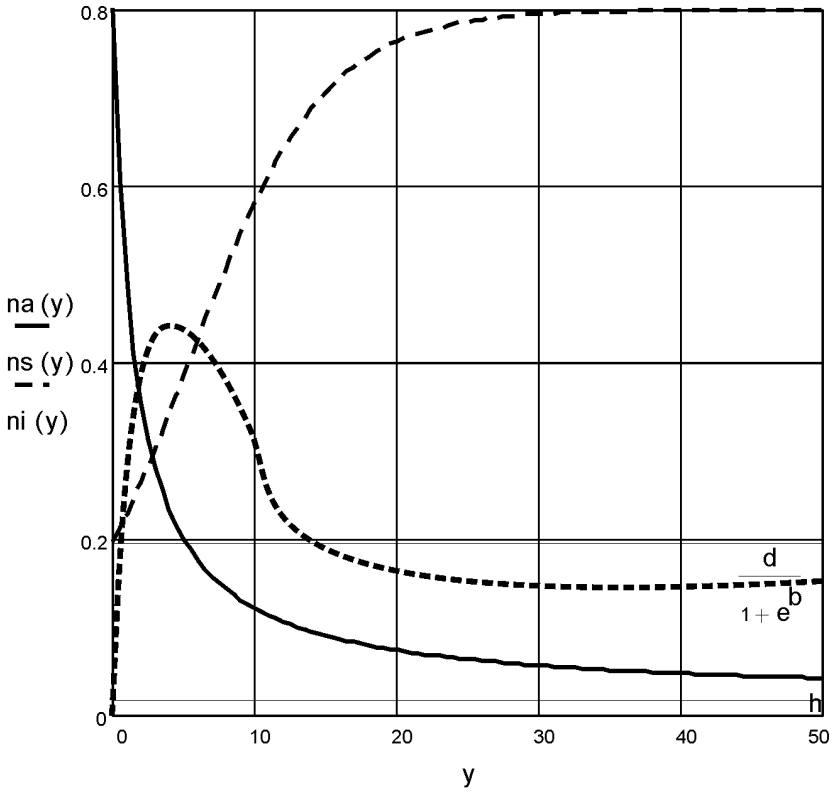
$$ni\,(y) = 1 - \{[(A*h*y + m*B) / (A*y + m)] + [d / (1 + e^{b-c*y})]\} \tag{6}$$

Also, taking into account hypothesis (2), we obtain the following implicit relation:

$$B = 1 - [d / (1 + e^{b})] \tag{7}$$

We calibrated the model on the basis of available cross-section statistical data over the period 1970-2000 for a number of about 100 countries (including all groups of countries, from poorest to richest), and on the hypothesis of some long-run asymptotical trajectories. The simulation of the model demonstrated that in the case of industry a local minimum and a global maximum may be identified, corresponding to two specific critical values of the income per capita. On the basis of the model, we can also simulate certain relevant long-run trajectories of the structural changes. For instance, using the following set of values for parameters, A=2, h=0.02, m=3, d=0.8, b=1.12, and c=0.21, from the simulation of the model we got in the case of industry a maximum of its share in total employment, ni, equal to around 42% (corresponding to a critical value of GDP per capita y = 4000 USD) and a minimum equal to around 14.7% (corresponding to y = 28500 USD). The complete map of simulation is shown in Figure 1 (where y is given in thousand USD). Discrepancies among countries can be viewed now not only as differences in income per capita, but also in terms of structural gaps. Moreover, the simulation of the model demonstrates a general convergence of structures in the long run, along with the economic growth process.

Figure 1



3. Convergence in UE-27

On the basis of the study of structural changes by stages of economic development, it resulted that the differences among countries can be evaluated by the discrepancies in the services sector contribution both to total employment and to GDP. Analysing the data regarding the share of services in GDP over a short historical period, 1995-2005, demonstrates a strong expanding tendency for all the EU countries. Regarding this criterion of convergence, Romania is the second country within the EU, with an increase by 16.1 percentage points, from 38.8% to 54.9% (Latvia, placed first, registered during the same period a growth by 17.4 percentage points, from 56.6% to 74.0%). However, Romania continues to be the last in the EU in what regards the share of services in total GDP (see Appendix 1). Consequently, in the case of Romania the shares of agriculture and of industry, respectively, in total GDP are the highest among the EU members (10.1% and 35.0%, respectively, in 2005).

In order to estimate the trends in structural convergence in the EU in relation to economic growth, we used a model only a little different from the previous theoretical one. The statistical data are referring to 2004. Figure 2 presents the variation in structure by the

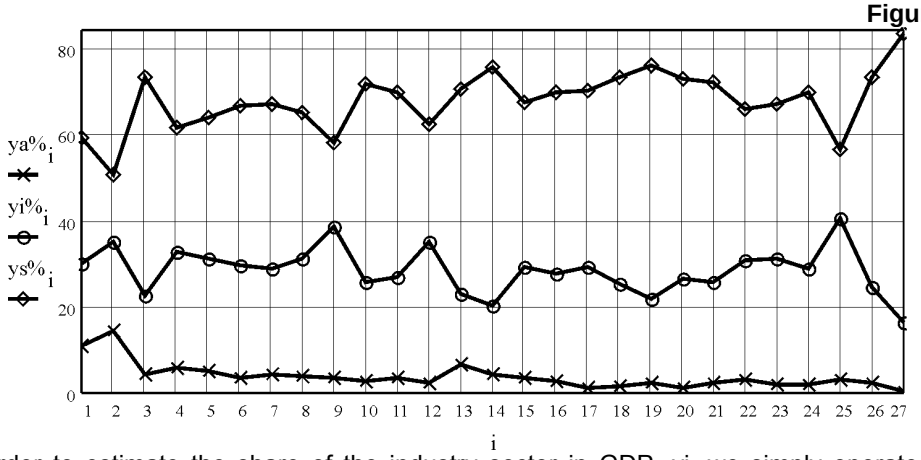
three sectors of the economy in the EU in relation to GDP per capita (where on abscise axis there are countries in the EU-27 arranged increasingly by the level of GDP per capita, y). We calibrated the econometric model on the assumption that there are certain limit-values to which each of the three trajectories is tending along with the growth in income per capita. Thus, the specification of the model is in line with both the long-run growth theory and the empirical data supplied by the economic history. These hypotheses are synthetically expressed by the following equations used for regression in the case of the agriculture sector, ya, and the services sector, ys, respectively:

$$ya\_E\,(y) = [\,(k1*y + k2) / (k3*y + k4)\,] \quad (8)$$

$$ys\_E\,(y) = [\,k5 / (1 + k6*e^{k7*y})\,] \quad (9)$$

where: k1...k7 are estimated and e is the base of the natural logarithms.

Figure 2



In order to estimate the share of the industry sector in GDP, yi, we simply operate the substitution of the above two relations in the balance relation, ya+yi+ys=1, obtaining the following equation:

$$yi\,(y) = 1 - \{[(k1*y + k2) / (k3*y + k4)] + [k5 / (1 + k6*e^{k7*y})]\} \quad (10)$$

The results of applying the cross-section model to the EU countries are presented in Figures 3-5 (where the two dashed lines defines the confidence statistical interval). Moreover, Figure 6 shows the resulted general theoretical model at the level of the entire EU for 2004. Thus, as a minimum for the share of the agriculture sector the resulted value was equal to about 1.7% and as a maximum for the share of the services sector resulted a value was equal to about 82.7%. These values show that in the case of the new member countries there still is a big gap to the average EU level in what regards the structural changes (see Appendix 1). In the case of the industry sector, it resulted in a value of global maximum equal to about 31.4% (corresponding to a critical value of GDP per capita equal to about 9700 USD) and a value of the long-run minimum equal to about 15.6%, respectively (in the case of a very large income per capita). More detailed interpretations can be extracted from the so-called surface plot or 3D map and contour plot representations of the estimated EU model (see Appendix 2). In a future study, we intend to expand our analysis of the structural EU model from only one year (2004 in this paper) to a series of years by using a sort of panel models.

According to the resulted cross-section model (estimated on the basis of 2004 data) we can evaluate the long-run dynamics of structural changes for each individual country. Thus, the actual gap between the new member countries and the average level in the EU could be interpreted as a delay in time, their actual structure of the economy representing a similar situation to that existing 10-20 years ago in the developed western countries of the EU. Moreover, there are evidences demonstrating that the long-run trends in the new members of the EU will be similar to those registered in the western countries. For instance, according to the simulation of the general estimated model for the EU, in the case of an annual 6% GDP growth in Romania for the entire interval 2006-2015, the following shares will be registered at the end of period: ya=4.6%, yi=31.3%, and ys=64.1%. Indeed, such a significant decrease in the agriculture sector share in only ten years means huge investment and modernisation efforts.

Figure 3

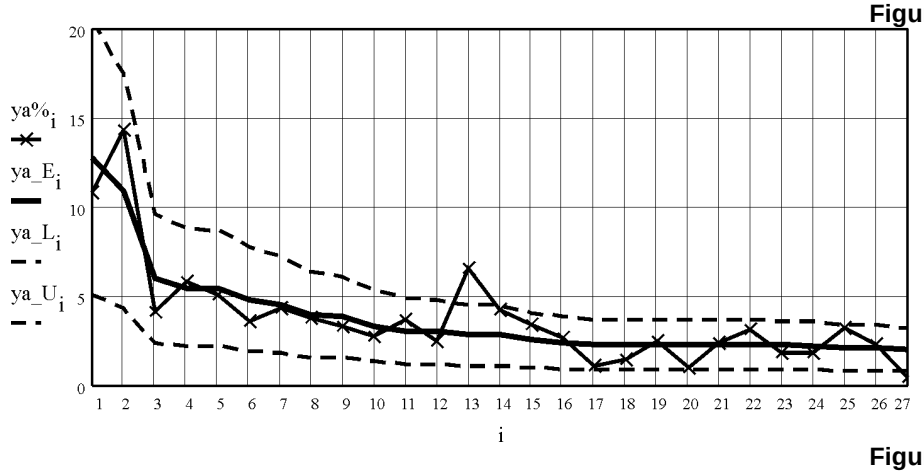


Figure 4

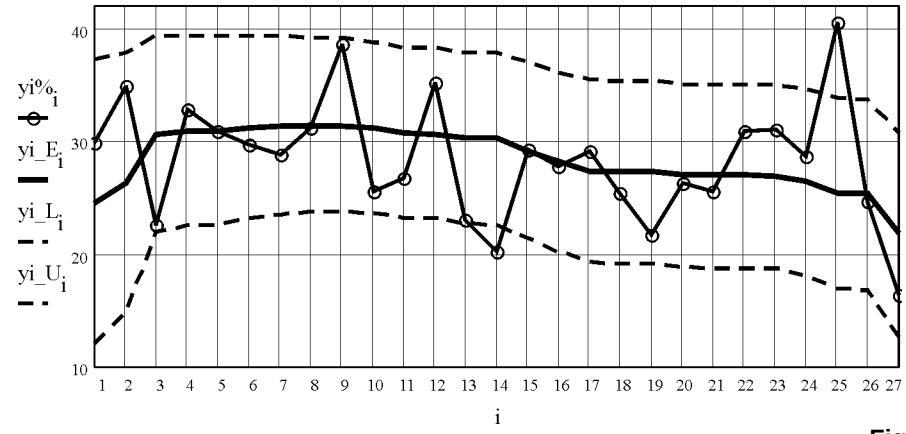


Figure 5

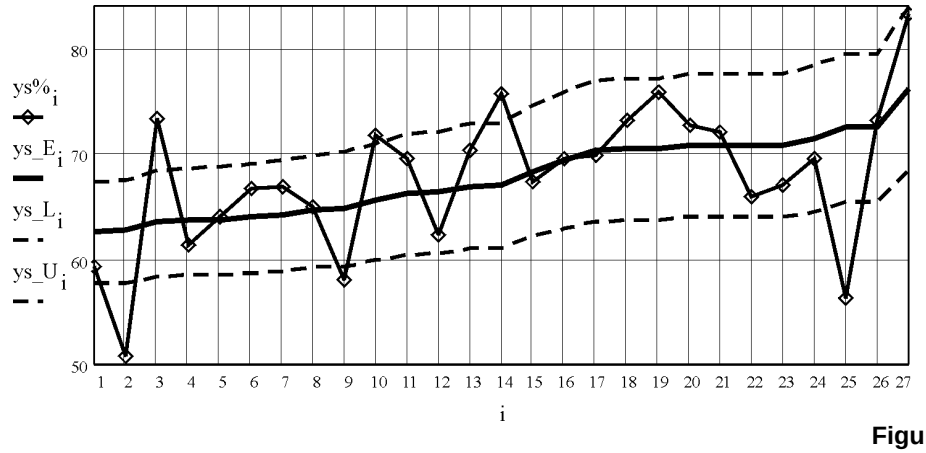
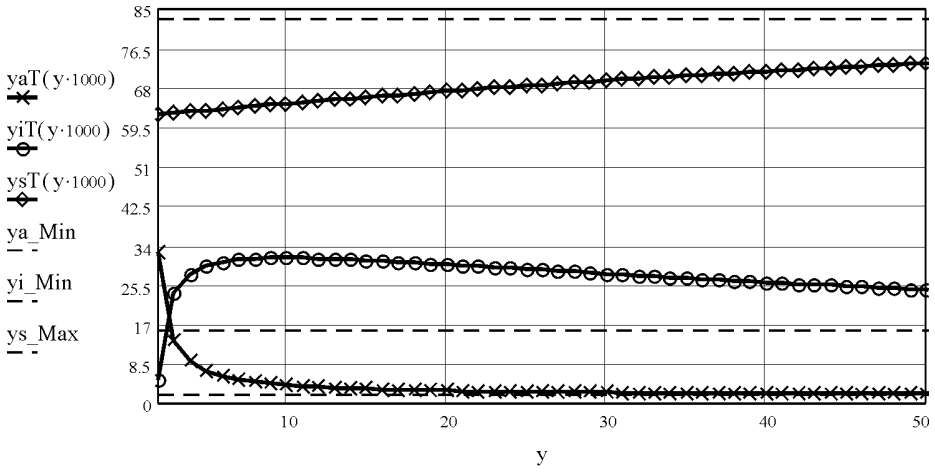


Figure 6



References

Albu, L.-L. (1991), *Raportul industrie-agricultură şi dezvoltarea economică*, Teză de doctorat, Academia Română, INCE, Bucureşti.

Barro, R. J. and Sala-i-Martin, X. (1995), *Economic Growth*, McGraw-Hill, New York.

Canton, E., Minne, B., Nieuwenhuis, A., Smid, B., and Steeg, M. (2005), "Human Capital, R&D and Competition in Macroeconomic Analysis", ENEPRI, *Working Paper*, no. 38.

Clark, C. (1957), *The Conditions of Economic Progress*, MacMillan, ed. III, London.

Denison, E. F. (1985), *Trends in American Economic Growth, 1929-1982*, Brookings Institution, Washington, D.C.

Dobrescu, E. and Albu, L.-L. (coordinators) (2005): *Dezvoltarea durabilă în România – modele şi scenarii pe termen mediu şi lung*, Editura Expert, Bucureşti.

King, W. (1923), The Wealth and Income of the People of USA, Macmillan, New York.

Mankiw, N. G., Romer, D. and Weil, D. N. (1992), "A Contribution to the Empirics of Economic Growth", *Quarterly Journal of Economics*, 107: 407-437.

Ngai, R. and Pissarides, C. (2004), *Structural Change in a Multi-Sector Model of Growth*, London School of Economics, Centre for Economic Performance, CEPR and IZA.

Pindyck, R. S. and Rubinfeld, D. L. (1998), *Econometric Models and Economic Forecasting*, Irvin McGraw-Hill, Boston, Massachusetts, New York, San Francisco.

Romer, P. M. (1989), "Capital accumulation in the theory of long-run growth", *Modern Business Cycle Theory* (Coordinator: Barro R. J.), Basil Blackwell, Oxford, p. 51-127.

Rostow, W. W. (1953), *The Process of Economic Growth*, Oxford.

Rostow, W. W. (1960), *The Stages of Economic Growth: A Non-Communist Manifesto*, Cambridge University Press, Cambridge.

Rostow, W. W. (1962), *The Process of Economic Growth*, The Morton Library.

Solow, R. M. (1956), "A Contribution to the Theory of Economic Growth", *Quarterly Journal of Economics*, 70: 65-94.

Swan, T. W. (1956), "Economic Growth and Capital Accumulation", *Economic Record*, 32: 334-361.

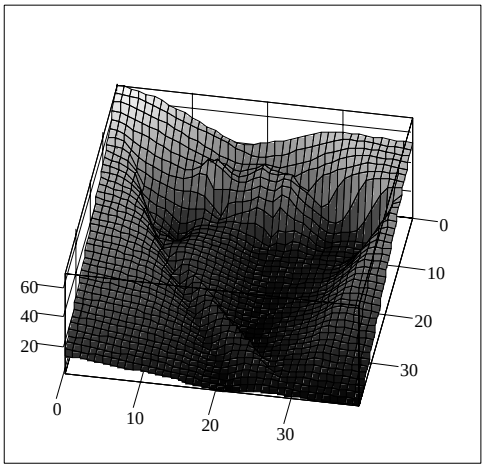
Todaro, M. P. (2000), *Economic Development*, Addison-Wesley, New York.

Appendix 1

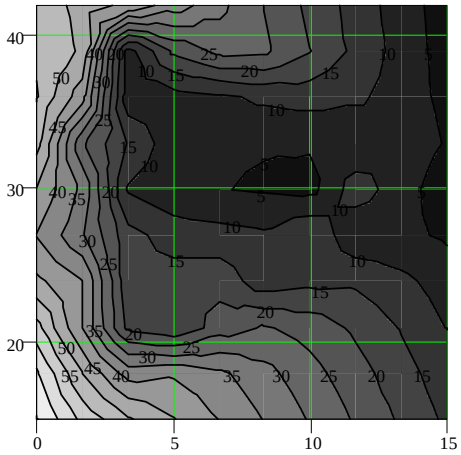
		1995			2004				2005			
		ya%	yi%	ys%	y	ya%	yi%	ys%	y	ya%	yi%	ys%
1	Bulgaria	13.4	32.4	54.3	3131	10.8	29.9	59.3	3443	9.3	30.5	60.3
2	Romania	20.9	40.3	38.8	3481	14.3	35.0	50.7	4556	10.1	35.0	54.9
3	Latvia	9.9	33.5	56.6	5932	4.1	22.6	73.3	6857	…	…	…
4	Lithuania	11.7	33.2	55.0	6537	5.9	32.8	61.3	7466	5.9	31.1	63.0
5	Poland	6.9	33.3	59.8	6610	5.1	30.9	64.0	7838	4.9	30.7	64.5
6	Slovakia	6.0	38.2	55.8	7635	3.6	29.7	66.7	8615	3.5	29.4	67.2
7	Estonia	8.7	31.0	60.3	8328	4.3	28.8	66.9	9745	…	…	…
8	Hungary	6.8	30.9	62.3	9962	3.8	31.1	65.0	10820	…	…	…
9	Czech Rep.	4.7	41.9	53.4	10542	3.4	38.6	58.0	11999	…	…	…
10	Malta	2.9	33.7	63.4	13256	2.8	25.5	71.7	13783	…	…	…
11	Portugal	5.2	30.0	64.9	15970	3.7	26.7	69.6	16396	…	…	…
12	Slovenia	5.5	41.7	52.8	16271	2.5	35.2	62.3	17030	…	…	…
13	Greece	9.9	22.4	67.7	18560	6.6	23.1	70.4	19271	…	…	…
14	Cyprus	5.0	22.5	72.4	18668	4.3	20.2	75.6	…	…	…	…
15	Spain	4.4	29.6	66.0	24360	3.5	29.2	67.3	25898	…	…	…
16	Italy	3.2	30.1	66.7	29143	2.6	27.8	69.6	29981	…	…	…
17	Germany	1.3	32.1	66.6	33212	1.1	29.1	69.8	33726	…	…	…
18	Belgium	1.6	28.1	70.3	33808	1.4	25.4	73.2	34834	…	…	…
19	France	3.2	26.3	70.5	33896	2.5	21.8	75.8	34740	…	…	…
20	UK	1.8	30.9	67.3	35485	1.0	26.3	72.7	36420	…	…	…
21	Netherlands	3.5	27.8	68.6	35560	2.4	25.6	72.0	36423	…	…	…
22	Finland	4.7	32.2	63.1	35562	3.2	30.9	65.9	36830	…	…	…
23	Austria	2.5	30.8	66.7	35766	1.9	31.1	67.0	37086	…	…	…
24	Sweden	2.7	30.1	67.2	38525	1.8	28.7	69.4	39241	…	…	…
25	Ireland	7.7	38.2	54.1	44644	3.2	40.5	56.3	47316	…	…	…
26	Denmark	3.6	24.9	71.5	44673	2.3	24.6	73.1	46952	…	…	…
27	Luxembourg	1.0	21.2	77.8	70295	0.5	16.3	83.2	73961	…	…	…

Source: World Development Indicators database, August 2006.

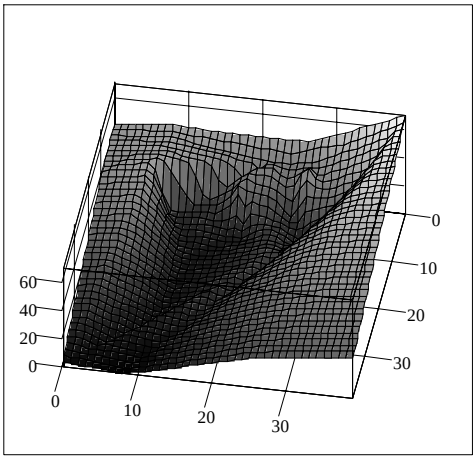
Appendix 2



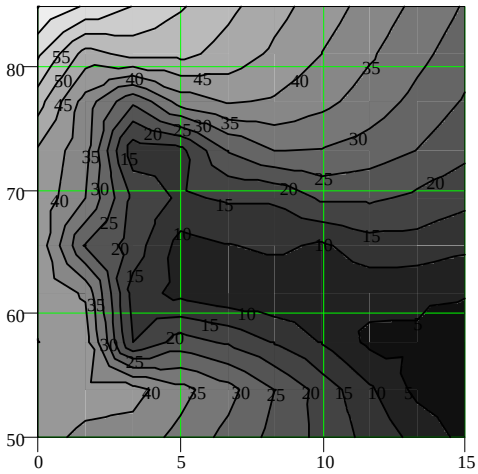
$$ya\%, yi\%, \frac{y}{1000}$$



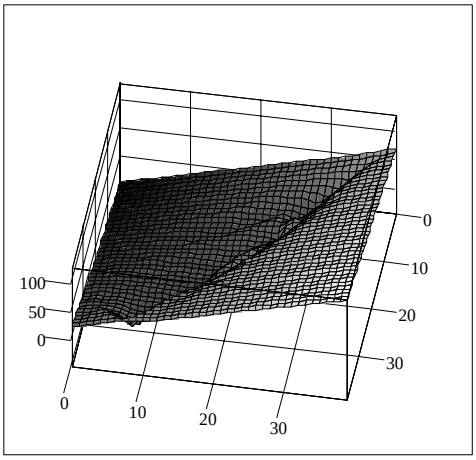
$$ya\%, yi\%, \frac{y}{1000}$$



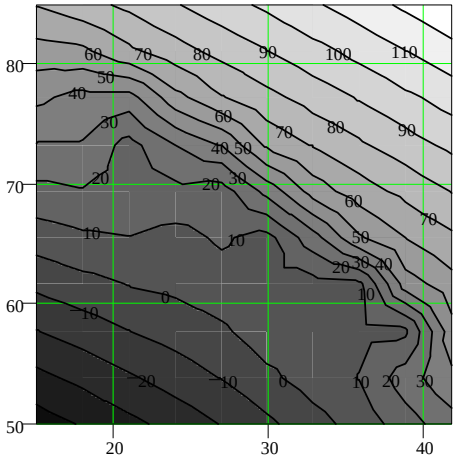
$$ya\%, ys\%, \frac{y}{1000}$$



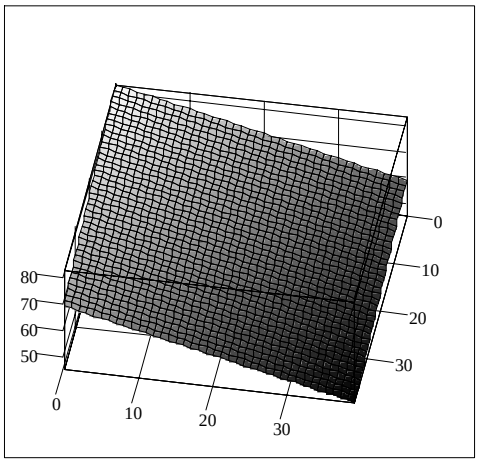
$$ya\%, ys\%, \frac{y}{1000}$$



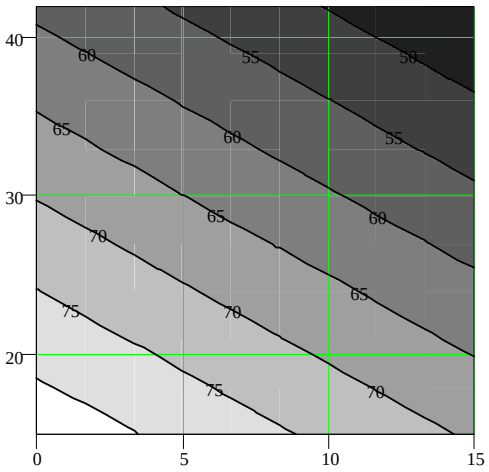
$yi\%, ys\%, \frac{y}{1000}$



$yi\%, ys\%, \frac{y}{1000}$



$ya\%, yi\%, ys\%$



$ya\%, yi\%, ys\%$