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Scenarios for post-crisis period based on a set of presumed changes in the interest rate – investment – GDP growth relationship

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- Abstract -

The interest rate and investment are among the central variables influencing the growth rate. Due to the complexity empirically demonstrated of the interest rate – investment – GDP growth relationship, last decades a growing concern over the modelling this relationship has increased attention among officials, politicians, and economists. Moreover, the actual global crisis seems to provoke new changes in the economic growth mechanism. Based on statistical data for last period, we try to build a set of partial models in order to investigate the interest rate - investment - growth rate relationship in case of EU members and in the same time to verify some hypotheses usually in standard economic literature. Applying such simple models derived from standard ones in our experiment we estimated their parameters in case of EU countries. The main two partial models are referring to the impact of investment on GDP growth rate and respectively to the relation between interest rate and investment. Moreover, an equation including inflation dynamics was taken into account. Finally, the derived global model demonstrates complex dynamics, moreover permitting to compute so-called natural rate of interest and other key-parameters for macroeconomic decisions.

JEL Classification: C51, E27, E43, O47

Introduction

Among macroeconomic correlations, interest rate – investment – GDP growth relationship places a fundamental role. In the general process of economic development and last time in the context of convergence in EU this relationship becomes to be more studied by economists and policy makers. As illustration, based on empirical data for 2007, a 3D representation and its attached so-called geodesic map or contour plot for the correlation interest rate (i) – investment ratio in GDP (α) – annual GDP growth rate (r), in case of EU-27, are shown in Figure 1. As general rule, we can see that GDP growth rate is higher (red colours) for smaller values of interest rate and respectively for higher values of investment ratio. Contrary, smaller growth rate (blue colours) corresponds to higher values of interest rate and respectively to smaller values of investment rate. Indeed, moreover inflation must be considered together with other macroeconomic variables. In such way, we shall take into account within a dynamic model an equation including inflation dynamics. Further, the model, demonstrating complex dynamics, could supply solution to estimate natural rate of interest and other essential parameters for macroeconomic decisions.

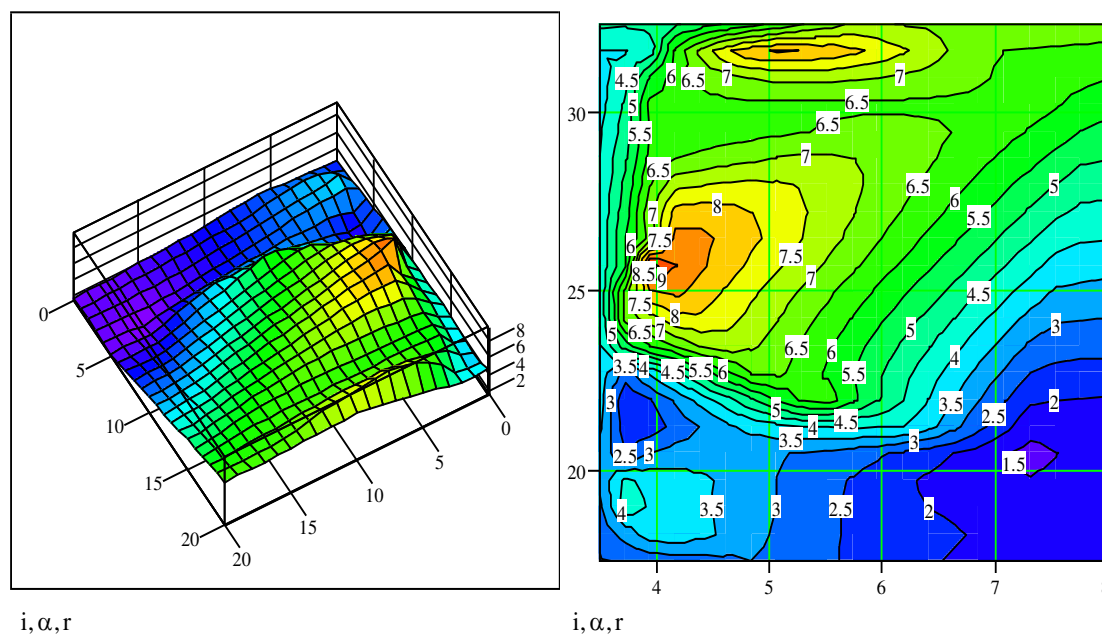


Figure 1.

The Model

Coming from standard literature we used the following three basic equations:

$$r(\alpha) = a\alpha + b \quad (1)$$

$$\alpha(i) = c / (d + i) \quad (2)$$

$$i(p) = e*p + f \quad (3)$$

where r is GDP growth rate, α – investment rate (in GDP), i – interest rate, p – inflation, $a, b, c, d, e,$ and f – parameters (estimated econometrically).

First equation tries to capture the impact of investment on GDP growth. Second equation demonstrates an inverse relation between interest rate and investment. Third equation takes into account a direct relation between inflation and interest rate. Using some simple algebraic operations, based on the above equations we can obtain also some other useful derivate equations, as follows:

$$r(i) = b + a*c / (d + i) \tag{4}$$

$$\alpha(p) = c / [d + (e*p + f)] \tag{5}$$

$$i(\alpha) = (c / \alpha) - d \tag{6}$$

Moreover, we can express the empirical inflation – GDP growth rate relation as follows:

$$r(p) = b + a*c / (d + e*p + f) \tag{7}$$

Estimations

We tried to estimate the parameters of equations in case of the Romanian economy after 1989. The output of our experiment on the period 2000-2005 is shown in Figures 2-4, where: variables on ordinate axis and inflation are in per cent; years are noted from 1=2000 to 6=2005; E attached to the name of variable means estimated; r_L and r_U (represented as black dashed lines) mean the lower limit and respectively upper limit (95% Confidence Intervals).

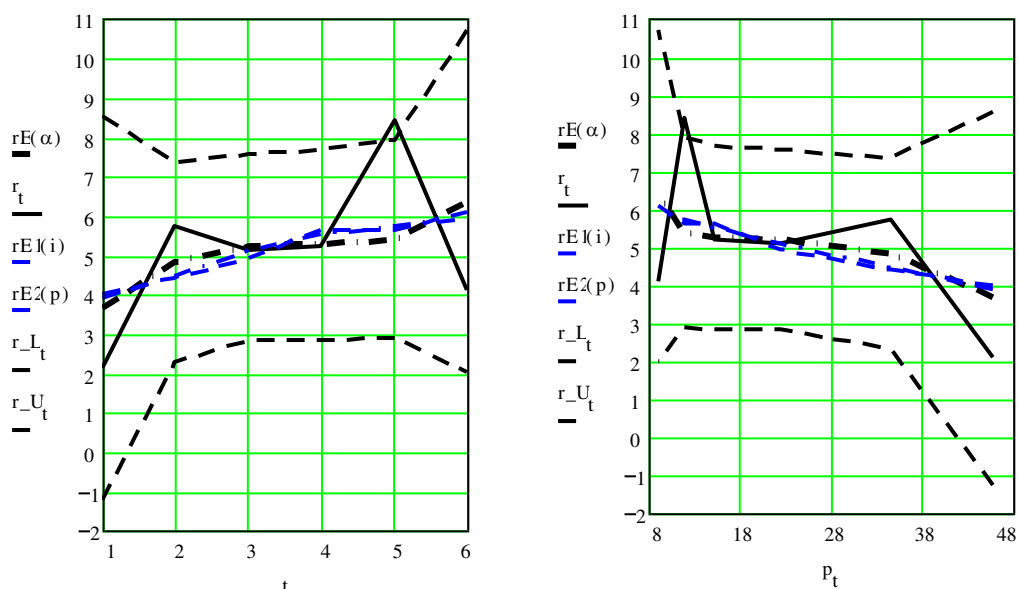


Figure 2.

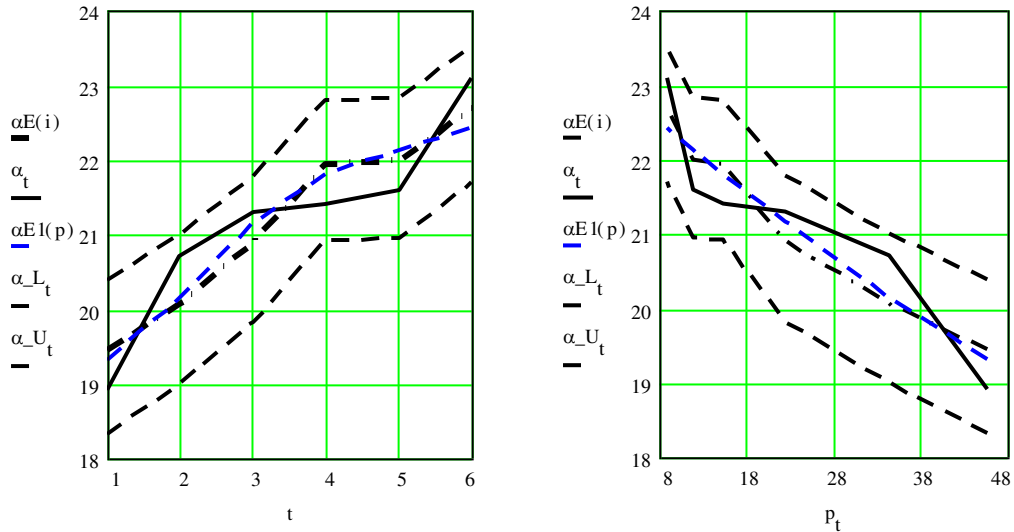


Figure 3.

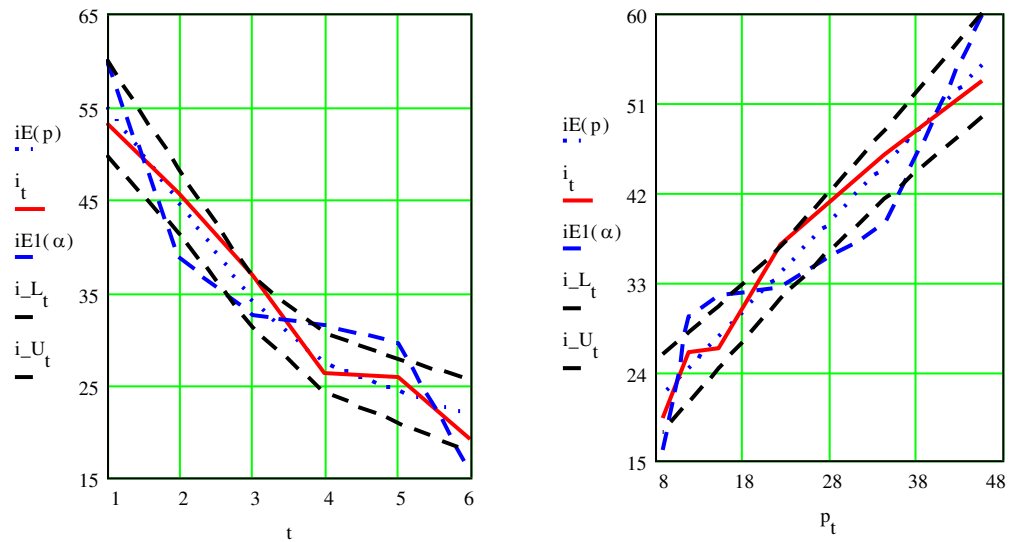


Figure 4.

Also, in Appendix are presented some 3D graphic representations for variables and their attached Contour Plots corresponding to real annual registered data in period 2000-2005. Based on historical data, among other conclusions, we can see that a GDP growth rate of about 7% could be obtained for an investment rate of around 22% and an interest rate of about 10% (it is represented by peak 7 on the map noted (α, i, r)). From the contour map (p, i, r) we can see the line 5 (5% GDP growth rate) that follows very close the diagonal line of plan p - i , which can be interpreted as a natural rate of GDP growth rate. Similar conclusion, but for investment rate, could be derived from contour map (p, i, α) , where as trajectory for its natural rate could be considered the top line following very close the diagonal line of plan p - i . Contour map (p, α, r) demonstrates the negative impact of inflation on GDP growth.

Simulation

Based on relation (1) the simulation of model demonstrated a critical value of 13.2% for investment rate (α_{cr1}). For $\alpha < 13.2\%$ the GDP growth rate will be negative. Moreover, in the extreme case of no investment ($\alpha=0$) GDP will decrease by 8.6% per year (estimated value of coefficient b is around -8.6%). Accepting the hypothesis of a constant level of the so-called capital coefficient (computed as Stock of Fixed Capital / GDP) the value 8.6% could be used as a first estimate for the annual rate of capital depreciation in case of Romania which means that in case of no investment the whole stock of fixed capital will be consumed only in 12 years (must be noted that this shows a special situation for the capital stock in Romania: many productive capacities are still old, physic and/or moral depreciated, more of them being underused or in conservation). Simulation of equation (2) shows a strong inverse correlation (hyperbolic correlation) between investment and interest rate: Coefficient of Multiple Determination $R^2=0.845443$; Adjusted coefficient of multiple determination $R_a^2=0.806804$; Durbin-Watson statistic=2.032844; Variable c – t-ratio=4.56026, Prob(t)=0.01034; Variable d – t-ratio=3.87819, Prob(t)=0.01787). It also permitted us to compute the potential level for GDP growth rate of about 7.6% – a theoretical level computed as value of GDP growth rate at the point $\alpha_{cr2}=c/d=25.1\%$, corresponding to an hypothetical interest rate tending to be equal to zero. Based on the simultaneous simulation of the two equations we computed a more realistic maximum for GDP growth rate, namely equal to about 7% – also a theoretical level computed as value of GDP growth rate at the point $\alpha_2=24.1\%$, corresponding to the situation in which GDP growth rate tends to equal interest rate. To note that in this situation we could suppose the stability of whole economic system, like in case of studying the sustainability of public debt and deficits (Albu and Pelinescu, 2000). Some results of simulation of the two partial models represented by equations (1) and (2) are shown in Figures 5 and 6.

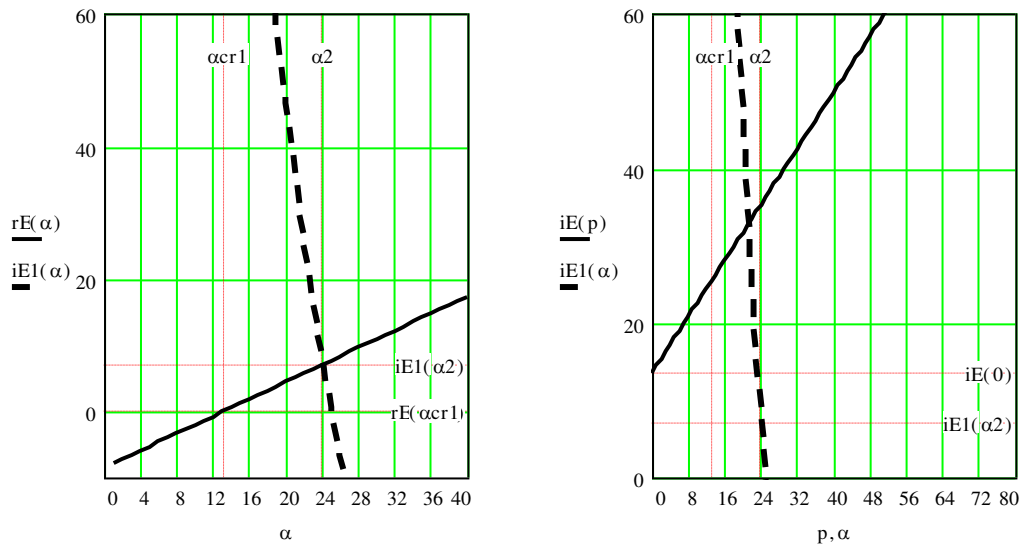


Figure 5.

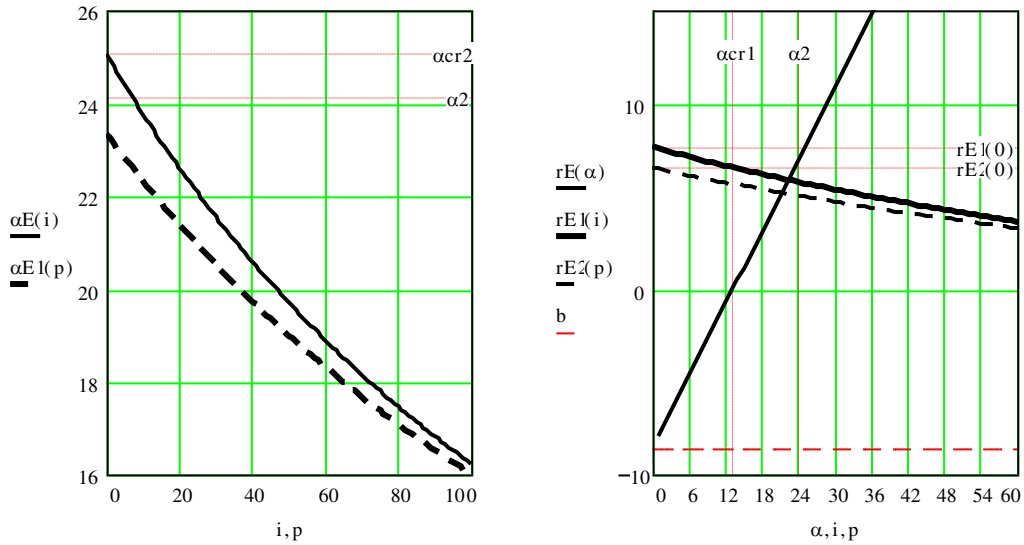


Figure 6.

Conclusions

Based on simulation model some significant macroeconomic indicators can be estimated. Their values vary with the development stage in which countries are located, mainly with GDP per capita level. For instance, in following Table there are compared values of some essential parameters of the model for different EU countries, estimated for the period 1995-2007:

Countries	Parameters			
	a	b (depreciation rate of capital)	$\alpha^* = \alpha cr1$	k=K/Y (capital coefficient)
Germany	0.221	-2.8	12.8	4.526
Estonia	0.574	-9.4	16.4	1.742
Austria	0.233	-2.7	11.5	4.284
Portugal	0.406	-7.3	18.0	2.465
Romania	0.702	-12.0	17.1	1.424

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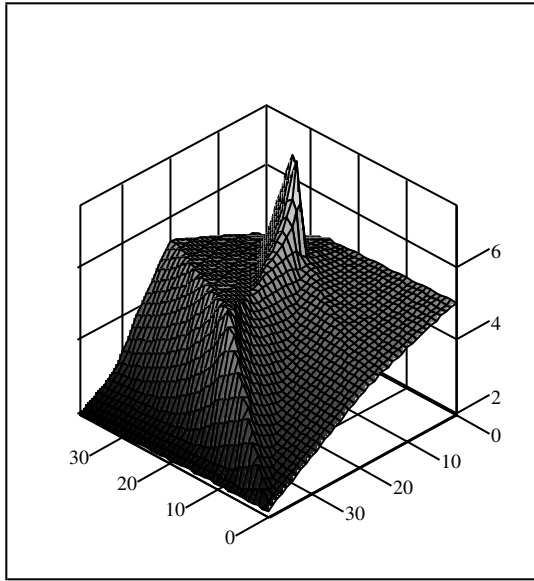
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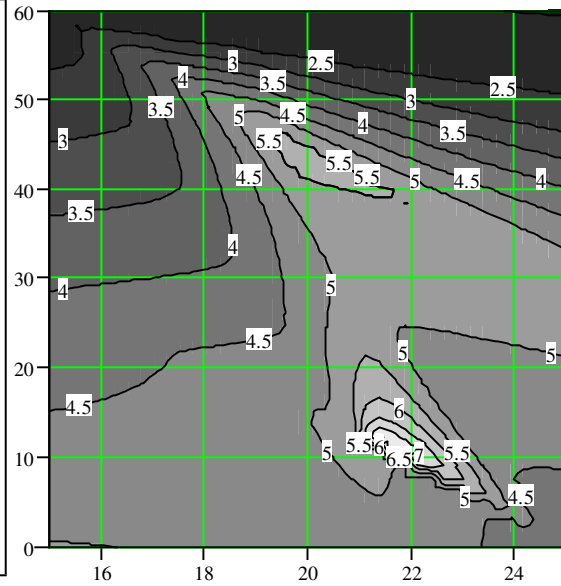
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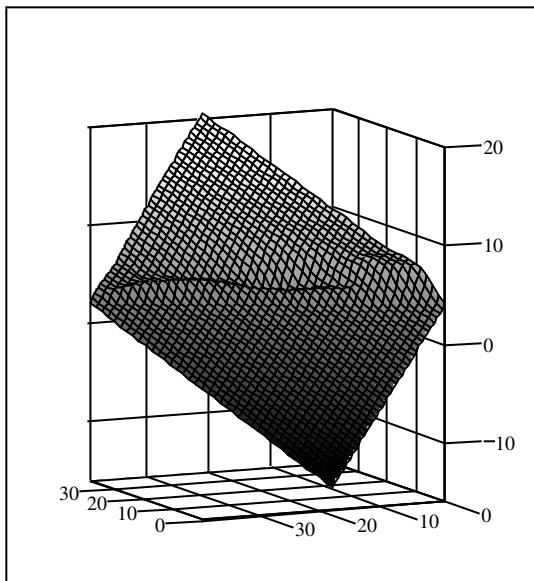
Appendix



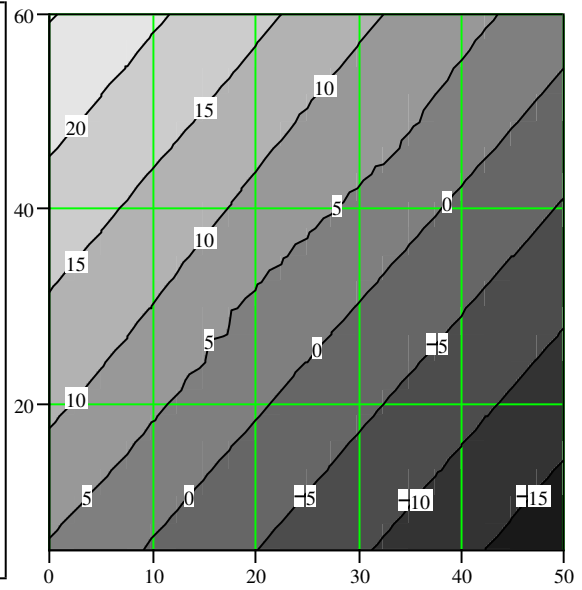
α, i, r



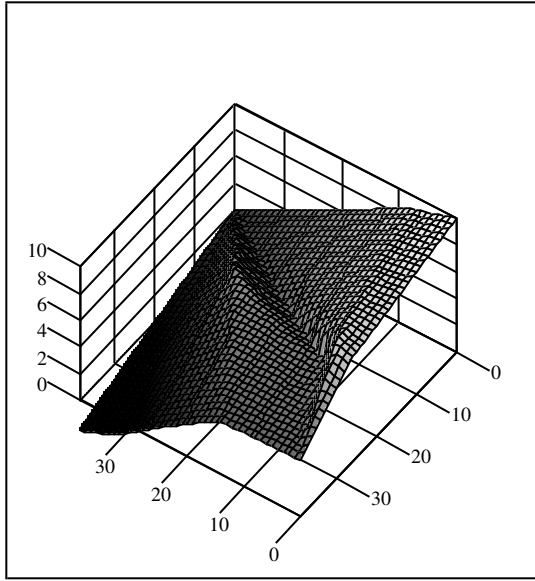
α, i, r



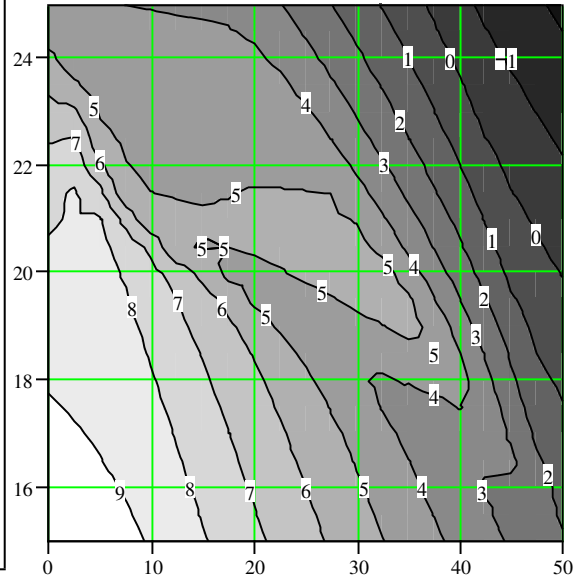
p, i, r



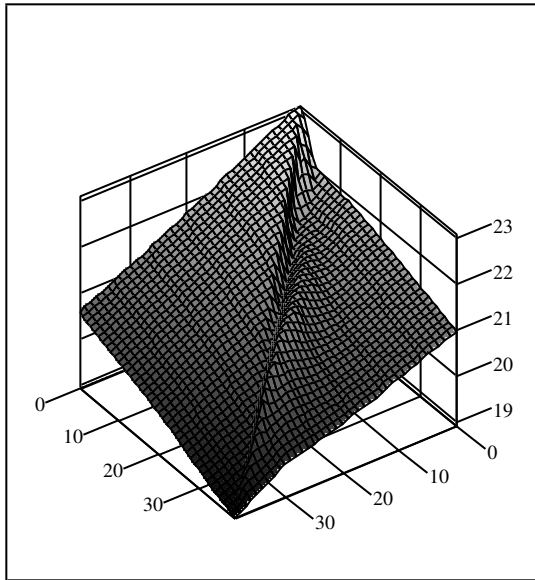
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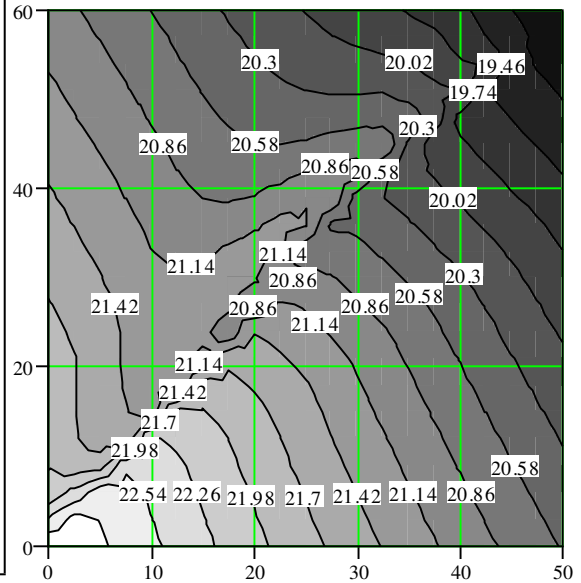
p, α, r



p, α, r



p, i, α



p, i, α