

SYSTEM DYNAMICS COMPUTER SIMULATION MODEL OF C R O A T I A

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ABSTRACT

The proposed model is a scientific attempt to apply the methodology of System Dynamics to research one of the most complex organization system of management, with the aim of finding out the most suitable scenario of the management by economic migration flows. The problem of economic migration is one of the most important problems both for the countries of origin and for the receiving countries. Computer simulation of the proposed model confirms most of the results achieved by Andre Sapir, but pointing to the possibility of multilateral consultation of the managers of the regional system, as well as of the society to which it belongs, in this case : **REPUBLICA of CROATIA**, and the managers of the countries which absorb the economic migrations flows. The result of these multilateral consultations would be very useful for the countries of origin, and for the countries that receive economic migrants as well !

1. INTRODUCTION

It is generally believed that economic migrations bring profit to the receiving countries, while they have negative effect on the countries of origin ! In the case of **REPUBLICA of CROATIA**, however, as the regional system of YUGOSLAVIA, economic migrations have, in spite of numerous negative effects, contributed to the development of **CROATIA**, respectively YUGOSLAVIA as a whole, after the World War II.

It is possible to meet the interests of those countries of origin of economic migrants on which the migrations had negative effects, and even to assure their future development ! Such countries must change from countries of origin to the countries which receive their own migrants, in the following way :

1. Receiving countries and countries of origin of economic migrants must jointly plan the input and output flow of migrants in accordance with "foreseen" trade prosperity movements of the world market !

2. The country of origin will, in the feedback cycle of the migrations flows, change to the country which receives its own economic migrants (returned economic migrants) !

It will in this way, with the help of the developed countries that had up to that point been using its migrations flows, realise the conditions for its own progressive development.

The System Dynamics Computer Simulation Model of the flows of populations, economic migrants, financial investment capital, economic migrants policy, economic and social development of a relatively "developed" : **REPUBLICA of CROATIA**, as a part of **YUGOSLAVIA**, is proposed in order to facilitate the multilateral negotiations between **REPUBLICA of CROATIA**, **YUGOSLAVIA** and **THE REST OF THE WORLD**.

2. BASIC CHARACTERISTICS OF THE REGIONAL SOCIO-ECONOMIC SYSTEM OF REPUBLICA OF CROATIA

By regional socio-economic system in Yugoslavia is meant : "Territorial-geographical and analytical-planning frame for mutual solving of the common needs of associated communes.", in this project called : **CROATIA** ! Owing to the knowledge and methodology of the following scientific disciplines : The General Theory of Systems, The General Theory of Management, The Theory of Information, The System Dynamics, The Global Theory of Organization, The Theory of Reproduction of Socio-Economic Systems, and The Theory of Chaos, it is possible to represent **REPUBLICA of CROATIA** with "rudimentary model of cause-consequences communication canals which flowing by material, energy and information flows , link between three systems: **CROATIA**, **YUGOSLAVIA (VDES)** and **THE REST OF THE WORLD (VDEIS-the remaining world to which economic migrations of CROATIA tend to flow)!**

REPUBLICA of CROATIA is, at the same time, a subsystem of **YUGOSLAVIA** (the country to which it belongs), and **THE REST OF THE WORLD** (of the developed countries-the remaining world to which economic migrations of **CROATIA** tend to flow)!

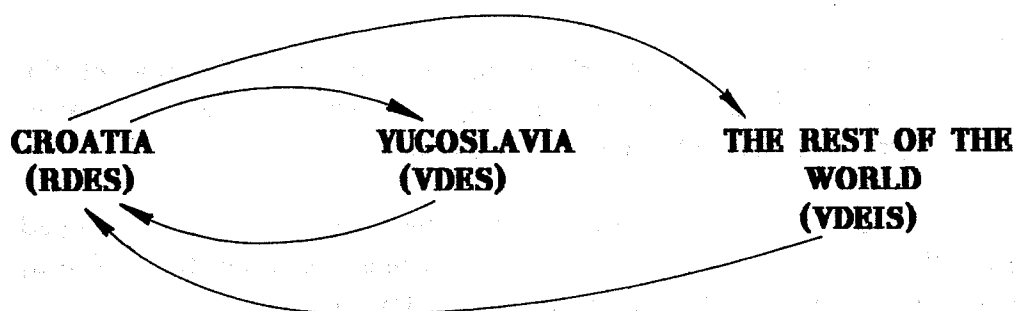


Figure 1. Rudimentary model of material, energy and information communication canals of **CROATIA**.

The directed full-curves represent at least one flow of matter or information, in this case : economic migrants, financial capital, information of trade prosperity e.t.c..

Let it be :

- MZS** =Material Standard of Living of **CROATIA**
(national income per capita, \$/person-year)
- MZSO** =Material Standard of Living of **YUGOSLAVIA**
(national income per capita, \$/person-year)
- MZSI** =Material Standard of Living of **THE REST OF THE WORLD** (national income per capita, \$/ person-year)
- RNPR** =The Level of the Economic Migrants of **CROATIA** in **THE REST OF THE WORLD** (persons)
- RPORO** =Restrictive Policy of The Employing Possibility for Economic Migrants of **YUGOSLAVIA** in **CROATIA** (mechanical inflow) (dimensionless)
- RPORI** =Restrictive Policy of The Employing Possibility for Economic Migrants of **CROATIA** in **THE REST OF THE WORLD** (dimensionless)

It is possible to present the structural-causal model of

CROATIA by these cause-consequences links between level and rate variables (Figure 2.):

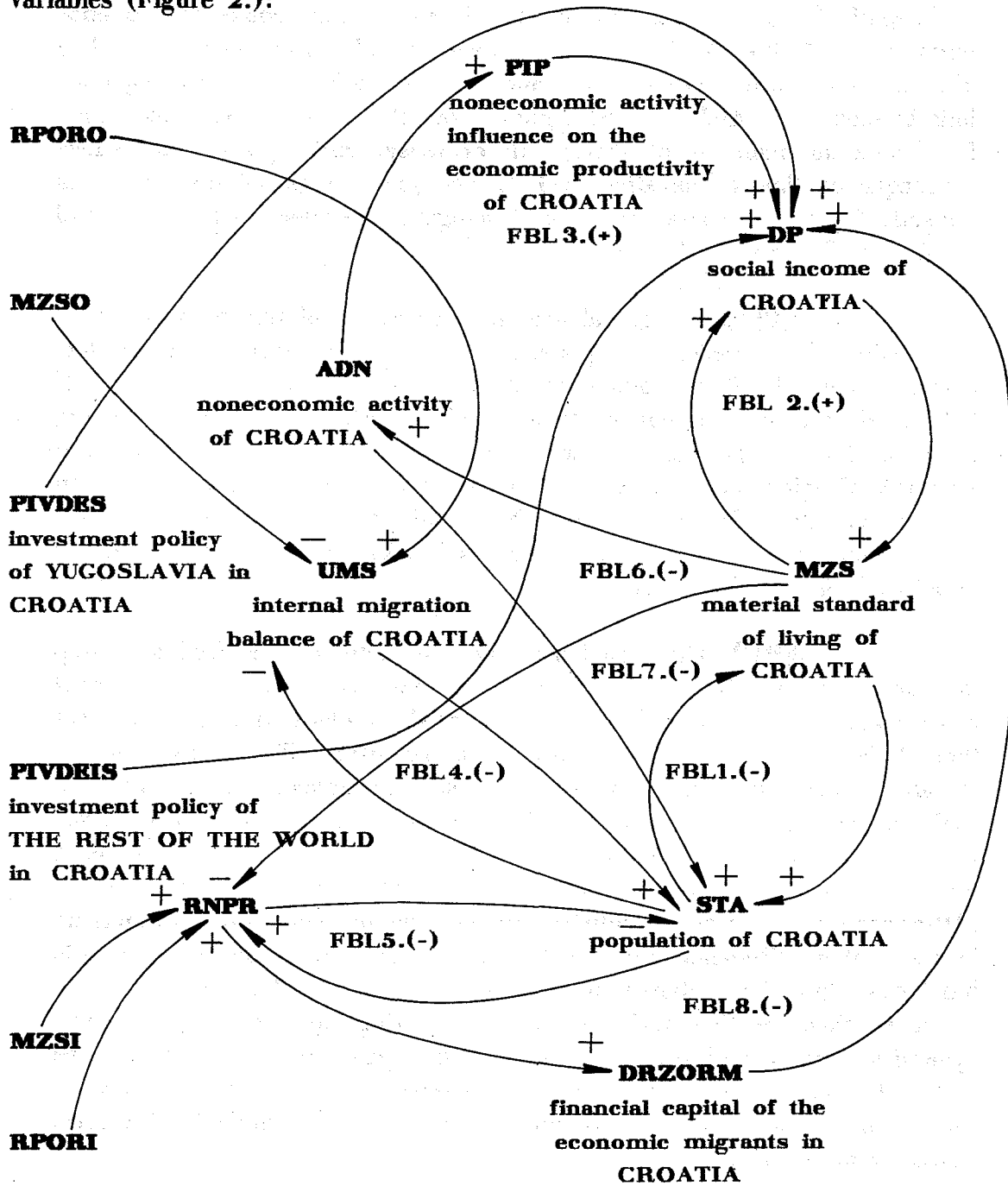


Figure 2. The structural model of **CROATIA**

FBL1. This feedback loop has a self-managing character, or "negative" sign, because in the FBL1. exists next cause-consequence links : " If the MZS- material standard of living increases then STA-population will increase too, and sign of this cause -consequence link is plus (+)". And, " if STA-population of CROATIA increases then MZS-material standard of living will decrease, and sign of this cause -consequence link is "negative" (-) ". The global sign of the FBL1. is "negative", or its character is selfmanaging, because FBL1. has odd number of "negative" signs !

FBL2. The global dynamics character of this feedback loop is "positive". It means : exponential increase or decrease character, because in this feedback loop exist those cause-consequences links : " If DP social income increases than MZS-material standard of living (national income per capita) will increase too. And, if MZS-material standard of living increases that DP-social income will increase too." ! In this case, this feedback loop has not any dynamics character cause-consequences links with "negative" sign and result is global "positive" sign of the FBL2. .

FBL3. The global dynamics character of this feedback loop is same as FBL2., because in this feedback loop exists next cause-consequences links : " If MZS-material standard of living increases then ADN-noneconomic activity (or social activity) will increase too. It means: "positive" sign of this cause-consequences link! And, if ADN-noneconomic or social activity increases then PIP-noneconomic activity influence on the economic productivity of CROATIA will increase too, and dynamics character of this link is also "positive". Further, if PIP-noneconomic or social activity influence on the economic productivity increases then DP-social income will increase too, and it means, that this link has "positive" dynamics character. And, if DP-social income increases then MZS-material standard of living will increase too, and dynamics character of this link will also be "positive" We could see that FBL3. has not any "negative" dynamics character cause-consequences links, and direct effect is : "positive" dynamics character of the FBL3.!

FBL4. This feedback loop represents an "internal migrations balance" of **CROATIA**, and so, it has special importance, because **CROATIA** is very interesting for the population of the "rest of Yugoslavia" (economic emigration flow = "mechanical inflow"). In this

feedback loop exists following cause-consequences consideration holds good : "If the MZSO-material standard of living of YUGOSLAVIA increases then the UMS-internal migration balance of CROATIA will decrease, because "mechanical inflow" from the rest of YUGOSLAVIA could be decrease. This means, that dynamics character of this cause-consequence link has "negative" sign. Further, if RPORO-restrictive policy of the employing possibility for economic migrants of YUGOSLAVIA (VDES) in **CROATIA** increases then the UMS-internal migration balance will increase too, it means : "positive" sign of this link. At same case, if the UMS-internal migration balance of **CROATIA** increases then also the STA-global level of population will increase, it means, that this link has "positive" dynamics character. And, if STA-global level of population of **CROATIA** increases then the UMS-internal migrations balance of **CROATIA** will decrease, it means, that this link has "negative" sign. The global dynamics sign of the FBL4. is "negative", it means, that FBL4 has "selfmanaging dynamics character"."!

FBL5. This feedback loop represents an external migrations balance, or exactly : RNPR-level of economic emigrant workers of **CROATIA** on temporary work in THE REST OF THE WORLD (VDEIS), and it is very important for **CROATIA** ! RNPR-level of economic emigrant workers of CROATIA on temporary work has greatly contributed to the development of **CROATIA**, in the post-II World War period. The FBL5. has also "self-managing" character, or "negative" global sign. This dynamics character is result existing of the next cause-consequences links : " If the RNPR-level of economic emigrant workers on temporarily work in THE REST OF THE WORLD increases then STA-global level of population of **CROATIA** will decrease, and it means: "negative" dynamics character of this link. Further, if STA-global level of population of **CROATIA** increases then RNPR will increase too, and it means : "positive" dynamics character of this cause-consequences link, or "positive" sign" ! The global dynamics character of FBL5. is "negative", or "selfmanaging", because it has odd number of "negative" signs.

FBL6. This feedback loop is very important for socio-economic development of **CROATIA**, because it has "self-managing" or "self regulation" dynamics character, and in this feedback loop exists the next cause-consequences links : " If MZS-material standard of living of **CROATIA** increases then ADN-social

activity of **CROATIA** will increase too, and this means : "positive" dynamics character of this link. Further, if ADN-social activity of **CROATIA** increases then STA-global level of population of **CROATIA** will increase also, and we see that dynamics character of this cause-consequences link is "positive". And, if STA-global level of population increases then MZS-material standard of living of **CROATIA** (national income per capita) will decrease, and the dynamics character of this cause-consequences link is "negative" or "self-managing"!". In any case, the global dynamic character of FBL6. is "negative" or "self-managing" or "self-regulation", because FBL6. has odd number of "negative" signs.

FBL7. This feedback loop has "self-managing", or "self-regulation" dynamics character, also as FBL6., because it has next cause-consequences links : " If the MZS-material standard of living increases then RNPR-level of economic emigrants workers of **CROATIA** on temporary works in THE REST OF THE WORLD will decrease, and it means : "negative" sign of this cause-consequences link. Further, if RNPR-variable increases then STA-global level of population of **CROATIA** will decrease, and it means : "negative" sign of this cause-consequences link, and, if STA-global level of population of **CROATIA** increases then the MZS-material standard of living will decrease, and it means also : "negative" sign of this cause-consequences link."! Because FBL7. has odd number (3) of "negative" signs then FBL7. has also "negative" sign, or "self-managing" or "self-regulating" dynamics character!

FBL8. The FBL8. has also "self-managing" or "self-regulation" dynamics character, because in it exists next cause-consequences links : " If the RNPR-migrant workers of the **CROATIA** on temporary work in THE REST OF THE WORLD increases then DRZORM-investment capital, or worker remittance, of the abroad economic migrants will also increase, and dynamic character of this cause-consequences link is "positive", and, if DRZORM- variable increases then DP-social income of **CROATIA** will also increase, which it means also "positive" sign of this link. Further, if DP-social income of **CROATIA** increases then MZS-material standard of living of **CROATIA** will increase too, and it means also "positive" sign of this link. And, if MZS-material standard of living of **CROATIA** increases then RNPR-variable will decrease, and this last cause-consequences link has "negative" sign."! The global sign of FBL8. is "negative" , or "self-managing" too, because it has odd number of "negative" dynamics

character links!

Also, it is very important to tell that YUGOSLAVIA (VDES) and THE REST OF THE WORLD (VDEIS) have had special investment policy for social-economic developing of **REPUBLICA CROATIA** (RDES). For this reason, in this model, there are two variables : PIVDES-investment policy of YUGOSLAVIA (VDES) in the **CROATIA**, and PIVDEIS-investment policy of THE REST OF THE WORLD (VDEIS) in the **CROATIA** ! Both have same dynamics character : "positive", because their increase has for influence also increased the DP-social income of **CROATIA** !

3. CONSEQUENCE : "SYSTEM DYNAMICS COMPUTER SIMULATION MODEL OF C R O A T I A"

On this " system dynamics way ", and, in the same time, in the accordance with System Dynamics knowledge and experiences, the autor of this paper has worked out two : "System Dynamics Computer Simulation Model of **CROATIA**" :

1. "**MRDES**"-first simpler, with only 131 main equations (the autor had represented this model on the INTERNATI- ONAL SYSTEM DYNAMICS CONFERENCE 1988, San Diego, California, La Jolla, July 5-8), and
2. "**PSMURPI**"-second complex, with more than 655 equations (the autor worked out this model at the beginning of 1991.).

"**MRDES**" is composted of the 9 sectors :

1. POPULATION,
2. GLOBAL MIGRATION BALANCE,
3. WORKINGACTIVE POPULATION,
4. LABOUR,
5. LABOUR ON THE TEMPORARY WORK,
6. ECONOMIC AND NONECONOMIC PRODUCTION CAPACITIES,
7. SOCIAL AND NATIONAL INCOME,

8. REPRODUCTION FUNDS,

9. INFLUENCE OF ENVIRONMENT (VDES AND VDEIS).

"PSMURP1" is composed of 4 parallel "MRDES" submodels, because **REPUBLICA of CROATIA** as a whole, has 4 Regional Socio-Economic System, or 4 regions, and summary model of **CROATIA**.

"MRDES" and "PSMURP1" has one special **MACRO** function for computing "average growth rate" of any variable, in (%), and it has next model in **DYNAMO** :

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MACRO PCSRV(X,DELP)
INTRN DELX,SLOPE
L DELX.K-DELX.J+(DT/DELP)*(X.K-DELX.K)
N DELX=X
A SLOPE.K-(X.K-DELX.K)/DELP
A PCSRV.K-(SLOPE.K/DELX.K)*100
MEND

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In any case, DELP=average time period, and modeller has a possibility to take any number of elementary time period !

"MRDES" and "PSMURP1" have two worked out software versions :

1. in "SYSDYNS" (autor is Dr. Ante Munitic), which has for operative base : **QUICK BASIC (QB)** language, and
2. in "PROFESSIONAL DYNAMO PLUS" (PDP) !

4. INSTEAD CONCLUSIONS

"MRDES" and "PSMURP1" have instaled in **STATE INSTITUTION OF REPUBLICA OF CROATIA** (Project : " **SYSTEM DYNAMICS COMPUTER SIMULATION MODEL OF C R O A T I A** ") , and theirs author is ready to represent them on PC , to anybody interested in it, if he could, and what he could have too!

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