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MODELLING OF CAPITAL ACCUMULATION AND INVESTMENT BY SYSTEM DYNAMICS APPROACH

Capital is one of the basic factors of production along with land and labor. It includes all goods that are made or created by humans and used for producing goods or services. Capital can also refer to money invested in a country.

Our task was to investigate the structure of capital stock accumulation and to analyze the main relations in this sector of economy. The aim of our project was to explore the behavior of capital and investment by using system dynamics approach. We also wanted to show how our model is suitable for estimating the values of main variables in Capital sector.

Furthermore using opportunities of Stella Architect we have compared the output variable of model with historical values of this variable. In addition, Theil statistics helped us to measure the root mean square error and to characterize the source of error.

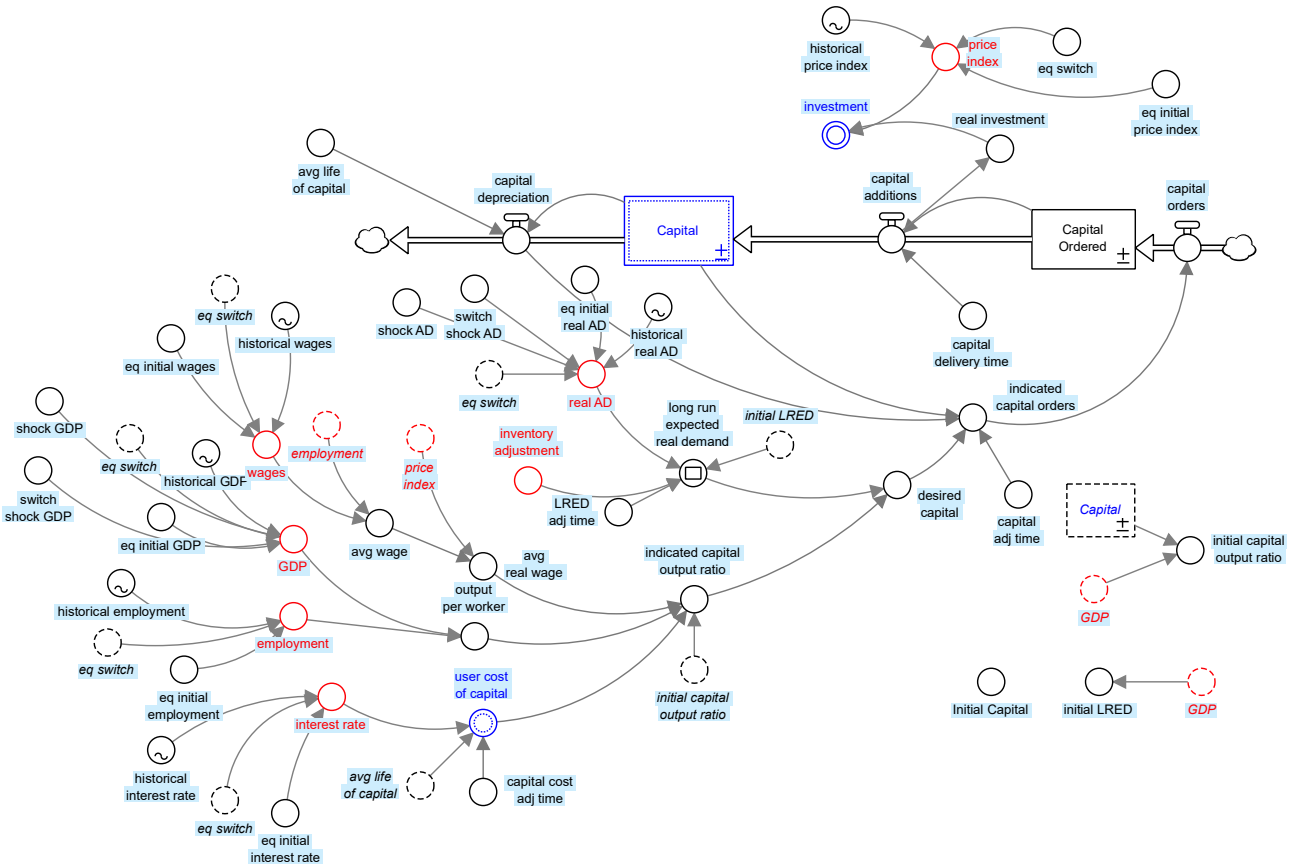

Figure 1. **The system dynamic model of capital and investment**

Investment is the outcome of a capital decision-making process that generates "orders" for capital, along with a plan to pay for those orders. Real investment is the nominal payment for the capital additions, which result from capital orders. The

amount of investment is needed to maintain the value of the capital stock at its current level.

The graph below helps to compare the behavior of historical investment and model data of investment.

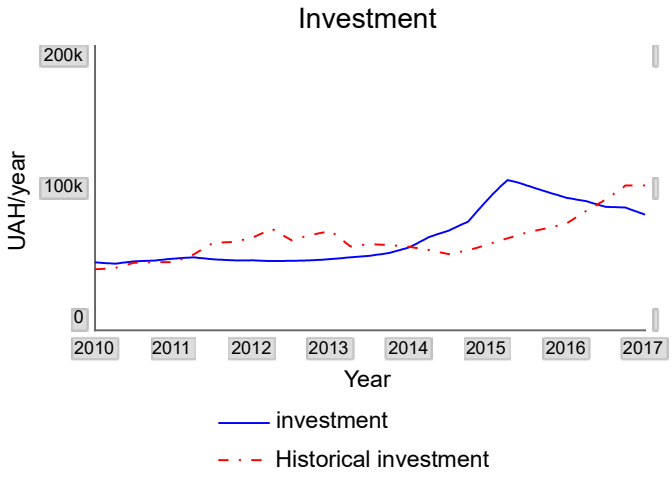

Figure 2. **Comparison of model and historical data of investment**

Indicated capital orders flow from a decision rule that starts with capital depreciation and then adds the difference between desired capital and current capital. Desired capital is equal to long run expected real demand multiplied by indicated capital output ratio. Desired capital rises when long run expected real demand rises, following extended period of LRED adjustment time and updating perceptions of aggregate demand.

Capital model contains 7 endogenous variables: real AD, employment, wages, GDP, interest rate, price index and inventory adjustment. To investigate the behavior of outputs we used historical data for all of them. Historical horizonts starts from 2010 to 2017.

The capital sector contains five time-related parameter assumptions: average life of capital, capital adjustment time, capital delivery time, capital cost adjustment time and LRED adjustment time.

In the capital model the initial value of the capital stock depends, in part, on the average life of capital. Thus, a change in the assumption for the average life of capital affects more than just the model's response to the demand shock; it also affects the initial investment necessary to maintain the initial equilibrium condition.

Gross domestic product (GDP) is the monetary value of all the finished goods and services produced within a country's borders in a specific time period. Output per worker equals GDP divided by employment.

Interest rate is the amount charged by a lender to a borrower for the use of assets. Changes in interest rates affect the public's demand for goods and services and, thus, encourage additional investment spending, which gives the economy a boost in times of slow economic growth. When interest rate rises and the average life of capital declines, the user cost of capital rises and a lower indicated capital output ratio is desired. When average real wage rises faster than output per worker, relatively less labor is desired, and higher indicated capital output ratio is desired.

For better understanding the model structure, we should consider our model in equilibrium. Equilibrium implies that all stocks stop changing, which in turn means the values of flows become zero.

The system dynamics models provide the opportunity to analyze the results of particular parameters interacting and reactions to individual factors changing.

During our modeling project, we have considered the Capital model, defined the model boundary and described the behavior of the key variables. Moreover, we have converted feedback diagrams to level and rate equations, estimated and selected parameters values, simulated the model and tested the model behavior and sensitivity to perturbations. We have explored the main principles of Capital model. Both qualitative and quantitative system dynamics modeling of the investment have been presented.

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THE POLICY IMPLEMENTATION ACCORDING TO SYSTEM DYNAMIC APPROACH

Policy analysis is a social and political activity. True, analysts take moral and intellectual responsibility for the quality of their policy-analytic work. But policy analysis goes beyond personal decision making. First, the subject matter concerns the lives and well-being of large numbers of their fellow citizens. Second, the process and results of policy analysis usually involve other professionals and interested parties: it is often done in teams or officewide settings; the immediate consumer is a "client" of some sort, such as a hierarchical superior; and the ultimate audience will include diverse subgroups of politically attuned supporters and opponents of the analysts' work. All of these facts condition the nature of policy analysis and have a bearing on the nature of what is meant by "quality work."

Talking about policy implementation worth to know about distinction of two types of model: explanatory model and policy model.

Explanatory model is a model which explain the past. This model should include policies that were operating in the past and should not include new policy structure.