Ivona Milić Beran
University of Dubrovnik, Dubrovnik, Croatia
Maritime Department
E-mail: ivona.milic-beran@unidu.hr

SYSTEM-DYNAMIC MODELING OF THE IMPACT OF SOCIAL CAPITAL ON ECONOMIC GROWTH

Abstract

This paper presents a qualitative and quantitative system-dynamic modeling of the impact of social capital on economic growth. Social capital is the most problematic of all the concepts that determine progress. On a broad conceptual level, there is agreement about the importance of social capital, which has been used to explain differences in progress among nations with similar natural, human and physical capital. Recent research suggests that it is more important to include an explanation of the interaction of economic actors and their organization when measuring progress than to measure progress without the influence of social capital. The purpose of this paper is to develop a system-dynamic model of the impact of social capital on economic growth that will enable better understanding and management of social capital. In order to build a system dynamics model, the paper will: provide an analysis and overview of social capital and system dynamics; develop a system dynamics structural and mental-verbal model of the impact of social capital on economic growth; and develop a mathematical model of economic growth. This will provide a practical insight into the dynamic behavior of the observed system, i.e., analyzing economic growth and observing the mutual correlation between individual parameters.

Key words: social capital, economic growth, system dynamics, structural model

1. INTRODUCTION

The subject of this paper is qualitative and quantitative system dynamics modeling of the effects of social capital on economic growth. The methodology of system dynamics modeling, which has been rarely used in researching economic issues, is nonetheless treated in this paper. System dynamics is a computer simulation modeling method used to analyze complex, nonlinear, dynamic feedback systems to gain insight and design strategies that improve system performance. System dynamics models are built by identifying and linking the relevant parts of a system's structure and simulating the behavior produced by that structure. Through an iterative process of structure identification, linkage, and simulation, a model is created that can explain the problematic behavior of a system and serve as a vehicle for policy development and testing strategies.

Social capital is an important factor in economic growth, both directly and indirectly. Exploring the nature of capital from the perspective of economists and social planners contextualizes social capital as an economic concept and provides ideas on how to conceptualize social capital in organizational terms. There is no consensus on the definition of social capital: its

composition, functioning, scope, sources, manifestations and consequences. Despite its problematic nature, there are four broad approaches (OECD, 2001) that can help define it.

1. anthropological - it is the biological foundation of social order: people have a natural instinct to associate and form groups for mutual benefit, and it is part of human nature (interest).
2. sociological - emphasizes social organizations, certain aspects of trust, reciprocity, and civic engagement network that reflect interest at the organizational level.
3. economic - focuses on how individuals communicate with each other out of self-interest (individual interest to increase personal gain) and how they invest and exploit resources.
4. political - emphasizes the role of institutions, political and social norms in shaping human behavior.

Social capital is the most problematic of all the concepts that determine progress. On a broad conceptual level, there is agreement about the importance of social capital, which has been used to explain differences in progress among nations with similar natural, human and physical capital.

2. LITERATURE REVIEW

In economic theory, capital is defined as one of the three primary factors of production (land, labor and capital). The basic definition was expanded in the second half of the twentieth century by three additions. The first of these was proposed by Solow (Slow, 1956), who became known as the neoclassical growth model, which explained how innovation and capital affect each other. His model described the multiplier effect of investment in technology and the processes that develop innovative technologies on capital and manufacturing. The other two are the ideas of human capital and the idea of social capital. Schultz (Schultz, 1961) developed human capital as an economic concept in terms of the added value of work through the provision of knowledge and skills, and so did Becker (Becker,1964) in terms of education in a broader sense. Putnam and others added a third innovation in thinking about capital, about social capital, emphasizing that human capital is found in individuals and that it is necessary to build a network of relationships and norms of reciprocity and trust between people in order to use it. The World Bank, as an international agency whose main interest is to mobilize investment in human capital and reduce poverty, describes social capital as institutions, relationships, networks and norms that shape the quality and quantity of social interactions.

Social capital can be considered (Bourdieu, 1985) in two elements: the first, in the size of the network of relations (social relations to gain access to resources) and the second, in the sum of its cumulative, cultural and economic resources, focusing on the social and economic resources embodied in social networks (quantity and quality of these resources). For Bourdieu, social capital has never been separated from economic capital. Instead, capital is expanded to include material exchange relations and non-economic forms of capital, especially cultural capital. He also points out that social capital is realized by individuals but is not owned by them.

Social capital is linked to economic capital through a series of economic and power relations (non-economic). The emphasis on the complementarity between social and human capital in relation to school attendance, stimulated interest in the study of social capital. Coleman attempted to reconcile the sociological view, according to which people are shaped by the environment or social structures, and the economic view, according to which people act as independent individuals who seek to maximize profits and act rationally (Coleman, 1988).

The accumulation of social capital is very important to improve performance as it can integrate human capital and organizational capital to form intellectual capital. Integration of the three capitals stimulate mutual trust within the organization, improve innovative capabilities, and enlarge the network of connections which can ultimately improve organizational development and financial performance (Liu, 2017). Scholars (Zhao et al., 2011; Sultana et al., 2019) claim that social capital greatly contributes to the improvement of organizational capabilities, influencing

individual decisions in improving business performance. Employees of various service organizations recommended to invest in social capital because it is proven to have a significant influence on employee commitment (Ellinger, 2013). Other studies (Syed & Kamel, 2018; Kaltenbrunner & Renzl, 2019) showed that social capital is related to organizational performance.

Recent research suggests that it is more important to include an explanation of the interaction of economic actors and their organization when measuring progress than to measure progress without the influence of social capital.

3. SYSTEM DYNAMIC STRUCTURAL AND MENTAL-VERBAL MODEL OF SOCIAL CAPITAL

Based on the analysis of parameters influencing social capital and interaction of social, psychological and moral capital, its structural model is designed (Figure 1) The basic variables in this model are: relative changes in trust, employment, moral capital and psychological capital.

Social capital plays an important role in increasing the efficiency of political institutions and improving economic performance. The system dynamics model integrates both economic variables and the perceived social capital of the state. The economic variable is employment (although other variables also enter the model, but indirectly), while the so-called soft variable is trust in government institutions.

While trust is only one component of social capital in different definitions and dimensions of social capital, the research shows that this dimension is indispensable for social and economic relations. Trust between individuals (interpersonal trust) and trust in institutions (institutional trust) have been shown to be a decisive determinant of economic growth, social cohesion and well-being (Yann Algan, 2010). Countries with higher levels of trust tend to have higher income. In this way, whether people trust or not depends on their perception of how well societal institutions function. If people believe that strong enforcement mechanisms are in place to discourage cheating or other forms of uncooperative or socially harmful behaviours, they will be more likely to trust others in general (Knack and Keefer, 1997; Rothstein, 2000; Beugelsdijk, 2006). In this case, efficient institutions in which individuals trust are a key driver of trust in others in a cross-section of countries (Rothstein, 2011). Trust varies significantly within countries, depending on income, education, employment status and household type (OECD, 2017). Both generalised trust and trust in institutions are higher among higher income groups and among more highly educated people, and lower among unemployed people and single-person households with at least one dependent child.
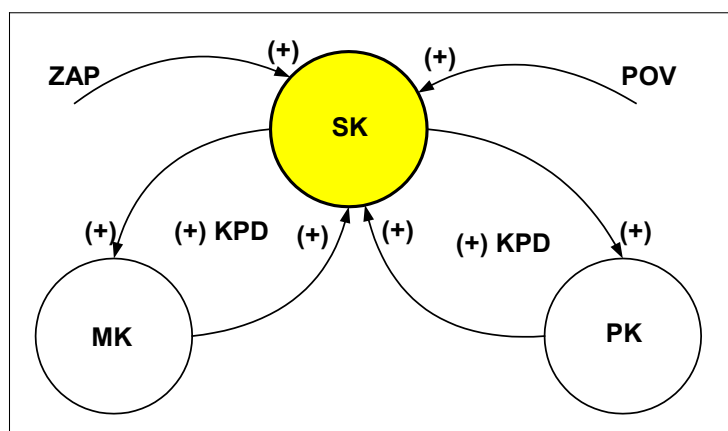
Source: Author's own.

Figure 1 Structural diagram of social capital

Social and moral capital influence each other, social capital increases economic rewards (Collier 2002), compliance with norms (Narayan and Cassidy 2001), which leads to increased morale and increases positive or socially desirable strengths of the individual (Hayashi and Yamagishi 1998). A more moral group or society is primed with the conditions for social capital, while an immoral society is clearly not. Morality relates to acting fairly and not harming others so creates favourable conditions for a wide range of factors related to social capital such as trust, reciprocity, and norms of giving, sharing, and helping. Immoral acts, on the other hand, have ripple effects through society that are likely to have negative effects on various aspects of social capital (Claridge, 2019).

An association between social capital and a better state of individual and public health, higher optimism, increased engagement in positive hygienic behaviours, increased resilience to difficulties and reduced mental disorders. Moreover, people with higher psychological capital are more capable of engaging in group interactions and social participations. Thus, psychological capital connects people to each other and enable repeated and sustained interaction. It appears that people with higher psychological capital tend to have more and continued social interactions and enjoy a better social life (Allameh et all. 2018).

4. SYSTEM DYNAMIC MENTAL-VERBAL MODEL OF SOCIAL CAPITAL

Social capital (SK) is most strongly influenced by employment of the working age population (ZAP), trust in government institutions (POV), moral capital (MK) and psychological capital (PK). When the ZAP increases, the SK increases, which means that the internal relationship is positive. When the POV increases, the SK increases, so the effect on the SK is positive. When the MK increases, the SK also increases, which means that the dynamic nature of the internal feedback is positive. The KPD feedback cycle is positive. When the PK increases, the SK increases, so the KPD feedback cycle has a globally positive character. Figure 1 shows a structural diagram of social capital, using the same labels as in the following system-dynamic mental-verbal model.

The flowchart is a quantitative system model that clarifies the basic physical system structure and provides more information than a structural diagram. The stock and flow diagram of social capital in DYNAMO symbolic, shown in Figure 2 is based on the structural and mental-verbal models.
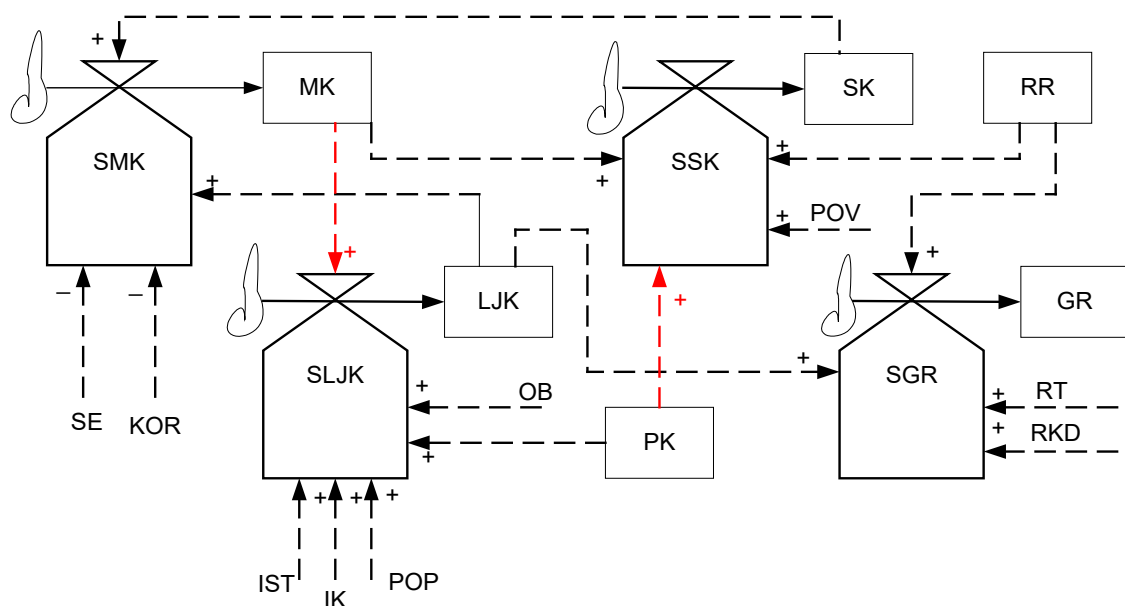
Source: Author's own.

Figure 2 Social capital stock and flow diagram

Basic features of the stock and flow diagram are: system stocks, flows between stocks, control function that controls the amount of matter, energy, or information that flows between system stocks and information channels that connect the system stocks to the control function.

The value of social capital depends on its previous value and the rate of its change. The rate of change of social capital is affected by the change in moral capital, psychological capital, employment of the working age population and trust in government institutions.

5. MATHEMATICAL MODEL OF THE EFFECT OF INTELLECTUAL CAPITAL ON ECONOMIC GROWTH

After the definition of the problem, which is the first stage of system dynamics modeling, the second stage takes place - the system conception. It includes the development of the mathematical model based on the created cause-effect diagrams and the structural system model. The stage of mathematical model development is crucial for modeling the system dynamics. The dynamic mathematical model is created theoretically using the basic laws of system behaviour. The Cobb-Douglas formula is the basic starting point for the development of the mathematical model of the influence of social capital on economic growth.

GR in the equation (1) represents a relative value of the economy growth at a specific time interval and it is calculated by adding up the preceding economy growth value to economy growth relative change rate integral in the preceding time interval. SGR stands for the economy growth relative change rate which is equal to the first economy growth derivation and it is obtained by adding up the technological capital relative value RT, the capital goods relative value RKD, the human capital relative value LJK as well as the work resources relative value RR multiplied with the corresponding coefficient indicated in the equation (2).

Human capital-LJK- (equations 3 and 4), moral capital-MK- (equations 5 and 6), social capital-SK- (equations 7 and 8) and psychological capital- PK-(equations 9 and 10) can be calculated according to the following equations:

$$GR = GR_0 + \int_{t_1}^{t_2} SGRdt \tag{1}$$

$$SGR = \frac{d}{dt}(k_1 * RT + k_2 * RKD + k_3 * LJK + k_4 * RR) \tag{2}$$

$$LJK = LJK_0 + \int_{t_1}^{t_2} SLJKdt \tag{3}$$

$$SLJK = \frac{d}{dt}(k_6 * OB * KSGRO + k_7 * POP + k_8 * PK + k_9 * IK + k_{10} * IST + k_{11} * MK) \tag{4}$$

$$MK = MK_0 + \int_{t_1}^{t_2} SMKdt \tag{5}$$

$$SMK = \frac{d}{dt}(k_{12} * SK - k_{13} * KOR - k_{14} * SE + k_{15} * LJK) \tag{6}$$

In equation (5), the MK is the relative value of moral capital growth in a given time interval and is calculated by adding the previous value of moral capital and the product of the time step and the relative rate of change of moral capital in the previous time interval. The SMK means the relative rate of change of moral capital, which is equal to the first derivative of moral capital, and is obtained by subtracting the relative value of the change in corruption and the relative value of the change in the shadow economy from the relative value of the change in social capital, multiplied by the corresponding coefficients given in equation (6).

$$SK = SK_0 + \int_{t_1}^{t_2} SSKdt \tag{7}$$

$$SSK = \frac{d}{dt}(k_{17} * PK + k_{18} * POV + k_{19} * RR + k_{20} * MK) \tag{8}$$

$$PK = PK_0 + \int_{t_1}^{t_2} SPKdt \tag{9}$$

$$SPK = \frac{d}{dt}(k_{25} * SK + k_{21} * PR + k_{22}O * GR - k_{23} * N + k_{24}LJK) \tag{10}$$

In equation (7), the SK is the relative value of social capital growth in a given time interval and is calculated by adding the previous value of social capital to social capital relative change rate integral in the previous time interval. The SSK expresses the relative rate of change of social capital equal to the first derivation of social capital and is obtained by summing the following values: relative values of change in psychological capital, relative values of change in trust in institutions, relative values of change in labor resources, relative values of change in moral capital, multiplied by corresponding coefficients in equation (8).

In equation (9), the PK is the relative value of the growth of psychological capital in a given time interval and is expressed by the sum of the previous value of psychological capital and the integral of the relative rate of change of psychological capital in the previous time interval. The SPK represents the relative rate of change of psychological capital, which is equal to the first derivation of psychological capital and is obtained by the sum of: relative values of change of social capital, relative values of change of productivity, relative values of change of secondary education multiplied by economic development, relative values of change of human capital. unemployment, multiplied by the corresponding coefficients indicated in equation (10).

The values of intellectual capital IK, research IST, corruption KOR, education OB, government institutions credibility POV, work resources RR, grey economy SE, psychological capital PK, population POP, capital goods RKD as well as technological capital TK are variables that are important for economic growth, but are not the subject of study in this work.

6. CONCLUSION

Social capital is found in individuals, and in order to use it, it is necessary to establish networks of relationships and norms of reciprocity and trust between people. Social capital contributes to productivity and is associated with economic security. Social networks and norms help people to act collectively and improve the efficiency of economic agents.

The paper presents the complexity of the influence of social capital on the dynamics of economic growth behavior. The structural diagram of social capital provides a graphical representation of the interaction of individual factors under direct and indirect influence. Knowledge of the cause-effect relationships between variables and social capital factors is particularly valuable. They are represented by feedback loops that appear as negative or positive feedback and are constructed based on the mental-verbal model presented.

The final phase of the research was to develop a mathematical model for the system of influence of social capital on economic growth, based on mental-verbal and structural models. Mathematical models are a very precise way to describe the functioning of individual subsystems and the interaction of individual parameters and factors within the system.

The impact of social capital on economic growth is a topic that undoubtedly can and must be discussed further. As the COVID -19 pandemic has affected economic and social activities, national blockades and government restrictions require the adaptive capacity of individuals as well

as economies, further research needs to analyze and determine how individual economies have responded and how successful they have been and can be.

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