

## Social Capital and the Narrow Corridor of Development

By Hassan Daliri\*

*The central question of this research is: under what conditions can social capital improve economic development? The results of the analysis show that the relationship between micro and macro levels of social capital is the key factor to answer this question. Countries can use the benefits of social capital and be in the “corridor of development” when both micro and macro levels of social capital are high in that country and society. Otherwise, social capital cannot improve economic development indicators. According to the relative levels of micro and macro social capital, countries are placed in four main groups in terms of moving towards development: a. development corridor, b. “Swamp Corridor of Underdevelopment” c. “Uphill Corridor of Development” and d. “Rugged Corridor of Development”. To examine the idea presented in the research, an Agent-based approach was used. The simulation results indicate that the relative levels of micro and macro social capital are an important factor in determining the long-term economic welfare and development of societies. So in summary we can say: In order for social capital to have beneficial effects on economic performance; first, there is a need for the social capital formed in the society to be of a good type and help the development path. Secondly, in-group social capital and outgroup social capital should be placed in an optimal fit (relative to society structures). Thirdly, the economic and social platforms of the society that direct and create these connections (such as institutional arrangements, property rights, etc.) are sufficient to form these intermediary circles with the appropriate force.*

**Keywords:** Development Corridor, Social Capital, Trust, Agent Based Model.

### Introduction

While countries exhibit profound heterogeneity in developmental trajectories, traditionally explained by divergent institutional frameworks (Acemoglu & Robinson 2012), resource endowments (Sachs & Warner 2001), or technological diffusion (Comin & Hobijn 2010), an emerging body of research compels us to ask: could deep-seated differences in social trust and capital—the informal norms and networks facilitating cooperative action (Putnam 1993, Fukuyama 1995)—constitute a fundamental, yet underexplored, determinant shaping these economic foundations and their effectiveness? Before the 1950s, economists generally treated the labor force as a homogeneous variable, overlooking the possibility that individuals might have varying capabilities. Economic models based on this assumption struggled to fully explain the complexities of economic growth, highlighting a need to consider the role of human capital. The subsequent incorporation of human capital into growth models helped address some gaps; however, the introduction of social

---

\*Associate Professor of Economics, Department of Management and Economics, Faculty of Humanities and Social Sciences, Golestan University, Gorgan, Iran.

capital into economic analysis raised a new and critical question: Why do some countries fail to achieve sustainable economic growth despite having access to modern technology and a well-educated labor force (human capital)? This question gained prominence after the early 1990s, when some countries rapidly progressed toward development, even though they lacked substantial physical capital and had limited human capital. It was during this period that researchers began to recognize the economic importance of social capital—a concept with deep historical roots essential to human society since the dawn of social life. Although the term "social capital" was first introduced by the sociology teacher Hanifan in 1916, it remained largely within the domain of sociology until the early 1990s. At this time, economists began to appreciate the significance of social capital, identifying it as a "missing link" in understanding economic growth. As a result, empirical studies investigating the impact of social capital on economic growth and productivity proliferated globally. These studies consistently demonstrated that social capital plays a significant role in enhancing economic production, reinforcing its value as a crucial component in economic development frameworks. This shift marked a broader recognition of social capital's impact, not only as a complement to physical and human capital but as a distinct force capable of influencing economic trajectories across nations. By social capital it is meant the social and cultural cohesion of society and norms and values governing the interactions between individuals and institutions. Social capital is as social glue which guarantee the cohesion of societies and without it nor economic growth neither betterment of human life is possible (Fine 2001). Social capital concept is indicative of the fact that how the social structure of a group can act as a source for the individuals of that group. In other words, social capital is the value of social structure, as a source, which is put at the members' disposal as a source to achieve their objectives (Coleman 1990).

This paper aims to fill this gap by developing an agent-based model that simulates the effects of social capital on development within the narrow corridor framework. Agent-based modeling captures decentralized, adaptive interactions between individuals and groups—mirroring real-world social capital dynamics—and reveals emergent outcomes inaccessible to aggregate models (Teshfatsion 2006). Agent-Based Modeling (ABM) provides a powerful and flexible framework for analyzing the complex and dynamic nature of social capital, particularly in settings where individual behaviors and local interactions aggregate into emergent macro-level patterns. Unlike traditional analytical or econometric models that often rely on equilibrium assumptions and aggregate relationships, ABM allows for the explicit modeling of heterogeneous agents who interact, learn, adapt, and form or dissolve social ties over time. This is especially relevant for social capital, which is inherently rooted in micro-level relationships such as trust, reciprocity, and norms of cooperation. Through ABM, we can simulate how bonding (intra-group) and bridging (inter-group) social capital evolve under different institutional or economic settings, observe feedback loops between social cohesion and collective welfare, and explore non-linearities and tipping points that may arise from structural shifts in networks. Specifically, we examine how different levels of intra- and inter-group trust—key components of social capital—influence collective welfare and resilience. We hypothesize that higher levels of both types of trust promote conditions that enable

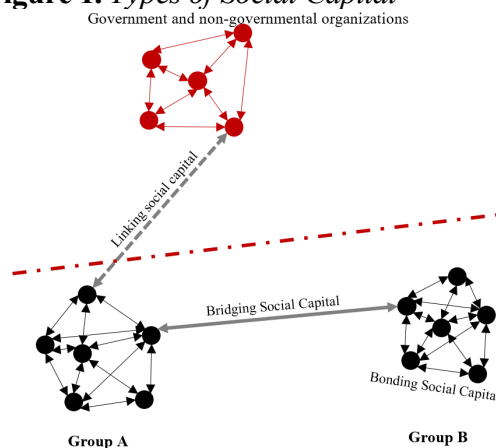
societies to stay within the narrow corridor, while low levels increase the risk of instability. The results have significant policy implications, offering insights for countries seeking to strengthen social capital as a means to foster sustainable development within the narrow corridor.

## Core Concepts

### *Types of Social Capital*

Social capital can be categorized in different aspects. Bonding Social Capital, as its name implies, is a type of social capital that describes the connections within a group or society with high levels of similarity in demographic characteristics, attitudes, and information. Bonding Social Capital shows the links between people with a relatively high degree of dependence. This type of social capital often flows as horizontal ties between people in the same social group where people have close interactions with each other. According to Figure 1-3, Bonding Social Capital refers to the connections of each person within each group, people who are placed together and have deep connections due to a common characteristic. Bonding Social Capital is often associated with strong norms, customs and trust. In-group social capital exists between "people like us" who are "together and usually have close and strong relationships." (Claridge 2018). This type of social capital can be operationalized by measuring some specific trust indicators; For example, the severity of people's responses to the question "How reliable do you consider your family members, relatives and friends?".

**Figure 1.** *Types of Social Capital*



Groups are often separated based on certain characteristics (such as race, class, or religion), Bridging Social Capital is a type of social capital that binds people in these separate groups together; In other words, it "bridges" between different groups. According to Putnam, Bonding Social Capital is built around family, close friends and other close relatives. Instead, bridging social capital connects people with more distant acquaintances in circles other than their own. Instead of strengthening a small and

limited group, this type of capital tends to create wider identities and broader exchanges. Putnam believes that although Bonding Social Capital is useful for overcoming obstacles, Bonding Social Capital is necessary for progress. Some authors relate the difference between Bonding and Bridging social capital to different types of trust. Accordingly, bridging social capital can be conceptualized as Generalized Trust (earned trust) and Bonding social capital as Ascribed Trust (Van Staveren & Knorringa 2007). According to the dimension of communication that is formed in Bridging social capital, its benefits are very wide and can include: increasing the ability to gather information, the ability to gain power or a better position in the network, or the ability to better recognize new opportunities (Adler & Kwon 2002).

In addition to the two levels of social capital mentioned, some authors believe that a third type of social capital is needed to understand the power dynamics of vertical associations to complete the conceptualization of social capital. Woolcock calls this level linking social capital and defines it as a subset of Bridging social capital. If linking social capital is the third-level, in this case, Bridging social capital is an intermediate step between Bonding social capital and linking social capital. Linking social capital refers to the relationships between individuals and groups at different social levels in a hierarchy where power, social status, and wealth are accessible by different groups (Woolcock 2001). Linking social capital is a type of social capital that describes the norms of respect and networks of trust relationships between people who interact across overt, formal, or institutionalized power or authority in society (Szreter & Woolcock 2004). While bridging (outgroup) social capital creates horizontal trust between groups, Linking social capital involves classic Patron/Client or Mentor/Mentee relationships (Schneider 2006).

Here we consider two types of social capital. a. Micro social capital: This type of social capital emphasizes trust and connection with the circle of relatives and friends. b. Macro social capital: This type of social capital emphasizes trust and communication between individuals and small groups, with formal and informal institutions in society.

### *Narrow Corridor*

The "narrow corridor" framework, developed by Acemoglu and Robinson (2019), conceptualizes liberty as emerging from a perpetual and precarious balance between state capacity ("Leviathan") and societal countervailing power. This dynamic equilibrium—where a sufficiently centralized state enforces rules and provides public goods while being constrained by mobilized citizenry—constitutes the corridor (pp. 61-75). Societies outside this corridor face distinct pathologies: Absent Leviathans (weak states) descend into lawlessness or warlord dominance; Despotism (strong states unchecked by society) enable extractive institutions and suppress freedoms (pp. 41-60). Crucially, entering the corridor requires "Shackled Leviathan"—a state powerful enough to enforce order yet bound by societal norms, coalitions, and institutionalized contestation (e.g., England's Glorious Revolution, pp. 302-350). Sustained liberty demands continuous societal mobilization to prevent state overreach and institutional erosion, as backsliding occurs when either side gains decisive advantage (pp. 77-81). This framework rejects deterministic institutional paths,

emphasizing that corridor transitions depend on "History-dependent junctures" where contingent struggles reshape power balances (pp. 455–470). This conceptual framework is visually captured in the book's iconic diagram, where the vertical axis represents state capacity and the horizontal axis denotes societal power. The "narrow corridor" appears as a band along the diagonal, illustrating the delicate space where state and society grow together in mutual constraint and reinforcement. Above this corridor lie despotic states with overwhelming Leviathan power, while below it lie weak states dominated by fragmented societies or local actors. The figure vividly demonstrates that liberty is not the midpoint between state and society, but rather the outcome of their simultaneous empowerment under institutional checks and balances.

### Stylized Facts

While social capital is often associated with improved economic outcomes, its effectiveness critically depends on contextual factors such as institutional quality, trust enforcement mechanisms, and complementarity with formal governance structures (Knack & Keefer, 1997; Ostrom, 2000; Durlauf & Fafchamps, 2005). For instance, high levels of bonding social capital may enhance trust within close-knit groups but can inhibit inter-group cooperation and market expansion if not balanced with bridging ties (Putnam, 2000). Moreover, the presence of inclusive political institutions often determines whether social capital translates into collective action or rent-seeking behavior. Therefore, stylized facts about social capital's effects must be interpreted in light of these conditional mechanisms, as the same levels of interpersonal trust or civic participation can lead to very different economic outcomes depending on broader institutional and cultural contexts.

To examine the impact of varying levels of social capital on economic development indicators, data from the 2020 Global Values Survey<sup>1</sup>, covering 80 countries, were utilized. Stylized facts indicate that, first, the level of social capital is a determining factor in its effect on development. Second, the relative proportions of micro and macro social capital within a society significantly influence the extent of social capital's impact on the economy. Cross-country comparisons reveal that this variation is evident across income levels; specifically, in higher-income countries, social capital tends to have a more favorable effect on economic performance. In contrast, in

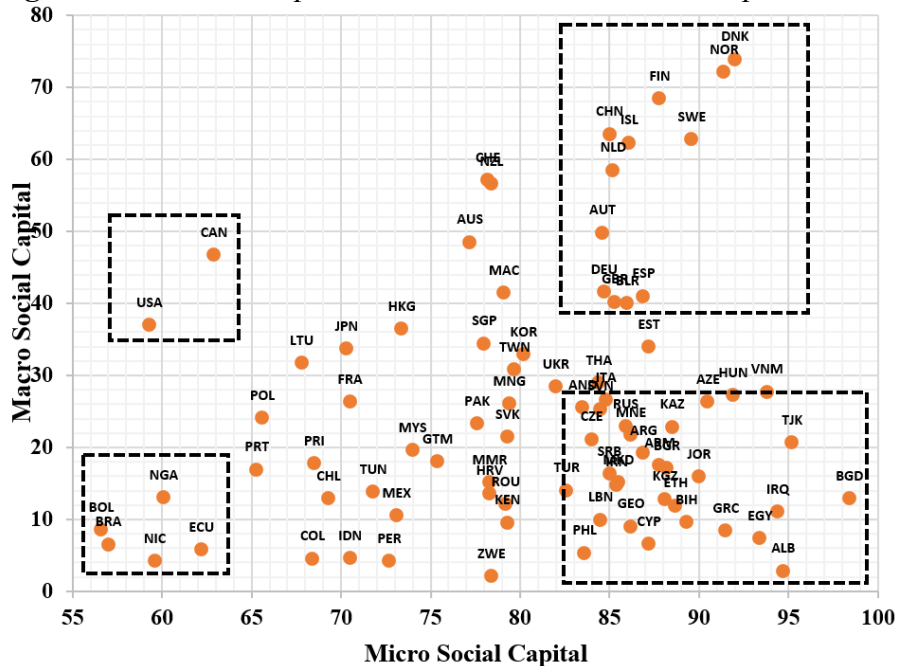
---

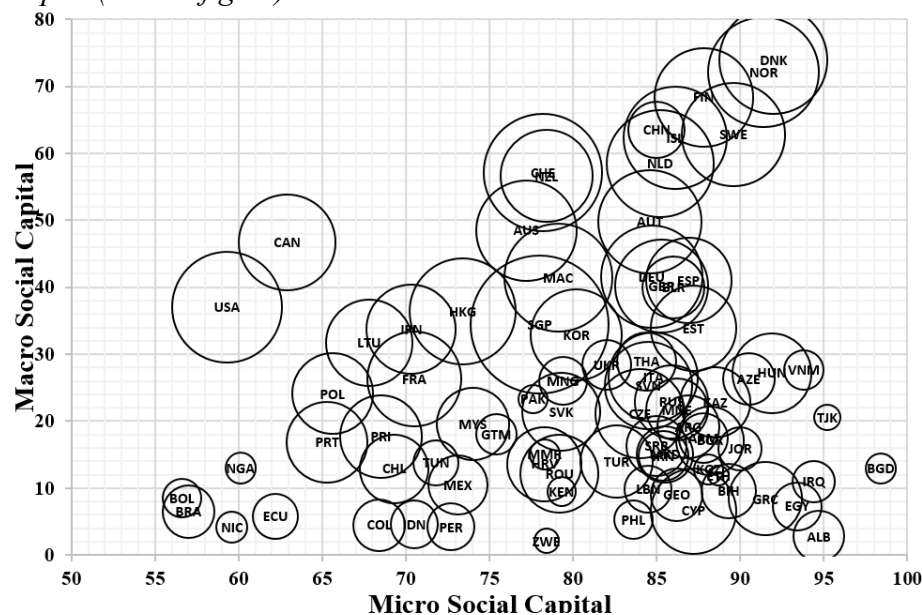
<sup>1</sup>The trust-related indicators used in this study are derived from the 2020 wave of the World Values Survey (WVS), a large-scale, cross-national survey designed to capture attitudes, values, and beliefs of individuals across the globe. Specifically, I utilized responses to two distinct items: one measuring generalized interpersonal trust ("Generally speaking, would you say that most people can be trusted...?"), and the other assessing particularized trust within the family ("How much confidence do you have in your family?"). These questions were selected due to their conceptual alignment with the notions of bridging and bonding social capital, respectively. Country-level averages were calculated based on individual-level responses, weighted using the WVS post-stratification weights to ensure national representativeness. This operationalization allowed for a comparative assessment of micro- and macro-level trust across countries. While recognizing limitations inherent in self-reported survey data, the WVS remains a widely accepted source in the literature on trust and social capital, used in numerous empirical studies to evaluate institutional performance, civic engagement, and development outcomes (e.g., Bjørnskov 2006, Tabellini 2010).

lower-income countries, this effect is either weaker or not positive at all. Fig. 2 illustrates the relationship between generalized trust (macro social capital) and family-based trust (micro social capital) across different countries in 2020, potentially highlighting some key insights. According to this figure, several primary categories of countries can be distinguished:

First, countries that are at low levels in both micro and macro social capital levels (southwest part of the figure), which include countries such as Bolivia, Nicaragua, Nigeria and Ecuador. The second category of countries has high micro social capital, but macro social capital is weak in them (southeastern part of the figure). In this category, you can see Albania, Turkey, Tajikistan, Azerbaijan, Egypt, and Greece. The third group of countries includes areas where the micro social capital is relatively weak, but the macro social capital in these countries is at high levels (northwest part of the figure), which includes countries such as America and Canada. The fourth group of countries, which have experienced both micro social capital and high macro social capital (northeast part of Fig. 2), which includes countries such as Denmark, Sweden, Finland, Iceland, the Netherlands, and Norway.

**Figure 2.** *The Relationship between Micro and Macro Social Capital between Countries*



**Figure 3.** *The Relationship Between Micro and Macro Social Capital and GDP per Capita (Bubble figure)*

This classification of countries based on different levels of micro and macro social capital (in-group and out-group) has very interestingly separated countries in terms of the structure of economic wealth and macroeconomic performance and even institutional arrangements. If the per capita production of each country is also drawn based on the bubble chart in Fig. 3, it can be seen that the more we move to the northeast of the chart, the countries have a higher per capita income more homogeneously. Most of the countries that fall into this category have higher prosperity (the size of the bubbles indicates the per capita production of each country). In addition, above the threshold of in-group and outgroup social capital, the balance between two levels of capital can be considered an important factor for the economic progress of societies. According to Fig. 3, countries located along the 45 degree line (and around it) often have better economic performance.

### Social Capital and the Narrow Corridor of Development

#### *Advanced Economies and Social Capital, the Role of Middle-Level Institutions*

But how is it that in more developed countries, social capital has more favorable effects on the economy? It seems that there is restructuring and deepening of social capital in advanced economies based on the market. Of course, this procedure is not only in the form of laws and regulations to replace or complement the market and the government, but also in the form of tacit knowledge. In these economies, markets and institutions are deep, and at the same time, the complexities of production and exchange are also deep. Partnership arrangements (which encourage monitoring) replace vertically integrated cluster firms. Large bureaucracies, cultures, and even

languages develop dense networks of interpersonal tacit knowledge, which is the key to their success. Apart from the areas where the market and government can work more efficiently, social capital is restructured and adapted to specific circumstances. Therefore, the relationship between market and non-market will not be uniform and complete throughout the world (Stiglitz 2000). Due to weak physical and institutional infrastructure in developing countries, there is a weak connection between the government and the market. Such societies will often not be capable of profitable interaction between the state and the market. In these societies, institutional connections between society and the market and between society and the government are often weak or non-existent; therefore, even when societies are highly inclined to cooperate collectively for mutual benefit, they may not be able to communicate effectively with the opportunities that exist in their external environments. In order to succeed in achieving their collective goals, citizens should at least be aware of the decision-making processes in the government and the market and be able to access the officials who make and implement these decisions. However, information is not always available in developing countries. Low literacy and low-quality physical infrastructure exacerbate this gap. But the ability of less developed communities to obtain high-quality information is also limited due to the weakness of middle-level institutions (those between the grassroots and the national level) (Krishna 2007). National-level institutions and community-level social capital can be made more productive through policies that help build effective middle-level institutions. In the absence of effective and powerful middle-level institutions, societies resort to alternative ways; Therefore, increasing the productivity of social capital requires investment in institution building at the middle level; That is, in the wide and uncovered boundaries between society and the government and between society and the market (Krishna 2007). Meanwhile, the real disaster happens when the central government is powerful enough to interfere with the functioning of existing local cooperatives. But its strength is not enough to introduce a practical alternative for these cooperatives. Many examples can be listed here that show the destructive role of development programs that were planned with desirable goals. Another type of extreme is also possible; Latin America has an oligarchic autonomous structure and, at least historically, there has been a more powerful central government to balance local forces (Stiglitz 2000). Empirical tests conducted in developing countries have also shown the importance of intermediary links to improve the productivity of social capital (Krishna 2000, 2001, Lambright 2004, Meinzen-Dick et al. 2002, Warren et al. 2001, Woolcock 1998).

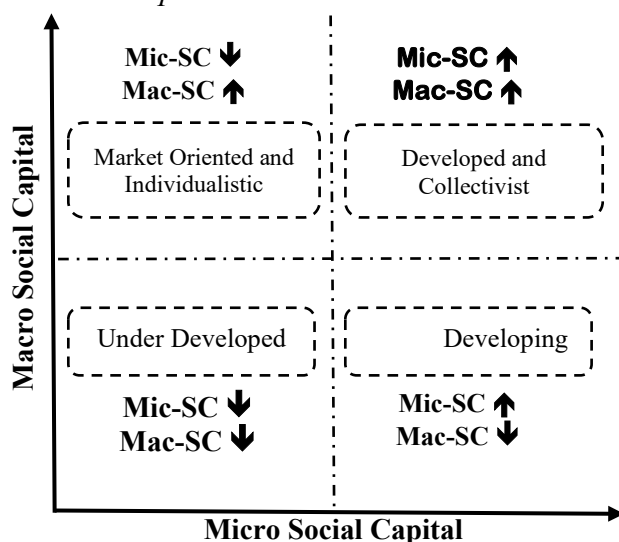
### *Classification of Societies*

Therefore, it can be seen that the relative structure between different levels of social capital in societies can be very important for its effect on economic performance. It is important that there is an appropriate balance between all types of social capital. Empirical studies have also shown that without types of outgroup social capital (bridging), in-group social capital alone may not be enough to realize development in society. Moreover, it was observed here that countries were able to act successfully in the development process that have both levels of in-group and out-

group social capital, or in other words, micro and macro social capital at optimal levels. It is possible to summarize the process of the impact of social capital on the economic performance of societies in Figure 2 and 3. In Fi. 4, the classification of countries based on social capital levels can be seen. According to the figure (and comparing it with Fig. 4), it can be seen that the societies in this framework can be divided into four general categories:

First, societies that often have a less developed economy, with structural problems in macro areas. This group of societies will have little micro and macro social capital. In this situation, micro and macro social capital exists at a low level, and this procedure causes the positive effect of social capital on economic performance to be very small. Schuller (2007) considers these conditions to be the cause of instability and lack of optimal productivity. Here there is little trust in the people around and there is xenophobia in its social sense. Individuals in these societies probably do not get much benefit from their resources, nor will they benefit much from communication outside the groups.

**Figure 4.** *Conceptual Relationship between Relative Levels of Social Capital and Economic Development*



Second, it includes a category in which individualism exists at high levels and trust in the circles of friends and acquaintances is low, but the market structure and macro-institutions in the society, due to official guarantees, can Create official trust. Although this group of societies can achieve favorable levels of development, collective cooperation in them is based on formal communication and can be fragile. The current structure provides higher costs for exchange. Schuller (2007) considers this group as a group that is ready to redistribute itself through central incoherence, or its members do not consider this group as their main reference point and use it only as a tool for progress.

Third, it includes societies where micro social capital is high but macro social capital is at a low level. In these societies, due to the limited circles of trust, the positive effects of social capital are not so widespread, and in extreme conditions, sometimes strong links within micro-networks conflict with each other and with macro social

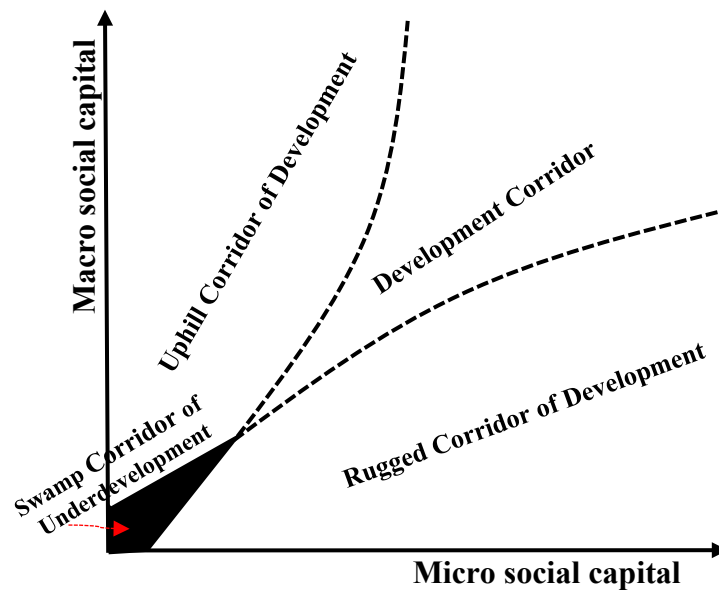
capital. This feature will cause production and economy to be limited and volatile. Schuller (2007) also considers these conditions as limiting. According to him, high intragroup social capital can have cultural and economic limiting effects. Maybe people in micro groups have a high sense of belonging, but since there are no strong connections and macro links in this group of societies, the positive return of social capital will be limited.

The fourth category of countries includes regions with high micro and macro social capital. In these societies, micro and macro social capital vectors often reinforce each other and will cause acceleration and stability in development and progress. Schuller (2007) considers this combination as a state where high trust is established in the society and creativity is cultivated; In other words, in terms of identity, it is self-secure and internally coherent.

### *Social Capital and Development Corridor*

By comparing this classification with Figure 5, we can reach a central idea to explain the relationship between social capital and economic performance. In Figure 4, it was seen that the countries that had proportional levels of the two levels of social capital are in a more suitable situation in terms of economic performance and welfare structure. It is clear, the formation of social capital at micro and macro levels will require requirements and platforms. As stated before, if the existing platforms can establish this connection between the levels of social capital and the relative proportion between the two levels of social capital is established, the countries can be on the path of development. According to Figure 4, we can consider the hypothetical path of development for societies, which corresponds to Figure 5. In this way, the countries that are in the hypothetical corridor of development, according to the cultural, social and economic structure of their society and the existing platforms, have been able to establish a relative proportion between the two levels of social capital. In this case, social capital can facilitate development. Obviously, the greater the amount of both levels of social capital (moving towards the northeast of the graph), the stronger the positive effects that social capital can have on economic performance. This state is called "development corridor"

On the other hand, when we approach the origin of the coordinates, although the proportion between the levels of social capital is relatively established, but due to the low size of social capital in both levels, its impact on economic performance is disturbed. As stated before, in many societies that fall into this category, the foundations and institutional arrangements necessary for the impact of social capital on economic performance are not provided, or are very weak. In this situation, it is not possible to transform weak in-group and out-group ties into stronger ties; therefore, the positive effects of social capital are very limited and can be destructive at very low levels. These societies are in the so-called "Swamp Corridor of Underdevelopment" and in order to get out of this Swamp, they will need to increase the levels of social capital and provide the necessary institutional, social and structural arrangements for development.

**Figure 5.** *Social Capital and Development Corridor*

Two other categories of countries are at the bottom and top of the development path. The countries that are at the top of the development path have a strong individualism and the levels of micro social capital in them are small. Maybe they are developing, but if they plan to develop micro-levels of social capital, they will be able to make more use of the benefits of social capital and travel with a higher speed and quality in the path of development. This group of countries are so-called in the "Uphill Corridor of Development". Their movement will be fragile and sometimes slow.

The third category of countries that are under the development path have low levels of macro social capital. In these communities, micro-networks have not been able to establish extensive inter-group communication, and in some of them, the communicative social capital, as a level of out-group social capital, is very weak. Institutional arrangements and market structure are not able to cure this deficiency. This disproportion between in-group and out-group social capital will cause this group of societies to be caught in the "Rugged Corridor of Development" and their movement in the course of development will be very costly, limited and fluctuating. It is clear that in this category of societies, by planning for the preparation of institutional arrangements and the creation (and foundation) of outgroup social capital, it is possible to enter the smooth path of development.

In order for social capital to have beneficial effects on economic performance; first, there is a need for the social capital formed in the society to be of a good type (Productive/Development-Enhancing Social Capital) and help the development path. Secondly, in-group social capital and outgroup social capital should be placed in an optimal fit (relative to society structures). Thirdly, the economic and social platforms of the society that direct and create these connections (such as institutional arrangements, property rights, etc.) are sufficient to form these intermediary circles with the appropriate force.

## Agent based Model Description

Agent-based modeling provides a powerful tool for analyzing the ideas presented in this paper, allowing for the simulation of interactions among individuals and the observation of emergent outcomes at the macro level. Unlike traditional models, agent-based models can capture the decentralized and adaptive nature of social capital, making them particularly well-suited for studying complex social dynamics within the narrow corridor of development. Although some research has explored social capital in development, few studies have utilized agent-based models to analyze how variations in social capital levels might impact a society's ability to remain within the narrow corridor. Therefore, the following section will attempt to evaluate the impact of different levels of micro and macro social capital on the welfare of societies by presenting a simple agent-based model. In other words, we will investigate the concept of the narrow corridor of development and the role of social capital within it, as presented in Figure 5. This section details the Agent-Based Model (ABM) developed to explore the dynamic interplay between micro (intra-group) and macro (inter-group) social capital and their collective impact on the development and welfare of agents. The model simulates a population of heterogeneous agents organized into distinct groups, where their individual welfare and levels of trust evolve based on both internal group dynamics and inter-group relationships.

**Agents:** The model consists of  $N$  individual agents, where  $N=100$ . Each agent  $i$  possesses a welfare level ( $W_{i,t}$ ) at time  $t$ , representing their overall well-being. Agents also hold a micro social capital (or intra-group trust) value ( $SC_{micro,i,t}$ ), reflecting their trust within their immediate group. Initially, individual welfare is randomly assigned from a uniform distribution  $[0,1)$ , while micro social capital is initialized to either a high (0.9) or low (0.1) value across all agents, depending on the simulation scenario.

**Groups:** Agents are organized into  $G$  distinct groups, with  $G=10$ . Each group consists of  $N/G=10$  agents. Groups are characterized by macro social capital (or inter-group trust) ( $SC_{macro,g_1,g_2,t}$ ), which quantifies the trust between any two groups  $g_1$  and  $g_2$ . Similar to micro social capital, initial macro social capital values are set uniformly to either a high (0.9) or low (0.1) level across all inter-group pairs for specific scenarios. Self-trust between a group and itself is assumed to be perfect ( $SC_{macro,g_1,g_2,t}=1.0$ ). Table 1 presents the initial parameters utilized in the model's simulation.

The model progresses in discrete time steps,  $t$ , with interactions and state updates occurring in a defined sequence. The core dynamics involve how welfare influences social capital, and how social capital, in turn, impacts welfare, forming a crucial feedback loop. This model simulates the evolution of welfare and group dynamics in a society where agents interact both intragroup (within groups) and intergroup (between groups), with the interactions influenced by varying levels of micro-level social capital (social capital within groups) and macro-level social capital (social capital between groups). The agents adjust their welfare, group sizes, and social capital based on these interactions over time. The system is modeled through a set of differential equations that govern these dynamics.

**Table 1.** *Parameters in Model*

| Symbol                            | Definition                                          | Value/Range             |
|-----------------------------------|-----------------------------------------------------|-------------------------|
| $\Delta N$                        | Group size increase constant                        | 1                       |
| <b>threshold</b>                  | Trust threshold for group growth (conflict)         | 0.5                     |
| <b>learning rate</b>              | Rate of learning for trust adjustment               | 0.01                    |
| <b>N</b>                          | Total number of individual agents in the simulation | 100                     |
| <b>G</b>                          | Total number of distinct groups                     | 10                      |
| <b>time steps</b>                 | Number of simulation steps                          | 150                     |
| $\alpha$                          | Intra-group trust impact factor (on welfare)        | 0.05 to 0.5 (10 steps)  |
| $\beta$                           | Inter-group trust impact factor (on welfare)        | 0.05 to 0.5 (10 steps)  |
| <b>Initial SC<sub>micro</sub></b> | Initial micro social capital (intra-group trust)    | 0.9 (high) or 0.1 (low) |
| <b>Initial SC<sub>macro</sub></b> | Initial macro social capital (inter-group trust)    | 0.9 (high) or 0.1 (low) |

The welfare of each agent within a group is updated based on the social capital within that group. The intragroup welfare update is governed by the following equation:

$$W_{i,t} = W_{i,t-1} + \alpha \cdot \log(1 + SC_{micro,i,t})$$

Where,  $W_{i,t}$  is the welfare of agent  $i$  at time step  $t$ ,  $SC_{micro,i,t}$  is the average social capital within the group to which agent  $i$  belongs at time step  $t$ ,  $\alpha$ , is a constant that determines the strength of the effect of intragroup social capital on welfare. In this model, welfare ( $W_{i,t}$ ) is conceptualized as an abstract, quantitative measure of an agent's overall well-being or prosperity within the simulated environment. It is represented as a numerical value without specific real-world units, ranging from its initial random assignment and potentially growing or diminishing over time. While not directly equivalent to real-world metrics like GDP per capita or subjective well-being scores, it serves as a proxy for an agent's accumulated benefits derived from social interactions and capital. A higher welfare value indicates a more favorable state of well-being, reflecting improved access to resources, opportunities, or overall life satisfaction within the model's framework. Its changes are directly linked to the dynamics of intra-group and inter-group social capital, allowing us to observe how social connectedness contributes to (or detracts from) an agent's flourishing. This equation reflects a non-linear (logarithmic) relationship between intragroup social capital and welfare. As social capital increases within a group, the welfare of the agents increases, but at a diminishing rate due to the logarithmic form. We adopt a logarithmic specification to model welfare effects because it captures diminishing marginal returns from social capital. That is, as social capital increases, its marginal impact on welfare diminishes—an assumption widely supported in behavioral and network-based economic models (see Glaeser et al., 2002). The update rule for agent welfare is modeled using a logarithmic function, specifically  $W_{i,t}$  for intra-group effects and similar for inter-group effects. This functional form is chosen to capture the principle of diminishing returns. It implies that while increases in social capital consistently lead to welfare improvements, the magnitude of these improvements decreases as the baseline welfare or social capital level increases. For

instance, a unit increase in trust will have a more significant welfare impact on an agent with low existing welfare or social capital than on an agent who already possesses high levels. This non-linear relationship is commonly observed in real-world social and economic systems, where initial investments yield larger proportional gains than subsequent ones<sup>2</sup>. In addition to intragroup interactions, agents also interact with other groups based on macro- social capital. The intergroup welfare update is given by:

$$W_{i,t} = W_{i,t} + \beta \cdot \log(1 + SC_{macro,g_1,g_2,t})$$

Where  $SC_{macro,g_1,g_2,t}$ , is the social capital between group  $g_1$  and group  $g_2$  at time step  $t$ , and  $\beta$ , is a constant that determines the strength of the effect of intergroup social capital on welfare. This equation models the non-linear interaction between groups, where welfare increases with higher social capital between groups, but at a diminishing rate as social capital increases.

If the social capital within a group falls below a threshold  $SC_{threshold}$ , the agents in that group experience a penalty to their welfare. This penalty is proportional to the difference between the threshold and the mean social capital within the group:

$$W_{i,t} = W_{i,t} - (SC_{threshold} - SC_{group,i,t}) \cdot (1 - SC_{group,i,t})$$

This equation captures the conflict that arises when social capital is low. The lower the social capital within a group, the greater the penalty to welfare.

Group size evolves over time depending on the social capital within the group. If the average social capital within a group exceeds the threshold, the group size increases, and if it falls below the threshold, the group size decreases. The group size update follows:

$$N_{g,t} = N_{g,t-1} + \delta_N (SC_{group,i,t} - SC_{threshold})$$

Where,  $N_{g,t}$  is the size of group  $g$  at time  $t$ , and  $\delta_N$ , is a constant that determines the rate of group size adjustment based on social capital.

Social capital levels are updated over time based on the welfare outcomes within the group. If the average welfare of a group is higher than the overall average welfare of the society, the social capital within the group increases, and if the average welfare is lower, the social capital decreases. This adjustment is given by:

$$SC_{group,i,t} = SC_{group,i,t-1} + \gamma \cdot (1 - SC_{group,i,t-1}) \cdot (W_{group,g,t} - \bar{W}_{all,t})$$

Where,  $SC_{group,i,t}$  is the social capital of agent  $i$  in group  $g$  at time step  $t$ ,  $\gamma$ , is the learning rate that controls the speed at which trust adapts to welfare outcomes,  $W_{group,g,t}$ , is the average welfare of group  $g$  at time step  $t$ , and  $\bar{W}_{all,t}$ , is the average welfare of all agents at time step  $t$ . The social capital updates increase when

---

<sup>2</sup>Alternative functions, such as linear or exponential, were considered but deemed less appropriate as linear functions do not capture diminishing returns, and exponential functions could lead to unrealistic, unbounded growth in welfare.

a group's welfare is above the societal average and decrease when it is below, simulating learning based on welfare outcomes. The value of social capital is constrained to lie between 0 and 1, ensuring that social capital cannot become negative or exceed perfect social capital.

A fundamental premise of this model is the existence of a bidirectional feedback loop between welfare and social capital. This assumption is firmly rooted in established sociological and economic theories, and supported by empirical evidence. Classic works by Bourdieu (1986), Coleman (1988), and Putnam (1995) posit that social networks, norms, and trust (i.e., social capital) facilitate collective action, reduce transaction costs, and enable resource sharing, thereby directly contributing to improved individual and collective welfare (e.g., economic prosperity, health outcomes, civic engagement). Our model reflects this by increasing welfare based on both intra-group and inter-group trust. Conversely, the model proposes that agents' experiences with welfare outcomes can shape their willingness to trust and engage in social interactions. When groups (or individuals within groups) experience improved welfare, their perceived benefits from cooperation and trust increase, leading to an upward adjustment in social capital. Conversely, persistent low welfare or negative experiences (e.g., conflicts) erode trust. This mechanism aligns with concepts of reciprocal altruism and learning from experience, where positive outcomes reinforce pro-social behaviors and trust, while negative outcomes diminish them.

The model runs over multiple time steps, with each time step representing a discrete point in time. For each scenario, the following steps are repeated: 1- Update Welfare: Welfare is updated based on intragroup and intergroup interactions, penalizing low social capital where applicable. 2. Adjust Group Size: Group sizes are modified based on the social capital level within each group. 3. Update social capital: social capital is updated according to the learning mechanism described above. Store History: The welfare, group sizes, and welfare volatility are recorded at each time step for later analysis.

Four scenarios of social capital dynamics are modeled:

1. **High-High Scenario:** High micro-social capital and high macro- social capital (i.e., social capital is high both within and between groups).
2. **Low-High Scenario:** Low micro- social capital and high macro- social capital (i.e., low social capital within groups, but high social capital between groups).
3. **High-Low Scenario:** High micro- social capital and low macro- social capital (i.e., high social capital within groups, but low social capital between groups).
4. **Low-Low Scenario:** Low micro-social capital and low macro- social capital (i.e., low social capital both within and between groups).

In each scenario, the model simulates the dynamics of welfare, group sizes, and social capital over time.

While this model provides valuable insights into the dynamics of social capital and welfare, it operates under several simplifications and inherent limitations that offer avenues for future research: *A. Homogeneous Agent Behavior:* All agents currently adhere to the same set of update rules for welfare and trust. Future extensions could introduce individual heterogeneity in agent preferences, learning rates, or propensities

for trust and cooperation, leading to more nuanced and realistic behavioral patterns. *B. Fixed Group Structure:* The model assumes fixed group memberships and a constant number of groups. Real-world social structures are dynamic, with individuals joining or leaving groups, and groups forming or dissolving. Incorporating dynamic group formation and dissolution mechanisms would significantly enhance the model's realism. *C. Simplified Welfare Definition:* Welfare is represented as a single, abstract numerical value. A more comprehensive model could disaggregate welfare into multiple dimensions (e.g., economic, social, psychological) and explore their differential impacts and interdependencies. *D. Static Macro Trust Interaction:* While macro trust influences welfare, its update rule in this model is relatively simple. More complex mechanisms for the evolution of inter-group trust, perhaps based on the outcomes of specific inter-group interactions or the reputations of groups, could be explored. *E. Absence of External Shocks:* The model does not account for external shocks or interventions that could disrupt welfare or social capital dynamics, such as economic crises, policy changes, or environmental disasters.

These simplifications allow for a focus on the core feedback mechanisms between micro and macro social capital and welfare but highlight opportunities for further model development to capture greater complexity.

## Result

This agent-based model simulates the effects of social capital within and between groups on welfare dynamics over time. Here's a breakdown of the initial setup, parameters, and stages of the simulation: 1- Agents and Groups: The model has 100 agents, divided into 10 groups of 10 agents each. Each group represents a distinct social unit where agents interact both within their group and with other groups. The agents are set to interact over 150 time steps, where each time step represents a single iteration in the model. 2- Initial Parameters: Intragroup Welfare Gain ( $\alpha$ ): A constant value (0.1) indicating the welfare gains from within-group interactions. Intergroup Welfare Gain ( $\beta$ ): A constant (0.1) showing welfare gains from between-group interactions. Group Size Adjustment Constant  $\delta_N$ : A value of 1, used to adjust group sizes based on trust levels. Social capital Threshold (threshold): Set at 0.5, this threshold determines if a group's internal social capital is high enough to support group growth. Learning Rate  $\gamma$ : A value of 0.01, which controls how quickly agents adjust their social capital levels based on welfare outcomes. The results include heatmaps showing welfare across groups and time for each scenario and line plots of average welfare and welfare volatility across scenarios, offering insights into how different levels of social capital affect group welfare and dynamics over time.

These heatmaps (Fig. 1) display the welfare levels of different groups over time under four social capital scenarios:

**High-High Scenario (Top Left):** In this scenario, both intragroup (within-group) and intergroup (between-group) social capital are high, which should theoretically lead to the highest levels of welfare. The welfare levels across groups are consistently high, reaching values above 80 in later time steps. This reflects strong, sustained positive

interactions both within and between groups, allowing welfare to grow substantially over time. The smooth gradient from lower welfare at early time steps to higher welfare later indicates a cumulative benefit from high social capital. This outcome aligns with theories suggesting that high social capital within and between groups enhances cooperative behavior, leading to greater collective welfare. This scenario represents an ideal social structure where social capital facilitates sustained welfare improvements. This result is consistent with the idea presented in Figure 4, which suggests that the greater the amount of both levels of social capital (moving towards the northeast of the graph), the stronger the positive effects social capital can have on economic performance. This is referred to as the "development corridor."

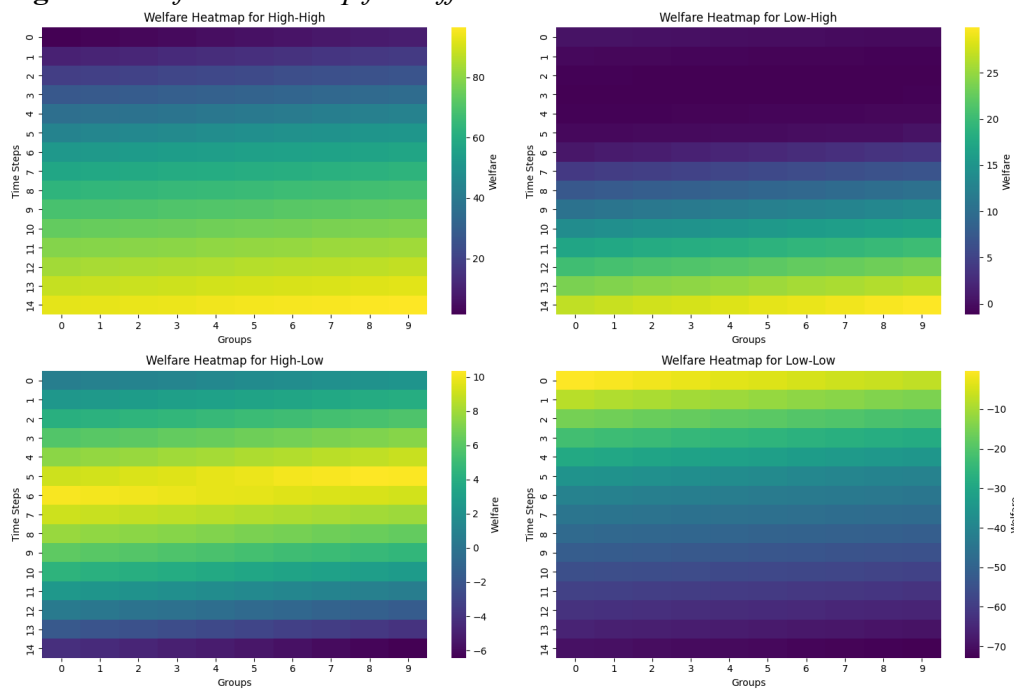
**Low-High Scenario (Top Right):** In this case, intragroup social capital is low, but intergroup social capital is high. This means that while groups do not strongly support internal welfare, there is positive interaction across groups. Welfare levels are positive and increase over time, reaching around 25 by the end of the simulation. This result suggests that high intergroup social capital partially compensates for low intragroup social capital, allowing welfare to improve but at a slower rate compared to the High-High scenario. The welfare increase is noticeable but more gradual. The Low-High scenario indicates that while intergroup social capital fosters cooperation and welfare, a lack of internal cohesion (low intragroup social capital) limits overall welfare gains. This scenario could represent societies where external partnerships are strong, but internal group dynamics need improvement for optimal welfare. This result is similar to the idea presented in Figure 4, where countries at the top of the development trajectory had low levels of micro-social capital. This group of countries is located in the so-called "uphill corridor of development" where their movement will be fragile and sometimes slow. That is, exactly the result obtained in the simulated model.

**High-Low Scenario (Bottom Left):** In this scenario, intragroup social capital is high, but intergroup social capital is low, meaning groups experience high welfare internally but face limitations in interactions with other groups. Welfare levels are moderate, around 10 at later stages. The welfare distribution appears more balanced across groups compared to the Low-High scenario, indicating stable but limited growth within groups. However, the low intergroup social capital hinders further welfare improvement, suggesting isolation or competition between groups. High intragroup social capital supports internal group welfare but fails to generate broader societal benefits due to low intergroup social capital. This scenario may represent communities with strong local ties but limited cooperation with external groups, resulting in a moderate welfare plateau. Here too, the results of the simulated model are exactly in line with the idea presented in Figure 4. When macro social capital in countries is low, the imbalance between intra-group and extra-group social capital causes this group of societies to be trapped in the "Rugged Corridor of Development" and their movement along the development path is very costly, limited, and fluctuating.

**Low-Low Scenario (Bottom Right):** Here, both intragroup and intergroup social capital levels are low, leading to minimal cooperation within and between groups. Welfare levels are negative, decreasing significantly over time, reaching values around -70 in later steps. This decline reflects the lack of supportive interactions in

both dimensions, leading to deteriorating welfare across all groups. The steep downward gradient indicates that low social capital conditions create persistent welfare losses. The Low-Low scenario illustrates a breakdown in both intra- and intergroup cohesion, resulting in a lack of cooperative behavior and negative welfare outcomes. This case represents environments with high conflict or isolation, where low trust and social capital prevents any meaningful welfare growth. This situation is also exactly equivalent to the “Swamp Corridor of Underdevelopment” in Figure 4.

**Figure 5.** *Welfare Heat Map for Different Scenarios*

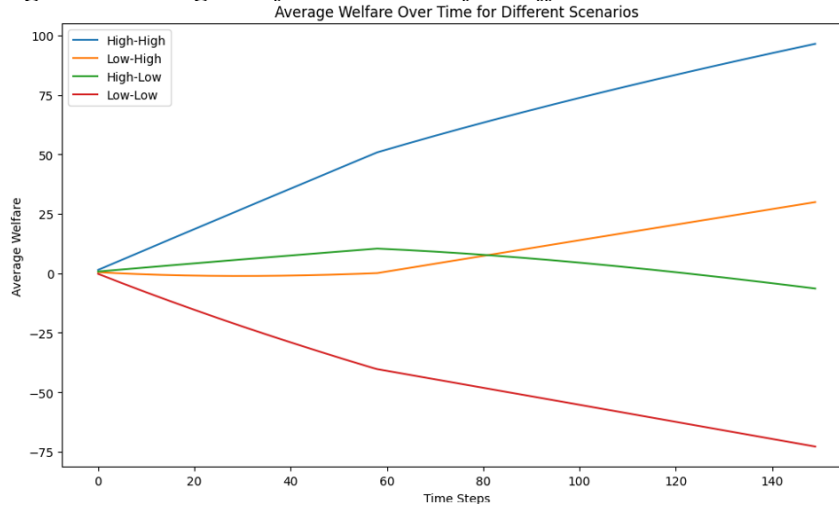


These heatmaps confirm the hypothesis that social capital levels significantly influence welfare outcomes. High social capital within and between groups maximizes welfare, while any deficiency in social capital (either intra- or intergroup) limits or even reverses welfare growth. This supports social capital theories, which posit that both internal cohesion and external cooperation are crucial for sustainable welfare. Each scenario illustrates potential real-world social structures and the welfare dynamics they create, providing valuable insights into the role of social capital in economic and social development. Furthermore, the results of this section fully confirm the idea presented about the “narrow development corridor” in Figure 4.

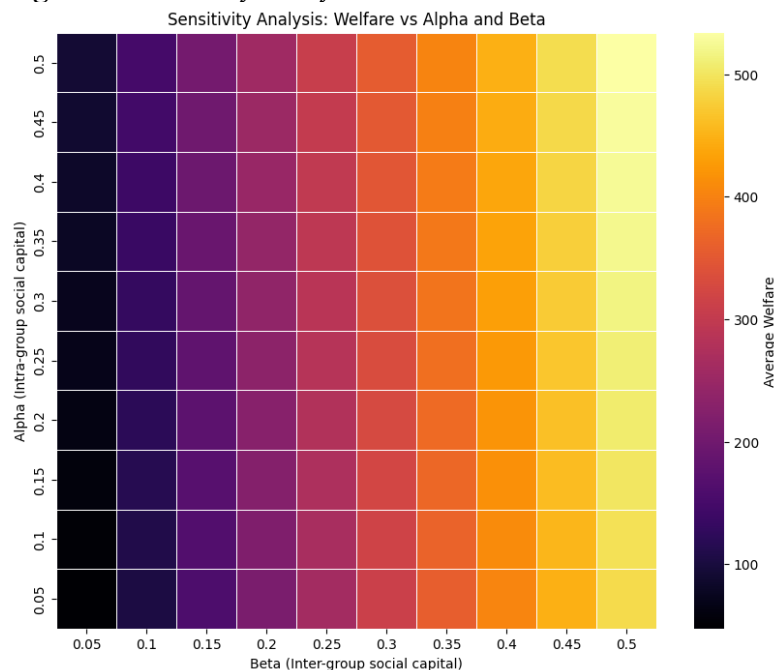
Figure 6 illustrates the average welfare over time across four different social capital scenarios. This chart illustrates that high levels of social capital, both within and between groups, are essential for sustained welfare growth. In the High-High scenario (high social capital at both levels), welfare steadily increases, indicating the synergistic effect of cooperation within and between groups. The Low-High scenario (low within-group social capital and high between-group social capital) shows moderate growth, suggesting that inter-group social capital can partially compensate for the lack of intra-group social capital. In contrast, High-Low (high within-group social capital and low between-group social capital) leads to stagnation, and Low-

Low (low social capital at both levels) results in a continuous decline in welfare, highlighting the negative impact of limited social capital on overall welfare. Here too, it can be seen that the levels of well-being of societies over time are consistent with the idea presented in the four categories of societies in Figure 4.

**Figure 6. Average Welfare over Time for Different Scenarios**



This sensitivity analysis chart (Figure 7) shows the impact of varying levels of intra-group social capital ( $\alpha$ ) and inter-group social capital ( $\beta$ ) on average welfare. The horizontal axis represents  $\beta$  (inter-group social capital), while the vertical axis represents  $\alpha$  (intra-group social capital). Higher values of  $\alpha$  and  $\beta$  correspond to warmer colors, indicating higher levels of welfare. The chart reveals a positive relationship between both social capital variables and welfare: as both  $\alpha$  and  $\beta$  increase, average welfare improves significantly. Specifically, the highest welfare levels are observed in the upper-right corner where both  $\alpha$  and  $\beta$  are maximized, suggesting that fostering both strong intra-group cohesion and inter-group cooperation is crucial for achieving optimal welfare outcomes. Lower values of both variables (bottom-left corner) result in minimal welfare, underscoring the importance of both dimensions of social capital for collective welfare enhancement. Comparing Figure 7 with the idea presented in Figures 3 and 4 shows that the level of well-being is closely related to the relative levels of micro and macro social capital. Accordingly, societies can be classified into four general categories based on their relative levels of micro and macro social capital: 1- High micro-social capital and high macro- social capital (Development Corridor). 2- Low micro- social capital and high macro- social capital (Uphill Corridor of Development) 3- High micro- social capital and low macro- social capital (Rugged Corridor of Development) 4- Low micro-social capital and low macro- social capital (Swamp Corridor of Underdevelopment).

**Figure 7. Sensitivity Analysis**

The results of this sensitivity analysis align with established theoretical frameworks in social capital and welfare economics, which emphasize the role of trust and social capital in fostering economic and social welfare. In particular, the positive relationship between intra-group (within-group) trust and inter-group (between-group) trust with welfare outcomes reflects Putnam's theory of social capital, which distinguishes between "bonding" social capital (within groups) and "bridging" social capital (between groups). According to Putnam, both types of social capital are essential for economic development and societal well-being, as bonding capital promotes close-knit community support, while bridging capital facilitates broader cooperation and resource sharing across groups.

The findings also resonate with concepts from economic theories on collective action and cooperation, such as Ostrom's work, which suggests that trust within and between groups is fundamental to sustaining cooperative behaviors that lead to higher welfare outcomes. The results showing maximum welfare when both intra- and inter-group trust are high support the idea that balanced social networks with both strong internal cohesion and cross-group linkages enable efficient resource allocation, reduce transaction costs, and minimize conflict, thus contributing to optimal welfare.

In contrast, lower levels of social capital in both dimensions, which lead to poor welfare outcomes in this model, echo findings in the social dilemma and game theory literature, where lack of trust often results in suboptimal outcomes like the "tragedy of the commons" due to selfish or non-cooperative behaviors. Thus, this analysis reinforces existing theoretical views that balanced, multi-level social capital is critical for maximizing welfare and fostering a stable and cooperative society.

## Conclusion

This study confirms that the alignment of micro and macro levels of social capital is pivotal for sustainable economic development. Through an agent-based model, we observe that balanced intra- and inter-group social capital significantly enhances welfare and stability in societies, allowing them to stay within the "development corridor." High levels of social capital at both levels drive welfare gains, while imbalances or low levels lead to stagnation or decline, consistent with the "Swamp Corridor of Underdevelopment." In high-intra-group but low-inter-group social capital scenarios, welfare is limited due to social fragmentation, whereas high inter-group social capital with low intra-group cohesion fosters incremental gains but lacks depth. These findings support the theory that both bonding and bridging social capital are essential for long-term economic growth and collective well-being.

Our results offer insights for policy design, underscoring the importance of fostering cohesive communities and robust inter-group connections to harness the full benefits of social capital. The study advocates for policies that strengthen institutional support for both local and broader social networks. Additionally, future research may explore how dynamic external factors and evolving trust levels impact social capital's influence on welfare. In sum, this analysis provides a foundation for understanding how targeted investments in social capital can steer nations toward sustainable growth and resilience within a well-defined development framework.

## References

- Adler PS, Seok-Woo K (2002) Social Capital: Prospects for a New Concept. *Academy of Management. The Academy of Management Review*, 27(1):17–40.
- Aldrige S, Halpern D, Filzpatrick S (2002) *Social Capital, a Discussion Paper*, Performance & Innovation Unit.
- Claridge T (2018) *Functions of social capital – bonding, bridging, linking*, Social Capital Research.
- Coleman J (1998) The Creation and Destruction of Social Capital: Implication for the Law, *Notre Dame Journal of Law, Ethics and Public Policy*, Vol.3.
- Coleman J (1990) *Equality and Achievement in Education*, West View Press, Boulder.
- Coleman J (1994) *Foundation of Social Theory*, Belknap Press, Cambridge MA.
- Durlauf SN, Fafchamps M (2005) *Social Capital*. In P. Aghion & S. N. Durlauf (Eds.), *Handbook of Economic Growth*, Vol. 1B (pp. 1639–1699). Elsevier.
- Fine B (2001) *Social Capital versus Social Theory: Political Economy and Social Science at the Turn of the Millennium*, Routledge, First Published.
- Fukuyama F (1997) Social Capital and the Modern Capitalist Economy: Creating a High Trust Workplace, *Stern Business Magazine*, 4(1).
- Knack S, Keefer P (1997) Does social capital have an economic payoff? *The Quarterly Journal of Economics*, 112(4), 1251–1288.
- Krishna A (2000) *Creating and Harnessing Social Capital*, in P. Dasgupta and I. Serageldin (eds.), *Social Capital: A Multifaceted Perspective*. Washington, DC: World Bank, 71–93.
- Krishna A (2001) Moving from the Stock of Capital to the Flow of Benefits: The Role of Agency, *World Development*, 29: 925–43.

- Krishna A (2007) How Does Social Capital Grow? A Seven-Year Study of Villages in India. *The Journal of Politics*, 69(4), 941–956.
- Lambright G (2004) *Silence from Below: The Impact of Civil Society and Social Capital on Local Government Performance in Uganda.* Paper presented at the annual meeting of the American Political Science Association, Chicago, 2 September 2004.
- Meinzen-Dick R, Raju KV, Gulati A(2002) ‘What Affects Organizational and Collective Action for Managing Resources? Evidence from Canal Irrigation Systems in India’, *World Development*, 30/4: 649–66.
- Ostrom E (2000) *Social Capital: A Fad or a Fundamental Concept?* Paper presented at the Annual Meeting of the American Political Science Association, Washington, D.C.
- Putnam R (1993) the Prosperous Community-Social Capital and Public Life, *American Prospect*, 13, p. 36.
- Putnam RD (2000) *Bowling alone: The collapse and revival of American community.* Simon & Schuster.
- Schuller T (2007) Reflections on the Use of Social Capital, *Review of Social Economy*, Vol. 65, No. 1, Beyond Social Capital, 11-28.
- Stiglitz J (2000) The Contributions of the Economics of Information to Twentieth Century Economics, *The Quarterly Journal of Economics*, 2000, vol. 115, issue 4, 1441-1478
- Tirole, J., (1988). The multicontract organization. *Can. J. Econ.* 21, 459\_466.
- Warren M, Thompson J, Saegert S (2001) *The Role of Social Capital in Combating Poverty*, in S. Saegert, J. Thompson, and M. Warren (eds.), *Social Capital and Poor Communities*. New York: Russell Sage Foundation, 1–28.
- Woolcock G (2002) *Social Capital and Community Development: Fad, Friend or Foe?* in Queensland Local Government Community Services Association Annual Conference. Rockhampton.
- Woolcock M (1998) Social Capital and Economic Development: Towards a Theoretical Synthesis and a Policy Framework, *Theory and Society*, 27 (2): 151–208.