

Understanding Urban Quality of Life and Sustainability

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ABSTRACT

For an urban area to be sustainable, its resources cannot be depleted faster than they can replenish. If an urban area is to provide a high quality of life, it must offer and maintain an amenity package that satisfies its resident's preferences. Past studies on these topics all have a common thread: sustainability and QOL both pertain to people's relationship to capital. Capital is something that can accumulate and add value to a person or society. If sustainability and QOL are a function of people's relationship with capital, how they use it, deplete it, replenish it and transform it into something else is important to know. The most common forms of capital affecting urban systems are economic, natural, human and social capital. Previous models that incorporate two or three of these stocks helped inform our structure. However, no model includes the dynamics of all four forms of capital. In this paper, we provide a conceptual model of how these forms of capital interact with a city's population to create the behavior and quality of the area.

INTRODUCTION

The purpose of this study is to examine the relationship between urban sustainability and quality of life (QOL). Over 50% of the world's population now lives in urban areas, and both that fraction of the world's population and the total number of people living in cities is expected to continue increasing (McGranahan, et al., 2005). Much of this trend is due to migration. However, not all cities are revered the same. A Pew report identifying determinants of community satisfaction found some U.S. cities (Detroit, Cleveland, Cincinnati and Minneapolis) ranking as undesirable for relocation (Taylor, et al., 2009).

This study examines the question of what factors and feedbacks might govern migration of people into and out of urban areas. For people who can move freely and do so as a result of dissatisfaction over their quality of life, we ask what conditions spark their desire to move, and what would they look for in a new home? And, how do we know if that set of conditions is sustainable? This paper approaches these questions by summarizing the amenities of an urban area as different forms of capital: economic, natural, social and human. Sustainability and QOL, therefore, are a function of people's relationship with these capital forms: how they use, create and transform them into something else, and whether the services provided by capital match

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their preferences. Therefore, it is important to understand the structure of an urban system that influences the dynamics of sustainability and QOL.

In this paper, we model people's relationship with different forms of capital and the influence different forms of capital have on each other. We monitor the accumulation of different forms of capital to evaluate sustainability and use the distribution of capital as proxy for quality of life. First, we describe the concepts of urban sustainability and quality of life and then discuss our modeling approach.

PROBLEM STATEMENT

A high concentration of people in a small area poses threats to social, environmental and economic welfare. A growing population puts additional stress on these systems, and if these risks are not managed properly, the long term sustainability and desirability of a city is likely to slip (McGranahan, et al., 2005). Understanding the structure that governs the change in capital stocks is the first step toward understanding how urban sustainability and quality of life might be managed.

As Figure 1 shows, the fraction of the world's population living in cities is expected to continue increasing. The Rio Declaration recognizes humans as the center of concern and "entitled to a healthy and productive life in harmony with nature" (WCED, 1987). We therefore need to understand the dynamics of urban society that contribute to people's relationship with natural resources, economic growth and each other.

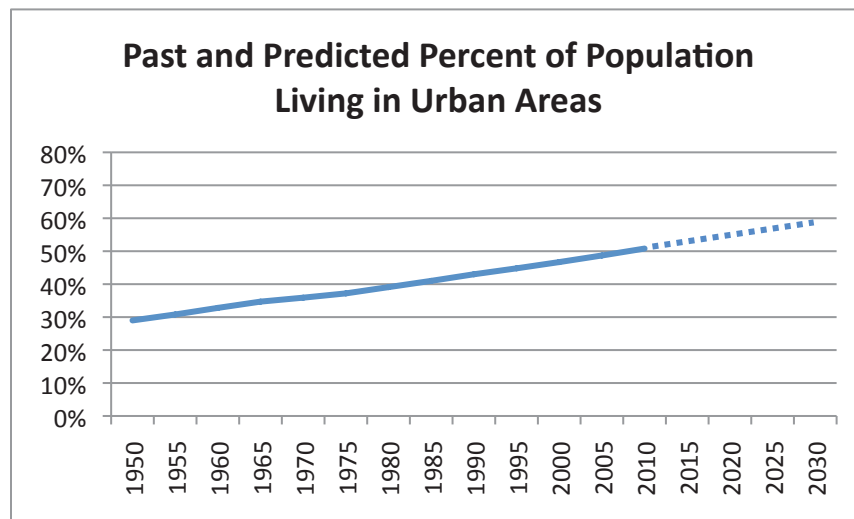


Figure 1: Growth in urban populations over time, future growth projected to 2030
Source: UN Department of Economic and Social Affairs/Population Division, 2005

Our goal with the conceptual model of urban sustainability presented here is to describe the structure underlying urban sustainability and identify policy levers for promoting long term social and environmental viability. Sustainability is often viewed as a luxury of the wealthy

(Campbell, 1996). Some go as far as to find “sustainable development” and “economic growth” as synonymous (Woodwell, 1998). However, economic decisions need to be made within the context of the social desires of residents and limitations of the environment (Levett, 1998). A purely economic understanding of capital limits our ability to bring social and environmental concerns into an examination of sustainability and livability. We argue that viewing an urban area as a place that accumulates and distributes multiple forms of capital provides a richer basis for understanding sustainability and QOL issues.

Discussions about sustainability and quality of life have a common thread. Implicitly or explicitly, sustainability and QOL both pertain to people’s relationship to capital (Figure 2). Therefore, examining how people use, deplete, replenish and transform capital can help identify points of leverage for promoting sustainability. We use the term “capital” to mean something that can accumulate and add value to a person or society. Later sections expand this definition and highlight four different forms of capital in greater detail.

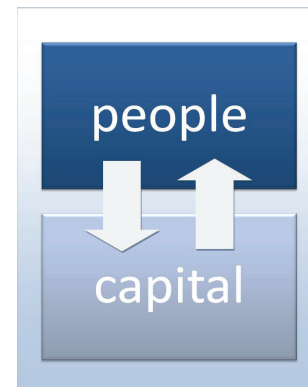


Figure 2: Sustainability and QOL are a function of the interaction between people and capital

Sustainability, often used interchangeably with the term sustainable development, is commonly defined as “development that meets the needs of the present without compromising the ability of future generations to meet their own need” (World Commission on Environment and Development [WCED], 1987). Sustainability is based on the idea that resources should be used as needed for present needs, but not be used faster than they can naturally regenerate and be available for the future. For example, ground water should not be taken from the ground faster than rain can replenish it, forests should not be cut faster than they can regenerate and farming should not be performed at a rate that degrades the nutrients in the soil.

The United Nations Conference on Sustainable Development promoted a framework for sustainable development that emphasizes a three pillar approach to institutional reform: economic development, social development and environmental protection. “Poverty eradication, changing unsustainable patterns of production and consumption and protecting and managing the natural resource base of economic and social development are overarching objectives of, and essential requirements for, sustainable development” (Johannesburg Plan of Implementation [JPOI], 2002: Chapter 2).

There are a number of ways of illustrating the relationship between the three pillars (Cato, 2010). For example, Campbell (1996) discussed the intersection of environmental, economic, and social pillars as it applies to the field of urban planning in a “planner’s triangle.” In this modification of a “three ring” framework (Cato, 2010), illustrated in Figure 3, sustainable development is the equitable balance of the physical, social, and economic environment. This figure places sustainable development in the center of equally important economic, social, and environmental sectors of a city to signify their equal importance (Cato, 2010). This balance has yet to be achieved and therefore sustainable development is not yet a planning reality (Campbell, 1996). Stakeholders from the fields of public health, business, planning, and environmental protection fall somewhere along this spectrum of priorities and their position shapes the lens through which they see a city (Campbell, 1996).

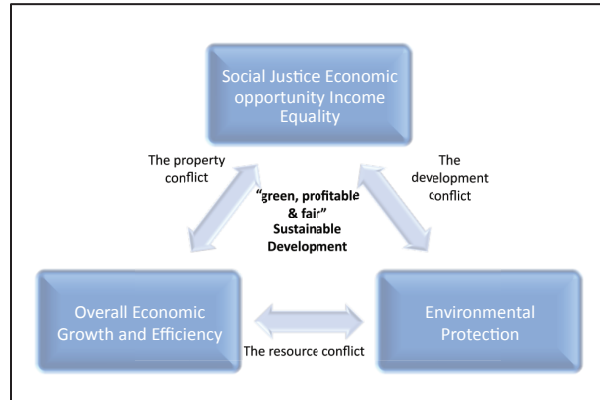


Figure 3: Pillars of sustainability as three equal sectors

Campbell’s depiction of conflicts in society illustrates tensions keeping us from fully realizing sustainability. Another popular framework is that of a Russian Doll structure, depicted in Figure 4, which adds a different dimension by illustrating the embedded nature of the sectors (Levett, 1998; Cato, 2010).

Levett (1998) proposes two advantages of thinking about sustainability as embedded systems rather than independent realms. First, society and the economy would not exist without the life-supporting services provided by the environment. Second, he argues the economy, its institutions and behaviors are all a social construct and thus fit within the society sphere. Because the outer sphere, the environment, has physical limitations, and in turn, bounds the inner economic and social spheres (Cato, 2010; Daly, 1990). Levett warns against using the term “balance” in discussions of sustainable development but argues sustainability is a reconciliation of quality of life and environmental limits. Economic priorities cannot be weighed equally against environmental priorities if the economy is pushing beyond the boundaries of environmental capacity.

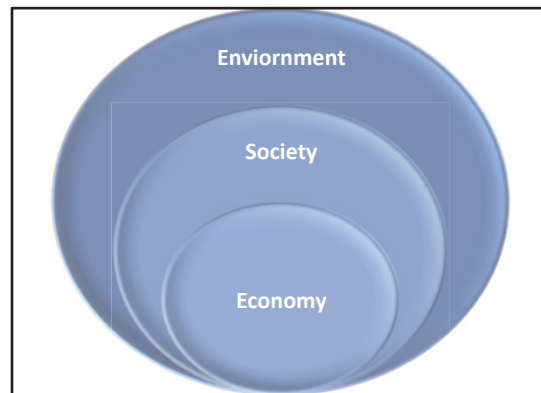


Figure 4: Pillars of sustainability in Russian Dolls framework

Quality of Life (QOL) is a subjective term, representing human perceptions of different aspects of their environment. It is “meant to represent either how well human needs are met or the extent to which individuals or groups perceive satisfaction or dissatisfaction in various life domains” (Costanza, et al. 2006, p. 268). QOL is one of many possible measures. For instance, Sawicki (2002) describes Community Indicator Systems (CIS) which encompass QOL, but also include quality of place (QOP), livability, performance and sustainability measures (Sawicki, 2002). An early congressional report from the US Department of Health, Education and Welfare (1970) focused on health and illness, social mobility, physical environment, income and poverty, public order and safety, learning, science and art, participation and alienation (Sawicki, 2002).

QOL is a focus on a person’s well being and mental state, while QOP looks at the physical characteristics of an area that make it attractive as a place to live. It could include the weather or certain well represented services, like health facilities (Sawicki, 2005). But, for place based indicators to be relevant, they must be perceived by residents to be important, thus fulfilling some aspect of their quality of life (Sawicki, 2005). Because what one resident may value may differ from another, an urban area should be evaluated both in terms of its objective qualities as well as its residents’ perception and appreciation for those qualities. Also, when polled, individuals often indicate their “most important problem” is a QOP or sustainability issues. These two approaches, subjective and objective measures of QOL, are addressed in more detail below.

Diener and Suh (1997) define two main approaches to measuring QOL. Objective or social indicators are relevant measures of society, such as crime rate, high school graduation rates, volunteerism and unemployment. They have the benefit of being easily quantified. Diener and Diener (1995) found measuring the wealth of a nation was so strongly correlated with other social indicators (such as infant mortality and literacy) they raised the question whether anything above economic measures was necessary. Despite the strength in these correlations Diener and Diener (1995) proceed to compare countries of similar economic status that vary widely in QOL, concluding that other indicators are indeed necessary for estimating QOL. Therefore, social indicators are widely used today in conjunction with economic indicators to provide a more robust look at society (Bognar, 2005).

The second major approach is measuring subjective well being (SWB) which is “concerned with individual’s subjective experience of their own life” (Diener and Suh, 1997) and seeks to understand “people’s happiness or life satisfaction” (Bognar, 2005 p. 563). While this is harder to capture, it is an important to consider and is highly indicative of reality when used in conjunction with objective social indicators. Levett (1998) argues, “‘Objective’ proxies are only valid in so far as they reflect people’s preferences and values.” In this way, we not only have the objective sense of the state of a community, but also on the satisfaction of preferences among citizens. “The basic premise of SWB research is that in order to understand the well

being of an individual, it is important to directly measure the individuals cognitive and affective reactions to her or his whole life as well as to specific domains of life” (Levett, 1998 p. 200).

METHOD

We used these perspectives on sustainability and QOL to develop a conceptual map describing how people interact with and feel about the resources available. Another way to think about resources is capital. As discussed in Diener and Diener (1995), QOL is made up of more than just economic capital. As Gro Harlem Brundtland discusses in the Chairman’s Forward to Our *Common Future* (WDEC, 1987), sustainability is more than a discussion of environmental issues. Therefore, people’s interactions with economic, natural, social and human capital, representing the three pillars of sustainability and contributing greatly to QOL, must be understood to explain the behavior of urban systems.

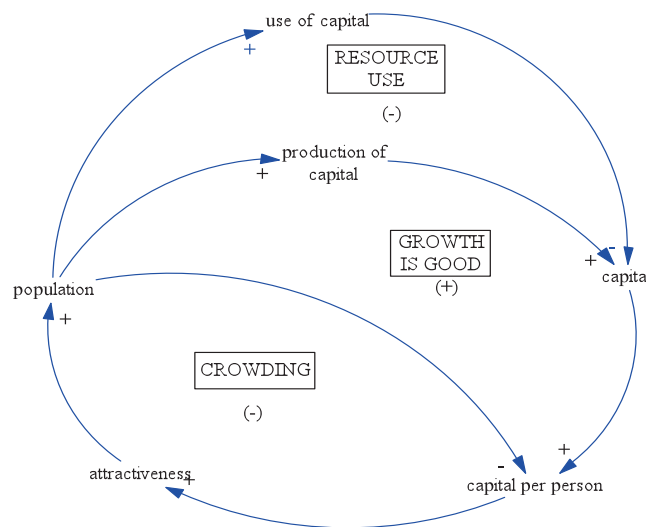


Figure 5: Simple population and capital causal loop diagram

To represent sustainability and QOL systemically, we began with a simple representation of people’s relationship to a generic form of capital, illustrated in Figure 5, based on the literature and on thought experiments of how a population can both add and detract from a given capital stock. As population grows, capital use will generally increase. If people are very productive, they could create more than they use. If they are wasteful or disregard limits, they will deplete the stock of capital before they can replenish it. As a population grows and shrinks, sustainability will be determined by these rates of production and usage. A population must maintain a high level of productivity in order to provide enough capital for the population and quality of life can be understood as the capital per person. If the population grows disproportionately to capital, it isn’t going to be a very satisfying place to live and people may leave. Or, if capital is abundant and people are enjoying a high level of capital, it will attract new residents, reducing the capital per person ratio. The key to sustainability is to work at a level that provides enough capital to satisfy the population.

This structure serves as the basis for understanding how the stocks of capital discussed above change with population and add or detract from the attractiveness of a city. Using theoretical literature on social, human, natural and economic capital and taking structural cues from previous system models, we expand upon this simple structure to incorporate the changing stocks of each form of capital and the interactions that exist between them, introduced in Figure 6. Below is a brief review of the theory and previous models and discussion of the details of each of the major sectors in the overall conceptual model.

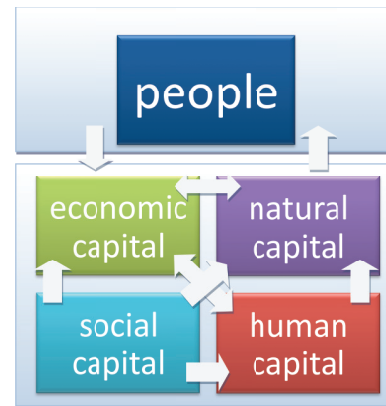


Figure 6: Expansion of the interaction between people and capital to include the interactions between various forms of capital

Human Capital (HC) is the accumulation of skills and capabilities that allow people to work more productively (Coleman, 1988; Bourdieu, 1986). Sociologist James

Coleman (1988, p. 83) writes, “just as physical capital is created by changes in materials to form tools that facilitate production, human capital is created by changes in persons that bring about skills and capabilities that make them able to act in new ways.” Human capital is often measured by educational achievement and the health of a population and is similar to embodied cultural capital discussed by French sociologist, Pierre Bourdieu (1986), who used the concept to explain why there was an unequal education attainment of children in different socioeconomic classes. He looked at the range of educational “profits” produced in the academic market by these different classes. His findings did not support the idea that there is a natural and equal aptitude inherent in all students, but some are advantaged by the passing down of academic investment by previous generations.

Coleman (1988) approaches the same theory by evaluating social capital in the home’s contribution to the development of human capital. Parents who are engaged and involved in promoting their children’s knowledge formation positively influence those children’s attainment. If parents have a high level of human capital, but their connection to their children is weak, their influence on that child’s development will be weak as well (Coleman, 1988).

In this way, human capital formation is both a private and social activity, and the benefits impact the individual and the greater community. Earning potential and productivity increase with human capital, growing the economy and contributing to the knowledge base for future generations to build upon (Vidal, 1998).

The submodel illustrated in Figure 7 shows the relationships between population and human capital. When a population increases, the demand for human services, such as health and education, increases as well. If that demand is met with the necessary support, human capital will increase. As human capital increases, the attractiveness of the community will increase

through the spillover affects that benefit the entire community (added productivity, economic growth, etc). But, if these effects are not at the level desired, or the population is not producing enough to satisfy managers, the population could be overworked to produce more, thereby reducing their health and human capital. Qureshi (2008 and 2009) describes a model of human and economic development that incorporates some of these relationships.

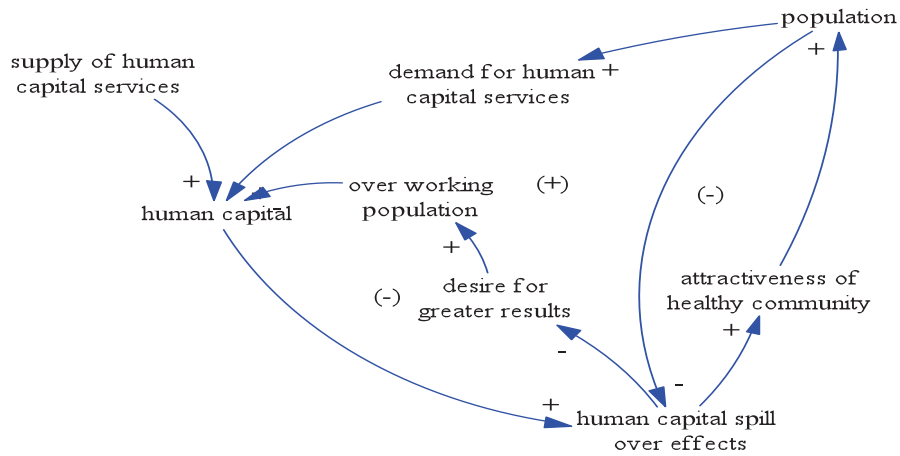


Figure 7: Human capital causal loop diagram

Economic Capital (EC) both generates and reflects the performance of an economy. It is the basis for economic production and accumulates as the economy grows. In our aggregate model, we use one stock to include both liquid and illiquid assets that give a region its value.

In the banking system, economic capital is not a measure of actual capital acquired, but a measure of risk and “is typically defined as the difference between some given percentile of a loss distribution and the expected loss” (FDIC, 2011). It is just the level a company needs to accumulate in order to remain solvent.

This is different from the way a city’s economy is measured. Gross domestic product is a widely accepted measure of economic vitality. It is a measure of an area’s total production of goods and services and is a function of the regions amount and productivity of labor, natural and manmade capital (Bureau of Economic Analysis, 2011). Productivity is the output produced from a unit of input, whether that input is a person or form of capital.

In the economic capital sub model, economic capital is increased by the production of products and services, a portion of which is reinvested into the production of more products and services. A region with more economic capital has more to distribute in the form of money and amenities to the population, thus the per capita income rises. This leads to a more attractive city to those seeking economic prosperity, and the population rises. If that population maintains a high level of productivity, then they will continue to produce goods and services.

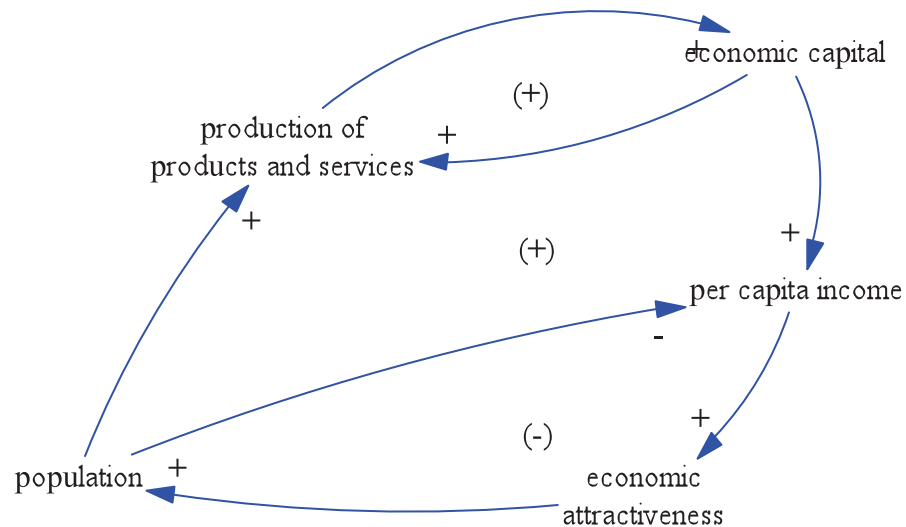


Figure 8: Economic capital causal loop diagram

Natural Capital (NC) represents “the resources provided by nature that are in some way essential to human well-being” (Beddoe et al, 2009, p. 2488). The most distinguishing feature of natural capital is that it is not human made, and therefore presents a unique set of characteristics and challenges.

First, natural capital is provided by nature and can only be provided by nature (O’Conner, 2000). While humans can modify natural capital, we cannot create a perfect substitute for it with something human-made because human-made capital requires natural capital to create. Therefore they are complements, rather than substitutes for each other (Costanza and Daly, 1992).

Second, natural capital encompasses a set of functions and systems that provide direct and indirect benefits for humans today and into the future. In this way, it represents more than a simple stock (O’Conner, 2000). Ecosystem goods include food and building materials while services include water purification and waste recycling. The structure of the system drives these behaviors and produces these good, and is therefore important to understand (Costanza

et al 1997). Natural capital is an aggregate of natural resources and their life sustaining services.

Finally, the loss of natural capital is more permanent than human made forms (O’Conner, 2000). When a resource has been degraded, we not only risk losing it forever, but also may see the life supporting processes discussed above become compromised as well. A chain reaction of instability is likely to follow as a result. For example, the loss of the Great Barrier Reef due to coral bleaching and warmer temperatures would be tragic in that a great natural wonder would be gone, but it means a loss of habit for aquatic life, and would not serve as a wave barrier leaving the shoreline exposed to the full impact of ocean waves.

We represent these dynamics in the causal loop diagram shown in Figure 9. As the population increases, more natural capital is consumed, reducing the stock of raw materials and natural processes that sustain life. This reduces the ecosystem services available per person, making the environment less attractive and motivating more people to move. There is a positive loop between natural capital and regeneration. Nature does naturally restore itself after it has been disturbed. But only if the rate of regeneration is greater than consumption will this loop dominate. (See Woodwell, 1998; Jin et al., (2009); Guan et al., (2011); Senge et al., (2000); and Chen, et al., (2006) for models of natural capital, people and the economy.)

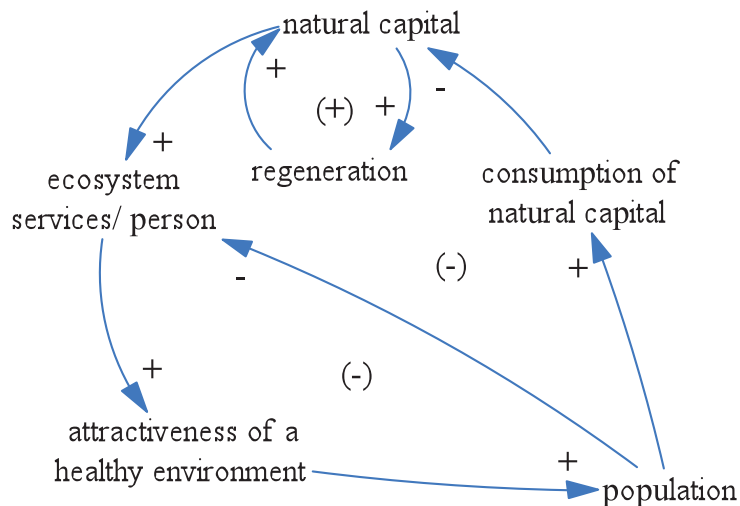


Figure 9: Natural capital causal loop diagram

Social Capital (SC) “comes about through changes in the relations among persons that facilitate action” and is a less tangible form than natural or economic capital (Coleman, 1988, p. 83). Personal productivity is increased with social capital because people benefit from the resources and assistance of those around them. As a person increases the size of their social network, their social capital increases. This is often done through group membership (Putnam 2000). Portes explains, “the consensus is growing in the literature that social capital stands for the

ability of actors to secure benefits by virtue of membership in social networks or other social structures” (Portes, 1998, p. 6).

Social capital is a function of trustworthiness, efficient information channels, closure of social networks, the presence of norms and reciprocity. It increases the amount of organized efforts to improve quality of life, and as they increase, the organization is perpetuated, perpetuating these other elements (Coleman, 1988). As Robert Putnam (2000, p. 21) explains, “Trustworthiness lubricates social life. Frequent interaction among a diverse set of people tends to produce a norm of generalized reciprocity.” Social capital is both a result of trust and a cause of trust. Researchers have struggled with the “chicken and the egg” nature of social capital definitions. However, this is simple a feedback loop of cyclical, rather than linear cause and effect.

There are personal and societal benefits of social capital. For example, communal spaces, such as park and public transit, would be unbearable due to the distrust of others if we felt no connection to feel residents. Also, without social capital, business would be conducted at a much slower pace, increasing transaction costs and efficiency (Jankauskas and Seputiene, 2007; de Blasio and Nuzzo, 2010). Community efforts are much more effective when a group is acting in a mutually beneficial way with common objectives, values, and concerns for one another. The flow of knowledge and ideas is more productive, and reciprocity increases the work done (Bourdieu, 1985).

Too much of a good thing could degrade these benefits, however. Studies of social capital reveal that both very low and very high levels can be detrimental. High levels may increase benefits to some at the exclusions of others, raising entry barriers and creating high preferential treatment towards only one group (Dudley, 2009).

Figure 10 illustrates the relationship between a population and social capital. Dudley (2009) created a model on the dynamics of people and social capital and helped inform our higher level social capital sub model. As people move into a community, the total number of connections will increase. We assume that people will make at least one connection with another community member when they relocate. The amount of connections per capita gives us a measure of the intensity of social capital in the community. When the intensity increases, the benefits also increase but at a diminishing rate. The costs also increase. People can only maintain a certain level of interpersonal connections before the time and energy required is greater than the benefits received from the relationship (Dudley, 2009). On the societal level, the costs also rise, such as the exclusivity and barriers to innovation (Dudley, 2009).

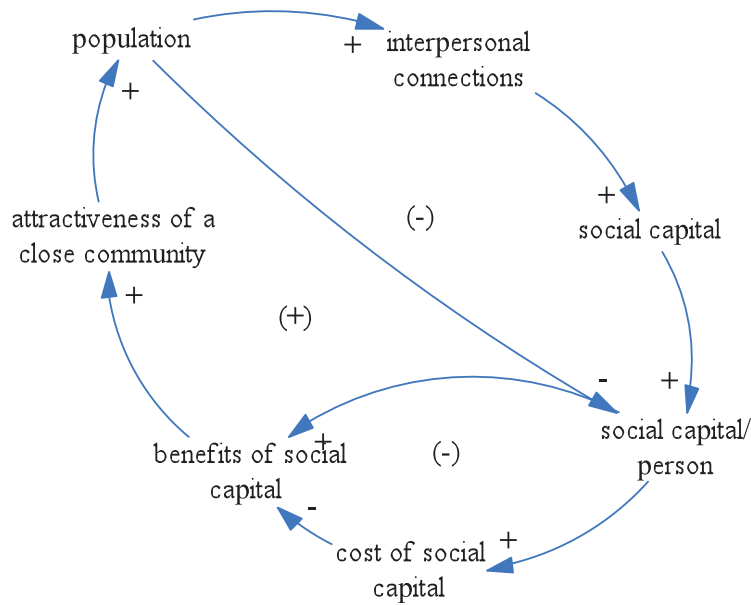


Figure 10: Social capital causal loop diagram

OVERALL CONCEPTUAL MODEL

Regardless the form, people interact with capital and the services it provides in roughly the same way. If people are productive, a stock of economic capital will grow. If they are efficient, they can do so without depleting natural capital. If they interact, social connections grow, and if the supply is there, they can develop greater capabilities. These capital stocks each produce benefits that can satisfy a certain population level, thus as population increases, that stock will be stretched farther, reducing the per capita benefits.

The theory and sub models described above clarified the relationship between people and capital. The interactions between these forms of capital, however, are the drivers of economic growth, social equity, and environmental degradation/protection. At this point in our study, we are focusing on the interesting feedback loops that emerged between the capital forms. Figure 11 illustrates a causal loop diagram incorporating population’s relationship with each form of capital. Connecting these “petals” are green arrows that describe the interaction between the social, economic and environmental sectors of society.

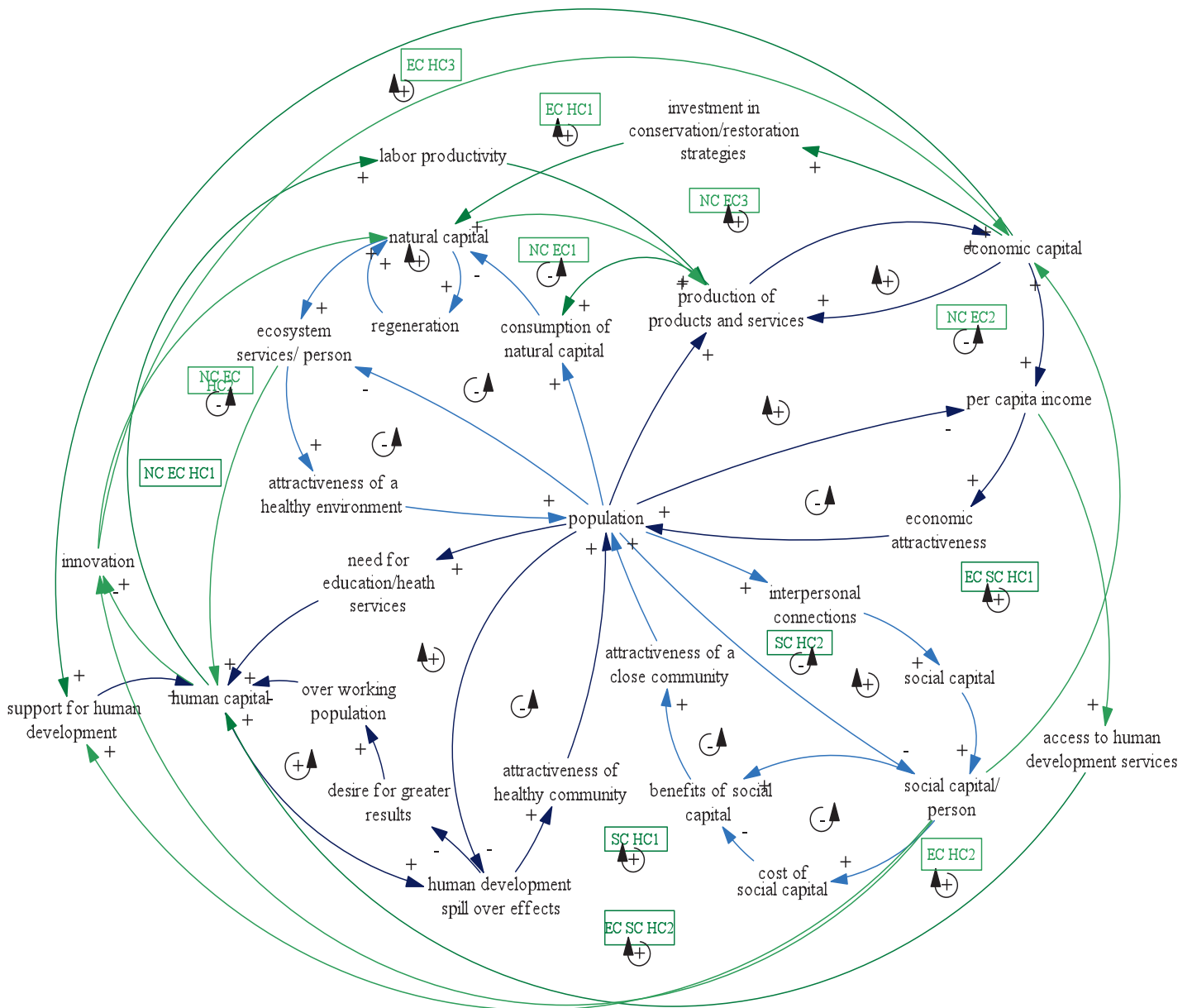


Figure 11: Full causal loop diagram

Connecting loops

NC EC1, balancing: Natural capital is used in the production of products and services and the more there is, the more can be used. The more used, the less natural capital stock remains.

NC EC2, balancing: Likewise, when products and services are consumed, it also leads to the consumption of natural capital, either raw materials or through waste. This reduces the stock of natural capital with reduces the amount left for the production of products and services. As this reduces economic capital, per capita income will go down, making the area less attractive and reducing the population that wants to live there. But, as the population decreases, consumption of products and services will decrease as well.

NC EC3, reinforcing: with local revenue, investment in conservation and restoration strategies could increase the availability of natural capital, increasing the material necessary for production and economic capital. This is assuming the strategies are effective, and consumption is not outpacing the restoration efforts. It may help stabilize the economic growth and decline that would result from using up the natural resources, then crashing as they are depleted completely.

NC EC HC1, reinforcing: A way to make more efficient use of our natural capital in production is to develop better technology. If we can reduce the amount of natural capital we use in production, we can produce more, increase economic capital, and better support human development which leads to more innovation.

EC HC1, reinforcing: This would probably be the result of less economic capital resulting from the population's production. The production of products and services is a function of labor productivity which is derived from how capable they are, or their level of human development. As economic capital grows, support for human development can also grow, improving human development, increasing labor productivity, production and increasing economic capital.

EC HC2, reinforcing: as economic capital increases, per capita income increases. As people become richer, they can better afford and gain access to human development services. Accessibility leads to greater human development, more productivity, more production and more economic capital.

EC HC3, reinforcing: Likewise with economic capital directly, innovation helps spur economic growth, leading to better economic support for education and health, better enabling people to be creative and innovative.

NC EC HC2, balancing: as human development increases, labor productivity increases, and production of products and services increases. As consumption of natural capital increases with that production, the stock of natural capital decreases. With this

decrease, the ecosystem services per person decreases as well. Ecosystem services include those that improve air and water quality, soil fertility, etc. Thus, as these go down, the health of the community will go down as well, decreasing human development.

SC HC1, reinforcing: When social capital per person increases, it helps support human development through more community and family involvement in school and health. As human development increases, it spills over its benefits to the society, making it a more attractive place to live, increasing the population. A larger population leads to more connections, and more connections per person. However, if the connections do not keep pace with the population, the increased population will dilute the social capital/person ratio, decreasing the support for human development.

EC SC HC1, reinforcing: As per capital income increases, access to human services increases. As people gain access, the level of human development increases. As human development spillover effects increase, the attractiveness of a healthy community increases, increasing the population. As the population increases, it increases social capital. Social capital helps making business more efficient and profitable by building trust, mutual dependencies, and access to information. Thus it increases economic capital, increasing per capital income. But, that rise in population also directly decreases per capital income, so it is hard to say whether there would be any net change.

EC SC HC2, reinforcing: A risk a society runs in being too close, or having too much social capital is that the barriers to entry can be high, discouraging creative people from entering (Florida, 2003). Social capital also strengthens the rules and norms. If rules and norms become too stringent, they can inhibit creative thinking. Therefore, if social capital increases to a certain threshold it could reduce innovation decreases. As innovation decreases, economic capital can stagnate and decrease, which reduces the area's economic attractiveness, reduces the population which increases the social capital/person, making the social capital more saturated and further inhibiting outside ideas.

DISCUSSION AND NEXT STEPS

The purpose of this model was to understand how people interact with capital and use it to identify potential urban planning and policy strategies to promote sustainability and quality of life. Applying the ideas in this model to Nevada, for example identifies some potential problems for the long term. One strategy for economic recovery has been to keep taxes low to help residents and attract new business. However, to balance the budget with low revenue resulted in drastic cuts to the Las Vegas education system. According to the feedback loops illustrated above, removing support for HC reduces the productivity of the workforce, reducing our ability to restore our stock of EC. Also, the low HC spillover effects reduce the attractiveness for both business and resident in migration.

Moving forward, we plan to fine tune the model to better represent certain sectors. For example, social capital is unique in that both too much and too little present problems for a city. If there are few bonds among the community, the community seems cold and impersonal. Those bonds help create stability and have been known to improve public safety (Coleman, 1988.) However, if social capital gets too high, it can sometimes make a community too exclusive to outsiders, reducing diversity and stifling creativity. A challenge moving forward is capturing the full effect of social capital on the human, environmental and economic sectors.

Using the CLD in Figure 11 as a foundation, we plan to operationalize this model for a hypothetical city and use it to examine the dynamics these relationships generate. We will then identify and test the relative effectiveness of various policy levers for achieving sustainability and quality of life.

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