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Social capital and the distribution of household income in the United States: 1980, 1990, and 2000

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ABSTRACT

Social capital is a person or group's sympathy or sense of obligation for another person or group. The objects of sympathetic feelings have social capital. Those holding sympathetic feelings for others provide social capital. Because social capital providers internalize the consequences of their choices on the objects of their social capital, they trade with each other on different terms and at different levels than would occur in arm's length transactions, all other things equal. Furthermore, changes in the distribution of social capital alter the terms and level of trade which in turn alter the distribution of income.

This paper demonstrates mathematically the connection between changes in social capital and income distributions and then tests empirically the influence of social capital on household income distributions in the 50 U.S. states for the census years 1980, 1990, and 2000. The mathematical and empirical findings of this paper support the proposition that social capital measured by social capital indicator variables have important influences on the distribution of household incomes.

1. Introduction

Social capital is a multi-disciplinary concept that has been employed to explain a variety of socio-economic phenomenon. This paper employs social capital to explain variations in household incomes across the 50 U.S. states for U.S. census years 1980, 1990, and 2000. The main connection between social capital and household income distributions is social capital's influence on the terms and level of trade which in turn alters the distribution of income. This study follows a similar work by Robison and Siles (1999, RS) who found support for the hypothesis that social capital measured by social capital indicator variables was a significant influence on the distributions of household incomes in the 50 U.S. states for the census years 1980 and 1990.

In what follows we define social capital and explain why its applications in economics have been limited. Then, we introduce the concept of social capital into the standard neoclassical utility maximizing model and deduce several important outcomes. In particular we show that under certain conditions, increases in social capital can increase average income and reduce disparity of income between trading partners. In a later section, the macro consequences of social capital are examined. The macro analysis is based on the fundamental assumption that increasing specialization and trade increase productivity.

Final sections of this paper examine the empirical evidence for social capital's influence on income distributions for the 50 U.S. states for census years 1980, 1990, and 2000. This paper concludes by restating earlier findings, that changes in social capital have important consequences on the distribution of household incomes in the U.S.

2. The difficulty of employing social capital in economic models

The definition of social capital adopted in this paper is that proposed by Robison et al. (2002b, RSS): social capital is: . . . *a person or group's sympathy or sense of obligation for another person or group.*[1] They defend their definition of social capital as sympathy because it takes seriously the capital metaphor and is social.

[1] Sympathy as used here is consistent with Smith's (1759) notion o f sympathy and the definition found in Webster's Ninth Collegiate Dictionary; namely, sympathy is an affinity, association, or relationship between persons or things wherein whatever affects one similarly affects the other.

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A long list of alternative social capital definitions have been suggested by Bourdieu (1985), Burt (1992), Coleman (1988), Fafchamps and Minten (1998), Flora and Flora (2003), Fukuyama (1995), Lin (2001), Narayan and Pritchett (1999), Putnam (2000), and Woolcock (1998) to name a few. However, RSS argue that many proposed definitions of social capital are not really definitions. Instead of defining social capital using statements like *A equals B*, many of its definitions equate it to its possible uses, where it resides, and how its service capacity can be changed. In addition, RSS argue that many of the proposed definitions of social capital fail to satisfy the fundamental requirements of capital. The consequence of social capital definitions that do not define and conflicting definitions that differ across the social sciences and which are not always consistent with the concept of capital has been to limit social capital's application, especially in economics, and made interdisciplinary communication about social capital difficult.

In an effort to separate the definition of social capital from other discussions related to social capital, Robison et al. (2004), Robison and Flora (2003), and more recently Robison and Ritchie (2010) proposed the social capital paradigm. The social capital paradigm separates the definition of social capital from what social capital produces, where it resides, how it is conveyed, the rules that organize its use, and the power associated with social capital.

3. Introducing social capital into the neoclassical utility maximizing model

Social capital as defined above introduces several changes into the neoclassical utility maximizing model. First, including social capital in the neoclassical model allows for sympathetic relationships to alter the terms and level of exchanges. Allowing sympathetic relationships to enter in the standard economic model also redefines externalities. An externality or spillover of an economic transaction is created when an agent can impose consequences on another agent not directly involved in the transaction without the agent's consent. A positive externality, for example, would be created when a home owner invests in and increases the value of her home and in the process improve home values for the entire neighborhood. A negative externality, for example, would be created when a factory pollutes a river and reduces the well-being of those living downstream.

When social capital providers create externalities for the objects of their social capital, they experience vicariously the effects of their choices on the objects of their social capital, internalizing what was once an externality. As a result, what is an externality may depend on the distribution of social capital.

An absence of social capital will motivate an agent to behave as if he were selfish. In contrast, the presence of social capital motivates decision makers to allocate more (less) resources to a project than their own profit maximizing output would require when there are benefits (costs) for those who own social capital. And if social capital is strong enough to induce an agent to weigh his/her own income and another agent's equally, then the agent will allocate resources to maximize the total of his income and the income of those who own social capital.

The main point of social capital is this: rational economic agents attempt to meet not only their own economic and physical needs, but their social ones as well. These social needs include the need for validation, the need to experience caring, and the need for knowledge of connections between actions and physical and social outcomes. Economic and physical needs are fulfilled by the consumption of goods and services provided by physical, financial, and human capital. Social needs are fulfilled by consuming socio-emotional goods created by social capital that resides in relationships. Including social capital in the standard neoclassical economic model allows agents to allocate resources to meet both their economic and physical needs as well as their socio-emotional ones.

Traditional economic models include measures of profit and wealth may provide adequate proxies for economic goods and services in arms-length transactions. But these models contain no arguments that represent an agent's social needs, nor the mechanism through which these needs are satisfied. Thus, traditional profit and utility maximization models fail to account for social motives that often substitute for and sometimes complement the pursuit of economic goals. While some models such as principle agent (Laffont and Martimort, 2001), transaction cost (Coase, 1937), warm glow (Videras and Owen, 2006), club (Cole and Prescott, 1997), and altruism models (Rose-Ackerman, 1996) may mimic social capital outcomes, they do so inadequately because they do not recognize that social capital resides in relationships in which resources are invested and disinvested, and that one's social capital provides both economic and socio-emotional goods and services valued by agents.

The social capital model that is introduced next describes how sympathetic relationships influence how decision makers pursue their economic and social goals. It further enhances economic analysis by recognizing that social capital, like other forms of capital, can be changed through investment (disinvestment), maintenance, and used in ways consistent with well-accepted maximization principles.

4. Including social capital in the own utility maximizing model

In what follows we introduce social capital into the neoclassical economic model by assuming that people satisfy socio-emotional needs through vicarious experiences—something like watching an engrossing movie in which the viewer becomes involved with the actors, vicariously experiencing their successes and disappointments. In this approach the social capital providing agent i experiences the social capital owning agent j's well-being vicariously and in the process earns a socio-emotional good. A social capital coefficient k_{ij} describing the degree to which agent i experiences vicariously changes in the well-being of agent j. The argument that vicarious experiences can produce socio-emotional goods has some support from a rich body of evidence that we choose the location and intensity of our vicarious experiences so as to maximize our own utility.[2]

4.1. Social capital motives

In an earlier work, Robison and Schmid (1994) identified five distinct social capital motives. These motives include investing resources α to increase one's own income, $\pi_i(\alpha)$; investing to increase the income of a friend, $\pi_j(\alpha)$; investing to increase the social capital one provides a friend, $k_{ij}(\alpha)$; investing to increase the social capital one is provided by a friend, $k_{ij}(\alpha)$; and investing to increase one's social capital with one's idealized self, $k_{ij}(\alpha)$. Robison et al. (2011) recently explored the relative importance of these motives and found them to be significant. The model they examined is expressed as:

$$\underset{\alpha}{\text{Max}} U_i[(\pi_i(\alpha), \pi_j(\alpha), k_{ij}(\alpha), k_{ji}(\alpha), k_{ii}(\alpha)] \quad (1)$$

Maximizing Eq. (1) over the resource α leads to the five motives already discussed.

[2] A discussion of this point is found in Robison and Ritchie (2010).

4.2. A simplified model

To simplify our investigations and to make some progress in modeling the socio-emotional goods associated with social capital we consider only the first two motives.

Assume two economic agents i and j have respective incomes $\pi_i(\alpha_i)$ and $\pi_j(\alpha_i)$ that depend on the distribution of resource α_i that is controlled by agent i. In other words, agent's allocation of his resource α_i produces external consequences for agent j. An example might be an agricultural producer whose efforts to control pests on his own farm alter his neighbor's pest population.

Then assume that i's utility function depends on a linear combination of i and j's profits with the weight on j's profits determined by the social capital coefficient k_{ij}. For the moment, k_{ij} is considered to be exogenous, such as might be the case if social capital were inherited or based on genealogy or other conditions related to one's birth. Agent i's problem then becomes:

$$\underset{\alpha_i}{\text{Max}} U_i[\pi_i(\alpha_i) + k_{ij}\pi_j(\alpha_i)] \tag{2}$$

where U_i is an increasing and concave function and where $\pi_i(\alpha_i)$ and $\pi_j(\alpha_i)$ are increasing and concave in α_i. This is the approach followed by Robison et al. (2002a, RMS) in their study of the role of social capital on agricultural land sales.

This preference specification in (2) is clearly restrictive because it requires social capital (and the socio-emotional goods it produces) to enter the utility function in a very special (linear) way. However, the linear specification is justified because it provides a first order approximation of more general forms and provides a starting place for future efforts designed to generalize these results.

We assume $0 < k_{ij} < 1$ because values of $k_{ij} > 1$ implies agent i has more concern for how his/her actions affect agent j's income than how they affect his/her own income which seems unreasonable. Values of $k_{ij} < 0$ imply agent i would be willing to reduce j's income even if it cost himself/herself to do so, an assumption we are not yet willing to adopt.[3] Furthermore, either attitude ($k_{ij} < 0$ or $k_{ij} > 1$) would threaten agent i's survival in the long run.

Eq. (2) is similar to a standard altruism model with the welfare of one agent depending on the welfare of another. One difference between altruism and the social capital model is that altruism assumes the social capital coefficient to be one. In the social capital model, the strength of agent i's vicarious sensing varies and is reflected by the social capital coefficient k_{ij} which in turn influences how agent i allocates his resources α_i which in turn influences the distribution of income between agents i and j.

5. Social capital and income distributions

Perhaps the most significant result of introducing social capital into the neoclassical model is that it alters the distribution of household income. We expect a connection between changes in social capital and changes in income distribution for the following reasons. If changes in social capital alter the level and terms of trade and changes in the level and terms of trade alter income distributions, then changes in social capital must alter income distributions. What follows explores this important connection between changes in social capital and changes in income distributions.

[3] Although we are unwilling to introduce the assumption in this model, it does have widespread application. Unfortunately, it applies to most vindictive acts such as those committed by suicide bombers.

A social capital utility function for agent i with desirable properties was described in Eq. (2). The utility maximizing solution for α_i in the simplified utility function can be written as:

$$\frac{dU_i}{d\alpha_i} = \frac{\partial \pi_i(\alpha_i)}{\partial \alpha_i} + \frac{k_{ij}\partial \pi_j(\alpha_i)}{\partial \alpha_i} = 0 \tag{3}$$

For $0 < k_{ij} < 1$, Eq. (3) implies that $\left|(\partial \pi_i(\alpha_i)/\partial \alpha_i)\right| < \left|(\partial \pi_j(\alpha_i)/\partial \alpha_i)\right|$ and that the terms $(\partial \pi_i(\alpha_i)/\partial \alpha_i)$ and $(k_{ij}\partial \pi_j(\alpha_i;\alpha_j)/\partial \alpha_i)$ are opposites in sign. Furthermore, it follows that sign of $[(\partial \pi_j(\alpha_i)/\partial \alpha_i) + (\partial \pi_i(\alpha_i)/\partial \alpha_i)]$ equals the sign of $(\partial \pi_j(\alpha_i)/\partial \alpha_i)$.

Assume that the second-order conditions for Eq. (3) are satisfied; namely, that $(d^2U_i/d\alpha_i^2) < 0$. Then totally differentiating the first-order condition and setting the result equal to zero produces the result:

$$\frac{d\alpha_i}{dk_{ij}} = \left[\frac{-\partial \pi_j(\alpha_i)/\partial \alpha_i}{\partial^2 U_i/\partial \alpha_i^2}\right] \gtreqless 0 \quad \text{for} \quad \frac{\partial \pi_j(\alpha_i)}{\partial \alpha_i} \gtreqless 0 \tag{4}$$

Eq. (4) states that when increase in α_i increases (decreases, or has no effect on) j's profit, then an increase in k_{ij} increases (decreases or has no effect on) i's allocation of α_i. Stated another way, the sign $(d\alpha_i/dk_{ij})$ equals the sign of $(\partial \pi_j(\alpha_i)/\partial \alpha_i)$. The importance of this result will become evident in the next section.

5.1. Increases in social capital and changes in total income

Consider the economic consequences on the sum of agent i's and j's income as j's social capital provided by agent i is increased. Let the sum of agents i's income and j's income equal $\pi_T = \pi_i(\alpha_i) + \pi_j(\alpha_i)$. Maximizing π_T with respect α_i produces the result:

$$\frac{d\pi_T}{d\alpha_i} = \frac{\partial \pi_i(\alpha_i)}{\partial \alpha_i} + \frac{\partial \pi_j(\alpha_i)}{\partial \alpha_i} = 0 \tag{5}$$

Assume that agent i has chosen his/her utility maximizing level of α_i, namely α_i^*. Next, consider the effect on α_i^* of an increase in k_{ij}. As j's social capital increases, the effect on total income can be expressed as:

$$\frac{d\pi_T}{dk_{ij}} = \left[\frac{\partial \pi_i(\alpha_i^*)}{\partial \alpha_i^*} + \frac{\partial \pi_j(\alpha_i^*)}{\partial \alpha_i^*}\right]\frac{\partial \alpha_i^*}{\partial k_{ij}} \geq 0 \tag{6}$$

Eq. (6) can be signed because we have already demonstrated that the sign of the bracketed expression and the sign of $(\partial \alpha_i^*/\partial k_{ij})$ equal the sign of $(\partial \pi_j(\alpha_i^*)/\partial \alpha_i^*)$. Thus, we deduce that increases in social capital increase total income whenever i's actions produce positive or negative external consequences for agent j.

5.2. Increases in social capital and changes in income differences

Next, consider the effect of an increase in social capital on the difference between π_i and π_j measured by the square of their income difference:

$$\pi_D = (\pi_i - \pi_j)^2 \tag{7}$$

As j's social capital increases, the effect on π_D can be found by differentiating Eq. (7) with respect to k_{ij} to obtain:

$$\frac{d\pi_D}{dk_{ij}} = 2[\pi_i(\alpha_i^*) - \pi_j(\alpha_i^*)]\left[\frac{\partial \pi_i(\alpha_i^*)}{\partial \alpha_i^*} - \frac{\partial \pi_j(\alpha_i^*)}{\partial \alpha_i^*}\right]\frac{\partial \alpha_i^*}{\partial k_{ij}} \tag{8}$$

The sign of Eq. (8) can be established with the aid of Appendix Table 1 and earlier derived results. In effect, it can be demonstrated that increases in social capital reduce (increase) differences in income when agent j has less (more) income than agent i.

6. Macro implications of increases in social capital

Still relevant to our understanding of gains in economic efficiency and increases in productivity is Adam Smith's (1776) insight. He observed that one person working alone could scarcely produce one pin a day. But ten men working together and each specializing in one aspect of the pin production process could make 48,000 pins a day. Smith's observation that specialization increased productivity is now practiced world-wide in global economic markets.

There is, however, another side to Adam Smith's story that deserves at least as much attention as the one regarding the importance of specialization. It is that unless one can trade for what one no longer produces when specializing, specialization is no longer possible. Thus, while specialization is a sufficient condition for increased productivity, the ability to trade is a necessary one.

With regard to the ability to trade, social capital theory has much to say. RMS demonstrated that as increases in social capital increase the benefits of trades between social capital rich trading partners, the likelihood that trades between them will increase. Supporting their theoretical observations, Siles et al. (2000) found that in Illinois, Michigan, and Nebraska, 52% of agricultural land trades occurred between friends and family and only 2% of land sales occurred between estranged or unfriendly persons.

Increases in social capital increase productivity by increasing the likelihood for increased trade in two ways. First, it can increase productivity intensively by increasing the level of trades between existing trade partners, taking still further advantage of comparative advantage and other benefits that occur from specialization. Or second, increases in social capital can increase productivity extensively by increasing the size of the trading networks, allowing still further increases in productivity from specialization. Increasing productivity intensively by increasing the level of existing social capital leads to what some have called bonding social capital. Increasing productivity extensively increases what Granovetter (1973) has called weak ties.

6.1. Intensive gains in productivity resulting from increases in social capital

Let N equal the number of workers in an economy. Let $n(x)$ equal the number of networks of size x where $0 \le x \le N$. Finally, let the percentage of workers employed in networks of size x be represented by the distribution function $(xn(x)/N) = f(x)$ where $\int_0^N f(x)dx = 1$.

Let $y = g(x,k)$ equal the income per worker in networks of size x characterized by mutually symmetric social capital coefficient k among network members. Then represent extensive gains in income that reflect increased productivity resulting from increases in social capital as $(\partial g/\partial x) > 0$ and let intensive gains in productivity resulting from increases in social capital as $(\partial g/\partial k) > 0$.Holding social capital constant, we calculate the average income per worker in the economy as:

$$\mu = \int_0^N g(x, k)f(x)dx \tag{9}$$

Finally, we describe the disparity of income using the variance of the population of worker's income as:

$$\sigma_p^2 = \int_0^\infty g^2(x, k)f(x)dx - \mu^2 \tag{10}$$

The effect on the average income output of intensive gains in social capital can be represented as:

$$\frac{d\mu}{dk} = \int_0^\infty \frac{\partial g(x, k)}{\partial k} f(x) > 0 \tag{11}$$

The influence of intensive increases in social capital within the network on the disparity of income per worker can be represented as:

$$\frac{d\sigma_p^2}{dk} = 2\int_0^\infty [g(x, k) - \mu]\left[\frac{\partial g(x, k)}{\partial k}\right] f(x)dx \tag{12}$$

whose sign depends on weights applied to differences in incomes from their means described by the partial derivative $[(\partial g(x, k)/\partial k)]$. For example, if the weighting function were a constant, then intensive increases in social capital would have no effect on the disparity of income. On the other hand, if the weighting function were increasing (decreasing) in x, then intensive increases in social capital would increase (decrease) income disparity. The implication of these results will become significant later when we interpret our empirical results. For example, redistribution of workers to smaller networks, while at the time decreasing the internal level of social capital within networks have offsetting effects on the disparity measure described in Eq. (11). The next section describes these offsetting effects.

6.2. Extensive gains in productivity resulting from increases in social capital

Next suppose that because of extensive gains in social capital that $\Delta \le f(x_1)$ percent of the workers employed in networks of size x_1 find themselves with the opportunity to work in networks of size $x_2 > x_1$ and earn $g(x_2, k) > g(x_1, k)$. Because moving to a network of increased size increases one's productivity, assume that Δ percent of the workers do indeed change their employment to the network of increased size and productivity. The question is: what effect does the shift in employment have on the average income and disparity of households' salaries?

As a result of the increased productivity of its work force, the average income per worker increases to:

$$\hat{\mu} = \mu + [g(x_2, k) - g(x_1, k)]\Delta > \mu \tag{13}$$

After some rearranging, the new variance of household income can be written as:

$$\hat{\sigma}^2 = p\sigma^2 + [g(x_2, k) - g(x_1, k)]\Delta[g(x_2, k) + g(x_1, k) - \hat{\mu} - \mu] \tag{14}$$

Because the first bracketed expression in (14) is positive, the difference between $\hat{\sigma}^2$ and σ^2 depends on the sign of the second bracketed expression in (14) which in turn depends on the difference $g(x_2, k) + g(x_1, k) - \mu - \hat{\mu} = \{[g(x_2, k) - \hat{\mu}] + [g(x_1, k) - \mu]\}0$. For example, if $g(x_1, k), g(x_2, k) \le \mu$, then shifting workers from lower earning networks to higher earning networks decreases the variance (workers are moving toward the mean). If $g(x_1, k), g(x_2, k) \ge \mu$, then the shift in workers from lower earning networks to higher earning networks increases the variance (workers are moving away from the mean). Finally if $g(x_1, k) < \mu < g(x_2, k)$ the effect on the variance of worker's income of shifting workers from lower earning networks to higher earning networks is indeterminate. Of course it is possible to have shifts in workers to different networks that leave unchanged the variance of workers income.

6.3. Extensive changes in social capital: an empirical investigation

RS used U.S. Census and other data for 1980 and 1990 to test for influences of social capital on income distributions by states. To measure social capital, they collected data on social capital indicator variables that are generally accepted measures of social capital. Their social capital indicator variables were grouped into four categories: family integrity variables, educational achievement variables, litigation variables, and labor force participation variables. Their study provided support for the deductions made

in this paper that under fairly general conditions intensive gains in social capital among members of a social capital-rich network increase average income by internalizing what otherwise would be considered to be externalities while the effect on intensive gains in social capital on income disparity is generally ambiguous. On the other hand, extensive losses in social capital that occur when members of the economy move from larger and richer social capital networks to smaller and less productive networks reduces average income while the effect on income disparity is generally ambiguous.

One of the important findings of the RS study was that an increasing percentage of households headed by a single parent, mostly single mothers, who earn roughly one-third the income of two-parent households is accounting for significant increases in income inequality. New U.S. Census data for 2000 allows us to update their earlier findings and to respond to some criticism of their earlier work. It also allows us to present a much simpler method for deriving the model to be tested.

Assume an economy where households belong to either a network of a single parent households earning $g(x_S, k)$, or a network of a two-parent households earning $g(x_T, k)$. The networks of single parents and the networks of two parents are considered to possess similar intensive levels of social capital links within their networks. But since the two networks possess different levels of extensive social capital (the size of the single parent network is assumed less than the size of the two parent network), we assume that $g(x_S, k) < g(x_T, k)$. If δ percent of the households are single parent households, then the average household income in this economy is:

$$\mu = \delta g(x_S, k) + (1 - \delta) g(x_T, k) \tag{15}$$

The household income disparity in this economy is:

$$\sigma^2 = g^2(x_S, k)\delta + g^2(x_T, k)(1 - \delta) - \mu^2 \tag{16}$$

Because of the differences in earnings of the two networks, as the percentage of households headed by a single parent increases, the average income decreases:

$$\frac{d\mu}{d\delta} = [g(x_S, k) - g(x_T, k)] < 0 \tag{17}$$

The effect of increasing the percentage of households headed by a single parent on the distribution of household income can be expressed as:

$$\frac{d\sigma^2}{d\delta} = [g(x_S, k) - g(x_T, k)]^2(1 - 2\delta) \tag{18}$$

whose sign depends on the size of δ. When δ is small (less than half the number of households) an increase in the percentage of single parent households increases the disparity of household incomes. When δ is large (more than half the number of households) an increase in the percentage of single parent households decreases the disparity of household incomes. That variance is a concave function can be confirmed by differentiating (18) with respect to δ:

$$\frac{d^2\sigma^2}{d\delta^2} = -2[g(x_S, k) - g(x_T, k)]^2 < 0 \tag{19}$$

We can also confirm that variance is a concave function of the mean by combining Eqs. (15) and (16) and eliminating δ. The resulting equation can be written as:

$$\sigma^2 = [g(x_S, k) + g(x_T, k)][\mu - g(x_T, k)] + g^2(x_T, k) - \mu^2 \tag{20}$$

Furthermore,

$$\frac{d\sigma^2}{d\mu} = [g(x_S, k) + g(x_T, k)] - 2\mu \tag{21}$$

and

$$\frac{d^2\sigma^2}{d\mu^2} = -2 < 0 \tag{22}$$

confirming that variance defined over the mean is a concave function. Furthermore, we can find the maximum variance of (20) by setting (21) equal to zero. The result is that the maximum variance is obtained when:

$$\mu = \frac{g(x_S, k) + g(x_T, k)}{2} \tag{23}$$

Finally, we can confirm that (16) reaches its maximum by setting $(d\sigma^2/d\delta) = 0$ and solving for δ. The value for v that maximizes disparity of household income is $\delta = 1/2$ consistent with our results in (23)

Increasing the percentage of households headed by a single parent initially increases the disparity of household incomes but when more than 50% of the households are headed by single parents, further increases will decrease household income disparity.

7. Empirical evidence: the effect of social capital on income distribution

The theoretical model in the previous section demonstrates mathematically the connection between social capital and household income distributions. In this section, we propose an estimation strategy to empirically test the hypothesized relationship between social capital and income distribution using panel data from the 50 U.S. states for the census years 1980, 1990 and 2000.[4]

The model to be estimated empirically improves on the RS estimation effort in the following way. The RS model has been criticized because its pooled OLS estimation was not able to control for unobservable heterogeneity and simultaneity between the income and the social network variables. The empirical approach employed in this paper overcomes the RS model's lack of control for unobservable heterogeneity and simultaneity by employing panel estimation of panel data for three time periods spanning 30 years. Both the fixed-effect and first-differenced estimation approaches were used to control for the individual unobservable heterogeneity bias. In addition, instrumental variable approach is employed to control for potential reverse causality between income and social network (or other control variables) by using the lagged social network variable and other control variables as instrumental variables to instrument the first differenced social network and other control variables.

[4] Data used in this research project were obtained from published secondary sources. Most of the variables' data come from the U.S. Census Bureau "General Social and Economic Characteristics" publication for each of the 50 states. Among these variables we can cite: Household Income, Population, Percentage of Household Graduates, Percentage of Female Headed Households, Gini Coefficients, Family Poverty Rates, and Household Median Income. Since income data is gathered and published in a categorical type, we calculated the mean income and standard deviation variables using conventional statistical equations for categorical data. Real income data was calculated based on the 1982–84 CPI = 100 deflator. Another important source of data is "Kids Count" a yearly publication of the Annie E. Casey Foundation for the 50 U.S. states. The variables obtained from these publications are: Low Birth Weight Babies, Births from single Teens, Infant Mortality Rates, Juvenile Crime, Children Poverty Rates, Teen Violent Deaths, and Teens not in School. Data for Labor Force Participation Rates, Divorce Rates, and Family Poverty Rates came from the "Statistical Abstract of the United States" yearly publication. Finally, crime related variables were obtained from the Federal Judicial Caseload Statistics including Rape Rates, Robbery Rates, Murder Rates, and Total Crime.

7.1. Empirical model and estimation strategy

To test the relationship between social capital and the mean household income in a given state, we specify the following reduced form equation:

$$Y_{it} = \lambda_i + \beta Soc_{it} + \gamma X_{it} + \delta D_t + \varepsilon_{it} \quad (24)$$

where Y_{it} is the mean per capita income in state i for year t, Soc_{it} is a vector of social capital indicator variables, X_{it} is a vector of other state characteristics that are expected to have separate effects on household income, D_t is the year dummy to capture the time trend, β and γ are vectors of parameters to be estimated, and ε_{it} is the i.i.d. random error term.

The term λ_i is included to capture all the time invariant state-specific unobserved fixed effects, such as endowment of natural resources, access to different economic opportunities, etc. In general, λ_i is correlated with both Soc_{it} and Y_{it}. It is well established in econometrics that the presence of λ_i leads to the biased OLS estimates of β in Eq. (24). To deal with this endogeneity problem, we calculate first differences on both sides of Eq. (24). Specifically, the first differenced (FD) model of Eq. (24) can be written as:[5]

$$\Delta Y_{it} = \beta\ \Delta Soc_{it} + \gamma\, \Delta X_{it} + \delta\, \Delta D_t + \Delta\varepsilon_{it} \quad (25)$$

where Δ is the symbol for first differencing (e.g., $\Delta Y_{it} = Y_{it} - Y_{it-1}$). In the process of calculating first differences for Eq. (24) the constant term λ_i is eliminated in Eq. (25). However, ΔSoc_{it} could still be endogenous (or $E(\Delta Soc_{it|}\Delta\varepsilon_{it}) \neq 0$) if there are time variant unobserved factors that are correlated with both ΔSoc_{it} and ΔY_{it}. One source of such endogeneity could be the reverse causality between ΔY_{it} and ΔSoc_{it}. For example, if Y_{it} and/or Y_{it-1} affect Soc_{it}, then it is apparent that ΔY_{it} would also affect ΔSoc_{it}. For the same reason, some elements in ΔX_{it} could also be potentially endogenous. To deal with the endogeneity problems for ΔSoc_{it} and/or ΔX_{it}, we use instrumental variable (IV) approach. The lagged values of the endogenous variables could be potential instrumental variables for the respective first-differenced terms.[6] For example, either Soc_{it-2} or Soc_{it-1} can be the potential instrument variable for ΔSoc_{it}.

The two critical conditions for a variable to be a valid instrumental variable for ΔSoc_{it} include (1) the instrumental variable must be correlated with ΔSoc_{it}, and (2) the instrumental variable must not be correlated with ΔY_{it} (or $\Delta\varepsilon_{it}$). Soc_{it-2} is not correlated with ΔY_{it} (or $\Delta\varepsilon_{it}$), which is not surprising given the long time gap (10 years) between two consecutive panel periods. But the long time gap between two consecutive panel periods also causes the correlation between Soc_{it-2} and ΔSoc_{it} to be extremely weak. Cameron and Trivedi (2005) indicate that extremely weak correlation between instrumental variable and the endogenous variable that is instrumented could cause serious efficiency loss (or the failure to reject the null hypothesis). And the problem is especially severe when the sample size is small. The extremely weak correlation between Soc_{it-2} (or X_{it-2}) and ΔSoc_{it} (or ΔX_{it}) and the small sample size (50 states) seem to merit concern. Therefore, Soc_{it-2} (or X_{it-2}) are not valid instrumental variables for ΔSoc_{it} (or ΔX_{it}).

If we can assume that Soc_{it} and/or X_{it} are strictly predetermined variables (i.e., Soc_{it} or X_{it} are only affected by the past mean income, but not the current and future income), then Soc_{it-1} (or X_{it-1}) is a valid instrument variable for ΔSoc_{it} (or ΔX_{it}).[7] The assumption that Soc_{it} and/or X_{it} are strictly predetermined variables is reasonable because income is not realized until the end of the year and it only affects the social capital or other state level variables for the future years. Hence, we use Soc_{it-1} and X_{it-1} to instrument ΔSoc_{it} and ΔX_{it}.

Finally, we have a few variables in X_{it} that happen to be highly correlated with each other; we exclude some of these variables from the main equations of interest (Eq. (25)). But we include their lagged values as extra instrumental variables for ΔSoc_{it} and the remaining elements of ΔX_{it}. Following this procedure allows us to test whether all the instrumental variables are indeed jointly exogenous (the over identification test). As we will see in the tables for regression results, the Hanson-J tests show that our choice of instrumental variables passes the over identification test.

Changing Y_{it} to the variance of Y_{it} (or $Var(Y_{it})$) on the left hand side of Eq. (25) and adding a squared term of Soc_{it} (i.e., Soc_{it}^2) on the right hand side of the same equation yield a reduced form equation for the determinants of the variance of household income. Specifically, this reduced form equation can be written as:

$$\Delta Var(Y_{it}) = \beta_1\ \Delta Soc_{it} + \beta_2\, \Delta Soc_{it}^2 + \gamma\, \Delta X_{it} + \delta\, \Delta D_t + \Delta\varepsilon_{it} \quad (26)$$

where $\Delta Var(Y_{it}) = Var(Y_{it}) - Var(Y_{it-1})$, and $\Delta Soc_{it}^2 = Soc_{it}^2 - Soc_{it-1}^2$, the other terms were already defined in Eq. (25). Eq. (26) can be estimated in the same fashion as Eq. (25).

7.2. Social capital indicators and variables included in X vector

The social capital indicator variables include measures of family integrity, educational achievement, litigation, and labor force participation. The rationale for inclusion of these variables and the expected direction of impact of each of these variables is described in great detail in the RS study. These variables are, of course, related. For example, the percentage of households headed by a single female with children in each state in each time period may influence household income through its effect on education (Baliamoune-Lutz, 2009).

However, most of the variables identified by RS as social capital indicator variables also represent different economic opportunities and economic conditions across states. Here we treat these variables as part of the X_{it} variables. Indicator variables selected to measure education achievements include high school graduation rates and percentages of teens attending private school. Indicator variables selected to measure crime is the total number of criminal activities. And indicator variables selected to measure the labor market include labor force participation rates.

Other variables included in the X_{it} vector include low birth weight babies, infant mortality rates, child poverty rates and total population. Ideally, we would include as many control variables as possible. But given the relatively small number of observations, we exclude some variables that are highly correlated with other variables from Eq. (25) but use the lagged value for some of these excluded variables as extra instrumental variables.

7.3. Estimation results

The econometrics results for the mean income regression (Eq. (25)) and variance regression (Eq. (26)) are presented in Tables 1 and 2, respectively. For each regression, we report the results for the first differences model (FD), fixed-effect model (FE) and the first differences instrumental variable model (FD-IV). We did not report the OLS results because they are biased for the reasons already discussed. OLS estimation not only biased the magnitude of the coefficients for many variables, it also altered the sign of coefficient for some variables including the key social capital variable. For example, the sign for the key social capital variable (percentages of households headed by a single female with

[5] An alternative way to remove λ_i from Eq. (24) is to estimate Eq. (24) using fixed-effect estimation method. Given the small number of periods, we would expect that the results from the fixed-effect model are similar to those from the first differences model, which is further supported by the results in Tables 1 and 2.

[6] See Bond (2002).

[7] See Wooldridge (2002), p. 303.

Table 1
Relationship between social capital and mean household income.

	OLS	First-difference	Fixed-effect	First-difference IV
Female headed households	731.793** (2.41)	−533.760*** (2.68)	−782.302** (2.21)	−970.285*** (2.81)
High school graduates	−5.309 (0.07)	72.442** (2.54)	59.133** (2.17)	114.297** (2.05)
Children attending private schools	−0.005 (1.35)	−0.006*** (4.72)	−0.005*** (3.03)	−0.008*** (2.85)
Labor force participation rates	303.788*** (3.01)	362.182*** (4.77)	212.915*** (3.06)	446.678* (1.79)
Low birth weight babies	27.971 (0.06)	−840.073** (2.07)	−442.431 (1.08)	−2824.818* (1.72)
Infant mortality rates	−230.609 (0.85)	−166.367 (1.15)	−50.456 (0.33)	105.988 (0.29)
Children poverty rates	−505.260*** (6.08)	−220.986*** (4.53)	−267.603*** (4.47)	−251.617** (2.32)
Total crime	0.218 (0.62)	−0.548** (2.49)	−0.517** (2.52)	−0.385 (1.33)
State population	0.000*** (4.12)	0.000*** (2.75)	0.000*** (3.20)	0.000 (1.11)
Year 1990	3997.266** (2.16)	−5441.926*** (4.88)	−2517.341* (1.86)	
Year 2000	4566.853* (1.86)		−499.742 (0.30)	6721.114*** (2.70)
Constant	5496.981 (0.61)	2054.802*** (3.40)	26738.905*** (4.75)	−2718.802 (1.15)
Observations	150	100	150	100
R-squared	0.66	0.63	0.86	
Hanson-*J* test for exogeneity of IVs (*p*-value)				0.88 (0.65)

z Statistics in parentheses. Robust *t* statistics in parentheses.
* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

Table 2
Relationship between social capital and variance of household income.

	OLS	First-difference	Fixed-effect	First-difference IV
Female headed households	77.106 (1.59)	61.816*** (2.95)	53.392 (1.65)	84.352 (1.57)
Female headed households squared	−2.282 (1.35)	−3.702*** (4.02)	−3.690*** (2.95)	−5.034** (2.19)
High school graduates	−0.167 (0.06)	2.691** (2.25)	1.911* (1.86)	3.353 (1.26)
Children attending private schools	−0.000 (0.98)	−0.000*** (2.86)	−0.000* (1.94)	−0.000** (2.07)
Labor force participation rates	8.988** (2.43)	9.605*** (3.98)	4.615* (1.68)	14.655 (1.19)
Low birth weight babies	14.344 (0.78)	−34.445*** (2.66)	−21.402 (1.31)	−173.314** (2.36)
Infant mortality rates	−12.805 (1.34)	−5.082 (0.92)	0.925 (0.15)	7.431 (0.41)
Children poverty rates	−11.362*** (3.41)	−5.680*** (2.74)	−7.268*** (2.80)	−7.926 (1.47)
Total crime	−0.003 (0.24)	−0.027*** (3.09)	−0.025*** (2.76)	−0.011 (0.70)
State population	0.000*** (4.16)	0.000*** (2.65)	0.000*** (2.88)	0.000 (0.96)
Year 1990	148.124** (1.98)	−152.477*** (3.14)	−24.991 (0.46)	37.761 (0.29)
Year 2000	169.192* (1.71)	0.000 (.)	65.668 (1.11)	212.580*** (3.33)
Constant	−562.911 (1.14)	85.256*** (4.22)	210.283 (0.78)	0.000 (.)
Observations	150	100	150	100
R-squared	0.69	0.71	0.91	
Hanson-*J* test for exogeneity of IVs (*p*-value)				1.30 (0.50)

z Statistics in parentheses. Robust *t* statistics in parentheses.
* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

children) is positive and significant from the OLS regression but negative and significant from all other estimations.

The models in general performed well. R^2's for the FD-model and FE-model is 0.63 and 0.86 in the mean income regression (and even higher in the variance regressions). The high *p*-values from the Hanson-*J* test suggest that Soc_{it-1} and X_{it-1} are valid instrumental variables for ΔSoc_i and ΔX_{it}. Furthermore, the coefficients for social capital and many other control variables have the right signs and are statistically significant. And these results are also robust across different estimation methods.

7.4. Results for the mean income regression

The results for the mean income regression are presented in Table 1. The results in Table 1 strongly support our theoretical prediction that level of social capital in a state is positively related to the mean income of the state. The coefficient on the percentage of households headed by a single female with children (our key measure of social capital) has the expected sign and is statistically significant. The results are also highly consistent across different estimation methods.

The magnitude of the impact of social capital on mean income is large. For example, one percentage point increase of households headed by a single female with children would reduce the mean income of the state by between $534 (FD model) to $970 (FD-IV model). In terms of percentage change, percentage point reduction in households headed by a single female with children would increase the average income ($27,000 for the entire sample) by 1.5–3.7%.[8]

[8] To examine whether the same negative effect of female headed households on mean household income holds across states, we augmented the mean income regressions (Eqs. (24) and (25)) by including an interaction term between female headed households and a dummy variable for population density (which is equal to one for the 15 states with the highest population density, and equal to zero for the rest of the states). Specifically, we wanted to know if decreases in intensive levels of social capital were partially offset in high density states when extensive levels of social capital may be higher. The regression results are reported in Appendix Table 2. While the coefficients on all other variables are highly consistent with those reported in Table 1, the results suggest that female headed households has a larger negative effect on household income in low density states than in high density states. For example, based on FD-IV (the most reliable specification), 1% increase in female headed households reduces household income by $1600 in low density states, which is twice as large as the reduction in income for the high density states ($812 – last column of the bottom panel of Appendix Table 2). The result that female headed

The results on other variables are also largely consistent with our expectation. The positive and significant coefficients for share of high school graduates, total labor force participation and total population suggest that there are economies of scale and that the human capital stock is importance for a state's economy. For example, 10 percentage points increase in share of high school graduate would increase per capital mean income by $590–1140 depending on the estimation methods. And another one percentage point increase in labor force participation is associated with another $213–447 increase in per capital income. The negative and statistically significant coefficients for the number of students attending private schools account for some of the negative social capital effects. Also consistent with our prior expectation, low birth weights, infant mortality rate, and children poverty and total crime are all negatively related to mean income though the statistical significance is less consistent across the estimation methods. One percentage increase in children poverty rate would reduce the mean income by between $220 and $267.

7.5. Results for the variance of income regression

The results for the variance of income regression also support the hypothesis derived from the theoretical model that the relationship between social capital and the variance of income is quadratic. In particular, the variance of income increases with the level of social capital until the level of social capital reaches a certain point. Then the variance of income decreases as the level of social capital further increases. The positive coefficient on the linear term and negative coefficient on the squared term is exactly what the model predicts. While the coefficient on the squared term is consistently significant at 5–1% level, the coefficient on the linear term is ranging from marginally significant (11% FE or FD-IV) to significant at 1% level (FD estimation).

It is interesting to note that the reflection points are between 8% and 10%, suggesting that the presence of households headed by a single female with children impose considerable negative externalities (possible reductions in intensive levels of social capital) on societies even when the percentage of households headed by a single female is at a relatively low level.

7.6. Interpreting the empirical results

One surprising result of the empirical section is that the maximum level of disparity is reached at a much lower percentage of households headed by a single female than expected. In addition, an increase in the percentage of households headed by a single parent has a much more significant decrease on average household income than expected.

One possible explanation for these findings is that accompanying the shift of workers from larger (two parent) and more productive networks to smaller (single parent) and less productive networks has been an overall decrease in the intensive levels of social capital. While a description of the possibility or likelihood that decreases in extensive and intensive social capital are related is beyond the scope of this paper, we will demonstrate next that changes in intensive and extensive levels of social capital may have offsetting effects.

households are more important in low density states than in high density states may suggest that larger networks of weak ties can partially compensate the loss of bonding social capital in states with high population density such as New York, Massachusetts, New Jersey, etc.

Differentiating (15) with respect to k confirms that increases (decreases) in intensive levels of social capital within networks increases (decreases) average household income under our previous assumption that $(\partial g(x, k)/\partial k) > 0$.

$$\frac{d\mu}{dk} = \delta \frac{\partial g(x_S, k)}{\partial k} + (1-\delta)\frac{\partial g(x_T, k)}{\partial k} > 0 \tag{27}$$

Next we differentiate (16) with respect to k to find the effect of changes in the intensive level of social capital on the disparity of household incomes and obtain the result:

$$\frac{d\sigma^2}{dk} = 2\frac{\partial g(x_S, k)}{\partial k}\delta[g(x_S, k) - \mu] + 2\frac{\partial g(x_T, k)}{\partial k}(1-\delta)[g(x_T, k) - \mu] \tag{28}$$

For small values of δ and knowing that $g(x_T, k) > \mu$ and that $g(x_S, k) < \mu$, we expect that decreases in the intensive levels of social capital will decrease household income disparity. Decreases in the intensive levels of social capital also may explain why we observe maximum levels of disparity to be reached at lower values of δ than expected and why increases in δ have much more significant effect on average income than expected. All of this leads to the hypothesis that $k = h(\delta)$ and that $(dk/d\delta) = h'(\delta) < 0$ leading to the conclusion that $(d^2\sigma^2/d\delta^2) = -2[g(x_S, k) - g(x_T, k)]^2 < 0$

8. Conclusions

Including social capital in the neoclassical utility maximizing model allows us to model the important effects of relationships of sympathy (antipathy) or social capital have on terms of trade and likelihood of trades. The capital-like properties of social capital have been described elsewhere. The important point is that these capital-like properties allow economists to model social capital much like they might model the economic consequences of other forms of capital.

What social capital provides are socio-emotional goods (SEGs) and services that are valued, much like the goods and services produced by other forms of capital like physical, human, and financial capital. Since SEGs may complement or substitute for financial services, their effects cannot be modeled in isolation without imposing seriously limiting assumptions. Thus, the interdependent nature of producing SEGs and other types of goods in utility maximizing models suggests significant opportunities for cooperation between economists and other social sciences.

An empirical effort was made and reported in this paper to test the influence of social capital on terms of trade and likelihood of trades and by implication on the distribution of household income. The empirical results support the social capital model deductions-namely, that increases in social capital improve the likelihood of trades between friends and family when the buyer has a comparative advantage in the use of the traded asset. Additional deductions showed that increases in intensive and extensive levels of social capital have important and predictable consequences on the income distribution of social capital rich-networks-increases in social capital increase the average income and reduce income differences.

In conclusion, social capital offers economists a new tool. It redefines externalities, broadens the definition of what is considered rational behavior, recognizes an important resource whose management offers new policy options, and suggests the need for increased cooperation among social sciences.

Appendix A.

See Tables A1 and A2.

Table A1
Changes in differences of income in response to increases in social capital.

(1) Sign $(\pi_i^* - \pi_j^*)$ is assumed	(2) Sign $(\partial\pi_i/\partial\alpha^*)$ is assumed	(3) Sign $(\partial\pi_j/\partial\alpha^*)$ is assumed	(4) Sign $((\partial\pi_i/\partial\alpha^*) - (\partial\pi_j/\partial\alpha^*))$ is determined by assumptions in columns (2) and (3)	(5) Sign $(\partial\alpha^*/k_{ij})$ is determined by the sign of column (3)	(6) Sign $(\pi_i - \pi_j)((\partial\pi_i/\partial\alpha) - (\partial\pi_j/\partial\alpha))(\partial\alpha/\partial k_{ij})$ is determined by the signs of columns (1), (4), and (5)
+	0	0	0	0	0
+	+	−	+	−	−
+	−	+	−	+	−
−	0	0	0	0	0
−	+	−	+	−	+
−	−	+	−	+	+

Table A2
Relationship between social capital and mean household income (interaction term between dummy for high density population and added).

	First-difference	Fixed-effect	First-difference IV
High school graduates	72.697** (2.59)	58.874** (2.11)	148.511* (1.92)
Labor force participation rates	362.407*** (4.75)	212.396*** (3.02)	691.197* (1.86)
Low birth weight babies	−841.990** (2.07)	−436.104 (1.05)	−4060.774** (2.03)
Infant mortality rates	−169.240 (1.16)	−55.260 (0.38)	−63.478 (0.14)
Children poverty rates	−221.502*** (4.50)	−268.146*** (4.43)	−297.290* (1.89)
Total crime	−0.549** (2.52)	−0.517** (2.51)	−0.379 (1.05)
Female headed households (α_0)	−564.889* (1.81)	−823.715** (2.20)	−1600.917** (2.25)
Female headed households*Dummy for high density states (α_1)	32.184 (0.12)	46.912 (0.15)	788.546 (1.09)
Children attending private schools	−0.006*** (4.33)	−0.005*** (2.80)	−0.011*** (2.69)
State population	0.000*** (2.66)	0.000*** (2.98)	0.001 (1.26)
Year 1995	−5509.378*** (5.13)	−2579.900** (2.08)	0.000 (.)
Year 2000	0.000 (.)	−548.444 (0.34)	9654.468*** (2.65)
Constant	2067.238*** (3.30)	27144.162*** (4.82)	−4901.997 (1.48)
$\alpha_0 + \alpha_1$ (net effect for high density states) (p-value)	−532.73*** (0.01)	−776.81** (0.04)	−812.37** (0.03)
Hanson-J test statistics (p-value)			0.61 (0.73)
Observations	100	150	100
R-squared	0.63	0.86	

Robust t statistics in parentheses. The 15 states with highest population density include: New Jersey, Rhode Island, Massachusetts, Connecticut, Maryland, New York, Delaware, Florida, Ohio, Pennsylvania, Illinois, California, Hawaii, Virginia, Michigan.

* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

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