Trust and Macroeconomic development

- an agent-based modeling approach -

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Contents

1 Introduction

1.1 Background

Economic theory suggests that market failures arise when contracts are difficult to enforce or observe. Social capital can help these failures. The more individuals trust each other, the more they are able to contract with each other. Hence many believe that trust is a critical input for both macro- and microeconomic outcomes.

The intellectual tradition stressing the importance of social attitudes date back to at least Max Weber, and has seen many recent restatements in political science in particular, recent ones being Robert Putnam showed, for instance, how civic attitudes and trust could account for differences in the economic and government performance between northern and southern Italy. This tradition has been so influential that it has led the World Bank to put on the top of the agenda the promotion of a new kind of capital stock to trigger economic development: the social capital. Following Fukuyama, this social capital can be defined as the "set of informal values or norms shared among members of a group that permits them to cooperate with one another". Obviously the propensity to trust each other is likely to be key for fostering such mutual cooperation and growth.

But paradoxically, economists are still struggling to providing empirical evidence on such a causal impact of social attitudes on economic development. Most of the time, the economic literature has been successful to emphasise the existence of a cross-country correlation, instead of a causal relationship, between growth and social attitudes. For instance, Stephen Knack and Philip Keefer, economists at the World Bank, proposed to measure the cross-country heterogeneity in social capital by using an international social survey(the World Values Survey), which reports direct information on the level of trust of people asking them: "Generally speaking, would you say that most people can be trusted, or that you need to be very careful in dealing with people?" Knack and Keefer then showed a strong cross-country correlation pattern between country levels of trust and country levels of income per capita.

Yet this correlation pattern leaves completely unexplained the relation of causality between trust and growth and may result in misguided policy recommendations. Individuals who are living in

wealthy countries, with efficient institutions, are likely to more trusting people then individuals living in developing countries at war. The relation between trust and growth could thus go the other way around, in which case a prerequisite to strengthen social cooperation is to foster economic development first.

What do economists need to uncover a causal relationship running from social attitudes toward economic development? They basically need to find social attitudes that not over-determined by economic development. A priori, this is a difficult task to the extent that social attitudes can always been influenced by the economic and social environment where people live. These difficulties show up even in the most complete and remarkable peices of work of Guido Tabllini, who shows that the literacy rate and the political institutions in place over the past several centuries are correlated with trust at the end of the twentieth century, and thus capture the current impact of trust on the income per capital across European regions. But since these historical variables are time-invariant, they could also pick up the more fundamental influence of specific time-invariant features such as legal origins, political institutions, and more generally historical and geographical factors. At the end of the day, the question whether it is trust or any other specific feature which matters for explaining growth is thus still open.

1.2   Research Aim

This paper proposes a new method to uncover the causal link between trust and economic development by using Agent-Based modeling approach. Its empirical strategy is based on the cogent definitions and dynamics of trust of the agent in the model. In the spirit of the epidemiological literature, it seeks to finding out the qualitative/qunatative effect of trust on economic growth in simulated model.

2 Literature Review

2.1 Understanding Trust through lens of Economics

2.1.1 Notion of Trust

2.1.2 Trust in Economics

What the trust game measures is an ongoing controversy among many economists. Early studies showed that the trust game does not measure trust at all, but rather trustworthiness(Glaeser, et al.(2000), "Measuring Trust"). However more recent research suggest that the trust game measures the beliefs component of trust(how likely is it that an unknown other will cheat you). See, e.g., Sapienza, Toldra and Zingales(2012) "Understanding Trust"; or Butler, Guulian and Guiso(2012) "Trust and Cheating". This raises the important practical concern over whether behaviors in the widely-used "trust game" actually measure trust, or instead reveal more about risk attitudes. It is critical to confront this question rigorously, as data from these games are increasingly used to support conclusions from a wide variety of fields including macroeconomic development, social psychology and cultural anthropology.

2.1.3 Modeling Irrational Preferences

With regard to irrationality, many influential economists, including Adam Smith(1759), Kenneth Arrow(1981), Paul Samuelson(1993) and Amartya Sen(1995) have acknowledged that individuals often have "irrational preferences". These economists have noted that such irrationality may have important economic consequences. However, these incidental opinions have little impact in mainstream economic thoughts. Economists believe, and rightly so, that by choosing the right preferences, everything can be explained.

In fact, the physical spaces that most people interact in cannot be modeled as competitive markets. People operate in markets with a small number of traders. These markets are often laden with "informational friction" - which makes fully rational decision difficult. Individuals often make decisions that are far from well thought-out. Economists term such activities as "irrational behaviors" because they do not conform to conventional thoughts about what is

advantageous to the individuals.

2.2 Agent-Based Modelling approach and NetLogo

2.2.1 Agent-Based Modelling approach and its feature

The reason is obvious: when designing trust and reputation models, game theoretical approaches work perfectly in simple environments. Nevertheless, if we want to undertake problems found in socially complex virtual societies, like negotiation issues, more sophisticated models baseed on solid cognitive theories are needed. One of the advantages of cognitive-based modeling is that the structure of the mental state can be as important as the final value.Thus, processes like argumentation, automated negotiation etc. can take place.

Another advanttage is the proximity with human comprehension. For a human being, it is easier to understand an explanation based on beliefs, desires and intentions than an explanation full of numbers.

2.2.2 Overview of NetLogo

Social information enables individuals to refine their interaction behvior based on their preset preferences of cooperative strategies. Lik Mui()have shown both analytically and through game simulations that agents who are able to utilize their social information can aquire more fitness than those who are not.

Social information is about the social structure such as trust and reputation which are propagated through social networks(Wasserman and Faust, 1994; Granovetter, 1983).To enable an informed research agenda, we need a cross-disciplinary perspective which is sociologically justified, statistically sound computational formulation of trust.

Bounded rationality : Agents make decisions under conditions of bounded rationality.

Each agent is aware of its own state An agent is said to be autonomous, in the sense that it can decide what to do based on endogenous goals and information, much like a social actor, without necessarily requiring exogeneous guidance. Besides making decisions based on its own internal

state, an agent can also decide to act in reaction to some perceived environmental situation. Moreover, agents can also behave proactively, based on goals Agents can communicate, sometimes generating emergent patterns of sociality(e.g., collective behavior) by making their attributes visible or actually passing information

We can gain knowledge principally upon the laboratory since ethics, legality, and costs are the factors that most field experiments infeasible. For example, one hopes that Federal Reserve Chair Janet Yellen does not plan on deploying field experiments to refine her knowledge of the effect of interest rate on inflation. Similarly, field experiments on the effects of trust are impractical in real world. In these cases, laboratory experiments often provide the best(albeit imperfect) source of information on causal effects.

heterogeniety in trust beliefs coupled with the tendency of individuals to extrapolate belifs about others from their own level of trustworthiness could generate non-monotonic relationship:

NetLogo can be adapted to allow the observer greater ability to manipulate each independent agents, or to create a model closer to reality. An observer may wish to include procedures that allow for the level of trust be increased or reduced.. This procedure could be helpful for determining how the agent's microscopic behaviors are evolve into macroscopic pattern.

3 Model Description

3.1 Overview of Simulation Step

This model tests the effect of three independent variables on whether or how society's level of trust will affect total wealth. The independent variables are (1) the level of benefit(cost) the agent receives from trusting others, as measured through the amount of energy (2) the degree of trustee's population at the beginning of the model; this is also measure using the quantity of energy someone has at the beginning of the model.

Energy is the common currency for movement and independence in this model as all agents must have energy to move; however, agents can have a negative energy balance. The rules of the model require that these agents find additional sources of energy, similar to a person with a negative

balance in their bank account seeking ways to bring that balance back to a positive number. Energy can be gained by going to work, symbolized by changing the cyan-colored patches to black.

The hypothesis of this model is that as the society's average level of trust increases, and as the level of benefit of trusting behavior increases, the total wealth in the society increases.

A second procedure that could be included would be the role of recent psychological discovery of relationship between individual trust and economic performance(Butler et al. 2015), which purports that individual income is hump-shaped in a measure of intensity of trust beliefs.

The model assumes two different groups of people: people with trusting behavior(designated with trust level between 4 to 7), people with non-trusting behavior(designated with trust level between 0 to 3). As simulation runs, all people expend energy through movement. IF their energy reaches zero, then they are no longer able to participate and are removed from the program. All people can regain energy through working.

Economists have singled out trust as an important phenomenon at the individual level, and for society as a whole. This raises natural questions about the determinants of trust. We knew already that decisions about whom and how much to trust are partly based on pecuniary considerations, but that there is a substantial and varied role for moral considerations.

Our evidence suggests that recievers' belief in what the senders would consider as cheating is strongly correlated with how receivers themselves define cheating. This is a pattern consistent with the psychological phenomenon of 'false consensus(Ross et al. 1977)in which we tend to think that others are like us.

If some individual hold persistently mistaken trust beliefs, then these mistaken beliefs may create substantial economic losses. We replicate this relationship between mistaken trust beliefs and earnings losses in an experimental trust game, where we also find a false consensus in shaping trust belifs(Butler et al. 2015)

It is vital to understand that as the models run as a time-series, the value of output variables change, and this may occur because of autocorrelation.

3.2 Mathematical Representation

3.3 validation

structural validity The majority of simulations contain a degree of randomness, so exact matches of the initial data and generated forecast are rare. For a more thorough discussion of validation, please refer to Gilbert(2008).

theoretical test of validation

behavioral validity

4 Experiments and Results

4.1 Scenario Analysis

A model is operational valid to a degree that it makes available an acceptable range of accuracy consistent with the projected application of the model. Thus, if the intention is to accurately represent economic reality, then validation is about assessing how well the model is capturing the quintessence of its empirical referent. This might be measured in terms of goodness of fit to the characteristics of the model's referent.

Operational validation will check how the model performs during running a set of computer experiments in the frame of NetLogo software platform using personal experience in using the Behavior Space tool located in Tools menu of NetLogo interface.

4.2 Results

5 Conclusions

We document Though prior study suggests that both excessive trust and excessive mistrust are individually costly, the experimental data suggest that the cost of trusting too little far exceeds that of trusting too much. This is because from societal view, excessive trust may create social

surplus.

First, if you believe that laboratory experiments artificially inflate scrutiny, and that this induces artificially altruistic behaviour, then you should lean toward field experiments since they guarantee natural scrutiny levels for the environment in question. As is evident in the model, scenarios can be very abstract, the range of actions unrealistically small, and participants take on unfamiliar roles(Levitt and List 2007)

Obviously, there are drawbacks in cognitive modelling. Because of their complexity, some of the models remain at a descriptive level. Only few of the cognitive models(BDI+Repage) contemplates procedural aspects of trust.

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