This is an Accepted Manuscript of an article published by Taylor & Francis Group in the Journal of Economic Issues, Vol. 52(2), 2018, p. 559-569, available online: https://doi.org/10.1080/00213624.2018.1469936

To Trust or to Control: Informal Value Transfer Systems and Computational Analysis in Institutional Economics

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Abstract: This article illustrates the usefulness of computational methods for the investigation of institutions. As an example, we use a computational agent-based model to study the role of general trust and social control in informal-value transfer systems (IVTS). We find that the terms of interaction between general trust and social control have an impact on how IVTS work, become stable and prove highly effective. The case shows how computational models may help (i) to operationalize institutional theory and to clarify the functioning of institutions; (ii) to test the logical consistency of alternative hypotheses about institutions; and (iii) to relate institutionalist theory with other paradigms and to practice an interested pluralism.

Keywords: agent-based computational economics, evolutionary-institutional economics, general trust, informal-value transfer systems, social control

JEL Classification Codes: C63, C72, D02, F33, G23

Institutions are an essential part of any socio-economic system, yet to study them is challenging. Many institutions are "intangible" or "informal" and, therefore, not directly observable. Thus, the way they affect human cognition and behavior is difficult to assess. Institutional economists have developed a number of operational tools that help them understand institutions (see, for example, Radzicki [1988] on system dynamics; Hayden [2006] on the social-fabric matrix; or Elsner [2012] on game theory). In this article, we strive to illustrate the usefulness of a relatively new tool, which we consider helpful in the study of institutions: computational agent-based models (ABMs). Together with a sound theoretical foundation, these models may help study institutions in more depth, settle disagreement among competing theories and propositions about their functioning, and even improve the interaction with other schools of economic thought.

We illustrate our argument with an example, an informal-value transfer system (IVTS) called "hawala." This system allows people to transfer cash from one country to another in a cheap, quick, effective, and discrete way. Its basic functioning is illustrated in Figure 1. A person who wishes to send money from one country to another, contacts a hawaladar in her current region and hands him the cash. The hawaladar provides the person with a remittance code, which he also communicates to a hawaladar in the target region. Once the second hawaladar is contacted and given the right remittance code, he hands over the money to the receiver. After a completed transfer, the traces of the transaction will be removed. The hawaladars settle their mutual debts, inter alia, through import-export deals with intentionally distorted prices for the exchanged goods.

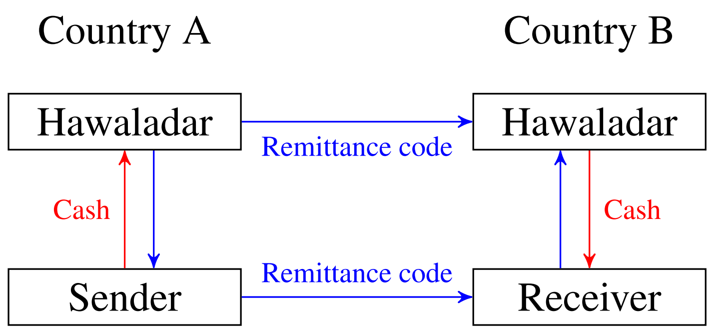

Figure 1: *The basic functioning of Hawala.*

People transfer up to 680 billion dollars yearly through hawala (e.g., Shehu 2004), but the mechanisms ensuring its functioning remain poorly understood. Although the literature so far has suggested generalized trust and social control as the main drivers of hawala (Das and Teng 2001; Costa and Bijlsma-Frankema 2007; Lascaux 2015), it remains ambiguous about their precise meaning and role in the system of hawala transactions. Thus, there has not been a successful attempt to reconcile the conflicting propositions about the functioning of hawala. Using an ABM, we were not only able to suggest and apply a clear operationalization of the key concepts of "trust" and "social control," but we also clarified the necessary and sufficient conditions for the successful functioning of hawala. This case study, therefore, may illustrate how institutionalists can benefit from ABM. In the next section of the article, we clarify what ABMs are, while in the third section we introduce the hawala system. In the fourth section, we discuss the potential of ABMs to facilitate cross-paradigmatic dialogue, and we offer our conclusions in the final section.

Computational Models and Their Relation to Traditional Modeling Approaches

The basic idea of ABMs is to program an artificial world populated by software agents, and to simulate the dynamics resulting from their interaction.[1] The decision-making of the agents is specified through algorithms and can range from simple random behavior to very complex AI-like decision-making. Usually, the model is simulated many times and summary statistics are analyzed. The researcher can conduct computational experiments by changing some of the input parameters or mechanisms of the model, and then see whether this change has some significant implications for the resulting dynamics.

[1] Here we clarify some fundamentals of ABMs. For a more extensive introduction, see for instance Leigh Tesfatsion (2017), for its meta-theoretical affinity to institutionalism, see Claudius Gräbner (2016).

Before we proceed, we want to eschew three potential misunderstandings:

1. "Agents" in ABMs do not necessarily represent people. They can represent firms, groups, countries or anything else.
2. Despite being frequently associated with the idea of modeling social phenomena "from the bottom up" (Epstein 2007), the epistemology underlying ABMs is not necessarily individualistic. Because "agents" can refer to various beings on different ontological layers of reality, ABMs are best characterized as "systemist" tools seeking the middle way between individualism and holism (Bunge 2000; Gräbner 2016).
3. Although ABMs and *equation-based* models are often considered substitutes, their relationship is more subtle (Gräbner et al. 2017). Because of the Church-Turing thesis, every ABM could, in principle, also be written entirely in equations (Epstein 2006). However, these equations would be hard to interpret, which is why most ABMs consist of a mixture of equations and algorithms. Also, there are various ways of how agent-based and equation-based models can be used conjointly (see, for example, Gräbner et al. 2017).

Consequently, ABMs are more flexible than conventional equation-based models. Many features of reality, which can hardly be expressed via mathematical equations (e.g., Knightian uncertainty, learning, or bounded rationality in a Simonian sense), can be straightforwardly considered in ABMs. Moreover, ABMs are well-suited for studying systems in disequilibrium. At the same time, ABMs are more precise than purely verbal analysis. Since every argument must be written down in the language of algorithms, ABMs can also be used to test for the consistency of alternative verbal theories and propositions (more on this below).

Studying Hawala with a Computational Model

As we already stated, hawala is a flourishing and financially relevant IVTS. Yet, the institutions and mechanisms underlying its success remain opaque. The literature suggests generalized trust and social control as the main drivers of hawala, but remains vague and inconclusive with regard to some very fundamental questions:

1. How should trust and control be operationally defined and operationalized formally?
2. Which (if any) of the two carries a larger relevance for the functioning of hawala?
3. Are they related to each other as substitutes or complements, and is this relationship stable over time?
4. Are trust and control sufficient for the functioning of hawala, or are other "framework" conditions important?

In a previous work (Claudius Gräbner, Wolfram Elsner and Alexander Lascaux 2017), we used an ABM to answer these questions. We focused on the interactions among the hawaladars, and did not consider the interactions between hawaladars and their customers. In other words, we only considered the upper half of the process illustrated in Figure 1. Adding the customers to the model is possible, but given our main interest in the role of trust and control, we left this task for further research.

The Structure of the Model

There is a population of N hawaladars that reside in M regions. There are two main types of hawaladars: (i) *cooperative* hawaladars who *always* cooperate when interacting with other hawaladars; and (ii) *selfish* hawaladars who are willing, under certain conditions, to deceive their fellows. The hawaladars can rely on *general trust* and/or *social control*. Prior to each simulation run, we specify the levels of trust and control, and we are able to study the importance of these two concepts for the functioning of the system. Each simulation run consists of a number of time steps (see Figure 2), to which we turn in the next section.

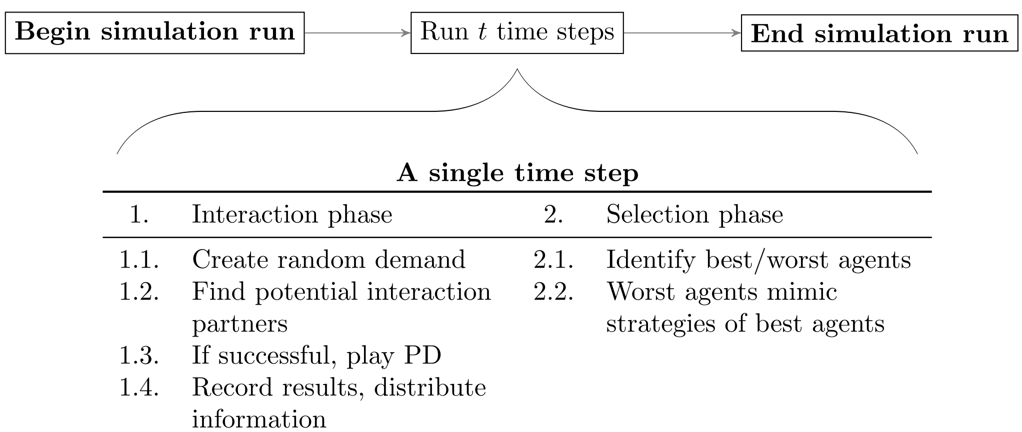

Figure 2: *The procedure for a single simulation run. The default value for t was 750. Our results refer to the summary statistics of 50 simulation runs.*

First, a sender and a receiving region are chosen randomly. Then, a hawaladar in the sending region is chosen randomly. This hawaladar needs to find a partner in the receiving region. He first checks whether there is a hawaladar with whom he already interacted successfully in the past (such hawaladars will be called his "associates"). If yes, this hawaladar will be contacted. If not, only hawaladars that have trust will contact another, so far unknown hawaladar at random. Hawaladars without trust forgo this business opportunity. If the hawaladar relies on social control, he will not contact hawaladars that have cheated on him or any other associate of his in the past.

The contacted hawaladar in the receiving region can accept or reject the interaction. He will certainly accept an interaction with any of his associates. If he has no information about the inquiring hawaladar from the sending region, he will accept the interaction only if he has trust. If he uses social control, he will inquire his associates' network whether the sending hawaladar has cheated in the past, in which case he also rejects the interaction.

Against this backdrop, we can now precisely formulate our operationalization of trust and social control, which we consider to be generic and thus applicable to any informal strategic interaction system that involves a population of heterogeneous agents:

- *Trust* captures the willingness of an agent to interact with someone he has no information about and who has the potential capability to harm him.
- *Control* captures the ability and willingness to memorize, monitor, communicate, and sanction agents who have exploited others in the past.

Interactions among hawaladars are modeled as a prisoners' dilemma (PD). We depict its payoff structure Figure 3, which should characterize the real situation of hawaladars. The number of possible interactions per time step is specified as a parameter. After all interactions have taken place, the hawaladars adapt their behavioral disposition from selfish to cooperative or vice versa. If they belong to the worst agents in terms of accumulated payoff, they change their disposition. The probabilities for their new disposition to be chosen are distributed equally to the distribution of dispositions of the most successful agents.

		Hawaladar 2	
		C	D
Hawaladar 1	C	a / a	b / d
	D	d / b	c / c

		Hawaladar 2	
		C	D
Hawaladar 1	C	4 / 4	8 / -2
	D	-2 / 8	0 / 0

Figure 3: *The payoff structure for the underlying prisoners' dilemma, and the default values used in our simulations. Aside from the logical restriction of c=0, we have the usual restriction* $b > a > c > d$ *and* $2a > b + d$.

Results

We ran the model for 750 time steps and analyzed the summary statistics of fifty simulation runs. We were particularly interested in the share of realized transactions, the share of the maximum potential payoff realized, and the share of cooperations. Our analysis conveys a number of insights of which we highlight three in this sub-section:[2]

- Trust and social control are both necessary for the functioning of hawala.
- The relationship between trust and control changes over time, but there is no crowding out among them.
- Trust and social control are both not sufficient.

[2] The results of the full model go beyond what we have described in this section. For a more extensive description and interpretation see Gräbner, Elsner, and Lascaux (2017).

Both Trust and Social Control Are Necessary for the Functioning of Hawala

Only if agents use social control and have trust, the system can function properly. Figure 4 illustrates this. *Without both trust and control*, the system breaks down. No interactions take place and almost no payoffs are realized. Similarly stated, if there is social control but no trust, hawaladars cannot form any business relationships. Thus, the system does not take off. This changes if there is trust but no control. Yet, agents can also interact naively with known defectors. There is no way of keeping defecting hawaladars out, and the system remains highly dysfunctional. However, if the hawaladars use social control *and* have trust, the system approaches a state of considerable efficiency. Defecting agents are crowded out, almost all interactions are realized, and on average almost 80 percent of the potential payoff can be realized.

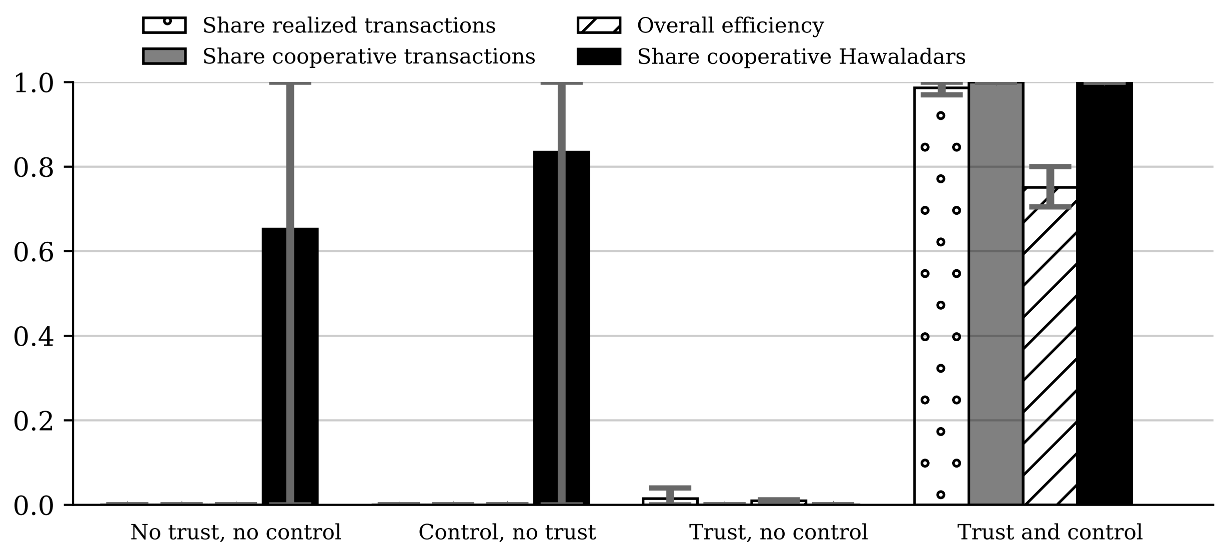

Figure 4: *The results of the baseline simulation: without both trust and control, the Hawala system does not work at all. The figure shows the means of 50 simulation runs. Whiskers again indicate the 10^{th} and 90^{th} percentiles.*

The Relationship Between Trust and Control Changes Over Time, but There Is No Crowding Out Among Them

To understand their temporal relationship, we "shock" the system by exogenously removing trust or control from the system after a particular number of time steps. The single bar on the left of every panel in Figure 5 refers to the case where no shock affects the system. Bars indicating the results for a shock at a time step zero are equivalent to runs where no trust or control operate at all.

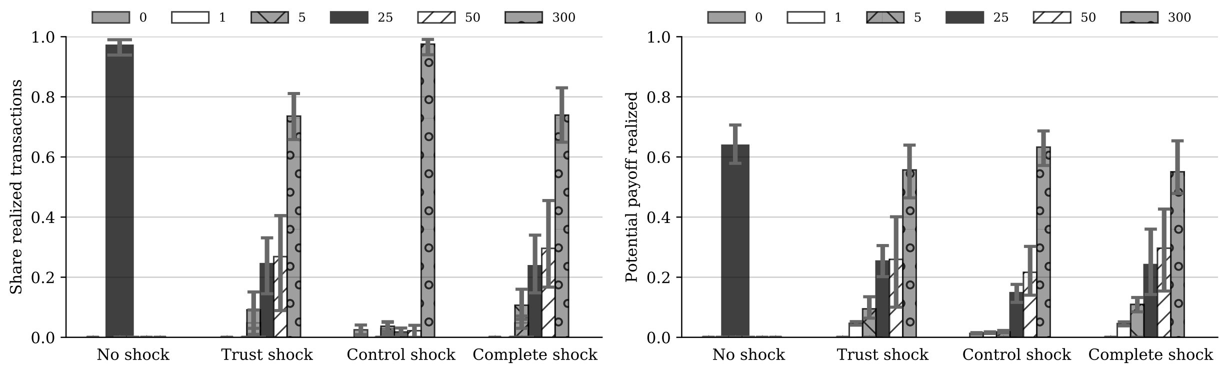

Figure 5: *The effects of trust and control shocks at different time steps. The figure shows the means of 50 simulation runs. Whiskers again indicate the 10^{th} and 90^{th} percentiles.*

The results confirm the importance of the timing of shocks: shocks after 300 time steps have little effect, yet earlier shocks can have profound and self-reinforcing effects. Earlier trust shocks have profound effects since in the beginning, agents do not know each other and can form new relationships only if they trust strangers. Once trust erodes, no additional relationships can be formed and successful transactions only pass through the (few) relationships already formed (see left panel of Figure 6). Every *control shock* before the complete eradication of defecting agents leads to a breakdown, since the short-term gains of the defectors are larger than those of cooperators. Thus, defectors take over the population. Once there are no defectors in the system left, social control becomes obsolete (see right panel of Figure 6).

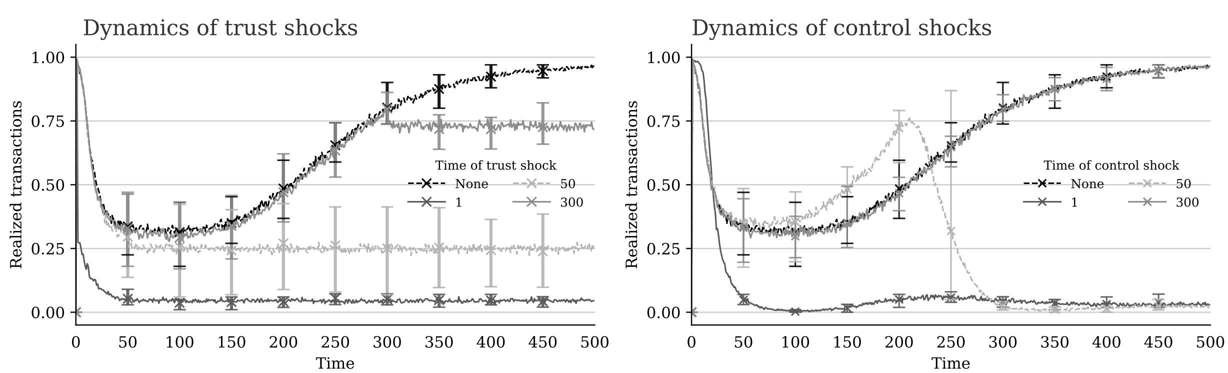

Figure 6: *The dynamics of trust and control shocks.*

The similarity of the results for the trust and complete shocks suggests that the eradication of trust after some time can serve as a functional substitute for control. Once trust is eradicated, there is no situation in which cooperators could be exploited since hawaladars will only interact with their associates — who are unlikely to become defectors. So, the need for social control is diminished — at least, for the protection of cooperators with a number of working relationships. However, the resulting system remains cemented at its status quo of relations existing prior to the trust shock. Overall, trust and social control exhibit a *clear temporal pattern*: Trust is required for the system to take off, but simultaneously establishes the need for control. Later, trust may be somewhat dispensable, but the system can realize its potential only if both are operating simultaneously.

Trust and Social Control Are Both Not Sufficient

There are a number of environmental conditions that need to be met. First, the ratio between the total number of possible interactions and the number of hawaladars needs to be sufficiently high. Second, agents must not make too many mistakes (i.e., defect accidentally). Third, there must be a moderate level of forgiveness, whereby agents that have defected at some stage should be given a new chance after a sufficient number of time steps. Table 1 summarizes these results.[3]

Necessary conditions: need to be present for the system to function at all	General trust: willingness of cooperative hawaladars to interact with strangers
	Social control: willingness and ability of cooperative hawaladars to monitor and exclude fraudulent hawaladars
Other important conditions: must jointly provide a sufficiently friendly environment for the system to function	Size of population: absolute number of hawaladars may not be too large
	Interaction density: number of interactions per period is sufficiently large
	Forgiveness: period in which former defectors are excluded is not too long.

Table 1: *Summary of the necessary and sufficient conditions for hawala to function and of the impact of the important parameters.*

Discussion

All in all, our model allows for a direct depiction of the hawala and its mechanisms. The language of an ABM permits us to provide a clear operationalization of trust and control, and to answer controversial questions. For example, while Reinhard Bachmann (2001) considers trust and social control as complementary (i.e., he argues that they reinforce each other), Lars Huemer, Gert-Olof Boström, and Christian Felzensztein (2009) maintain that trust and control are substitutes (i.e., more trust comes with less control) and vice versa. Similarly, Alexander Lascaux (2015) suggests that trust gets crowded out by social control over time. However, because of the ambiguous terminology, it was impossible to test such conflicting hypotheses against each other. Our model shows that the complementary perspective generally applies, but that there are specific dynamic constellations in which a reduction of trust substitutes for social control.

Because our model fits IVTS more generally, our results appear to be applicable to systems others than hawala. Moreover, not only can ABMs be useful for applied institutionalist research, but

[3] For a discussion of the underlying mechanisms, see Gräbner, Elsner, and Lascaux (2017).

they can also help to bridge institutional economics with other schools of thought.

Computational Modeling and the Practice of Pluralism

One contribution of the ABM in the hawala case was its ability to translate competing explanations and propositions into a common language, and to test their consistency. This is a considerable asset that could help to foster a constructive exchange between different perspectives, or even schools of thought. In this context, Leonhard Dobusch and Jakob Kapeller (2012) sketched a framework for a meta-paradigm of an "interested pluralism," in which they suggest to compare different economic paradigms with regard to their proposed explanations for real-world cases. Yet, there are two main challenges for practicing an interested pluralism, both of which are not at the core of Dobusch and Kapeller's framework. First, the fact that different paradigms often use distinct languages and terminology complicates the practice of interested pluralism since it often is not clear how they should communicate with each other. Second, Dobusch and Kapeller focus on applied models. Many differences among paradigms emerge already at fundamental and meta-theoretical levels. Putting these into perspective is not straightforward since model structures and terminologies may differ significantly.

Our experience in the hawala case suggests that ABMs may help address these challenges by translating the propositions of two paradigms into a common, computational language. As our ABM helped us settle on a clear operationalization of the concepts of "general trust" and "social control," ABMs could help two distinct research communities translate their specific concepts into a commensurate language, and explore their logical and empirical relationships in a defined model frame. Such a research strategy might be relevant not only for applied models, but also for stylized and more abstract theoretical models. Examples of ABMs integrating different paradigms are the "Keynes-meets-Schumpeter" models (Dosi, Fagiolo and Roventini 2010) or the agent-based stock-flow consistent models à la Alessandro Caiani et al. (2016). This way, ABM can be a useful vehicle in making pluralism interactive and fruitful in research practice.

Conclusion

We illustrated that ABMs can be a useful tool for institutionalist analysis by discussing an ABM of the IVTS "hawala." The model allowed us to operationalize two concepts that are of essential relevance for institutionalist analyses: trust and social control. It assisted us in relating and making commensurate the ambiguous literature on hawala, as well as in settling some controversy around its functioning. The model provides an openly available computational platform, on which the relative effects and interactions between trust, control, and other "framework" factors, their temporally changing patterns of complementarity and substitutionality, and thresholds and bottlenecks for the emergence, stability, and performance of the system can be explored. Therefore, it also helped corroborate propositions about the importance of other complementary factors, such as forgiveness or adequate arena sizes for the emergence of institutionalized cooperation (Elsner and Schwardt 2013).

Finally, we argued that ABM can be a helpful vehicle in making pluralist economics work. The ambiguity of concepts and terminologies used in different paradigms is a challenge for pluralism. Because of their flexibility, computational models can help translate various theories into a common language, thereby assessing their relationship and practicing an "interested pluralism" (Dobusch and Kapeller 2012). It is in this way that we hope to further clarify overlaps and potentials for convergence among different economic approaches, taking into account insights from different theoretical lineages.

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