Trust and Law in Credit Markets*

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Abstract

This paper studies the interactions between trust and contract enforcement in a model of credit markets with asymmetric information. Strong enforcement benefits civic entrepreneurs, who have to cross-subsidize uncivic ones intending to cheat. When civic values are instilled by parents who respond to expectations about future quality of enforcement, the model creates an underdevelopment trap, with mistrust and weak enforcement, where the economy receiving a trust-destroying shock could be caught. We argue that technological innovation and contractual innovation may be detrimental to the underdeveloped economy by undermining trust and enforcement, but that public education may help the economy escape the trap.

JEL Classification: O10, O16, Z13.

Keywords: culture, trust, institutions, enforcement, collateral, cultural transmission, history, technical change, public education.

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1 Introduction

The working of credit markets is central to understanding the development process. Well-functioning credit markets reduce the cost of credit, encourage entrepreneurial activities, and lead to economic prosperity. Taking these benefits seriously, a large literature has attempted to identify determinants of financial development. On the one hand, La Porta et al. (1997a, 1998) and La Porta et al. (2008) emphasize the legal systems by showing that stronger creditor protection and its enforcement lead to better access to finance. On the other hand, Guiso et al. (2004, 2008) argue that trust, the faith that borrowers have norms of good conduct, mitigates lenders' anxiety of being cheated and encourages their participation in financial markets.

Recent research documents, however, that institutions and trust cannot be treated separately (Alesina and Giuliano, 2015). They interact with each other and can be complementary based on the evidence that the quality of institutions, which enforce contracts, is positively associated with measures of trust among countries (Algan and Cahuc, 2014, Tables 2.6a), European regions (Tabellini, 2008a), or Italian provinces (Guiso et al., 2004). These observations raise two key questions. Why is there complementarity between legal institutions and trust? And what are the implications of this complementarity for credit markets and economic development?

We develop a dynamic model in which trust and the institutions of credit markets co-evolve. In our model, trust is defined as beliefs about civicness of agents and institutions are measured by strength of contract enforcement. Our model of credit markets plagued by asymmetric information features complementarity between trust and institutions, leading to multiple steady states. We argue that technological innovation and contractual innovation may have adverse effects on the economy which has been trapped in a state with a low-level of trust and weak enforcement, but that educational policies may play a key role in helping the economy get out of the trap.

We provide a model of credit markets where entrepreneurs borrow funds by offering financial contracts and then decide whether to invest the funds in projects or divert them to personal use secretly. To mitigate the agency problem, entrepreneurs pledge their wealth as collateral

in the case of default. Entrepreneurs have private information concerning their civic values. Civic entrepreneurs have a feeling of guilt for cheating and are attracted to investing, whereas uncivic entrepreneurs prefer cheating to investing. We for now focus on a pooling contract in which uncivic entrepreneurs who will cheat also receive financing. The resulting financial contracts entails cross-subsidization of uncivic entrepreneurs by civc ones, where they must promise higher repayments than under symmetric information. In equilibrium, an aggregate level of trust, which is consistent with a fraction of civic entrepreneurs, is a determinant of financial and economic development.

The financial contracts respond to a change in quality of institutions which determine how likely claims on collateral is to be enforced. Stronger enforcement increases the possibility that entrepreneurs lose their collateral when they default and instead, they can decrease the repayment. The effect of institutions on contractual terms motivates entrepreneurs to participate in the political process to select the strength of enforcement. Civic entrepreneurs prefer stronger enforcement because it increases the burden uncivic entrepreneurs incur and lowers the degree of cross-subsidization. In contrast, uncivic entrepreneurs prefer weaker enforcement to reduce the loss resulting from cheating but do not demand for too weak enforcement because it leads to breakdown of credit markets. Thus, in a majority voting system, a high-trust economy where civic entrepreneurs hold the majority choose the strongest enforcement, whereas a low-trust economy where uncivic entrepreneurs are widely dominant choose the weakest enforcement conditional on being funded.

The important feature of our model is that entrepreneurs' civic values are endogenously determined through parental education. Following Bisin and Verdier (2001) and Tabellini (2008b), we assume imperfect empathy; parents care about utilities of their children but evaluate their children's behavior based on their own values. As a result of the paternalistic altruism, civic parents have incentives to lead their children to invest in projects rather than to cheat by instilling civic values in their children, whereas uncivic parents do not have such incentive. As the gap between civic children's and uncivic ones' payoffs widens, they exert higher levels of civic

education, leading to a larger fraction of civic children.

This cultural transmission mechanism, combined with the political process on levels of enforcement, generates complementarity between trust and institutions, leading to multiple steady states. If civic parents anticipate that there is a low degree of cross-subsidization in credit markets with strong enforcement, they are willing to make their children civic and exert high levels of educational effort. As a result, a high-trust economy will emerge in the child's generation and support strong enforcement, so that the initial beliefs are again justified. If, instead, civic parents anticipate that there is a high degree of cross-subsidization in credit markets with weak enforcement, they exert low level of educational effort. The resulting low-trust economy will support weak enforcement and thus the initial expectations are justified. While the former steady state economy achieves high level of trust, strong enforcement, and high aggregate outputs, the latter one achieves low level of trust, weak enforcement, and low aggregate outputs.

Which steady state the economy will end up in depends on history and expectations. When either civic values are widely dominant initially, history matters; that is, the economy with the initial low (high) level of trust, along with weak (strong) enforcement, reaches a low-trust (high-trust) steady state. When there is no widely dominant civic value initially, such precondition alone does not determine the long-run outcome and expectations play a role in selecting it. If a society expects weak (strong) enforcement, it achieves a low (high) level of education and converges to the low-trust (high-trust) steady state.

It is well known that history and expectations determine the long-run economic development, as in Krugman (1991) and Matsuyama (1991). The implication of our model is that history and expectations have the long-lasting effect on not only economic prosperity but also trust and institutions. This argument resonates with empirical works that find the long-term persistence of trust. Once a positive historic shock, such as the free city-states experience in the Italian Middle Ages (Putnam, 1993 and Guiso et al., 2016), or a negative historic shock, such as Africa's slave trade (Nunn and Wantchekon, 2011), influence beliefs in trustworthiness of current and future generations in the society, the resulting trust persists over the long-run and generates the

persistence of development. In our model, these historic shocks have long-lasting effects because of the feedback from institutions.

As stressed by Tabellini (2008a,b), the culture-based approach can also explain the persistence of institutions. Beck et al. (2003) and Acemoglu and Johnson (2005) state that bad institutions set up by European colonialists have persisted for a long time and deterred financial and economic development. By considering the colonial experience as a trust-destroying shock in our model, we show that such historic shock generates a low-trust society in which financial institutions remain weak. La Porta et al. (1998, 2008) also argue that legal origins transplanted by the origin countries through conquest and colonization have the persistent effect on the legal protections of investors and financial development. French civil law countries are more likely to adopt weak legal protections and have less developed financial markets than English common law countries. Our model may explain this legal origin theory based on La Porta et al.'s (2008) argument that French civil law system embeds the beliefs that a country needs to be concerned with private disorder, whereas the common law system embeds the beliefs that private citizens are so peaceful that the country needs to be less concerned with disorder. According to such a view, while the transplantation of civic law changes peoples' mindset and brings about distrust in other people, the transplantation of common law encourages the formation of trust in others. Therefore, we can consider that the historic shock about the transplantation of civil (common) law corresponds to the initial low (high) level of trust whereby the economy converges to the steady state with weak (strong) financial institutions.

In addition to these empirical relevance, our model delivers a new insight into the relationship between culture and institutions. Trust and contract enforcement are complements in the long run, but may be substitutes in the short run. Consider the transitional path towards a low-trust steady state, during which uncivic entrepreneurs keep holding political power. Because a higher trust increases the ability to borrower funds from markets, it allows uncivic entrepreneurs, who select the weakest enforcement as long as they secure financing, to weaken enforcement further. Thus, as trust becomes higher over time, enforcement becomes weaker.

Our model also provides an explanation for why innovations have not closed the gap between underdeveloped and advanced economies, although ideas and knowledge can spread rapidly. We focus on two types of innovations, technological innovations and contractural innovations. Technical change that enhances productivity of projects increases benefits of being civic and encourages family civic education, driving cultivation of trust and economic development in a high-trust steady state. However, the benefits of technological advancement is exploited by uncivic entrepreneurs in a low-trust steady state. Higher productivity enhances the ability to attract funds and allows uncivic entrepreneurs to choose weaker enforcement, which discourages parental education. If the adverse effect on trust building is large, despite the direct and positive effect stemming from increased productivity, then aggregate output decreases. Contractual innovation is also detrimental to the underdeveloped economy. When civic entrepreneurs utilize more sophisticated contracts than a pooling contract in previous analysis, they have incentives to separate from uncivic entrepreneurs to resolve their cross-subsidization. But again civic entrepreneurs who receive its benefits are taken advantage of by uncivic ones in the low-trust economy. As a result, contractual innovation can exacerbate weak enforcement, mistrust, and economic backwardness.

These adverse effects of technological and contractual innovation on the underdevelopment economy motivate us to focus on another way to help it escape from the trap. We argue that public civic education has the potential. If educational resources are concentrated among a small fraction of children so that they become civic, it encourages family civic education because an increase in a fraction of civic children resulting from public education improve their contractual terms. The combination of public and family education overcome the exploitation by uncivic entrepreneurs and cultivate trust even in the low-trust economy. If educational resources are used extensively and close a gap between preferences of civic children and those of uncivic children, private contracts among agents, combined with enough quality of institutions, resolve the fundamental frictions stemming from information asymmetry.

Literature review: This paper is related to several strands of literature.

A vast body of research has studied what is a primary determinant of formal institutions that affect financial markets and suggested two distinct hypotheses. The first view is that the cross-country variation in formal institutions is shaped by historic accident, such as the conquest and colonization by European countries (La Porta et al., 1998, Beck et al., 2003 and Acemoglu and Johnson, 2005). The second view is that legal rules protecting investors are the result of the political economy process. The preferences of groups with political power are reflected in decisions on legal protections. Recent contributions include Rajan and Zingales (2003), Pagano and Volpin (2005, 2006), Perotti and von Thadden (2006), and Biais and Mariotti (2009). Like our paper, Ševčík (2012) and Matsuoka et al. (forthcoming) include insights of both views by developing a dynamic model with political economy of investor protections, but our model focuses on its link with culture.

Our paper also contributes to an extensive literature that has recognized the importance of civic values and trust in determining economic performances (see e.g, Putnam, 1993, Fukuyama, 1995, Knack and Keefer, 1997, La Porta et al., 1997b, Algan and Cahuc, 2010, and Tabellini, 2010). Following the seminal work of Bisin and Verdier (2001), the theoretical works on this field focuses on cultural transmission of values, such as those regarding trustworthiness (Francois and Zabojnik, 2005) and corruption (Hauk and Saez-Marti, 2002).[1] In contrast with these papers, we incorporate policies that are determined by collective decisions to study joint dynamics of trust and the institutions of financial markets.

There is a recent burgeoning literature on the coevolution of culture and formal institutions. Bisin and Verdier (2017) studies the connection in the general setup. Tabellini (2008b) provides a theoretical model of interaction between values about cooperation and legal institutions that enhance cooperation. Alesina and Angeletos (2005) and Bénabou and Tirole (2006) focus on the interaction between culture of work and redistribution policies. Bidner and Francois (2011) analyze the dynamic systems of honesty norms and institutions that encourage trading and

[1] Kumar and Matsusaka (2009) develop alternative model to study cultural evolution and development process, where they distinguish social capital that relies on personal network from social capital that is useful for enforcing contracts with strangers.

show that larger scale of a country has higher level of trust. Aghion et al. (2011), Michau (2013) and Alesina et al. (2015) pay attention to the interplay between labor market institutions and cultural trait. In contrast with all of these papers, our paper focus on trust and institutions that enforce financial contracts.

The closer works to our interests are Aghion et al. (2010) and Carlin et al. (2009), which focus on the co-evolution between trust and government regulation. In Aghion et al. (2010), trust and entry regulation are substitutes because low-trust countries demand for entry regulation to prevent uncivic entrepreneurs from misbehaving, whereas under strong regulation people become uncivic to pay bribes and entry the market. Carlin et al. (2009) place financial markets at the center and show that whether trust and regulation are substitutes or complements depends on values of social capital. In contrast our model shows that trust and contracting institutions can be substitutes in the short run, but are complements in the long run, and that the complementarity generates novel insights on the effects of innovations and public education for economic development.

The rest of the paper is organized as follows. Section 2 provides the framework of the static model in which civic values are exogenous. Section 3 analyzes the equilibrium of the static model and shows the one-way effect of trust on quality of enforcement. Section 4 extends the model to the dynamic setting in which trust is endogenously determined through family civic education. The dynamic economy describes the divergence in development through the two way effects between trust and institutions. Section 5 analyzes the effects of technological innovations and contractual innovations. Section 6 analyzes the effects of educational policies. Section 7 discusses robustness. Section 8 concludes.

2 The Static Model

In this section, we describe the basic framework of the static model in which civic values are given whereas a level of enforcement is an endogenous variable.

There are a continuum 1 of entrepreneurs and lenders. Both agents are risk-neutral and consume at the end of the period. Both are protected by limited liabilities.[2] There is a storage technology that produces zero profit. Each entrepreneur has a project requiring an fixed investment $I > 0$. The project produces cash flows $R > 0$ with probability $p \in (0, 1]$ and nothing with probability $1 - p$. While entrepreneurs have no funds, lenders receive sufficiently large amount of cash. Entrepreneurs need to rely on external financing to run their projects.

Entrepreneurs have illiquid wealth of which value is $C > 0$. The wealth cannot be transformed into cash and consumed until the investment return is realized. The entrepreneur can pledge the wealth as collateral in the case of default. The pledge is enforced and lenders seize collateral C with probability $\tau \in [0, 1]$, implying that an effective value of collateral is τC. The probability τ measures the strength of financial institutions, such as strength of creditor rights and their enforcement, with a higher value corresponding to better quality of institutions. The idea behind this interpretation is that law that improves the creditor rights and its strong enforcement enhances the power of creditors against defaulting borrowers.[3] Before financing occurs, the strength of legal enforcement is determined in the political process in which each agent votes on τ with majority rule. Although in reality some costs are present when bankruptcy laws and formal legal procedure are reformed, we assume that τ can change without any cost to focus on the main mechanism.

Projects are subject to entrepreneurs' moral hazard. Entrepreneurs can divert funds I and use them for the private purpose instead of investing them in the project. This misbehavior results in default but leads to private benefits b for the entrepreneurs. Their decisions on whether invest or cheat is affected by own civic values. Each entrepreneur has own cultural trait $i \in \{G, B\}$, indicating good (or civic) type and bad (or uncivic) type, respectively. A good type has civic values and views that investing in lenders' interests is the right behavior. The deviation from it (i.e., cheating) incurs disutility $\Delta^G \geq 0$ and leads her to obtain net private benefits $b^G \equiv b - \Delta^G$.

[2] We assume that the legal rules about limited liability cannot be changed in the political process.

[3] We can also interpret τ as the strength of property rights as in Besley et al. (2012), where improving property rights enhances the entrepreneurs' ability to pledge assets as collateral.

A bad type has uncivic values and experiences disutility $\Delta^B \geq 0$ from investing in projects.

Each entrepreneur becomes the good type with probability $\phi \in (0,1]$ and becomes the bad type with probability $1-\phi$ independently. The law of large number implies that ϕ is also the share of good entrepreneurs. The entrepreneur's type is her private information. Because in the equilibrium, as we will see later, only bad types cheat and lenders cannot distinguish both types, ϕ is not only the share of civic entrepreneurs but also the lenders' beliefs concerning the probability of not being cheated (except for Section 6.2). Thus, ϕ measures how much lenders can trust an entrepreneur to behave in line with their interests, based on Gambetta's (2000) definition of trust.[4] Hereafter, following this interpretation, we refer to ϕ as a measure of trust. While we take ϕ to be exogenously given in the static model, we allow ϕ to be determined endogenously as a result of family civic education in Section 4.

We focus on the contract that specifies (i) that lenders contribute I, (ii) that the lenders receive $r \in [0, R]$ and the entrepreneur receives $R-r$ when the investment succeeds, and (iii) that lenders try to seize collateral C in the case of default. [5] Because lenders observe only whether the entrepreneur defaults on payments or not, the enforcement occurs when she engages in cheating or her project fails. [6]

The timing of events is as follows:

1. Nature determines each entrepreneur's type.

2. All agents vote on quality of creditor protections τ with majority rule.

3. Entrepreneurs make a take-it-or-leave-it offer that specifies a repayment r to lenders and

[4] Gambetta (2000) defines trust as "the subjective probability with which an agent assesses that another agent or group of agents will perform a particular action" and states that "when we say we trust someone or that someone is trustworthy, we implicitly mean that the probability that he will perform an action that is beneficial or at least not detrimental to us is high enough for us to consider engaging in some form of cooperation with him."

[5] Even when entrepreneurs can offer the contract in which they pay parts of their collateral, pledging all wealth C as collateral is an optimal contract.

[6] When the default after cheating and the one after project failure are distinguishable and verifiable, entrepreneurs can offer the contracts with the different amount of wealth pledged as collateral in both states. However, the optimal contract does not change; entrepreneurs choose to pledge all their wealth as collateral in both cases. This is because the contract provides the maximum incentive not to cheat and maximizes the good entrepreneurs' payoff.

they decide whether to accept. If lenders accept the offer, they lend money. If lenders reject the offer, they use storage technology and entrepreneurs consume only collateral.

4. If an entrepreneur borrows funds, she faces moral hazard problem.

5. Investment returns are realized, the realized outcome is shared as contracted, and consumption takes place.

Then, we define an equilibrium. In addition to the requirements of the perfect Bayesian equilibrium, we need to incorporate how to determine quality of enforcement in the political process into the equilibrium definition. The assumption of simple majoritarian voting implies that the government's preference coincides with the median voter's one. Our (economic and political) equilibrium is defined in the following way.

Definition 1 *An equilibrium is given by the strength of enforcement τ, the entrepreneurs' decisions on cheating, their payment r to lenders when the project is successful, lenders' decision for financing, and the market's beliefs about the type of entrepreneurs such that the following conditions are satisfied:*

- *The choices on cheating and the contract that specifies r maximize the utility of entrepreneurs where beliefs and the lenders' financing strategies are taken as given;*

- *The financing decisions of the lenders maximize their utility, where beliefs, the entrepreneurs' choice on cheating and the contracts they offer are taken as given;*

- *The market's beliefs are consistent with Bayes's rule given equilibrium strategies, whenever possible.*

- *The strength of enforcement τ maximizes the utility of the median agent.*

Finally, we makes three parametric assumptions. The first assumption guarantees that a project produces a positive net present value (NPV), but cheating conducted even by a bad entrepreneur produces a negative NPV:

Assumption 1 $pR > I > b$.

The second assumption assures that a bad type experiences significant disutility by the deviation from a cheating norm:

Assumption 2 $b - C > pR - I - \Delta^B$.

This assumption means that cheating even in the perfect enforcement leads to greater payoff than investing. In this case, the bad type becomes "commitment type" and follows a cheating norm. This assumption also assures that when the entrepreneur is identified as a bad type, she cannot obtain financing. Section 6.2 analyzes the situation in which the difference in values between civic and uncivic agents Δ^B is small so that Assumption 2 does not hold.

The third assumption insures that the collateral value is low such that the bad type finds it profitable to engage in cheating even in the case with perfect enforcement:

Assumption 3 $b > C$.

In Section 7.1, we discuss the situation where the value of collateral is high such that $b \leq C$.

3 Analysis of the Static Model

This section analyzes the equilibrium of the static model. Section 3.1 characterizes the optimal contract and shows that higher trust or stronger contract enforcement allows entrepreneurs to borrow funds with lower repayments. Section 3.2 investigates how trust has an effect on quality of enforcement.

3.1 Optimal Contracts

Given a level of trust ϕ and quality of contract enforcement τ, we solve financial contracts problem. Under Assumption 2 and Assumption 3, a bad type always tries to participate in financial contracts steal funds by mimicking a good type. Thus, entrepreneurs have to offer a pooling contract r that cross-subsidizes the bad type at the expense of the good one. In

particular, we focus on the pooling contract that solves the following problem:[7]

$$U^G = \max_r p(R-r) - (1-p)\tau C \tag{1}$$

subject to

$$\phi p r + (1-\phi p)\tau C \geq I, \tag{2}$$

$$p(R-r) - (1-p)\tau C \geq b^G - \tau C. \tag{3}$$

The objective function (1) is the good entrepreneur's net expected payoff. The constraint (2) is the participation constraint for lenders. The left-hand side represents the expected payoff to lenders, whereas the right-hand side represents the lending amount given that the storage technology that produces zero profit is the outside option. The constraint (3) is the incentive compatibility (IC) constraint. The left-hand side is the good entrepreneurs' expected payoffs in the case of not cheating and the right-hand side is those in the case of cheating.

The problem (1)–(3) shows that a lower r gives a good entrepreneur higher payoff and stronger incentive not to cheat. Because of these benefits, the good entrepreneur is willing to decrease r as long as lenders have incentive to participate in the financial contracts. Thus, the optimal level of r is determined from the participation constraint (2) holding as equality. This implies that (3) boils down to

$$\phi\left(pR - b^G\right) + \tau C \geq I. \tag{4}$$

This condition means that the amount that at most are expected to be paid to lenders without inducing the good entrepreneur to cheat is larger than the cost of financing I. If the condition (4) holds, lenders are willing to provide funds to all entrepreneurs. The pooling equilibrium features cross-subsidization: lenders make money on the good entrepreneur and lose money on the bad one. If (4) is violated, no financing occurs.

[7] Although there are many pooling equilibria depending on off-the-equilibrium-path beliefs, we focus on this pooling allocation because it is the unique equilibrium that satisfies the definition of perfect sequential equilibrium.

The value function of a good entrepreneur is given by

$$U^G = \frac{1}{\phi}(\phi pR - I) + \frac{1-\phi}{\phi}\tau C. \tag{5}$$

U^G is increasing in trust ϕ because a higher level of trust mitigates the problem of asymmetric information and lowers its cost incurred by the good entrepreneur. Moreover, U^G is increasing in strength of enforcement τ under the equilibrium where a bad entrepreneur is cross-subsidized at the expense of a good one. By reducing the loss lenders suffer owning to a bad entrepreneur, stronger enforcement can decrease the degree of cross-subsidization. Indeed, when lenders believe that an entrepreneur is a good type and cross-subsidization does not occur (i.e., $\phi = 1$), strength of enforcement affects only the contractual term r but does not affect the entrepreneur's payoff U^G.

On the other hand, a bad entrepreneur offers the same contract as a good one and obtains the payoff

$$U^B = b - \tau C. \tag{6}$$

The bad entrepreneur chooses cheating to enjoy private benefits at the expense of losing collateral because the cheating is more attractive than investing in the project from Assumption 3. U^B is independent of trust ϕ because it affects only a repayment r, which is irrelevant to bad entrepreneurs who will default on the repayments. More important, U^B is decreasing in τ in contrast with the payoff of a good entrepreneur (5). A bad entrepreneur faces the fear that lenders will attempt to foreclose on her wealth as a result of cheating. To reduce the fear and have the wealth in hand, the bad entrepreneur prefer to weaken contract enforcement.

In addition to the financing constraint (4), in the equilibrium where entrepreneurs secure financing by offering the pooling contract, it has to lead to greater payoffs for both types of entrepreneur than their outside option. The bad type finds it profitable to participate in financial contracts under Assumption 3, whereas the good type does if the following individual rationality

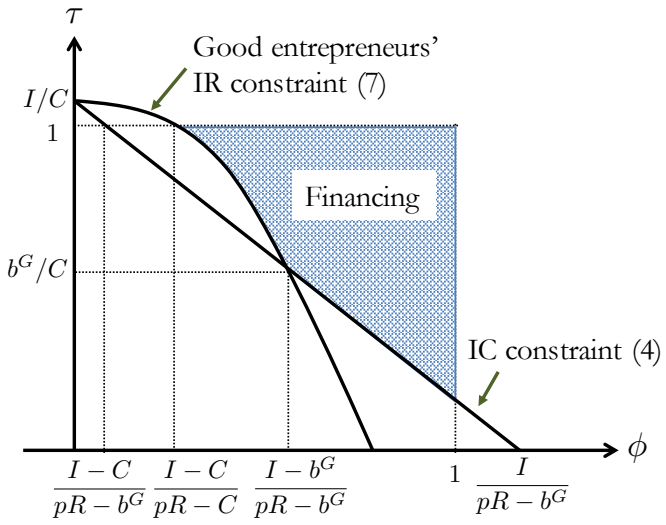


Figure 1: Financing conditions

(IR) constraint holds:

$$U^G \geq 0. \tag{7}$$

Therefore, financing occurs under the following condition,

$$\tau C \geq \max\left\{ I - \phi\left(pR - b^G\right), \frac{I - \phi pR}{1 - \phi} \right\}. \tag{8}$$

The following lemma characterize an lower bound on τ above which (8) hold for each ϕ.

Lemma 1 *Suppose that Assumptions 1–3. When $\tau \geq \underline{\tau}(\phi)$ where*

$$\underline{\tau}(\phi) \equiv \begin{cases} \dfrac{I - \phi pR}{C(1-\phi)} & \text{if } \phi(pR - b^G) \leq I - b^G, \\ \dfrac{I - \phi(pR - b^G)}{C} & \text{if } I - b^G < \phi(pR - b^G) \leq I, \\ 0 & \text{if } I < \phi(pR - b^G), \end{cases} \tag{9}$$

(8) holds. Then, $\underline{\tau}(\phi)$ is nonincreasing in ϕ.

Proof. See Appendix A. ■

Figure 1 explains Lemma 1 graphically. The horizontal axis represents a level of trust ϕ and the vertical axis represents strength of enforcement τ. The solid lines are constraints (4) and (7)

that hold with equality. Figure 1 has two features. First, as ϕ increases, both constraints are more likely to hold. A higher level of trust allows entrepreneurs to lower repayments by mitigating adverse selection and to have stronger incentive not to cheat. Accordingly, both constraints (4) and (7) are satisfied when the quality of enforcement is lower. When ϕ is very high, (4) and (7) hold even under the condition where the quality of enforcement reaches out to the lowest level, 0. Thus, the lower bound $\underline{\tau}(\phi)$ is nonincreasing in ϕ.

Second, the severer constraint changes depending on ϕ. If ϕ is low, the IR constraint (7) demands higher level of τ than the IC constraint (4). The more severe effect of adverse selection puts a large burden on good entrepreneurs. When ϕ is high, the IC constraint (4) is tighter than the IR constraint (7). In that case, a good type finds it more difficult to have an incentive to invest in the project than to have a profitable financial contract. Thus, the lower bound $\underline{\tau}(\phi)$ is determined by (4) when ϕ is low and by (7) when ϕ is high.

To characterize the optimal contract completely, we need to consider the highest value of τ, which takes up to 1. The presence of the upper bound implies that when ϕ is sufficiently low, even perfect enforcement cannot compensate for it. The lower bound on ϕ below which no financing occurs for any $\tau \in [0,1]$ is given by

$$\underline{\phi} = \max\left\{\frac{I-C}{pR-C}, \frac{I-C}{pR-b^G}\right\}. \tag{10}$$

Proposition 1 *Suppose that Assumptions 1–3 hold. If τ is high such that $\tau \geq \underline{\tau}(\phi)$ for any $\phi \geq \underline{\phi}$, both types of entrepreneur obtain financing by offering the contracts $r = \frac{I-(1-\phi p)\tau C}{\phi p}$. Otherwise, no financing occurs.*

Proposition 1 has two implications. First, as Guiso et al. (2004) has emphasized, trust and institutions matter in financial contract and the effect of trust on external cost of financing is larger in the economy which suffers from weaker enforcement ($\partial^2 r/(\partial\phi\partial\tau) < 0$). Second, although entrepreneurs can offer a menu of contracts, there is no separating equilibrium in which different types of entrepreneurs choose different contractual terms. Under Assumption 2

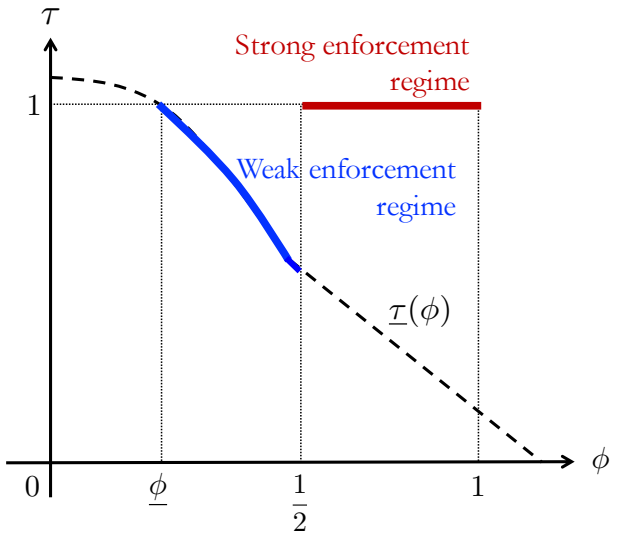


Figure 2: Equilibrium level of enforcement

and Assumption 3, a bad entrepreneur has an incentive to participate in financial contracts but if lenders know her type, she cannot obtain financing. Thus, the bad type tries to mimic the good type by offering the same contract and any separating equilibrium unravels.

3.2 The Equilibrium Quality of Enforcement

Given a level of trust ϕ, strength of enforcement τ is determined by the preference of the median voter. Because lenders earn zero profit regardless of τ, we assume that they do not participate in the voting. This means that the median voter can be a good entrepreneur or a bad one. [8]

To guarantee that financing can occur even when a bad entrepreneur is the majority, that is, $\underline{\phi} < 1/2$, we make the assumption that the NPV is sufficiently large:

Assumption 4 $pR > 2(I-C) + \max\{C, b^G\}$.

Figure 2 illustrates the result of voting. While the dashed line represents the cutoff point of financing $\underline{\tau}(\phi)$, the bold line represents the equilibrium level of enforcement. The level is dependent upon a fraction of good entrepreneurs. When a good entrepreneur is the majority

[8] In general, lenders have some bargaining power at financial contracts and earn positive profits. In that case, lenders prefer stronger enforcement because rents for entrepreneurs can be reduced. If the lenders' bargaining power is strong, the good entrepreneur prefers weaker enforcement as with the bad one to obtain more rents. Therefore, if lenders have weak political power so that they find it difficult to influence policy choices (e.g., they cannot engage in lobbying activities effectively or they are foreign investors) and their bargaining power is sufficiently weak, our conclusion remains unchanged.

(i.e., $\phi \geq 1/2$), she becomes the median voter. The good entrepreneur's payoff (5) implies that, given that she obtains financing, she prefers perfect enforcement (i.e., $\tau = 1$) because stronger enforcement reduces the degree of cross-subsidization. The exceptional case is that when lenders expect that the economy consists of only good types ($\phi = 1$), they are indifferent to τ. It seems natural, however, that the continuity of preferences holds; that is, the preferences of good entrepreneurs over quality of enforcement in the case that $\phi = 1$ are the same as those in the case that ϕ is sufficiently high. Thus, we assume that in the economy with $\phi = 1$, a good entrepreneur prefers $\tau = 1$.[9] We refer to the situation in which the good type becomes the median voter as the *strong enforcement regime*, represented as the (red) bold line in Figure 2.

When a bad entrepreneur is the majority (i.e., $\phi < 1/2$), her preference is reflected in the policy decision as the median voter. The bad entrepreneur prefers obtaining financing to not being funded, and conditional on securing financing, prefers weaker contract enforcement from her payoff (6) because it reduces the effectiveness of the punishment against cheating. This, coupled with Proposition 1, implies that the bad entrepreneur sets $\tau = \underline{\tau}(\phi)$ for any $\phi \in [\underline{\phi}, 1/2)$. We call the situation that the bad type becomes the median voter the *weak enforcement regime*, depicted as as the (blue) bold line in Figure 2. When the number of bad entrepreneur is sufficiently large such that $\phi < \underline{\phi}$, all entrepreneur cannot obtain financing for any τ. In that case, the bad entrepreneurs are indifferent to τ.

Proposition 2 *Suppose that Assumptions 1–4 hold. If $\phi \geq 1/2$, the equilibrium involves $\tau = 1$ (strong enforcement regime). If $\underline{\phi} \leq \phi < 1/2$, then $\tau = \underline{\tau}(\phi)$ as given in (9) (weak enforcement regime). Otherwise, the equilibrium level of enforcement takes any value in $[0, 1]$.*

Proposition 2 exhibits the non-linear relationship between trust and enforcement. The economy with distrust rampant demands for strong enforcement to secure financing. Then, as trust is cultivated, the need for enforcement decreases and uncivic entrepreneurs shape weaker enforcement to their own advantage. Once the economy achieves sufficient level of trust, civic

[9] This assumption does not matter because in a dynamic model, we focus on a situation in which a level of trust is lower than one in the equilibrium path.

agents are placed to have political power, followed by strong enforcement. In the next section, we endogenize choices of civic values and present results consistent with the empirical regularity.

4 Dynamics

In this section, we extend the one-shot model developed in Section 3 into a dynamic setting, which allows us to analyze the intergenerational cultural transmission and the evolution of trust. Section 4.1 describes the dynamic setting. Section 4.2 analyzes the educational choice. Section 4.3 shows that complementarity between trust and legal institutions leads to multiple steady states. Section 4.4 characterize the transitional dynamics and discusses about the role of history and expectations in selecting the steady state where the economy will end up.

4.1 Dynamic Setting

The important departure from the model of Section 3 is the presence of family civic education. Parents choose what values to transmit to their children and through the parental education influence the civic values that their children have. Following Bisin and Verdier (2001) and Tabellini (2008b), we have the "imperfect empathy" approach: parents are altruistic and take into account the utility of their children, but evaluate their children's actions based on their own preferences but not on the children's preferences. In the sense, this approach reflects the idea that parents are paternalistic. Through the cultural transmission, trust evolves and interact with institutions.

We consider an overlapping generations model with a continuum of mass one of risk-neutral lenders and entrepreneurs.[10] Time is discrete, indexed by $t = 0, 1, 2, \ldots$, and goes on forever. Lenders live one period and provide their cash for active entrepreneurs in each period. We assume that lenders cannot observe the performance of entrepreneurs of past generations. This assumption allows us to ignore the difference between an individual level of trust and an aggre-

[10] We assume away occupational choice from the model. The assumption of intergenerational transfer of entrepreneurship can be supported by the empirical evidence that entrepreneurial parents are more likely to have entrepreneurial children by about 60% through prebirth and postbirth factors. See Lindquist et al. (2015).

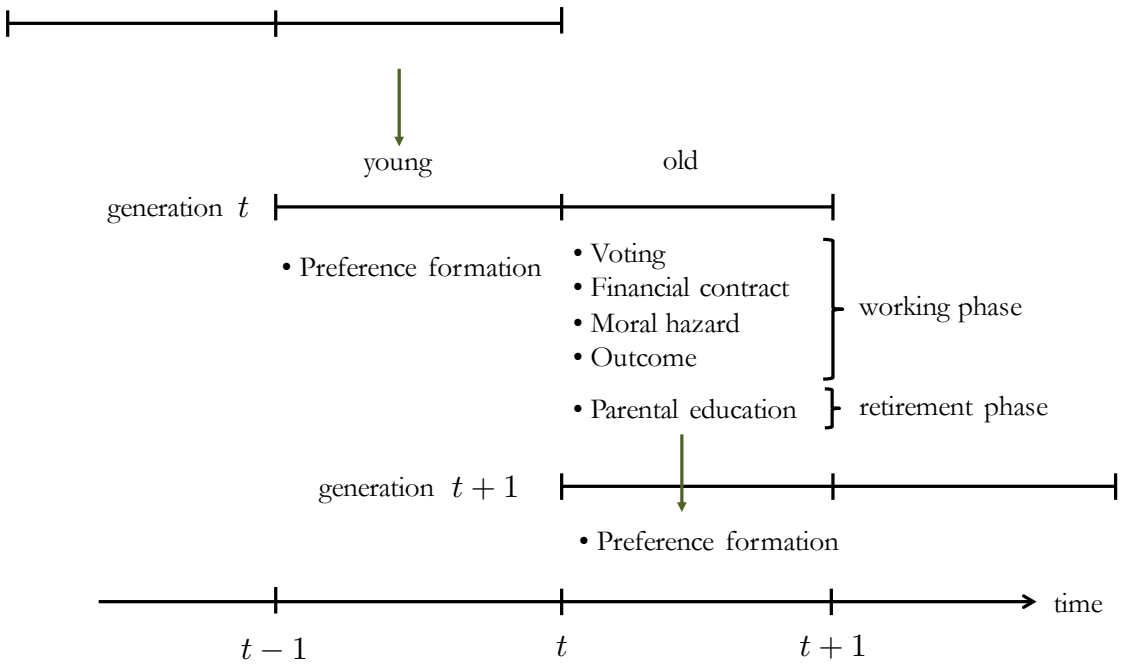


Figure 3: Time structure of overlapping generations model

gate level of trust.

There are ex-ante identical entrepreneurs who lived two periods. A new generation of entrepreneurs has the timeline as in Figure 3. When young, they merely receive family civic education and know their own type. When old, they become active and experience the same events as those in the static model of Section 3; during a working phase in period t, they receive illiquid wealth, vote on level of enforcement τ_t, offer financial contracts r_t, face moral hazard, and consume. Additionally, after working (in the retirement phase) each old entrepreneur has one child and instills civic virtues in youth individually, regardless of the project outcome. Following Tabellini (2008b), we assume that an old entrepreneur with a type $i \in \{G,B\}$ of generation t exerts costly effort to educate the child and increases the probability that the child becomes good by $f_t^i \geq 0$. [11] To exert educational effort, the old entrepreneur must incur psychological cost $(f_t^i)^2/2\gamma$ with $\gamma > 0$. Here, we assume that γ is sufficiently small to ensure the optimal level of education is lower than the upper bound, $1-\delta$.

[11] When bad parents are allowed to instill their uncivic values in their own children, i.e., f_t^B can take negative values (the minimum value is $-\delta$), the number of good entrepreneur is less likely to increase and level of trust is lower. However, the qualitative result is the same.

Let U^i_{t-1} and V^{ij}_t denote the expected net payoff to a type i entrepreneur of generation $t-1$ deriving from her own activity in the working phase and the one deriving from the activity in the working phase of her type j child, $i,j \in \{G,B\}$, respectively. The expected lifetime utility of a type i entrepreneur of generation $t-1$ is given by

$$U^i_{t-1} + (\delta + f^i_{t-1})V^{iG}_t + (1-\delta-f^i_{t-1})V^{iB}_t - \frac{(f^i_{t-1})^2}{2\gamma}, \tag{11}$$

where $\delta \in (\underline{\phi}, 1/2)$ is the probability that a good child is born naturally and assures that entrepreneurs secure financing in every period.

We focus on the Markovian strategies, such that strategies selected by agents only depend on the current state variable, that is a level of trust. In period t, old entrepreneurs' decisions about voting, contracts, and cheating during the working phase depend on a level of trust ϕ_t. Because their payoffs U^i_t also depends on ϕ_t, their parents payoff deriving from their activity in the working phase V^{ij}_t also does.[12] Thus, by combining this with additive separability of utility function (11), we can separate the optimization problem in the working phase from the one in the retirement phase.

This simplifies the equilibrium analysis in the working phase and allows us to apply the result of Section 3. Proposition 1 and Proposition 2 imply that with a given level of trust ϕ_t, the equilibrium contract and the equilibrium level of enforcement in period t are given by

$$r_t = r(\phi_t) = \frac{I - (1-\phi_t p)\tau(\phi_t)C}{\phi_t p}, \tag{12}$$

and

$$\tau_t = \tau(\phi_t) \begin{cases} = 1 & \text{if } 1/2 \leq \phi_t, \\ = \underline{\tau}(\phi_t) & \text{if } \underline{\phi} \leq \phi_t < 1/2, \\ \in [0,1] & \text{otherwise,} \end{cases} \tag{13}$$

[12] Although V^{ij} depends on the parent's expectation on a level of trust in the child's generation, in the equilibrium the expected level of trust has to be consistent with the realized level of trust. Thus, there is the dependence of V^{ij} on ϕ_t in the equilibrium.

respectively. When a good (bad) entrepreneur is the majority in period t, the strong (weak) enforcement regime emerges during the period. Correspondingly, the value functions of entrepreneurs with type $i \in \{G, B\}$ are given by:

$$U_t^G = U^G(\phi_t) = pR - \frac{I}{\phi_t} + \frac{1-\phi_t}{\phi_t}\tau(\phi_t)C, \tag{14}$$

$$U_t^B = U^B(\phi_t) = b - \tau(\phi_t)C, \tag{15}$$

where (14) and (15) are derived from (5) and (6), respectively.

4.2 Parental Choice

Next, consider the parental education of old entrepreneurs. Let $V^{ij}(\phi_t)$ denote the equilibrium payoff that a type i parent (an entrepreneur of generation $t-1$) derives from a type j child (an entrepreneur of generation t) when a level of trust is ϕ_t. The optimization problem that a type i parent of generation $t-1$ solves is to maximize the overall payoff (11) by choosing education effort f_{t-1}^i, given the expectation on future level of trust ϕ_t. The problem boils down to

$$\max_{f_{t-1}^i \geq 0} (\delta + f_{t-1}^i)V^{iG}(\phi_t) + (1-\delta-f_{t-1}^i)V^{iB}(\phi_t) - \frac{(f_{t-1}^i)^2}{2\gamma}. \tag{16}$$

When a parent's type and a child' one is the same (i.e., $i = j$), there is a perfect congruency between the parent and the child: $V^{GG}(\phi_t) = U^G(\phi_t)$ and $V^{BB}(\phi_t) = U^B(\phi_t)$. When parens have different civic values from their children (i.e., $i \neq j$), the idea of imperfect empathy comes in. Parents evaluate their children's actions with their own values:

$$V^{GB}(\phi_t) = b^G - \tau(\phi_t)C, \tag{17}$$

$$V^{BG}(\phi_t) = pR - \frac{I}{\phi_t} + \frac{1-\phi_t}{\phi_t}\tau(\phi_t)C - \Delta^B. \tag{18}$$

Good parents consider cheating as a shameful conduct and derive small payoff (17) from their

bad children, who obtain large private benefits b. In equilibrium, because good parents always prefer investing in projects to cheating, we have $V^{GG}(\phi_t) \geq V^{GB}(\phi_t)$. Alternatively, bad parents incur significant disutility by the deviation from cheating under Assumption 2 and thus derives from small payoffs $V^{BG}(\phi_t) < V^{BB}(\phi_t)$ from their good children.

As a result of imperfect empathy, parents' optimization problem (16) shows that bad parents do not have incentives to educate their children, that is, $f_{t-1}^{B} = 0$ for any period, while good parents have incentives to exert educational effort. Their optimal educational level is determined at the point where its marginal benefits equals to marginal cost:

$$\frac{1}{\phi_t}\left[\phi_t\left(pR - b^G\right) + \tau(\phi_t)C - I\right] = \frac{f_{t-1}^{G}}{\gamma}. \tag{19}$$

(19) implies that the share of good entrepreneurs of next generation ϕ_t not only directly influence the optimal level of education, but also has an indirect effect on it through a change in institutional quality. The linkage between future enforcement and current educational choices generates the mechanism through which multiple steady states emerge.

To simplify the analysis, we assume that level of enforcement is always positive in the equilibrium path, that is, $\underline{\tau}(\phi_t) > 0$ for any $\phi_t \in [\delta, 1/2)$.[13] Substituting the equilibrium level of enforcement (13) in (19), we have the optimal education effort:

$$f^G(\phi_t) = \begin{cases} f_s(\phi_t) = \gamma\left[pR - b^G - \dfrac{I - C}{\phi_t}\right] & \text{if } \dfrac{1}{2} \leq \phi_t, \\ f_w(\phi_t) = \gamma\left(\dfrac{I - \phi_t pR}{1 - \phi_t} - b^G\right) & \text{otherwise,} \end{cases} \tag{20}$$

where we focus on the situation in which $f_w(\phi_t) > 0$.[14] When parents expect that $\phi_t \geq 1/2$ so that strong enforcement regime appears, the optimal level of education given by $f_s(\phi_t)$ is increasing in ϕ_t, or there is *cultural complementarity*; that is, good parents have more incentive to

[13] Without the assumption, good parents make positive educational efforts because the quality of enforcement reaches the lowest level 0. This possibility might create multiple steady states only under weak enforcement regime.

[14] Explicitly, we assume parameter values in which the exogenous probability of having the good child δ is such that $\delta < (I - b^G)/(pR - b^G)$. This guarantee that good parents exert positive levels of educational efforts.

instill their civic values in their children as good types will be more dominant in the population. An increase in ϕ_t decreases the extent of cross-subsidization by good entrepreneurs, followed by an increase in their payoff $U^G(\phi_t)$. The beneficial effect makes their good parents' payoff $V^{GG}(\phi_t)$ higher and encourages parental education.

When parents expect that $\phi_t < 1/2$ so that weak enforcement regime appears, their educational level is given by $f_w(\phi_t)$. When the IR constraint (7) is binding and the IC constraint (4) is not, we have $V^{GG}(\phi_t) = 0 > V^{GB}(\phi_t)$. The negative payoff when having a bad kid provides good parents with incentives to educate their children. In contrast with strong enforcement regime, weak enforcement regime shows that f_w is decreasing in ϕ_t, or there is *cultural substitution*; that is, the more popular good types are, good parents have less incentive to educate their children. Higher degrees of trust increases entrepreneurs' ability to attract funds and thus yields more room to weaken enforcement, as Figure 2 suggests. The resulting weaker enforcement increases the payoff of a bad kid and discourages parental education.

4.3 Dynamic Analysis: Steady States

We move on to the analysis of the dynamics. Trust evolves according to

$$\phi_t = \phi_{t-1}(\delta + f^G_{t-1}) + (1-\phi_{t-1})\delta = \delta + \phi_{t-1} f^G_{t-1}. \tag{21}$$

The total number of good children in period t is the sum of a measure $\delta + f^G_{t-1}$ of good children raised by good parents and a measure δ of good children raised by bad parents.

Combining (21) with (20), we can analyze the complete dynamics of trust. Figure 4 plots the evolution of trust and steady states. The dynamic equation under the strong enforcement regime ($\phi_t \geq 1/2$) shows convexity. Because of cultural complementarity, as good types are more dominant in the population, they are more willing to exert educational effort, resulting in even greater trust. Despite the feature, the strong enforcement regime has the unique steady

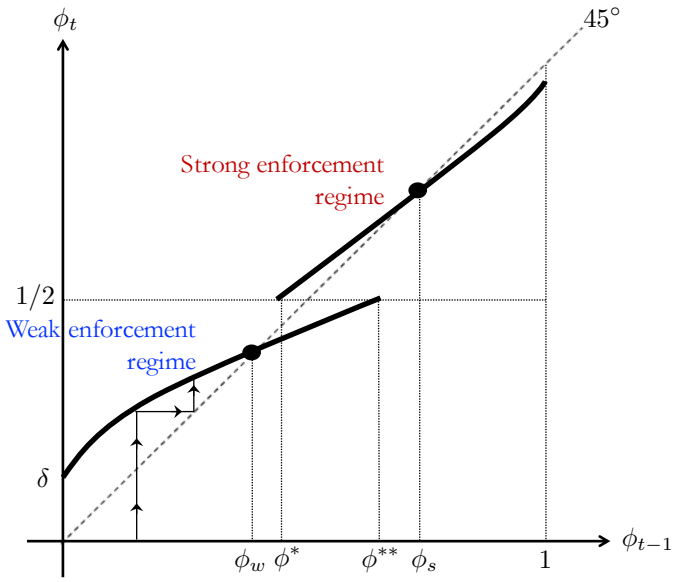


Figure 4: Multiple stable steady states

state where the level of trust is given by

$$\phi_s = \frac{\delta - \gamma(I - C)}{1 - \gamma(pR - b^G)}. \tag{22}$$

As opposed to the strong enforcement regime, the map under the weak enforcement regime ($\phi_t < 1/2$) is concave. The mechanism behind it is cultural substitution property. As ϕ_t increases, parents are less willing to exert family civic education, which impedes cultivating trust. Thus, the weak enforcement regime has the unique steady state ϕ_w such that

$$\phi_w = \frac{(\phi_w - \delta)(1 - \phi_w)}{\gamma[I - b^G - \phi_w(pR - b^G)]}. \tag{23}$$

To ensure the existence of steady states in each regime, we make the following assumption:

Assumption 5

$$2I - pR < \frac{1 - 2\delta}{\gamma} + b^G \leq pR - 2I + 2C.$$

The first inequality assures that $\phi_w < 1/2$, whereas the second inequality assures that $\phi_s \geq 1/2$. Assumption 5 holds when productivity p or R are high, or fixed cost I is low. Because this point has an important implication, we discuss about the effect of an increase in p or R in Section 5.1.

Proposition 3 *Suppose that Assumptions 1–5 hold. There exist two steady states, one with high level of trust ϕ_s given by (22) and perfect enforcement and one with low level of trust ϕ_w given by (23) and weak enforcement $\tau(\phi_w)$.*

Proof. See Appendix B. ■

The multiplicity in Proposition 3 comes from complementarity between trust and enforcement through regime change. In a high-trust economy, good entrepreneurs have political power and demand for strong enforcement regime. The strong enforcement in turn provides good entrepreneurs with sufficient incentive to instill their civic values, leading to a high-trust economy. On the other hand, in the economy with a low-level of trust bad entrepreneurs exert their political power and creates weak enforcement regime. The weak enforcement, in turn, dampens educational incentives and shapes weak trust.

The multiple steady states are consistent with the observed variation across countries or regions, if we consider that different countries or regions rest on different steady states. The one steady state is characterized by a high level of trust, strong enforcement, well-developed financial markets (in the sense that the cost of external financing r is low), and high aggregate output. The other steady state has a low level of trust, weak enforcement, less developed financial markets (high r), and low aggregate output. Comparing the steady states, we have the positive relationship between the level of trust, quality of enforcement, and degree of economic development.

4.4 Dynamic Analysis: Transitional Dynamics

Figure 4 suggests that the initial level of trust ϕ_0 and expectations play a role in selecting the steady state where the economy will end up in. If $\phi_w < \phi^* \equiv (1/2-\delta)/f_s(1/2)$, in the economy where the initial level of trust ϕ_0 is also lower than ϕ^*, there exists a unique equilibrium path, along which entrepreneurs make education $f_w(\phi_t)$ and weak enforcement regime persists, and the economy will end up in the steady state represented by ϕ_w. If $\phi_s > \phi^{**} \equiv (1/2-\delta)/f_w(1/2)$, in the economy where the initial level of trust ϕ_0 is also higher than ϕ^{**}, a unique equilibrium

path is that entrepreneurs choose education $f_s(\phi_t)$, strong enforcement regime persists, and the economy converges monotonically to the steady state represented by ϕ_s. In these situations, preconditions determine the equilibrium path and the resulting steady state.

If $\phi_w < \phi^*$, $\phi^{**} < \phi_s$, and the economy with a given ϕ_0 starts from the region, $[\phi^*, \phi^{**}]$, multiple equilibria are possible. Expectations determine which equilibrium emerges. If a good parent expects that other parents exert high (low) level of educational effort and future level of trust is high (low), followed by strong (weak) enforcement regime, she also provides high (low) education. As a result of the self-fulfilling features, if the initial level of trust is inside the region, $[\phi^*, \phi^{**}]$, there exists at least one dynamic path toward either steady state.

Proposition 4 *Suppose that Assumptions 1–5 hold. If $\phi_w < \phi^*$, starting from any $\phi_0 < \phi^*$, ϕ_t monotonically converges to ϕ_w. If $\phi^{**} < \phi_s$, starting from any $\phi_0 > \phi^{**}$, ϕ_t monotonically converges to ϕ_s. Otherwise, both steady states can be reached.*

Proposition 4 has two implications about trust, legal enforcement, and financial and economic development. First, history could be the long-term determinant of the divergence in levels of trust, institutions and economic development. If the initial level of trust is very high (very low), such preconditions drive a society to a high-trust (low-trust) steady state. That history is decisive seems consistent with empirical evidence on the long-term persistence of trust. Once trust is destroyed by the slave trade in Africa (Nunn and Wantchekon, 2011) or cultivated by the emergence of the free cities of the Italian Middle Ages (Putnam, 1993 and Guiso et al., 2016), affected trust has not been restored to a previous level for the long time and leads to the persistence in development.

Moreover, history dependence of our model can also explain the reason why legal origins transplanted by the origin countries through conquest and colonization have the long-lasting effect on the legal protections of investors. La Porta et al. (2008) argue that French civil law system embeds the beliefs that a country needs to be more concerned with private disorder than the dictatorship, whereas the common law system embeds the beliefs that a country does not need to be concerned with disorder compared to the dictatorship. Based on the argument, we

can consider that when French civic law is transplanted, distrust in other people incorporated in the law is also transmitted, whereas the transplantation of common law brought about trust in other people. Therefore, the transplantation of French civil law sets the initial low level of trust and generates the persistence of weak financial institutions. In contrast, the transplantation of common law sets the initial high level of trust and leads to the persistence of strong financial institutions.

Second, whether trust and legal enforcement are complements or substitutes for each other depends on the time span. In the long-run, the economy reaches one of the steady states, showing that trust and enforcement are complements. In the short-run, however, trust and law may be substitutes. Along the adjustment path leading to a steady state under weak enforcement regime, greater trust increases entrepreneurs ability to receive financing and thus allows a society to weaken enforcement further. This is a testable implication left for future work.

5 The Effect of Innovation

We next turn to focus on two types of innovations pertaining to economic development, technological innovation which increases the productivity of projects and contractual innovation which enhances the flexibility of contracts. Both innovations promote transactions and benefit particularly entrepreneurs who need much funds to implement their productive projects. However, less developed economies have not received the benefits of these advancement, although ideas and knowledge, which are important parts of technologies, spread instantly. In contrast with the existing literature that emphasizes the differences in capital-labor ration (Basu and Weil, 1998) or skill supplies (Acemoglu and Zilibotti, 2001), we focus on the difference in a level of civicness and corresponding institutions. In this section, we show that in response to innovations, the underdeveloped economy may be impoverished rather than enriched because the benefits of innovations are exploited by uncivic agents.

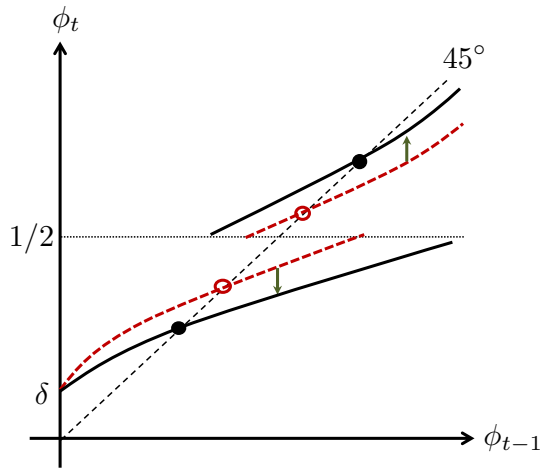


Figure 5: The effect of technological change (increase in R)

5.1 Technological Innovations

We view technological change as the increase in project return R. [15] Figure 5 depicts the effect of technological change on levels of trust. Given the strong enforcement regime, the increase in R makes the good entrepreneur's payoff larger and encourages their family education, followed by the shift of dynamic equation upward. The steady state level of trust ϕ_s and the corresponding aggregate output are also higher. Given the weak enforcement regime, higher R enhances entrepreneurs' ability to attract funds and thus creates more room to weaken enforcement. The resulting weaker enforcement discourages family education, making the dynamic equation shift downward. The steady state level of trust ϕ_w decreases and, if the decrease is sufficiently large, the corresponding aggregate output also drops. Moreover, the shifts of both dynamic equations imply that the region where enforcement regime in the next period depends on expectations, $[\phi^*, \phi^{**}]$, becomes wider.

Proposition 5 *ϕ_s is increasing and ϕ_w and $\tau(\phi_w)$ are decreasing in R. The width of the region, $[\phi^*, \phi^{**}]$, is increasing in R. When $\delta < (1+\gamma b^G)\phi_w^2$, an increase in R decreases an aggregate output at the steady state ϕ_w.*

Proof. See Appendix C. ■

[15] The increase in p and the decrease in I are also interpreted as technological progress. These changes have the same effect as the increase in R.

This exercise has two implications. First, technological progress exacerbate the level of inequality in trust, institutions, and aggregate income between steady states. If the technical change drives a high-trust economy to the new high-trust steady state, then the economy will cultivate trust further and becomes more prosperous. In contrast, if the technological progress drives a low-trust economy to the new low-trust steady state, then the economy would suffer from lower institutional quality and more severe trust deficit. The adverse effect may lower the level of aggregate output by offsetting the benefit of technical change.

This result may explain why Latin American economies stagnated in the 90s despite technological advances. Although the poor countries can have access to new technology developed in advanced economies and enhance the productivity, the change favors uncivic citizens, worsens mistrust in other people and stifles economic development. Indeed, the low levels of trust in Latin America further decline during the late 90s.[16]

Second, technical change may increase the relative importance of expectations over history. In the wider range of initial level of trust, beliefs in trustworthiness of other people of future generations determine the long-run outcome. This implies that managing expectations is more important to achieve great trust.

5.2 Contractual Innovations

So far we have focused on the simple financial contract that demands compensations only in the case of success. The restriction on the contracting leads to the pooling contract. In this section, we consider more sophisticated contracts that allows a good entrepreneur to separate from a bad one. We show that the separating contract gives the good entrepreneur higher compensation at the stage of contracting than the pooling contract because the over-investment problem the pooling contract entails is resolved. In the long-run, however, the contractual innovation does

[16]The Latinobarómetro measures interpersonal trust as the share of respondents who say "You can trust most people" to the following question: "Generally speaking, would you say that you can trust most people, or that you can never be too careful when dealing with others?." The overall level of trust in Latin America declines from 20 percent in 1996 to 15 percent in 2000. Each country also shows the decline in level of trust; e.g., from 23 to 11 percent in Argentina, from 11 to 4 percent in Brazil and from 33 to 23 percent in Uruguay.

not help the economy caught in the low-trust trap cultivate trust. If anything, the advent of sophisticated contracts may cause trust collapse.

We modify contract design by an entrepreneur in two ways as in Tirole (2006, Chapter 6). First, contactual terms contain not only the lenders' stake r but also the probability that they provide funds I to the entrepreneur, $x \in [0,1]$, and her compensations in the absence of funds, $T \geq 0$. Second, these contractual terms depend on entrepreneurs' type.

In period t, an entrepreneur offers an "option contract," $\{(r_t, x_t, T_t), (\tilde{r}_t, \tilde{x}_t, \tilde{T}_t)\}$. If lenders accept the contract, the entrepreneur chooses between the contractual terms for the good type, (r_t, x_t, T_t), and the one for the bad type, $(\tilde{r}_t, \tilde{x}_t, \tilde{T}_t)$. Given a level of trust ϕ_t and strength of enforcement τ_t, the optimal contract that is incentive compatible solves

$$\max_{r_t, x_t, T_t, \tilde{r}_t, \tilde{x}_t, \tilde{T}_t} x_t[p(R - r_t + C) + (1-p)(1-\tau_t)C] + (1-x_t)(T_t + C) \tag{24}$$

subject to

$$\phi_t[x_t\{p r_t + (1-p)\tau_t C - I\} - (1-x_t)T_t] + (1-\phi_t)\left[\tilde{x}_t(\tau_t C - I) - (1-\tilde{x}_t)\tilde{T}_t\right] \geq 0, \tag{25}$$

$$p(R - r_t) - (1-p)\tau_t C \geq b^G - \tau_t C, \tag{26}$$

$$x_t[p(R - r_t + C) + (1-p)(1-\tau_t)C] + (1-x_t)(T_t + C)$$
$$\geq \tilde{x}_t[p(R - \tilde{r}_t + C) + (1-p)(1-\tau_t)C] + (1-\tilde{x}_t)(\tilde{T}_t + C), \tag{27}$$

$$\tilde{x}_t[b + (1-\tau_t)C] + (1-\tilde{x}_t)(\tilde{T}_t + C) \geq x_t[b + (1-\tau_t)C] + (1-x_t)(T_t + C), \tag{28}$$

The objective function (24) is the good entrepreneur's gross utility. (25) is the lenders' IR constraint. (26) means that the good entrepreneur prefers investing to cheating. (27) and (28) requires that the good and bad entrepreneur choose the contractual term for their own type.

Given that a bad entrepreneur cheats after receiving funds I, the optimal contract must be designed to give the opportunity to invest to a good entrepreneur. The requirement, coupled with the linearity of our model structure, leads to $x_t = 1$ and $T_t = 0$. However, because the bad

entrepreneur yields negative social surplus, $b - I < 0$, by cheating from Assumption 1, it can be more efficient to prevent her from receiving funds I through the lump-sum transfer. Therefore, the optimal separating contract specifies $\tilde{x}_t = 0$ and $\tilde{T}_t = b - \tau_t C$ from (28). In that case, $\tilde{r}_t$ does not affect the optimal allocation and thus takes any value in $[0, R]$. Also, the good entrepreneur obtains the highest payoff by setting the repayment r_t as (25) is binding. This contract allows the good type to separate from the bad type and to extract higher compensation compared to the one in the case of pooling contract (5). We focus on the equilibrium in which entrepreneurs offer the separating contract, if feasible, rather than the pooling contract.[17]

Consequently, the separating contract is optimal if the following constraint is satisfied:

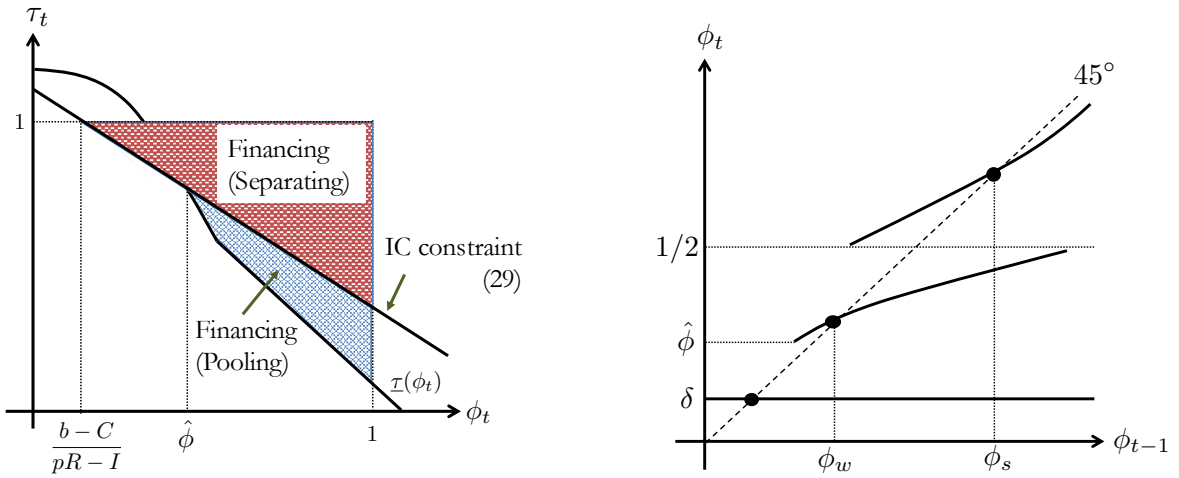
$$\tau_t C \geq b - \phi_t(pR - I), \tag{29}$$

where the condition is derived by plunging (25) into IC constraint (27) that leads the good type to reveal own type. Note that when (29) holds, the optimal contract also satisfies IC constraint (26) that makes the good type behave and limited liability constraints. If (29) is violated, the separating equilibrium unravels and the equilibrium results in the pooling allocation or no financing, as shown in Proposition 1.

The conditions under which entrepreneurs borrow funds with the use of sophisticated contracts are depicted in Figure 6a. While in the (red) dark shaded area, entrepreneurs offer the separating contract, in the (blue) light shaded area, they offer the pooling contract. The advent of separating contracts enhances the ability to attract funds, when ϕ_t is low so that the good type suffers from severe adverse selection problem. When ϕ_t is higher, however, the incentive problem that the good type mimics the bad type and receive the lump-sum payment for the bad type $\tilde{T}_t$ is more serious than the problem in the pooling contract. This creates the region in which only pooling contracts are feasible.

Despite the beneficial effect, contractual innovations can have a negative effect on the society

[17] When both the pooling and separating contracts are feasible, the unique equilibrium features the separating contract based on the definition of perfect sequential equilibrium as discussed in footnote 7 because the deviation from offering the pooling contract to doing the separating one benefits both types.



(a) Financial contracts (b) Trust Collapse

Figure 6: The effect of contractual innovation

once we consider the political economy. Let $\hat{\phi}$ be defined as an upper bound below which the pooling contract is not offered in the equilibrium regardless of τ_t. Figure 6a implies that when $\phi_t \geq \min\{\hat{\phi}, 1/2\}$, the equilibrium level of enforcement is unaffected although the equilibrium features the separating contract when $\phi_t \geq 1/2$. When $(b-C)/(pR-I) \leq \phi_t < \min\{\hat{\phi}, 1/2\}$, however, bad entrepreneurs expect that the separating contract enhances the ability to secure financing and lower the level of enforcement τ_t further. Thus, the equilibrium level of τ_t is determined by (29) with equality but not $\underline{\tau}(\phi_t)$.

The adverse effect of the contractual innovation is clearer in the dynamic model where parents choose levels of education by solving the optimization problem given by (16). When $\phi_t < \min\{\hat{\phi}, 1/2\}$, because τ_t decreases up to (29) holding with equality, good parents are indifferent to the type of their kids (i.e., $V^{GG}(\phi_t) = V^{GB}(\phi_t)$) and have no incentive to make family education. The diminished incentive to educate the child creates the trust trap, as shown in Figure 6b which exhibits the dynamics of trust (21) in the case of contractual innovation. The important difference from Figure 4 is that there exists another steady state in which nobody exerts educational effort and the level of trust reaches the minimum level, δ. An economy with any initial condition can end up in the steady state δ. If a parent expects that other parents do not educate their children and the strength of enforcement weakens up to the level at which (29) holds with equality, the parent also does not have any incentive to make education and

the initial expectation is justified. Thus, contractual innovation would not make the economy escape from the trap and would lead to trust collapse.

Proposition 6 *Consider the dynamic economy with contractual innovation, starting with an initial condition $\phi_0 > 0$. Suppose that*

$$\delta \leq \frac{I-b}{2(pR-I)}\left(-1+\sqrt{1+4\frac{pR-I}{I-b}}\right). \tag{30}$$

The dynamics of trust is governed by $\phi_t = \delta + \phi_{t-1} f^{CI}(\phi_t)$ where

$$f^{CI}(\phi_t) = \begin{cases} \gamma[pR-I-(b-C)/\phi_t] & \text{if } \frac{1}{2} \leq \phi_t, \\ f_w(\phi_t) & \text{if } \hat{\phi} \leq \phi_t < \frac{1}{2}, \\ 0 & \text{if } \phi_t < \min\left\{\hat{\phi}, \frac{1}{2}\right\}. \end{cases} \tag{31}$$

Then, there exists an equilibrium path towards the steady state in which the level of trust is δ.

Proof. See Appendix D. ■

6 The Effect of Educational Policies

Although we have focused on family civic education, public education also offers alternative mechanism through which civic virtues and trust are formed. In this section, we consider two types of policies about public civic education. The first policy is to spend resources to a small fraction of children and instill thoroughly civic values in them. Section 6.1 shows that the "selection and concentration" strategy encourages parental education and may help the underdeveloped economy get out of the mistrust trap. The second policy is to use educational resources extensively and narrow down the difference in values between civic and uncivic children. Section 6.2 argues that the extensive investment in education enables private contracts with the help of enough quality of institutions to resolve agency problems, leading to economic development.

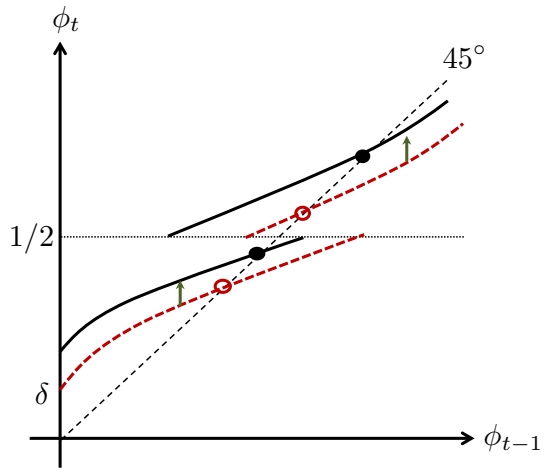


Figure 7: The effect of concentrated educational investment (increase in δ)

6.1 Concentrated Educational Investment

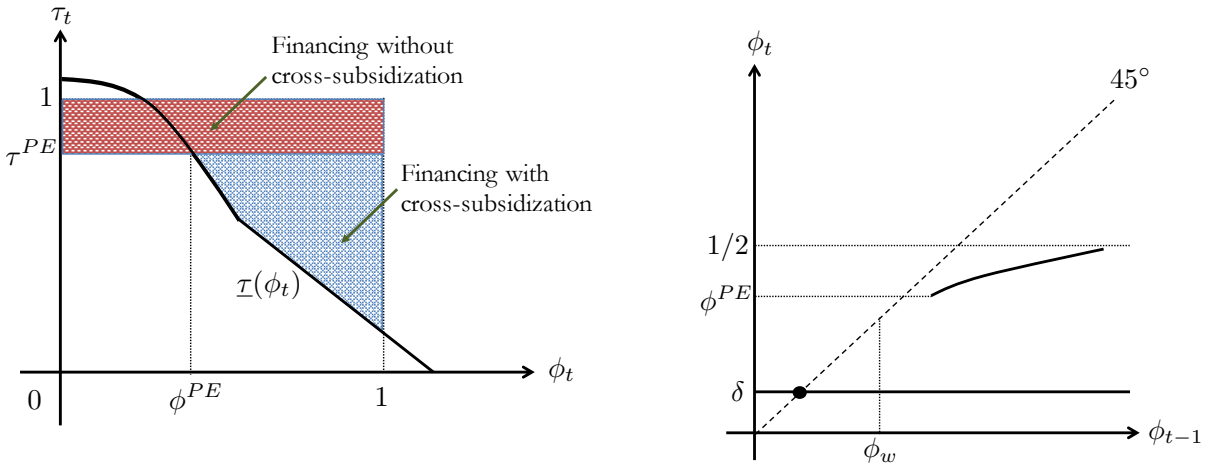
We consider that the concentration of educational resources on a small fraction of children enables them to become civic-minded and such investment leads to an increase in a fraction of entrepreneurs that become civic regardless of parental education, δ. A higher δ increases the number of good children directly and allows them to receive financing at the better contractual term. In turn, good parents become more willing to educate their children. The combination of public and family education foster trust under strong enforcement regime as shown in Figure 7. Under weak enforcement regime, the higher trust leads to lower quality of enforcement and discourages family education. Despite the crowd-out effect, provision of public education can cultivate trust and thus the dynamic equation in weak enforcement regime also shift upwards. Accordingly, the steady-state levels of trust and aggregate output in both regimes increase.

Proposition 7 *We have*

$$\frac{\partial \phi_s}{\partial \delta} > \frac{\partial \phi_w}{\partial \delta} > 0 = \frac{\partial \tau(\phi_s)}{\partial \delta} > \frac{\partial \tau(\phi_w)}{\partial \delta}.$$

Proof. See Appendix E. ■

Proposition 7 has the implications for divergence in economic performances. If the effect of educational policy is small, although the low-trust economy improves, the inequality with the



(a) Financial contracts (b) Unique steady state

Figure 8: The effect of extensive educational investment

high-trust economy is widen. If, instead, the effect of education is sufficiently large, the low-trust steady state vanishes and the economy which has been trapped in the state jumps on the path toward a high-trust steady state. The effectiveness of concentrated educational investment may be a key to closing the gap between developed and developing econimies.

6.2 Extensive Educational Investment

The extensive public education is helpful for uncivic agents to revise their value and narrows down the differences with civic agents. We consider the case where the policy decreases Δ^B so that Assumption 2 does not hold. Figure 8a displays the effect of extensive educational policy. When a level of enforcement τ is lower than the threshold $\tau^{PE} \equiv (b - pR + I + \Delta^B)/C$, financial contracts do not change and still entail cross-subsidization. In contrast, when $\tau > \tau^{PE}$ the optimal contract induces bad entrepreneurs to invest in projects rather than to follow a cheating norm and resolves the issue of cross-subsidization. Under the situation, payoffs of good and bad entrepreneurs are independent of a fraction of good entrepreneurs ϕ and strength of enforcement τ, and the economy achieves the first-best level of aggregate output, $pR - I$.

In response to the policy, the level of enforcement determined in the political process also changes. When $\phi_t \geq 1/2$, good entrepreneurs select any $\tau_t > \tau^{PE}$. Under the control of bad

entrepreneurs, when $\phi^{PE} \leq \phi_t < 1/2$ where ϕ^{PE} is such that $\tau^{PE} = \underline{\tau}(\phi^{PE})$, they prefer $\underline{\tau}(\phi_t)$, whereas in the case that $\phi_t < \phi^{PE}$, they choose any $\tau_t > \tau^{PE}$.

The public education influences the long-run outcome through parents' optimization problem about education (16). If anticipating that a fraction of good entrepreneurs in the next generation is $\phi_t \geq 1/2$ or $\phi_t < \phi^{PE}$ so that strength of enforcement is higher than τ^{PE}, good parents do not have any incentive to educate their children because their children invest in projects regardless of civic values and thus $V^{GB}(\phi_t) = V^{GG}(\phi_t)$. The realized fraction of good entrepreneurs must be $\phi_t = \delta$. This means that the steady state $\phi_s \geq 1/2$ disappears. Figure 8b illustrates the resulting dynamics of ϕ_t. The new steady state with a fraction of good entrepreneurs δ emerges, where only private contracts supported by enough quality of institutions matter for the aggregate economy. If the educational policy is effective so that $\phi^{PE} > \phi_w$, it also eliminates the underdeveloped steady state ϕ_w. As a result, any economy will end up in the steady state with δ. Our analysis suggests that the extensive public education helps align incentives of bad entrepreneurs with those with good entrepreneurs and enables private agents to correct the distortion in credit markets.

7 Robustness

In this section, we discuss assumptions and check the robustness of our conclusion.

7.1 Collateral Value

We have assumed that collateral value is lower than private benefit from Assumption 3. We consider the case in which collateral value is high such that $b < C$ but Assumption 2 still holds. When $\tau_t > b/C$, bad entrepreneurs who will cheat make a loss by engaging in financial contracts. Because they do not find it profitable to invest in projects from Assumption 2, collateral plays a role in driving bad entrepreneurs out of financial markets. While under strong enforcement regime, good entrepreneurs benefit from high collateral value, under weak enforcement

regime, they do not because bad entrepreneurs weaken enforcement as collateral value is higher, leaving effective collateral value $\tau_t C$ constant in equilibrium. Eventually, collateral does not work as a sorting device under weak enforcement regime. Therefore, higher collateral value does not affect educational choice and dynamics of ϕ_t under weak enforcement regime. This feature implies that even if collateral value C fluctuates along the process of economic development, our conclusion does not change.

7.2 Implementation of Laws

Although we have assumed that agents can determine any level of enforcement in the political process and implement the law without restriction, it is possible that the ability to implement the law depends on a level of civicness in the economy. Even if agents demand for strong legal rules, it would not be implemented in the economy with a large fraction of uncivic citizens because public officials who have uncivic values are dominant in this economy and are corrupted. Our model can incorporate this idea by introducing the upper bound of τ_t depending on a level of civicness ϕ_t. In the political process, agents choose any level of enforcement in the region of $[0, \overline{\tau}(\phi_t)]$ where $\overline{\tau}(\phi_t)$ is increasing in ϕ_t. This prevents agents from selecting strong enforcement in the economy with a low level of trust. But that economy prefers weak enforcement, so that this model yields qualitatively similar results to the model without the upper bound of τ_t.

8 Summary and Concluding Remarks

This paper studies the coevolution of culture defined as trust and institutions defined as creditor protections, both of which are important determinants of financial and economic development. In credit markets with informational asymmetry, the model features complementarity between trust and contract enforcement, leading to multiple steady states depending on the initial condition. While the economy with the initial high level of trust end up in a steady state with a high level of civicness and strong enforcement, the economy with the initial low level of trust

resulting from a historic shock has been caught in a state with distrust and weak enforcement. The long-run outcomes are consistent with the observed cross-country heterogeneity in levels of trust, financial institutions, and economic development. Our analysis provides a novel explanation for why technological innovation and contractual innovation has not closed the gap between developed and underdeveloped economies. Public education can have the potential to drive the underdeveloped economy out of the mistrust trap.

We conclude with some remarks on issues we did not dig deep into in this paper. While we describe quality of legal enforcement as an endogenous outcome in dynamic situations, the analysis is, however, based on static voting. In reality, it seems more natural that institutions have some dynamic linkage. For example, when there is intergenerational wealth transfer, the current policies affect the ex post wealth inequality, social mobility and the distribution of political power in the future. The dynamic collective decisions will derive even more important implications and are promising areas left for future research.

From a policy perspective, our model emphasizes the role of public education for development. However, the provision of public school is also determined in the political process. To spend resources in public education and escape from a low-trust trap, uncivic citizens need to agree with such policy. Although they benefit from higher trust, it causes the shift of political power to civic citizens, who will implement strong enforcement. The fear of losing political power might induce uncivic citizens to oppose to public education. The political economy of public education is also an important issue for understanding a formation of trust.

Appendix A Proof of Lemma 1

Proof. In the equilibrium with financing, the condition (8) and the following limited liability condition must hold: $\tau C \geq \frac{I-\phi pR}{1-\phi p}$. Let us define

$$\Psi_1(\phi) = I - \phi\left(pR - b^G\right), \quad \Psi_2(\phi) = \frac{I-\phi pR}{1-\phi} \quad \text{and} \quad \Psi_3(\phi) = \frac{I-\phi pR}{1-\phi p}.$$

We have $\Psi_1' < 0$, $\Psi_1'' = 0$, $\Psi_2' = -(pR - I)/(1-\phi)^2 < 0$, $\Psi_2'' < 0$, and $\lim_{\phi \to 1} \Psi_2 = -\infty$. Ψ_1 and Ψ_2 are crossed at two points, 0 and $(I - b^G)/(pR - b^G) \in (0, I/(pR - b^G))$. Figure 1 describes these two functions.

If $\phi \in [0, (I - b^G)/(pR - b^G)]$, we have $\Psi_2 \geq \Psi_1$. We also have

$$\Psi_2 - \Psi_3 = \frac{\phi(1-p)(I - \phi pR)}{(1-\phi)(1-\phi p)} \geq \frac{\phi}{1-\phi p}(1-p)b^G > 0$$

where the second inequality is from $\phi \leq (I - b^G)/(pR - b^G)$. Thus $\underline{\tau}(\phi)$, denoted by a lowest level of τ above which financing occurs, is determined by $\underline{\tau}(\phi) = \Psi_2(\phi)/C$.

If $\phi \in ((I - b^G)/(pR - b^G), I/(pR - b^G)]$, we have $\Psi_2 < \Psi_1$. We also have

$$\Psi_1 - \Psi_3 = \frac{\phi}{1-\phi p}\left[-p(I - \phi pR) + (1-\phi p)b^G\right] > \frac{\phi}{1-\phi p}(1-p)b^G > 0$$

where the second inequality is from $\phi > (I - b^G)/(pR - b^G)$. Thus $\underline{\tau}(\phi)$ is determined by $\underline{\tau}(\phi) = \Psi_1(\phi)/C$. Finally, if $\phi > I/(pR - b^G)$, we set $\underline{\tau}(\phi) = 0$. ■

Appendix B Proof of Proposition 3

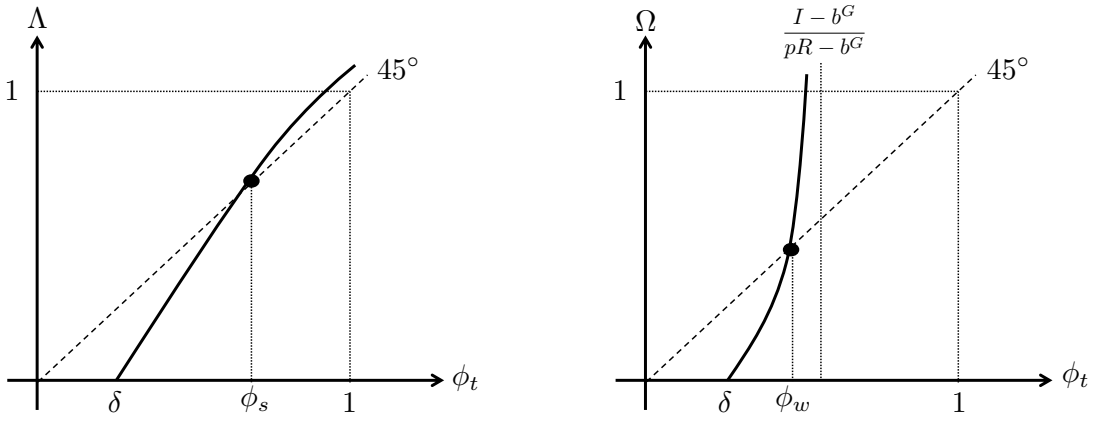
Proof. First, we show the following lemma that characterizes the steady state and transitional dynamics if the strong enforcement regime is selected any time.

Lemma 2 *Suppose that Assumptions 1–4 hold and $\tau(\phi_t) = 1$ for any t. There exists the unique steady state with a level of trust $\phi_s \in (\delta, 1)$ given by (22). Moreover, starting from any $\phi_0 \in (0, 1]$, ϕ_t evolves as the dynamic equation $\phi_t = \delta + \phi_{t-1} f_s(\phi_t)$ and monotonically converges to ϕ_s.*

Proof. Given the educational effort f_s from (20), the dynamic equation (21) boils down to

$$\phi_{t-1} = \Lambda(\phi_t) = \frac{(\phi_t - \delta)\phi_t}{\gamma[\phi_t(pR - b^G) - (I - C)]}. \tag{32}$$

Figure 9a shows $\Lambda(\phi_t)$ graphically. Because $\delta > \underline{\phi}$, the denominator of Λ is positive when



(a) When $\tau(\phi_t)=1$ (b) When $\tau(\phi_t)=\underline{\tau}(\phi_t)$

Figure 9: A fixed point

$\phi_t \geq \delta$. We have $\Lambda(\delta)=0$ and

$$\Lambda'(\phi_t)=\frac{\phi_t^2(pR-b^G)-(2\phi_t-\delta)(I-C)}{\gamma[\phi_t(pR-b^G)-(I-C)]^2}>0$$

for any $\phi_t \geq \delta$ because the numerator is positive when $\phi_t=\delta$ and is increasing in ϕ_t. We also have

$$\Lambda''(\phi_t)=\frac{-2(I-C)[\delta(pR-b^G)-(I-C)]}{\gamma[\phi_t(pR-b^G)-(I-C)]^3}<0,$$

for any $\phi_t \geq \delta$. Moreover, as $\phi_t \to \infty$, $\Lambda'(\phi_t) \to \gamma^{-1}/(pR-b^G)$. Because we assume that γ is sufficiently small to rule out the corner solution ($f^G(\phi_t)=1-\delta$), we have $\lim_{\phi_t \to \infty} \Lambda'(\phi_t) > 1$ and the unique fixed point $\phi_s = \Lambda(\phi_s) \in (\delta, 1)$ given by (22). Figure 9a shows that ϕ_t monotonically converges to ϕ_s. ■

Next, we characterize the steady state and transitional dynamics if the weak enforcement regime is selected in any period.

Lemma 3 *Suppose that Assumptions 1–4 hold and $\tau(\phi_t)=\underline{\tau}(\phi_t)$ for any t. Suppose that $pR-b^G \leq I$. There exists the unique steady state $\phi_w \in \left(\delta, (I-b^G)/(pR-b^G)\right)$ given by (23). Moreover, starting from any $\phi_0 \in (0,1]$, ϕ_t evolves as the dynamic equation $\phi_t=\delta+\phi_{t-1}f_w(\phi_t)$ and monotonically converges to ϕ_w.*

Proof. We focus on the situation in which $\delta < \phi_t < (I-b^G)/(pR-b^G)$, where $(I-b^G)/(pR-$

$b^G) < 1$ from Assumption 1. The dynamic equation (21) is rewritten as

$$\phi_{t-1} = \Omega(\phi_t) = \frac{(\phi_t - \delta)(1-\phi_t)}{\gamma[I - b^G - \phi_t(pR - b^G)]}. \tag{33}$$

Figure 9b illustrates the function $\Omega(\phi_t)$. We have $\Omega(\delta) = 0$ and $\Omega(\phi_t) > 0$. Moreover,

$$\begin{aligned}\Omega'(\phi_t) &= \frac{(-2\phi_t + 1 + \delta)[I - b^G - \phi_t(pR - b^G)] + (\phi_t - \delta)(1-\phi_t)(pR - b^G)}{\gamma[I - b^G - \phi_t(pR - b^G)]^2} \\ &= \frac{(1-\phi_t)[I - b^G - \phi_t(pR - b^G)] + (\phi_t - \delta)(pR - I)}{\gamma[I - b^G - \phi_t(pR - b^G)]^2} > 0\end{aligned} \tag{34}$$

because the numerator is decreasing in ϕ_t and when $\phi_t \to (I - b^G)/(pR - b^G)$ the numerator is positive. We also have $\Omega(\phi_t) \to \infty$ as $\phi_t \to (I - b^G)/(pR - b^G)$. This implies that there exists the unique fixed point $\phi_w = \Omega(\phi_w) \in (\delta, (I - b^G)/(pR - b^G))$. Figure 9b shows that ϕ_t monotonically converges to ϕ_w. ■

Taking into account Lemma 2 and Lemma 3, we can characterize the complete dynamics. When $\phi_t \geq 1/2$, strong enforcement regime appears and the evolution of trust is given by $\phi_t = \delta + \phi_{t-1} f_s(\phi_t)$. When $\phi_t < 1/2$, weak enforcement regime emerges and the dynamics evolve according to $\phi_t = \delta + \phi_{t-1} f_w(\phi_t)$. Thus, under Assumption 5, steady state in each regime exists. ■

Appendix C Proof of Proposition 5

Proof. From (20) and (22), ϕ_s and the width of the region, $[\phi^*, \phi^{**}]$, are increasing in R. Totally differentiating (23) with respect to ϕ_w and R, we have

$$\begin{aligned}\frac{\partial \phi_w}{\partial R} &= -\frac{\partial \Omega(\phi_w)}{\partial R}\frac{1}{\Omega'(\phi_w)-1} \\ &= \frac{-\phi_w p(1-\phi_w)(\phi_w-\delta)}{(1-\phi_w)[I-b^G-\phi_w(pR-b^G)]+(\phi_w-\delta)(pR-I)-\gamma[I-b^G-\phi_w(pR-b^G)]^2} \\ &= \frac{-\phi_w p}{\delta(1-\phi_w)/(\gamma\phi_w^2)+(pR-I)/(1-\phi_w)} < 0\end{aligned}$$

where the second equality is derived from (34) and the third equality is derived from (23). We also have

$$\frac{\partial \tau(\phi_w)}{\partial R} = \frac{\partial}{\partial R}\left[\frac{I-\phi_w pR}{C(1-\phi_w)}\right] = \frac{p\phi_w}{C(1-\phi_w)}\left(-1+\frac{\gamma\phi_w^2(pR-I)}{\delta(1-\phi_w)+\gamma\phi_w^2(pR-I)}\right) < 0.$$

Then, aggregate output is given by $Y(\phi_t) = \phi_t pR$. The effect of an increase in R on Y when $\phi_t = \phi_w$ is

$$\begin{aligned}\frac{\partial Y(\phi_w)}{\partial R} &= \phi_w p + pR\frac{\partial \phi_w}{\partial R} = \frac{\gamma\phi_w^3 p}{\delta(1-\phi_w)^2+(pR-I)\gamma\phi_w^2}\left[\phi_w pR - I + \frac{\delta}{\gamma}\left(\frac{1}{\phi_w}-1\right)^2\right] \\ &= \frac{\phi_w^3 p(1-\phi_w)}{\delta(1-\phi_w)^2+(pR-I)\gamma\phi_w^2}\left[\frac{\delta}{\phi_w^2}-1-\gamma b^G\right]\end{aligned}$$

where we have the second equality by substituting (23). When $\delta < (1+\gamma b^G)\phi_w^2$, we obtain $\partial Y(\phi_w)/\partial R < 0$. ■

Appendix D Proof of Proposition 6

Proof. For $\phi_t \in [0,1]$, (4) with equality and (29) with equality intersects only at $(I-b)/(I-b^G)$ and (7) with equality and (29) with equality intersects only at $\frac{I-b}{2(pR-I)}\left(-1+\sqrt{1+4\frac{pR-I}{I-b}}\right)$.

Let us define

$$\hat{\phi} \equiv \max\left\{\frac{I-b}{I-b^G}, \frac{I-b}{2(pR-I)}\left(-1+\sqrt{1+4\frac{pR-I}{I-b}}\right)\right\}. \tag{35}$$

The equilibrium level of enforcement is

$$\tau^{CI}(\phi_t) = \begin{cases} \dfrac{b-\phi_t(pR-I)}{C} & \text{if } \dfrac{b-C}{pR-I} \leq \phi_t < \min\left\{\hat{\phi}, \dfrac{1}{2}\right\}, \\ \tau(\phi_t) & \text{otherwise,} \end{cases} \tag{36}$$

where $\tau(\phi_t)$ is given by (13). This implies that if $\hat{\phi} \leq \phi_t < 1/2$, the pooling contract occurs in the equilibrium; otherwise, the separating contract appears on the equilibrium path. The equilibrium payoffs during the working periods in the case of separating contract are given by

$$U^{G,sep}(\phi_t) = \begin{cases} \phi_t(pR-I) & \text{if } \dfrac{b-C}{pR-I} \leq \phi_t < \min\left\{\hat{\phi}, \dfrac{1}{2}\right\} \\ pR-I-\dfrac{1-\phi_t}{\phi_t}(b-C) & \text{if } \dfrac{1}{2} \leq \phi_t \end{cases} \tag{37}$$

for the good type and

$$U^{B,sep}(\phi_t) = \begin{cases} \phi_t(pR-I) & \text{if } \dfrac{b-C}{pR-I} \leq \phi_t < \min\left\{\hat{\phi}, \dfrac{1}{2}\right\} \\ b-C & \text{if } \dfrac{1}{2} \leq \phi_t \end{cases} \tag{38}$$

for the bad type.

When $\hat{\phi} \leq \phi_t < 1/2$, the optimal level of education is given by (20). When $\delta \leq \phi_t < \min\{\hat{\phi}, 1/2\}$, $V^{GG}(\phi_t) = U^{G,sep}(\phi_t) = U^{B,sep}(\phi_t) = V^{GB}(\phi_t)$, implying that the optimal level of education is 0. When $1/2 \leq \phi_t$, because $V^{GG}(\phi_t) = U^{G,sep}(\phi_t) > U^{B,sep}(\phi_t) = V^{GB}(\phi_t)$, the optimal level of education is given by $f^G_{t-1} = \gamma[pR-I-(b-C)/\phi_t]$.

We characterize the economy by putting the optimal educational choice (31) into the dynamic equation (21). When (30) holds, $f^{CI}(\delta) = 0$, implying that $\phi_t = \delta$ satisfies (21) for any

ϕ_{t-1}. Thus, any economy can reach the steady state δ. ■

Appendix E Proof of Proposition 7

Proof. We obtain $\partial\phi_s/\partial\delta > 0$ from (22). Total differentiation of (23) with respect to ϕ_w and δ yields

$$\begin{aligned}\frac{\partial\phi_w}{\partial\delta} &= -\frac{\partial\Omega(\phi_w)}{\partial\delta}\frac{1}{\Omega'(\phi_w)-1} \\ &= \frac{(1-\phi_w)[I-b^G-\phi_w(pR-b^G)]}{(1-\phi_w)[I-b^G-\phi_w(pR-b^G)]+(\phi_w-\delta)(pR-I)-\gamma[I-b^G-\phi_w(pR-b^G)]^2} \\ &= \frac{\phi_w(1-\phi_w)^2}{\delta(1-\phi_w)^2+\gamma(pR-b^G)\phi_w^2} > 0\end{aligned}$$

where we have the second equality by using (34) and the third equality by using (23). We also have $\partial\tau(\phi_w)/\partial\delta < 0$.

Moreover, we have

$$\begin{aligned}\frac{\partial\phi_s}{\partial\delta}-\frac{\partial\phi_w}{\partial\delta} &= \frac{\gamma(pR-b^G)\phi_w(\phi_w+(1-\phi_w)^2)-(\phi_w-\delta)(1-\phi_w)^2}{[1-\gamma(pR-b^G)][\delta(1-\phi_w)^2+\gamma(pR-b^G)\phi_w^2]} \\ &= \gamma\phi_w\frac{(pR-b^G)(\phi_w+(1-\phi_w)^2)-(1-\phi_w)[I-b^G-\phi_w(pR-b^G)]}{[1-\gamma(pR-b^G)][\delta(1-\phi_w)^2+\gamma(pR-b^G)\phi_w^2]}\end{aligned}$$

where the denominator is positive and the numerator can be rewritten as

$$\gamma\phi_w(pR-b^G)(1-\phi_w)\left[\frac{\phi_w}{1-\phi_w}+1-\frac{I-b^G}{pR-b^G}\right].$$

Because this numerator is also positive from Assumption 1, we have $\partial\phi_s/\partial\delta > \partial\phi_w/\partial\delta$. ■

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