# Trust and Growth*

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# Trust and Growth

**Abstract**

Why does trust vary so substantially across countries? How does trust affect growth? This paper presents a general equilibrium growth model in which heterogeneous agents transact and face a moral hazard problem. Agents in this world may trust those with whom they transact, but they also have the opportunity to invest resources in verifying the truthfulness of claims made by transactors. We characterize the social, economic and institutional environments in which trust will be high, and show that low trust environments reduce the rate of investment and thus the economy's growth rate. Further, we show that very low trust societies can be caught in a poverty trap. The predictions of the model are examined empirically for a cross-section of countries and have substantial support in the data. Trust is higher in more ethnically, socially and economically homogeneous societies and where legal and social mechanisms for constraining opportunism are better developed. High-trust societies, in turn, exhibit higher rates of investment and growth.

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*If a covenant be made, wherein neither of the parties perform presently, but trust one another...he that performeth first, has no assurance the other will perform after; because the bonds of words are too weak to bridle men's ambition, avarice, anger, and other Passions, without the fear of some coercive Power...*

Thomas Hobbes, Leviathan, 1651

*Doveryai, no proveryai (Trust, but verify)*

Russian Proverb

# 1 Introduction

ADAM SMITH (1997 [1766]) OBSERVED notable differences across nations in the "probity" and "punctuality" of performance of their populations. For example, the Dutch "are the most faithful to their word." John Stuart Mill wrote: "There are countries in Europe...where the most serious impediment to conducting business concerns on a large scale, is the rarity of persons who are supposed fit to be trusted with the receipt and expenditure of large sums of money" (Mill, 1848, p. 132). Enormous differences across countries in the propensity to trust others survives today. In Scandinavian cities, bicycles are still commonly left on the street unlocked and unattended (although anecdotal evidence suggests this practice has begun to decline). Danish citizens routinely leave small children in strollers on the sidewalk while shopping or dining–a practice which resulted in the arrest of a Danish mother who was visiting New York City, where many people are not trusting enough to leave even their dogs tied up on the sidewalk (New York Times, 1997).

Economists tend to view Copenhagen as the exception and to consider New York (or Manila, or Lima) the norm. Evidence from experiments reveals a surprising amount of trusting behavior, however, among Americans. In several sets of experiments, one-half of the players in anonymous one-shot sequential prisoner's dilemma games chose to trust their partners, three-quarters of whom declined to violate this trust, cooperating rather than defecting to the Nash equilibrium (Berg, Dickhaut & McCabe 1995; V. Smith, 1997). Why do we observe so much trust in the laboratory but not on the streets of New York?

This paper presents a general equilibrium heterogeneous agent growth model in which consumers are randomly matched to an investment broker for a single period. We permit consumers to choose the degree to which they trust their brokers, given their own and their broker's characteristics. In this way we are able to characterize why trust varies across societies, and to determine the consequences of different levels of trust on economic performance. In the model, we assume that brokers are the only conduit through which consumers can access the capital market. Further, brokers possess more information about the return on their clients' investments than do their clients; thus brokers have a moral hazard problem. Consumers determine the degree that they trust their brokers by choosing how much time to spend verifying their broker's fealty. The cost of such an investigation is the wage foregone, as time spent investigating is time spent away from production. We show that trust depends on the social, economic and institutional environments in which transactions occur. For example, we show that trust falls when there is wage discrimination based on noneconomic factors; that is, trust is higher in "fair" societies.

Because trust reduces the cost of transactions (i.e. less time is spent investigating one's broker), high trust societies exhibit better economic performance than low trust societies, as shown in the empirics of Knack and Keefer (1997). *A fortiori*, a sufficient amount of trust may be crucial to successful development. Douglass North (1990, p. 54) writes,

> *The inability of societies to develop effective, low-cost enforcement of contracts is the most important source of both historical stagnation and contemporary underdevelopment in the Third World.*

We show that a (Northian) low-trust poverty trap exists. If trust is too low in a society, savings will be insufficient to sustain positive output growth. Such a poverty trap is more likely when institutions–both formal and informal–which punish cheaters are weak. Most importantly, we show that the amount of trust and the existence (or lack thereof) of a poverty trap depends critically on the level of social heterogeneity (in a sense made formal in the next section) in a society.

The model and the results derived from it are contained in Section 2. The theory generates a number of testable predictions that are explored in Section 3 of the paper. We investigate both the model's predictions for the determinants of variations in trust across societies as well as the implications for growth, using data for a reasonably large cross-section of countries. These analyses reveal strong support for all of the primary results of the theory. Section 4 concludes with suggestions for extensions to this research.

## 2 The Foundations of Trust

Consider an economy with a continuum of infinitely-lived consumers. Agents vary in a potentially large number of ways, including their income, wealth, education, ethnicity, religion, etc. We reduce all the ways in which agents can vary into a single index, with an agent's "type" identified by $i$ distributed over the positive real line. Consumers in this economy have standard preferences and seek to smooth consumption by saving each period, but to access credit markets, they must utilize an investment broker. There is a continuum of investment brokers who are distinct from consumers and are also identified by their type, lying on the positive real line. Only the broker knows the actual return earned on an investment, and thus brokers have a moral hazard problem as they have the opportunity to cheat their clients. The consumer, knowing this, may choose to spend some of his or her time investigating their broker in order to reduce the broker's ability to cheat.[1] Each period, through a random draw, consumers are matched with investment brokers and, at the time the investment is made, the broker's type is unknown, though the distribution of types is known. In the following period, when the investment is closed out, but prior to its payout, the broker's type is revealed, at which point a decision is made on how much time to spend investigating the broker. Note that, as in the experimental literature, we focus on the starkest case–the degree of trust in a one-shot transaction without individual-specific reputational effects.

There are two institutional effects, besides an individual's investigation of the broker's investment, that motivate inherently untrustworthy brokers to reduce the amount that they cheat. The first of these is formal institutions. Formal institutions include investigative agencies, like the Securities and Exchange Commission, that oversee brokers as well as the judicial system that can enforce contracts and prosecute cheaters.[2] In the model, punishments take the form of the partial loss of the broker's fee.[3]

Second, in addition to formal institutions, cheating brokers may face sanctions produced by informal institutions. While Hobbes viewed the government as the sole source of trust between strangers, J. S. Mill (1848) wrote that "much of the security of person and property in modern nations is the effect of manners and opinion" and of "the fear of exposure" rather than "the direct operation of the law and the courts

[1]The time spent investigating one's broker can be thought of, more generally, as time spent writing contracts, which can be trivial when one trusts one's broker (when a handshake may suffice), in contrast to an iron-clad contract specifying all manner of contingencies when one suspects one's broker will cheat. The model here is related to a large literature on moral hazard and asymmetric information, especially Tsiddon (1992) who shows that moral hazard can lead to poverty traps (i.e. multiple equilibria). Also see Hermalin & Katz (1991), Bhattacharyya & Lafontaine (1995), Mukherji & Nagarajan (1995) and Phelan (1995).

[2]Other formal mechanisms serving to constrain opportunism in financial markets can include regulation (such as financial disclosure requirements), and private organizations such as credit bureaus, codes of professional ethics (for example for CPAs), mercantile agencies (such as Dun and Bradstreet), bond ratings services (such as Moody's), and stock exchange memberships. In other markets, these mechanisms include arbitration procedures of trade associations, Better Business Bureaus, Consumer's Union, and Underwriter's Laboratories (see Klein, 1997 and Zucker, 1986).

[3]For simplicity, we assume that the fees collected as penalties are disposed by the government and are not recycled into the economy.

of justice" (p. 135-136). Mill was highly critical of the English legal system, but believed that reputational effects served as effective substitutes in keeping economic agents honest (p. 444). Informal sanctions constraining opportunism by agents can include guilt associated with violating moral norms, "afterlife sanctions" associated with religious dictates, social sanctions (such as ostracism), and loss of profits through reputational effects.

All of these potential informal sanctions are dependent on or facilitated by social ties. Moral and religious norms depend on prior socialization processes; reputational loss depends on dissemination of information regarding who cheats, which can occur through formal institutions such as credit bureaus, but which more often–especially where formal mechanisms are lacking–occurs through informal means such as gossip. Transactions occur within a social structure, and this structure determines the types of rewards for cooperation or penalties for deviation (Becker 1974). Granovetter (1985) has called this the "embeddedness" of economic actions. Psychologists attribute this embeddedness to a need to belong to a social group, which provides an evolutionary advantage in survival and reproduction (Baumeister & Leary 1995).[4] The important benefits of group membership for many individuals may be inseparable from socialization processes and empathetic ties that reduce the utility one obtains from acting opportunistically.

A case can be made for a genetic basis for honest behavior. Frank (1987) develops a model in which having a conscience–and a statistically reliable signal of one, such as blushing upon telling a lie–solves commitment problems with potential trading partners, engendering trust.[5] McCabe, Rassenti & Smith (1997) report that in laboratory experiments, subjects who play one-shot games with a first-mover choice seldom choose the subgame perfect non-cooperative payoff. They attribute this result to genetic coding in which cheating on one-shot social exchanges will be punished and cooperation rewarded since life itself is a repeated game. Similarly, Bergstrom (1995), Samuelson (1993) and Simon (1993) argue that there is a genetic basis for altruism, especially among like agents, based on the evolutionary theory of kin selection. Cosmides & Tooby (1992) report evidence for a brain function that detects cheating which, presumably, provides a survival advantage to those living in social groups.

In the model in this paper, when "similar" consumers and brokers transact, these agents are more closely related genetically and socially than are "dissimilar" agents. Brokers cheat those similar to them less because there is a genetic and social impera-

[4]The drive to reproduce is a biological imperative more easily satisfied in a social group which provides access to sexual partners.

[5]Frank (1987) shows, under reasonable assumptions about mimicry of the signaling device by persons without a conscience and about payoffs to honest and dishonest behavior, that both honest and dishonest agents can survive in equilibrium.

tive to protect one's (extended) family. The drive to protect one's family is strongest for blood relatives and diminishes as one moves down the family tree. This is known in evolutionary biology as "Hamilton's Rule," which specifies the level of altruistic behavior among family members (and, with in-breeding, neighbors) that maximizes the survival of one's genes, including those shared among relatives.[6] Transactions among dissimilar agents involve weaker genetic and social ties so that cheating is more likely. Indeed, the animals genetically closest to humans, chimpanzees, live in social, hierarchical groups, but are aggressive towards chimps who are members of other groups (Ridley 1993, p. 216). Both an agent's social environment and genetic makeup are part of the informal behavioral drivers influencing the way transactions are effected. Because the genetic predisposition to cooperate is unlikely to vary much across societies, this factor explains baseline cooperative behavior, but variations in trust across societies must be attributable to differences in the social, economic and legal environments.

Landa's (1981) study of contract enforcement in transactions involving Chinese middlemen in the rubber trade in Singapore and Malaysia in the 1960s identified seven categories of social relations. In ascending order of social distance and descending order of trustworthiness these were near kinsmen, distant kinsmen, clansmen, fellow villagers from China, fellow Hokkiens (Chinese region), non-Hokkien Chinese, and non-Chinese. In the absence of well-developed legal mechanisms for contract enforcement, traders tended to trust, and therefore to transact more with, partners who were ethnically similar, as dense communication networks within ethnic communities facilitated the pooling of information about the reliability of potential partners. Common moral codes and dense ties among traders reinforce reputational effects (Bernstein, 1992; Greif, 1989), as the effectiveness of gossip depends on close-knit social ties and normative homogeneity (Merry, 1984).

The idea that reputational effects deter cheating in repeat dealings dates at least to Adam Smith.[7] However, reputational effects do not always require repeated dealings with the same partners. If ties within a set of traders are sufficiently dense and information on cheating is widely disseminated, reputation can be an effective deterrent to cheating even in trades involving partners who will never meet again (Kandori, 1992; Greif, 1989). As social distance increases, information and commonality of moral codes decline, and trust will fall in the absence of effective formal institutions. For example, as the diamond industry becomes more ethnically heterogeneous, traders increasingly rely on formal sanctions administered by their trading

[6] Excellent discussions of the implications of Hamilton's Rule can be found in Bergstrom (1995) and Dawkins (1976).

[7] "Where people seldom deal with one another, we find that they are somewhat disposed to cheat, because they can gain more from a smart trick than they can lose by the injury which it does their character," Smith (1997 [1766]).

associations (Bernstein, 1992).[8]

There are, then, a variety of influences that motivate individuals to trust each other. A built-in genetic predisposition towards cooperation, especially among similar agents, is affected by time spent verifying the transaction itself as well as by informal institutions, including moral codes and social sanctions against cheating. In addition, when formal oversight institutions that detect and punish cheaters are strong, agents will be more likely to behave in a trustworthy manner. The interaction between these forces determines the degree of trust between transacting agents.[9]

# 3 The Model

Formalizing the discussion above, let $d(i,j) : \mathbb{R}\times\mathbb{R} \to \mathbb{R}^+$ be the *distance* between investor $i$ and broker $j$.[10] The social and genetic forces described in Section 2 are weaker as the dissimilarity, or distance, between agents increases. Equivalently, when $d(i,j)$ is small, baseline cheating will be reduced.

The effects of a given distance between agents on trust varies with social factors influencing the abilities and incentives for opposing groups to mobilize for collective action.[11] Informal sanctions are modeled by defining $D(i,j;\theta) \equiv \frac{d(i,j)}{\theta}$, where $\theta \geq 1$. A higher value of $\theta$ indicates that social institutions (or geographic dispersion) reduce the salience of differences across types. Where these social restraints are sufficiently strong, the effective distance between an investor and broker of different types can be narrow even if the nominal distance $d(i,j)$ is large.

Now we introduce some notation from which the model will be built. Let $c^i$ be consumption of a type $i$ consumer who earns wage $w^i$, has wealth $a^i$, spends time $h^i$ working in production, and devotes time $e^i$ to investigate the return on his or her investments, with total time normalized to unity. Formal institutions, denoted $p$, seek to detect and punish cheating brokers and are funded by a lump-sum tax, $\tau$, paid by consumers. Agents have access to an *investment investigation technology,*

[8] Milgrom, North & Weingast (1990) show that where loose ties among members of a trading community prevent them from effectively informing each other about cheating behavior, a private adjudication system can support honest exchange by supplying information (even if any pair of traders interact very infrequently and judges have no enforcement power).

[9] The discussion in this section suggests an answer to the question posed in the introduction on the differences observed between trust in laboratory experiments and trust on New York City streets. Though we may be genetically predisposed to trust, the high level of social heterogeneity in New York and the low probability that "cheaters" (criminals) will be punished results in rationally lower trust than that seen among fellow undergraduates in a laboratory.

[10] Akerlof (1997) uses a distance function between agents in order to analyze choices that involve gaining status or conforming to group expectations.

[11] For example, spatial concentration of ethnic groups (as in Nigeria) may facilitate their organization.

$\eta(e^i, p, D(i,j;\theta)) : [0,1] \times \mathbb{R}^+ \times \mathbb{R}^+ \times \mathbb{R}^+ \longrightarrow [0,1]$ which permits agents to determine the fealty of brokers in reporting their investment income, with, from the discussion above, $\frac{\partial \eta}{\partial e^i} > 0$, $\frac{\partial \eta}{\partial p} > 0$, $\frac{\partial \eta}{\partial d(i,j)} < 0$, and $\frac{\partial \eta}{\partial \theta} > 0$.[12] Thus, the return from investigation increases with the time a consumer puts into this activity, as well as with the strength of formal and informal sanctions, and decreases when the social distance between the consumer and broker increases. The time spent investigating one's investments, $e^i$ can be called *diligence*. We will further suppose that the increase in one's return from investigation displays diminishing marginal returns to diligence, $\frac{\partial^2 \eta}{\partial (e^i)^2} < 0$.

The timing of decisions is as follows. Consumers observe their current wage and expected investment income, with the type of investment advisor they had last period being revealed, and choose an allocation of time between working in production and investigating their broker. Next, the agent works for a firm and receives the post-investigation return on investment from the previous period's broker. At this point, current period savings is chosen given the agent's labor income, investment income from the previous period and the net-of-cheating expected return on savings from the current period to the next period. A broker is then randomly assigned to invest the agent's savings. The type of investment broker to which a consumer is matched is drawn from a continuous CDF with support on $(0, \infty)$ and finite first and second moments. A single broker invests all of a consumer's wealth.[13] The return on an agent's investment is stochastic because the type of investment advisor (and therefore the amount of cheating) to which one has been matched is unknown when savings is chosen. To wit, agent $i$ in this economy maximizes lifetime utility by solving[14]

$$Max_{c^i, e^i} E \Sigma_{t=0}^{\infty} \beta^t U(c_t^i) \tag{1}$$

s.t.

$$\begin{aligned} c_t^i &= w_t^i h_t^i + R_t a_t^i \eta^{ij}(e_t^i, p_t, D_t(i,j;\theta)) - a_{t+1}^i - \tau_t \\ 1 &= e_t^i + h_t^i \end{aligned}$$

where $U(c)$ is a continuous, increasing and strictly concave utility function satisfying the Inada conditions, $\beta \in (0,1)$ is a subjective discount factor, $R = 1 + r - \delta$ is the gross yield on investment with $\delta \in [0,1]$ the depreciation rate of capital and $r$ the interest rate.

[12] Bernheim & Stark (1988) show that, within a family, high levels of altruism erode the desire to punish noncooperators leading to, in the notation used here, a nonmonotonicity of $\eta$ in social distance, $d(i,j)$. Randomly matching consumers with brokers in a large society, a monotone investigation technology in formal and informal sanctions seems reasonable.

[13] If one could distribute investments among brokers, then some diversification of risk would be possible. This is ruled out in order to focus on the effect of trust in one-to-one transactions.

[14] The initial condition for this economy is a distribution of wealth among consumers which is assumed nondegenerate.

Investment brokers lend the funds of the principal to whom they are matched to firms for use in production. In the period following the investment, the position is closed out and, given their own type and the type of agent to which they have been matched, brokers take a portion of the investment principle and interest to fund their consumption $c^I$. For simplicity, brokers are assumed to be risk neutral and do not save. Consumption of investment broker $j$ at time $t$, $c_t^{Ij}$, who is matched to agent $i$ with assets to invest $a_t^i$, is[15]

$$c_t^{Ij} = [1 - \eta^{ij}(e_t^i, p_t, D_t(i,j;\theta))]R_t a_t^i. \tag{2}$$

Every broker is matched with a consumer each period, and a broker's consumption is zero when the consumer to whom he or she is matched is identical in type, $\eta^{ij}(e_t^i, p_t, 0) = 1$.

The necessary and sufficient conditions for a consumer optimum are

$$U'(c_t^i) = \beta E\{U'(c_{t+1}^i)R_{t+1}\eta_{t+1}^{ij}\}, \tag{3}$$

$$w_t^i = \frac{\partial \eta_t^{ij}}{\partial e_t^i} R_t a_t^i. \tag{4}$$

The first equation (3) is a standard consumption–savings Euler equation with the expected net yield on savings being $E\{R_{t+1}\eta_{t+1}^{ij})\}$. The second condition, (4), balances the income earned by working with the extra income one can generate by investigating one's broker. Call the solutions to conditions (3) and (4), $a_{t+1}^{i\star}$ and $e_t^{i\star}$, respectively.

Firms take loans from investment brokers and use the proceeds for production. Suppose that all agents are equally productive when employed by firms. Thus, firms care only about the aggregate labor hours supplied to production. The representative firm, which we take to be the entire economy, operating in a perfectly competitive environment, maximizes profits by solving

$$Max_{K,H} F(K_t, H_t) - r_t K_t - w_t H_t, \tag{5}$$

where $F(\cdot,\cdot)$ is a neoclassical production function satisfying the Inada conditions, $K$ is aggregate capital, and $H_t \equiv \int_0^\infty h_t^i d\mu^i$ is aggregate labor hours with $\mu^i$ being the measure of consumers. The solution to (5) produces the standard inverse demand functions for capital and labor,

[15] We have chosen not to consider brokers' alternatives to cheating, such as working, to keep the model's focus on consumers' decisions. If brokers supply labor to firms and act as investment intermediaries, the results derived below continue to hold. Furthermore, when brokers face tradeoffs, it can be shown that the larger the assets they are managing, the more likely they are to cheat. This derivation is available from the authors on request.

$$r_t = F_1(K_t, H_t) \tag{6}$$
$$w_t = F_2(K_t, H_t). \tag{7}$$

Equation (7) is total wage expenditures; the wage for a type $i$ worker is determined through an allocation relation, $w_t^i = w_t G(i)$, such that $\int_0^\infty w_t^i d\mu^i = w_t$ (more will be said about this in the next section). The gross yield on savings is $R_{t+1} = r_{t+1} + 1 - \delta$.

The state of the economy is a distribution of asset holdings $\tilde{a}$. Given such a distribution, we can define a competitive equilibrium.

DEFINITION. A competitive equilibrium for problem (1) is a set of prices $\{w_t^i, R_{t+1}\}_{t=0}^{\infty}$ $\forall i \in \mathrm{I\!R}^+$ given an initial distribution of asset holdings $\tilde{a}_0$, where $\int_0^\infty a_0^i d\mu^i = K_0 > 0$, a law of motion for the distribution of assets, $\tilde{a}_{t+1} = \Gamma(\tilde{a}_t)$, a distribution relation $G(i)$ satisfying $\int_0^\infty G(i) d\mu^i = 1$, and an investment investigation technology, $\eta^{ij}(e^i, p, D(i,j;\theta))$ such that, taking prices as given, consumers maximize utility using (3) and (4), firms maximize profits solving (5). In addition, $w_t^i$ clears the labor market $\forall t$, $\forall i$, and the capital market clears at time $t$ at price $E\{R_{t+1}\eta^{ij}(e_{t+1}^{i\star}, p_{t+1}, D_{t+1}(i,j;\theta))\}$ where capital market clearing is

$$K_{t+1} = \int_0^\infty a_{t+1}^{i\star} d\mu^i \tag{8}$$

where $D_{t+1}(i,j;\theta)$ is the saver-broker match made at time $t$ when type $j$ is unknown which terminates at time $t+1$. Finally, the consumption of investment brokers is given by (2).

The competitive equilibrium in this model is not Pareto optimal since agents do not receive the full return from savings that they would if there were perfect trust (i.e. if $\eta^{ij} = 1\ \forall i, j$). In addition, there are no insurance markets to hedge the loss of investment due to untrustworthy brokers. Formal institutions serve to reduce losses due to untrustworthiness, but the funding of institutions, $p$, constitutes a deadweight loss to a society.

## 3.1 OPTIMAL DILIGENCE

First, we examine the optimality condition for diligence. It is straightforward to show, using (4), that the following results hold for the optimal time allocated to investment investigation.

**Theorem 1** *Assume that the return to investigation due to changes in diligence when formal institutions and effective distance vary satisfies* $\frac{\partial^2 \eta^{ij}}{\partial e^i \partial p} < 0$*, and* $\frac{\partial^2 \eta^{ij}}{\partial e^i \partial D(i,j;\theta)} < 0$*. Then the following hold for the optimal time spent in diligence,* $e_t^{i\star}$*,*

- *diligence increases with one's wealth,* $\frac{\partial e_t^{i\star}}{\partial a_t^i} > 0$;
- *diligence decreases with one's wage,* $\frac{\partial e_t^{i\star}}{\partial w_t^i} < 0$;
- *diligence decreases when formal institutions are more developed,* $\frac{\partial e_t^{i\star}}{\partial p_t} < 0$;
- *diligence decreases when informal institutions more effectively sanction cheaters,* $\frac{\partial e_t^{i\star}}{\partial \theta} < 0$;
- *diligence increases when transacting agents are more dissimilar,* $\frac{\partial e_t^{i\star}}{\partial d(i,j)} > 0$.

PROOF See Appendix.

The theorem shows that when wealth is high, one is less likely to count on formal or informal institutions to reduce cheating. Rather, wealthy agents will forego resources to investigate one's broker and protect their considerable wealth. These incentives are mitigated when one's wage is high, as time must be taken off of work to investigate one's broker. Very high wage agents will simply tolerate cheating as in the predation models of Zak (1998) and Grossman & Kim (1995). Similarly, agents optimally reduce their diligence when either formal or informal institutions reduce cheating by brokers. Lastly, when one's broker is revealed to be socially distant, optimal diligence increases since such a broker has a greater incentive to cheat.

*Trust* in a society can be defined as the aggregate time that agents do not spend in verifying other's actions. That is, trust is

$$H_t = 1 - \int_0^\infty e_t^{i\star} d\mu^i. \tag{9}$$

In other words, trust is the time agents are able to spend in production rather than investigating their brokers. This is, of course, not the only definition one can give for trust, but it will turn out to be useful in the analysis that follows. Note that this is an economy-wide measure of trust, not an agent-specific one. This was done because the analysis that follows will characterize the circumstances which cause societies to have more or less (aggregate) trust, and the empirical tests of the model follow this tack.

Several results follow immediately from Theorem 1. In particular, since growth causes wages and wealth to increase together, but the former reduces diligence while the latter raises it, it is natural to ask which effect is stronger.

**Corollary 1** *If at time t,* $\frac{\partial \eta^{ij}(e_t^i, p_t, D(i,j;\theta))}{\partial e_t^i} > \frac{1}{R_t}$, *then a simultaneous change in wages and wealth raises trust.*

This corollary shows that the effect of wages on diligence generally dominates the wealth effect. As a result, when growth causes equiproportional changes in wages and wealth (for example, when utility is homothetic) and for moderate values of $K$, growth will raise trust (absent changes in the relative distribution of income).

We can also ask about the relative strengths of simultaneously changing both formal and informal sanctions against cheating. It is straightforward to show

**Corollary 2** *A change in social sanctions against cheating, $\theta$, raises trust more than a change in formal sanctions against cheating, $p$.*

Corollary 2 shows that the social aspects of transactions are more important in maintaining trust than are governmental institutions. This provides an insight into the social cost and effectiveness of the government in maintaining trust. Formal institutions raise trust, but this comes with a cost, the tax paid $\tau$. Conversely, social sanctions against cheating arise because of the social embeddedness of transactions, have no direct cost, and more effectively police cheating than do formal institutions. If formal and informal institutions change as the social environment changes, it is instructive to examine which has a larger impact on trust.

**Corollary 3** *If $\theta > 1$, then a simultaneous increase in social distance $d(i,j)$, and social sanctions $\theta$, raises trust.*

**Corollary 4** *A simultaneous increase in social distance $d(i,j)$, and formal institutions $p$, raises trust.*

These two results show that if changes in the social milieu result in changes in formal or informal sanctions against cheating, diligence is more sensitive to these penalties than to the distance between an investor and broker. Thus, if institutions against cheating evolve with social and economic environments, trust will be maintained.

## 3.2 Income Distribution and Trust

Several additional implications of the model can be drawn by reconsidering the firm's problem. If the population is divided into "classes" which partitions $(0,\infty)$ into $N > 1$ distinct subintervals, then we can examine the effect of discrimination on diligence. If society dictates that some classes receive less than their marginal value in production and others receive more than their marginal value, trust in this society may be eroded.[16] To see this, define the $N$-vector $\epsilon$ to be $\{\epsilon^1, \epsilon^2, ..., \epsilon^N\}$, with

[16] Akerlof (1997) shows that agents will naturally group themselves into stable "classes" when private transactions depend on the distance between the transacting agents and yield both intrinsic benefits as well as social benefits.

$\Sigma_{n=1}^{N}\epsilon^n\mu^n = 1$, where $\mu^n$ is the mass of agents of type $n$. Let us order agent classes by their wages, $\epsilon^1 < \epsilon^2 < ... < \epsilon^N$. This allocation rule and the solution to the firm's problem (5) can be used to determine the wage structure in this society, $w_t^n = w_t\epsilon^n$ for $n = 1, ..., N$.

The typical pattern of discrimination is a reduction in the wages of a large number of individuals, because of their race, religion or national origin, which enriches a small number of agents. In such a society, the following theorem shows that discrimination reduces trust.

**Theorem 2** *Suppose that $\frac{\partial^3\eta^{ij}}{\partial(e^i)^3} > 0$ and consider the wage distribution parameters $\epsilon^m$ and $\epsilon^n$, with $m < n$ and $\epsilon^m < \epsilon^n$. Let the number of agents satisfy $\mu^m \geq \mu^n$. If wage discrimination reduces the wages of a type $m$ worker and raises the wages of a type $n$ worker by the same amount, then trust will fall.*

Proof See Appendix.

This result obtains because a decrease in wages by the poor causes a greater amount of time to be spent investigating these agents' brokers than the increase in wages of the rich causes them to decrease their investigation time. As a result, trust in this society falls with discrimination. The theorem is easily generalized to include discrimination of one group that raises the wages of multiple groups, as long as the group being exploited earns lower wages then the groups whose wages increase.

The partitions of agents above can be thought of as segregating society into classes. If the majority of transactions in a segregated society are between agents within a class, this will lead to both high trust and higher incomes for consumers (since less time will be spent in verifying investment returns so that more time is spent working). Put differently, segregation of social groups leads to increased trust if the majority of transactions occur within these groups.[17] Conversely, if most transactions are between agents from different groups, cheating will be high and trust low. Using this line of argument, a society in which there are few differences among agents will have higher trust and higher consumer incomes.[18]

[17] In an evolutionary game with different types of agents, Mailath, Samuelson & Shaked (1997) show that agents will endogenously segregate themselves into homogeneous groups, and that this segregation is efficient. This result is consistent with the findings here.

[18] In an extension to the model here, it is possible that over long periods of time the opposite result, that less segregation will lead to *greater* trust, will obtain if inter-group transactions lead to an increase in informal sanctions against cheating. Similarly, formal institutions may increase trust over time as they encourage dissimilar agents to transact. In a model with community effects on the accumulation of human capital, Bénabou (1996b) shows that when a society is stratified by wealth, integration initially leads to slower growth but, in the long-run, growth will be higher as heterogeneity is reduced. In the context of the model here, this suggests that growth may reduce the salience of differences in types if $K$ sufficiently high; i.e. $\frac{\partial\theta}{\partial K} > 0$. Durlauf (1996) finds the opposite

The relationship between the distribution of income, wealth and trust is more general than that given in Theorem 2. In general, inequality erodes trust. Inequality in income, presumably a major source of differences among agents, increases $e^i$ indirectly by increasing $d(i,j)$.

**Theorem 3** *Suppose that* $\frac{\partial^3 \eta^{ij}}{\partial (e^i)^3} > 0$ *and* $d(i,j) < \infty$ *is increasing in the difference in wages between i and j. If* $\frac{\partial^2 \eta^{ij}}{\partial e^i \partial D(i,j;\theta)} Ra^i > \theta \; \forall i$*, then a mean preserving spread of the distribution of wages reduces trust.*

PROOF See Appendix.

The relationship between the distribution of wages and trust fails to hold in several circumstances worth mentioning. In particular, the theorem does not obtain when informal sanctions, $\theta$, are sufficiently high. When informal sanctions are high, the distance between consumers and brokers is irrelevant since little or no cheating occurs and the income effect from a mean preserving spread (i.e. a redistribution of wages) exceeds the substitution effect (i.e. more investigation as the dissimilarity between agents has increased, raising cheating).[19] The conditions in the theorem are actually stronger than are needed for trust to fall with a mean preserving spread of the distribution of wages. If a sufficient mass of agents increase their investment investigation with a mean preserving spread, *viz.* when the inequality in the theorem holds for a sufficient number of agents, then trust (an aggregate measure) will still fall. This can be seen by observing that the last inequality in the theorem will not obtain for agents whose wealth $a^i$ is sufficiently low. If there is a large number of agents with low wealth, then a mean preserving spread will cause poor agents to spend *more* time in investment investigation to protect their very low levels of consumption, reducing trust. This is a Giffen-good type of result. Finally, note that the theorem will not be satisfied if cheating by a large number of brokers is sufficiently high, i.e. $\eta^{ij} \simeq 0$. Absent these exceptional conditions, as the distribution of wages becomes more unequal, trust will fall.

### 3.3 AN EXAMPLE OF DILIGENCE

At this point, we construct a parameterized example to demonstrate the relationship between institutions, social distance and trust. Let the investment investigation technology be given by

result in a model where neighborhood effects create incentives for families to stratify which leads to persistent income inequality over generations.

[19] The proof examines the income and substitution effects fully.

$$\eta^{ij} = (e^i)^\nu p^{-\gamma} D(i,j;\theta)^\sigma, \tag{10}$$

where the parameters $\nu, \gamma, \sigma \in (0,1)$. In this case, the optimality condition for diligence is

$$e^{i\star} = [\frac{\nu R_t a_t^i p_t^{-\gamma} d_t(i,j)^\sigma \theta^{-\sigma}}{w_t^i}]^{\frac{1}{1-\nu}}, \tag{11}$$

where, as above, $D(i,j;\theta) = \frac{d(i,j)}{\theta}$.

The optimal time spent in diligence is increasing in wealth and the distance between transacting agents, while it is decreasing in formal and informal institutions, and wages. This matches the results derived in Theorem 1. When production is Cobb-Douglas, $Y_t = F(K_t, H_t) = K_t^\alpha H_t^{1-\alpha}$, the wage of a type $i$ agent is $w_t^i = (1-\alpha)K_t^\alpha H_t^{1-\alpha}\epsilon^i$ where there are $N$ distinct classes of agents. Then, trust in this society has a closed-form solution when $\nu = \frac{1}{2}$ and $\delta = 1$,

$$H_t = \frac{-1 + [1 + 4A_t]^{\frac{1}{2}}}{2A_t}, \tag{12}$$

where

$$A_t = [\frac{\alpha p_t^{-\gamma}}{2(1-\alpha)K_t}]^2 \Sigma_{i=1}^N [\frac{a_t^i D(i,j;\theta)_t^\sigma}{\epsilon^i}]^2 \mu^i, \tag{13}$$

with $H$ restricted to lie on [0,1].[20]

Comparative statics on the parameterized trust relation (12) can be used to establish that trust is increasing in formal and informal institutions, $p$ and $\theta$, from a deterrence-of-cheaters effect, and trust falls when the social distance between agents, $d(i,j)$ increases. It can also be shown that trust increases with the capital stock, $K$, due to an income effect. Though higher incomes raise trust, we can say nothing about the converse relationship–the effect of trust on incomes–without examining the consumer's investment decision. It is that to which we turn next.

### 3.4 Optimal Investment

In this section we examine the impact of the distribution of agents on the optimal investment given by (3). Recall that when the investment decision is made, the type of one's broker is unknown and is only revealed in the subsequent period when the investment is closed out. The optimality condition (3) for investment $a_{t+1}^i$ can be written as

[20] Recall that when the diligence/labor-hours choice is made, the type of one's broker is revealed so that distance $d(i,j)$ is nonstochastic so no expectation operator appears.

$$U'(c_t^i) = \beta R_{t+1}[E\{U'(c_{t+1}^i)\}E\{\eta_{t+1}^{ij}\} + Cov\{U'(c_{t+1}^i), \eta_{t+1}^{ij}\}]. \tag{14}$$

Under the assumption that $\eta_{t+1}^{ij}$ and $c_{t+1}^i$ are distributed bivariate normal, (14) is equivalent to

$$U'(c_t^i) = \beta R_{t+1}[E\{U'(c_{t+1}^i)\}E\{\eta_{t+1}^{ij}\} + E\{U''(c_{t+1}^i)\}Var(\eta_{t+1}^{ij})], \tag{15}$$

by applying Stein's lemma, where $Cov\{x, y\}$ is the covariance of $x$ and $y$ and $Var\{x\}$ is the variance of $x$.[21] Equation (15) shows that optimal investment depends on both the expectation of the cheating that the broker will engage in, as well as the variance of returns due to cheating. Since the amount that brokers cheat is increasing in the distance between the broker and client, the variance of cheating is increasing in the variance of the distribution of agents.

**Theorem 4** *An agent's optimal investment choice, $a_{t+1}^{i\star}$ is decreasing in the variance of the distribution of agents.*

This result is standard in finance when the agent chooses an optimal "portfolio" between risk-free current consumption and risky investment.[22] The import of Theorems 3 and 4 is that heterogeneous societies have lower trust and therefore lower investment than do homogeneous societies.

It is straightforward to show that if a society is sufficiently heterogeneous, investment will be too small to sustain growth (i.e. if $\eta^{ij} \to 0$ as $d(i,j) \to \infty$). That is, a low-trust poverty trap exists when social heterogeneity is high. Such a poverty trap is more likely to exist when formal and/or informal institutions are weak (an "institutional poverty trap") since both these effects reduce investment returns.[23]

Several additional implications for optimal investment behavior can be drawn from condition (15). First, a strengthening of formal institutions may raise investment if this policy is not too costly (i.e. if $\tau$ is not too high). In terms of investment, there is an optimal level of funding for formal institutions if $\eta^{ij}$ is concave in $p$. Funding beyond this point will inhibit investment by reducing the income available to consumers more than it raises the return in investment by reducing cheating. As a result, over a large sample of countries, unless most countries underfund formal institutions, the relationship between the funding of formal institutions and investment is ambiguous.

[21]Stein's lemma states that if random variables $x$ and $y$ are bivariate normally distributed, then $Cov\{g(x), y\} = E\{g'(x)\}Cov\{x, y\}$, providing that the function $g(\cdot)$ is differentiable and some regularity conditions are met. If $\eta^{ij}$ and $c^i$ are not bivariate normally distributed, then equation (15) is approximates (14) by a central limit theorem.

[22]See, for example, Huang & Litzenberger (1988, p. 95) for a discussion of this result.

[23]Azariadis (1997) examines various mechanisms that produce poverty traps.

Second, similar to the argument given above, wage discrimination reduces investment as aggregate diligence increases (under the restrictions in Theorem 2) and incomes fall.[24]

Investment in our model can also be generalized to include investments in ideas, or in capital embodying technological advances, generating a relationship between trust and growth across countries. For example, if the production function is of the "AK" type, the higher investment in high trust societies will be associated with higher rates of output growth on a balanced growth path when $\frac{\partial H}{\partial K} > 0$, as in the example in Section 3.2. With production exhibits diminishing returns, higher rates of capital accumulation are associated with higher growth rates in the transitional dynamics so that higher trust leads to faster transitional growth rates. Combining the results in the previous three subsections, we have shown that heterogeneous societies, especially those with weak formal and informal institutions, have lower trust and less growth than less heterogeneous, higher trust societies. As in Alesina & Rodrik (1994) and Persson & Tabellini (1994), inequality reduces growth, but through a completely different mechanism.

# 4 Empirics

In this section, we test the primary predictions of the model, those being
*i)* Higher trust increases investment and growth;
*ii)* Homogeneous societies exhibit higher trust, and thereby investment and growth;
*iii)* Egalitarian distributions of income enhance trust, and thereby raise investment and growth;
*iv)* Discrimination reduces trust, raising investment and growth;
*v)* The direct effect of formal institutions on investment and growth is ambiguous.

## 4.1 Measuring Trust

The first step in testing the model is to identify a reasonable cross-country measure of trust. We use a measure based on data from the World Values Surveys. In each of several dozen countries, respondents have been asked whether they agree that "most people can be trusted," or if "you can't be too careful in dealing with people." The measure of trust we use is the percentage of respondents in each country agreeing that "most people can be trusted." Trust data for 29 market economies are calculated directly from the World Values Surveys (ICPSR, 1994), with surveys conducted in

[24] Technically, this argument holds when preferences are homothetic.

21 countries in 1980-81 and 8 additional countries in 1990-91.[25] These are the 29 nations included in the Knack & Keefer (1997) sample. For the current study, six additional observations are taken from Inglehart (1996), from surveys conducted in the mid-1990s. Two more observations are from Eurobarometer surveys, for a total sample of 37 nations.

In our model, trust increases whenever investors' confidence that brokers will not cheat them increases, whether that confidence is derived from effective formal or informal institutions. Some authors define trust more narrowly to exclude any effects of legal mechanisms or formal institutions more generally (e.g., Williamson, 1993; Charny, 1990). Yamagishi & Yamagishi (1994) define trust as "a cognitive bias"; high-trust individuals are those who overestimate the benevolence of others (p. 136). Our definition of trust includes what they refer to as "assurance," an expectation of benign behavior derived from knowledge of the incentive structure facing one's trading partner (p. 132).

We assume that the survey measure of trust captures the effects of formal as well as informal sanctions against cheating. If some respondents interpret the question to apply only to interpersonal transactions beyond the reach of the law, then our empirical tests will underestimate the relationship between (broadly defined) trust and formal institutions.[26]

In the model, trust is a continuous variable. At the individual level, trust as measured by the World Values Surveys is dichotomous; at the national level, it ranges from 5.5% in Peru to 61.2% in Norway. Surveys typically include between one and two thousand respondents, designed to be a nationally representative sample. Knack & Keefer (1997) provide empirical support for the validity of these data, finding, for example, that trust is strikingly correlated across countries and regions with the number of wallets that were "lost" and subsequently returned with their contents intact, in an experiment conducted in various European nations and the United States. Values for trust are also consistent with anecdotal and case study evidence on trust across countries and regions. For example, values for northern regions of Italy are higher than for the south, consistent with evidence reported by Putnam (1993) and others. Brazil and the Philippines rate among the lowest-trust countries, with the Scandinavian nations at the other extreme.

[25] All but one (Australia) of the original 21 were re-surveyed in 1990-91, when many formerly-Communist nations were also surveyed. Where multiple observations on trust for a country are available, we use the earliest observation when trust is an independent variable, and the latest observation when trust is the dependent variable.

[26] For the most part, Knack & Keefer (1997) treated this survey-based trust indicator as a measure of confidence in trading partners derived from informal mechanisms only.

## 4.2 Trust and Growth

In Table 1, our trust variable is included in simple Barro-type cross-country investment and growth regressions. Dependent variables are investment as a percentage of GDP, averaged over the period 1970-92, and average annual growth in per capita income over the same period, as constructed from Summers & Heston (1991) data. Other than trust, regressors in Table 1 include 1970 per capita income, schooling attainment for 1970 (mean years for the population aged 25 and over) from Barro & Lee (1993), and the price of investment goods for 1970, as a percentage of U.S. prices (from Summers & Heston, 1991).

Equation 1 shows that investment is higher in richer countries, where investment goods prices are relatively low, and where trust is higher. The investment/GDP share rises by one percentage point with every seven-percentage point increase in trust.

Trust's positive relationship with growth is shown in Equation 2. In our 37-nation sample, convergence and the effects of schooling are weaker than in larger samples. Higher investment goods prices, relative to U.S. levels, are significantly and negatively associated with growth, as expected. Controlling for these influences, growth rises by about 1 percentage point on average for each 15-percentage point rise in trust.

The majority of our trust observations are from surveys conducted halfway through the 1970-92 period, with the remainder from surveys conducted even later, raising the possibility of reverse causation. For 20 of the 21 nations surveyed in 1980-81, surveys were also conducted in 1990-91. The two sets of trust measures were correlated at .91, suggesting that the timing of surveys is not critical. However, we also replicated our analyses for the 1980-92 period, which is somewhat less subject to reverse causation. The coefficient of trust is higher for the 1980-92 regression, as shown in Equation 3, than it is for the longer period in Equation 2. Finally, we employ an exogenous instrument for trust (latitude, in degrees of distance from the equator, using data from Hall & Jones, 1996) in Equation 4, again finding a positive and significant association between trust and growth.

In Knack & Keefer (1997), the trust–growth relationship, while generally robust to specification changes, was somewhat sensitive to the inclusion of two influential observations (Korea and Brazil), and to the choice of human capital measures (with the Barro-Lee school attainment variables producing the weakest relationship between trust and growth). Here, with eight new observations not included in Knack & Keefer (1997), those qualifications to the generally robust relationship disappear.

The negative coefficient on initial per capita income in Equation 2 indicates that other things equal, poorer countries grow faster, on average, than rich. Relative backwardness does not necessarily help every poor country, however. Attracting and successfully adapting foreign capital and technology may be facilitated by trust between economic agents; backwardness would then provide a larger advantage for a high-trust poor nation than for a low-trust poor nation. This hypothesis implies a

| Equation | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Dependent Variable | Inv/GDP 1970-92 | Growth 1970-92 | Growth 1980-92 | Growth 1970-92 | Growth 1970-92 |
| Method | OLS | OLS | OLS | 2SLS | OLS |
| Constant | 24.806 | 4.300 | 1.920 | 4.067 | 4.511 |
| | (2.516) | (0.903) | (1.002) | (1.071) | (0.956) |
| GDP per capita | 0.833 | -0.081 | -0.013 | -0.089 | -0.096 |
| (000s) | (0.199) | (0.102) | (0.157) | (0.108) | (0.089) |
| Schooling | -0.003 | -0.092 | -0.165 | -0.252 | -0.016 |
| Attainment | (0.383) | (0.140) | (0.248) | (0.234) | (0.133) |
| Price of | -0.147 | -0.044 | -0.019 | -0.046 | -0.042 |
| Inv. Goods | (0.030) | (0.010) | (0.008) | (0.012) | (0.011) |
| Trust | 0.141 | 0.066 | 0.086 | 0.106 | 0.056 |
| | (0.052) | (0.021) | (0.030) | (0.044) | (0.018) |
| Trust*GDP | | | | | -0.010 |
| | | | | | (0.004) |
| Adj. $R^2$ | .53 | .37 | .20 | .29 | .44 |
| SEE | 4.05 | 1.30 | 1.94 | 1.37 | 1.23 |
| Mean, D.V. | 2.62 | 1.95 | 1.29 | 1.95 | 1.95 |

Sample size is 37. White-corrected standard errors are in parentheses.
Note $R^2$ does not have its usual interpretation in 2SLS.

Table 1: Trust, Investment and Growth

negative coefficient on the interaction term, trust*GDP. This prediction is borne out in Equation 5. For nations with trust levels 10 percentage points above the mean, the coefficient on initial income more than doubles and attains statistical significance. For those 10 points below the mean, the coefficient drops to zero, and backwardness yields no growth advantage over rich nations.[27] This result is consistent with theory which showed that low-trust poverty traps exists. If trust is sufficiently low, growth will flounder.

## 4.3 The Correlates of Trust

We now turn to the determinants of trust. In the model, trust increases with formal institutions, $p$, informal institutions, $\theta$, wages, $w^i$, and decreases with population heterogeneity, $d(i, j)$, and wealth, $a^i$. Empirically, at the national level, per capita income is the best available proxy for both wealth and wages. Since wealth and wages have opposing effects on trust, the expected effect of per capita income on trust is ambiguous. Mean years of schooling is included as a second proxy for wages. Education and income may also be positively associated with trust through their strong correlation with subjective rates of time preference (Hausman, 1979 and Womeldorff, 1991). Individuals who discount future utility heavily are more likely to cheat their trading partners, and will rationally expect them to cheat in turn.

We employ several alternative proxies for formal institutions and for population heterogeneity. The index of property rights introduced by Knack & Keefer (1995), based on data from the International Country Risk Guide (ICRG), is available for all 37 countries in our trust sample. This index is constructed from an equal weighting of five subjectively-scored indicators: quality of the bureaucracy, severity of governmental corruption, the rule of law, risk of governmental repudiation of contracts, and risk of expropriation of investments. Values potentially range from 0 to 50, with higher scores indicating more effective governmental institutions that protect property rights and enforce contracts. We take the earliest available observation for each country, which is from the early 1980s for almost every country.

A second proxy for formal institutions is "contract enforceability," a subjective variable ranging from 0 to 4 in value, and based on surveys of international business experts by Business Environmental Risk Intelligence (BERI). This variable is available for fewer countries than is the property rights index, but has the virtue of being available farther back in time. We take the average of values for contract enforceability over the 1972-89 period. Higher values indicate more reliable enforcement of contracts.

A third measure is a bribery index based on surveys of businesspersons (both nationals and expatriates) in each of 46 countries, and published in the 1996 World

[27] Similarly, Keefer & Knack (1997) show empirically that the growth advantages of relative backwardness are greater in nations with institutions supportive of secure property rights.

Competitiveness Yearbook (International Institute for Management Development, 1996). Countries are rated on a subjective 1-10 scale, with 1 indicating that "improper practices such as bribing or corruption prevail in the public sphere" and 10 indicating that they "do not prevail." Bribery scores for countries in our trust sample range from Denmark's 9.55 to Venezuela's 1.00.

A fourth measure of formal institutions is an index of investor rights from the Center for International Financial Analysis and Research, Inc. The index was created by examining and rating companies' 1990 annual reports on the inclusion or omission of 90 items relating to accounting standards, income statements, flow of funds statements, stock data, etc. At least three companies were evaluated in each of 44 countries. Values, as reported in La Porta, Lopez-de-Silanes, Shleifer, & Vishny (1997), range from a low of 24 for Egypt to a high of 83 for Sweden. Unlike our other proxies for formal institutions, this measure is objective, and clearly reflects protections available to domestic investors.

Equations 1-4 of Table 2 show that each of these indicators of formal institutions is positively and significantly related to trust. Each 2-point rise in the 50-point Knack-Keefer property rights index is associated with a 1 percentage point increase in trust (Equation 1). Each 1-point rise in the 4-point "contract enforceability" scale is associated with a 12-point increase in trust (Equation 2). Each 1-point rise in the 10-point bribery scale increases trust by nearly 2 percentage points.[28] Trust is higher where laws protect investors' rights more effectively, as measured by the inclusion of items in companies' annual reports: each 3-point rise in the investor rights index is associated with an increase in trust of more than 1 percentage point (Equation 4). Consistent with the model, per capita income is not significantly related to trust, while each additional year of educational attainment is associated with an increase in trust of about 3 percentage points.

Next, we use several alternative proxies for the average social distance between investors and brokers in society. Social distance can be measured along various dimensions, such as blood and ethnic ties; differences in language, culture, education, income, wealth, occupation, social status, or political and economic rights; or geographic distance. Zucker (1986, p. 63) writes:

> *Just as ethnicity, sex, or age may be used as an index of job skills by employers, they can be used as an index of trust in a transaction. They serve as indicators of membership in a common cultural system, of shared background expectations. In general, the greater the number of social similarities (dissimilarities), the more interactants assume that common back-*

[28]Results are very similar using either of two alternative variables from the World Competitiveness Yearbook, one on "confidence in the fair administration of justice" and one on "confidence among people that their person and property are protected."

| Equation | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Institutional/ Heterogeneity Var. | Property rights ind. | Contract enforce. | Bribery index | Account. standards | Gini inc. inequality | Gini land inequality | Economic discrim. | Ethnic heterogen. |
| Constant | -3.906 | -10.206 | 3.704 | -15.530 | 29.758 | 24.752 | 10.960 | 9.997 |
| | (7.795) | (8.917) | (5.703) | (8.117) | (8.799) | (7.211) | (3.626) | (4.275) |
| GDP per capita 1980 (000s) | -0.446 | 0.023 | -0.058 | 0.859 | 0.187 | 1.238 | 0.998 | 0.817 |
| | (0.696) | (0.852) | (0.832) | (0.900) | (0.885) | (1.060) | (0.698) | (0.849) |
| Schooling 1980 | 3.733 | 2.086 | 3.368 | 2.448 | 3.661 | 2.762 | 3.188 | 3.803 |
| | (1.159) | (1.468) | (1.403) | (1.365) | (1.253) | (1.463) | (0.959) | (1.160) |
| Institutional/ Heterogeneity Var. | 0.474 | 11.840 | 1.795 | 0.454 | -0.531 | -0.313 | -4.511 | -0.573 |
| | (0.256) | (5.213) | (1.061) | (0.164) | (0.206) | (0.089) | (1.408) | (0.215) |
| Heterogeneity squared | | | | | | | | 0.647 |
| | | | | | | | | (0.255) |
| Adj. $R^2$ | .57 | .55 | .57 | .60 | .61 | .62 | .65 | .59 |
| SEE | 10.8 | 11.1 | 10.5 | 10.6 | 10.7 | 10.8 | 9.9 | 10.5 |
| N | 37 | 32 | 33 | 34 | 33 | 32 | 35 | 37 |
| Mean, D.V. | 35.3 | 35.0 | 37.3 | 35.6 | 35.2 | 35.5 | 35.1 | 35.3 |

The dependent variable is trust. White-corrected standard errors are in parentheses.

Table 2: Formal Institutions, Heterogeneity and Trust

| Equation | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Constant | 4.554 | 1.982 | -11.533 | -14.889 | -0.276 | -11.748 | 9.910 |
| | (11.200) | (10.585) | (5.793) | (7.103) | (5.787) | (6.159) | (5.527) |
| GDP per capita | 0.292 | 1.320 | 0.831 | 0.930 | -0.194 | 0.029 | 0.459 |
| 1980 (000s) | (0.930) | (1.110) | (0.746) | (0.775) | (0.495) | (0.530) | (0.598) |
| Schooling | 2.182 | 1.735 | 2.489 | 2.003 | 3.012 | 0.821 | 1.927 |
| 1980 | (1.399) | (1.580) | (1.235) | (0.991) | (0.845) | (1.091) | (1.341) |
| Accounting | 0.549 | 0.408 | 0.520 | 0.548 | | | |
| standards | (0.162) | (0.204) | (0.127) | (0.140) | | | |
| Property rights | | | | | 0.580 | | |
| index | | | | | (0.220) | | |
| Contract | | | | | | 17.723 | |
| enforcability | | | | | | (4.312) | |
| Bribery | | | | | | | 2.527 |
| index | | | | | | | (0.922) |
| Gini income | -0.532 | | | | | | |
| inequality | (0.154) | | | | | | |
| Gini land | | -0.251 | | | | | |
| inequality | | (0.078) | | | | | |
| Ethnolinguistic | | | -0.596 | | | | |
| heterogeneity | | | (0.181) | | | | |
| Heterogeneity | | | 0.589 | | | | |
| squared | | | (0.227) | | | | |
| Economic | | | | -4.407 | -4.818 | -5.512 | -4.589 |
| discrimination | | | | (1.180) | (1.106) | (1.180) | (1.338) |
| Adj. $R^2$ | .68 | .65 | .67 | .73 | .70 | .73 | .70 |
| SEE | 9.9 | 10.6 | 9.6 | 8.9 | 9.2 | 8.6 | 9.0 |
| N | 30 | 29 | 34 | 32 | 35 | 32 | 31 |
| Mean, D.V. | 35.6 | 35.9 | 35.6 | 35.5 | 35.1 | 35.0 | 37.2 |

The dependent variable is trust. White-corrected standard errors are in parentheses.

Table 3: Formal Institutions, Heterogeneity and Trust, II

*ground expectations do (do not) exist, hence trust can (cannot) be relied upon.*

Our first measure of heterogeneity is income inequality, as measured by Gini coefficients (mostly from the early and mid-1980s) from the Deininger & Squire (1996) "high-quality" dataset. A second measure is the Gini coefficient for land inequality, mostly from the early and mid-1980s, calculated from the U.N.'s Food and Agriculture Organization censuses (Jazairy, Alamgir & Panuccio, 1992) . A third measure is the "intensity of economic discrimination," a subjective variable evaluated for 1975 by Ted Gurr and reported in Taylor & Jodice (1983). Countries are rated on a 1-4 scale with higher values indicating more severe discrimination.[29] A fourth measure is "ethnolinguistic fractionalization," also reported in Taylor & Jodice (1983). Values are equal to the probability that any two randomly-selected persons are from different ethnic or linguistic groups.[30]

Each of these four heterogeneity measures is significantly related to trust (Equations 5-8 of Table 2). Trust falls by more than 1 percentage point for each 2-point increase in the Gini coefficient for income inequality (Equation 5).[31] Each 3-point increase in the Gini for land inequality reduces trust by nearly a percentage point (Equation 6). Trust falls by 4.5 percentage points for each 1-point increment in the 4-point discrimination scale (Equation 7).

In the model, trust declines continuously as social distance increases. As our measure of ethnolinguistic heterogeneity increases, the likelihood of two randomly-matched individuals (such as a broker and investor) being from different groups rises, and trust is predicted to fall. However, ethnolinguistic heterogeneity has no significant linear relationship with trust. Horowitz (1985) and others have noted that the salience of group differences is maximized where there is a limited number of sizable groups (as in Fiji, Guyana, or Trinidad, for example). Where there is a proliferation of small groups (as in Tanzania), no one group presents much of a threat to dominate all of the others, and each group has less incentive to organize for political action. In particular, if the small groups are not geographically or occupationally concentrated, it is relatively costly to organize. By this logic, the average effective social distance is actually greatest for middle values of the ethnolinguistic heterogeneity measure. Equation 7 shows that trust is in fact a quadratic function of heterogeneity, with

[29] A companion variable evaluated by Gurr, and more weakly related to trust and to growth, is the percentage of the population subject to discrimination.

[30] Data for this variable are missing for Korea and Taiwan. Values for these countries were computed using data from other sources on their ethnic compositions. None of our results are sensitive to the inclusion of these two observations.

[31] Kawachi, Kennedy, Lochner, & Prothrow-Smith (1997) show that survey measures of interpersonal trust are correlated with income inequality in U.S. states.

predicted values for trust lowest at a value for heterogeneity of about .44.[32]

To maximize the sample size, only one proxy for formal institutions or social distance is included in each regression in Table 2. When two measures are included together, however, both remain significant in most cases. For example, Table 3 pairs the accounting standards measure of formal institutions with each of the four heterogeneity measures (Equations 1-4), and pairs the discrimination measure with each of the four indicators of formal institutions (Equations 4-7). In all seven regressions, the proxies for formal and informal sanctions are both significant and retain their predicted signs. Note that these equations explain two-thirds or more of the cross-country variance in trust, even when neither income nor schooling is significantly related to trust.

Because our proxies for social heterogeneity tap various dimensions of social distance that are largely orthogonal to each other, the heterogeneity variables remain significant in almost every case when two of them are included together (results available on request). This is less true for pairs of our indicators of formal institutions, which are (not surprisingly) more strongly intercorrelated.

The model predicts that the trust-eroding impact of increases in (nominal) social distance are tempered by factors reducing the salience of differences in types. For example, if types are geographically dispersed (e.g., Chinese and Taiwanese in Taiwan) rather than concentrated (e.g., Nigeria's major ethnic groups), or if ethnic, class, and religious cleavages are cross-cutting (e.g., wealth and religion in the U.S.) rather than coinciding (e.g., wealth and ethnicity in Malaysia), individuals of different types are less likely to mobilize for collective action on behalf of their own type against other types. Political and legal institutions may also reduce the salience of nominal differences in type. For example, where courts are well-funded and independent of the other branches of government, and the rule of law prevails, and where there is a professional, reasonably independent civil service, fewer resources will be up for grabs by whichever types succeed in taking over the executive and legislative branches.

These predictions find some support in the data. As a measure of institutions reducing the impact on trust of differences in type, we use the "Rule of Law" variable that is part of the Knack and Keefer (1995) property rights index. Interactions of this variable with income inequality and with economic discrimination are significant and in the expected direction in trust regressions. Conditional on the minimum value of "Rule of Law," the coefficient for income inequality is -2.7, rising to +0.3 for the maximum value of "Rule of Law." The impact on trust of a 1-unit change in the 4-point "economic discrimination" scale varies from -10.23 to -2.53 percentage points, depending on the value of "Rule of Law." Results are very similar when the "Bureaucratic Quality" component of the property rights index is substituted for

[32]Keefer & Knack (1995) report that the stability of property rights, and the ability of nations to avoid debt crises, are related to ethnic heterogeneity across countries in the same nonlinear way.

"Rule of Law."[33]

## 4.4 Formal Institutions, Heterogeneity and Growth

Table 4 includes each of the determinants of trust in growth equations that exclude trust itself as a regressor. To maximize the sample size, only one proxy for formal institutions or population heterogeneity is included in each regression. Each measure is statistically significant, and has the expected sign. Each 10-point increase in the 50-point Knack-Keefer property rights index (Equation 1), or 2-point rise in the 10-point bribery index (Equation 3), or 20-point rise in the investor rights index (Equation 4), is associated with a one percentage point rise in growth.[34] A 10-point rise in the income Gini, or 40-point rise in the land Gini, is associated with a one-percentage point decline in growth.[35]

While ethnolinguistic heterogeneity was related to trust in a nonlinear way, the quadratic specification is not significant in growth equations. Growth declines linearly as heterogeneity increases (Equation 8), a result previously presented in Easterly & Levine (1997). This result is consistent with the model above, rather than with the hypothesis derived from Horowitz' (1985) analysis of ethnic conflict discussed above.

Others have advanced explanations for relationships between growth and polarization or heterogeneity measures that have little or nothing to do with trust. For example, the median-income voter in democracies has more incentive to favor progressive taxation and redistribution in more unequal societies (Persson & Tabellini, 1994). However, there is little empirical support for this argument: countries with more inequality do not exhibit greater levels of fiscal redistribution, and countries with more fiscal redistribution do not grow more slowly (Perotti, 1996). Similarly, models which link inequality and growth via credit constraints and education (for example, Bénabou, 1996a) find little support in the data (Perotti, 1996). Murphy, Shleifer & Vishny (1989) link inequality and growth through increasing returns to scale and the size of the middle class, but offer only the broad U.S. historical experience in support of their thesis. Keefer & Knack (1995) argue that polarization in incomes, ethnicity or other dimensions makes it less likely that a society will arrive at a stable, predictable set of rules governing property rights, thereby slowing growth. In their

[33] Rodrik (1998) makes a somewhat similar distinction, finding evidence that the growth effects of external shocks worsen with proxies for "latent social conflict", particularly in the absence of effective "institutions of conflict management."

[34] Unlike the other independent variables, the bribery index and the investor rights' index are (unavoidably) measured near the end of the growth period.

[35] Because the dependent variable here is income growth over the 1970-92 period, we use Gini measures from around 1970.

| Equation | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Institutional/ Heterogeneity Var. | Property rights ind. | Contract enforce. | Bribery index | Account. standards | Gini inc. inequality | Gini land inequality | Economic discrim. | Ethnic heterogen. |
| Constant | 0.410 | -0.078 | 4.797 | 0.754 | 7.078 | 3.107 | 2.516 | 2.918 |
| | (0.575) | (1.175) | (0.964) | (1.637) | (1.262) | (0.840) | (0.579) | (0.639) |
| GDP per capita | -0.391 | -0.349 | -0.235 | -0.198 | -0.261 | -.0223 | -0.164 | -0.216 |
| 1980 (000s) | (0.087) | (0.103) | (0.094) | (0.131) | (0.103) | (0.093) | (0.084) | (0.078) |
| Schooling | 0.251 | 0.098 | -0.242 | -0.017 | 0.210 | 0.450 | 0.284 | 0.354 |
| 1980 | (0.128) | (0.178) | (0.101) | (0.162) | (0.130) | (0.130) | (0.112) | (0.107) |
| Price, investment | -0.014 | -0.008 | -0.029 | -0.003 | -0.011 | -0.011 | -0.011 | -0.015 |
| goods, 1970 | (0.004) | (0.003) | (0.015) | (0.008) | (0.005) | (0.003) | (0.003) | (0.005) |
| Institutional/ | 0.098 | 1.626 | 0.472 | 0.051 | -0.095 | -0.025 | -0.379 | -1.647 |
| Heterogeneity Var. | (0.024) | (0.836) | (0.098) | (0.025) | (0.026) | (0.011) | (0.157) | (0.654) |
| Adj. $R^2$ | .38 | .23 | .39 | .13 | .29 | .25 | .19 | .27 |
| SEE | 1.72 | 1.70 | 1.37 | 1.68 | 1.73 | 1.82 | 1.78 | 1.85 |
| N | 99 | 53 | 42 | 42 | 57 | 92 | 76 | 103 |
| Mean, D.V. | 1.31 | 1.93 | 2.48 | 2.30 | 1.96 | 1.35 | 1.68 | 1.43 |

The dependent variable is growth. White-corrected standard errors are in parentheses.

Table 4: Formal Institutions, Heterogeneity and Growth 1970-1992

| Equation | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Constant | 1.322 | 1.873 | 2.558 | 3.678 | 4.560 | 4.368 |
| | (1.395) | (1.369) | (1.178) | (1.590) | (1.048) | (0.996) |
| GDP per capita | -0.314 | -0.264 | -0.182 | -0.134 | -0.169 | -0.150 |
| 1970 (000s) | (0.135) | (0.121) | (0.156) | (0.127) | (0.128) | (0.114) |
| Schooling | 0.054 | -0.095 | -0.045 | -0.118 | -0.045 | -0.136 |
| 1970 | (1.202) | (0.107) | (0.196) | (0.168) | (0.144) | (0.135) |
| Price of investment | -0.025 | -0.031 | -0.048 | -0.052 | -0.035 | -0.037 |
| goods, 1970 | (0.012) | (0.013) | (0.016) | (0.015) | (0.015) | (0.016) |
| Property rights | 0.112 | 0.085 | | | | |
| index | (0.032) | (0.031) | | | | |
| Contract | | | 1.745 | 0.721 | | |
| enforcability | | | (0.723) | (0.652) | | |
| Bribery | | | | | 0.297 | 0.181 |
| index | | | | | (0.094) | (0.142) |
| Trust | | 0.044 | | 0.063 | | 0.042 |
| | | (0.019) | | (0.023) | | (0.022) |
| Adj. $R^2$ | .41 | .48 | .26 | .40 | .26 | .31 |
| SEE | 1.25 | 1.18 | 1.45 | 1.31 | 1.34 | 1.29 |
| N | 37 | 37 | 32 | 32 | 33 | 33 |
| Mean, D.V. | 1.96 | 1.96 | 2.00 | 2.00 | 2.16 | 2.16 |

The dependent variable is growth. White-corrected standard errors are in parentheses.

Table 5: Trust, Formal Institutions and Growth (1970-1992)

| Equation | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Constant | 7.753 | 5.842 | 7.071 | 5.701 | 5.016 | 4.499 |
| | (2.042) | (1.880) | (1.429) | (1.200) | (1.030) | (0.904) |
| GDP per capita | -0.218 | -0.191 | -0.022 | -0.050 | -0.044 | -0.082 |
| 1970 (000s) | (0.152) | (0.143) | (0.110) | (0.097) | (0.114) | (0.104) |
| Schooling | 0.048 | -0.062 | 0.062 | -0.086 | 0.137 | -0.061 |
| 1970 | (0.151) | (0.154) | (0.139) | (0.148) | (0.149) | (0.146) |
| Price of investment | -0.014 | -0.022 | -0.040 | -0.044 | -0.040 | -0.044 |
| goods, 1970 | (0.012) | (0.013) | (0.010) | (0.010) | (0.010) | (0.010) |
| Gini income | -0.090 | -0.049 | | | | |
| inequality | (0.035) | (0.030) | | | | |
| Gini land | | | -0.035 | -0.018 | | |
| inequality | | | (0.013) | (0.012) | | |
| Economic | | | | | -0.364 | -0.122 |
| Discrimination | | | | | (0.145) | (0.141) |
| Trust | | 0.042 | | 0.049 | | 0.058 |
| | | (0.020) | | (0.022) | | (0.022) |
| Adj. $R^2$ | .28 | .31 | .33 | .40 | .27 | .38 |
| SEE | 1.36 | 1.33 | 1.35 | 1.28 | 1.43 | 1.32 |
| N | 29 | 29 | 36 | 36 | 35 | 35 |
| Mean, D.V. | 2.21 | 2.21 | 1.93 | 1.93 | 1.92 | 1.92 |

The dependent variable is growth. White-corrected standard errors are in parentheses.

Table 6: Trust, Informal Institutions and Growth (1970-1992)

model, unlike ours, polarization influences investor confidence indirectly, through political mechanisms. Keefer & Knack (1995) provide empirical evidence that income and land inequality impair growth in part by making property rights less secure, as measured by the property rights index from ICRG used here, but they also find that inequality has a significant association with growth independent of this effect.

The connection between inequality and growth thus remains largely an open question. The theory expatiated here suggests that more unequal societies grow more slowly, in part, because inequality increases the social distance between transactors, eroding trust. Ethnic conflict, like inequality, undoubtedly impairs growth through channels that are unrelated to trust between private economic agents. More ethnically-polarized societies may have more political violence, rent-seeking (Lane & Tornell, 1996, Easterly & Levine, 1997), policy instability (Keefer & Knack, 1995), and difficulty in providing productive public goods (Alesina, Baqir & Easterly, 1996). The association of ethnic and linguistic heterogeneity with slower growth is also consistent with the model presented here, however.

Tables 5 and 6 present preliminary tests of the channels through which our proxies for formal institutions and social distance influence growth. For the sample of countries with data on trust, we report results for pairs of growth regressions. The first equation of each pair includes a proxy for formal institutions or social distance but omits trust. The second equation in each pair adds the trust variable, to determine whether formal institutions or social heterogeneity remain significantly correlated with growth controlling for trust.

Most of our proxies (all but the investor rights index) for formal institutions and social heterogeneity are significantly associated with growth even in these smaller samples that exclude countries for which trust data are missing. While the inclusion of trust reduces the coefficient of the property rights index by about one-fourth, that index remains significantly related to growth (Table 5, Equations 1 and 2). In the case of contract enforceability (Equations 3 and 4), the bribery index (Equations 5 and 6), income inequality (Table 6, Equations 1 and 2), land inequality (Table 6, Equations 3 and 4), or economic discrimination (Equations 5 and 6), the inclusion of trust drastically reduces the coefficient of the relevant proxy for formal institutions or social distance, and none remain significant at conventional levels.[36] Not included in Tables 5 or Table 6 is the ethnolinguistic heterogeneity index: its coefficient in the 37-nation trust sample drops from -2.22 to -1.86, but remains significant when trust is added to the growth regression. Trust itself is positively and significantly related to growth in every case when it is included in growth regressions with a measure

[36]Of our measures of formal institutions, only the property rights index is defined explicitly to include government actions against private agents, namely expropriation of property or repudiation of contracts by government. It is therefore not surprising that this index remains significantly related to growth, when trust between private agents is controlled for.

of formal institutions or of social distance. Results in Tables 5 and 6 are strongly supportive of the hypothesis that formal institutions and social homogeneity increase growth in part by building trust among a nation's residents.

# 5 Conclusion and Extensions

The model in this paper describes a principal-agent structure with investors as principals and brokers as agents, where the principals are subject to moral hazard by the agents. Investors and brokers are randomly matched and therefore play a one-shot game where cheating by the broker is possible. We show that cheating is more likely (and trust is therefore lower) when the social distance between agents is larger, formal institutions are weaker, social sanctions against cheating are ineffective, the amount invested is higher, and the investors' wages are lower. Most importantly, the model shows that the amount invested decreases as social heterogeneity increases, adversely impacting income growth. These implications have strong support in our cross-country empirical work. Trust, and the social and institutional factors that affect it, significantly influence growth rates. Thus, this research provides a new insight into the way that institutional factors affect economic performance.

The model in this paper generalizes to other principal-agent relationships, for example, creditors and debtors, employers and employees, clients and consultants, insurers and insurees, and retailers and consumers. Further, our conceptual definition of trust, and our empirical measures, encompass prisoners' dilemmas as well as principal-agent incentive structures.

Several extensions of the model here would be interesting to undertake. First, the random matching of transacting agents could be relaxed by allowing the probability of a match between two agents to vary inversely with the social distance between the two, as in Akerlof (1997). In this case, segregation increases and time devoted to investigating brokers falls. A second extension along this line is to permit agents to choose whether or not to trade with another using a matching technology as in Burdett & Coles (1997). Again, this would lead to economic segregation. With sufficiently extreme segregation, time spent investigating approaches zero, and trust–the proportion of time spent working–approaches one. There are potentially enormous costs associated with extreme segregation, however, as gains from specialization may be severely limited, particularly where there are a large number of agent groups, or where a scarce resource is concentrated within one agent group (e.g., Lebanese entrepreneurs in Africa, or Jewish bankers in medieval Europe). As discussed in the text, endogenizing the feedback between formal and informal institutions and changes in trust would help us understand these issues.

In our model, trust always promotes social efficiency. Yet, some forms of trust can be put to socially inefficient uses as well, for example in executing cartel agreements, lobbying for protection from competition, engaging in criminal conspiracies, persecuting minorities, or organizing political violence. These issues merit further investigation in elaborations of the model presented here. However, there is a strong reason to believe that, on balance, more trust will improve welfare; with no trust whatsoever, the only observed transactions between private agents would be spot transactions.

We also do not explore in this paper the indirect economic effects of trust and social cohesion, i.e. those that influence economic policies through political mechanisms. Divided societies may adopt inefficient and unstable economic policies (Easterly & Levine, 1997; Keefer & Knack, 1995), or may be slow to formulate a response to adverse shocks (Alesina & Drazen, 1991; Rodrik, 1998) or may find it difficult to agree on the appropriate quantity and quality of public goods (Alesina, Baqir & Easterly, 1996). Finally, our model addresses trust between private transactors, not between a private transactor and the government. Trust in government should also be associated with better economic performance. Whether or not governments can credibly commit not to expropriate investments, either directly, or through surprise inflation or other policy reversals, is likely to be influenced by many of the same factors as trust between private agents.

Taking into account the value of leisure, and of transactions facilitated by trust that do not enter the national accounts, the model also predicts that trust should be positively related to subjective measures of well-being across countries or other economic units. J. S. Mill (1848, p. 131) argued: "The advantage to mankind of being able to trust one another, penetrates into every crevice and cranny of human life: the economical is perhaps the smallest part of it, yet even this is incalculable." We thus would expect that more inclusive measures of well-being will be associated with trust in the same way that, as we have shown here, investment and growth improve with trust.

# 6 Appendix: Proofs

Proof. [Theorem 1] Implicit differentiation of the optimality condition, produces

$$\frac{\partial e^{i\star}}{\partial a^i} = \frac{-\eta_1}{a^i \eta_{11}},$$

$$\frac{\partial e^{i\star}}{\partial w^i} = \frac{1}{R a^i \eta_{11}},$$

$$\frac{\partial e^{i\star}}{\partial p} = \frac{-\eta_{12}}{\eta_{11}},$$

$$\frac{\partial e^{i\star}}{\partial \theta} = \frac{\eta_{13}}{\theta^2 \eta_{11}},$$
$$\frac{\partial e^{i\star}}{d(i,j)} = \frac{-\eta_{13}}{\theta \eta_{11}},$$

where $\eta_m$ denotes the partial derivative of $\eta^{ij}(e^i, p, D(i,j;\theta))$ with respect to the m$^{th}$ argument, and similarly, $\eta_{mm}$ is the cross-partial of the m$^{th}$ and n$^{th}$ arguments. The application of the restrictions in the theorem proves the results. ∎

PROOF. [Theorem 2] The restriction in this theorem guarantees that $e^{i\star}$ is convex in $w^i$ $\forall i$ (it is decreasing by the maintained assumptions on $\eta^{ij}(e^i, p, D(i,j;\theta))$. For agents $m$ and $n$ that satisfy the restrictions in the theorem, let the wage distribution for agent $m$ fall and the wage distribution for agent $n$ increase by an equivalent amount, say $\zeta$, where $0 < \zeta < \epsilon^m$. Then, the wages of both types of agents are $w^m = w(\epsilon^m - \zeta)$ and $w^n = w(\epsilon^n + \zeta)$. Denote the change in $e^{i\star}$, $i = m, n$, from the base case ($\zeta = 0$) to the wage discrimination case ($\zeta > 0$) by $\Delta e^{i\star}$. Then, by the convexity of $e^{i\star}(w^i)$, the change in the aggregate time spent investigating one's broker is $\Delta e^{m\star}\mu^m + \Delta e^{n\star}\mu^n > 0$. Therefore, trust falls with wage discrimination. ∎

PROOF. [Theorem 3] We will prove this theorem for a simple mean preserving spread (MPS) which guarantees that the spread distribution has a higher variance than the base distribution (Rothschild & Stiglitz, 1971). As in Theorem 2, the third derivative restriction on $\eta^{ij}$ results in a $e^{i\star}$ that is convex in $w^i$. A MPS changes the optimal investigation time spent by individual $i$ in two ways. Let the change in optimal investment time for $i$ be given by $\Delta e^i$. Then,

$$\Delta e^i = \frac{\partial e^{i\star}}{\partial w^i} + \frac{\partial e^{i\star}}{\partial d(i,j)}.$$

The first effect is an income effect (income has been transferred among agents), while the second is a substitution effect (other agents are increasingly dissimilar and thus cheating rises). Using the proof of Theorem 1 and rearranging, $\Delta e^i$ can be written

$$\Delta e^i = \frac{\theta - \eta_{13} R a^i}{\theta \eta_{11} R a^i}.$$

For all agents of type $i$, the change in $e^i$ is

$$\Delta E^i \equiv \Delta e^i \mu^i = \mu^i \frac{\theta - \eta_{13} R a^i}{\theta \eta_{11} R a^i}.$$

Similarly, the aggregate change in time allocated to investigation, $\Delta E$ is

$$\Delta E \equiv \Sigma_{i=1}^N \Delta E^i = \Sigma_{i=1}^N \mu^i \frac{\theta - \eta_{13} R a^i}{\theta \eta_{11} R a^i}.$$

The convexity of $e^{i\star}(w^i)$ and $\frac{\partial^2 \eta^{ij}}{\partial e^i \partial D(i,j;\theta)} Ra^i > \theta$, ensure that $\Delta E^i > 0 \; \forall i$, so that $\Delta E > 0$. Therefore, the change in trust, $\Delta H = -\Delta E < 0$. ∎

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