TRUST AND GROWTH*

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Why does trust vary so substantially across countries? This paper presents a general equilibrium growth model in which heterogeneous agents transact and face a moral hazard problem. Agents 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 characterise the social, economic and institutional environments in which trust will be high, and show that low trust environments reduce the rate of investment. The predictions of the model are examined empirically for a cross-section of countries and have substantial support in the data.

> 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...
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> Thomas Hobbes, *Leviathan*, 1651

> Doveryai, no proveryai (Trust, but verify)
>
> Russian Proverb

Adam Smith (1997 [1766]) observed notable differences across nations in the 'probity' and 'punctuality' 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 survive 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. Nevertheless, evidence from experiments reveals a surprising amount of trusting behaviour. In several sets of experiments, one-half of the first-move players in anonymous sequential prisoner's dilemma games chose to trust their partners, while three-quarters of second-movers declined to violate this trust, cooperating rather than defecting to the Nash equilibrium (Berg *et al*. 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 that they trust their brokers, given their own and their broker's characteristics. In this way we are able to characterise 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 investment 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 taken 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 (ie less time is spent investigating one's broker), high trust societies produce more output than low trust societies. *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 for the model in this paper. 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 of a poverty trap depend critically on the level of social heterogeneity in a society.

The model offers an explanation for the empirical findings of Easterly (2000), Easterly and Levine (1997), and Knack and Keefer (1997) that is grounded in transactions costs rather than on inefficient and unstable government policies. Easterly and Levine (1997) find that ethnic heterogeneity slows

growth, and report simple correlations between heterogeneity and various policy measures that have been linked to growth. Easterly (1999) extends these results to another source of polarisation, income inequality. We find in standard Barro-type growth regressions that growth's relationship with these polarisation variables weakens considerably when we control for levels of interpersonal trust, a finding that is consistent with a transactions cost-based explanation for the heterogeneity–growth link.

Knack and Keefer (1997) find that higher trust is conducive to growth for a sample of 29 market economies, but are largely agnostic on the policy or transactions-cost channels through which trust affects growth. The present paper provides a formal model based on transactions costs which identifies the particular channels through which the institutional environment impacts investment decisions. Empirical tests of the predictions of the theory use a sample nearly half again as large as that used by Knack and Keefer (1997), including many additional less-developed nations, and clearly support the theory's predictions that institutions affect growth via their impact on trust. Further, our empirics demonstrate that trust's relationship with growth is far more robust to changes in the specification or time period than in Knack and Keefer (1997), and is much less sensitive to outlying observations. The theory and robust empirical tests taken together engender confidence in our results linking institutions and heterogeneity to economic growth through trust.

This paper is structured as follows. The model and its implications are derived in Section 1. In Section 2, we subject the model to a battery of empirical tests and demonstrate robust support for all the model's predictions: trust is higher in more ethnically, socially, and economically homogeneous societies, and where legal and social mechanisms for constraining opportunism are better developed, with high-trust societies exhibiting higher rates of investment and growth. Section 3 concludes with suggestions for extensions to the model.

1. Theory

Consider an economy with a continuum of infinitely-lived consumers. Agents vary in a potentially large number of ways, including their income, 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. Though an agent's type may evolve over time, it is fixed at any point in time. Consumers in this economy have standard preferences and seek to smooth consumption by saving each period, but to access credit markets they must utilise an investment broker. There is a continuum of investment brokers who are distinct from consumers but are identified by the same attributes. 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. Consumers, knowing this, may choose to

spend 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 match 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 regarding 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.[2] One of the innovations of the theory is that there are degrees of trust, rather than having agents choose to trust their transaction partner completely or not at all as in trust games in the laboratory.

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 Commision, that oversee brokers, as well as the judicial system that enforces contracts and prosecutes cheaters.[3] In the model, punishments take the form of the partial loss of the broker's fee.

Second, in addition to formal institutions, cheating brokers may face sanctions due to 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 of justice' (p. 135–6). Mill was highly critical of the English legal system, believing 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 informal sanctions depend on, or are facilitated by, social ties. Moral and religious norms depend on prior socialisation processes; reputa-

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[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 will 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 and Katz (1991), Mukherji and Nagarajan (1995), and Phelan (1995).

[2] Multiperiod relationships between consumers and brokers will strengthen the results here as individual (rather than group) reputations will matter. The impact on growth of private information and reputational effects is examined by Khan and Ravikumar (1998) and Marcet and Marimon (1992). On long-lasting contractual relationships, see Townsend (1982), Atkeson (1991) and Atkeson and Lucas (1995).

[3] Other formal mechanisms serving to constrain opportunism in financial markets include regulation (such as financial disclosure requirements), and private organisations 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 (see Klein, 1997, and Zucker, 1986).

tional loss depends on dissemination of information regarding who cheats, which can occur through formal institutions such as credit bureaus, but which more often occurs through informal means such as gossip – especially where formal mechanisms are lacking. Transactions occur within a social structure, and this structure determines the rewards for cooperation or penalties for deviation (Becker 1974; Greif, 1989, 1994; Kandori, 1992). Granovetter (1985) calls 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 and Leary 1995).[4]

In the model, when 'similar' consumers and brokers transact, these agents are more closely related socially than are 'dissimilar' agents. Brokers cheat those similar to them less because of an innate desire 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 behaviour among family members (and, with in-breeding, neighbours) that maximises the survival of one's genes, including those shared among relatives.[5] Transactions among dissimilar agents involve weaker genetic and social ties so that cheating is more likely, matching the experimental results found by Glaeser *et al.* (2000). Both an agent's social environment and genetic makeup are part of the informal behavioural 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 behaviour, but variations in trust across societies must be attributable to differences in the social, economic, and legal environments.[6]

1.1. *The Model*

Formalising the discussion above, let $d(i, j): \mathbb{R}^+ \times \mathbb{R}^+ \to \mathbb{R}^+$ be the *distance* between investor i and broker j. The social and genetic forces described in Section 1 are weaker as the dissimilarity, or distance, between agents increases. Equivalently, when $d(i, j)$ is small, baseline cheating will be low.

The effects of a given distance between agents on trust vary with social factors influencing the abilities and incentives for opposing groups to mobilise

[4] A case can be made for a genetic basis for honest behaviour. 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. McCabe *et al.* (1997) attribute cooperative behaviour to genetic coding in which cheating on one-shot social exchanges will be punished and cooperation rewarded since life itself is a repeated game. Cosmides and Tooby (1992) report evidence for a brain function that detects cheating which, presumably, provides a survival advantage to those living in social groups.

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

[6] 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 undergraduates in a laboratory.

for collective action.[7] Informal sanctions are modelled by defining the *effective distance*, $D(i, j; \theta)$ UIV $d(i, j)/\theta$, where $\theta \geqslant 1$. A higher value of θ indicates that social institutions reduce the salience of differences across types. When social restraints are sufficiently strong, the effective distance between an investor and broker of different types is small 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 normalised to unity. Formal institutions, denoted p, seek to detect and punish cheating brokers and are funded by a lump-sum tax, τ, paid by consumers. Agents have access to an *investment investigation technology*, $\eta[e^i, p, D(i, j; \theta)]:[0, 1] \times \mathbb{R}^{2+} \to [0, 1]$ which permits agents to determine the fealty of brokers in reporting investment income, with, from the discussion above, $\partial\eta/\partial e^i > 0$, $\partial\eta/\partial p > 0$, $\partial\eta/\partial d(i, j) < 0$, and $\partial\eta/\partial\theta > 0$. That is, 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 broker, e^i, will be called *diligence*. We will further suppose that the increase in one's return from investigation displays diminishing marginal returns to diligence, $\partial^2\eta/\partial(e^i)^2 < 0$.

The timing of decisions is as follows. A consumer observes his or her current wage and expected investment income, with the type of investment advisor last period being revealed, and chooses an allocation of time between working in production and investigating last period's 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 labour 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 savings.[8] 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 maximises lifetime utility by solving

$$\text{Max}_{c^i, e^i} \mathrm{E} \sum_{t=0}^{\infty} \beta^t U(c_t^i) \qquad (1)$$

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[7] For example, spatial concentration of ethnic groups may facilitate their organisation.

[8] If one could distribute savings among brokers, then some diversification of risk would be possible. In addition, markets are incomplete as contingent contracts that would allow consumers to insure against broker cheating are unavailable. The model is designed in this way so that the effect of trust in one-to-one transactions is as transparent as possible. Diversification among brokers and partial insurance would reduce the effect of broker cheating in the model, but the qualitative results of the model remain unchanged.

s.t

$$c_t^i = w_t^i h_t^i + R_t a_t^i \eta^{ij}[e_t^i, \ p_t, \ D_t(i, \ j; \ \theta)] - a_{t+1}^i - \tau \tag{2}$$

$$1 = e_t^i + h_t^i \tag{3}$$

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, $w_t^i h_t^i$ is labour income, $R_t a_t^i \eta_t^{ij}$ is investment income, R_t is the gross yield on investment from $t-1$ to t, and a_{t+1}^i is assets invested in period t that payoff in $t+1$.

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 as their wage w^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[9]

$$c_t^{Ij} = w_t^{Ij} = \{1 - \eta^{ij}[e_t^i, \ p_t, \ D_t(i, \ j; \ \theta)]\} R_t a_t^i. \tag{4}$$

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

$$U'(c_t^i) = \beta \, \mathrm{E}[\, U'(c_{t+1}^i) R_{t+1} \eta_{t+1}^{i\hat{j}}\,], \tag{5}$$

$$w_t^i = \frac{\partial \eta_t^{ij}}{\partial e_t^i} R_t a_t^i. \tag{6}$$

The first equation (5) is a standard consumption-savings Euler equation with the expected net yield on savings being $\mathrm{E}(R_{t+1} \eta_{t+1}^{i\hat{j}})$, for $j \neq \hat{j}$. The second condition, (6), balances the marginal income earned by working with the extra income one can generate by investigating one's broker. Call the solutions to (5) and (6), a_{t+1}^{i*} and e_t^{i*}, respectively.

Firms take funds collected by investment brokers and use the proceeds for production. In addition, firms hire labour to work in production. The representative firm, which we take to be the entire economy, operating in a perfectly competitive environment, maximises profits by solving

$$\mathrm{Max}_{K, H} F(K_t, \ H_t) - r_t K_t - w_t H_t, \tag{7}$$

where $F(\cdot, \ \cdot)$ is a neoclassical production function satisfying the Inada conditions, K is aggregate capital, and $H_t \, UIV \int_0^\infty h_t^i \, d\mu$ is aggregate labour hours with μ an appropriately defined probability measure over consumers. The

[9] 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 labour to firms and also 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.

solution to (7) produces the standard inverse demand functions for capital and labour,

$$r_t = F_1(K_t, H_t) \tag{8}$$

$$w_t = F_2(K_t, H_t). \tag{9}$$

Equation (9) 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 $\int_0^\infty w_t^i \, d\mu = w_t$ (more will be said about this in the next Section). The gross yield on savings is $R_{t+1} = r_{t+1} + 1 - \delta$, where r_{t+1} is the interest rate from t to $t+1$ and $\delta \in [0, 1]$ is the depreciation rate on capital.

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 the problem defined by (1), (2) and (3) is a set of prices $\{w_t^i, R_{t+1}\}_{t=0}^\infty \forall i \in \mathbb{R}^+$ given an initial distribution of asset holdings $\tilde{a}_0$, where $\int_0^\infty a_t^i \, d\mu = K_0 > 0$, a law of motion for the distribution of assets, $\tilde{a}_{t+1} = \Gamma(\tilde{a}_t)$, a wage distribution relation $G(i)$ satisfying $\int_0^\infty G(i) \, d\mu = 1$, and an investment investigation technology, $\eta^{ij}[e_i, p, D(i, j; \theta)]$ such that, taking prices as given, consumers maximise utility using (5) and (6), firms maximise profits solving (7). In addition, w_t^i clears the labour market $\forall t, \forall i$, and the capital market clears at time t at price $E\{R_{t+1}\eta^{ij}[e_{t+1}^{i*}, p_{t+1}, D_{t+1}(i, j; \theta)]\}$ where capital market clearing is

$$K_{t+1} = \int_0^\infty a_{t+1}^{i*} \, d\mu \tag{10}$$

and $D_{t+1}(i, j; \theta)$ is the saver-broker match made at time t when type j is unknown and terminates at time $t+1$. Finally, the consumption of investment brokers is given by (4).

Equation (10) depicts the dynamic evolution of this economy: agents' investment decisions provide the capital that firms use to produce in the following period, where investment depends on the social and institutional milieux. The competitive equilibrium in this model is not Pareto optimal since agents do not receive the full return on savings which would obtain if there were perfect trust (i.e. if $\eta^{ij} = 1 \ \forall i, j$). Formal institutions serve to reduce losses due to untrustworthiness, but the funding of institutions, p, constitutes a deadweight loss to a society. As a result, the equilibrium allocation is second-best efficient.

1.2. Optimal Diligence

After putting some structure on the investment investigation technology η, we characterise the effect on diligence as the social, institutional, and economic environments change.[10]

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[10] Proofs are contained in the Appendix.

PROPOSITION 1. *If the return to investigation due to changes in diligence when formal institutions and effective distance vary satisfies $\partial^2 \eta^{ij}/(\partial e^i \partial p) < 0$, and $\partial^2 \eta^{ij}/[\partial e^i \partial D(i, j; \theta)] < 0$, then the following hold for the optimal time spent in diligence, e_t^{i*},*

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

The proposition 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 income to investigate their brokers 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 (2000) and Grossman and 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 others' actions. That is, trust is

$$H_t = 1 - \int_0^\infty e_t^{i*} \, d\mu.$$

In other words, trust is the time agents spend in production rather than investigating their brokers. This is, of course, not the only definition one can give for trust, but it is a natural one given the structure of the model.[11] Note that this is an economy-wide measure of trust, not an agent-specific one. This was done because the analysis that follows characterises the circumstances that cause *societies* to have more or less trust, and the empirical tests of the model follow this tack.

1.3. *Income Distribution and Trust*

Consider a partition that divides the population into $N > 1$ distinct 'classes'. Define the N-vector ϵ to be $\{\epsilon^1, \epsilon^2, \ldots, \epsilon^N\}$, with $\sum_{n=1}^N \epsilon^n \mu^n = 1$, where μ^n is the mass of agents of type n. Let us order agent classes by their wages,

[11] Trust increases whenever investors' confidence that brokers will not cheat them increases, whether that confidence is derived from formal or informal institutions or other sources. Some authors define trust more narrowly to exlude any effects of legal mechanisms or formal institutions (e.g., Williamson, 1993; Charny, 1990). Our definition of trust is similar to what Yamagishi and Yamagishi (1994) refer to as 'assurance', an expectation of benign behaviour derived from knowledge of the incentive structure facing one's trading partner (p. 132).

$\epsilon^1 < \epsilon^2 < \ldots < \epsilon^N$. This allocation rule and the solution to the firm's problem (7) can be used to determine the wage structure in this society, $w_t^i = w_t \epsilon^n$ for $n = 1, \ldots, N$. 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 proposition shows that discrimination reduces trust.

PROPOSITION 2. *Suppose that $\partial^3 \eta^{ij}/\partial(e^i)^3 < 0$ and consider the wage distribution parameters ϵ^m and ϵ^n, with $\epsilon^m < \epsilon^n$. Let the mass of agents satisfy $\mu^m \geqslant \mu^n$. 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.*

The restriction in the proposition on the third derivative of η^{ij} guarantees that low wage agents are more sensitive to a change in wages than are high wage agents (viz. that e^{i*} is decreasing and concave in w^i), which appears a reasonable assumption. The proposition obtains because a decrease in wages by poor agents 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. The implication of this proposition is that when agents live in a society that is 'unfair' in that agents earn less than their marginal products, trust is reduced.

The next result demonstrates that the relationship between inequality and trust is more general than that given in Proposition 2.

PROPOSITION 3. *Suppose that η^{ij} satisfies $\partial^3 \eta^{ij}/\partial(e^i)^3 < 0$. Then, a mean preserving spread of the distribution of wages reduces trust.*

Proposition 3 reveals that a society with high wage inequality, from any source, will have lower trust than in an otherwise identical but more egalitarian society. This follows directly from the supposition that low wage agents are more sensitive to a change in income when choosing optimal diligence than are high wage agents.

1.4. *Optimal Investment*

In this Section we examine the impact of trust and the distribution of agents on investment. 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 (5) for investment a_{t+1}^{i*} can be written as

$$U'(c_t^i) = \beta R_{t+1}\{E[U'(c_{t+1}^i)]E(\eta_{t+1}^{ij}) + \text{Cov}[U'(c_{t+1}^i), \eta_{t+1}^{ij}]\} \qquad (11)$$

where $\text{Cov}(x, y)$ is the covariance of x and y.

Under the assumption that η_{t+1}^{ij} and c_{t+1}^i are distributed bivariate normal, (11) is equivalent to

$$U'(c_t^i) = \beta R_{t+1}\{E[U'(c_{t+1}^i)]E(\eta_{t+1}^{ij}) + E[U''(c_{t+1}^i)]\text{Var}(\eta_{t+1}^{ij})\}, \qquad (12)$$

by applying Stein's lemma, where Var$\{x\}$ is the variance of x.[12] Equation (12) shows that optimal investment depends on both the expectation of brokers cheating, as well as the variance of cheating by brokers. 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.

PROPOSITION 4. *Suppose the condition in Proposition 3 holds. Then, an agent's optimal investment choice, a_{t+1}^{i*} is decreasing in the variance of the distribution of agents.*

This result is standard in finance when the agent chooses an optimal 'port-folio' between risk-free current consumption and risky investment.[13] The import of Propositions 3 and 4 is that heterogeneous societies have lower trust and therefore lower investment than do homogeneous societies. This occurs via two mechanisms: in low trust societies, incomes are lower since more time is spent in diligence (Propositions 1 and 3), and investment is lower since agents are risk averse (Proposition 4). As long as savings is not too sensitive to changes in the net interest factor $\eta^{ij}R$, a decrease in investment lowers capital formation through the law of motion for the capital stock (10), reducing output growth in the transitional dynamics.[14] Hence, growth is generally lower in heterogeneous low trust 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 (a 'Northian poverty trap') since both of these reduce investment returns by raising cheating.

Several additional implications for optimal investment behaviour can be drawn from condition (11). First, strengthening formal institutions may raise investment if this policy is not too costly (i.e. if τ is not too high). In terms of investment, there is an optimal level of funding for formal institutions if η^{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 to investment by reducing cheating. Second, similar to the argument given above, wage discrimination reduces investment as aggregate diligence increases (under the restrictions in Proposition 2) and incomes fall.

Combining the results in the previous subsections, we have shown that heterogeneous societies, especially those with weak formal and informal institutions, have lower trust and retarded income growth than less hetero-

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[12] Stein's lemma states that if random variables x and y are bivariate normally distributed, then $\text{Cov}[g(x), y] = \text{E}[g'(x)]\text{Cov}(x, y)$, providing that the function $g(\cdot)$ is differentiable and some regularity conditions are met. If η^{ij} and c^i are not bivariate normally distributed, then (12) approximates (11) by a central limit theorem.

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

[14] Blinder and Deaton (1985) find robust support showing that savings is insensitive to the interest rate; see also Deaton (1992, pp. 59–75).

geneous, higher trust societies. Thus, we have demonstrated that inequality reduces growth through a novel mechanism – variations in trust.[15]

2. Empirics

Propositions 1, 2, 3, and 4 produce the five primary predictions of the model:

   (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 lowers trust, reducing investment and growth;

  (v) There is a low-trust poverty trap.

2.1. *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 (WVS), conducted in several dozen countries in three 'waves', 1981, 1990–1, and 1995–6 (Inglehart *et al.*, 2000). The measure of trust we use is the percentage of respondents in each country agreeing that 'most people can be trusted' against the alternative that 'you can't be too careful in dealing with people'. Values range from a low of 5.5% in Peru to a high of 61.2% in Norway. Surveys typically include between 900 and 2,800 respondents, designed to be a nationally representative sample. Knack and 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. Values are highest for the Scandinavian countries.

   Trust data are available for 41 market economies. Most of these countries were included in at least two survey waves; we use the earliest observation when trust is an independent variable, and the latest observation when trust is the dependent variable. Of these 41 countries, only 29 were included in the empirical analysis of Knack and Keefer (1997). Values for 9 additional developing countries were obtained from the 1995–6 survey wave, providing us with a much more representative sample than the OECD-heavy sample analysed by

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Knack and Keefer. Two more observations (Greece and Luxembourg) are taken from Eurobarometer surveys conducted in the 1980s, and another is from a government-sponsored survey in New Zealand patterned after the World Values Survey (Gold and Webster, 1990).[16]

In the model, trust is produced by formal institutions as well as by social homogeneity and informal sanctions against cheating. Several authors (e.g. Yamagishi and Yamagishi, 1994) distinguish between two types of trust, one based on 'deterrence' and another based on 'benevolence'. The former type roughly corresponds to trust produced by formal institutions as well as informal sanctions such as ostracism, while the latter type can be identified loosely with social homogeneity. The very general phrasing of the WVS survey question on trust suggests that it is a reasonable proxy for our concept of trust, which encompasses both deterrence-based and benevolence-based trust. Most importantly, the question does not contain qualifications implying any exclusion of trust derived from the presence of effective legal sanctions. We cannot rule out the possibility that some respondents may interpret the question to apply only to interpersonal transactions beyond the reach of the law; to the extent that this happens, our empirical tests will underestimate the relationship between formal institutions and our definition of trust.

2.2. *Trust, Investment and Growth*

In Table 1, our trust variable is included in 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 and Heston (1991) data, version 5.6. Other than trust, regressors include 1970 per capita income, schooling attainment for 1970 (mean years for the population aged 25 and over) from Barro and Lee (1993), and the price of investment goods for 1970, as a percentage of United States prices (from Summers and Heston, 1991). Table A1 in the Appendix presents means, standard deviations, and sample sizes for the variables used in the analysis. Correlations among the independent variables are shown in Table A2 in the Appendix.

Equation 1 shows that investment is higher where incomes are higher, where investment goods prices are relatively low, and where trust is higher. The investment/GDP share rises by nearly one percentage point for each seven-percentage point increase in trust. Equation 2 demonstrates the positive relationship between trust and growth. In our 41-nation sample, convergence and (especially) the effects of schooling are weaker than in larger samples. Higher investment goods prices, relative to US levels, are significantly and negatively associated with growth, as expected. Controlling for these influences, growth rises by nearly 1 percentage point on average for each 15-

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[16] Although the trust question asked in these surveys is identical to that in the World Values Surveys, we cannot rule out the possibility that other differences in survey content and administration may affect the trust values for these three countries. However, the results reported below are not sensitive to the inclusion of these three non-WVS observations.

Table 1
Trust, Investment and Growth

Equation	1	2	3	4	5	6	7	8
Dependent variable	Inv/GDP 1970–92	Growth 1970–92	Growth 1970–92	Trust	Inv/GDP 1970–92	Growth 1970–92	Inv/GDP 1970–92	Growth 1970–92
Method	OLS	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS
Constant	21.549	3.998	1.073	33.769	21.503	4.020	15.599	2.320
	(2.680)	(0.782)	(0.719)	(5.940)	(3.340)	(0.898)	(3.649)	(0.948)
GDP per capita	0.817	−0.085	−0.196	1.627	0.814	−0.084	1.990	0.245
(000s)	(0.240)	(0.099)	(0.098)	(0.590)	(0.361)	(0.097)	(0.347)	(0.099)
Schooling	0.376	−0.039	−0.091	0.486	0.356	−0.029	0.544	0.008
Attainment	(0.486)	(0.123)	(0.092)	(1.017)	(0.576)	(0.155)	(0.453)	(0.110)
Price of investment goods	−0.136	−0.043	−0.024	−0.019	−0.136	−0.043	−0.136	−0.043
	(0.026)	(0.009)	(0.008)	(0.055)	(0.041)	(0.011)	(0.024)	(0.010)
Trust	0.133	0.063	0.045		0.139	0.060	0.323	0.117
	(0.051)	(0.020)	(0.017)		(0.093)	(0.025)	(0.079)	(0.034)
Investment/GDP			0.136					
			(0.031)					
Percent Catholic				−0.231				
				(0.039)				
Percent Muslim				−0.226				
				(0.058)				
Percent Eastern orthodox				0.091				
				(0.085)				
Trust × GDP							−0.036	−0.010
							(0.011)	(0.004)
R^2	0.55	0.43	0.57	0.76	0.55	0.37	0.61	0.50
SEE	4.67	1.26	1.10	7.95	4.67	1.26	4.44	1.19
Mean, D.V.	21.8	1.88	1.88	32.3	21.8	1.88	21.8	1.88

Sample size is 41. White-corrected standard errors are shown in parentheses. Note R^2 does not have its usual interpretation in 2SLS. Instruments in 2SLS include percent Muslim, percent Catholic, and percent Christian Orthodox; p values in test of overidentifying restrictions are 0.19 in equation 5 and 0.34 in equation 6.

percentage point increase in trust (a one standard deviation increase). Fig. 1 depicts the partial relationship between trust and growth.

Controlling for investment rates in the growth regression (Equation 3), the trust coefficient declines somewhat but remains significant.[17] This finding has two plausible explanations: first, that some components of investment broadly defined – including investments in ideas – may not show up in the investment data, and second, that trust may influence growth through other channels besides investment.[18]

Half of our trust observations are from surveys conducted midway through the 1970–92 period (the 1981 wave), with the remainder from surveys conducted even later, raising the possibility that our estimates reflect reverse causation from growth to trust. The extremely high (0.91) correlation of trust from the 1981 to 1990–1 survey waves suggests that changes in trust over time are small relative to cross-country variations, and that these values are likely reasonably good proxies for the desired – but unavailable – 1970 values for trust.[19] To correct for possible endogeneity, we ran two-stage least squares regressions, using as exogenous instruments for trust the Catholic, Muslim, and Christian Orthodox shares of each country's population, following La

Fig. 1 *Trust and Growth (partial plot)*

[17] In the smaller sample used by Knack and Keefer (1997), trust was no longer significant in growth regressions when investment was included as a regressor.

[18] Fukuyama's (1995) popular book on trust emphasises constraints on firm scale produced by low trust; La Porta *et al.* (1997) provide some empirical support for this view.

[19] It is not obvious that reverse causation from growth to trust should lead to an upward bias for the trust coefficient in OLS. Olson (1963) among others has argued that rapid growth can disrupt traditional social structures and ties, which can erode trust.

Porta *et al.* (1997).[20] Equation 4 shows results for the first-stage regression, which explains 76% of the variation in trust; in the absence of the religion variables, income, schooling, and investment goods prices explain only 48%. Two of the three hierarchical religion variables – percent Catholic and percent Muslim – are negatively and significantly associated with trust.

The exogenous component of trust is positively associated with investment and growth in (Equations 5 and 6, respectively), with coefficients similar in magnitude to those estimated using OLS in Equations 1 and 2. Trust is significant only at the 0.07 level for a one-tailed test in Equation 5, but is highly significant in Equation 6. The instruments are valid, as indicated by p values of 0.19 (Equation 5) and 0.34 (Equation 6) from overidentification tests. In Knack and 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. Neither these nor any other one or two observations are very influential in the tests here, which add 12 countries not in the Knack-Keefer sample. Using the specifications of Equations 1 and 2 from Table 1, robust regression techniques which downweight cases with large residuals produce coefficients for trust that remain significant at the 0.01 level in the case of investment, and at the 0.04 level in the case of growth. Deleting the three non-WVS observations on trust (Luxembourg, Greece, and New Zealand), the coefficients (and standard errors) for trust are 0.132 (0.061) for investment, and 0.070 (0.022) for growth.

The trust-growth relationship in Knack and Keefer was also sensitive to the choice of human capital measures, with the Barro-Lee school attainment variable used here producing the weakest partial relationship between trust and growth. Our results are robust to the choice of human capital variables as well as to the inclusion of policy variables often included in growth regressions, such as inflation, financial development, and trade intensity.

The negative (but insignificant) 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. Investment sufficient for positive growth is facilitated by trust between economic agents; backwardness then provides a larger advantage for a high-trust poor nation than for a low-trust poor nation. This implication of the model predicts a negative coefficient on the interaction term trust × GDP per capita in investment and growth regressions. This prediction is borne out in Equations 7 and 8. For nations with very low trust levels, coefficients on initial income are large, positive, and statistically significant – indicating that backwardness yields no growth advantage over rich nations, despite the presumption of higher returns to capital and the potential for rapid growth. For trust levels above 25%, the point estimate for the impact of initial income on growth turns negative, indicating that backwardness is advantageous for

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[20] La Porta *et al* (1997) classify these as 'hierarchical religions' with inimical effects on interpersonal trust. Putnam (1993) and Verba *et al.* (1995) discuss the implications of Protestant-Catholic differences in hierarchical vs. congregational organisation, lay participation in the clergy, and in congregation size for the acquisition of civic skills and interpersonal trust.

growth in a high-trust environment. These results are consistent with the theory showing that a low-trust poverty trap exists: if trust is sufficiently low, growth stalls.

2.3. *The Correlates of Trust*

We now turn to the determinants of trust. In the model, trust increases with formal institutions, p, informal institutions, θ, 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; 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 and Keefer (1995), based on data from the International Country Risk Guide (ICRG), is available for all 41 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 use the mean value over the period 1982–90.

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 Transparency International's Corruption Perceptions Index, constructed by aggregating various subjective ratings of the frequency with which public officials demand bribes, based on expert opinion and on surveys of businesspersons and citizens. Scores on this corruption index can range in principle from 0 to 10; in our sample Denmark has the highest score of 10, while Nigeria has the lowest score of 1.6.[21]

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

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[21] See www.transparency.de for the data and a description of underlying sources and methodology.

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, *et al.* (1998), 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 rather than subjective.

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 background 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 and 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 UN's Food and Agriculture Organization censuses (Jazairy *et al.*, 1992). A third measure is the 'intensity of economic discrimination', a subjective variable evaluated for 1975 by Ted Gurr and reported in Taylor and Jodice (1983). Countries are rated on a 1–4 scale with higher values indicating more severe discrimination.[22] A fourth measure is ethnic homogeneity, from Sullivan (1991). Homogeneity is equal to the share of the country's population accounted for by the largest 'ethnic' group, where ethnicity is defined by race, religion, or language, depending on which of these is the most salient source of cleavages in a given society.

In Table 2, trust values are regressed on per capita income, mean years of education, and on proxies for formal institutions and social distance. Trust's association with income and education varies depending on the sample and specification, but in those cases where the relationship is significant, it is uniformly positive. Equations 1–4 include the Knack-Keefer property rights index, paired with each of the three proxies for social distance and the discrimination measure. The coefficient of the property rights index is positive in every case, marginally significant in Equations 1–3 and highly significant in Equation 4. Both income inequality (Equation 1) and land inequality (Equations 2) are strongly associated with lower trust levels.[23] Trust falls by nearly 5

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

[23] Kawachi *et al.* (1997) show that survey measures of interpersonal trust are correlated with income inequality in US states.

Table 2.
Formal Institutions, Heterogeneity and Trust

Equation	1	2	3	4	5	6	7	8
Constant	33.520	17.723	27.287	−4.194	−9.819	7.141	−3.763	53.734
	(8.209)	(8.857)	(12.261)	(5.858)	(5.787)	(4.734)	(5.821)	(9.874)
GDP per capita 1985 (000s)	−0.262	0.258	0.032	−0.149	−0.194	0.820	1.478	1.030
	(0.798)	(0.958)	(0.887)	(0.599)	(0.495)	(0.399)	(0.529)	(0.868
Schooling 1985	1.871	1.629	2.029	1.592	3.012	0.393	1.077	1.485
	(1.159)	(1.095)	(1.088)	(0.805)	(0.845)	(1.026)	(0.897)	(1.305)
Property rights index	0.465	0.559	0.608	0.863				
	(0.290)	(0.384)	(0.357)	(0.271)				
Gini Income Inequality	−0.764							−0.744
	(0.158)							(0.232)
Gini Land Inequality		−0.325						−0.205
		(0.076)						(0.082)
Ethnic homogeneity			−1.067					
			(0.402)					
homogeneity squared			0.008					
			(0.003)					
Economic discrimination				−4.758	−5.631	−5.168	−4.415	
				(0.906)	(1.325)	(1.005)	(0.991)	
Contract enforceability					16.477			
					(5.837)			
Corruption index						3.451		
						(0.930)		
Investor rights							0.342	
							(0.114)	
R^2	0.69	0.65	0.61	0.72	0.73	0.74	0.71	0.71
SEE	9.8	10.2	10.6	9.1	9.3	8.8	9.5	9.7
N	36	36	41	38	33	37	35	33
Mean, D.V.	32.3	32.4	32.1	32.1	32.2	32.3	32.1	32.6

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

percentage points for each 1-point increment in the 4-point discrimination scale (Equation 4).

In the model, trust declines continuously as social distance increases. As our measure of ethnic homogeneity increases, the likelihood of two randomly-matched individuals (such as a broker and investor) being from different groups falls, and trust is predicted to rise. However, ethnic homogeneity has no significant linear relationship with trust. Horowitz (1985) and others have noted that the salience of group differences is maximised where there is a limited number of sizable groups (as in Fiji, Guyana, or Trinidad, for example). When 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 organise for political action. In particular, if small groups are not geographically or occupationally concentrated, it is relatively costly to organise. By this logic, the effective social distance is actually greatest for middle values of the ethnic homogeneity measure. Equation 3 shows that trust is in fact a quadratic function of homogeneity, with predicted values for trust lowest at a value for homogeneity of about 0.66.[24]

Equations 5–7 substitute for the property rights index our other three proxies for formal institutions. In each case, the association with trust is positive and highly significant. 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. Equation 8, for example, shows that income and land inequality are both significantly associated with lower levels of trust when included together.

While these findings on associations between trust and formal institutions and social distance are consistent with our model, they are presented here as preliminary tests that do not fully resolve causality issues. For example, cohesive and trusting societies may more easily agree on an efficient, stable set of property rights, or on policies to reduce inequality and discrimination. Treating formal institutions and social distance proxies as endogenous would require identifying instruments for them that are otherwise unrelated to trust, which is quite difficult.

2.4. *Formal Institutions, Heterogeneity and Growth*

Tables 3 and 4 present tests of the channels through which our proxies for formal institutions, social distance, and discrimination 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, social distance, or discrimination but omits trust. The second equation in each pair adds the trust variable, to determine whether formal

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[24] Similar results are found using the variable 'ethnolinguistic fractionalisation', reported in Taylor and Jodice (1983). Unlike the case with Sullivan's homogeneity measure, data are unavailable on fractionalisation for a few countries in our sample.

Table 3

Trust, Formal Institutions and Growth (1970–92)

Equation	1	2	3	4	5	6
Constant	1.471	1.775	2.474	3.717	3.870	4.054
	(1.137)	(1.075)	(1.655)	(1.565)	(0.936)	(0.897)
GDP per capita 1970 (000s)	−0.297	−0.269	−0.180	−0.134	−0.133	−0.097
	(0.129)	(0.115)	(0.156)	(0.126)	(0.110)	(0.090)
Schooling 1970	0.021	−0.090	−0.047	−0.117	0.022	−0.099
	(0.112)	(0.092)	(0.196)	(0.168)	(0.154)	(0.129)
Price of investment goods, 1970	−0.026	−0.031	−0.047	−0.053	−0.037	−0.042
	(0.011)	(0.011)	(0.016)	(0.015)	(0.009)	(0.010)
Property Rights Index	0.112	0.088				
	(0.028)	(0.026)				
Contract Enforceability			1.759	0.709		
			(0.719)	(0.650)		
Corruption index					0.278	0.065
					(0.120)	(0.153)
Trust		0.043		0.062		0.062
		(0.017)		(0.023)		(0.025)
R^2	0.49	0.57	0.36	0.50	0.31	0.45
SEE	1.19	1.11	1.43	1.29	1.41	1.28
N	41	41	33	33	39	39
Mean, D.V.	1.88	1.88	2.00	2.00	1.91	1.91

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

Table 4

Trust, Heterogeneity and Growth (1970–92)

Equation	1	2	3	4	5	6
Constant	7.140	4.756	6.459	5.030	4.946	4.353
	(1.960)	(1.844)	(1.329)	(1.147)	(0.936)	(0.810)
GDP per capita 1970 (000s)	−0.170	−0.163	−0.031	−0.065	−0.035	−0.088
	(0.148)	(0.137)	(0.106)	(0.097)	(0.107)	(0.102)
Schooling 1970	0.103	−0.003	0.119	−0.019	0.124	−0.054
	(0.159)	(0.144)	(0.139)	(0.137)	(0.135)	(0.126)
Price of investment goods, 1970	−0.024	−0.030	−0.039	−0.043	−0.040	−0.044
	(0.013)	(0.013)	(0.009)	(0.009)	(0.009)	(0.009)
Gini income inequality	−0.071	−0.025				
	(0.033)	(0.030)				
Gini Land Inequality			−0.031	−0.013		
			(0.013)	(0.012)		
Economic Discrimination					−0.335	−0.078
					(0.132)	(0.136)
Trust		0.049		0.049		0.060
		(0.019)		(0.020)		(0.022)
R^2	0.32	0.40	0.38	0.46	0.34	0.47
SEE	1.38	1.32	1.32	1.25	1.39	1.26
N	32	32	40	40	38	38
Mean, D.V.	2.12	2.12	1.86	1.86	1.87	1.87

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

institutions, social heterogeneity, or discrimination remain significantly correlated with growth controlling for trust.[25]

Each proxy for formal institutions, social distance, and discrimination is significantly associated with growth in the first of each pair of regressions. While the inclusion of trust reduces the coefficient of the property rights index by about one-fifth, that index remains significantly related to growth (Table 3, Equations 1 and 2). Unlike our other proxies for formal institutions, 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, controlling for trust between private agents. In the model, trust is related to the likelihood of being cheated by private agents, not by government officials. Similarly, our survey-based measure (which inquires about 'most people') is likely to be little affected by perceptions of the trustworthiness of government agents acting in their official capacities.

Results for each of our other proxies for formal institutions, social distance, and discrimination in Tables 3 and 4 suggest that much of their influence on growth occurs through their impact on trust. In the case of contract enforceability (Table 3, Equations 3 and 4), the corruption index (Equations 5 and 6), income inequality (Table 4, Equations 1 and 2), land inequality (Equations 3 and 4), economic discrimination (Equations 5 and 6), and ethnic homogeneity, the inclusion of trust drastically reduces the coefficient of the relevant proxy for formal institutions or social distance. Not included in Table 3 or 4 is the investor rights index. It is not significant with or without trust in the regression, but its coefficient is positive and decreases with the inclusion of trust, consistent with the interpretation that investor rights improve growth by increasing trust.[26] Trust itself is positively and significantly related to growth in every case when it is included in growth regressions with a measure of formal institutions or of social distance. Results in Tables 3 and 4 strongly support the model's prediction that formal institutions and social homogeneity increase growth in part by building trust.[27]

3. 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

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[25] Because the dependent variable here is income growth over the 1970–92 period, we use Gini measures from around 1970. The corruption index and the investor rights' index are (unavoidably) measured near the end of the growth period.

[26] Investor rights are significantly related to growth in larger samples that are not restricted by the availability of data on trust.

[27] These results also suggest that most of our proxies for formal institutions and social distance are valid instruments for trust in the growth regressions in Table 1. Except for the property rights index (for reasons explained above), any pair of these proxies in fact passes an overidentification test, and the predicted component of trust is significantly related to growth in two-stage least-squares regressions.

transact for a single period 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, and when formal and informal institutions are weaker, 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 social and institutional factors impact economic performance.

The model in this paper generalises to other principal-agent relationships, for example, creditors and debtors, employers and employees, clients and consultants, insurers and insured, 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 each other using a matching technology as in Burdett and 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 specialisation may be severely limited, particularly where there are many 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).

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 that '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.

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Appendix

Table A1
Descriptive Statistics

	Mean	Std. Dev.	N
Trust (initial value)	32.2	15.0	41
Growth, 1970–92	1.88	1.57	41
Investment/GDP, 1970–92	21.8	6.6	41
Per capita income, 1970	$5,936	$3,610	41
Years of education, 1970	5.43	2.56	41
Investment goods price, 1970	80.7	19.7	41
Property rights index	37.2	12.3	41
Corruption index	6.2	2.5	39
Investor rights index	59.7	12.7	37
Contract enforceability	2.60	0.65	33
Income inequality (circa 1985)	37.4	9.2	36
Land inequality (circa 1985)	57.9	15.8	36
Ethnic homogeneity	81.9	18.2	41
Catholic percent	46.6	40.5	41
Muslim percent	7.2	21.5	41
Christian Orthodox percent	2.4	15.3	41

Table A2
Intercorrelations of Table 1 regressors

	2	3	4	5	6	7
1. Trust	0.68**	0.29	0.60**	−0.57**	−0.31*	0.19
2. Per capita income, 1970		0.81**	0.38*	−0.05	−0.41*	−0.07
3. Years of education, 1970			0.31*	−0.21	−0.49**	−0.02
4. Investment goods price, 1970				−0.14	−0.16	−0.04
5. Percent Catholic					−0.41**	−0.07
6. Percent Muslim						−0.04
7. Percent Eastern Orthodox						

A * (**) indicates significance at 0.05 (0.01) for two-tailed test.

Appendix: Proofs

Proof. [Proposition 1] Implicit differentiation of the optimality condition, produces $\partial e^{i^*}/\partial a^i = -\eta_1/a^i\eta_{11}$, $\partial e^{i^*}/\partial w^i = 1/(Ra^i\eta_{11})$, $\partial e^{i^*}/\partial p = -\eta_{12}/\eta_{11}$, $\partial e^{i^*}/\partial\theta = \theta^2\eta_{11}$, and $\partial e^{i^*}/d(i,j) = -\eta_{13}/\theta\eta_{11}$, where η_m denotes the partial derivative of $\eta^{ij}[e^i, p, D(i,j;\theta)]$ with respect to the mth argument, and η_{mn} is the cross-partial of the mth and n^{th} arguments of η^{ij}. Using the restrictions in the proposition proves the results.   □

Proof. [Proposition 2] The restriction in this proposition guarantees that e^{i^*} is decreasing and concave 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 proposition, let the wage distribution parameter for agent m fall and the wage distribution parameter for agent n increase by an equivalent amount, say ζ, 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^*}, $i = m, n$, from the base case ($\zeta = 0$) to the wage discrimination case ($\zeta > 0$) by Δe^{i^*}. Then, by the concavity of $e^{i^*}(w^i)$, the change in the aggregate time

spent investigating one's broker is $\Delta e^{m^*} \mu^m + \Delta e^{n^*} \mu^n > 0$. Therefore, trust falls with wage discrimination.   □

Proof. [Proposition 3] We prove this proposition for a simple mean preserving spread (MPS) which guarantees that the spread distribution has a higher variance than the base distribution (Rothschild and Stiglitz, 1971). As in Proposition 2, the third derivative restriction on η^{ij} results in an e^{i^*} that is decreasing and concave in w^i. Define μ_0 as the distribution of consumers before the MPS, and μ_1 as the distribution after the MPS. Proposition 1 of Diamond and Stiglitz (1974) characterises the effect of a MPS on a concave function. Then, under Theorem 1 of Diamond and Stiglitz (1974), the following holds

$$\int_0^\infty e^{i^*}\, d\mu_1 > \int_0^\infty e^{i^*}\, d\mu_0.$$

As a result, MPS of the distribution of wages increases aggregate diligence and therefore decreases trust.   □

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