Individualism and Economic Development: Evidence from Rainfall Data

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Abstract:
This paper contributes to the economics of culture by introducing an instrument for individualism that is supported by economic theory. Extending a familiar model of risk sharing arrangements to incorporate optimal socialization decisions, I show that collectivist social ties are stronger in riskier environments. This result motivates the use of rainfall variation, a measure of exogenous agricultural risk, as an instrument for individualism. Using this variable and a measure of individualism from the World Values Survey, I find that rainfall variation reduces individualism. Moreover, I find that individualism has a large, statistically significant effect on economic development: a standard deviation increase in individualism causes per capita income nearly to triple. This result is robust to the inclusion of a variety of variables that control for potential correlations between rainfall variation and agricultural development, institutional quality, and cultural variation linked to religion and regional location.

Keywords: Culture, Development, Individualism, Collectivism, Risk Sharing, Kinship Networks, Socialization, Rainfall

JEL Classifications: O1, Z13, Q54
Section 1: Introduction

Individualism and collectivism refer to the relative importance of group values and identity in determining individual values and identity, and together define a key dimension of cultural variation. While economists have long suspected that individualism may play an important role in economic development, until recently empirical work in this area has been bedeviled by significant measurement and identification issues. Empirical measures of individualism are positively correlated with per capita income, but it is unclear a priori to what degree this correlation reflects the positive influence of individualism on economic development rather than negative impact of economic development, and it’s accompanying the structural transformations, on the maintenance of collectivist social norms.

Economic theory has also provided little guidance in resolving the debate over the role of individualism in development. Arguments that appeal to the importance of entrepreneurship, innovation and risk-taking tend to find that individualism plays a positive role in economic growth. For example, Weber (1930, p. 179) highlights importance of Calvinism for the development of “individualistic motives of rational legal acquisition by virtue of one’s own ability and initiative,” and Bauer and Yamey (1957) and Lewis (1955) highlight the disincentives for innovation and investment that arise from collectivist obligations to share income gains with distant family members. In contrast, arguments that appeal to importance of interpersonal interactions and collective behavior often posit a positive role for collectivism. Arguing in this vein, Ball (2001) finds that collectivist social relations may support development by fostering interpersonal trust, thereby facilitating market expansion and exchange, as in Arrow (1972), Dixit (2003) and Tabellini (2008b), a point supported by the extensive literature on ethnic business groups and trading networks that begins with Landa (1981). If collectivism increases social capital, it may also enhance the effectiveness of political institutions, as argued by Banfeld

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1 For example, Triandis (1990, p. 42) argues that “in individualistic cultures most people’s social behavior is largely determined by personal goals that overlap only slightly with the goals of collectives…. Whereas in collectivist cultures social behavior is determined largely by goals shared with some collective, and … it is considered socially desirable to place collective goals ahead of personal goals.”


3 Cited in MacFarlane (1978). See Ball (2001) for a review of the literature on individualism and economic development.
In a significant advance, recent empirical work has provided evidence consistent with a positive role for individualism in economic and institutional development. Licht, Schwartz and Goldschmidt (2007) find there is a significant causal relationship between three measures of individualism and collectivism developed by Schwartz (2006) and measures of institutional and political development. In a similar study, Tabellini (2008a) finds evidence of a robust causal relationship between measures of trust and respect from the World Values Survey and institutional development. As Tabellini argues that trust and respect reflect a deeply held social belief in the value of individual political and human rights, this study adds weight to the evidence individualism supports institutional and economic development. Finally, Gorodnichenko and Roland (2010) find a causal relationship between individualism and innovation and economic development.

These papers address the significant identification issue raised by the endogeneity of cultural variables by employing instrumental variables drawn from the fields of linguistics and genetics. While highly creative, the use instrumental variables from outside the traditional realm of economic expertise poses a potential problem in that it is difficult for economists to evaluate arguments regarding their relevance and validity. For example, as I point out in the following section, one of the linguistic variables used as an instrument by Tabellini (2008a) and Licht et al. (2007) exhibits historical variation that is correlated with significant economic and political events that plausibly exert an independent influence on economic development. This example serves to highlight the disadvantages of relying too heavily on non-economic instruments in statistical inference.

This paper addresses this criticism by proposing an economic instrument for individualism, the coefficient of variation of monthly rainfall. The link proposed here between rainfall variation and collectivist social norms draws on an extensive theoretical and empirical literature on risk sharing among agricultural households in less developed countries. In the presence of high information costs, moral hazard undermines the development and efficient

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4 In contrast, see Kranton (1996) and Grief (1994 and 2006) for an argument that that informal exchange relations may impede the development of impersonal market transactions. Similarly, Tanzi (1994) and Platteau (1994, 2001) argue that a collectivist social norms undermine the development of formal political institutions.
functioning of formal insurance markets for agricultural risk, leaving rural households to rely on informal risk sharing arrangement. Modeling these arrangements as self-enforcing contracts, Coate and Ravallion (1993) show that in the absence of third party enforcement, incentive compatible contracts may be constrained in that they fall short of full risk pooling. More recent contributions show that strong social ties may enhance the risk pooling capacity of an informal risk sharing arrangement by facilitating information transfer, as in Bloch, Genicot and Ray (2008), or increasing the level of inter-household altruism, as in Foster and Rosenzweig (2001) and Ambrus, Mobius and Szeidl (2010), which increases the cost of defection. An extensive empirical literature provides support for the important role of social ties in informal risk sharing arrangements.5

I extend this literature in section 3 by developing a formal model of informal risk sharing in which the strength of social ties, a measure of collectivism, is endogenous. In particular, the strength of equilibrium social ties is determined by the efforts of parents to socialize their children. While parental socialization efforts are costly, stronger social ties permit the children to commit to larger transfers in an informal risk sharing arrangement. Comparative statics indicate that the equilibrium strength of collectivist social ties is increasing in the riskiness of the natural environment. According to this logic, societies should develop more collectivist social norms where nature is more capricious.

The contemporary relevance social norms developed to facilitate agricultural risk sharing to urban, industrial economies depends on the argument that social norms are highly persistent. Williamson (2000, p. 596) argues that such persistence is in fact characteristic of social norms, a position that is supported by an emerging body of evidence including Nunn and Wantchenkon (2009) on the transatlantic slave trade and trust in contemporary Africa, Tabellini (2005) on early development and trust in European regions, Guiso et al. (2006) on the persistence of cultural norms among US immigrants.

Using rainfall variation as an instrument for individualism, this relationship is also economically significant. In the baseline regression, an increase in individualism of one standard deviation is associated with a nearly three-fold rise in per capita income. Individualism appears to have a large positive effect on economic development.

Section 4 describes the data on individualism and the construction of the measure of rainfall variation. In section 5, I test the relationships between rainfall variation, individualism and economic development in a broad sample of 89 countries. The results provide evidence of highly significant negative relationship between rainfall variation and individualism, a finding that is consistent with the role of agricultural shocks in the formation of social norms as predicted by the formal model. In addition, using rainfall variation as an instrument for individualism, I find evidence of a positive causal relationship between individualism and the level of economic development. This relationship is also economically large. In the baseline regression, a standard deviation increase in individualism is associated with a nearly three-fold rise in per capita income.

In section 6, I consider three challenges to the validity of rainfall variation as an instrument. First, rainfall variation is negatively correlated with the average level of rainfall, which may affect development through its effect on agricultural output as argued by Miguel, Satyanath and Sorgenit (2004) and Barrios, Bertenelli and Strobl, (2010). Second, rainfall variation is correlated with measures of climate and crop selection that have been shown to affect institutional transfer or development, as argued by Hall and Jones (1999), Acemoglu, Johnson and Robinson (2001), Engerman and Sokoloff (1997, 2002) and Easterly (2007). Finally, rainfall variation is correlated religious affiliation and geographic region, variables that are themselves strongly correlated with broader cultural classifications, as proposed by Schwartz (2006) and Huntington (1993), suggesting that the coefficient on individualism may in part reflect the influence of omitted cultural variables on development. The primary finding of statistically significant relationships between rainfall variation, individualism and economic development is robust to the inclusion of a wide variety of variables that control for the relationships between rainfall variation and agricultural output, climate and culture.

In a paper written contemporaneously with this one, Durante (2010) finds evidence of a robust positive relationship between historical rainfall variation and levels of social trust using regional data on 24 countries from the European Social Survey. While I investigate individualism rather than social trust, in documenting the relationship between rainfall variation and the formation of social norms our work is largely complementary. His interpretation of this finding is also similar to that proposed here: exposure to exogenous agricultural risk increases the return to the formation of social norms that enhance cooperation. A particular strength of
Durante’s paper is the use of historical data on rainfall variation dating back to 1500, which provides evidence on the persistence of social trust. In contrast, the paper employs a global sample of countries, which indicates that the relationship between rainfall variation and social norms is not restricted to European societies. A second distinction is that Durante does not model the formation of social norms.

**Section 2: Identification Issues in the Economics of Culture**

In order to overcome the significant identification problems that arise from the endogeneity of culture, the studies by Tabellini (2008a) and Licht et al. (2007) mentioned above employ language variables introduced by Kashima and Kashima (1998) as instruments for cultural values. Drawing on the Linguistic Relativity hypothesis of Whorf (1956) and Saphr (1970), Licht, Goldschmidt and Schwartz (p. 672) argue that the “grammar of a language may transmit and reproduce culture and social categories” and that therefore “language functions as a constraint of cultural change.” The first variable describes whether pronoun drop is permitted. For example, pronoun drop is permitted in Spanish, so that the English sentence “I love” may be translated as either “Amo” or “Yo amo.” In languages that permit pronoun drop, the identity of the subject is understood in the context of the rest of the sentence. In contrast, in languages that do not permit pronoun drop, the subject stands apart from the context. Pronoun drop is therefore associated with less individualistic cultures, a more limited morality or greater embeddedness. The second language variable used as an instrument is the presence of multiple second person singular pronouns, which linguists refer to as the T-V distinction after the French pronouns *tu* and *vous*. Languages with two second person singular pronouns allow formal and informal forms of address that are symptomatic of greater attention to hierarchy and social distance. Tabellini (2008a) associates this trait with more limited morality, while Licht et al. (2007) associate it with a more hierarchical and less egalitarian culture.

The use of linguistic variables as instruments for culture poses two problems. First, formal tests of instrument validity rely on overidentifying restrictions. These test the hypothesis that all the instruments are correctly excluded conditional on the existence of a subset of correctly excluded instruments. As Murray (2005) has pointed out, these test are more
trustworthy when the arguments used to motivate the instruments are different. Because the studies above use two instruments supported by similar linguistic arguments, it raises the suspicion that a failure to reject the maintained hypothesis occurs because neither of the instruments is valid. Because of this concern, tests of overidentifying restrictions carry more weight when the instruments employed are supported by different arguments and theories.

Second, it is troubling to rely on arguments for the relevance and validity of variables taken from outside our area of expertise. Tabellini argues that linguistic rules will be valid as cultural instruments if they reflect distant cultural traditions that are uncorrelated with other aspects of economic performance (2008a, p. 278): “[T]he two grammatical rules of the use of pronouns capture deep and stable features of the language…. Hence, there is little doubt that that they are correlated with distant cultural traditions, rather than with more recently acquired traits.” But the evolution of the T-V distinction in the English language suggests that the stability of grammatical rules may be overstated. Moreover, because there are five English speaking countries in the Kashima and Kashima (1998) data set, the manner in which English is coded with respect to this variable is potentially important for empirical results.

According to the history of English usage in Lass (1999), in Old English there were two second person pronouns, with *thou* being the singular form and *ye*, of which *you* is the accusative, being plural. In Middle English, however, *you* is increasingly used as a formal form of singular address, a change that may reflect French influence on English courtly life. However, as noted by Lass (1999, p. 149-50), “What evolved was loose, unstable and pragmatically more subtle, with some T-V properties and other quite different ones…. [And] starting in the late fourteenth century, and increasing into the seventeenth, *you* gradually becomes the neutral term of singular address.” Finally, with the emergence of Modern English in the second half of the seventeenth century, the use of *thou* is dropped altogether from common speech.

This brief history of English usage suggests caution in attempts to interpret linguistic rules as Tabellini (2008a) does as a “deep and stable feature of the language.” More importantly, note that the disappearance of the T-V distinction in English coincides with a period of religious instability and dramatic political and economic change in English history that might be expected to exert an independent influence on the evolution of English cultural values. In particular, this period is marked by the Glorious Revolution, in 1688, which is associated with the adoption of more egalitarian political institutions, and an acceleration of the enclosure movement, marking a
shift from collective to private property rights in land (Moore, 1966). While it is impossible to know whether these political and economic events did in fact play a role in the disappearance of *thou* from common English usage, this brief account of the evolution of English usage serves to highlight the potential difficulties of relying too heavily instruments taken from fields outside the economist’s area of expertise.

A different concern applies to the genetic variables use as instruments for individualism by Gorodnichenko and Roland (2010). Their primary instrument is a measure of the genetic distance between a country and the US, as measured by the Euclidean distance between the frequency of their population’s blood types. This choice of instruments is based on two factors. First, like genes, the culture is transmitted from parents to children, and second, the US is the most individualistic country in their sample. Under this argument, similar genetic make-up is a proxy for a history of inter-marriage and cultural transmission between societies. A potential criticism of this argument is that similarities in the genetic composition of the US and other countries may reflect historical migration patterns more than a pattern of inter-marriage between US and local populations. Moreover, as a country of immigrants, individualism in the US may depend somewhat less on the parent-child transmission of culture and somewhat more on the role of individualism in migration decisions or the influence of the experience of migration on immigrant cultural values. A second potential criticism regards the validity of genetic distance as an instrument for cultural distance. In particular, Spolaore and Wacziarg (2009, p. 470) have argued that genetic distance is a proxy for barriers to the diffusion of knowledge, as “[m]ore closely related societies are more likely to learn from each other and adopt each other’s innovations.”

The discussion above is intended to suggest that some caution may be appropriate in employing instruments from fields outside our area of expertise. In keeping with this concern, a major contribution of this paper is to introduce an instrument for individualism that is both economic in nature and plausibly exogenous, implying that we do not need to rely exclusively on non-economic instruments.

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7 MacFarland (1978) challenges the notion that pre-enclosure Britain was characterized by collective of property rights in land. In particular, he notes that British legal findings going back to the thirteenth century clearly defend individual property rights in land, permitting for example, the alienation of land from one’s inheritors.

8 Gorodnichenko and Roland (2010) also use as instruments variables measuring the frequency of genes linked to depression and stress from social rejection, which are available for 30 and 23 countries respectively. Unlike genetic information on blood types, these variables may fail the exclusion restriction if, for example, they have a direct effect on economic development through their impact on motivation or entrepreneurship.
Section 3: A Model of Risk Sharing and Collectivism

This section develops a simple model illustrating the role of collectivist social ties in informal insurance arrangements. The model considers the formation of informal risk sharing arrangements by two households in an environment in which variations in income are exclusively due to exogenous income shocks, as assumption intended to capture the importance of weather shocks to output in a primitive agricultural economy. The primary purpose of the model is to motivate the use of rainfall variation as an instrument for individualism in the empirical exercises below. No attempt is made here to address the persistence of collectivist social values or their impact on economic performance in an industrial or industrializing economy in which income variations may depend less on nature and more on individual decisions regarding effort or investment.

There is widespread evidence of the use of risk sharing arrangements by historical and contemporary communities of hunter-gatherers, pastoralists and subsistence farmers, (see e.g. Durante, 2010). In practice agricultural communities have a number of alternatives to these arrangements as mechanisms for coping with agricultural risk, such as the use of storage and water management technologies, that we do not consider in the model below. However, because they are subject to substantial economies of scale, these technologies require significant levels of cooperation and collective action to implement and maintain. Consequently, the adoption of these technologies would tend to raise the return to investments in collectivist social norms in much the same way as the use of informal risk sharing arrangements that are analyzed here.

The model developed below extends that of Coate and Ravallion (1993) by incorporating and endogenizing the strength of collectivist social ties. Collectivism takes the form of internalized social norms regarding the fulfillment of one’s social obligations as part of an informal risk sharing arrangement. In particular, I assume that an individual who reneges on an informal risk sharing arrangement suffers a loss of utility and that this disutility is larger the more collectivist are the individual’s values. Furthermore, the size of this disutility depends on

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There is widespread evidence of the use of risk sharing arrangements by historical and contemporary communities of hunter-gatherers, pastoralists and subsistence farmers. See Durante (2010) for a review of the literature. There is a large literature that investigates the role of cooperation in irrigation. See in particular, Bardhan (2000) and Ostrom (2000). See Berg (2007) and Stead (2004) on the role of cooperation in the use of storage technologies.
the socialization efforts of an individual’s parent. The logic linking risk to collectivist socialization is as follows. By raising the cost of defaulting on an individual’s social obligations, collectivist social ties act as a commitment device that permits informal risk sharing arrangements to achieve greater risk pooling. In an environment with a higher exogenous level of risk, the return to socialization is higher, and parents opt to instill more collectivist values in their children.

There are two infinitely lived, risk averse dynastic households, A and B. In each period, a household consists of two members, an adult and a child, and each individual spends one period as an adult and one as a child. Children received social training from their parent, but are otherwise passive. Households maximize a dynastic utility function,

$$V = \sum_{t=0}^{\infty} (1 + r)^{-t} v_t,$$

where \( r \) is the intergenerational discount rate. The variable \( t \) refers to the time period and, equivalently, to the parent’s generation. The periodic utility function is given by

$$v(c_t, q_t, s_t, x_t) = u(c_t) - q_t x_t - s_t.$$  

The first term in this utility function is the utility derived from consumption and is assumed to reflect risk-averse preferences: \( u'(c) > 0 \) and \( u''(c) < 0 \), which provides an incentive for households to engage in risk sharing arrangements as detailed below. The remaining terms capture the utility cost of socialization, \( s_t \), the strength of collectivism, \( q_t \), and the status of the relationship between the two households, \( x_t \).

In the second term captures the effects of collectivism on utility. Here, \( q \geq 0 \) denotes the strength of internalized collectivist values, and the dichotomous variable \( x \in \{0,1\} \) indicates whether a household has fulfilled its social obligations, with \( x = 1 \) if it has and \( x = 0 \) otherwise. Thus, \( q \) measures the disutility experienced by a household if it fails to fulfill its social obligations, which occurs if it violates the terms of a risk sharing arrangement.

The third term captures the disutility of socialization effort, a proxy for the time and energy expended in the socialization process. Socialization refers to a process by which social norms are internalized by individuals and become incorporated in their preferences. Here, cultural value formation is assumed to take the form of “vertical socialization,” in which parents
instill collectivist social norms in their children.\textsuperscript{10} In particular, the value an individual places on honoring their social obligations is assumed to be an increasing function of their parent’s socialization effort:

\begin{equation}
q_t = q(s_{t-1}),
\end{equation}

where the follow Inada-type restrictions are assume to hold: \(q(0) = 0\), \(q'(s) > 0\), \(q''(s) < 0\), \(\lim_{s \to 0^+} q'(s) = \infty\), and \(\lim_{s \to \infty} q'(s) = 0\). As is shown in the analysis below, collectivist social values serve an economic rationale in that they act as a commitment device that permits a household to implement an informal insurance arrangements involving larger transfers, and thus reduce the post-transfer variance in household incomes.

Risk enters the model through uncertainty regarding the level of periodic income. Each period, \(t\), each household receives an income \(y^k \in \{y_1, y_2\}\), \(k = A, B\), and \(y_1 > y_2\). The probability of a given pair of household incomes is given by \(p_{ij} = \Pr\{y^A = y_i, y^B = y_j\}\). We further assume these probabilities are symmetric across households and define the probability of an asymmetric income shock as \(p = p_{12} = p_{21}\). It will be useful to express these income levels as deviations from average income: \(y_1 = y + \Delta\) and \(y_2 = y - \Delta\), where \(y\) is average income and \(\Delta\) is an income shock. Income takes the form of a non-storable consumption good, such that each period a household’s consumption is determined by their income net of any inter-household transfers.

Coupled with risk-averse preferences, uncertainty over household income provides an incentive for the households to engage in risk-sharing by forming informal insurance arrangements. In particular, it is assumed that households play the following are non-cooperative game. Each period, parents socialize their children. Then, nature selects a pair of incomes. Observing these incomes and socialization efforts, and knowing the history of the game, each household chooses a transfer to the other household. The game is infinitely repeated and the analysis focuses on subgame perfect equilibria. An insurance agreement can be characterized by a set of state contingent net transfers from A to B, \(\Theta = (\theta_{11}, \theta_{12}, \theta_{21}, \theta_{22})\). Since

\textsuperscript{10} See Bisin and Verdier (2010) for a review of the literature on socialization.
income shocks are symmetric and the households are otherwise identical, we focus on the subset of symmetric transfers: \( \Theta = (0, \theta, -\theta, 0) \), where \( \theta \in [0, y_i] \).

The absence of third party enforcement implies that informal insurance agreements must be self-enforcing. Let \( v^f(\Theta, s) \) denote a household’s expected utility per period under insurance agreement \( \Theta \) and socialization effort \( s \), and \( v^f(0, 0) \) equal a household’s expected utility per period in the absence of transfers. Then a symmetric insurance arrangement \( \Theta \) is implementable provided

\[
(4) \quad u(y + \Delta) - u(y + \Delta - \theta) \leq \frac{v^f(\Theta, s) - v^f(0, 0)}{r} + q(s).
\]

This condition states that the utility loss experienced by the household making the agreed-upon transfer must not exceed the expected value of maintaining the insurance arrangement. Following Coate and Ravallion (1993), we call this condition the implementability constraint (IC).

Note the role of collectivism in the IC, which is captured by the presence of \( q \) on the right-hand side of (4). If a household decides to default on an insurance arrangement, it suffers a one-time utility loss equal to the strength of its collectivist social ties, \( q \). Thus, the violation of a social obligation makes defaulting on the insurance arrangement more painful, an effect that is larger the greater the strength of collectivism. Because of this, strong collectivist social bonds tend to relax the IC, allowing larger transfers, and increasing the risk sharing capacity of implementable informal insurance arrangements. For notational convenience, we restate the IC as

\[
(5) \quad G(\theta, s) = r \left[ u(y + \Delta) - u(y + \Delta - \theta) - q(s) \right] - p \left[ u(y - \Delta + \theta) + u(y + \Delta - \theta) - u(y + \Delta) - u(y - \Delta) \right] - s \leq 0
\]

As is common in non-cooperative games, when there is an implementable informal insurance arrangement, there will generally be more than one, each of which is an equilibrium in the repeated non-cooperative game described above. We focus here, on the implementable insurance arrangement that maximizes expected dynastic household utility.

The household’s problem is to choose the socialization effort and implementable informal insurance arrangement that maximizes expected dynastic utility. This implies that each period, each household solves the following problem:
\[
\max_{\theta, s} u^e(\theta) - (1 + r)s, \text{ subject to } G(\theta, s) \leq 0 \text{ and } s \geq 0,
\]
where the first term in the objective function is expected periodic consumption utility and the second term captures the current value of the parent’s socialization effort. The LaGrangian and complementary slackness conditions for this problem are given by

\[
(6) \quad L(\theta, s, \lambda, \mu) = u^e(\theta) - (1 + r)s - \lambda G(\theta, s) + \mu s
\]
and

\[
(7) \quad \lambda G(\theta, s) = 0, \quad \lambda \geq 0 \text{ and } G(\theta, s) \leq 0,
\]

In these equations, the LaGrange multiplier \( \lambda \) denotes the marginal utility obtained by relaxing the IC, such that the shadow value of collectivism is given by \( r \lambda \). Similarly, in equilibrium, \( \mu \) denotes the marginal disutility of socialization.

The first-order Kuhn-Tucker conditions for this problem are

\[
(8) \quad u^e_\theta(s, \theta) - \lambda G_\theta(\theta, s) = 0
\]
and

\[
(9) \quad -(1 + r) - \lambda G_\theta(\theta, s) + \mu = 0.
\]

In \( s - \theta \) space, this problem may support either an interior or a boundary equilibrium. In a boundary equilibrium the IC is not binding, such that \( G(\theta^*, s^*) < 0 \) and \( \lambda = 0 \). From (8), households choose the level of transfer that maximizes expected periodic consumption utility: \( u^e_\theta(s, \theta) = 0 \), implying \( \theta^* = \Delta \). Intuitively, in a boundary equilibrium, the households choose the transfer level equal to the size of the income shock. As a result, consumption is equal across households in all states of nature, implying that the informal insurance arrangement results in complete risk-pooling.

As noted before, the value of socialization lies in its ability to permit larger transfers and thereby greater risk sharing in informal insurance arrangements. Because the unconstrained equilibrium results in complete risk pooling, there is no reason for parents to engage in costly socialization efforts. More formally, substituting \( \lambda = 0 \) into (9), we find that the disutility of socialization is positive, \( \mu = 1 + r > 0 \), which implies \( s^* = 0 \).
Next, consider an interior equilibrium in which \( G(\theta, s) = 0 \) and \( \lambda > 0 \). In this case, (8) becomes \( u_\theta^*(\theta) = \lambda G_\theta(\theta, s) > 0 \), implying less than complete risk sharing, \( \theta^* < \Delta \), such that both expected utility and the IC are increasing in transfer size, \( u_\theta^*(\theta^*) > 0 \) and \( G_\theta(\theta^*, s) > 0 \), where the final inequality follows from (9) and \( \lambda > 0 \). Incomplete informal risk pooling in an interior equilibrium provides an economic rationale for collectivist socialization. In particular, by increasing the disutility of reneging on a risk sharing arrangement, socialization relaxes the IC, permitting greater risk sharing. Substituting (8) into (9) to eliminate \( \lambda \), the condition for optimal socialization can be expressed as

\[
1 + r = u_\theta^*(\theta) \frac{-G_\theta(\theta, s)}{G_s(\theta, s)}.
\]

Note that this condition requires \( G_s(\theta, s) < 0 \), which implies \( q'(s) > 1/r \).

A more revealing version of the optimal socialization condition may be obtained by making use of the fact that, in an interior equilibrium, the IC may be used to define the transfer level as an implicit function of socialization. In particular, define \( \theta = \hat{\theta}(s) \) implicitly by

\[
G(\hat{\theta}(s), s) = 0,
\]

such that \( \hat{\theta}'(s) = \frac{-G_s(\theta, s)}{G_\theta(\theta, s)} > 0 \). Using this function, the optimal socialization condition in (10) may be written as

\[
1 + r = u_\theta^*(\hat{\theta}(s)) \hat{\theta}'(s),
\]

which permits easier interpretation. In particular, the level of socialization is chosen such that the marginal cost of socialization to the parent, \( 1 + r \), is equal to the utility gained by the child from the resulting increase in risk sharing that more collectivist values permit. In an interior equilibrium, the combinations of transfer and socialization levels that satisfy the optimal socialization condition may be represented conveniently in the following form:

\[
H(\theta, s) = u_\theta^*(\theta)[rq'(s) - 1] - (1 + r)G_\theta(\theta, s) = 0
\]

Figure 1 illustrates an interior equilibrium in the \( s-\theta \) plane. This occurs at the intersection of the IC and the condition for optimal socialization. As shown in figure 1, the optimal socialization locus is downward sloping, as indicated by

\[
\left. \frac{d\theta}{ds} \right|_{H=0} = \left. \frac{-H_\theta(\theta, s)}{H_\theta(\theta, s)} \right|_{H=0} = \frac{u_\theta^*rq''(s)}{(1 + r)G_\theta(\theta, s) - G_\theta u_\theta^*} < 0,
\]
where the sign of (11) follows from $G_{\theta \theta} = -(r + p)u''(y_1 - \theta) - p u''(y_2 - \theta) > 0$, 
$u_{\theta \theta}^s = p[u''(y_1 - \theta) + u''(y_2 - \theta)] < 0$, and $G_s < 0$. In a boundary equilibrium, the IC constraint lies entirely above the optimal socialization locus, and the equilibrium occurs at the intersection of the optimal socialization locus and the vertical axis, as indicated by $(s*, \theta*) = (0, \Delta)$.

Results for the two equilibria may be summarized in the following proposition:

**Proposition 1:** The model permits both interior and boundary equilibria in $s - \theta$ space. A boundary equilibrium is characterized by complete risk pooling and the absence of socialization and collectivist social norms: $(\theta^*, s) = (\Delta, 0)$. In contrast, an interior equilibrium is characterized by incomplete risk sharing and positive levels of socialization, as indicated by $\theta^* < \Delta$ and $s^* > 0$. In an interior equilibrium, the equilibrium the transfer size and socialization effort are uniquely determined by $G(\theta, s) = 0$ and $H(\theta, s) = 0$.

Next we consider comparative statics for the constrained equilibrium, and in particular relationship between equilibrium outcomes and the size and probability of income shocks, both of which correspond to an exogenous increase in the riskiness of nature. As shown in figures 2a and 2b, an increase in the riskiness of nature increases the marginal utility of transfers, shifting the optimal socialization locus, $H(\theta, s) = 0$, up and to the right. In addition, an increase in the riskiness of nature increases the value of the informal risk sharing arrangement relative to default, which corresponds to an upward shift of the IC constraint, $G(\theta, s) = 0$. Since both effects act to increase the level of the equilibrium transfer, the sign of the comparative static on equilibrium transfer size are unambiguous:

\[
\begin{align*}
\frac{d \theta^*}{dp} &= \left[ \frac{-1}{\Sigma} \right] \left[ H_s G_p - G_s H_p \right] > 0 \\
\frac{d \theta^*}{d\Delta} &= \left[ \frac{-1}{\Sigma} \right] \left[ H_s G_\Delta - G_s H_\Delta \right] > 0,
\end{align*}
\]

where $\Sigma = G_{\theta}H_s - G_s H_{\theta} < 0$.

In contrast, an increase in the riskiness of nature has offsetting effects on the equilibrium socialization effort. An increase in the riskiness of nature increases in the expected marginal utility of transfers, which increases the return to socialization, as indicated by the upward shift in the optimal socialization locus. However, by increasing the expected value of maintaining the risk-sharing arrangement, an increase in the riskiness of nature relaxes the IC, decreasing the
strength of the social tie that is needed to sustain a given level of transfer in an informal risk sharing arrangement. This corresponds to an upward and inward shift in the IC locus. In spite of this graphic ambiguity, as shown in the appendix, the net effect of an increase in size or probability of an income shock is to increase the equilibrium socialization effort:

\[
\frac{ds}{dp} = \left[ \frac{-1}{\Sigma} \right] \left[ H_p G_\theta - G_p H_\theta \right] > 0
\]

\[
\frac{ds}{d\Delta} = \left[ \frac{-1}{\Sigma} \right] \left[ H_\Delta G_\theta - G_\Delta H_\theta \right] > 0.
\]

The comparative statics in (14) contain the central insight of this model. The model has shown that in the absence of formal insurance contracts, collectivist social bonds may be used to increase the size of transfers that are supported by informal risk sharing arrangements. In addition, parental efforts at socialization are responsive to the size and probability of income shocks. In environments with a greater level of exogenous risk, as indicated by larger or more frequent income shocks, parents have an incentive to exert greater effort at instilling collectivist social norms in their children. These results serve as to motivate the use of rainfall variation as an instrument for individualism in the empirical exercises performed below.

Section 4: Data

The primary measure of development is real per capita income in international prices as reported in the Penn World Tables, 6.3, measured in 1996, a year that is near the average for the data on individualism. Below, I discuss in some detail the definition and construction of individualism and rainfall variation, which are either uncommon or unique to this paper. I employ a variety of economic, cultural and institutional variables as controls in our empirical analysis. As many of these are likely to be familiar to the reader, I briefly define these variables and note their sources as they are introduced in the analysis below.

Individualism

The measure of individualism is taken from the World Values Survey (WVS), which was conducted in four waves beginning in 1981, 1990, 1995 and 2000. Respondents are asked to indicate their position on a ten-point scale where one corresponds to the position that “People
should take more responsibility to provide for themselves” and ten corresponds to the position “The government should take more responsibility to ensure that everyone is provided for.” I subtract responses to this question from eleven to obtain a measure for which higher values correspond to greater individualism. Survey responses are then averaged across individuals and waves to produce a single measure of individualism for each country. Licht et al. (2007) and Gorodnichenko and Roland (2010) use measures of individualism from Schwartz (2006) and Hofstede (2000), respectively. A key advantage of using the WVS is that it provides observations on individualism for 89 countries, relative to 51 countries in Schwartz (2006) and 65 countries in Hofstede (2000).

A potential problem with this measure individualism is that it may confound collectivism with attitudes toward government redistribution. In particular, answers to this question might differ if survey respondents were asked about a different form of collective responsibility; for example, whether family members or the local community or religious institutions “should take more responsibility to ensure that everyone is provided for.” To avoid confusing collectivism with attitudes toward government redistribution, in the analysis below we control for the influence of variables that have been found to influence attitudes toward the redistributonal role of government, including ethnic fractionalization, international openness and a history of socialism.

Rainfall

The proxy for exogenous risk is a measure of rainfall variation constructed from observations of monthly precipitation reported in the Global Historical Climate Network (GHCN) dataset, version 2, which is produced by the National Climatic Data Center at Oak Ridge National Laboratory.¹¹ The dataset consists of over 12 million observations of monthly rainfall, or more precisely precipitation, measured in tenths of millimeters recorded at 20,614 weather stations in 233 countries taken since 1697. Since the quality of the older data may vary, I omit observations from before 1900.

These data are used to generate two variables that measure the average level and variability of monthly rainfall for each country. Our measure of risk is based on the coefficient

¹¹ Version 1 of the GHCN data is described in Peterson and Vose (1997), and the data are available online at http://www.ncdc.noaa.gov/oa/mpp/freedata.html.
of variation of monthly rainfall, which provides a measure rainfall variation relative to the
average level of rainfall. The argument for using the coefficient of variation, rather than the
standard deviation, is that a small change in rainfall probably affects agricultural output more in
areas in which rainfall is relatively scarce. Moreover, the standard deviation of monthly rainfall
is highly correlated with average rainfall, which may affect development through mechanisms
like crop selection that are unrelated to risk. As a result, using the coefficient of variation makes
it less difficult to identify the channel of influence running from risk to cultural norms to
economic development.

I focus on monthly rather than annual variation in rainfall under the assumption that the
timing of rainfall matters for agricultural output. For many crops, rain in November may not be
a good substitute for rain in May. A similar logic underpins the approach employed by
Rosenzweig (1988), Rosenzweig and Binswanger (1993) and Foster and Rosenzweig (2001),
who use the timing of the monsoon, interacted with household assets, to estimate weather related
household-specific income shocks. In contrast, Miguel et al (2004) and Barrios et al. (2010) use
measures of annual rainfall in their work on agricultural output in sub-Saharan Africa.

For each observation point, I compute a separate coefficient of variation of rainfall for
each month. These are then averaged across months for each observation point and then across
observation points within each country to obtain a single measure of national rainfall variation. I
compute the average monthly rainfall for each country in a similar fashion. As the distribution
of these variables is significantly skewed to the left, I use the natural log of both variables in the
remainder of the paper. By reducing the influence of outliers, this transformation increases the
fit of most regressions, but it does not significantly alter the qualitative results. The resulting
variables are \( \ln \text{avrain} \) and \( \ln \text{covrain} \). Table 1 presents data on the natural log of average rainfall
and rainfall variation for the 89 countries in the sample along with the average and standard
development of each variable.

12 Most weather stations record multiple rainfall series collected from different observation points in the surrounding
region. While the GHCN reports information on the geographic location of each weather station, it does not report
the location of individual observation points. It is likely, however, that these vary widely and that the geographic
dispersion of observation points is correlated with development. In particular, in many of the smaller developing
countries all rainfall observations are recorded at a single weather station located in the capital city. In addition,
several weather stations in developing countries record observations from collection points in neighboring countries.
Because of the geographic limitations of the data, I focus on the temporal variation in monthly rainfall at each
observation point, rather than the spatial variation across observation points.
As a proxy for exogenous income shocks, the measure of rainfall variation used here suffers from a number of sources of measurement error. For example, we weigh each month’s observation equally, rather then focusing on rainfall during the growing season, which varies substantially in timing and duration across countries and crops. In addition, this variable does not account for the role of rivers as an alternative source of water, nor does it capture flooding as a source of risk. To the degree that these factors introduce noise into our measure of agricultural risk, the coefficient estimates we present in the following section should be interpreted as the lower bound of the actual effect of rainfall on individualism.

Figure 3 shows the partial relationship between rainfall variation and individualism along with the line that best fits this relationship. As discussed in the following section, this relationship controls for the influence of a history of socialism and is taken from the regressions in column (3B) of Table 3. As seen in Figure 3, there is a strong negative relationship between rainfall variation and individualism. Countries with greater variation in monthly rainfall have lower levels of individualism. In spite of unavoidable measurement error in both variables, the relationship between rainfall variation and individualism is highly significant, with a t-statistic of 5.46.

Table 2 presents data on rainfall variation and selected covariates for the ten countries with the highest and lowest level of rainfall variation for which data on individualism is also available. Note, as expected from Figure 3, that individualism is much higher in low rainfall variation countries, with an average difference in individualism between the two groups of 0.93, which is close to the standard deviation of 0.98. Comparing averages for high and low rainfall variation countries, it is also apparent that rainfall variation is correlated with a number of variables believed to affect economic development or the formation of cultural values. We review these briefly here, as these correlations serve to motivate several of the robustness tests undertaken in section 6.

First, rainfall variation is negatively correlated with average rainfall and distance from the equator. Indeed, average rainfall in the countries with the lowest rainfall variation is over 2.5 times that of average rainfall among the ten countries with the highest rainfall variation. Similarly, on average low rainfall variation countries are more than 17 degrees of latitude further from the equator than are high rainfall variation countries. Because rainfall variation is correlated with other dimension of climate, it will be necessary to control for the impact of
climate on development, including both direct effects that act through agricultural productivity and indirect effects that act through the transfer and evolution of institutions.

Second, high and low rainfall variation countries differ dramatically with respect to geographic region and religious affiliation. Of the ten high rainfall variation countries, seven are in the Middle East or North Africa and the remaining three are in sub-Saharan Africa. In contrast, of the ten countries with the lowest rainfall variation, the majority are European, with five in Western Europe and three in Central Europe. These groups of countries are similarly divided with respect to the dominant religion. Of the countries with the greatest variation in rainfall, six are majority Muslim countries, and the second highest category according to the average share is “other religions,” which includes Judaism, animism and local variants of Christian. In contrast, the countries with the lowest rainfall variation have much larger shares belonging to the Christian traditions, 31% Catholic, 23% Protestant and 8% Orthodox, and greater religious diversity, as indicated by the lower share of the dominant religion. These relationships suggest that rainfall variation may be correlated with other dimensions of cultural variation that are associated with religious or regional groupings.

Section 5: Individualism and Economic Development

This section examines the relationship between individualism and economic development. Development is measured by the natural log of real per capita income in 1996 from the Penn World Tables, mark 6.3. The year is chosen to be near the average year for our survey data on individualism. Our basic empirical model is given by

\[ income_i = \alpha_i + \gamma \cdot individualism_i + \epsilon_i, \]

where \( i \) indexes countries and \( \gamma \) is the primary coefficient of interest.

The first column of Table 3 presents our estimate of equation (15) using an ordinary least squares (OLS) regression with robust standard errors. As seen in the first column of Table 3, the coefficient on individualism is positive, suggesting that it is associated with greater economic development, and statistically significant at the 1% level.

While individualism is positively correlated with good economic outcomes, there are several reasons for being careful when interpreting this relationship as causal. Perhaps the most obvious issue is the endogeneity of individualism to economic and institutional variables that are
correlated with economic development. At the most general level, economic development brings about dramatic changes in the organization of society, including urbanization, increases in the scale of productive units, changes in family structure that tend to de-emphasize extended family and kinship networks, and increased personal mobility, anyone of which plausibly affect cultural values related to individualism and collectivism. For example, the theoretical analysis of informal insurance networks stresses the quality of information regarding the trustworthiness of network members and the probability of future encounters, both of which will tend to be adversely impacted by increases in scale of social organization and individual mobility. If as this discussion suggestions, economic development leads to greater individualism, then the OLS estimate of gamma reported in Table 3 will be biased toward zero, and will therefore underestimate the impact of individualism on development.

Alternately, the endogeneity of individualism may serve to create an upward bias in the OLS estimate of gamma, a problem that is exacerbated by the manner in which we measure individualism. Because the survey question we use to measure individualism contrasts self reliance with government support, it is likely to reflect attitudes toward government redistribution that depend, in turn, on a number of economic and social variables that are highly correlated with per capita income. Indeed, the secular rise of per capita incomes is associated with an increase in the legitimate role of government in general, and in particular with the rise of the welfare state and an increase in the use of policies, such as progressive taxation, specifically designed to influence the distribution of income. If economic development increases the acceptance of the government as an insurer of last resort, then the OLS estimate of gamma presented in column (1) of table 3 will biased upward.

To control for the endogeneity of individualism, we estimate (15) using two-stage least squares (2SLS) and instrument for individualism using the measure of rainfall variation described in the previous section, the natural log of the coefficient of variation of monthly rainfall. That is, we estimate the system of equations

\[
\begin{align*}
\text{income}_i &= \alpha_i + X_i \beta_1 + \gamma \hat{\text{ind}}_i + \epsilon_i \\
\text{individualism}_i &= \alpha_2 + X_i \beta_2 + Z_i \delta + u_i,
\end{align*}
\]

where X is a vector of determinants of income, Z is a vector of instruments, and ind-hat is the exogenous variation in individualism identified by the first stage regression. The identifying assumption for this system of equations is that the instruments, Z, are correctly excluded from
the second stage regression. As discussed further below, this assumption will be violated if rainfall variation is correlated with the error term in the second stage of (16).

IV estimates of this system of equation are shown in columns 2A and 2B of Table 3. As seen in column 2A of Table 3, using the exogenous variation in individualism increases the magnitude of the coefficient on individualism by a factor of 2.5. This suggests that the OLS estimate of this coefficient was biased toward zero, which is consistent with the hypothesis that the changes in social organization that accompany development tend to foster individualism. In addition, note that the coefficient on individualism remains significant at the 1% level. Turning to the first-stage of the regression, shown in column 2B, we see that the coefficient on rainfall variation has the expected sign. Countries that experience greater variation in rainfall tend to have lower levels of individualism as measured by the World Values Survey. Furthermore, rainfall variation is significant at the 1% level, and explains about 11% of the observed variation in individualism across countries. Moreover, the F-statistic for the first-stage regression is 12.36, which is comfortably above the customary threshold for weak instruments.

Next we consider whether our estimates are affected by the omission of variables that may affect an individual’s attitude toward the proper role of government. In particular, we consider two influences on the role of government, a history of socialism and the rise of the welfare state. As noted in Table 2, rainfall variation is low in several former communist countries. Moreover, for the sample as a whole, we find that a history of socialism, as indicated by the presence of a socialist legal heritage, taken from Djankov et al. (1999), is negatively correlated with rainfall variation, corr. = -0.3385. If a history of socialism leads people to favor redistributational government, then rainfall variation will be correlated with the error term in the first-stage regression and the coefficients reported in columns (2A) and (2B) will be biased toward zero.

To test this hypothesis, we include history of socialism as a regressor, with results reported in columns (3A) and (3B). Including history of socialism as a regressor, we find that it is, indeed, strongly negatively correlated with individualism, and significant at the 1% level. More importantly, the inclusion of this variable significantly increases the magnitude of the coefficient on rainfall variation, the precision of the coefficient estimate (t-stat. = 5.46), and the fit of the first-stage regression. In addition, while a history of socialism does not appear to exert an independent influence on economic development, the inclusion of this regressor significantly
increases the precision of the estimate for the coefficient on individualism. Because of strong a\n priori arguments for including this variable and its sizable impact on our estimates of the primary\n coefficients of interest, we include history of socialism in the remaining specifications.

Quantitatively, the estimate of gamma reported in column (3A) suggest that\n individualism has a highly significant impact on economic development. In particular, a one-\n standard exogenous increase in individualism, roughly the difference in the levels of\n individualism of Bangladesh and Portugal or of Portugal and Sweden, is associated with a near\n tripling of per capita income: \( \exp(1.103*0.9797) = 2.947 \). The partial relationships between\n rainfall variation and individualism is shown in Figure 3. The relationship between predicted\n individualism and income is shown in Figure 4.

We turn next to the determinants of attitudes toward government redistribution\n highlighted by Alesina, Glaeser and Sacerdote (2001) in their investigation of the welfare state.\n Alesina et al. (2001) find that support for government redistribution is lower in societies with\n greater ethnic fractionalization, a result that echoes other studies that find that ethnically diverse\n societies are less willing to provide public goods, e.g. Easterly and Levine (1997), Alesina et al.\n (2003) and Alesina, Easterly and Baqir (1999). Alesina et al. (2001) also find evidence to\n support Rodrik’s (1998) claim that economic openness may increase an economy’s exposure to\n risk from term of trade and other international shocks, increasing the demand for a\n redistributinal role for government. In the regressions reported in columns (4A) and (4B), we\n find that both international openness, as measured by the volume of trade in the 1990s, and\n ethnic fractionalization have the expected sign and are significantly related to economic\n development. However, the inclusion of these variables has little impact on the significance or\n magnitude of the coefficients on individualism or rainfall variation. Because the inclusion of\n these variables reduces our sample size by over 10%, we do not include these controls in any\n other regressions.

Finally, we add a second instrumental variable for individualism, a dummy variable for\n whether the primary language permits speakers to drop pronouns. As discussed in section 2, in\n languages that permit pronoun drop, the subject of the sentence is understood in context, a\n linguistic characteristic that has been used by Tabellini (2008a) and Licht et al. (2007) as an\n indicator of collectivism. As seen in column 5B, the coefficient on pronoun drop has the\n expected sign and is highly statistically significant in the first-stage regression. However, the
inclusion of a second instrument has little effect on the coefficients on rainfall variation or individualism. Both continue to have the expected signs and remain significant at the 1% level.

The addition of a second instrument allows us to perform an over-identifying restrictions test. The null hypothesis is that the instruments are correctly excluded from the second stage of the regression. Consistent with the use of robust standard errors, I report the p-value for Wooldrich's robust test of overidentifying restrictions. Given the p-value of this test, I cannot reject the hypothesis that the instruments are correctly excluded from the second stage of the regression. Because the inclusion of the second instrument significantly reduces the size of our sample, I do not include it in the remainder of the analysis.

The evidence presented in this section supports the hypothesis that individualism has a strong, positive effect on economic development. Moreover, rainfall variation appears to decrease individualism, as predicted by the theoretical model presented in section 3, exerting a persistent effect on economic development. Having a socialist history is negatively correlated with both rainfall variation and individualism, suggesting that this variable should be included in the remainder of the analysis to avoid bias in first-stage coefficient estimates. It remains to be shown that these results are robust to potential correlations between rainfall variation and the error term in the second stage regression. I address this issue in the following section.

**Section 6: Robustness**

In this section I address three sources of potential concern over the validity of rainfall variation as an instrument for individualism. These arise because rainfall variation is correlated with variables that plausibly influence the level of economic development and are omitted from the regressions in Table 3, implying that rainfall variation may be correlated with the error term in the second stage of these regressions. First, because rainfall variation is correlated with average rainfall, I consider whether the previous results are robust to the inclusion of variables related to agricultural development and agricultural productivity shocks. Second, because rainfall variation is correlated with other aspects of climate, I consider whether our results are robust to the inclusion of climate variables that have been linked to institutional transfer and development. And third, because rainfall variation is correlated with religious affiliation and geographic
regions, which may in turn serve as proxies for cultural groupings, I consider whether our results are robust to the inclusion of measures of religion and region.

In assessing the robustness of our earlier results to these changes in specification, I take as my reference point the baseline regression in column (3A) and (3B) of Table 3 that includes the variable for a history of socialism as a regressor. In particular, I consider the confidence interval for the coefficients on individualism and rainfall variation established by two standard errors to either side of the point estimate reported above. For the coefficient on individualism, the standard error is 0.2535 and the associated confident interval is (0.596, 1.61). For the coefficient on rainfall variation, the standard error is 0.2040 and the associated confidence interval is (-1.52, -0.706).

Rainfall, Agricultural Output and Economic Development

The first source of concern arises because rainfall variation is negatively correlated with its level of average rainfall, which may affect per capita income through its impact on agricultural productivity and agricultural development. Recent papers by Miguel et al (2004) and Barrios et al. (2010) present evidence that within a country the level of annual rainfall is strongly positively correlated with the contemporaneous level of per capita income, such that rainfall shocks are positively correlated with income shocks. Both papers argue that this relationship depends on the importance of rain-fed agriculture, and thus matters more for African countries, due to their low levels of industrialization and irrigated agriculture. In support of this conjecture, these papers find that income depends positively on rainfall among African countries. In addition, they find that this relationship is not statistically significant for countries in other regions or for non-African developing countries as a whole.

The mechanism linking rainfall to output proposed in these papers differs in significant and testable ways from the relationship I propose here. In particular, both Miguel et al. (2004) and Barrios et al. (2010) argue that current rainfall levels influence short run income levels through their impact on agricultural production. In contrast, I argue that historical levels of rainfall variation exerts an indirect influence on long run development by through its effect on the evolution of highly persistent social norms. In spite of these differences, it is possible that the correlation between rainfall variation and average rainfall biases our previous coefficient estimates in two ways.
One possibility is that short run relationship between rainfall and agricultural output found by Miguel et al. (2004) and Barrios et al. (2010) gives rise to a long run relationship between rainfall and the level of economic development. Economic theory suggests the relationship between agricultural productivity and economic development may be either positive or negative. For example, in Matsuyama (1992) the agricultural sector provides a source of demand for industrial goods, increasing the rate of economic growth, and competes with the industrial sector for resources, reducing the rate of economic growth. Thus, the omission of average rainfall from our initial specification may bias the coefficient on individualism in either direction.

To control for the impact of average rainfall on economic development, I add the natural log of average monthly rainfall, reported in Table 1, as a regressor to our baseline specification. As seen in column (1B) of Table 4, the inclusion of average rainfall does not appear to have much effect on the first stage of the regression. The coefficient on average rainfall itself is not significant, while the coefficient on rainfall variation remains highly significant and is similar in magnitude to the values previously reported. The coefficient on average rainfall is negative and highly significant in the second stage regression, which is consistent with a negative relationship between agricultural productivity and long run economic development. Moreover, with the inclusion of average rainfall, the coefficient on individualism increases in magnitude and remains highly significant. These results suggest that, if anything, the omission of average rainfall from our earlier regressions may have led us to underestimate the role of individualism in economic development, though it should be noted that the coefficient value reported in column (1A) of Table 4 is well within the confidence interval for this coefficient established above.

A second source of potential bias exists if the rainfall shock in 1996 causes current output to deviate from its equilibrium level, such that per capita income in 1996 is a noisier measure of long run development in countries with greater rainfall variation. In addition, note some aspects of annual weather patterns are regional or global in nature; for example, Barrios et al. (2010) provide evidence that the post-war period in Africa has been characterized overwhelmingly by negative rainfall shocks. Because of this the measurement error introduced by annual rainfall shocks is unlikely to classical in nature. In particular, it may be correlated with both rainfall variation and regional income levels and, thus, has the potential to bias the coefficient on individualism in the second state regressions in Table 3.
To test whether the omission of annual rainfall shocks does indeed bias our results, I construct a measure of the rainfall shock in 1996, which is equal to the share of agriculture in national output multiplied by difference in the log of annual rainfall in 1996 from the log of average annual rainfall. As seen in columns (2A) and (2B), the inclusion of this variable does not have much effect on our results. The variable for rainfall shock is not significant in either the first or second stage regression, and the inclusion of this variable does not have an appreciable effect on either coefficient of interest. The coefficients on individualism and rainfall variation are similar in magnitude to what was previously reported, and both remain significant at the 99% level. Note that the absence of a significant effect of the rainfall shock on output is in keeping with the results reported Miguel et al. (2004) and Barrios et al. (2010), who fail to find a robust relationship between rainfall and income levels for non-African countries.

As a final test of the robustness of our results, we run our initial specification on a sample that is restricted to countries that are not in sub-Saharan Africa. As noted above, both Miguel et al. (2004) and Barrios et al. (2010) report that the relationship between rainfall shocks and income levels is insignificant for various samples of non-African countries. If the correlation between rainfall variation and development were due to an agricultural channel rather than a cultural channel, we might expect this relationship to be less important in countries in which rain-fed agriculture is less important to national output. However, as reported in columns (3A) and (3B) of Table 4, the omission of African countries from our sample does not significantly affect our coefficient estimates. In particular, while somewhat smaller in magnitude, the coefficient on individualism reported in column (3A) of Table 4 is just over one standard error less than that the coefficient estimate from our baseline regression. Once again, the robustness of our primary results suggests to these variations in specification suggests that the correlations between historical rainfall variation, agricultural development and current rainfall shocks do not significantly bias our results.

Rainfall, Climate and Institutional Transfer

As noted in our preliminary examination of the data on rainfall variation in Table 2, countries with highly variable rainfall are more likely to be located near the equator than those with less variable rainfall. This raises an important concern with the econometric specification employed in Table 3. Previous work on institutions and development has highlighted important
links between certain dimensions of climate and the transfer of institutions under colonial rule. If rainfall variation is positively correlated with aspects of climate related to low levels of institutional quality, then the coefficient estimate for individualism presented in Table 3 will be biased away from zero. That is, we may have mistakenly attributed to individualism some part of the role that institutional quality plays economic development.

As pointed out by Acemoglu, Johnson and Robinson, it is highly likely that institutional quality is itself endogenous to the development process, and as argued more recently by Tabellini (2008a) and Licht et al. (2007), institutional quality may depend on aspects of culture related to individualism. Because of this, in assessing the role of institutional quality on we rely on the exogenous shocks to institutional quality that occurred during colonization. In particular, we examine two well-known hypotheses regarding the role of tropical location and crop selection in colonial institutional transfer and development.

The first hypothesis regards the role of location in the tropics on the transfer of institutions during colonization. Acemoglu, Johnson and Robinson (2001) have argued that climate affected the disease burden faced by European immigrants, and that colonies in which the disease burden was particularly high were developed as extractive colonies and consequently did not develop institutions for the protection for private property. A related hypothesis by Hall and Jones (1999) holds that European immigration and settlement was greater in countries with higher latitudes. Because of limited overlap between our dataset with that for which Acemoglu, Johnson and Robinson (2001) present data on European settler mortality rates, we focus on the related hypothesis that European immigration was higher in colonies at higher latitudes, as suggested by Hall and Jones (1999).

The second hypothesis, due to Engermann and Sokoloff (1997, 2002), holds that the nature of the primary crops produced in each colony had a strong impact on its institutional development. In colonies that specialized in crops or minerals that involved significant economies of scale, European colonists tended to limit immigration resulting in highly unequal distribution of economic and political power that persisted in the form of institutions designed to preserve the relative status of European and non-European (indigenous and slave) populations. In particular, Engermann and Sokoloff (1997) highlight the roles of wheat and sugar production in colonial institutional development, arguing that sugar production being closely associated with plantation agriculture, high income inequality and restrictive institutions. In keeping with this,
we employ a measure of crop selection developed by Easterly (2007), which is the natural log of the share of land suitable for wheat cultivation relative to that suitable for sugarcane cultivation, who finds strong empirical support for the links between crops, inequality and institutional quality proposed by Engermann and Sokoloff.

Our results are presented in Table 5, in which we include as regressors first the distance from the equator, then the log of the wheat-sugar ratio, and finally both measures of institutional transfer. As seen in columns 1A, 2A, and 3A, the inclusion of proxies for institutional transfer somewhat reduces the magnitude of the coefficient on individualism relative that reported for the baseline regression. These results are consistent with the hypothesis that the omission of variables linked to institutions transfer resulted in biased estimates of the relationship between individualism and development in Table 3. Note, however, that in each regression the reported coefficient is greater than the lower bound of the standard confidence interval established above, (0.596, 1.61). Moreover, in each regression the coefficient on individualism remains significant at the 1% level. Note also that the positive coefficient on distance from the equator in column (1B), though only significant at the 10% level, suggests that institutions play a role in the evolution of culture. This finding is consistent with Tabellini’s (2008a) finding that a history of despotic government is negatively associated with respect for individual human rights.

**Regional and Religious Correlates of Culture**

A third source of potential bias of our previous estimates concerns the omission of cultural variables that are correlated with individualism and have an independent effect on economic development. The notion that specific values and beliefs are highly correlated with each other is widely accepted, and indeed it is arguably the correlations among different values, beliefs and norms that people are referring to when they speak of culture. The idea that values can be meaningfully aggregated into cultures, and that these cultural groups are roughly identified with either religious traditions or regional location, is a fundamental assumption underlying such diverse work as Weber (1930), Huntington (1993), Landes (1998) and Djankov et al. (1999), and the widespread use of religious affiliation and regional dummy variables in cross-country econometric analysis.\(^{13}\) As noted in Table 2, rainfall variation is correlated with

\(^{13}\) The aggregation of cultural values has also been examined econometrically. For example, Schwartz (2006) finds that the covariation among seven dimensions of cultural values, including three related to individualism, may be
religious affiliation and regional location. If it is also correlated with cultural values (other than individualism) that influence economic development, then the coefficient estimates from our baseline regression will be biased.

We control for the influence of religion on development by including variables that measure the share of a country’s population affiliated with each of a number of prominent religious traditions that were compiled by Barro and McCleary (2006). In particular, I use five categories of religious affiliation, measuring the share of a country’s population that is Protestant, Catholic, Orthodox, Muslim, is non-religious and professes another religion, which is the omitted category in our regressions. Our second control for omitted cultural variables relies on the correlation between culture and regional location. Not only are regional categories correlated with religious affiliation and Huntington’s civilizations, but the cultures identified by factor analysis of values variables by Schwartz (2006) finds that cultures are geographically concentrated. In controlling for regions, we control both for regional variation in religious and philosophical traditions and for other political and historical factors that may influence cultural evolution. Our regional dummy variables are taken from Easterly (2001) and the omitted regional categories are Western Europe and North America.

Results from these regressions are reported in Table 6. Two results are worth noting in column (1A) of Table 6, which incorporates religious affiliation shares as regressors. First, the coefficient on individualism is now only significant at the 10% level, suggesting that levels of individualism vary much less among coreligionists. However, at 1.208, the magnitude of this coefficient is well within the confidence interval established earlier in our baseline regression. Second, none of the religious affiliation variables is itself significant. Thus, based on the evidence presented here, we cannot reject the hypothesis that religious affiliation does not affect development beyond its impact on individualism and collectivism.

As seen in column (1B), the share of a country’s population that is Protestant is positively correlated with individualism and significant at the 1% level. The share of the population that is Catholic also has a positive effect on individualism, though the coefficient is smaller than that for Protestantism and has a lower level of significance. While the coefficient on rainfall variation

used to define a number of distinct cultures, that correspond to regional groupings. Similarly, Owen and Videras (2006) employ latent class analysis to aggregate religious beliefs into broader categories that are related a person’s understanding of the supernatural, e.g. traditionalism, spiritualism, secularism, etc., and show that these groupings matter for explaining an individual’s environmental behavior.
remains significant at the 5% level, at -0.575, it lies just above the upper bound of the confidence interval on this coefficient established in our baseline regression. These results indicate that the religious affiliation variables are highly correlated with rainfall variation and, in the absence of supernatural mechanisms through which religious affiliation affects weather patterns, may suggest a tendency for religions to spread more easily to countries that have similar rainfall patterns. The results presented here suggest the need for further investigation of the nature of the linkages between rainfall variation, religious affiliation and individualism.

Columns (2A) and (2B) report results from the regression including regional dummy variables. Three results are noteworthy in the first-stage regression. First, controlling for rainfall variation, every included region has a level of individualism that are significantly lower than that of the two omitted regions, Western Europe and North America, though the coefficients on two regions, the Middle East and North Africa and South Asia, are significant only at the 10% level. Second, the inclusion of regional dummy variables significantly reduces the coefficient on rainfall variation, though the reported value is just with the confidence interval reported earlier. This result is consistent with the hypothesis that omitted regional variables have a significant effect on individualism beyond that captured by the regional differences in rainfall variation. Finally, note that rainfall variation is still significant at the 5% level, suggesting that intraregional differences in the rainfall variation are still sufficient to estimate this coefficient with a fair degree of accuracy.

Turning to the results for the second stage regression reported in (2A), we see that controlling for differences in individualism attributable to rainfall variation and regional location, only two of the regional dummy variables remain significant in determining per capita income, South Asia and sub-Saharan Africa. This result suggests that, with the exception of these two regions, regional differences in individualism go a long way toward accounting for interregional differences in the average level of economic development. Second, the inclusion of regional dummy variables reduces both the magnitude and level of statistical significance of the coefficient on individualism in the second stage regression is both smaller and significant at the 10% level. This suggests the intra-regional variation in individualism is not sufficient to estimate this coefficient more precisely.

In conclusion, for the most part, the results from our baseline regression are robust to concerns over the validity of our instrument that arise due to the correlations between rainfall
variation and variables related to agriculture, institutional transfer, and cultural categories associated with regional location and religious affiliation. With the inclusion of variables to control for the roles of agriculture and institutional transfer in economic development, the coefficients on rainfall variation and individualism remain significant at the 1% level in every specification. In addition, while the magnitude of the coefficients vary to some degree across specifications, in every specification they are within the confidence interval established by two standard errors to either side of the point estimate reported in our baseline regression.

The results for regressions including regional location and religious affiliation, which we interpret as proxies for omitted cultural values, raise some concerns. With the inclusion of regional dummy variables, the coefficient on individualism is exactly on the boundary of the established confidence interval, and with the inclusion of religious affiliation variables, the coefficient on rainfall variation falls outside the previously established interval. These results suggest the need for further study of the relationships between individualism and other cultural values, and suggest that looking at religious and regional correlations among different dimensions of culture would be a fruitful place to start. Note also, though, that in both of these cases the coefficient in question remains significant at the 5% level. This suggests that while the precise magnitude of the relationships I examine may be somewhat uncertain, the none of these results calls into question the validity of rainfall variation as an instrument for individualism or the causal role of individualism in economic development.

Section 7: Conclusion

This paper has introduced a new instrument for individualism, the coefficient of variation in monthly rainfall. It developed a simple formal model that links risk to individualism by showing that the return to collective social norms is higher among individuals exposed to greater exogenous variation in income. The evidence presented supports the existence of statistically and economically significant relationships between rainfall variation and individualism and between individualism and economic development. These relationships are robust to the inclusion of controls for agricultural development, measures of climate linked to institutional development, and omitted regional variables. The inclusion of religious affiliation weakens the results somewhat, resulting in a significantly lower coefficient on rainfall variation in the first
stage regression. The evidence presented suggests that individualism plays a positive and economically large role in economic development. The relationship between individualism and religion appears to deserve further attention.

References


Bauer, Peter T. and Basil S. Yamey. 1957. The Economics of Under-Developed Countries. Chicago: University of Chicago

Berg, B., Volatility, integration and grain banks: studies in harvests, rye prices and institutional development of the parish magasins in Sweden in the 18th and 19th centuries, Economic Research Institute, Stockholm School of Economics (EFI), 2007


Figures:

**Figure 1**: An interior equilibrium

![Diagram of Figure 1 showing an interior equilibrium with $G(s, \theta) = 0$ and $H(s, \theta) = 0$.]

**Figure 2a**: An increase in the size of a shock, $\Delta$

![Diagram of Figure 2a showing an increase in the size of a shock with $G(s, \theta, \Delta') = 0$ and $H(s, \theta, \Delta') = 0$.]

**Figure 2b**: An increase in the probability of a shock, $p$

![Diagram of Figure 2b showing an increase in the probability of a shock with $G(s, \theta, p') = 0$ and $H(s, \theta, p') = 0$.]
Figure 3: Rainfall Variation and Individualism, controlling for socialist history

Figure 4: Instrumented Individualism and Development, controlling for socialist history
Table 1: Rainfall Data for 89 Countries

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### Table 2: High and Low Rainfall Variation Countries, Selected Variables

#### Table 2A: High Rainfall Variation Countries

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### Table 3: Individualism and Development

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* significant at 10%; ** significant at 5%; *** significant at 1%
Columns (1), (2B), (3B), (4B) and (5B) robust t statistics in parentheses.
Columns (2A), (3A), (4A) and (5A) robust z statistics in parentheses.

### Table 4: Robustness: Rainfall, Agriculture and Development

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* significant at 10%; ** significant at 5%; *** significant at 1%
A columns: Robust z statistics in parentheses.
B columns: Robust t statistics in parentheses.
Columns (4A) and (4B): Sample is restricted to countries not in sub-Saharan Africa.
Table 5: Robustness: Climate and Institutions

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* significant at 10%; ** significant at 5%; *** significant at 1%
A columns: Robust z statistics in parentheses.
B columns: Robust t statistics in parentheses.
Table 6: Robustness Tests: Religious Affiliation and Regional Location

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* significant at 10%; ** significant at 5%; *** significant at 1%

Robust t statistics in parentheses
Robust z statistics in parentheses
Appendix: Not for Publication

This appendix signs the comparative statics reported in (14). The equilibrium transfer and socialization are given by

\[ G(\theta, s) = r[u(y_1) - u(y_1 - \theta) - q(s)] - p[u(y_2 + \theta) + u(y_1 - \theta) - u(y_1) - u(y_2)] + s = 0 \]

and

\[ H(\theta, s) = p[u'(y_2 + \theta) - u'(y_1 - \theta)][rq'(s) - 1] - (1 + r)[(r + p)u'(y_1 - \theta) - pu'(y_2 + \theta)] = 0. \]

At an interior equilibrium, the partial derivatives of these equations may be signed as follows:

\[ G_\theta = (r + p)u'(y_1 - \theta) - pu'(y_2 + \theta) > 0 \]
\[ G_s = 1 - rq'(s) < 0 \]
\[ G_p = -[u(y_2 + \theta) + u(y_1 - \theta) - u(y_1) - u(y_2)] < 0 \]
\[ G_\Delta = (r + p)\left[u'(y + \Delta) - u'(y + \Delta - \theta)\right] + p\left[u'(y - \Delta + \theta) - u'(y - \Delta)\right] < 0 \]
\[ H_\theta = \left[rq'(s) - 1\right]\left[p\left[u''(y_1 - \theta) + u''(y_2 - \theta)\right]\right] + (1 + r)\left[(r + p)u''(y_1 - \theta) + pu''(y_2 - \theta)\right] < 0 \]
\[ H_s = u^*_s r q''(s) < 0. \]

Comparative statics for the probability and size of income shocks are given by

\[ \begin{bmatrix} \frac{d\theta}{ds} \\ \frac{ds}{dp} \end{bmatrix} = \begin{bmatrix} -1 \\ \Sigma \end{bmatrix} \begin{bmatrix} H_s & -G_s \\ -H_\theta & G_\theta \end{bmatrix} \begin{bmatrix} G_p dp + G_\Delta d\Delta \\ H_p dp + H_\Delta d\Delta \end{bmatrix} \]

where \( \Sigma = G_\theta H_s - G_s H_\theta < 0 \). Comparative statics for transfer size are therefore:

\[ \frac{d\theta}{dp} = \begin{bmatrix} -1 \\ \Sigma \end{bmatrix} \begin{bmatrix} H_s G_p - G_s H_p \end{bmatrix} > 0 \]
\[ \frac{d\theta}{d\Delta} = \begin{bmatrix} -1 \\ \Sigma \end{bmatrix} \begin{bmatrix} H_\Delta G_\theta - G_\Delta H_\theta \end{bmatrix} > 0 \]

where the signs follow directly from the partial derivatives above. Additional analysis is necessary, however, to sign the comparative statics of socialization:

\[ \frac{ds}{dp} = \begin{bmatrix} -1 \\ \Sigma \end{bmatrix} \begin{bmatrix} H_p G_\theta - G_p H_\theta \end{bmatrix} \]
\[ \frac{ds}{d\Delta} = \begin{bmatrix} -1 \\ \Sigma \end{bmatrix} \begin{bmatrix} H_s G_\theta - G_s H_\theta \end{bmatrix}, \]

which we sign by applying the Le Chatelier principle.

Define \( \hat{s}(\theta; p) \) such that \( G(\theta, \hat{s}(\theta); p) = 0 \), and let \( \theta^*(p) \) solve the problem

\[ \max_{\theta} F(\theta; p) = u'(\theta; p) - (1 + r)\hat{s}(\theta; p), \text{ such that } F_\theta(\theta^*(p); p) = u^*_\theta(\theta^*(p); p) - \]

44
\[-(1 + r) \left[ -\frac{G_\theta(\theta^*(p); p)}{G_s(\theta^*(p); p)} \right] = 0 \text{ and } \theta^*(p) = \frac{-H_p}{H_\theta} \] Note that the ordered triple 

\[(\theta^*(p), \hat{s}(\theta^*(p)), p)\] satisfies both conditions for an interior equilibrium for the problem in (5).

Furthermore, denote by \(R(p) = F(\theta^*(p); p)\) the value of the maximized function.

In addition, let \(\bar{\theta}(p)\) max \(F(\theta; p)\) subject to the constraint \(G(\theta, \hat{s}(\theta^*(p_0); p) = 0\), for some
fixed value \(p_0 \in (0, 1)\), such that \(\bar{\theta}'(p) = \frac{-G_p}{G_\theta}\) and \(\bar{\theta}(p_0) = \theta^*(p_0)\). And, furthermore, let \(Q(p) = F(\bar{\theta}(p); p)\) be the value of the maximized function for this second problem. It follows from the Le Chatelier principle that \(Q_{pp}(p_0) < R_{pp}(p_0)\). Substituting in from above, we have

\[
F_{\bar{\theta}p}(\bar{\theta}(p_0), p_0)\bar{\theta}'(p_0) + F_{pp}(\bar{\theta}(p_0), p_0) < F_{\theta p}(\theta^*(p_0), p_0)\theta^*(p_0) + F_{pp}(\bar{\theta}(p_0), p_0)
\]

\[
F_{\bar{\theta}p}(\bar{\theta}(p_0), p_0) \left[ \frac{-G_p}{G_\theta} \right] < F_{\theta p}(\theta^*(p_0), p_0) \left[ \frac{-H_p}{H_\theta} \right]
\]

\[
\frac{G_p}{G_\theta} > \frac{H_p}{H_\theta}
\]

\[
H_p G_\theta > G_p H_\theta
\]

Since \(p_0\) was freely chosen, this inequality holds for all \(p\), allowing us to sign the comparative static,

\[
\frac{ds}{dp} = \left[ -\frac{1}{\Sigma} \right] \left[ H_p G_\theta - G_p H_\theta \right] > 0, \text{ as reported in the text. In the derivation above, the third inequality follows from } F_{\theta p} = u_{\theta p} + (1 + r) \left[ \frac{G_{\theta p}}{G_s} - \frac{G_\theta}{G_s^2} G_{ss} \right] > 0, \text{ which in turn follows from the following partial derivatives:}
\]

\[
u_{\theta p} = [u'(y_2 + \theta) - u'(y_1 - \theta)] > 0,
\]

\[
G_{\theta p} = -u_{\theta p} < 0,
\]

\[
G_{ss} = -rq''(s) > 0,
\]

\[
G_s = rq'(s) - 1 < 0, \text{ and }
\]

\[
\frac{G_s}{c'p} = -\frac{G_p}{G_s} < 0.
\]

A parallel argument may be used to show \(\frac{ds}{d\Delta} = \left[ -\frac{1}{\Sigma} \right] \left[ H_\Delta G_\theta - G_\Delta H_\theta \right] > 0\). In particular, replacing \(p\) with \(\Delta\) in the previous paragraphs, we have:
\[
Q_{\Delta \Delta}(\Lambda_0) < R_{\Delta \Delta}(\Lambda_0)
\]
\[
F_{\partial \Lambda}(\hat{\Delta}(\Lambda_0), \Lambda_0) \left[ -\frac{G_{\Lambda}}{G_{\theta}} \right] < F_{\partial \Lambda}(\hat{\Delta}(\Lambda_0), \Lambda_0) \left[ -\frac{H_{\Lambda}}{H_{\theta}} \right]
\]
\[
\frac{G_{\Lambda}}{G_{\theta}} > \frac{H_{\Lambda}}{H_{\theta}}
\]
\[
H_{\Lambda} G_{\theta} > G_{\Lambda} H_{\theta}
\]

where the third inequality follows from \( F_{\partial \Lambda} = u_{\partial \Lambda}^{\varepsilon} + (1 + r) \left[ \frac{G_{\partial \Lambda}}{G_{s}} - \frac{G_{\theta}}{G_{s}^2} G_{ss} \frac{\partial \tilde{s}}{\partial \Delta} \right] > 0 \), which may be signed using the following partial derivatives:

\[
u_{\partial \Lambda}^{\varepsilon} = -p [u^{\varepsilon}(\gamma - \Delta + \theta) + u^{\varepsilon}(\gamma + \Delta - \theta)] > 0,
\]
\[
G_{\partial \Lambda} = (r + p)u^{\varepsilon}(\gamma + \Delta - \theta) + pu^{\varepsilon}(\gamma - \Delta + \theta) < 0, \quad \text{and}
\]
\[
\frac{\partial \tilde{s}}{\partial \Delta} = -\frac{G_{\Lambda}}{G_{s}} < 0.
\]

This shows \( \frac{ds}{d\Delta} > 0 \), as reported in the text.