PARASITICAL CULTURES AND THE ORIGINS OF INSTITUTIONS

ABSTRACT

Do cultural attitudes have an effect on institutions and economic performance? This paper suggests that they do. To measure cultural attitudes, we use prevalence rates of the common parasite *toxoplasma gondii,* infection of which is known to affect individual attitudes and societal value orientations in predictable ways. By using prevalence rates of *toxoplasma gondii* as instrument for cultural variation, we are able to isolate the effects of cultural attitudes on institutions, distinguishing them from the effects of institutions and economic outcomes on culture. We thus find that variation in our indicators of cultural attitudes are strongly correlated with economic performance, and significant determinants of several dimensions of institutional quality.

INTRODUCTION

Institutions matter. There is broad consensus that the quality of the institutional environment, issues like secure property rights, rule of law, and absence of corruption, is an important element of a good business climate (Durnev, Errunza and Molchanov 2009; Globerman and Shapiro 2003; Kaufmann 1999). Variation in institutional environment is generally considered to explain differences in performance and behavior of firms from different countries (e.g. Capelleras, Mole, Greene and Storey 2008; Castrogiovanni 1992; Chacar, Newburry and Vissa 2010; Dikova and van Witteloostuijn, 2007; Hall and Soskice 2001; Luk, Yau, Sin, Tse, Chow and Lee 2008; Orr and Scott 2008) . Also,

institutional distance between home and host countries is believed to raise costs and risks for firms going abroad, affecting location and entry mode decisions of MNE's (Brouthers 2002; Dow and Karunaratna 2006; Guler and Guillén 2010; Slangen and Beugelsdijk 2010; Meyer 2001; Henisz and Swaminathan 2008; Wan and Hoskisson 2003).

More challenging is the question where these differences in institutions come from. Institutional differences have been retraced to historical variations in conditions, which set in motion divergent evolutionary paths (Acemoglu, Johnson and Robinson 2001; Engermann and Sokoloff 1997, 2002; Greif 1994, 2006; LaPorta et al 1998, 2008; North 1991; Tabellini 2007). In this debate, culture—differences in values, norms and beliefs—has attracted special attention as source of institutions, especially in International Business studies (Beugelsdijk and Maseland 2011; Landes 1998).

Empirical support for this link between culture and institutions is problematic, however. To address culture, researchers generally use survey measures such as those by Hofstede (2001) , GLOBE (House et al 2004), Schwartz (1994) or the World Values Survey (Inglehart 1997). Increasingly, however, such approaches have come under fire for not being able to distinguish variation in cultural attitudes from variation in institutional environments (Clarke et al 1999; Beugelsdijk 2006; Fernandez 2010; Maseland and van Hoorn 2009, 2010a, 2010b). We often do not know to what extent observed differences are retraceable to differences in 'mental programs' (Hofstede and Hofstede 2005, 2), and to what extent they are a reflection of similarly programmed agents responding to different contexts. This creates a problem: if our measures of cultural attitudes are reflections of differences in institutional contexts, they cannot be used to explain differences in these institutional contexts.

To assess the effects of culture on institutional environment, we need an instrument for cultural attitudes that is reasonably independent from institutional context. This paper provides such an instrument in the form of a biological determinant of culture; the prevalence of a pathogen called *toxoplasma gondii*. Infection with this parasite generally causes only temporary, mild flu-like symptoms, but has been shown to have enduring effects on individual personality (Flegr et al 1996; Webster 2001). For instance, infection tends to increase the focus on ego, ambition, material possessions, and self-achievement while it limits novelty-seeking, concern for relations and other people, and being rule-conscious, dutiful, conscientious, moralistic among males. Also, infected people tend to be more apprehensive, self-doubting, worried, and insecure. As a result of these effects on individuals, the parasite has been shown to affect culture in predictable ways, high prevalence rates being associated higher scores on aggregate neuroticism and cultural masculinity (Lafferty 2006). What is more, prevalence is common in industrialized societies, while prevalence rates vary strongly between them without apparent relation to economically relevant differences in social circumstances. These characteristics make prevalence rates of *toxoplasma gondii* a suitable proxy for cultural attitudes that is independent of institutional environment.

On basis of an analysis of 39 countries, this paper shows that differences in seroprevalence rates of toxoplasma, as a proxy for cultural attitudes, significantly explain a large part of the variation in institutional quality between societies, thus affecting performance of firms. This result is robust to controls for geographical features, income levels, and direct effects of seroprevalence rates on economic performance. In this way this paper empirically confirms the thesis, put forward in institutional theory (North 2005;

Williamson 2000) and historical analysis (Landes 1998), that cultural attitudes determine the institutional environment.

2. INSTITUTIONS AND CULTURE

The Origins of Institutions

Nowadays, it is a commonplace to claim that the quality of institutions is a crucial factor in explaining differences in economic behavior and performance around the world (Acemoglu, Johnson, and Robinson 2001; Durnev, Errunza and Molchanov 2009; Easterly and Levine 2003; Engerman and Sokoloff 1997; Globerman and Shapiro 2003; Hall and Jones 1999; Hall and Soskice 2001; Henisz and Swaminathan 2008; Kaufmann et al 2002; Rodrik et al 2004). In situations where investors feel secure about their property rights, legal and macro-economic risks are limited, bureaucratic hurdles are minimized and access to functioning markets is secured, businesses are more likely to thrive. Societies where investors face high expropriation risks, recourse to the law is limited, corruption is severe, or bureaucratic demands are stifling, make it less attractive for entrepreneurs to invest.

Why do some societies have better quality institutions than others? Explanations typically go back to the historical roots of current institutions, arguing that initial differences in circumstances had lasting effects on institutions (Greif 1994, 2006; North et al 2000; Sokoloff and Robinson 2004; see Bertola 2010 for a discussion of this view). Some trace back differences in institutions to legal origins, determined by whether regions have been under (indirect) influence of the Roman empire or influenced by

English common law traditions (Beck et al. 2001; Glaeser and Shleifer 2002; LaPorta et al. 1998, 2008; Stulz and Williamson 2003; Zetzsche 2007).

Another line of literature invokes geography and climate. Tropical countries are thought to have worse institutions, for a variety of reasons. Europeans were more hesitant to settle in tropical regions because of climate and incidence of diseases, not introducing their high quality institutions there (Beck et al 2003; Hall and Jones 1999; Kaufmann et al 1999). Acemoglu, Johnson and Robinson (2001) show that in areas with high settler mortality colonizers tended to set up extractive states. Institutions were not focused on protecting property and promoting access to courts of the general population (as they were in settler colonies), but mainly developed to facilitate exploitation of the land by colonial elites. Sachs and Malaney (2002) add to this the costs of diseases in terms of loss in education, freedom of movement, and openness to trade, all limiting the potential for subsequent improvements in institutions (Rodrik 2003). Engerman and Sokoloff (1997, 2002) make a similar argument, though focusing on the effects of natural resource endowments. The crops grown in countries around the equator typically demanded large plantations worked by slaves or indigenous labor. Severe inequality in ownership of land associated with this type of production fostered extractive institutions that persist until today (Sokoloff and Zolt 2007). Through path-dependence, the effects of initial conditions linger on in today's institutions (Acemoglu et al 2001; Easterly and Levine 2003).

Cultural determinants

Another literature traces differences in institutional quality back to culture (Greif 1994, 2006; Harrison and Huntington 2000; Landes 1998; Tabellini 2007). The idea that culture may affect economic institutions goes back at least to Weber (1992 [1930]), who first argued that Protestant values and attitudes were responsible for the development of capitalist societies in the West. Weber's thesis has inspired a large body of research on the role between attitudes and economic institutions, though most of it is outside economics (e.g. Granato et al. 1996; Kahn 1979; Kim and Park 2003; Tawney 1926). Among economists, interest in culture resurfaced in the wake of new institutionalism (Beugelsdijk and Maseland 2011). New institutional economics stresses the embedded character of institutions in informal attitudes, values and beliefs (North 1991, 2006; Williamson 2000; Williamson 2009; the same point has been made by Hofstede and Hofstede 2005).

Because institutions are embedded, differences in cultural attitudes and values are partially responsible for enduring differences in institutions. Tabellini (2007) distinguishes three areas of attitudes likely to affect institutions: attitudes about the position of the individual vis-à-vis society and the state, trust, and generalized vs. limited morality.

With respect to the first, WVS data about individual self-confidence and sense of control are associated with higher quality institutions and economic performance (Tabellini 2007). Licht, Goldschmidt and Schwartz (2005) argue that a focus on the individual is associated with more rule of law and control of corruption. The reasoning is that a strong belief in individual control reduces demands for regulation and increases accountability. In the same vein, Jing and Graham (2008) show that Hofstede's (2001)

power distance and collectivism measures are positively correlated with regulation, inequality, and corruption. In high power distance cultures people expect and accept that institutions such as property rights, taxation, governance structures and courts are primarily designed to serve a privileged few (Hofstede and Hofstede 2005, 67). Husted et al (1999) show that cultures scoring high on power distance, masculinity and uncertainty avoidance dimensions suffer more from corruption and ineffective institutions. Masculine attitudes are thought to reduce concern for others and society in general (Hofstede 2001), while uncertainty avoidance may increase demand for rules while inducing people to pass over them in order to secure more certain results for themselves.

The second area of attitudes affecting institutions concern trust. Trust is generally associated with better and more flexible institutions. Lack of trust in people may inhibit collective decision-making, increasing the need for complex and costly enforcement mechanisms (Fine 2001; Knack 2000; Putnam 1993). As a result, institutions tend to be inefficient and remain so in low-trust societies, as it becomes hard to mobilize the social resources to change them. It matters whom you trust, however. Tabellini (2007) argues that in hierarchical cultures where codes of conduct and moral guidelines are limited to small circles of related people, this may hinder the development of neutral legal institutions facilitating economic interactions beyond the in-group (see also Greif 1994; Greif and Tabellini 2010). Although limited morality may be efficient in small-scale societies, generalized morality is needed for economic cooperation beyond the in-group (Greif and Tabellini 2010).

In addition to the attitudes discussed by Tabellini (2007), a wide variety of authors has suggested that (following Weber 1904/5) attitudes towards work and time are of importance. Tropical climates have been said to induce indolence and a slower rate of

activity (see Barr 1999; Landes 1998; Mahathir 1970; Montesquieu 1750, cited in Easterly and Levine 2003). Such characteristics also have repercussions on institutional quality: Jing and Graham (2008) show that the value attached to time in a culture is associated with the speed and costs of setting up a business.

The empirical challenge: distinguishing culture from institutions

The many suggestions about a link between culture and institutional quality notwithstanding, unambiguous empirical confirmation remains elusive. The reason for this is that it is hard to distinguish differences in cultural attitudes from responses to differences in institutional environment (Fernandez 2010; Maseland and van Hoorn 2010a). This problem has a methodological and a theoretical dimension. On the methodological level, it is unclear whether measures of culture reflect attitudes or circumstances. For instance, Beugelsdijk (2006) shows that trust measures reflect differences in institutional quality that enables people to trust each other rather than attitudinal traits. More in general, survey measures of cultural attitudes have been argued to reflect differences in conditions, not differences in attitudes (Clark et al 1999; Maseland and van Hoorn 2009, 2010b).

On the theoretical level, the problem is the familiar one of endogeneity; even when measured unambiguously, culture is deemed to determine institutions while institutions are deemed to determine culture. How can we distinguish these effects? Many authors acknowledge the problem, claiming that culture and institutions seem to move together in some kind of symbiotic relationship (Hofstede 2001, 2005; North 1990;

Tabellini 2007). Symbiosis, however, still implies also a causal relation from culture to institutional development; what kind of empirical support do we have for this thesis?

The problem is most effectively addressed in the literature of the epidemiological approach, mostly associated with Raquel Fernandez (Algan and Cahuc 2010; Fernandez 2007, 2008, 2010; Fernandez and Fogli 2005, 2006; Luttmer and Singhal 2008). In the epidemiological approach culture is measured by comparing the behavior and attitudes of immigrants, linking them to measures of culture of their countries of origin. The argument for focusing on immigrants is that formal institutions of the host country are homogenous between them, making it possible to distinguish cultural characteristics from differences in institutional environment. Although an important step forward, this approach does not entirely solve the problem. Different groups of immigrants are likely to encounter different informal institutional environments; some may enter in close-knit communities with strong social support and strict codes of conduct, others are likely to be on their own in their new country. In order to address this, a new line of literature has started looking for truly exogenous proxies for culture, borrowing from advances in personality research showing that personality structures often have biological roots.

3. PATHOGENS AND CULTURE

Literature linking pathogen prevalence to individual personality and culture is on the rise (Fincher et al 2008; Murray and Schaller 2010; Schaller and Murray 2008). In this literature, the usual logic is that individuals in environments with a high prevalence of infectious diseases respond to the threat posed by their environment by closing off their community and warding off potentially infected outsiders. As a result, in-group collective

ties are strengthened, and fear of outsiders increases. Societies plagued by infectious diseases consequentially tend to be more collectivistic and xenophobic, whereas low rates of infection make people more open to outsiders and extravert. On basis of a study of 98 regions throughout the world, Fincher et al (2008) show that collectivism is related to disease prevalence. Similarly, Schaller and Murray (2008) find evidence for a relation between prevalence and openness to experience, extraversion and sociosexuality. If pathogens are able to explain variation in attitudes, a next step is to relate their prevalence to political and economic outcomes induced by these attitudes. Letendre et al (2010) and Thornhill et al (2009) thus argue that pathogen prevalence can be used to predict levels of democratization and rates intra-state armed conflict.

Although interesting, the literature about prevalence of infectious diseases in general is as yet too broad and unspecified to be of much help in cross-cultural studies of institutions. For one thing, different diseases are likely to have different effects on personality and society. If we are to move beyond mere association, we need clearly motivated hypotheses based on characteristics of specific pathogens.

Secondly, the evolutionary argument in much of this literature is difficult to match with empirical studies comparing current countries, without making the problematic assumption that countries are primordial categories whose development is an entirely internal matter. Nations are not biological units. Human history is a constant story of migration, warfare, intermarriage, assimilation, synthesis and imitation. People living in contemporary France are not simply the descendants of the people living in the area centuries ago, let alone that French society and institutions developed in isolation from

developments elsewhere in the world. That makes historical prevalence of disease in France a problematic instrument for French culture.

Finally, and most seriously for our purposes, the prevalence of disease has regularly been invoked as a direct determinant of institutional quality (e.g. Acemoglu et al 2001; Easterly and Levine 2003). For these reasons, disease prevalence in general offers no useful instrument if we seek to investigate the cultural origins of institutions.

Why toxoplasma gondii is an effective instrument for culture

Although disease prevalence *in general* offers no useful instrument to assess culture, the specific prevalence of latent toxoplasmosis does.

Toxoplasma gondii is a protozoan parasite commonly found in the intestines of cats and other felines. Through the cats' faeces it may move on to other species such as mice or rats (Beverley 1976). Upon infecting the intermediate host, the organisms encyst in the brain and other tissues. They may subsequently infect other species when the intermediate host is eaten, thus moving up the food chain. If the intermediate host—usually rodents, but also carnivores like humans—is eaten by felines, the life-cycle is complete (Lafferty 2006)[1].

Latent infection among humans is common, though prevalence rates differ strongly between societies (Tenter et al 2000). Infection, usually caused by consumption of infected meat or ingestion of toxoplasmosis' eggs in food or water contaminated with feline faeces, initially only leads to only mild flu-like symptoms, though more serious effects can occur if foetuses or patients with AIDS are infected (Kasper and Buzoni-Gatel

[1] Occasions of humans eaten by cats are rather rare, so humans are generally a dead end for the parasite.

1998; Kravetz and Federman 2005). In the longer run, parasites may alter the behavior of their intermediate hosts. This trait is believed to be an evolutionary mechanism to increase the chance of hosts being eaten by felines (Moore 2002). There is an increasing amount of evidence that infected humans also appear to experience a variety of long-term personality changes due to changes in neurotransmitter functions (Webster 2001). For instance, infection has been associated with neuroticism and schizophrenia, but also more commonly with less serious personality changes (Lafferty 2006; Torrey and Yolken 2003).

Effects of latent infection differ between men and women. For men, it reduces intelligence, novelty-seeking, and rule-conscious, dutiful, conscientious, and moralistic behavior. Women, by contrast, tend to become more intelligent and conscientious, as well as more outgoing and affectionate. For both men and women, infection may result in increased insecurity, guilt, worrying, and self-doubting (Flegr et al 2000). On the societal level, these effects imply that high prevalence is associated with more differentiated gender roles, increased neuroticism, and more uncertainty avoidance (Lafferty 2006).

If pathogen prevalence in general offers no useful instrument to investigate the effects of culture on institutions, why would prevalence of *toxoplasma gondii* be any better? There are three reasons for this.

First, although infection with *toxoplasma gondii* is very common and globally spread, it only rarely has serious direct health-effects. Behavioral responses to the threat posed by the disease, such as reduced openness to strangers, are therefore likely to be limited. The parasite's widespread occurrence in combination with the relatively limited consequences of infection make it unlikely that differences in prevalence rate are

responsible for patterns of settlement, as in the argument of Acemoglu et al (2001). For this reason, there is little reason to expect effects on institutional quality unrelated to the parasite's effect on attitudes.

Second, prevalence rates of *toxoplasma gondii* are not determined by relevant differences in institutional environment either. Prevalence rates are mainly associated with societal norms about keeping cats as pets, cultural practices of preparing food, and temperate climates with infrequent freezing and thawing (Dubey & Beattie 1988; Tenter et al 2000). Of these, only climate is reasonably linked to economically relevant institutions. For this reason, we control for climate in our study.

Third, and most importantly, infection with *toxoplasma gondii* has been shown to have direct, specific effects on personality and culture, allowing us to formulate clearly motivated hypotheses without having to rely on indirect, evolutionary arguments.

Toxoplasma gondii and institutions: Hypotheses

In order to develop specific hypotheses about the relation between latent toxoplasmosis, institutional development and business performance, we combine the literature about cultural origins of institutions with what we know about the effects of latent toxoplasmosis. First, higher prevalence is associated with higher uncertainty avoidance and self-doubting cultures (Lafferty 2006). Uncertainty avoidance, lower self-confidence and reduced sense of individual control are linked to lesser quality institutions (Tabellini 2007). Institutions are less likely to be responsive to the needs of individual entrepreneurs and other agents when they lack the confidence to scrutinize institutions and make demands. In addition, latent toxoplasmosis tends to increase vigilance and mistrust (Flegr

et al 1996; Flegr 2007; Lindova et al 2006), which also has negative effects on institutional quality. This leads to the following hypothesis:

Hypothesis 1: Higher prevalence of toxoplasma gondii leads to lesser quality institutions.

More specifically, when individuals do not feel able or willing to keep government in check, this is likely to increase abuses such as corruption (Licht et al 2004; Hofstede 2001; Husted et al 1999). Corruption is also associated with so-called cultural masculinity (i.e. strongly differentiated gender roles), which is related to *toxoplasma* prevalence as well (Husted et al 1999; Vitell, Nwachukwu and Barnes 1993). What is more, infection reduces conscientiousness, morality, and rule-conscious behavior among males (which are in most societies disproportionately active in public life and business). All in all, we expect that

Hypothesis 2: Higher prevalence of toxoplasma gondii leads to more corruption.

Thirdly, at the individual level, subjects with latent toxoplasmosis have been shown to prefer strict rules and regulations (even though males feel less bound by rules themselves) (Flegr et al 2003). Also, inflated self-doubt, insecurity, worrying and reduced sense of individual control are likely to lead to increased calls for regulation and a larger role for government (Jing and Graham 2008).

Hypothesis 3: Higher prevalence of toxoplasma gondii leads to more regulation.

Not only the amount of bureaucracy, but also the speed and efficiency of bureaucrats are potentially affected by the character-changing effects of toxoplasmosis. Latent toxoplasmosis may result in lower intelligence and ability to concentrate for longer periods of time (Flegr et al 2002). Also, infected subjects tend to be more reserved, slower (Flegr et al 2003), more vigilant and more dogmatic (Flegr 2007). If these characteristics are widespread, it is likely to have a negative effect on a culture's valuation of time. This increases the time involved in encounters with other people, for example when dealing with tax officials or other bureaucrats (Jing and Graham 2008). We therefore expect bureaucrats acting slower (for similar levels of regulation) in environments with high toxoplasma prevalence.

Hypothesis 4: Higher prevalence of toxoplasma gondii leads to decreased speed of bureaucracy, controlled for the amount of regulation.

A larger government needs is to be financed, even more so when it is run by slower acting bureaucrats. Therefore, the calls for larger government associated with toxoplasma prevalence and the parasite's potential effects on the effectiveness of bureaucrats increase the fiscal burden for the government. This will result in higher taxes.

Hypothesis 5: Higher prevalence of toxoplasma gondii leads to a higher tax rate.

Through their effect on institutions, the attitudes enhanced by latent toxoplasmosis are likely to have an impact on business environment and performance. In addition, attitudinal effects of *toxoplasma gondii* infection may also have direct effects on performance without working via institutions. For example, latent toxoplasmosis reduces intelligence and concentration. For this reason, it is likely to have an effect on education levels in a population. In addition, latent toxoplasmosis tends to make men (the majority of entrepreneurs in most societies) less novelty-seeking and both men and women more insecure and worrying. Together with the parasite's effects on intelligence, this is likely to make people less inclined to develop and pursue new ideas and projects. As a result, Entrepreneurial activities and innovation rates are potentially negatively affected.

Hypothesis 6a: Higher prevalence of toxoplasma gondii leads to lower levels of education.

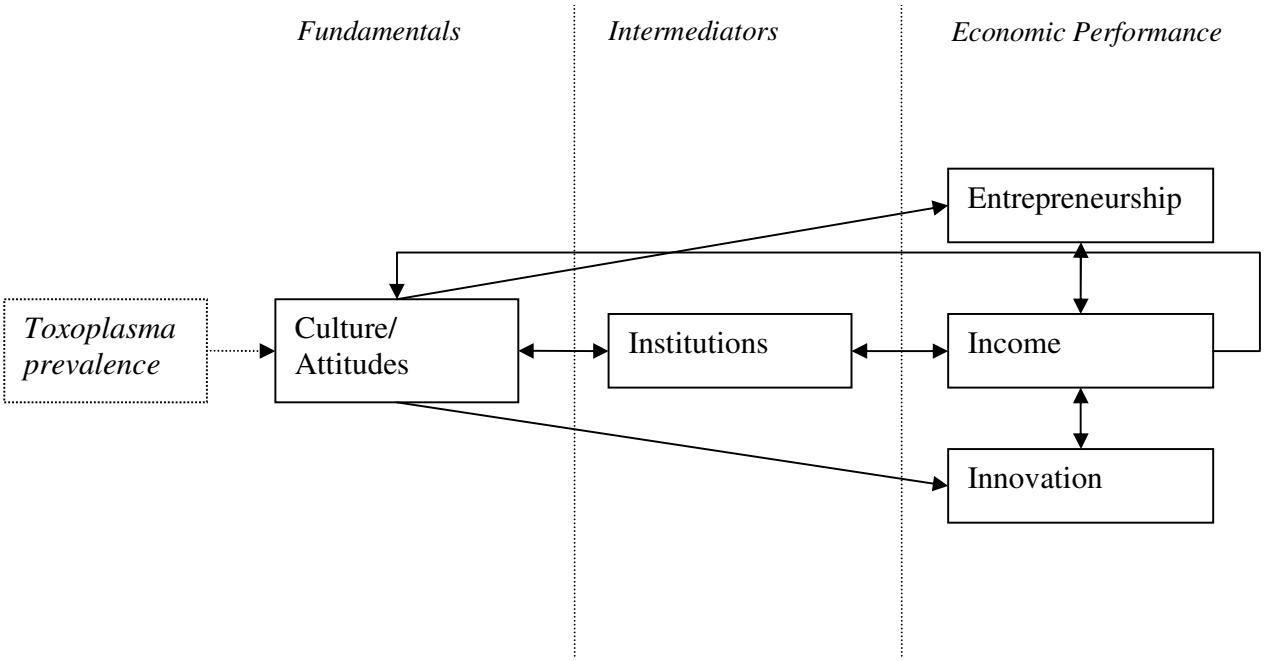
Hypothesis 6b: Higher prevalence of toxoplasma gondii has a negative effect on economic performance (income, innovation, business start-ups).

4. DATA AND ANALYSIS

Figure 1 sketches the complex relation between culture, institutions and economic performance. This figure highlights the empirical difficulty of linking culture to institutions and economic performance. Attitudes have an effect on institutions, and through institutions on economic performance. In addition, economic performance has

repercussions upon institutions and culture. Also, institutions influence culture. Empirically, it is difficult to disentangle the various causal relations in this web.

Figure 1. Relations between culture, institutions and performance



Using the prevalence rate of *toxoplasma gondii* as an instrument for culture/attitudes is a way to do so. As we have argued, prevalence of latent toxoplasmosis is a reasonably exogenous variable that has proven effects on attitudes and culture. If it can be shown to affect institutions and economic performance, we may conclude that culture/ attitudes play a role in institutional and economic development. A condition for this reasoning is that the prevalence of latent toxoplasmosis is not influenced by economic performance. While, as we have argued, there are no apparent reasons to believe that toxoplasmosis is a poverty-related condition, to be sure we include GDP/capita levels as controls in our

analysis of institutions. Since geographical factors such as climate may also influence both institutions, seroprevalence levels and economic performance, we control for distance to the equator as well. Except where indicated, all data we use come from the World Bank Development Indicators dataset[2].

Our main independent variable of interest is the prevalence rates of latent toxoplasmosis. Data are derived from Tenter et al (2000) and the GIDEON data resource (http://www.GIDEONonline.com). Most of the surveys on which these data are based are conducted among pregnant women. To control for country differences in the average age of pregnancy and ensure comparability of prevalence rates between countries, Lafferty (2006) has computed adjusted prevalence rates to a standard age of 22 years. In this study, we use these standardized figures, which are available for 38 countries[3]. Other independent variables include a set of macroeconomic variables such as GNI per capita, tax rates, education statistics, and sector structure. Our measure for a country's distance to the equator is derived from the Mobilgistix data set[4].

As dependent variables, we use a number of indicators of economic performance and a wide range of institutional measures. To assess economic performance we use GNI per capita levels, tertiary education levels, the numbers of new start-ups per capita, and the number of new patents per resident. As a measure of institutional and governance quality, we use the general World Bank's Ease of Doing Business Index alongside a number of measures covering specific aspects of business' institutional environment. To

[2] Publicly available from www.worldbank.org

[3] Countries included are: Argentina, Australia, Austria, Belgium, Brazil, China, Colombia, Croatia, Czech Republic, Denmark, Egypt, Ethiopia, Finland, France, Germany, Greece, Hungary, Indonesia, Ireland, Israel, Italy, Jamaica, Japan, South Korea, Netherlands, Norway, Peru, Poland, Serbia, Slovenia, Spain, Sweden, Switzerland, Thailand, Turkey, United Kingdom, United States, Venezuela.

[4] Data are publicly available from http://www.mobilgistix.com/Resources/GIS/Locations/average-latitude-longitude-countries.aspx.

measure corruption, we use country scores on the Transparency International index[5] (which we prefer above the corruption indicators in the WBDI database, as these are available only for a small part of the countries in our sample).

To assess the level of regulation, we use an index composed of a variety of measures of bureaucracy. This index includes the number of documents required to import and export as indicators of the level of regulation of trade. To measure business regulation, it includes the combined number of procedures required to either register a business, register property, build a warehouse, or enforce a contract. Finally, to assess the extensiveness of tax regulation, the regulation index includes the number of individual tax payments to be made by a firm. An alternative way to measure the extent of regulation is to look at the time firms spent on dealing with bureaucracy. To grasp this, we add up measures of the time involved in getting customs clearance, registering business, and preparing taxes to create an indicator of the speed of bureaucracy. Alternatively, we use the percentage of time management spends dealing with officials. Information about tax rates comes from the World Bank Development Indicators. Table A1 in the appendix provides summary statistics for the main variables.

5. RESULTS

Looking at the results we observe that attitudes, proxied by prevalence of *toxoplasma gondii*, are significantly correlated to three aspects of economic performance (Table 1). GDP per capita levels, innovation and entrepreneurship are all negatively correlated with frequency of latent toxoplasmosis. Mere correlations do not tell us much about the causal

[5] Data are publicly available from www.transparency.org

mechanisms involved, however. It is unclear, for example, whether this result reflects an effect of toxoplasma-induced attitudes on economic performance, or an effect of economic performance on prevalence rates of latent toxoplasmosis.

Table 1 Correlations with economic performance

		Toxoplasma seroprevalence	Start-ups per capita	Patent applications/ residents	GNI per capita
Toxoplasma seroprevalence	*Correlation*	1,000	-,436*	-,344*	-,449**
	Sig		,026	,040	,005
	N	38	26	36	38
Start-ups per capita	*Correlation*	-,436*	1,000	-,115	,643**
	Sig	,026		,569	,000
	N	26	29	27	29
Patent applications/ residents	*Correlation*	-,344*	-,115	1,000	,150
	Sig	,040	,569		,337
	N	36	27	44	43
GNI per capita	*Correlation*	-,449**	,643**	,150	1,000
	Sig	,005	,000	,337	
	N	38	29	43	57

In order to get a clear picture of the causal mechanism behind these results, we turn to the effect of toxoplasmosis prevalence on intermediate institutions, while controlling for economic performance. Is latent prevalence of *toxoplasma gondii* a good predictor of quality of institutions and governance (Hypothesis 1)? Our results provide some indications in favor of this thesis. Table 2 presents the results for our indicator of quality, ease of doing business. We see that seroprevalence rates of *toxoplasma gondii* are significant predictors of institutional quality (Model 1).

Table 2. Quality of Institutions and Governance

	Ease of Doing Business Index (lower scores indicate more business friendly institutions)		
	Model 1	Model 2	Model 3
Constant	12.005 (13.409)	64.577*** (19.876)	78.495*** (23.885)
Toxoplasma seroprevalence	1.323*** (3.69)	1.003*** (.341)	.657* (.346)
Distance to Equator		-1.120*** (.340)	-.326 (.441)
Agricultural employment ratio			-.301 (.645)
GNI per capita			-.001** (.000)
Adjusted R^2	*.242*	*.405*	*.498*
N	*37*	*37*	*36*

Notes: Figures represent unstandardized coefficients. Standard errors in parentheses. * denotes significance at 10% level; ** at the 5% level; * at the 1% level.

The result loses somewhat in strength but remains significant at the 10% level when controlling for distance to the equator, income per capita, and economic structure (Models 2-3). We conclude that Hypothesis 1 is confirmed. The concept and measure of institutional quality is still rather general, however. We would like to know which aspects of the institutional setting are affected in particular. In order to investigate this, we turn to the effect on specific institutions.

Which aspects of the institutional environment are affected?

We check whether prevalence rates of *toxoplasma gondii* determine various specific aspects of business' institutional environment (Table 3). In order to see whether attitudes

affect corruption, we estimate the effect of seroprevalence rates on country scores in the Transparency International corruption index (Models 4-5).

Results provide weak support for an effect of latent toxoplasmosis frequencies on corruption, but it is not robust for macro-economic variables and levels of regulation. We find that the initially observed effect of toxoplasma seroprevalence on corruption loses significance when including these control variables. This suggests that any relation between toxoplasma-induced cultural characteristics and corruption runs through toxoplasmosis' effect on the level of regulation rather than directly through a higher tolerance for corruption.

Observed effects of latent toxoplasmosis rates on several indicators of bureaucracy support this interpretation. The level of regulation is positively related to toxoplasma seroprevalence. This result is significant at the 1% level and robust for including sectoral structure and income levels as controls (Models 6-7). What is more, explanatory power of the model is quite high (with R-squares of . 538 and .711 respectively). Our alternative measures of the extent of bureaucracy (days lost in dealing with bureaucratic procedures and time spent dealing with officials) also appear to be positively related to toxoplasma seroprevalence (Models 8-9, 11-12). These results are all robust for macro-economic controls. We conclude that Hypothesis 3 appears to be confirmed.

However, these results do not tell us whether the observed effects are informed by differences in the extent of bureaucracy due to toxoplasma-related attitudes, or by differences in cognitive skills and valuation of time among bureaucrats. Since latent toxoplasmosis is known to affect intelligence and concentration negatively while raising

dogmatic and distrustful attitudes, we may expect prevalence to have a negative impact on speed of bureaucratic procedures that is not due to the level of regulation. In order to check whether the effect of attitudes on the time lost in dealing with bureaucracy runs through the extent of bureaucracy or via the working speed of bureaucrats, we control for regulation levels when estimating the effect on time-variables (Models 10, 13). We find that the effect of latent toxoplasmosis prevalence disappears when doing so. This leads us to conclude that it is the extent of bureaucracy alone and not the speed of bureaucrats that drives results. While accepting Hypothesis 3, we therefore reject Hypothesis 4.

Turning towards taxes, we find that both the number of tax payments and tax rates are positively influenced by toxoplasma seroprevalence rates, which is in line with our expectations (Models 14-17). These results are robust for controlling for GNI per capita levels and sector structure. Explanatory power of the models dealing with tax rates is rather low, however. We conclude that Hypothesis 5 is to be accepted, although toxoplasma-related attitudes appear not to be a very strong determinant of tax rates. Attitudes are only one of many factors determining governance and institutional structures.

Table 3. Effects on Institutional & Governance Environment

	Dependent Variable:													
	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14	Model 15	Model 16	Mode
	Corruption index	Corruption index	Regulations index	Regulations index	Days lost	Days lost	Days lost	Time dealing with officials	Time dealing with officials	Time dealing with officials	Tax payments	Tax payments	Tax Rates	Tax F
Constant	3.438*** (.859)	6.413*** (1.320)	104.895*** (10.421)	103.289*** (10.536)	79.390 (76.846)	37.375 (105.475)	-11.910 (208.162)	4.130 (5.463)	3.837 (7.968)	-9.063 (15.040)	24.364*** (8.549)	15.549 (10.995)	40.074*** (9.321)	51.75 (10.8
Toxoplasma sero-prevalence	-.033** (.015)	.006 (.011)	.656*** (.176)	.427*** (.152)	2.975* (1.540	3.124* (1.581)	2.808 (2.011)	.287** (.109)	.286** (.119)	.203 (.145)	.392** (.147)	.332** (.159)	.330** (.160)	.383* (.158
Distance to Equator	.089*** (.015)	.021* (.011)	-.752*** (.175)	-.134 (.195)	-2.968* (1.478)	-4.889** (2.000)	-4.902** (2.099)	-.090 (.105)	-.170 (.151)	-.173 (.151)	-.396** (.146)	-.182 (.203)	-.044 (.159)	-.193 (.201
Agricultural employment ratio		-.001 (.018)		.283 (.285)		.997 (2.694)	.885 (2.857)		-.015 (.204)	-.044 (.205)		.469 (.297)		-.674 (.294
GNI per capita		5.682E-5*** (.000)		.000 (.000)		.010 (.007)	.010 (.007)		.000 (.001)	.000 (.001)		-8.047E-5 (.000)		-7.11 (.000
Regulation rate		-.032 (.011)					.522 (1.881)			.136 (.135)				
Adjusted R^2	.585	.856	.538	.711	.259	.262	.187	.270	.178	.180	.330	.363	.076	.196
N	37	36	37	36	14	14	14	14	14	14	37	36	37	36

Notes: See Table 2.

Toxoplasma-related attitudes, performance and institutions

So far we have found that attitudes, proxied by the frequency of latent toxoplasma infection in a population, affect institutions. This may drive their correlation with several aspects of performance, such as the number of business start-ups, the level of innovation and GNI per capita levels. Alternatively, however, there may be direct effects of the character traits associated with toxoplasma seroprevalence on performance. For example, an explanation for the effect of toxoplasma seroprevalence on innovation levels and economic performance may be that the effect runs not through institutions but through latent toxoplasmosis' effects on intelligence or willingness to take risks.

In order to check whether it is the institutional impact of attitudes that drive their correlation with performance, Table 4 presents the uncontrolled effects of toxoplasma seroprevalence on education and literacy levels, innovation rates, business start-ups, and income/capita, as well as the effects controlled for institutional environment (as well as the usual controls). We find that, uncontrolled, toxoplasma seroprevalence has significant effects on all performance aspects, except for secondary education. When adding control variables, we observe that latent toxoplasmosis continues to significantly pull tertiary education and literacy levels downwards. This suggests that in addition to its effect on institutional quality, latent toxoplasmosis appears to cause direct significant losses in human capital. By contrast, effects of seroprevalence levels on innovation rates, business start-ups, and income per capita lose significance when controlled for institutional environment. Quality of the institutional environment significantly affects income per capita levels, though. Taken together, these results suggests that the effect of toxoplasma-

related attitudes on performance runs mainly through the institutional channel rather than being a direct effect.

Table 4 Economic Performance

	Dependent variables									
	Secondary education	Secondary education	Tertiary education	Tertiary education	Innovation	Innovation	Start-ups	Start-ups	GNI per capita	GNI per capita
Constant	43.720*** (7.630)	11.862 (18.752)	42.778*** (5.709)	77.232*** (13.403)	73077.325*** (24425.622)	207866.267 (28092.334)	.732*** (.127)	.884 (.650)	43113.009*** (6509.034)	43864.665** (18282.893)
Toxoplasma sero-prevalence	-.010 (.215)	.053 (.249)	-.475*** (.163)	-.316* (.183)	-1475.833** (691.646)	-1617.789 (1191.236)	-.009** (004)	-.004 (.005)	-540.023*** (179.336)	-174.040 (185.791)
Distance to equator		.818** (.296)		-.465** (.216)		-1915.376 (1444.567)		.001 (.007)		282.898 (223.627)
Agricultural employment ratio		-.141 (.488)		-.802** (.363)		-.423 (1.303)		-2.820E-6 (.000)		-258.525 (386.522)
GNI per capita		.000 (.000)		.000 (.000)		-81.559 (2707.915)		-.003 (.010)		
Ease of doing business index		.075 (.144)		-.169 (.106)		-800.598 (749.731)		-.004 (.003)		-267.439*** (94.194)
Tertiary Education						45.604 (1281.664)		.000 (.006)		-178.476 (200.021)
Adjusted R^2	*-.038*	*.134*	*.211*	.399	*.092*	*.071*	*.157*	*.152*	*.179*	*.599*
N	*27*	*27*	*28*	*28*	*35*	*27*	*25*	*21*	*37*	*28*

Notes: See Table 2.

Conclusion

This paper investigates the influence of culture on institutions and economic performance. In order to isolate the effect of culture on institutions, it uses an instrument in the form of prevalence rates of *toxoplasma gondii*. This common parasite is known to influence attitudes and mental capacities of infected people, while its prevalence is largely independent from economic institutions and conditions. We find that prevalence rates of latent toxoplasmosis are significant predictors of institutions and institutional quality. Also, there is a positive relation between toxoplasma seroprevalence and performance indicators such as business start-ups, income, education and innovation rates.

We conclude that culture has an effect on institutions, confirming empirically what others have argued theoretically or on basis of historical analysis. Although our results support the case for including culture in analyses of economic development, we should not take this to mean that societies unlucky enough to have the 'wrong' cultural attitudes are condemned to weak institutions and economic underperformance. Obviously, the channel investigated in this paper is but one of many and business performance is influenced by many more factors than culture alone. What is more, the fact that culture appears to have an impact on institutional quality does not preclude societies, once this effect is known, from taking measures to improve institutions in spite of their apparently 'disadvantageous' cultural baggage. Also, culture itself is more flexible than often considered. The argument in this paper shows that rather than a fixed, inherited given, culture and attitudes appear to be significantly influenced by current environmental conditions that society is able to control. All in all, the results in this paper

tell us that cultural attitudes help shape the institutional and governance environment in which firms operate.

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APPENDIX

Table A1. Descriptive statistics for main variables

	N	Min.	Max.	Mean	Std. Deviation
Variable of interest:					
Toxoplasma seroprevalence rate	38	4.31	66.91	32.170	17.031
Institutional & governance variables					
Ease of doing business index (1=most business-friendly regulations)	57	4.00	179.00	75.342	53.945
Documents to export	57	3.00	11.00	5.973	1.919
Documents to import	57	3.00	12.00	6.711	2.087
Trade regulation (index)	57	6.50	23.00	12.684	3.812
Procedures to build a warehouse	57	6.00	37.00	17.408	6.815
Procedures to enforce a contract	57	20.00	51.00	36.482	6.424
Procedures to register property	57	1.00	14.00	5.618	2.666
Start-up procedures to register a business	57	2.00	17.25	8.254	3.270
Procedures (index)	57	40.00	100.50	67.763	12.485
Tax payments (number)	57	2.00	72.00	26.504	18.376
Regulation (index)	57	52.00	178.25	106.951	27.805
Informal payments to public officials (% of firms)	26	3.95	85.07	25.877	20.958
Transparency International index	38	1.90	9.30	5.732	2.277
Time required to start a business (days)	57	2.00	144.00	31.118	28.157
Average time to clear exports through customs (days)	27	1.31	15.89	6.811	4.047
Time to prepare and pay taxes (hours)	57	12	2600	373	392
Days lost to bureaucracy (index)	27	40.04	484.89	113.027	90.025
Management time dealing with officials (% of management time)	28	.43	33.59	11.009	7.928
Macro-economic variables:					
Employment in agriculture (% of total employment)	42	.80	43.50	11.62	11.98
GNI per capita. Atlas method (current US$)	57	255	79535	184291	19874
Literacy rate. adult total (% of people ages 15 and above)	37	35.90	99.80	80.223	19.127
Labor force with tertiary education (% of total)	32	3.30	83.65	27.051	15.373
Total tax rate (% of profit)	57	14.33	108.10	47.2982	16.60
Patent applications per resident	44	1.00	336889	22335	66280
Number of start-ups per resident	29	.00	1.32	.419	.318
Distance to Equator	38	4.00	64.00	37.74	17.12