Tolerance For Uncertainty and the Growth of Informationally Opaque Industries*

Rocco R. Huang[+]

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Abstract:

Hofstede (1980)'s cross-country psychological survey of IBM employees shows that some countries (societies) are systematically more tolerant of uncertainty, while tolerance of uncertainty is shown by Rigotti et al. (2003)'s model to be essential to the growth of "emerging sectors about which little is known". We use Durnev, Morck and Yeung (2004)'s methodology to identify these informationally opaque industries. We hypothesize that, countries characterized by high uncertainty aversion (measured by Hofstede's indicator) will, because of uncertainty aversion, grow disproportionately slower in industrial sectors where information is less available (proxied by lower informativeness of stock prices in the U.S., Durnev et al. 2004). Using the Rajan and Zingales (1998) "differences-in-differences" methodology, in 34 countries and 36 manufacturing industries, we indeed find robust evidence for this pattern of industrial growth. We also show that national uncertainty aversion is not proxying for under-development of financial sector, inadaptability of civil law systems, lower level of economic development, or many other factors. Our results are also robust when we use religious (Protestant/Catholic) composition to instrument for national uncertainty aversion.

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[+] The World Bank and the University of Amsterdam. E-mail: rhuang@worldbank.org
Correspondence address: The World Bank, 1818 H Street, N.W. , MSN-MC9-905, Washington, D.C. 20433

1. Introduction

Tolerance for uncertainty[1] is defined as the willingness to take on gambles with imprecisely known odds. Not everyone likes uncertainty: some people prefer to eat well (i.e. they are uncertainty-tolerant), while others prefer to sleep well (i.e., they are uncertainty-averse). The working hypothesis of this paper is that countries characterized by high uncertainty aversion grow disproportionately slower in industrial sectors where information is less available[2]. Our hypothesis is motivated by Rigotti et al. (2003)'s model which shows that tolerance of uncertainty is essential to the growth of "emerging sectors about which little is known" because entrepreneurs, workers[3] and investors[4] lacking such personality are reluctant to enter such informationally opaque industries where "there are few market signals to guide the allocation of resources". In their model, uncertainty, i.e., the precision of objective risk information, is quantified in the form of belief function axiomatized by Jaffray and Wakker (1994). Comparative statics of the model suggest that scarcity of this personality trait in the population leads to slower diffusion rates of new technologies and slower grow rates of opaque sectors. We thus suspect that the cross-country differences in uncertainty aversion can explain why some countries grow more (or less) in opaque industries such as IT than others do.

To test for Rigotti et al. (2003)'s model, we exploit systematic variations of uncertainty aversion across countries as well as variations of informational opacity across industries. The working hypothesis (i.e., uncertainty averse countries grow slower in informationally opaque industries) is testable because

[1] A decision is called risky when the probabilities that certain states will occur in the future are precisely known, e.g. in a fair roulette game. In contrast, a decision is called uncertain when the probabilities are not precisely known. Camerer and Weber (1992) and Mukerji and Tallon (2003) survey the literature which shows that uncertainty aversion affects an individual's economic decisions in situations where information is not perfectly available.

[2] "Less information available" is academically known as Knightian uncertainty (a.k.a. ambiguity) , but "opacity" is a more natural word to describe such situations. In this paper, uncertainty, ambiguity, and opacity are interchangeable terms. Wherever we refer to an industry, we use the terms "opacity" or "opaque", as the alternative terms "ambiguous industries" sound quite confusing and strange to most readers.

[3] A worker of a firm operated in an opaque industry is exposed to vague and potentially large bankruptcy risk and must share the similar tolerance for uncertainty as the owner of this firm. Due to the limited liability constraints, workers may not receive a certain wage when the firm's revenue is lower than promised wage.

[4] The role of uncertainty-averse investors is modeled by another separate paper by Rigotti (2004)

there exist variations on two dimensions, which are described below.

First, there exists systematic difference of uncertainty aversion across countries. Guiso, Sapienza and Zingales (2003) show that culture shapes people's economic attitudes. Hofstede (1980, 2001)'s psychological survey of IBM employees in a wide cross-section of countries finds evidence that residents of continental (particularly southern) European countries (e.g., Greece, Portugal, Belgium, Spain, France, Italy) compared to Anglo-Saxons and Nordic countries, are averagely less tolerant of uncertainty, and thus their countries are relatively scarce of uncertainty-tolerant people. Many other straight replications of the IBM survey confirm this finding. Greeks top the league of uncertainty aversion in Hofstede's sample. We are not surprised after we get to know the Greek father in the best-selling movie "My big fat Greek wedding", who is constantly frustrated by his daughter's "adventures" (to marry a non-Greek guy? the "probability distribution" of whose quality he knows nothing about!). The survey also shows that Protestant countries generally have lower uncertainty aversion than Catholic ones. Religion composition alone can explain more than one third of the systematic variation of uncertainty aversion across countries.

Second, it is found that some industries are informationally more opaque than others. We use Durnev, Morck and Yeung (2004)'s methodology to quantify opacity. In the U.S., they find that stock prices in some industries are less informative than in others because information is dearer and less available in these industries. These industries are what Rigotti et al. (2003) define as "emerging sectors about which little is known". By Durnev et al. (2004)'s measure, we show that industrial sectors in the early stage of industry cycle, or using complex production and organization technologies, usually have less information available and thus have less informative stock prices. The variations of information availability across industries provides us with a good opportunity to examine the detailed channel through which uncertainty aversion affects growth when information is not perferectly available, by testing whether investment in informationally more opaque assets are more sensitive to a country's national uncertainty aversion.

Our working hypothesis is based on Rigotti et al. (2003)'s model. We examine short-term economic growth (in a decade). As high uncertainty aversion countries are relatively scarce of uncertainty-tolerant entrepreneurs, workers and investors[5], according to the theory we hypothesize that industries with more opacity will grow disproportionately slower if located in a country characterized by high uncertainty aversion. To measure national uncertainty aversion, we use Hofstede (1980)'s Uncertainty Avoidance Indicator (UAI), derived from a cross-country psychology survey of 88,000 IBM employees in 50 countries, which measures the collectively held attitude of a society toward uncertainty. To proxy for informational opacity at industry level, we use Durnev, Morck and Yeung (2004)'s measure of stock price informativeness at the industry level, which is actually a transformed version of Roll (1988)'s famous "R-Squared". The industry growth data is cleaned and complied by Rajan and Zingales (1998) (originally from United Nations Industry Database).

We attempt to test for the hypothesis by standard data and standard methodology. We use Rajan and Zingales (1998)'s interaction term ("differences-in-differnces") methodology, as well as the industry growth dataset they use, to examine the differential effect of national uncertainty aversion on growth rates across industries with different magnitude of informational opacity. The advantage of this methodology is that, by including country and industry dummies in the regression, we derive our results from within-country/cross-industry variations of growth rates, and thus avoid many of the country-specific "omitted variables" biases that cross-country growth regressions usually have to worry about.

Our results from a sample of 34 countries and 36 industries confirm our hypothesis: industries with more inforamtional opacity (proxied by less informative stock prices) indeed grow disproportionately slower in countries characterized by higher uncertainty aversion. The robustness tests show that national uncertainty aversion is not proxying for under-development of financial sector, or inadaptability of civil law systems, or many other factors.

The remainder of the paper is organized as follows: In Section 2, we introduce Hofstede's Uncertainty Avoidance Indicator (UAI). In Section 3, we construct a proxy for industry opacity, using Durnev et al. (2004)'s methodology. In Section 4, we discuss our empirical framework and report the

[5] In relation to stock price informativeness, Durnev et al. (2001) actually show that, in the U.S., industries with more informative stock prices are able to obtain more external finance.

regression results, which include a battery of robustness checks. Finally, we discuss our findings in Section 5, particularly on the implications and interpretations of our findings.

2. Measuring National Uncertainty Aversion

We derive our measure of national uncertainty aversion from a cross-country psychological survey conducted by Geert Hofstede (then director of personnel research department, IBM Europe) between 1967 and 1973, which involved a naturally matched sample of respondents: 88,000 IBM local employees of marketing and customer service positions deployed in 50 countries around the world.

Although part of the difference in uncertainty aversion can be explained by personal idiosyncratic factors, much more has to do with the society in which an individual is brought up, as the social norm (tolerance or intolerance of uncertainty) is transferred and reinforced through basic institutions such as the family, the school and the society[6]. Members of social group derive utility from following the prevalent social norm because social interactions, and get isolated if they do not. By comparing IBM local employees in different countries, a naturally matched group of people with rather homogenous background (education, type of work, personality) except for their nationality[7], Hofstede minimized the variation of uncertainty aversion due to an individual's idiosyncratic preference, and the observed variation of average uncertainty aversion across countries in the sample is more likely to reflect culture

[6] . The roots of cultural heritages are sometimes irrational and may lead to collective tolerance or intolerance of uncertainty in one society that may seem aberrant and incomprehensible to members of other societies. But as Hofstede (1991) puts it, culture and social norms are the "software of the mind" that mentally program you to cope with a same problem in a different way than people in other societies do, which is hard to escape from, rational or not.

[7] To measure cultural differences, we should use a matched sample of respondents from different countries. "Matching samples" mean that the respondents should be people who are as similar as possible in all aspects of their lives except for their nationality. For example, ten-year-old schoolchildren, female medical students. This is usually hard to be achieved by most country-wide general surveys such as World Value Survey (WVS), which generally involve people with very different social background and life style. As an internal survey, Hofstede's sample meets this requirement very well. The respondents have rather homogeneous background in terms of employer, kind of work, education level, and even personality (as IBM usually recruits people that fit IBM culture). This homogeneity of respondent background helps us greatly in disentangling the cross-culture differences from the variations due to idiosyncratic factors of individual respondents. Furthermore, Hofstede also finds that age, education and gender generally do not predict a person's uncertainty aversion.

difference.

Using this survey, Hofstede (1980, 2001) developed an indicator measuring national uncertainty aversion in fifty countries, which he calls "Uncertainty Avoidance Indicator" (UAI). He defines an individual's uncertainty aversion as "feeling uncomfortable with uncertainty and ambiguity, and therefore valuing beliefs and institutions that provide certainty and conformity", and national uncertainty aversion as the collectively held attitude of a society toward uncertainty. In high uncertainty aversion countries, "what is different, is dangerous", whereas in low uncertainty aversion countries, "what is different, is curious".

The indictor is constructed by averaging the answers to questions on three dimensions: rule orientation, employment stability, and stress. The use of average attitude in a country to reflect culture is commonly accepted in previous economic literature, e.g., Knack and Keefer (1997), La Porta, Lopez-de-Silanes, Shleifer and Vishny (1997), Guiso, Sapienza and Zingales (2004a, 2004b). We also find some interesting correlations. For the rule orientation question, we find that uncertainty-averse countries emphasize formality in judicial procedures (Djankov et al. 2003). For the employment stability question, we find that uncertainty-averse countries heavily regulate labor market (Botero et al. 2004). The third question about stress is already extensively researched by medical scientists, who suggest that uncertainty is what distinguishes stress from depression. Medical statistics also show that the cross-country differences of stress level of IBM employees apply to general population (Hofstede 2001 for a survey of the medical literature). The detailed methodology Hofstede uses to construct this uncertainty aversion indicator is described in Appendix A.

We have Uncertainty Avoidance Indicator (UAI) data for 50 countries, but we can only examine 34 of them in this paper, as the industry growth data collected by Rajan and Zingales (1998) are unavailable for the other 15, and following their practice we also exclude U.S. to avoid endogeneity problem as some of our right-hand-side variables are constructed by U.S. data. The UAI's for the 35 countries (including the U.S.) are reported in Table 1[8], with higher UAI's indicating higher national uncertainty aversion and relatively scarce of uncertainty-tolerant entrepreneurs, workers and investors. We also have UAI data from two straight replications of IBM survey, but on different people. One is Hoppe's Survey on Salzburg Seminar elite alumni from 17 European countries plus Turkey and the United States. The other is from the European Media and Marketing Survey 1997 by Inter/View International. They are also presented in Table 1. The high correlations are stunning since three surveys span three decades. We use them for robustness tests in later regressions, but we can only cover 15 countries and 12 countries respectively for the two alternative indicators.

[Insert Table 1 about here]

We find that Catholic countries generally have higher UAI's, whereas Protestant countries have lower. Religion composition alone can explain more than one third of the systematic variation of uncertainty aversion across countries. Holland and Germany, the only two low UAI countries that can be defined as continental Europeans in a broad sense (they are already quite close to Nordics), both have Protestant tradition.

We find that Anglo-Saxon and Nordic countries as well as previous British colonies are among those scoring the lowest in Uncertainty Avoidance Indicator (UAI), whereas typical continental European countries (Greece, Portugal, Spain, France, Belgium, Italy, etc.) as well as their previous Latino colonies are among those with the highest UAI's. We later show that our results are not driven by colonial origins though. The reason why colonies share similar culture with their former colonizers could be explained by the fact that former settlers still dominate the economic activities, or alternatively, that those who conform to the culture of former colonizers are more likely to be recruited into IBM.

[8] The UAI's for all the 50 countries are available in Hofstede (2001), alternatively, you can find them on the author's website.

3. Measuring Industry-Specific Informational Opacity

3.1. Information Content of Stock Prices as a Measure of Industry Opacity

Next, we shall quantify Rigotti et al. (2003)'s definition of "emerging sectors about which little is known" by measuring the informational opacity in a cross-section of manufacturing industries.

Durnev et al. (2003) and Durnev, Morck and Yeung (2004) find that stock price informativeness varies systematically across industries, and stock prices are more informative in some industries because firm-specific information is more available in these industries. Thus, by gauging the stock price informativeness, we can develop for each industry an index measuring the amount of private information available, or in other words, the informational opacity of this industry. This is quite consistent with Rigotti et al. (2003)'s definition of "emerging sectors about which little is known" in the sense that tolerance of uncertainty is important when "fewer market signals are available to guide the allocation of resources".

We use Durnev, Morck and Yeung (2004)'s "relative firm-specific stock return variations" to measure stock price informativeness at industry level. The "relative firm-specific stock return variation" is actually a transformed version of Roll (1988)'s famous R-Squared. Technical details can be found in Appendix B.

The rationale behind Durnev et al. (2004)'s measure is as follows. The variation of a stock return can be decomposed into market-related, industry-related, and firm-specific components, and the arrival of firm-specific information are rapidly capitalized into the firm-specific components if the market is very efficient (e.g., in the U.S. market). When there are less firm-specific information available, the stock prices become less informative as most of the returns are explained by market-wide and industry-wide factors. If we observe very few firm-specific stock return variations in an industry in the past, then it is likely that investors at this point in time have very few information about the future of this industry. We find Durnev et al. (2004)'s original words to have best conveyed the argument: "…in a market with many risky stocks, during any given time interval, information about the fundamental values of some firms might be cheap, while information about the fundamental values of others might be dear. Traders, ceteris paribus, obtain more private information about the former and less about the latter. Consequently, the stock prices of the former, moving in response to informed trading, are both more active and more informative than the stock prices of the latter…"

Durnev et al. (2004) show that such synchronicity of stock returns cannot be explained by co-movement of fundamentals (earnings, etc). Durnev et al. (2003) also confirms the information content of firm-specific stock return variations by showing that stock returns predict future earnings changes more accurately in industries with higher firm-specific return variation. Recently, Chen, Goldstein, and Jiang (2004) uses intra-day order flow data to construct alternative indicator of stock prices informativeness based on Easley, Kiefer and O'Hara (1997)'s market microstructure model, and find it highly correlated with Durnev et al. (2004)'s indicator. Unfortunately, we are not able to use this alternative indicator as intra-day order flow data are not available until early 1990s.

3.2. Using U.S. Market Data as a Benchmark for Information Availability

Stock price informativeness proxies for industry information availability only when certain conditions are met. Among others, we require (1) The stock market is able to incorporate available information into stock prices very efficiently, otherwise stock return variations may not completely reflect available information; (2) The listed firms must not diversify into many industries (otherwise stock returns of an individual company contain information from multiple industries). In this paper, we do not directly use the stock price informativeness actually observed in each country to measure information availability, as many markets may not meet all of the requirements. Instead, following Rajan and Zingales (1998) (which uses external financing needs of U.S. firms as a benchmark), we calculate the stock price informativeness of U.S. firms, and use them as a proxy for intrinsically given informational availability at industry level[9]. We justify this for several reasons elaborated below, and suggest that U.S. benchmark,

[9] Accordingly we exclude the U.S. from our cross-country regressions.

although not perfect, gets the closest to the requirements.

First, U.S. market is no doubt the market with the most efficient information environment, where arrivals of new information are capitalized into stock returns fully and rapidly. As we mentioned before, stock price informativeness is a valid proxy for informational availability only when we assume that firm-specific information will be capitalized into stock prices very efficiently, while this may not be the case in emerging markets where a lot of other things also affect stock price informativeness. On the other hand, outside the U.S. conglomerate firms and business groups dominate the corporate world, and it is thus very difficult to sort stocks into industry groups to extract industry-specific factors[10]. By using U.S. market data, we are more likely to capture cleanly the cross-industry differences in information availability. Finally, although Morck, Yeung and Yu (2000) find substantial cross-country difference in stock price informativeness caused by cross-country differences in protection of private property rights and shareholder rights, the ranking of industries in terms of informativeness however is not likely to vary across countries.

Second, by doing so we avoid any risks of endogeneity, For instance, in high uncertainty aversion countries, when people are too concerned about the availability of information, they are willing to pay very high price for information in faster-growing industries (from which the efforts are more likely to pay off), thus making stock prices in these industries more informative than in slower-growing industries. If this were true, then it can also generate a spurious result in favor of the hypothesis of this paper. By using U.S. market data as a benchmark, we avoid this possibility as the U.S. is a very uncertainty-tolerant society according to Hofstede's indicator. Another reason is that, in an uncertainty-averse country, as people avoid growing in an industry which would have been quite opaque had it grown at optimal speed, informativeness may increase because a slower-growing industry is adopting simpler production technologies.

[10] We also encounter data availability problems. Most developing countries as well as those bank-based developed countries have too few listed stocks to operationalize Durnev et al. (2004)'s methodology which requires sufficient number of firms not only in the whole market but also in each industry.

The implicit assumption of using U.S. as benchmark is that there exist intrinsic technological reasons why information in some industries should be dearer than in the others, and why the cross-industry differences in the U.S. can apply globally. We believe that these assumptions are not strong ones. The reasons are as follows. First, there exists an industry cycle element in the differences of informational opacity, concerning the uncertainty of a new technology's prospect[11]. This information can also be spilled over globally. For instance, internet industry is opaque in the U.S., and this should be true in any countries as the technology (and the uncertain future) is the same. We would certainly expect this opacity to diminish over time as the prospect of this industry becomes less uncertain, and the information that dot-com economy is proved viable in the U.S. can certainly be known to investors in other countries. Second, industries differ in terms of their intrinsic characteristics of the production and organization technology. Some industries generally adopt more complicated production methods and organization structures, incur more intensive R&D expenditure, and have larger share of intangible assets. It is thus more difficult for an outsider to evaluate their operations and assets to obtain useful information. This should also apply globally as the production technology of an industry should be similar in this respect regardless of the location of the machineries.

3.3. Index Construction

Using U.S. data, we choose a three-years window to measure stock price informativeness in an industry, which is found by Durnev et al. (2004) to best catch the cross-industry differences. We use the daily stock returns from January 1977 through December 1979, of all the U.S. public-listed

[11] For instance, in the early 19th century, share prices of railroads companies always went up and down together because railroads industry was at that time a "new economy" industry, and then more and more firm-specific information was able to be revealed and capitalized into prices as time went. The informativeness of their stock prices peaked when railroad comapnies eventually became typical blue-chip stocks. Certainly, it took quite a long time for this industry cycle to complete a round. History is repeating itself in an incredibly similar fashion nowadays, but the leading actor becomes the information technology sector, whose stock prices were found to comove greatly particularly in the 1990s. One of the explanations of this phenomenon is: in the course of R&D races and technological changes, there are fewer firm-specific information available, thus fewer firm-specific stock return variations (vis-à-vis industry- and market-wide variations); When the uncertainty gradually resolve as the races progress to the end, firm-specific information would come out bit by bit, produce more and more firm-specific stock return variations and less co-movements of stock returns. This point was suggested by Robert J. Shiller when commenting on Durnev, Morck and Yeung (2004) in a NBER meeting.

manufacturing firms. For robustness check, we also use 1980-1982 period to obtain an alternative measure. We choose this period because (1) we want to measure the industry opacity actually observed by investors PRIOR to the sample period (the 1980s) over which we measure our outcome variable: growth rate of value-added; (2) At any point in time, investors can only make judgments based on ex-ante information, not ex-post; (3) The evolution of uncertainty is a dynamic process, which is solved over time and created over time.

Throughout this paper, we denote this measure of industry opacity as INFO, short for "information". We do not dub it as "opacity" because we want to avoid using lower value to indicate higher opacity which are quite counter-intuitively. The estimated INFO's for the 36 manufacturing industries are reported in Table 2, with less information available in low INFO industries. In Table 2 we rank the industries from the lowest to the highest in terms of INFO, and the ranking looks quite intuitive. One of the patterns we can observe is that stock prices of "new economy" industries such as computer industry reveal less information, i.e., are more opaque, whereas stock prices of "old economy" industries such as wearing apparel industry reveal more firm-specific information. Also, a casual inspection should suggest that high INFO industries (e.g., pottery, leather, textiles) tend to use simpler production and organization technologies than low INFO industries (e.g., machinery, chemicals).

[Insert Table 2 about here]

4. Empirical Strategy and Regression Results

4.1. Empirical Strategy

Some people dismiss the impacts of cultural differences on real economic activities as trivial, by assuming that individuals can always escape from the cultural heritage of their society[12]. We however

[12] As a matter of fact, the disconformation to social norms, i.e., individualism per se is also a social norm and a matter of culture. High individualism typically found in American culture, however, is not necessarily the norm for the rest 95% of population outside the U.S.. It is not that easy to escape from tradition, particularly when a big fat

treat the validity of our claim, that culture makes a difference in the real sector, as an empirical question, and will test it with standard data and methodology.

To empirical test our hypothesis, we use the Rajan and Zingales (1998, RZ)'s "differences in differences" methodology, which solve the omitted variable problems very well in cross-country regressions. The methodology of RZ has been adapted in a number of ways to assess, among others, the impact on industrial growth of banking system concentration, the development of trade finance and the strength of property rights.[13] This paper further adapts the methodology to examine the differential effect of national uncertainty aversion on growth rates across industries with different extent of informational opacity.

The main regression equation is specified as follows:

$$\text{Growth}_{j,k} = \beta_1 \cdot (\mathbf{INFO_j} \times \mathbf{UAI_k}) + \beta_2 \cdot (\text{EXTFIN}_j \times \text{FD}_k) + \beta_3 \cdot (\text{Industry } j\text{'s share of manufacturing sector in country } k) + \text{Country Dummies} + \text{Industry Dummies} + \text{Constant} + \varepsilon_{j,k}$$

where each industry is indicated by index j and each country by index k.

The dependent variable is real growth rates in value-added in 36 industries and 34 countries in the 1980s, reported by RZ. The growth include not only value-added in the listed corporations but also the rest of the economy. We use country and industry dummies to remove observable and unobservable country- and industry-specific effects, and industry j's initial share in country k's manufacturing sector to control for the convergence effect. Following RZ, we also include $\text{EXTFIN}_j \times \text{FD}_k$ to control for the fact that industries with more external finance needs can grow disproportionately faster in countries with better financial development, where EXTFIN_j measures industry j's external finance dependence, while FD_k measures country k's financial development, as measured by domestic credit available to private

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Greek family is involved. Glaeser, Sacerdote and Scheinkman (2003) also document the existence of "social multipliers", that one person's attitudes influences his neighbor's attitudes, and as a result the economic effects aggregated at social group level can be much stronger than those seen at individual level.

[13] Other papers that use this approach include, among others, Cetorelli and Gambera (2001) which investigates the effects of bank concentration on sectoral growth, Fisman and Love (2003) which investigates the effects of trade credit usage on sectoral growth, and Claessens and Laeven (2003) which investigates the role of property rights on growth.

sector.

Most importantly, we include informational availability (**INFO**) of industry j interacted with Uncertainty Avoidance Indicator (**UAI**) of country k. If the interaction term $\mathbf{INFO_j} \times \mathbf{UAI_k}$ enters significantly in our regressions with a positive sign, then we can say that industries with more informational opacity grow disproportionately slower in countries characterized by higher national uncertainty aversion.

Table 7 provides detailed description of the variables we use in this paper

4.2. Main Result

We start from the basic regression specification describe in Section 4.1. In Table 3 Column (1), we find that the interaction term UAI ×INFO enters highly significantly in the regression and with positive sign. This suggests that investors in countries characterized by high uncertainty aversion are more concerned and cautious about the negative consequences of industry opacity, and thus avoid expanding in those opaque industries. Put in another way, industries with more informational opacity are disproportionately affected by the variation of national uncertainty aversion.

In Figure 1, we illustrate the growth pattern graphically. For each country-industry pair, we measure "abnormal growth rates" by the residuals from regressions without controlling for $INFO_j \times UAI_k$. For each country, we then deduct the average "abnormal growth rate" of high INFO industries (transparent industries) from that of low INFO industries (opaque industries). This gap of growth rates roughly measures how much the opaque industries outperform traditional industries in a certain country. The regression results we shown previously reveal that low uncertainty-averse countries should grow faster in low INFO industries than high INFO industries, and thus would have a bigger sectoral gap as defined above. In Figure 1, we plot the growth gaps (between low and high INFO industries) against the uncertainty aversion indicators. We can clearly identify a fitted regression line sloping downwards[14],

[14] To compress the size of the chart, we leave two "outliers" (Pakistan and Mexico) outside the visible region. They are however taken into account when the fitted line is drawn.

which visually demonstrates our regression results above. The chart also show that our results are not driven by only a sub-group of countries.

[insert Figure 1 about here]

To demonstrate the economical significance of this effect, following Rajan and Zingales (1998), we calculate the "differences-in-differences" growth rates. The exercise implies that an increase of national uncertainty aversion from that of United States (the 25th percentile country) to that of the France (the 75th percentile country) causes a real growth rate slowdown of nearly 0.8 percentage point annually, when we compare the Metal Products sector (the 75th percentile sector in terms of industry opacity) with the Spinning Textiles sector (25th percentile sector in terms of industry opacity). This is quite substantial in economic terms as the median annual growth rate in value added is less than three percents in our sample.

[Insert Table 3 about here]

In Column (2) and (3), we use uncertainty aversion indicators obtained from straight replication studies done later on different group of people. In Column (2), we use the uncertainty aversion indicators created from Salzburg Seminar alumni survey in early 1990s, while in Column (3) we use data from the European Media and Marketing Survey 1997 by Inter/View International. They are stunningly highly correlated with the indicators from IBM survey done in 1970s. Our samples substantially shrink as we can only cover 15 countries and 12 countries respectively for the two alternative indicators. The results are qualitatively unchanged and confirm our previous finding.

In Column (4), we also test whether industry uncertainty is proxying for industry risk. We measure the riskiness of an industry by averaging the time-series stock return standard deviations of all the firms in this industry. Theoretically everyone can eliminate exposure to industry risk by diversifying in their portfolios, but few investors, and even fewer entrepreneurs or employees are doing it, and thus industry risk may still matter. The measure of industry risk is reported in Table 2 as well, to be compared with industry uncertainty. We find that industry risk is not significantly correlated with industry uncertainty. The result in Column (4), which includes both industry uncertainty and industry risk in the regression, interacted respectively with national uncertainty aversion, clearly shows that high risk industries do not grow significantly slower in high uncertainty aversion countries, and thus rejects the hypothesis that our measure of industry uncertainty is proxying for risks.

4.3. Financial Sector Under-Development or National Uncertainty Aversion?

The development of financial sector has been shown to affect growth rates; indeed, the Rajan and Zingales (1998) paper's purpose was to show that financial development helps financial dependent industries grow faster. Financial development is likely to matter as well in relation to investors' uncertainty aversion and the growth of opque industries. Better financial development may help to pull resources together, minimize the risk and uncertainty each investor is required to bear, making it possible for projects of great uncertainty to be launched. Jovanovic and Greenwood (1990) indeed show that investors' access to developed financial markets permits diversification and the undertaking of more risky, but more profitable projects. Also, financial intermediaries can overcome the free-rider problem and exert efforts in collecting proprietary information, which is more difficult for single individuals. Well-developed stock markets can also play a similar role by capitalizing private information into stock prices, which can provide useful information for relatively uninformed small investors. To sum up, better financial development may relieve the underinvestment and undergrowth problem in face of informational opacity, and investors in a country with better development of financial sector may be less concerned about informational opacity regardless of their national uncertainty aversion.

Like previous literature, we measure financial development by two indicators. One is domestic credit to private sector over GDP in year 1980, the other is stock market capitalization over GDP in year 1980. Uncertainty averse countries generally have smaller stock market (ρ= -0.52, significant at 1%), but does not significantly have smaller banking sector (ρ= 0.06, not significantly correlated). In Column (5) and (6) of Table 3, we include in the regressions the measures of financial development (FD or Stock_Market) interacted with measures of industry opacity (INFO). The interaction terms do not enter significantly. This suggests that better development of financial sector (either bank-oriented or market-oriented) does not encourage people to undertake investment in more opaque industries. This is consistent with Knight (1921)'s and recently Mukerji and Tallon (2001)'s claim that, unlike risks, uncertainty cannot be insured or diversified by financial markets or intermediaries.

Finally, Acemoglu and Zilibotti (1997) show that only rich countries have the capacity (wealth) to undertake more risky but potentially more productive projects, as the sheer size of wealth enable them to diversify the risks in many projects. Furthermore, Morck, Yeung and Yu (2000) find that general economic development is a very important determinant of a country's information environment, and thus we suspect that economically more advanced countries may handle these opaque industries better. In Column (7), we control for economic development by including an interaction term between GDP per capita[15] and industry opacity. We do not find support in the data for the above hypotheses.

4.4. Civil Law Syndromes or National Uncertainty Aversion?

La Porta et al. (1998) argues that the better adaptability of common law system can minimize the gap between the contracting needs of the economy and the legal system's capabilities, as judges respond case-by-case to unforeseen and changing conditions. This could be particularly important to industries where information is less available either ex-ante or ex-post, because incomplete contracts are more demanded in such industries (Mukerji, 1998), which however are not well accommodated by civil law system that stick to strict codification. Acemoglu and Johnson (2003) define this as "contracting institutions", which determine what type of contracts can be written and enforced. Gennaioli (2004) indeed show that judicial discretion fosters the use of contingent contracts while code-driven adjudication

[15] We also try to measure nation wealth by the total GDP instead of GDP per capita of the countries. The interaction term does not enter significantly (not reported).

induces the adoption of non-contingent contracts. Empirically, we observe that civil law countries have significantly higher national uncertainty aversion (ρ= 0.51, significant at 1%), thus it is natural for us to suspect that national uncertainty aversion may be proxying for civil origins in our results.

In regressions reported in Table 4 Column (1) to (3) , we include interaction terms between legal origins and industry opacity. We identify legal origins in three different ways, from the roughest one to the finest one. In Column (1), we only sort countries into two groups: Common Law Origin and Civil Law Origin countries; In Column (2), we also distinguish between French Civil Law Origin and other Civil Law origins; In Column (3), we also separate Scandinavian Civil Law Origin from German Civil Law origin.

In Column (4) and (5), we explicitly consider the adaptability channel of legal systems, or in other words, contracting institutions. Common Law countries typically adopt case law and give judges more discretion against legal formalism, but many Civil Law countries also have such adaptability elements. To measure the adaptability of legal systems, Beck, Demirgüç-Kunt and Levine (2003) use two indicators. The case law indicator (La Porta et al, 2004) is a dummy variable that indicates whether judicial decisions are a source of law, while the legal justification indicator (Djankov et al. 2003) demonstrate whether judgments have to be based on statutory law rather than on principles of equity, and takes on values of 0, 0.33, 0.67 and 1 for bounced check case and tenet eviction case respectively (We use the average of the two cases).

Our results in Table 4 rule out our worry above. Common law is not associated with faster growth in industries of greater opacity, but quite the opposite. For exactly this reason, the effect of national uncertainty aversion actually becomes even stronger (almost a 50% increase), after legal origins are controlled for. We, however, do not have any ready theories to explain why legal systems of better adaptability discourage growth in industries of greater opacity. It is also quite possible that the high correlation between legal origins and national uncertainty aversion contaminates the result and gives us the wrong signs and meaningless results, which is not unusual econometrically speaking. Further theoretical research in this direction may provide new explanations.

[Insert Table 4 about here]

We next look into further details of the laws. La Porta et al. (1998) find that civil law origin is associated with worse protection of investors. Suppose some investors have private information on the prospect of some opaque industries (e.g., they know that there are going to be a lot of profit, while other people do not know), then these investors will be willing to invest only when their wealth can be secure and protected ex-post. Knight (1921) actually ague that the profits capitalist make are the compensation for their bearing and tolerance for uncertainty. If the bearing of uncertainty is not compensated for, then no one are willing to invest in opaque industries.

We measure investors' concern about protection of private property by several indicators. We first use La Porta et al. (1998)'s *de jure* shareholder rights indicator and creditor rights indicator. As these two indicators are completely based on law text written on the paper (but never 100% enforced), we also measure the *de facto* effective protection by multiplying them by a rule of law indicator from ICRG (averaged over 1980s). The shareholder rights indicator is missing for Costa Rica. Creditor rights indicator is missing for both Costa Rica and Venuzula in La Porta et al. (1998), but we find the updated value for them in Galindo and Micco (2001). As the predation of private property can come from the state as well, we also use another indicator, the risk of expropriation of private property by the government, also from ICRG (averaged over 1980s). All these indicators are constructed in a way that low values indicate less respect fro private property.

In Column (1) to (5) of Table 5, we interact each investor protection indicator with our measure of industry opacity. None of the results support the hypothesis above. We only obtain one significant result, with unexpected signs, in Column (1), when we use the *de jure* shareholder rights indicator to measure protection of private property. The strange findings say that those countries with law (on the paper) protecting shareholder rights do worse in opaque industries.

[Insert Table 5 about here]

Finally, a very special branch of the laws also draw our interest. Botero et al. (2004) find that civil law countries are also more protective of labors, and have more rigid labor laws. The uncertainty aversion measure we use in this paper is based on a survey of employees, and related to labor market situations. Since national approaches to labor protection differ, we suspect that labor protection may be driving both workers' uncertainty aversion (and their response to the surveys) as well as the growth of traditional industries (since labor's interests are more vested in the growth of traditional labor-intensive industries vis-à-vis new industries), i.e., there could be omitted variable problems. In Column (6) of Table 5, we include an interaction term between the rigidity of labor laws (from Botero et al. 2004) and the opacity of industries. The term does not enter significantly, thus rule out our concerns.

4.5. Robustness Checks on INFO

We first use two variants of INFO, to check the robustness of this proxy for industry opacity.

First, in Column (1) of Table 6, instead of using the continuous measure of INFO, we simply sort the industries into two categories: low opacity (high INFO) industries and high opacity (low INFO) industries, and use a dummy variable to indicate high INFO industries. The advantage of this binary measure is that we can be quite confident that industry opacity monotonously decreases in INFO and is less likely to be contaminated by measurement error problems, while the disadvantage is that we will not utilize all information available to us. Hence we have a more consistent though less efficient estimate of industry opacity. The results are robust to this alternative measure.

[Insert Table 6 about here]

Second, in Column (2), we use the stock prices of 1980-1982 period to compute INFO. This alternative measure is highly correlated with our main measure (INFO for 1977-1979 period) with a correlation coefficient as high as 0.858 (significant at 1% level), which suggests that the cross-industry difference in stock price informativeness is persistent at least in the near term . The results using this alternative measure are qualitatively unchanged.

We mentioned in Section 3.2. that industries differ in terms of intrinsic characteristics of production, and industries with more intensive R&D or large share of intangible assets may be more opaque. We worry that our measure of informational opacity may proxy for these factors alone. In Column (3) and (4), we also include uncertainty aversion interacted with industry R&D intensity (Fisman and Love 2003) and industry asset intangibility (Claessens and Laeven 2004) respectively. We do not find support for such possibilities, which means that our measure of industry opacity contains much richer information.

4.6. Catholic Culture and National Uncertainty Aversion

In this section, we shall touch on a rather subtle question: why do some countries have higher national uncertainty aversion than others, or what are the origins of national uncertainty aversion. There dos not exist an easy and good answer, but we will make an attempt.

Among others[16], Guiso, Sapienza and Zingales (2003) find that religious beliefs have an impact on people's economic attitudes. In our sample, we indeed find that, national uncertainty aversion is significantly and substantially lower (ρ= -0.50, significant at 1%) in countries with higher fraction of Protestant population, and significantly higher (ρ= 0.46, significant at 1%)) in countries with higher fraction of Catholic population. As a matter of fact, Weber (1930) already links the rise of capitalism with Protestant reformations and thus weakening of uncertainty aversion: "The Catholic is quieter, having less of the acquisitive impulse; he prefers a life of the greatest possible security, even with a smaller income,

[16] La Porta, Lopez-de-Silanes, Shleifer and Vishny (1997a) find that dominant hierarchical religions such as Catholic deter the formation of interpersonal trust between strangers and thus have negative impact on the performance of large organizations such as governments and large corporations. Stulz and Williamson (2003) find that Catholic countries protect the rights of creditors less than other countries, and long-term debt is less important in these countries.

to a life of risk and excitement, even though it may bring the chance of gaining honor and riches… The Protestant prefers to eat well, the Catholic to sleep undisturbed." Put formally, Catholics value a predictable life more than an exciting life, while Protestants do the opposite. We suspect that the Protestant reformations in 1500s could explain why English and Dutch began to challenge Spanish and Portuguese in long-distance Atlantic trade.

In this section, we use the religion composition (the fraction of Protestant, Catholic and Muslim population respectively[17]) of a country in year 1980 as a set of instrument variables for the Uncertainty Avoidance Indicator (UAI), to test whether religion composition is the origin of national uncertainty aversion in our context.

The Instrumental Variable regression results (estimated with GMM technique, or more specifically the IVREG2 program written by Baum et al.) are reported in Column (5) of Table 6. The results are even stronger than the OLS results, which confirms the role of religion composition behind national uncertainty aversion. The null of Over-Identifying Restriction (OIR) is rejected however, which suggests that there also exist other channels through which religion composition have effects on industry growth pattern. This is not surprising as in this paper we are studying only one dimension of culture: the cross-country difference in uncertainty aversion, while countries differ in numerous aspect of their culture as shaped by religions. We plan to search for other channels in future research. As a matter of fact, Huang (2004) finds that uncertainty-averse countries trade less with distant countries and as a result grow slower. His results also suggest that the correlation is causal.

A natural question a reader familiar with the law and finance literature would ask is that whether legal origins matter. In Column (6), we also attempt to use legal origins to instrument for national uncertainty aversion. We notice that common law countries are also Protestant-dominated, and our

[17] The rest of the population are defined as affiliated with "other religions and atheism" As usual practice, we drop it from the set of instrumental variables, as by construction the percentage of this group is always equal to 100 minus percentage of people affiliated with the three major religions. As La Porta et al. (1997a) argues, Eastern Orthodox is also a hierarchical religion, which we think can contribute to uncertainty aversion as well. We have only one Orthodox country, Greece, in our sample. The numbers of protestant population in U.K. is certainly underestimated in our data, as we make an conservative stand and leave out those affiliated with Church of England, Church of Scotland, etc, which are Protestant churches but still quite special.

religious argument could proxy for legal origin difference. The results in Column (6), using Common/French/Nordic law origins dummies, however show that legal origins are not the driving force behind uncertainty aversion in our context.

5. Discussions

In this paper, we find that industries with less information available grow disproportionately slower in countries characterized by higher national uncertainty aversion, which empirically confirms the prediction by Rigotti et al. (2003)'s model that tolerance of uncertainty is essential to the growth of emerging sectors about which little is known.

As Schumpeterian creative destructions (e.g., building of railways in the 19th century and more recently growth in the IT sector) usually involves a great deal of uncertainty, our findings might explain why some countries allocate more resources to innovative sectors. Our findings could imply that, uncertainty-averse countries tend to grow in incumbent industries of less opacity, preferring old stuffs that they are familiar with, to crazy novel stuffs that nobody knows where they will be led to, and as a result unwilling to make creative destruction. Those countries with lower uncertainty aversion, in contrast, are more willing to commit resources to industries of greater opacity. In this sense, the tolerance of uncertainty can be seen as a comparative advantage for low uncertainty aversion countries during periods of rapid technology changes.

There is an interesting piece of evidence form the field. In a survey done in El Salvador, a country where bankers chase after entrepreneurs "begging" them to borrow but still most of them stick to the several traditional cash-cow industries, local business owners were asked what they would like to do with a windfall of 2.5 million USD. To the disappointment of the development officers, most people say they want to retire and move to sunny Florida[18]. We notice that El Salvador has the fifth highest uncertainty aversion in Hofstede's fifty countries sample (although not included in our regressions for lack of growth

[18] This story is told by Simon Johnson in a speech, which is unusual as restricted by IMF policy he is very reluctant to mention country names in public. The ultimate source of this story is unknown.

data). From this example, we learn that culture is as important as access to finance, in determining innovation and entrepreneurship.

We are, however, neutral in terms of which investment and growth model is superior. Those high uncertainty aversion and thus less innovative countries, benefiting from technology spillovers, can under some conditions (e.g., with human capital exceeding some threshold level) converge toward the low uncertainty aversion countries, e.g., France after British industrial revolution. The success of Japan, a high uncertainty aversion society, is a good example. In R&D, she does very little basic research but much graduate product development based on relatively mature technologies coming out of U.S. research laboratories. The fact that Japan is also rich is the best demonstration that both high and low uncertainty aversion are comparative advantages and both growth patterns are optimally chosen. In truly innovative activities, there are always hundreds of failed attempts behind one success. We are not sure whether it is (always) bless or curse that investors ignore the potential dangers hidden inside opacity, as excessive overconfidence may not always be a good thing (it is a good thing when you have good luck). As a matter of fact, Rigotti et al. (2003) show that too many uncertainty-tolerant people in the population can also cause welfare-reducing adoptions of unsuccessful inventions. Empirically, Jin and Myers (2004) have already shown both theoretically and empirically that opaque stocks (by the same definition of ours, that is, less information contained in stock returns) are more likely to crash, that is, to deliver large negative returns.

The findings in this paper would suggest that low uncertainty aversion countries devote much more resources to innovative sectors in periods of great technological changes. For the past industrial revolutions we usually refer to qualitative descriptions, while for the present we have some data, which looks quite consistent with our country ranking of uncertainty aversion. The 2003 issue of European Innovation Scoreboard (EIS, European Commission), which measures innovativeness mainly by investment in innovation activities rather than inherited abilities, shows that the innovation gap between EU as a whole and the U.S is so large and persistent that the gaps in none of the eleven innovation indicators (for which comparable data are available) are likely to be closed before year 2010. Although

EU as a whole lags behind the U.S. in terms of innovation, the European leading countries are ahead of the U.S. in eight out of eleven indicators, and this trend is predicted to continue. The leaders are predominantly Scandinavian countries (with the Northern European countries such as the Netherlands and Germany following them). Particularly, Sweden and Finland rank as the most innovative countries in the world along with the U.S., and Sweden even has a more upward trend than the U.S. has.

In this paper we also find that, better development of financial sector does not necessarily encourage people to undertake projects of great uncertainty. This new finding will lead researchers to think more about the "human character" difference of financial system, besides the traditional "market-orientation vs. bank-orientation" dichotomy (although we may also say that banks tolerant uncertainty less than equity investors do). A country characterized by high uncertainty aversion may develop a financial system with a character of uncertainty aversion. With the same amount of financial resources available, countries with higher uncertainty aversion may tend to invest in safer assets with lower returns, instead of those risky and opaque assets with potentially higher returns, and as a result would work less effectively in boosting productivity growth. We can also understanding this from another perspective. If entrepreneurs and workers in high uncertainty aversion countries grow less in opaque assets, then they may have less needs for stock markets (as more opaque companies such as IT companies need to raise capital from stock markets), and this explains why high uncertainty aversion countries generally have smaller stock markets. If the culture has killed a potential Bill Gates, then they certainly are not concerned about whether they need a well-developed stock market to support his venture.

We must also be careful in extrapolating our results to individual level, not only to be politically correct. Glaeser, Sacerdote and Scheinkman (2003) suggest that it is problematic to make inferences about individual level behavior using aggregate data, because of existence of social externality, or "social multiplier". By their theory, although high opacity industries tend to grow faster in low uncertainty aversion countries, an individual with uncertainty aversion below society average may not *significantly* more likely to start a firm in emerging sector. You also need uncertainty-tolerant employees to work for you, as well as uncertainty-tolerant investors to give you the capital. Only the change of social norm, the average attitude in the society, can make a big difference.

Some words for future research. The systematic differences in uncertainty aversion across countries, the common perception that continental Europeans are more uncertainty averse people, albeit widely appeared in casual readings and frequently mentioned in everyday talks and even Hollywood movies, have not been yet formally analyzed in relation to its impact on the cross-country differences in economic activities. We hope this study can also contribute to the growing culture-determinism literature starting from among others La Porta, Lopez-de-Silanes, Shleifer and Vishny (1997), Knack and Keefer (1997), Stulz and Williamson (2003) and Guiso, Sapienza and Zingales (2003, 2004a, 2004b), and help fuel a new round of scientific debate on whether observable and quantifiable cultural factors can, at least statistically speaking, explain economic choices and outcomes, with detailed channels identified.

REFERENCES

Acemoglu, Daron and Simon Johnson. 2003. Unbundling Institutions. Working Paper, MIT

Acemoglu,Daron and Fabrizio Zilibotti. 1997. Was Prometheus unbound by chance? Risk, diversification, and growth. Journal of Political Economy. Vol. 105: 1167-1200

Barrett, David B. 1982. World Christian Encyclopedia, 1st ed., Oxford, Oxford U. Press.

Botero, Juan; Simeon Djankov; Rafael La Porta; Florencio Lopez-de-Silane; Andrei Shleifer. 2004. The regulation of labor. Working paper, Yale University

Camerer, Colin and M. Weber. 1992. Recent developments in modeling preferences – uncertainty and ambiguity. Journal of Risk and Uncertainty. Vol. 5 (4): 325-370

Cetorelli, Nicola and Michele Gambera. 2001. Banking Structure, Financial Dependence and Growth: International Evidence from Industry Data. Journal of Finance. Vol. 56 : 617–648.

Chen, Qi; Itay Goldstein; and Wei Jiang. 2004. Price Informativeness and Investment Sensitivity to Stock Price. Working Paper. Duke University.

Claessesn, Stijn and Luc Laeven. 2003. Financial development, property rights and growth. Journal of Finance, Vol. 58(6): 2401-2436.

Demirgüç-Kunt, Asli and Vojislav Maksimovic. 1998. Law, Finance and Firm Growth, Journal of Finance, Vol. 53(6):2107-2137

Djankov, Simeon, La Porta, Rafael, Lopez-de-Silanes, Florencio, Shleifer, Andrei, 2003. Courts. Quarterly Journal of Economics Vol. 118 (2): 453–517.

Durnev, Art; Randall Morck and Bernard Yeung. 2004. Value-enhancing capital budgeting and firm-specific stock return variation. Journal of Finance. Vol. 59(1):65-105

Durnev, Art; Randall Morck; Bernard Yeung; and Paul Zarowin. 2003. Does greater firm-specific return variation mean more or less informed stock pricing? Journal of Accounting Research. Vol. 41(5): 797-835

Durnev, Art; Randall Morck and Bernard Yeung. 2001. Does firm-specific information in stock prices guide capital allocation? NBER Working Paper. No. 8093

Easley, David; Nicholas Kiefer; and Maureen O'Hara. 1997. The information content of the trading process. Journal of Financial Economics. Vol. 4: 159-186

Elliot, Larry. 2005. Lunchers lurch behind lean, mean machine. Guardian newspaper. March 28, 2005

Fisman, Raymond and Inessa Love. 2003. Trade Credit, Financial Intermediary Development and Industry Growth. Journal of Finance, Vol. 58: 353-374

Galindo, Arturo and Alejandro Micco. 2001. Creditor Protection and Financial Cycles. IADB Working Paper

Gennaioli, Nicola. 2004. Contracting in the shadow of the law. Working Paper, Harvard University

Glaeser, Edward L.; Bruce I. Sacerdote and Jose A. Scheinkman. 2003. The Social Multiplier. Journal of the European Economic Association 1(2): 345-353

Greenwood, Jeremy and Boyan Jovanovic. 1990. Financial Development, Growth, and the Distribution of Income. The Journal of Political Economy, Vol. 98(5):1076-1107.

Guiso, Luigi, Paola Sapienza and Luigi Zingales. 2004b. Cultural Biases in Economic Exchange. Working Paper. GSB University of Chicago

Guiso, Luigi, Paola Sapienza and Luigi Zingales. 2004a. The Role of Social Capital in Financial Development. American Economic Review. Vol. 94(3)

Guiso, Luigi, Paola Sapienza and Luigi Zingales. 2003, People's opium? Religion and economic attitudes, Journal of Monetary Economics, Vol. 50(1): 225-282

Hofstede, Geert H., 2001, Culture Consequences: Comparing Values, Behaviors, Institutions, and Organizations Across nations. Thousand Oaks, CA: Sage.

Hofstede, Geert H. 1991. Cultures and Organizations: Software of the Mind. Thousand Oaks, CA: Sage.

Hofstede, Geert H., 1980, Culture's consequences : international differences in work-related values. Thousand Oaks, CA: Sage.

Huang, Rocco R. 2004. National uncertainty aversion, international trade, and growth. Working paper University of Amsterdam

Jaffray, J.-Y. and P. Wakker. 1994. Decision making with belief functions: compatibility and incompatibility with the sure-thing principle. Journal of Risk and Uncertainty. 8. 255-271

Jin, Li and Stewart C. Myers. 2004. R-Squared Around the World: New Theory and New Tests. Journal of Financial Economics, Forthcoming

Knack, Stephen and Philip Keefer. 1997. Does Social Capital Have an Economic Payoff? A Cross-Country Investigation. Quarterly Journal of Economics, Vol. 112(4): 1251-1288

Knight, Frank H., 1921, Risk, uncertainty and profit. Boston, MA: Hart, Schaffner & Marx; Houghton Mifflin Company,

La Porta, Rafael, Lopez-de-Silanes, Florencio, Pop-Eleches, Christian, Shleifer, Andrei. 2004. Judicial checks and balances, Journal of Political Economy. Vol. 112(2): 445-470

La Porta, Rafael; Florencio Lopez-de-Silanes; Andrei Shleifer; Robert W. Vishny, 1998, Law and Finance, Journal of Political Economy Vol. 106(6): 1113-1155

La Porta, Rafael; Florencio Lopez-de-Silanes; Andrei Shleifer; Robert W. Vishny, 1997a, Trust in large organizations, American Economic Review, Vol. 87(2): 333-338

Morck, Randall; Bernard Yeung and Wayne Yu. 2000. The information content of stock markets: why do emerging markets have synchronous stock price movements? Journal of Financial Economics. Vol. 58: 215-60

Mukerji, Sujoy and Jean-Marc Tallon. 2003. An overview of economic applications of David Schmeidler's models of decision making under uncertainty. Working Paper, Oxford University.

Mukerji, Sujoy and Jean-Marc Tallon. 2001. Ambiguity Aversion and Incompleteness of Financial Markets. The Review of Economic Studies, Vol. 68, pp 883-904

Mukerji, Sujoy . 1998. Ambiguity Aversion and Incompleteness of Contractual Form. American Economic Review, Vol. 88(5): 1207-1231.

Rajan, Raghuram G. and Luigi, Zingales, 1998. Financial Dependence and Growth, American Economic Review, Vol. 88(3): 559-586

Rigotti, Luca. 2004. Decisive entrepreneurs and cautious investors. Working Paper, Duke University

Rigotti, Luca; Matthew Ryan; Rhema VAithianathan. 2003. Tolerance of ambiguity and entrepreneurial innovation. (Invited) Resubmitted to the Review of Economic Studies

Roll, Richard . 1988. R-Squared, Journal of Finance Vol. 43: 541-566

Stulz, Rene M. and Rohan Williamson. 2003, Culture, openness, and finance, Journal of Financial Economics, Vol. 70(3): 313-349

Weber, Max. 1930. The protestant ethic and the spirit of capitalism. Translated by Talcott Parsons. New York: Free Press

Appendix A: Measuring National Uncertainty Aversion

(Mostly reproduced from Hofstede, 1980 and 2001)

To construct the Uncertainty Avoidance Indicator (UAI), Hofstede uses the answers of respondents to the three basic questions as follows (he asked other questions as well in the survey in relation to uncertainty aversion, but by factor analysis these three turn out to have already provided most of the information):

(a)Rule Orientation: Agreement with the statement “company rules should not be broken – even when the employee thinks it is in the company’s best interest” (1 for strongly agree and 5 for strongly disagree)

Motivation: Rule is a mechanism invented by human beings since primitive era, to stabilize the present and future, minimize undesirable uncertainty and hold organizations together. The disagreement with the “rule orientation” statement thus indicates a higher level of tolerance for ambiguity, by allowing the breaking of rules upon unexpected and unstructured situations. Rule is not a bad word per se, but it is usually perceived negatively as it is sometimes associated with bureaucracy and red tape. The answer to this question is highly correlated with formality in judicial procedures (data from Djankov et al. 2003)

(b)Employment stability: Employees’ statement that they intend to continue with the company for more than X years

Motivation: the “employment stability” statement reflects modern human beings’ attitude toward situation of ambiguity, in a employer-employee context. The answers to this question are strongly correlated with the answers to the “rule orientation” statement. Later survey also found that the intention is consistent with actual action. The answer to this question is highly correlated with the regulation of labor market (data from Botero et al. 2004).

(c)Stress: as expressed in the mean answer to the question: “how often do you feel nervous or tense at work” (1 for “I always feel this way” and 5 for “I never feel this way”)

Motivation: the question about stress is less familiar to economists, but a well-researched topic in social psychology literature. It taps a fundamental phenomenon in human life. Stress and anxiety is a state of mind and body, or anxiety about the future, which corresponds to the state of preparation for aggression in primitive man, released through acts of arbitrary aggression into unknown territory, and accumulated when the social norms and rules forbid him from overt aggression. The medical community commonly believes that stress and anxiety is mainly caused by the fear of uncertainty in the future, which is also the main differences of it from another psychological illness - depression - which is caused by the belief that the future is doomed (certain) to be hopeless. Therefore, ceteris paribus, people in an uncertainty avoidance society would generally accumulate more stress. The answer to this question is highly consistent with cross-country medical survey, which suggests that it is a social problem rather than a corporate problem.

Hofstede use the average value in a country to reflect culture. This practice is commonly accepted in previous literature, e.g., Knack and Keefer (1997), La Porta, Lopez-de-Silanes, Shleifer and Vishny (1997), Guiso, Sapienza and Zingales (2004a, 2004b). To make the contribution of each question roughly equal, Hofstede uses the following formula to adjust the weights and compute the aggregate score of national uncertainty aversion: UAI = 300 – 30 (mean score rule orientation) – (% intending to stay less than 5 years) – 40 (mean stress score)

Appendix B: Measuring Stock Price Informativeness (INFO)

(Mostly reproduced from Durnev, Morck and Yeung, 2004)

To measure stock price informativeness in an industrial sector, Durnev et al. (2004) modify Roll (1988)'s famous R^2 and gauge firm-specific return variations in industry i, by regressing firm j's returns $r_{i,j,t}$ on industry returns $r_{i,t}$ as well as market returns $r_{m,t}$:

$$r_{i,j,t} = \beta_{j,0} + \beta_{j,i} r_{i,t} + \beta_{j,m} r_{m,t} + \varepsilon_{i,j,t}$$

The industry returns are the returns on a value-weighted portfolios of all firms in industry i excluding firm j, while the market returns are returns on a market value-weighted portfolio including all NYSE, AMEX and NASDAQ listed stocks. The exclusion of firm j prevents spurious correlations between firm and industry returns in industries that contain very few firms.

One minus average R^2 of the regressions using each firm in an industry measures the stock price informativeness of that industry. The more information contained in the stock prices of individual firms, the lower the R^2 will be.

Standard variance decomposition lets us express an industry-average R^2 as

$$R_i^2 = \frac{\sigma_{m,i}^2}{\sigma_{\varepsilon,i}^2 + \sigma_{m,i}^2} \quad \text{where} \quad \sigma_{\varepsilon,i}^2 = \frac{\sum_{j \in i} SSR_{i,j}}{\sum_{j \in i} T_j} \quad \text{and} \quad \sigma_{m,i}^2 = \frac{\sum_{j \in i} SSM_{i,j}}{\sum_{j \in i} T_j}$$

where $SSR_{i,j}$ and $SSM_{i,j}$ are the unexplained and explained variations respectively of the regression, and the sum are scaled by $\sum_{j \in i} T_j$, the number of daily observations available in industry i.

The distribution of $1-R^2$ is negatively skewed and mildly leptokurtic, and has the econometrically undesirable characteristics of being bounded within the unit interval. Therefore, Durnev et al. (2004) circumvent the bounded nature of R^2 with a logistic transformation of $1 - R_i^2 \in [0,1]$ to $INFO_i \in \Re$

$$INFO_i = \ln\left(\frac{1 - R_i^2}{R_i^2}\right) = \ln(\sigma_{\varepsilon,i}^2) - \ln(\sigma_{m,i}^2)$$

which as a result of this manipulation become less skewed and less leptokurtic than $1-R^2$.

When collecting data from COMPUSTAT database, we discard duplicate entries for preferred stock, class B stock, and the like by deleting entries whose CRSP CUSIP identifiers append a number other than 10 or 11. We also discard those stocks with price history less than 30 days in the sample, as well as those thin trading stocks whose prices changed for less than 30 times in the three-year period.

Table 1. National Uncertainty Aversion (listing from the highest to the lowest)

UAI: Uncertainty Avoidance Indicator (UAI) from IBM sample, Hoppe Sample and EMS sample respectively. Higher UAI indicates higher uncertainty aversion or in other words less tolerance of uncertainty

Country	UAI IBM sample	UAI HoppeSample	UAI EMS sample	Legal Origin	Protestant %	Catholic %
Greece	112	80		French	0.1	0.4
Portugal	104	57	82	French	1.1	94.1
Belgium	94	100	80	French	0.4	90
Japan	92			German	0.9	0.6
Peru	87			French	2.7	0.5
Spain	86			French	0.1	96.9
France	86			French	2.4	76.4
Chile	86	87	89	French	1.9	82.1
Costa Rica	86	60	89	French	5.8	90.5
Korea	85			German	12.2	3.9
Turkey	85	72		French	0	0.1
Mexico	82			French	1.2	94.7
Israel	81			Common	0.2	1
Colombia	80			French	0.9	96.6
Venezuela	76			French	1	94.8
Brazil	76			French	4	87.8
Italy	75	77	80	French	0.4	83.2
Austria	70	66	64	German	6.5	88.8
Pakistan	70			Common	0.8	0.5
Germany	65	70	67	German	46.4	35
Finland	59	64	44	Nordic	93.1	0.1
Netherlands	53	47	53	French	42.4	42.6
Australia	51			Common	23.5	29.6
Norway	50	55	44	Nordic	97.8	0.3
South Africa	49			Common	39	10.4
New Zealand	49			Common	37.9	18.7
Canada	48			Common	29.6	46.6
United States	46	49		Common	43.6	30
Philippine	44			French	3.8	84.1
India	40			Common	1.1	1.3
Malaysia	36			Common	1.4	2.8
UK	35	66		Common	16.1	13.1
Sweden	29	41	24	Nordic	68.4	1.4
Denmark	23	31	23	Nordic	95.2	0.6
Singapore	8			Common	2.6	4.7
Correlation with UAI	-	0.698***	0.9399***		-0.496***	0.462***

Table 2. INFO: Stock Price Informativeness (negatively proxying for industry opacity) (Listing from the highest to the lowest by INFO)

ISIC Rev.2 Code	Industry Description	INFO 1977-79	INFO 1980-82	Risk 1977-1979
361	Pottery, china and earthware	4.259124	5.863572	0.01416
323	Leather	4.093001	5.54027	0.024319
322	Wearing apparel	3.728787	3.831158	0.027257
311	Food products	3.363503	3.167748	0.02026
321	Textile	3.305214	4.118685	0.036931
355	Rubber products	3.286406	3.213462	0.022841
332	Furniture	3.273199	3.419881	0.025185
314	Tobacco	3.263746	4.486215	0.016877
3211	Spinning, Weaving	3.232374	3.418762	0.02339
356	Plastic products	3.216704	3.330948	0.015769
341	Paper and Products	3.191218	3.628373	0.023186
390	Other industries	3.099329	3.076186	0.024869
324	Footwear	3.095508	3.440368	0.021086
369	Non metal mineral products	3.028327	3.476249	0.018358
3513	Synthetic resins	3.026929	2.983097	0.020302
331	Wood Products	3.015356	2.914899	0.030449
342	Printing and Publishing	2.983543	2.894957	0.017456
362	Glass products	2.937361	3.291834	0.02101
3841	Ship building and repairing	2.920880	3.853995	0.027988
313	Beverages	2.919565	2.82684	0.024335
383	Electric machinery	2.910576	2.732728	0.026734
3843	Motor vehicle	2.884311	3.097128	0.020622
3522	Drugs and medicines	2.877115	2.891061	0.02115
3832	Radio and telecom equipments	2.847439	2.426369	0.028551
372	Non-ferrous metal	2.842772	2.529846	0.023641
352	Other chemicals products	2.773733	2.844291	0.021926
381	Metal products	2.771943	2.902839	0.023237
354	Petroleum and coal	2.733379	3.777002	0.018101
385	Professional and scientific goods	2.672047	2.845871	0.02507
382	Machinery	2.644302	2.689463	0.020961
371	Iron and Steel	2.626205	2.777357	0.020975
384	Transportation equipment	2.488073	2.368532	0.026861
3511	Basic industrial chemicals	2.324591	3.059732	0.019186
3825	Office and computing machinery	2.269410	2.746127	0.026145
353	Petroleum refineries	1.854922	1.584258	0.017565
3411	Pulp, paper and paperboard	1.779791	1.610529	0.015114
Correlation		-	0.858***	0.109

Table 3. National Uncertainty Aversion and Industry Growth

Table 7 describes the variable definitions and sources. Dependent variables are real growth in value added for each industry and each country. All regressions include industry and country dummies. Heteroskedasticity robust standard errors appear in parenthesis. Significance levels ***, ** and * correspond to 1%, 5% and 10% respectively. The coefficients involving UAI are multiplied by 100.

Dependent Variables: Real Growth Rates in Value-added in the 1980s							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
INFO×UAI (IBM sample)	0.043 (0.016)***			0.043 (0.016)***	0.043 (0.017)***	0.040 (0.016)**	0.040 (0.016)**
INFO×UAI (Hoppe sample)		0.066 (0.027)**					
INFO×UAI (EMMS sample)			0.066 (0.019)***				
RISK*UAI				-0.061 (1.404)			
INFO×FD					0.001 (0.023)		
INFO×Stock_Market						-0.007 (0.013)	
INFO×GDPPC							-0.003 (0.002)
EXTFIN×FD	0.054 (0.021)**	-0.021 (0.022)	0.003 (0.026)	0.054 (0.021)**	0.055 (0.022)**	0.054 (0.021)**	0.049 (0.022)**
Share	-0.383 (0.130)***	-0.106 (0.107)	-0.080 (0.106)	-0.384 (0.130)***	-0.383 (0.130)***	-0.384 (0.130)***	-0.389 (0.131)***
Industry Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1071	461	353	1071	1071	1071	1071
R-Squared	0.3789	0.5899	0.4814	0.3790	0.3790	0.3791	0.3800

Table 4. Contracting Institutions vs. National Uncertainty Aversion

Table 7 describes the variable definitions and sources. Dependent variables are real growth in value added for each industry and each country. All regressions include industry and country dummies. Heteroskedasticity robust standard errors appear in parenthesis. Significance levels ***, ** and * correspond to 1%, 5% and 10% respectively. The coefficients involving UAI are multiplied by 100.

Dependent Variables: Real Growth Rates in Value-added in the 1980s					
	(1)	(2)	(3)	(4)	(5)
INFO×UAI	0.064	0.066	0.060	0.060	0.049
	(0.017)***	(0.022)***	(0.027)**	(0.019)***	(0.021)**
INFO×Common_Law	0.021	0.021	0.016		
	(0.010)**	(0.009)**	(0.014)		
INFO×French (exl. German)		-0.002	-0.005		
		(0.012)**	(0.012)		
INFO×Scandinavian			-0.008		
			(0.014)		
INFO×Case_Law				0.017	0.019
				(0.012)	(0.012)
INFO×Legal Formalism					0.016
					(0.017)
EXTFIN*FD	0.054	0.055	0.056	0.055	0.055
	(0.021)**	(0.021)**	(0.022)**	(0.021)**	(0.021)**
Share	-0.395	-0.396	-0.396	-0.385	-0.381
	(0.131)***	(0.130)***	(0.130)***	(0.128)***	(0.128)***
Industry Dummy	Yes	Yes	Yes	Yes	Yes
Country Dummy	Yes	Yes	Yes	Yes	Yes
Observations	1071	1071	1071	1071	1071
R-Squared	0.3818	0.3819	0.3820	0.3809	0.3815

Table 5. Investor Protection vs. National Uncertainty Aversion

Table 7 describes the variable definitions and sources. Dependent variables are real growth in value added for each industry and each country. All regressions include industry and country dummies. Heteroskedasticity robust standard errors appear in parenthesis. Significance levels ***, ** and * correspond to 1%, 5% and 10% respectively. The coefficients involving UAI are multiplied by 100.

Dependent Variables: Real Growth Rates in Value-added in the 1980s						
	(1)	(2)	(3)	(4)	(5)	(6)
INFO×UAI	0.058 (0.017)***	0.044 (0.017)**	0.055 (0.016)***	0.038 (0.018)**	0.040 (0.017)**	0.048 (0.018)***
INFO×Shr. Rights	0.009 (0.003)***					
INFO×Eff. Shr. Rights		0.000 (0.001)				
INFO×Creditor Rights			0.005 (0.004)			
INFO×Eff. Cred. Rights				0.000 (0.001)		
INFO×Expropriation					-0.001 (0.003)	
INFO×Labor Rigidity						0.000 (0.000)
EXTFIN*FD	0.051 (0.021)**	0.053 (0.021)**	0.058 (0.021)***	0.052 (0.021)**	0.052 (0.022)**	0.055 (0.021)***
Share	-0.394 (0.130)***	-0.380 (0.134)***	-0.388 (0.131)***	-0.382 (0.130)***	-0.384 (0.131)***	-0.386 (0.130)***
Industry Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Country Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1039	1039	1071	1071	1071	1071
R-Squared	0.4029	0.3976	0.3804	0.3791	0.3791	0.3791

Table 6. Further Robustness Tests and Instrumental Variable Results

Table 7 describes the variable definitions and sources. Dependent variables are real growth in value added for each industry and each country. All regressions include industry and country dummies. Heteroskedasticity robust standard errors appear in parenthesis. Significance levels ***, ** and * correspond to 1%, 5% and 10% respectively. The coefficients involving UAI are multiplied by 100. In Column (3), we use religion composition as Instrumental Variables, while in Column (4) we use legal origins.

Dependent Variables: Real Growth Rates in Value-added in the 1980s						
	(1)	(2)	(3)	(4)	(5)	(6)
High_INFO×UAI	0.035 (0.014)***					
INFO80_82×UAI		0.023 (0.009)***				
INFO×UAI			0.040 (0.016)**	0.044 (0.016)***		
R&D×UAI			-0.502 (0.340)			
Intangibility×UAI				-0.019 (0.103)		
INFO×UAI (Religious Origin IVs)					0.078 (0.024)***	
INFO×UAI (Legal Origin IVs)						0.032 (0.022)
EXTFIN*FD	0.054 (0.021)**	0.054 (0.021)**	0.057 (0.022)***	0.054 (0.021)**	0.057 (0.020)***	0.054 (0.021)**
Share	-0.387 (0.130)***	-0.383 (0.130)***	-0.399 (0.132)***	-0.383 (0.130)***	-0.410 (0.126)***	-0.378 (0.126)***
Industry Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Country Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1071	1071	1071	1071	1071	1071
R-Squared	0.3779	0.3784	0.3801	0.3790	0.3754	0.3787
OIR p-values	-	-	-	-	0.086	0.036

Table 7. Variable Definitions and Sources.

Abbreviation	Description	Sources
	Country-Industry Specific Variables	
Growth	Industry growth, measured by annually compounded growth rates in real value added, disaggregated at 36 ISIC manufacturing industries and 34 countries, in the 1980s	Rajan and Zingales (1998).
Share	An industrial sector's initial share of value added in total manufacturing in year 1980	Rajan and Zingales (1998).
	Industry-Specific Variables	
INFO	Stock price informativeness, (negatively) proxying for informational opacity in an industry. Measured by relative firm-specific stock return variations of U.S. firms in an industry, calculated over Jan 1977 - Dec 1979 period. Smaller INFO indicates less information available in an industry, thus more opacity.	Calculated by the authors following the methodology of Durnev et al. (2004)
High_INFO	Binary measure of informational opacity. 0 for opaque industries with an INFO smaller than the median, 1 for informationally transparent industries	Same as above
INFO80_82	The same as INFO, but measured over Jan 1980 – Dec 1982 period	Same as above
RISK	Industry risk, measured by standard deviation of stock returns, averaged over all U.S. firms in an industry during Jan 1977 -- Dec 1979	CRSP
EXTFIN	Dependence on external financing, measured by industry-level median of the ratio of capital expenditures minus cash flow over capital expenditures (the numerator and denominator are summed over 1980-1989 for each firm before dividing) for US.	Rajan and Zingales (1998)
R&D	R&D intensity, measured by R&D expenditure over fixed asset, U.S. industry median in 1980s	Fisman and Love (2003)
Intangibility	Asset intangibility, measure by intangibles over fixed asset, U.S. industry median averaged over 1980-1989	Claessens and Laeven (2004)
	Country-Specific Variables	
UAI (IBM sample)	Uncertainty Avoidance Indicator. Higher UAI's reflect higher national uncertainty aversion	Hofstede (1980, 2001)
UAI (Hoppe Sample)	Uncertainty Avoidance Indicator. Straight replication of IBM survey, using elite alumni from the Salzburg Seminar. Done in early 1990s	Hoppe

UAI (EMMS sample)	Uncertainty Avoidance Indicator. Straight replication of IBM survey, using respondents of European Media and Marketing Survey 1997	Inter/View International
FD	Domestic credit to private sector over GDP in 1980	Rajan and Zingales (1998).
Stock_Market	Stock market capitalization over GDP in 1980	Rajan and Zingales (1998).
GDPPC	Log of GDP per capita in year 1980	IFS
Legal Origins	Dummies for Common law, French civil law, German civil law and Scandinavian civil law respectively	La Porta et al. (1998)
Case Law	1 if judicial decisions are a source of law, and 0 otherwise	La Porta et al. (2004)
Legal Formalism	Between 0 and 1, whether judgments have to be based on statutory law rather than on principles or equity, averaged over two cases: eviction of tenets and collection of bounced checks	Djankov et al. (2003)
Shareholder Rights	De jure measure of shareholder protection, taking into account various provision of minority investors protection in security laws	La Porta et al. (1998)
Creditor Rights	De jure measure of shareholder protection, taking into account various provision of creditor protection in commercial laws	La Porta et al. (1998) and Galindo and Micco (2001)
Effective Protection of …	Effective protection of shareholder rights or creditor rights, measured by the de jure indicators above multiplied by judicial efficiency/integrity index averaged over the 1980s	La Porta et al. (1998) and ICRG
Risk of Expropriation	The risk of expropriation by government, averaged over 1980s	ICRG
Rigidity of Labor Laws	The rigidity of labor laws governing the hiring and firing process, as well as working hours	Botero et al. (2004)
Religion Composition%	The percentages of Protestant, Catholic and Muslim population respectively, in year 1980	Barrett (1982)

Figure 1:
Better performance of opaque industries in uncertainty-tolerant countries

On the Y-axis, we have the average abnormal growth rate of low INFO industries minus that of high INFO industries for country k. On the X-axis, we have national uncertainty aversion indicator. Two outliers (Pakistan and Mexico) are outside the visible region (they are however taken into account when the fitted line is drawn).