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Hübner, Malte and Vannoorenberghe, Gonzague

KfW Bankengruppe, Department of Economics, Tilburg University

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Malte Hübner[a,1], Gonzague Vannoorenberghe[b,1]

[a] *KfW Bankengruppe, Palmengartenstr. 5-9, 60325 Frankfurt, Germany*
[b] *Department of Economics, Tilburg University, P.O. Box 90153, 5000 LE Tilburg, The Netherlands*

Abstract

Complementing research on the effect of patience on individual behavior, we present empirical evidence that patience is an important determinant of long-run income differences between countries. To account for a potential endogeneity bias, we instrument patience by information on how languages spoken in the countries of our sample require speakers to encode time. The economic impact of patience and growth is sizable. Our results suggest that increasing patience by one standard deviation raises per-capita income by between 34% and 78%.

Keywords: long-run growth; time preferences; patience

1. Introduction

An important question in economics is why income levels vary across countries. Over time, economists have identified a number of political, economic and institutional factors that are robustly related to economic growth (see for instance Barro and Sala-i Martin, 2004, Ch. 12). Comparatively little attention has so far been given to cultural factors that might explain cross-country differences in income. In one of the most recent papers on the impact of culture on growth, Gorodnichenko and Roland (2010) provide strong evidence of a causal effect of individualism on income per worker and total factor productivity as well as on innovation. Using an empirical strategy almost identical to theirs, we provide evidence for the impact of a further cultural variable on income per worker: patience.

Patience, or the inverse of the time preference rate, is a central variable in theoretical models of economic growth. In the Ramsey-Cass-Koopmans growth model with exogenous technical progress and an endogenous saving rate, more patient countries have a higher steady state capital stock and higher output per worker. In models with endogenous technical change, patience is also associated with higher growth rates as more patient countries save more and make more resources available for research and development and innovation (e.g Romer, 1990).

Using a panel of 89 countries and three different measures of patience, we document a strong positive impact of patience on income per worker, total factor productivity and the capital stock. To account for a possible endogeneity bias arising from the fact that patience might itself depend on income levels, we use information on how the languages

Email addresses: malte.huebner@web.de (Malte Hübner), G.C.L. Vannoorenberghe@uvt.nl (Gonzague Vannoorenberghe)

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spoken in the countries of our sample require speakers to mark future events as an instrument for patience. The economic impact of patience and growth is sizable. Our results suggest that increasing patience by one standard deviation raises per-capita income by between 34% and 78%.

Our paper relates to two strands of the economic literature. Firstly, we contribute to the empirical literature trying to identify the impact of time preferences on behavior. While patience has already been shown to be an important predictor of individual behavior, such as health outcomes, school performance (Golsteyn et al., 2014), the likelihood of having credit card debt (Meier and Sprenger, 2010), alcohol consumption, body mass index and individual savings (Sutter et al., 2013), the literature seeking to identify the impact of time preferences on macroeconomic outcomes is still scant. The few existing studies on this topic do not go much beyond testing for mere correlations (Hofstede and Minkov, 2010, Wang et al., 2011, Preis et al., 2012). To the best of our knowledge, the only more in-depth study is Chen (2013), who argues that more patient countries have higher savings rates.

Secondly, we contribute to the empirical studies on the relationship between culture and growth. So far, economists studying this topic have looked at the relationship between ethnic diversity and growth (Easterly and Levine, 1997), mutual trust and growth (Knack and Keefer, 1997) and individualism, power distance, masculinity and uncertainty avoidance and growth (Gorodnichenko and Roland, 2010, 2011). The closest work to ours is a contemporaneous study by Dohmen et al. (2015), who also examine the link between patience and long run income in a cross-country framework. Using data on patience coming from an international survey they find evidence for a robust correlation between patience and different measures of long-run economic performance. Dohmen et al. (2015)'s work and ours can be seen as complement in that we use different measures of patience and different instrumentation strategies to come to a very similar and key conclusion, namely that patience is a determinant of long-run economic growth.

2. Data and empirical strategy

Our empirical strategy follows Gorodnichenko and Roland (2011) as closely as possible. To identify the impact of patience on long-run growth we estimate the following model in a cross-section of 89 countries:

$$y_i = \alpha P_i + \beta X_i + \epsilon_i \tag{1}$$

In equation (1), the variable y_i takes on various economic outcomes related to long-run growth that are potentially influenced by the time preference rate. P_i is a measure of patience for country i and X_i is a vector of control variables. Our vector X_i comprises the geographical and religious control variables of Gorodnichenko and Roland (2011). Our measures of long-term growth, y_i, are also almost identical to those considered in Gorodnichenko and Roland (2011) and include the logarithm of real output per worker for the year 2000 (at purchasing power parity) from the Penn World Tables, the logarithm of total factor productivity from Hall and Jones (1999) as well as two measures of innovation; i.e. the logarithm of the Innovation Performance Index (IPE) and the log of the number of patents per million population from the Economist Intelligence Unit (Economist Intelligence Unit, 2007, 2009). In addition to the variables considered by Gorodnichenko and Roland (2011) we also use the capital stock per worker, calculated from the Penn World Tables (Version 8) as a dependent variable.

There are a number of reasons that speak in favor of using levels instead of growth rates for the dependent variables. Hall and Jones (1999) argue, for instance, that there is only a low correlation between differences in growth rates across decades. Moreover, Jones (1995) presents a model in which growth is determined endogenously by resources devoted to research and development, but in the steady state these variables only have an effect on the level of income but not on its rate of growth.

Our variable of interest is the average degree of patience in an economy (P). We employ three different proxies for this variable. The first proxy stems from a large scale international survey on time discounting, comprising roughly 6000 students in 52 advanced and developing countries (Wang et al., 2011).The survey contains a binary choice question asking participants whether they prefer an immediate monetary reward over a higher payoff in the future. The precise wording of the question[2] was:

Which offer would you prefer?
A. a payment of $3400 this month
B. a payment of $3800 next month

The payoffs in this question were adjusted to each country's purchasing power parity. For each country, we use the share of participants who decided to wait for the higher monetary reward in the future, option B, as a proxy for patience (*Wait*).

Our second proxy of patience is Hofstede's Index of Long-Term Orientation, which is calculated from the answers to specific questions in the World Value Survey (Minkov and Hofstede, 2010). As a third measure we use the Future Orientation Index of Preis et al. (2012). For each country, this index reports the number of internet search engine queries for the next year (e.g. "2013" in 2012) relative to the search engine queries containing the previous year (e.g. "2011" in 2012). Our preferred measure of patience is the variable *Wait* as it is determined with methods most commonly used to elicit time preferences. The other two variables are significantly correlated with our preferred measure of patience with a correlation coefficient of around 0.3, indicating that all three variables measure indeed the same concept. Following Gorodnichenko and Roland (2011) we normalize our measures of patience to have zero mean and a standard deviation of one. Our central hypothesis is that the coefficient of interest, α is positive for all three proxies of patience.

Our empirical strategy is potentially prone to an endogeneity problem. As patience may itself be dependent on the level of income, estimations of equation (1) by OLS may be biased due to reverse causality[3]. Omitted variable

[2] The question refers to a hypothetical situation and no payments are actually made. See Wang et al. (2011) for a detailed description of the survey.

[3] It has already been pointed out by Irving Fisher that . . . *the smaller the income, the higher the preference for present over future income, that*

biases or measurement errors may also be an issue for the concept of patience, which is hard to elicit. To address these problems, we instrument for the three measures of patience using Chen (2013)'s data on the grammatical structure of languages spoken in each country. Chen (2013) argues that people speaking a language that has the property of strong future term reference (*strong FTR*) and hence does not strongly require speakers to distinguish grammatically between the future and present, discount future consumption to a lesser extent. Our instrument is the population weighted average of the *strong FTR* dummy for the languages spoken in a country. We expect the *strong FTR* variable to be negatively related to our measures of patience. The exclusion restriction for our IV strategy is that the grammatical structure of a country's language(s) is correlated with the patience of its inhabitants but not directly with long-run growth.

The size of our cross-section depends on the availability of our measures of patience. In our baseline estimation, in which we use the results from Wang et. al.'s binary choice tasks as a measure of patience, our cross-section includes 52 countries. Hofstede's Index of Long-Term Orientation is available for a larger set out countries, allowing us to expand our cross-section to 89 countries. Table 1 reports some summary statistics for our data.

Table 1: Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Wait	53	.63	.18	.08	.89
Hofstede's long-term	92	.46	.24	0	1
Future Orientation Index	44	.76	.30	.24	1.32
Real income per worker	92	31580	25737	1317	103209
Total factor productivity	74	.68	.30	.14	1.28
Capital stock per worker	92	88776	72560	1587	255513
Patents	68	80.4	183.88	.001	1274.53
Innovation Performance Index	68	6.51	2.16	1.44	10

Summary statistics calculated over all countries with data for at least one proxy for patience.

3. Results

To get a first impression of the relationship between patience and growth, Figure 3 shows some scatter plots of our preferred measure of patience and the various measures of economic growth considered by Gorodnichenko and Roland (2010). As expected, patience is positively related to all four components of economic growth displayed in Figure 3. This positive correlation is confirmed by the OLS regressions of the variable *Wait* on the different components of economic growth (columns 1-3 of Table 2). The coefficient on our preferred measure of patience has the expected positive sign in all estimations. With one exception, the coefficients are also significantly different from zero. Turning to the IV estimates which are robust to a possible endogeneity bias and measurement error, we continue to estimate a significantly positive relationship between patience and the various components of growth (columns 4-6 of Table 5).

is the greater the impatience … (cited in Thaler, 1997)

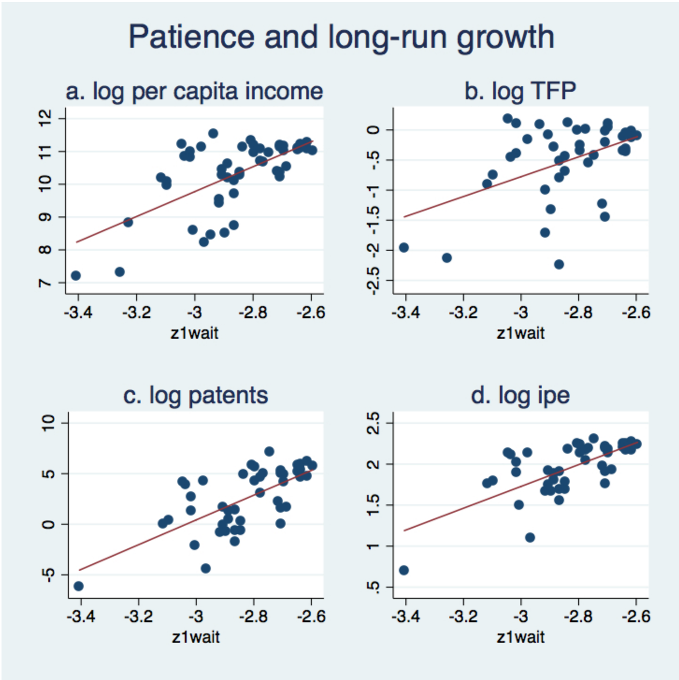

Figure 1: Patience, as measured by Wang et al.'s binary decision task and various measures of long-run growth.

The only exception is the correlation between patience and total factor productivity. Here we find a positive but only insignificant coefficient on patience.

The results are also economically significant. In the univariate regressions reported in column 1 of Table 2, patience explains about 40% of the cross-country variation in income. Moreover, a coefficient on patience between 0.432 and 0.786 means that increasing patience by one standard deviation (the difference between Germany and Slovenia or the Netherlands and Argentine) raises output per worker by between 34% and 78%.

The strong relation between patience and economic growth is confirmed by the estimations using the Future Orientation Index of Preis et al. (2012) as a proxy for patience (Table 3, columns 3 and 4). Again, we find a significantly positive coefficient on patience in all OLS regressions. This result is confirmed in all IV regressions. Despite the fact that the F-Test statistics on the excluded instruments are rather small in most IV regressions, our instrument has a strongly significant influence on patience in all first stage regressions[4]

Using Hofstede's Index of Long-Term Orientation as a measure for patience, we fail to find a significant relationship between patience and long-run growth (columns 1 and 2 of Table 3). The OLS regressions yield the expected positive correlation between patience and growth, but the coefficient on patience in generally not significant. This is most likely due to the fact that Hofstede's Index of Long-Term Orientation is highly correlated with the geographic controls[5] which is also not unproblematic for the IV specification. Due to the already strong correlation of Hofstede's

[4]The only exception being the IV regression of total factor productivity on patience.

[5]In the specification without controls, Hofstede's Index generally continues to have a weakly significant positive correlation with growth.

Index of Long-Term Orientation with the geographic controls, the *strong FTR* variable is not a good instrument for this particular proxy for patience in the full specification. The instrumental variable estimates reported in column 2 of Table 3 are therefore difficult to interpret.

4. Conclusion

Consistent with theories of economic growth, we provide empirical evidence for a positive impact of patience on long-term living standards. Our results complement the already broad literature on the impact of patience on individual behavior by showing that it also affects macroeconomic variables. However, the strength and the robustness of our results depend in part on the measure of patience used in the analysis.

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5. Literature

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Table 2: Wang et al. (2011)'s measure of time preferences

	OLS			IV		
	No controls	Religion controls	Religion & Geo Controls	No controls	Religion controls	Religion & Geo Controls
	(1)	(2)	(3)	(4)	(5)	(6)
			a. Dependent variable: Output per worker			
Wait	0.687***	0.677***	0.432***	0.585***	0.632***	0.786***
	(0.116)	(0.116)	(0.126)	(0.227)	(0.236)	(0.290)
F-Test				21.20	18.47	9.56
Observations	53	52	51	50	49	48
R-squared	0.407	0.439	0.680	0.234	0.254	0.455
			b. Dependent variable: Patents			
Wait	2.317***	2.296***	1.530***	2.839***	2.698***	2.991***
	(0.407)	(0.416)	(0.517)	(0.809)	(0.853)	(1.045)
F-Test	-	-	-	23.38	19.85	11.70
Observations	46	45	45	44	43	43
R-squared	0.424	0.431	0.625	0.290	0.308	0.533
			c. Dependent variable: Total factor productivity			
Wait	0.311***	0.293***	0.0598	0.186	0.172	0.299
	(0.0922)	(0.0936)	(0.109)	(0.196)	(0.206)	(0.283)
F-Test	-	-	-	17.06	14.66	5.40
Observations	42	41	40	39	38	37
R-squared	0.222	0.239	0.591	0.052	0.056	0.341
			d. Dependent variable: Innovation Performance Index			
Wait	0.262***	0.261***	0.115**	0.273***	0.266**	0.266***
	(0.0503)	(0.0519)	(0.0511)	(0.0973)	(0.104)	(0.100)
F-Test	-	-	-	23.38	19.85	11.70
Observations	46	45	45	44	43	43
R-squared	0.381	0.377	0.743	0.223	0.225	0.677
			e. Dependent variable: Capital Stock per worker			
Wait	0.688***	0.675***	0.470***	0.569***	0.596***	0.813***
	(0.119)	(0.119)	(0.139)	(0.219)	(0.229)	(0.308)
F-Test	-	-	-	21.20	18.47	9.56
Observations	53	52	51	50	49	48
R-squared	0.395	0.419	0.620	0.204	0.214	0.313

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

All dependent variables are in logs. *WAIT* is the share of respondents deciding to wait for the higher monetary reward in the future in WANG binary decision task.Religious control is the share of population practicing the main religions (Barro). Geographic controls are latitude, longitude and dummies for continent and landlocked countries. Instrument is the variable *strong FTR* from Chen.

Table 3: Other proxies for patience

	Religion & Geo Controls			
	Hofstede's Long-Term		Future Orientation Index	
	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)
	a. Dependent variable: Output per worker			
Patience	0.037	-6.523	0.591***	0.436**
	(0.170)	(13.89)	(0.099)	(0.186)
F-Test	-	0.19	-	5.343
Observations	86	48	43	30
R-squared	0.522	-19.390	0.758	0.757
	b. Dependent variable: Patents			
Patience	0.486	-29.14	2.198***	2.628***
	(0.628)	(75.90)	(0.291)	(0.615)
F-Test	-	0.12	-	5.343
Observations	64	43	43	30
R-squared	0.392	-34.594	0.834	0.824
	c. Dependent variable: Total factor productivity			
Patience	0.188*	-19.12	0.474***	0.394*
	(0.108)	(463.2)	(0.081)	(0.231)
F-Test	-	0.001	-	2.270
Observations	67	37	39	28
R-squared	0.535	-462.160	0.699	0.711
	d. Dependent variable: Innovation Performance Index			
Patience	0.0534	-2.582	0.208***	0.243***
	(0.0692)	(6.763)	(0.0361)	(0.0691)
F-Test	-	0.12	-	5.343
Observations	64	43	43	30
R-squared	0.399	-30.721	0.777	0.754
	d. Dependent variable: Capital Stock			
Patience	0.159	-6.876	0.565***	0.500***
	(0.180)	(14.58)	(0.123)	(0.222)
F-Test	-	0.192	-	5.343
Observations	86	48		
R-squared	0.583	-22.235	0.693	0.680

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Dependent variables are in logs. All specifications contain religious controls, i.e. the share of population practicing the main religions (Barro, 2003) and geographic controls, i.e. latitude, longitude and dummies for continents and landlocked countries. Instrument is the variable *strong FTR* from Chen.