View metadata, citation and similar papers at core.ac.uk
brought to you by CORE
provided by Research Papers in Economics

ECONSTOR
WWW.ECONSTOR.EU

Der Open-Access-Publikationsserver der ZBW – Leibniz-Informationszentrum Wirtschaft
The Open Access Publication Server of the ZBW – Leibniz Information Centre for Economics

Stöver, Jana

Working Paper

Do institutions affect sustainability?

HWWI Research Paper, No. 1-18

Provided in cooperation with:
Hamburgisches WeltWirtschaftsInstitut (HWWI)

Suggested citation: Stöver, Jana (2009) : Do institutions affect sustainability?, HWWI Research Paper, No. 1-18, http://hdl.handle.net/10419/48266

Nutzungsbedingungen:
Die ZBW räumt Ihnen als Nutzerin/Nutzer das unentgeltliche, räumlich unbeschränkte und zeitlich auf die Dauer des Schutzrechts beschränkte einfache Recht ein, das ausgewählte Werk im Rahmen der unter
→ http://www.econstor.eu/dspace/Nutzungsbedingungen
nachzulesenden vollständigen Nutzungsbedingungen zu vervielfältigen, mit denen die Nutzerin/der Nutzer sich durch die erste Nutzung einverstanden erklärt.

Terms of use:
The ZBW grants you, the user, the non-exclusive right to use the selected work free of charge, territorially unrestricted and within the time limit of the term of the property rights according to the terms specified at
→ http://www.econstor.eu/dspace/Nutzungsbedingungen
By the first use of the selected work the user agrees and declares to comply with these terms of use.

ZBW Leibniz-Informationszentrum Wirtschaft
Leibniz Information Centre for Economics

Mitglied der Leibniz-Gemeinschaft

Hamburg Institute
of International
Economics

Do Institutions Affect Sustainability?

Jana Stöver

HWWI Research

Paper 1-18
by the
HWWI Research Programme
Economic Trends

Hamburg Institute of International Economics (HWWI) | 2009
ISSN 1861-504X

Jana Stöver
Hamburg Institute of International Economics (HWWI)
Heimhuder Str. 71 | 20148 Hamburg | Germany
Phone +49 (0)40 34 05 76 - 667 | Fax +49 (0)40 34 05 76 - 776
stoever@hwwi.org

HWWI Research Paper
Hamburg Institute of International Economics (HWWI)
Heimhuder Str. 71 | 20148 Hamburg | Germany
Phone +49 (0)40 34 05 76 - 0 | Fax +49 (0)40 34 05 76 - 776
info@hwwi.org | www.hwwi.org
ISSN 1861-504X

Editorial Board:
Thomas Straubhaar (Chair)
Michael Bräuninger
Silvia Stiller

© Hamburg Institute of International Economics (HWWI)
January 2009
All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means (electronic, mechanical, photocopying, recording or otherwise) without the prior written permission of the publisher.

Do Institutions Affect Sustainability?

Draft[1]
January 6, 2009

Jana Stoever[2]
stoever@hwwi.org

Abstract

This paper shows a significant and causal positive relationship between good institutions and sustainability. Sustainability is measured by the indicator of adjusted net saving (ANS) and institutional quality by an average of six dimensions of governance. An instrumental variable is used to rule out reverse causality. Conducting the regression accordingly on the national savings rate yields a much weaker and smaller effect. This suggests that the saving of non-physical capital is influenced more strongly by institutional quality than that of physical capital. This further supports the explanation of the 'resource curse' by institutions.

Keywords: sustainable development, adjusted net saving, genuine saving, institutions, resource curse, settler mortality

---

[1]Preliminary version, please do not cite without permission.
[2]Hamburg Institute of International Economics (HWWI) & University of Hamburg

1 Introduction

The decision concerning the depletion rate of a natural resource or the harvesting rate of a renewable resource is based on long-term planning, and maximizing long-term utility may involve waiting e.g. stocks are re-grown or until resource prices reach a certain level. Thus, it is crucial for these decisions that an individual can rely on the institutions around to persist. The individual must be able to rely on the fact that his rights are also going to be enforced in the future. Institutions should therefore guarantee a stable framework in which the individual can decide on (sustainable) depletion rates. This example illustrates one way in which institutions may influence saving decisions not only for physical capital but also for natural capital. Following this motivation, the paper explores the impact of institutional quality on sustainable development in a cross-country framework. The goal of the paper is to quantify the effect that institutional quality has on adjusted net saving (hereafter ANS), a macroeconomic indicator for an economy's sustainability. This effect is shown to be positive, statistically and economically significant and robust to various tests. An instrumental variable is used to establish a one-direction impact from institutions to sustainability, i.e. to rule out reverse causality.

Sustainable development is defined as non-declining human welfare over time.[3] On national level, this implies that as long as the average individual is not becoming worse off, a country is developing in a sustainable way. Since the stock of natural resources and their depletion rates play a vital role for uture returns, welfare and wealth of a country, it is essential to include these other forms of assets into the concept of wealth and national

[3]Pearce, Markandya & Barbier (1989)

accounting.[4] The World Bank (1997) has introduced a measure of wealth that includes natural and intangible capital in addition to the 'traditional' physical capital. If capital is defined in a sufficiently broad way - i.e. if it includes everything that affects the well-being of individuals - changes in capital can be interpreted as changes in welfare.

Following the *constant capital rule*, a country develops sustainably if capital per capita is non-declining over time,[5] independent of the initial capital stock. This implies that a modified savings rule can be used to determine if a country is developing in a potentially sustainable way: If capital is defined broadly and includes natural and intangible capital in addition to physical capital, its change - saving or dis-saving of the entire asset base - indicates if an economy is developing sustainably. Adjusted net saving (hereafter ANS) reflects this change by subtracting (dis)saving of natural capital from and adding investment in human capital to the savings rate of physical capital. Since only the change in total capital is considered, ANS follows the concept of weak sustainability.[6]

Institutions are thought of as written and unwritten rules and norms that organize the life of individuals and in this way affect their welfare.[7] They provide the framework in which interactions in an economy take place.[8] One of the fundamental problems for measuring the impact of institutions is the question of causality: Although there is a positive correlation between institutional quality and ANS, the direction of the causality is not clear.

[4] Atkinson, Hamilton & Pearce (1997)

[5] E.g. in Pearce & Atkinson (1992).

[6] ANS can be seen as a lower bound: If the rate is negative, development is not sustainable following weak sustainability, but also not sustainable in the concept of strong sustainability (Clemens & Hamilton (1999)).

[7] Glaeser, Porta, Lopez-De-Silanes & Shleifer (2004)

[8] World Bank (2002)

Therefore, in order to assess the impact of institutions on sustainability, an exogenous factor has to be found, which can be used as an instrument for institutions but at the same time is not affected by the ANS level. With this variable, it would be possible to measure the effect avoiding problems of endogeneity.

Acemoglu, Johnson & Robinson (2001) use mortality rates European settlers faced in colonies at the time of settlement as an instrument for institutional quality today. Their approach is based on the assumption that the mortality rates settlers faced in the colonies were crucial for the type of institutions they set up: When they settled themselves, they brought with them their institutions, when they did not, they built institutions that allowed to exploit the local population. In places that provided a healthy environment for settlers, they replicated European institutions, i.e. copies of home institutions with well-enforced property rights were established. Those early institutions were highly persistent even after independence of the respective country and in this way, settler mortality rates a hundred years ago shaped current institutions. From today's perspective, current institutions were determined by early institutions; early institutions in turn were influenced by European settlement and the settlement was affected by settler mortality.[9] This approach is adopted and modified in this paper.

Atkinson & Hamilton (2003) suggest that a country's institutions may play an important role for an economy's sustainability, particularly in resource-abundant countries. The importance of institutions and especially of secure property rights for saving decisions is outlined for example in Acemoglu

[9] Acemoglu et al. (2001)

et al. (2001). The so-called resource curse,[10] which has been explained among other things by the quality of institutions,[11] makes it interesting to investigate how institutional quality affects ANS e.g. by determining the ability to invest natural resource rents in long-lasting investments. Therefore, the paper first aims to answer if institutional quality has an impact on ANS rates.

The public good character of many parts of natural and intangible capital is another reason why institutions could be particularly important for the difference between ANS and the saving of physical capital (net national saving). Therefore, in a second step it is tested if there is a difference between the impact institutions have on ANS and their impact on saving of physical capital.

The rest of the paper is organized in the following way: First the estimation method is presented and the data sets are introduced. This is followed by the results of the estimation. The paper then presents various checks for the robustness of the results and ends with a brief conclusion.

[10]Many resource-abundant countries suffer from low rates of economic growth.
[11]E.g. Rodrik, Subramanian & Trebbi (2002)

2 The Impact of Institutions on Sustainability

2.1 Estimation Method

The aim of the paper is to estimate the impact of institutional quality on ANS rates. This is captured by the following OLS regression:

$$ANS_i = \mu + \alpha R_i + X_i' \gamma + \epsilon_i \tag{1}$$

where ANS_i is the rate of adjusted net saving in country i, R_i stands for institutional quality in country i, X_i is a vector of covariates and ϵ_i is an error term. However, as argued in the introduction, there are reasons to suspect reverse causality and measurement error and therefore an OLS estimation of institutions on ANS rates leads to biased estimates for the coefficients. Consequently, institutional quality is instrumented and a 2-stage-least-square regression of institutional quality on ANS is conducted.

In the first stage (equation 2), the instrument (M_i) is regressed on the endogenous variable institutional quality (R_i). A high R^2 shows a close correlation between the instrument and current institutions. The basic IV estimation does not include any control variables and therefore, the first stage shows how much of the variation in current institutions can be explained by the instrument. The equation for the first stage estimation is thus:

$$R_i = \zeta + \beta log M_i + X_i' \delta + \nu_i \tag{2}$$

where R_i is the quality of institutions in country i, M_i is the instrument for institutional quality in country i, X_i is a vector of covariates that affect all variables (none in basic specification) and ν_i is an error term.

In the second stage (equation 3), ANS is regressed on the fitted values from the first stage estimation. This yields the impact of institutions on sustainability. The exclusion restriction is that M does not influence equation 3, i.e. that the instrument has no influence on current savings decisions, other than its effect through institutions. The equation for the second stage estimation is thus:

$$ANS_i = \mu + \alpha \hat{R}_i + X_i' \gamma + \epsilon_i \quad (3)$$

where ANS_i is the rate of adjusted net saving in country i, $\hat{R}_i$ stands for the fitted values from the first stage estimation for country i, X_i is a vector of covariates that affect all variables (none in basic specification) and ϵ_i is an error term.

2.2 Data

Sustainable development is measured by ANS rates that are published annually by the World Bank.[12] The rates are available for the period 1970-2006, expressed as a percentage of GNI and collected for 138 countries.[13]

To measure institutional quality (R_i from equation 2), data from Kaufmann, Kraay & Mastruzzi (2008) is used. The authors combine a large number of indicators to six measures of governance: voice and accountability, political stability, government effectiveness, regulatory quality, rule of law and control of corruption. These serve as a measure for current institutional quality in the following analysis. The indicators range from about -2.5 to 2.5, where

[12] World Bank (2008)

[13] In the estimation, ANS rates excluding PM10 damage are used. This allows to keep two more observations compared to ANS rates including PM10 rates.

a higher value means better outcomes and were rescaled to range from 1 to 10. Governance indicators were measured for 212 countries annually for the period 1996-2007.
The six governance indicators are highly correlated and cannot be used jointly in a regression for reasons of multicollinearity. Since they all measure parts of underlying true institutions, one should not focus on only one of them in this context. Therefore, an unweighted average of the six indicators is used to measure a country's institutional quality.[14]

For the years 1996-2006 data is available for both variables, ANS and institutional quality. Therefore, this period is considered in the following estimation. Both variables show relatively little variation over time.

As an instrument for institutional quality, mortality estimates from Acemoglu et al. (2001) are used. Settler mortality displays replacement rates of settlers in the individual colonies.[15] The authors state that settlers were well informed about expected mortality rates in the colonies, although they could not control the diseases. Thus, the expected mortality rates influenced their decision to settle.

Obviously, the time-less nature of the instrument does not allow for the treatment of variations over time. But since one of the main characteristics of institutions is that they change only gradually over time[16] and only *persistently* negative ANS rates indicate non-sustainable development,[17] in-

[14]Additionally, all regressions were conducted for each indicator separately. Results of these estimations can be found in the appendix (table 9).

[15]Acemoglu et al. (2001) take data for mortality rates in the colonies compiled by Phillip Curtin.

[16]Glaeser et al. (2004)

[17]Asheim (1994), cited in Atkinson et al. (1997)

stitutional quality and ANS rates are both long-term concepts. Therefore, averages of both variables were taken over the period 1996-2006. This should yield stable results that are not driven by a particular year.

Since settler mortality is calculated only for countries with colonial experience, the sample is reduced to 64 countries. Two more observations get lost because these countries lack ANS data. To make sure this reduction to 62 countries does not lead to a selection bias, for ANS and institutional quality descriptives for the world and the sample are compared. Table 1 shows that they hardly differ.[18]

Table 1: Summary statistics, world and sample

		N	Mean	Std. Dev.	Min	Max
inst	world	212	5.01	1.81	0.81	8.69
	sample	64	4.54	1.65	1.19	8.52
ANS	world	150	0.05	0.17	-1.06	0.42
	sample	62	0.04	0.15	-0.70	0.36

Additionally, OLS coefficients are calculated according to equation 1 for the world and for the sample. Table 2 shows that these estimates also differ very little. Therefore, it can be concluded that the sample can be reduced to 62 countries.

[18]Tests on the equality of means and QQ-Plots can be found in the appendix (tables 6 & 7 and figure 3.

Table 2: OLS estimation, world and sample

	N	Coefficient	(Std. Err.)	F	R^2
world	150	0.04***	(0.01)	34.09	0.19
sample	62	0.04***	(0.01)	13.01	0.18

Significance levels : $*$: 10% $**$: 5% $***$: 1%

Estimated equation: $ANS_i = \mu + \alpha R_i + X_i'\gamma + \epsilon_i$

2.3 Results

Results of the IV regression of institutions on ANS are displayed in table 3. The left part presents the results for the first stage estimation. It shows a strong negative relationship between (log) settler mortality and current institutions (-0.77). 36 percent of the variation in current institutions can be explained by settler mortality. The F-test is rejected and thus the model explains a significant part of all variation. Since the coefficient is highly significant and negative, low settler mortality can be associated with good institutions today.[19]

The corresponding second stage results on the table's right side display the impact of institutions on sustainability (ANS). The coefficient for institutional quality is positive (0.05) and highly significant. Therefore, since ANS is measured as a percentage share of GNI, an increase of institutional quality by one unit would lead to a rise in ANS of 5 percent. Although these numbers should not be interpreted too strictly due to potential measurement error, the positive effect is fairly strong. Hence it can be argued that institutional quality has a positive impact on sustainability.

In a second regression, the effect on institutions on net national saving (NNS) is estimated. This would be the 'right' measure for sustainability

[19]As presented in Acemoglu et al. (2001) for risk of expropriation.

Table 3: The impact of institutions on sustainability

Stage 1		Stage 2	
Variable	**Coefficient** (Std. Err.)	**Variable**	**Coefficient** (Std. Err.)
logM	-0.77***	$\hat{R}$	0.05***
	(0.13)		(0.02)
Intercept	8.04***	Intercept	-0.19**
	(0.64)		(0.09)
N	62	N	62
R^2	0.36	R^2	..
$F_{(1,60)}$	33.65	$F_{(1,60)}$	7.28

Significance levels : * : 10% ** : 5% *** : 1%

Stage 1: Dependent variable R: institutional quality, explaining variable/instrument M: settler mortality

Stage 2: Dependent variable: ANS, explaining variable: $\hat{R}$: (fitted) institutional quality

if only physical capital was accounted for. Table 4 presents the results. The estimated coefficient is smaller and weaker (not significant at the 10 percent level). From the reduced effect on NNS, one can conclude that the difference between NNS and ANS must be influenced strongly by institutions. Thus, the impact of institutional quality is especially important for the difference between the two measures, i.e. for the (dis-)investment in human capital and natural capital. The decisive element among these is energy depletion.[20] Therefore, countries with a high share of energy resources among their natural capital suffer the most from low institutional quality.

In this sense, the data supports the hypothesis that one reason why countries with a high share of natural resources perform especially poorly in terms of sustainability may be the quality of their institutions.

[20]This can be shown using a multiple OLS regression of ANS on all its components (table 8 in appendix).

Table 4: The impact of institutions on net national saving

Stage 1		Stage 2	
Variable	**Coefficient** (Std. Err.)	**Variable**	**Coefficient** (Std. Err.)
logM	-0.74***	$\hat{R}$	0.02
	(0.14)		(0.01)
Intercept	7.91***	Intercept	0.02
	(0.66)		(0.05)
N	60	N	60
R^2	0.34	R^2	..
$F_{(1,58)}$	29.66	$F_{(1,58)}$	2.38

Significance levels : $*$: 10% $**$: 5% $***$: 1%

Stage 1: Dependent variable R: institutional quality, explaining variable/instrument M: settler mortality

Stage 2: Dependent variable: Net National Saving (NNS), explaining variable: $\hat{R}$:(fitted) institutional quality

2.4 Checks

This section briefly presents the results for various robustness checks that were conducted. Tables and other details of the checks can be found in the appendix. First, the results are not driven by outliers from the Middle East and Africa (MENA) region, which has particularly low ANS rates. Second, the IV regression was also conducted with robust standard errors. The coefficient remains significant at the 1% level and the standard error stays constant (0.02). Therefore, the more efficient OLS estimator is kept in the calculation.

Third, results from the Hausman test imply that endogeneity is not as severe as assumed in the motivation and the IV approach is not necessary for this reason. Nevertheless, the OLS coefficients are smaller than the IV coefficients. Since the indices for institutions always reflect only parts of the complex and abstract 'true' institutions, and additionally are probably measured slightly different across countries,[21] they are likely to be measured with error. By using settler mortality as an instrument, the problem of measurement error is avoided. The presence of measurement error in the explanatory variable (in OLS) biases the estimates towards zero, while the presence of reverse causality leads to an overestimation via OLS. Therefore, the smaller estimated coefficients in the OLS regression indicate that the distortions caused by measurement error are bigger than the distortions rooted in reverse causality. Since both problems are accounted for by using the IV approach, this justifies the use of the instrument.

Fourth, the instrument passes two tests for weak instruments and fifth, potentially omitted factors are controlled for: The assumption that settler mortality has no direct effect on saving decisions today is crucial for the instrument to be valid. Therefore, additional variables are added that could presumably be correlated with both settler mortality and ANS. Since the inclusion of these variables does not lead to changes in the estimates, it is unlikely that the inclusion of potentially omitted variables would have an impact on the estimates.[22] Variables supposed to determine savings rates besides institutions, such as income, cultural factors and health variables are controlled for. In addition to these potential determinants of traditional savings, energy depletion is controlled for since it has a strong impact on ANS rates.

[21] See methodology in Kaufmann et al. (2008)

[22] Approach by Albuji, Elder & Teber (2000), taken from Acemoglu et al. (2001)

3 Conclusions

In this paper institutional quality was tested for its impact on sustainability measured by adjusted net saving (ANS). Instrumenting institutions by settler mortality, a positive and statistically significant impact of institutions on ANS was found.

In a second step, this effect was compared to the impact institutions have on the traditional measure of saving, net national saving. The result is a smaller and much weaker effect. This difference firstly reinforces the hypothesis that the quality of institutions is vital especially for countries with a high share of natural resources. Secondly, it supports the use of the comprehensive measure of saving.

References

Acemoglu, D., Johnson, S. & Robinson, J. A. (2001). The colonial origins of comparative development: An empirical investigation, *American Economic Review* **91 No.5**: 1360–1401.

Atkinson, G. & Hamilton, K. (2003). Savings, growth and the resource curse hypothesis, *World Development* **31**: 1793–1807.

Atkinson, G., Hamilton, K. & Pearce, D. (1997). Genuine saving as an indicator of sustainability, *CSERGE Working Paper* **GEC 97-03**.

Bendix, R. (1977). *Max Weber. An Intellectual Portrait*, University of California Press.

Clemens, M. & Hamilton, K. (1999). Genuine savings rates in developing countries, *The World Bank Economic Review* **13.2**: 333–356.

Glaeser, E. L., Porta, R. L., Lopez-De-Silanes, F. & Shleifer, A. (2004). Do institutions cause growth?, *Journal of economic Growth* **9**: 271–303.

Guiso, L., Sapienza, P. & Zingales, L. (2006). Does culture affect economic outcomes?, *Journal of Economic Perspectives* **20(2)**: 23–48.

Kaufmann, D., Kraay, A. & Mastruzzi, M. (2008). Governance matters vii: Governance indicators for 1996-2007, *World Bank Policy Research* **June**.

Loayza, N., Schmidt-Hebbel, K. & Servén, L. (2000). What drives private saving across the world?, *The Review of Economics and Statistics* **15(1)**: 222–279.

Pearce, D. & Atkinson, G. (1992). Are national economies sustainable? measuring sustainable development, *CSERGE Working Paper* **GEC 92-11**.

Pearce, D., Markandya, A. & Barbier, E. (1989). *Blueprint for a Green Economy*, Earthscan Publications Ltd.

Rodrik, D., Subramanian, A. & Trebbi, F. (2002). Institutions rule: The primacy of institutions over geography and integration in economic development, *NBER Working Paper* **9305**.

Stock, J. H. & Yogo, M. (2001). Testing for weak instruments in linear iv regression, *NBER Technical Working Paper* **284**.

World Bank (1997). Expanding the measure of wealth: Indicators of sustainable development, *ESD Studies and Monographs Series* **17**.

World Bank (2002). *Building Institutions for Markets*, Oxford University Press.

World Bank (2008). *The World Development Indicators 2008*, World Bank.

4 Appendix

List of Tables

List of Figures

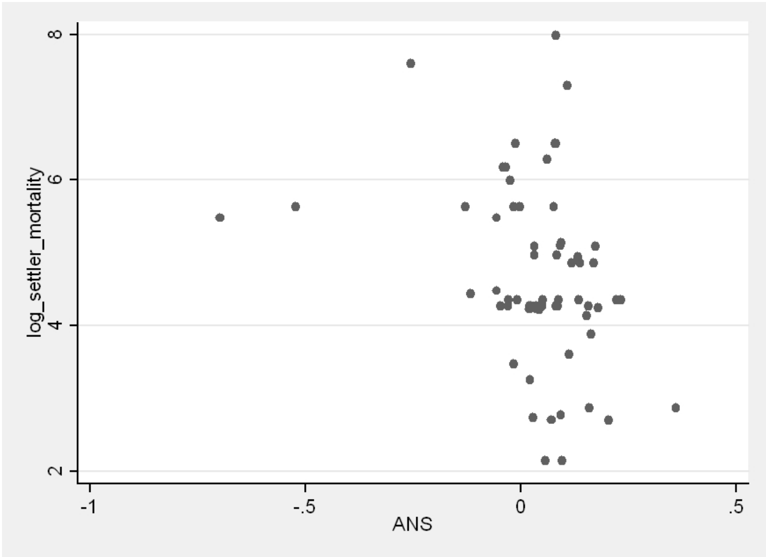

Figure 1: ANS and (log) settler mortality

	(log) settler mortality	institutional quality
ANS world	..	0.43
ANS sample	-0.32	0.42

Table 5: Correlations: ANS, (log) settler mortality and institutional quality

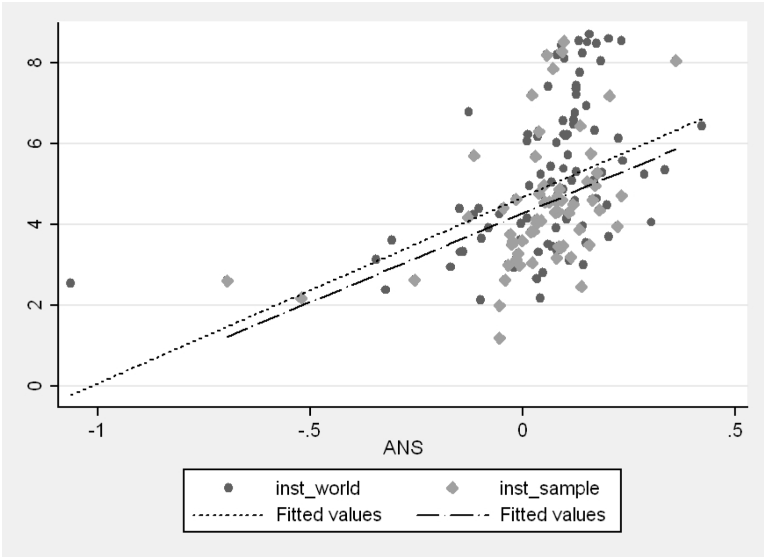

Figure 2: ANS and institutional quality (inst)

Paired t test, institutional quality			
Variable	Obs	Mean	Std. Err.
sample	64	4.54	0.21
μ	64	5.01	0
diff	64	-0.47	0.21
$Pr(\|T\| > \|t\|) = 0.0256$			

where μ is the mean of institutional quality for the world (212 observations). The hypothesis tested is H_o: mean(diff) = 0 against H_a: mean(diff) != 0, where mean(diff) stands for the mean of the sample minus the mean of institutional quality for the world

Table 6: Test on the equality of means, institutional quality

Paired t test, adjusted net saving (ANS)			
Variable	Obs	Mean	Std. Err.
sample	62	0.039	0.02
μ	62	0.051	0
diff	62	-0.011	0.02

$$Pr(|T| > |t|) = 0.5636$$

where μ is the mean of ANS for the world (150 observations). The hypothesis tested is H_o: mean(diff) = 0 against H_a: mean(diff) != 0, where mean(diff) stands for the mean of the sample minus the mean of ANS for the world

Table 7: Test on the equality of means, adjusted net saving

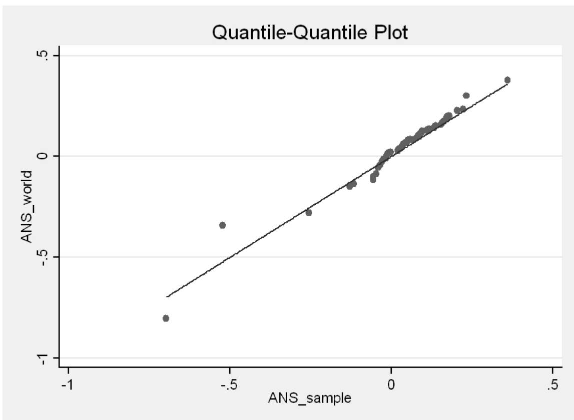

Figure 3: Quantile-quantile plot adjusted net saving, world and sample

To check which parts are the driving forces in a country's sustainability indicator, a multiple OLS regression is conducted. The results have a purely descriptive quality. It nevertheless provides important insights into which components are decisive for the behavior of ANS. The set-up implies that the standardized coefficients (beta) reflect the magnitude of the economic impact of the respective component. By construction (ANS equals the sum of its parts), the model explains nearly all variation in the data (p-value for F-test= 0.00, R^2= 0.99). The t-test is rejected on the 1% level for every component. Energy depletion has the biggest influence on the indicator (-1.02).

	GNS	CFC	EDE	NFD	END	MID	CO2
beta	0.57	-0.22	0.11	-0.08	-1.02	-0.13	-0.41
(std err)	(0.01)	(0.03)	(0.07)	(0.08)	(0.01)	(0.05)	(0.14)

Estimated equation: $ANS_i = \alpha + \beta_1 GNS + \beta_2 CFC + \beta_3 EDE + \beta_4 END + \beta_5 NFD + \beta_6 MID + \beta_7 CO2 + \epsilon_i$

Notation: GNS: Gross national saving, CFC: Consumption of fixed capital, EDE: Education expenditure, END: Energy depletion, NFD: Net forest depletion, MID: Mineral depletion, CO2: Carbon dioxide pollution, beta: standardized beta coefficients

Table 8: OLS regression, ANS on its components

Indicator	coefficient (std err)
Voice & accountability	0.06**
	(0.02)
Political stability	0.09**
	(0.04)
Government effectiveness	0.04***
	(0.02)
Regulatory quality	0.05***
	(0.02)
Rule of law	0.05***
	(0.02)
Control of corruption	0.04**
	(0.02)

Stage 1: Dependent variable R: institutional quality, explaining variable/instrument M: settler mortality

Stage 2: Dependent variable: ANS, explaining variable: $\hat{R}$: (fitted) institutional quality

Table 9: IV regression, all indicators separately

4.1 Checks of the IV regression

Outliers To make sure the results are not driven by outliers from the Middle East and Africa (MENA) region, which (has) particularly low ANS rates, the IV regression is conducted without the MENA region. Table 10 shows that the estimates hardly change. Nevertheless, excluding the so-called Neo-Europes,[23] which may be positive outliers regarding institutional quality, leads to changes in the estimates. For further interpretation, one should therefore bear in mind that those countries may have too strong an effect on the sample.

	basic IV	drop MENA	drop Neo-Europes	with robust std errors
coeff. inst	0.05***	0.05**	0.09**	0.05***
(std error)	(0.02)	(0.02)	(0.03)	(0.02)
coeff. intercept	-0.19**	-0.19*	-0.34**	-0.19**
(std error)	(0.09)	(0.09)	(0.14)	(0.08)
N	62	58	58	62
F	7.28	6.69	7.20	8.54

Table 10: IV regression, checking for outliers and heteroskedasticity

Heteroskedasticity The IV regression was also conducted with robust standard erros. The coefficient remains significant at the 1% level and the standard error stays constant (0.02). Therefore, the more efficient OLS estimator was used in subsequent calculations.

Endogeneity and Measurement Error Table 11 shows the results of the Hausman test. The null hypothesis that both OLS and IV estimators are consistent cannot be rejected. The results imply that endogeneity is not

[23] Australia, Canada, New Zealand, USA

as severe as assumed in the motivation and the IV approach is not necessary for this reason.

IV and OLS estimation			Hausman test	
	IV	OLS		
coefficient inst	0.05***	0.04***	$\chi^2(1)$	0.47
(std error)	(0.13)	(0.01)	Prob> χ^2	0.49

Table 11: Endogeneity and measurement error

Nevertheless, the table also shows that the OLS coeffcients are smaller than the IV coefficients. Since the indices for institutions always reflect only parts of the complex and abstract 'true' institutions, and are probably measured slightly different by country,[24] they are likely to be measured with error. By using settler mortality as an instrument, the problem of measurement error ist avoided. The presence of measurement error in the explanatory variable (in OLS) biases the estimates towards zero, while the presence of reverse causality leads to an overestimation via OLS. Therefore, the smaller estimated coefficients in the OLS regression indicate that the distortions caused by measurement error are bigger than the distortions rooted in reverse causality. Since both problems are accounted for by using the IV approach, this supports and justifies the use of the instrument.

Validating the Instrument

For the instrument to be valid it has to meet two conditions: First, the instrument must be sufficiently correlated with the included endogenous regressor. Second, the instrument must be distributed independently of the error process. If these two conditions are fulfilled, the IV estimator is consistent and settler mortality can be used as an instrument for institutions.

[24]See methodology in Kaufmann et al. (2008)

Weak Instruments When the instrument is only weakly correlated with the endogenous variable, the IV estimate may be biased towards the OLS. Additionally, weak estimates may not be consistent and, as a result, the tests of significance level would be incorrect in size. To test for weak instruments, a test derived by Stock & Yogo (2001) was used. It is based on the first-stage F-Statistic. The hypothesis that the instrument does not enter the first stage regression of the 2SLS, i.e. that the instrument is weak even though the parameters are identified, can be rejected (F: 33.65, critical value (10%): 16.38). Additionally, the rule of thumb that the F-Statistic should be bigger than 10 is satisfied.[25]

Control for Omitted Factors In this section, potential factors that might have had an impact on both settler mortality and ANS hare controlled for. The results suggest that some of those factors may invalidate settler mortality as an instrument for institutions in this context.

The assumption that settler mortality has no direct effect on saving decisions today is crucial for the instrument to be valid. Therefore, additional variables are added that could presumably be correlated with both settler mortality and ANS. If the inclusion of these variables does not lead to changes in the estimates, it is unlikely that the inclusion of potentially omitted variables would have an impact on the estimates,[26] although it can never be ruled out completely.

Variables that are supposed to determine savings rates besides institutions, such as income, economic growth and demographic factors[27] as well as cul-

[25] **?**
[26] Approach by Albuji, Elder & Teber (2000), taken from Acemoglu et al. (2001)
[27] Loayza, Schmidt-Hebbel & Servén (2000)

tural factors[28] and health variables are controlled for in the following paragraph. In addition to these potential determinants of traditional saving, energy depletion is controlled for since it has a strong impact on ANS rates.

Income Settlers could have been more likely to settle in richer areas and therefore the income level could have had an effect on institutions instrumented by settler mortality. Since the income level is also supposed to affect ANS, this is a potential threat to the instrument. Acemoglu et al. (2001) show that although settler mortality had a strong impact on income development and economic growth through institutions, settlers were not more likely to settle in richer areas at that time.[29] Therefore, it can be ruled out that saving and settler mortality are *both* affected by income/economic growth, which is what is needed to validate the instrument in our case.

	basic IV	leg origin	religion	life exp.	malaria risk	energy depl
inst	0.05***	0.05**	0.06***	0.01	0.06	0.03**
(std err)	(0.02)	(0.02)	(0.02)	(0.05)	(0.05)	(0.01)
coeff.added	.	-.002	-0.005***	0.01	0.04	-0.70***
(std err)	.	(0.04)	(0.002)	(0.01)	(0.12)	(0.08)
F	7.28	3.81	6.92	8.78	3.94	72.75

Table 12: Control for potentially omitted factors

Culture As Guiso et al. (2006) propose, cultural aspects may influence saving rates. Furthermore, according to Hayek (1960),[30] another explanation for institutional development may be legal origin, so this variable is controlled for. Since all countries in the sample have either British or French

[28]Guiso, Sapienza & Zingales (2006)

[29]The authors take income as the dependent variable in their approach and rule out the possibility that settler mortality has a (direct) effect on income other than through institutions by validating their exclusion restriction.

[30]cited by Acemoglu et al. (2001)

legal origin, a dummy for British legal origin is introduced. The results in table 12 show that the dummy is not significant and does not change the estimate. Therefore, legal origin can be ruled out as a source of distortion. A second line of argument based on Weber's theory of *Protestant Ethic* pursues that institutional development may be influenced by religious aspects.[31] Therefore, the percentage of protestants in 1980 is taken as a control variable.Column 3 in table 12 shows that this hardly changes the estimate.

Disease Environment & Health A major concern when taking settler mortality as a instrument for institutions is that it might mirror the current disease environment in the countries with colonial experience, which may have a direct impact on ANS. This would imply that settler mortality has an impact on ANS through other channels than institutions and would therefore invalidate it as an instrument. However, the main diseases causing death among settlers, and hence the main determinants of settler mortality, were malaria and yellow fever.[32] As Acemoglu et al. (2001) argue, the local population was to a large extend immune against these two health threats. This follows from low mortality rates of indigenous adults and rules out the possiblity of invalidating the instrument in this way.

The disease environment and notably yellow fever and malaria have influenced settler mortality to a great extend. Nevertheless, it might not have an influence on current saving decisions. Acemoglu et al. (2001) argue that the mortality rates in the colonized countries with high malaria risk were not particularly high, because local people had developed various types of

[31] Bendix (1977)
[32] Acemoglu et al. (2001)

immunities. Controlling for current malaria risk in these countries, i.e. including an endogenous variable, changes the estimates (see table 12, column 4&5). While the inclusion of endogenous variables should bias the coefficients downwards (as it does for life expectancy), it does not change when malaria is included. In both cases, the coefficient is not significant at the 10% level. This means that the factors potentially invalidate the instrument.[33] Nevertheless, one could argue that while current malaria risk has an impact on saving decisions, malaria risk at the time of settlement did not (see above). Unfortunately, it is not possible to test for this here, due to the lack of data.

Energy Depletion One major force driving ANS rates is energy depletion. A country's endowment with energy resources may also have influenced settlement patterns and could therefore be correlated with settler mortality. Energy depletion as a share of GNI (averages 1996-2006) is used as a control variable. This variable is highly endogenous and therefore likely to reduce the effect of institutions. In the IV regression, energy depletion is highly significant and has an economically large impact. But since the estimate for the institutional impact decreases only slightly (probably due to the endogeneity of the control variable) and is still statistically significant, this does not invalidate the instrument.

[33]Figures 5 and 4 show the relationship between ANS and malaria and ANS and life expectancy respectively.

4.2 Institutions, Life expectancy & Malaria

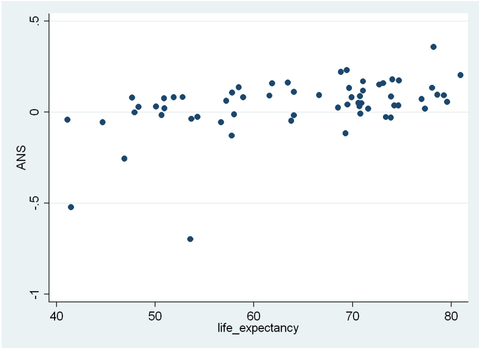

Figure 4: Life expectancy and ANS

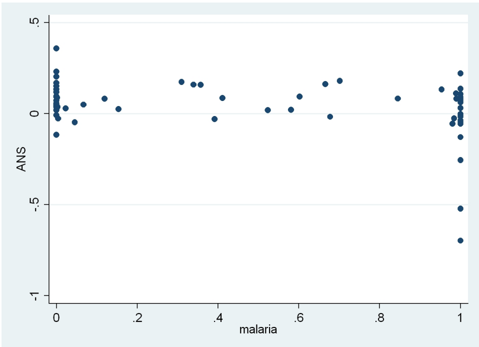

Figure 5: Malaria and ANS

HWWI Research Papers
by the HWWI Research Programmes
"Economic Trends" and "Hamburg and Regional Development"

17. What Drives Innovation? Causes of and Consequences for Nanotechnologies
Ingrid Ott, Christian Papilloud, Torben Zülsdorf, Hamburg, October 2008
16. EU Enlargement and Convergence – Does Market Access Matter?
Annekatrin Niebuhr, Friso Schlitte, Hamburg, June 2008
15. Is Unemployment a Consequence of Social Interactions? Seeking for a Common Research Framework for Economists and other Social Scientists
Andreia Tolciu, Hamburg, April 2008
14. Reform der schwedischen Arbeitsmarkt- und Tarifpolitik
Ulrich Zierahn, Hamburg, April 2008
13. Beschäftigungseffekte durch den Ausbau der erneuerbaren Energien in Norddeutschland
Norbert Kriedel, Hamburg, März 2008
12. Inequality of Learning Amongst Immigrant Children in Industrialised Countries
Sylke Viola Schnepf, Hamburg, February 2008
11. Regional Income Inequality and Convergence Processes in the EU-25
Tiiu Paas, Friso Schlitte, Hamburg, October 2007
10. Governmental activity, integration, and agglomeration
Ingrid Ott, Susanne Soretz, Hamburg, July 2007
9. Wie innovationsfähig ist Deutschland? – Ein Gesamindikator zur Messung der Innovationsfähigkeit
Henning Vöpel, Hamburg, Juli 2007
8. CDM potential of wind power projects in India
Pallav Purohit, Axel Michaelowa
Hamburg, June 2007
7. Ein makroökonometrisches Modell für Hamburg
Norbert Kriedel, Hamburg, Mai 2007
6. Managementstrategien im Fußball: „Big Push" oder Kontinuität? Ein dynamisches Modell zum sportlichen Auf- und Abstieg von Vereinen
Henning Vöpel, Hamburg, Februar 2007
5. Ein Transfermarktmodell und Implikationen für die strategische Transferpolitik der Vereine in der Fußball-Bundesliga
Henning Vöpel, Hamburg, November 2006
4. Gender Equality in the Labour Market: Attitudes to Women's Work
Sylke Viola Schnepf, Hamburg, Oktober 2006
3. Ein „ZIDANE-Clustering-Theorem" und Implikationen für den Finanzausgleich in der Bundesliga
Henning Vöpel, Hamburg, Juli 2006
2. Doping im Radsport als kollektives Gleichgewicht
Henning Vöpel, Hamburg, Juli 2006
1. Long Waves of Economic Development and the Diffusion of General-Purpose Technologies – The Case of Railway Networks
Norbert Kriedel, Hamburg, Januar 2006

The **Hamburg Institute of International Economics (HWWI)** is an independent economic research institute, based on a non-profit public-private partnership, which was founded in 2005. The University of Hamburg and the Hamburg Chamber of Commerce are shareholders in the Institute .

The HWWI's main goals are to:
- Promote economic sciences in research and teaching;
- Conduct high-quality economic research;
- Transfer and disseminate economic knowledge to policy makers, stakeholders and the general public.

The HWWI carries out interdisciplinary research activities in the context of the following research programmes: Economic Trends, Hamburg and Regional Development, World Economy and the Migration Research Group.

Hamburg Institute of International Economics (HWWI)

Heimhuder Str. 71 | 20148 Hamburg | Germany
Phone +49 (0)40 34 05 76 - 0 | Fax +49 (0)40 34 05 76 - 776
info@hwwi.org | www.hwwi.org