

# Development and Freedom as Risk Management

**Bhagwan Chowdhry, Richard Roll and Konark Saxena<sup>1\*</sup>**

Amartya Sen has argued that many development and freedom measures such as health, education, political and civil liberties are important constituents of human welfare. We concur with Sen and conjecture that an important reason these measures affect human welfare is because they allow individuals to better cope with risk and uncertainty that cannot be hedged using market based insurance mechanisms. We find some empirical support for this conjecture in that the volatility of consumption growth appears to be negatively related to life expectancy, political rights, and property rights (but is positively related to the rate of literacy) after controlling for the size of the country, per capita income, and openness to trade and capital flows, (which, as one would expect, also reduce consumption growth volatility) in cross-country panel regressions.

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Amartya Sen, in his influential book *Development as Freedom* (1999) argues that development expands freedom. A higher income, for instance, allows one to exercise more choice. Better health, higher education, political and civil liberties might also expand choices and thus be highly valued. In fact, Sen, together with Mahbub ul Haq, helped the United Nations Development Program (UNDP) construct a Human Development Index (HDI) in which per capita GDP is accorded a weight of only one-third. The remaining two thirds are allocated equally to Life Expectancy and Education (Human Development Report, 2007-08). Though intuitively appealing, the choice of equal weights on per capita GDP, Life Expectancy and Education is arbitrary. It should be worthwhile to more fully specify the mechanism by which development measures such as health and education enhance human welfare.

We conjecture that many development measures such as better health, education, political and property rights are mechanisms employed by individuals – as are savings made possible by higher income - to self-insure against risks because market-based insurance is often inadequate and incomplete. The seminal

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*\* Bhagwan Chowdhry and Richard Roll are Professors of Finance at the UCLA Anderson School, Los Angeles, CA. Konark Saxena is on the faculty of the University of New South Wales in Sydney. Email all enquiries to rroll@anderson.ucla.edu.*

work of Townsend (1994) demonstrates that risk-sharing obtained using informal social mechanisms may indeed be substantial. If individuals are better able to cope with risks using these mechanisms, then consumption volatility should be lower in countries where such measures of development are higher, after controlling for other pertinent influences such as per capita income, country size (measured by total country GDP) and level of international risk-sharing measured by openness to trade and capital flows.

We find some empirical support in that the volatility of consumption growth is negatively related to life expectancy, political rights, and property rights (but is positively related to literacy) after controlling for the size of the country, per capita income, and openness to trade and capital flows, (which, as one would expect, also reduce consumption growth volatility) in cross-country panel regressions.<sup>2</sup>

## Empirical Method

We want to investigate how development measures are related to imperfect consumption insurance across individuals. Following Townsend (1994), we assume a reduced form version of the consumption of an individual ( $c^i$ ):

$$c^i = a^i + b\bar{C} + dx^i + u^i.$$

where  $\bar{C}$  represents the average consumption in a country,  $x^i$  represents a shock to an individual that may affect consumption, and  $u^i$  represents a disturbance term. Townsend (1994) argues if the coefficient  $d$  in the above equation is not zero it is an indication of imperfect risk sharing. Cochrane (1991) makes a similar point by arguing that consumption *growth* should be unrelated to idiosyncratic shocks for there to be perfect risk sharing. Our hypothesis is that the coefficient  $d$  is a decreasing function of development measures like property rights, political rights etc. in any given country. However, since we do not have data for consumption of individuals for a large cross-section of countries, we do not test this directly. Instead we focus on a test based on aggregate measures. An expression for aggregate consumption ( $C$ ) can be obtained by taking the sum across all individuals in a country:

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<sup>2</sup> The referee points out that these development measures might be proxying for the availability market based insurance that we have not fully captured by size of the country, per capita income, and openness to trade and capital flows.

$$C_t = \sum_i c_t^i = \sum_i a^i + bC_t + d \sum_i x_t^i + \sum_i u_t^i.$$

Aggregate consumption growth ( $g$ ) can be written as:

$$g_{t+1} = bg_{t+1} + d \sum_i (x_{t+1}^i - x_t^i)/C_t + \sum_i (u_{t+1}^i - u_t^i)/C_t$$

which implies that

$$g_{t+1} = \frac{d}{1-b} \sum_i (x_{t+1}^i - x_t^i)/C_t + \frac{1}{1-b} \sum_i (u_{t+1}^i - u_t^i)/C_t.$$

The volatility of consumption growth will be

$$\sigma_t(g) = \left[ \left( \frac{d}{1-b} \right)^2 \sigma_t^2 \left( \sum_i (x_{t+1}^i - x_t^i)/C_t \right) + \left( \frac{1}{1-b} \right)^2 \sigma_t^2 \left( \sum_i (u_{t+1}^i - u_t^i)/C_t \right) \right]^{1/2}.$$

It follows that  $\sigma_t(g)$  is increasing in  $d$  which, according to our hypothesis, should be a decreasing function of development measures. This implies that a country with stronger development measures should have lower consumption volatility, controlling for other factors that may affect the level of consumption volatility. We test this hypothesis.

To get an estimate of consumption growth volatility for a country every year, we employ the generalized autoregressive conditional heteroscedasticity (GARCH(1,1)) model:

$$\begin{aligned} c_{i,t} &= \bar{c}_i + e_{i,t}, \\ e_{i,t} &= \sqrt{h_{i,t}} \varepsilon_{i,t}, \\ h_{i,t} &= \omega + \alpha \varepsilon_{i,t}^2 + \gamma h_{i,t-1}, \\ \varepsilon_{i,t} &\sim N(0,1). \end{aligned}$$

where  $c_{i,t}$  is the consumption growth of country  $i$  at time  $t$ ,  $\bar{c}_i$  is the average consumption growth rate for country  $i$ , and  $h_{i,t}$  is an estimation of the consumption growth volatility of country  $i$  at time  $t$ . To estimate the GARCH model of consumption growth volatility for each country, we use the longest available time series of consumption growth for that country.

## Data

We use data from World Development Indicators to obtain proxies for life expectancy, consumption growth, gross national income (in US dollars, adjusted for Purchasing Power Parity), and per capita income (in US dollars, adjusted for Purchasing Power Parity). Data for illiteracy are from the UNESCO website. For political rights, we use scores compiled by Freedom House; these depend on assessments of free elections, voting rights, self-determination, and freedom from military and totalitarianism which combine for a score from 1 to 7. For property rights, we use scores compiled by the Heritage Foundation, which range from 1 to 5. They assess attributes such as freedom from government influence over the judicial system, commercial contract code, sanctions of foreign arbitration of contract disputes, government expropriation of property, corruption within the judiciary, delays in receiving judicial decisions, and legally granted and protected private property. We use a measure for capital account openness, which Quinn and Toyoda kindly shared with us. This measure is described in Quinn and Toyoda (2007, 2008) and Quinn (1997). A measure for current account openness is highly correlated with the measure we use for capital account openness and therefore we do not use it in our statistical analysis. For ease of interpretation, we reverse the measures of political rights, property rights, and illiteracy, so that a larger value means a higher degree of these attributes.

For GARCH modeling (Bollerslev, 1986) of consumption growth volatility, we use yearly data as far back as available for each country – from 1962 to 2005 - in the World Development Indicators website. However, since data for property rights are available only from 1995 to 2005, the rest of our analysis is confined to this period. For variables such as illiteracy and life expectancy, yearly data are often not available. We use the most recent historical value of these variables to proxy for missing data.

## The Evidence

Table I provides summary statistics of all variables used in our statistical analysis in their original units. (For the later empirical analysis, we standardize these variables to have zero means and unit variance.) Table II provides a correlation matrix of all variables. First, notice that the univariate correlations between the natural log of the GARCH estimate of consumption growth volatility and each of the explanatory

variables are negative as hypothesized.<sup>3</sup> Second, the explanatory variables are positively correlated with each other and some are rather high, such as the correlation between Per Capita Income and Life Expectancy, 0.80. This multi-collinearity can pose a problem when attempting to distinguish the separate influences of explanatory variables in multiple regressions.

For example, Table III reports a regression of log of Per Capita Income on the remaining six explanatory variables; the R square of 83% which is equivalent to a correlation coefficient of 0.91. This suggests that the influence of Per Capita Income is spanned largely, though not completely, by the information in the other variables.

Armed with this prior information, we calculate a panel estimation of the influence of various factors on consumption growth volatility. The dependent variable is the natural log of the GARCH estimate of consumption growth volatility. The independent variables are measures of Political Rights, Property Rights, Literacy (Complete Literacy=100%), Life Expectancy, the natural log of Gross National Income (\$, PPP adjusted), the natural log of Per Capita Income (\$, PPP adjusted), and a measure of Capital Account Openness. All variables are normalized to have a mean of 0 and a standard deviation of 1 over the complete sample. Since the explanatory variables are highly persistent, OLS standard errors are biased so we report standard errors calculated after clustering by year and country (Peterson, 2009).

The coefficient estimates are reported in Table IV. Coefficients for Political Rights, Gross National Income, Literacy, and Capital Account Openness are significant. The sign of Political Rights, Gross National Income, and Capital Account Openness conforms well to the notion that these variables provide insurance against consumption volatility. The significance of Political Rights supports the hypothesis that social institutions are mechanisms designed to cope with risk and uncertainty. Property rights and Life Expectancy have the anticipated sign but are not statistically significant, even though the coefficient estimates are of the same order of magnitude as other statistically significant variables. Per capita income is insignificant.<sup>4</sup>

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<sup>3</sup> Scatter plots not reported here confirm that there are no significant outliers affecting our results. The complete data and some of the analysis are available at [bit.ly/DFRMdata](http://bit.ly/DFRMdata).

<sup>4</sup> We also estimated a pooled cross-sectional regression using the time-series average of each variable for each country. We find that the signs of all significant coefficients are unchanged but the standard errors are about 50% higher for Political Rights, Property Rights and Literacy. This suggests that indeed some explanatory power does come from time series differences which are absent in the pooled cross-sectional regression.

Literacy is statistically significant but its sign is opposite of what we had anticipated. It seems that a higher level of literacy, controlling for other explanatory variables, is associated with a higher level of consumption volatility. We suspect that this is either due to endogeneity or to more entrepreneurial activity in countries with higher literacy. Endogeneity is a possibility since literacy could be augmented by governments in an effort to deal with consumption volatility.<sup>5</sup> Countries with higher consumption volatility may be devoting more resources to education and increasing literacy in their countries, leading to a positive sign in our estimates. Another possibility is that countries with higher levels of literacy are associated with more entrepreneurial activity, which results in people taking more risks, which in turn leads to higher consumption volatility.<sup>6</sup>

While investigating the countries that might be responsible for this result, we found a surprising pattern. For Latin American countries, higher literacy is associated with higher consumption volatility. Table V and Table VI report regressions where Non Latin American countries and Latin American countries are estimated separately. Without Latin American countries, the sign of literacy is still positive, but the coefficient estimate drops from 0.28 to 0.12 and it loses statistical significance whereas for Latin American countries alone, the coefficient estimate 0.58 is much higher though not statistically significant (which is quite possibly because of lack of adequate number of observations in the sample consisting of only Latin American countries). This suggests that there may be something different about Latin American countries that we have not considered. But, as seen from results in Table VI, Life Expectancy is now significantly negatively related to consumption growth volatility for Non Latin American countries. Property Rights, with anticipated negative sign, also gains statistical significance for Non Latin American countries.

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<sup>5</sup> Acemoglu and Johnson (2005) have argued that many political and economic institutions arise endogenously; if so, to properly assess the impact of institutions, one should adopt an instrumental variable approach exploiting exogenous variation in institutions.

<sup>6</sup> The consumption growth volatility may be positively related to average consumption growth. Indeed, when we add average consumption growth as an additional explanatory variable, the coefficient estimate is positive and statistically significant. However, the coefficient estimates of all other explanatory variables, as well as their standard errors, remain virtually unchanged which suggests that average consumption growth is orthogonal to these variables. For brevity, we do not report these results here.

## Conclusion

We document empirical evidence that suggests that the volatility of consumption growth is negatively related to life expectancy, political rights, and property rights after controlling for the size of the country, per capita income, and openness to trade and capital flows, in cross-country panel regressions. We interpret this evidence as support of Amartya Sen's argument that many development and freedom measures enhance human welfare because they allow individuals to better cope with risk and uncertainty that cannot be hedged using market based insurance mechanisms.

On the other hand, our evidence also indicates that a higher level of literacy is associated with a higher level of consumption volatility. This effect appears to come largely from Latin American countries. We conjecture that because literacy could be augmented by governments in an effort to deal with consumption volatility, levels of literacy may be endogenous. Higher risky entrepreneurial activity by more educated population, may also result in higher consumption volatility. We leave to future research to examine these issues in greater detail.

**Table I. Summary Statistics**

The following table gives the mean, standard deviation, minimum, and maximum of the variables used in the analysis: the natural log of the GARCH estimate of consumption growth volatility, a measure of Political Rights (Lowest=1, Highest=7), Property Rights (Lowest=1, Highest=5), Literacy (Complete Literacy=100%), Life Expectancy (in years), the natural log of Gross National Income (\$, PPP adjusted), the natural log of Per Capita Income (\$, PPP adjusted), and a measure of Capital Account Openness (Lowest=0, Highest=100).

	<b>Average</b>	<b>Standard Deviation</b>	<b>Minimum</b>	<b>Maximum</b>
Consumption Growth Volatility	2.60	1.36	-2.41	6.03
Political Rights	4.96	1.95	1	7
Property Rights	3.27	1.12	1	5
Gross National Income	25.31	1.71	21.93	30.15
Per Capita Income	8.63	1.11	5.94	10.77
Literacy	82.75	17.53	32.80	100
Life Expectancy	68.66	9.51	36.04	82.08
Capital Account Openness	69.77	24.87	12.50	100



**Table II. Cross Country Correlations of Variables**

The following table gives the correlations of the different variables used in the analysis: the natural log of the GARCH estimate of consumption growth volatility, the natural log of Per Capita Income (\$, PPP adjusted), the natural log of Gross National Income (\$, PPP adjusted), a measure of Political Rights, Property Rights, Literacy, Life Expectancy (in years), and a measure of Capital Account Openness.

	Consumption Growth Volatility	Per Capita Income	Gross National Income	Political Rights	Property Rights	Literacy	Life Expectancy	Capital Account Openness
Consumption Growth Volatility	1.00							
Per Capita Income	-0.47	1.00						
Gross National Income	-0.44	0.52	1.00					
Political Rights	-0.44	0.57	0.29	1.00				
Property Rights	-0.44	0.65	0.34	0.53	1.00			
Literacy	-0.29	0.77	0.36	0.62	0.50	1.00		
Life Expectancy	-0.44	0.80	0.40	0.48	0.48	0.64	1.00	
Capital Account Openness	-0.41	0.39	0.03	0.42	0.35	0.37	0.35	1.00

**Table III. Panel Regression of Per Capita Income on Explanatory Variables**

We estimate a regression of the Per Capita Income on the remaining explanatory variables. The dependent variable is the natural log of Per Capita Income (\$, PPP adjusted). The independent variables are a measure of Political Rights, Property Rights, Literacy, Life Expectancy, the natural log of Gross National Income (\$, PPP adjusted), and a measure of Capital Account Openness. All variables are normalized to have a mean of 0 and a standard deviation of 1 for the complete sample. Standard errors are calculated after clustering by year and country. Statistical significance is indicated by \*, \*\*, and \*\*\* at the 10%, 5% and 1% levels respectively.

<b>Explanatory Variable</b>	<b>Coefficient Estimate</b>	<b>Standard Error</b>	<b>t-statistic</b>
Intercept	0.00	0.06	0.00
Political Rights	-0.01	0.08	-0.18
Property Rights	0.23	0.07	3.49 **
Gross National Income	0.16	0.06	2.86 **
Literacy	0.33	0.06	5.43 ***
Life Expectancy	0.41	0.10	3.94 **
Capital Account Openness	0.05	0.05	0.97

R-Square	83%
N	712

**Table IV. Panel Regression of Consumption Volatility on Explanatory Variables**

We estimate a regression of consumption growth volatility on seven explanatory variables. The dependent variable is the natural log of the GARCH estimate of consumption growth volatility. The independent variables are a measure of Political Rights, Property Rights, Literacy, Life Expectancy, the natural log of Gross National Income (\$, PPP adjusted), the natural log of Per Capita Income (\$, PPP adjusted), and a measure of Capital Account Openness. All variables are normalized to have a mean of 0 and a standard deviation of 1 for the complete sample. The number of countries per year in the data varies slightly depending on the availability of data. Standard errors are calculated by clustering by year and country. Statistical significance is indicated by \*, \*\*, and \*\*\* at the 10%, 5% and 1% levels respectively.

<b>Explanatory Variable</b>	<b>Coefficient Estimate</b>	<b>Standard Error</b>	<b>t-statistic</b>
Intercept	0.00	0.08	0.00
Political Rights	-0.21	0.08	-2.55 **
Property Rights	-0.14	0.09	-1.52
Gross National Income	-0.32	0.08	-4.24 ***
Per Capita Income	-0.04	0.21	-0.20
Literacy	0.28	0.11	2.57 **
Life Expectancy	-0.19	0.16	-1.19
Capital Account Openness	-0.29	0.10	-3.01 **

R-square	43%
N	712

**Table V. Panel Regression of Consumption Volatility on Explanatory Variables for Latin American Countries**

We estimate a regression of consumption growth volatility for Latin American Countries on seven explanatory variables. The dependent variable is the natural log of the GARCH estimate of consumption growth volatility. The independent variables are a measure of Political Rights, Property Rights, Literacy, Life Expectancy, the natural log of Gross National Income (\$, PPP adjusted), the natural log of Per Capita Income (\$, PPP adjusted), and a measure of Capital Account Openness. All variables are normalized to have a mean of 0 and a standard deviation of 1 for the complete sample. Standard errors are calculated by clustering by year and country. Statistical significance is indicated by \*, \*\*, and \*\*\* at the 10%, 5% and 1% levels respectively.

<b>Explanatory Variable</b>	<b>Coefficient Estimate</b>	<b>Standard Error</b>	<b>t-statistic</b>
Intercept	0.21	0.29	0.72
Political Rights	-0.54	0.22	-2.47 **
Property Rights	-0.10	0.15	-0.67
Gross National Income	-0.65	0.32	-2.04 ***
Per Capita Income	0.41	0.84	0.49
Literacy	0.58	0.41	1.41
Life Expectancy	0.34	0.73	0.46
Capital Account Openness	-0.51	0.25	-2.07 **

R-square	32%
N	199

**Table VI. Panel Regression of Consumption Volatility on Explanatory Variables for Non Latin American Countries**

We estimate a regression of consumption growth volatility for Latin American Countries on seven explanatory variables. The dependent variable is the natural log of the GARCH estimate of consumption growth volatility. The independent variables are a measure of Political Rights, Property Rights, Literacy, Life Expectancy, the natural log of Gross National Income (\$, PPP adjusted), the natural log of Per Capita Income (\$, PPP adjusted), and a measure of Capital Account Openness. All variables are normalized to have a mean of 0 and a standard deviation of 1 for the complete sample. Standard errors are calculated by clustering by year and country. Statistical significance is indicated by \*, \*\*, and \*\*\* at the 10%, 5% and 1% levels respectively.

<b>Explanatory Variable</b>	<b>Coefficient Estimate</b>	<b>Standard Error</b>	<b>t-statistic</b>
Intercept	-0.07	0.09	-0.78
Political Rights	-0.20	0.08	-2.42 **
Property Rights	-0.18	0.10	-1.81 *
Gross National Income	-0.30	0.08	-3.89 ***
Per Capita Income	0.14	0.21	0.67
Literacy	0.12	0.10	1.18
Life Expectancy	-0.31	0.15	-2.08 **
Capital Account Openness	-0.28	0.12	-2.43 **

R-Square	58%
N	513

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