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Some Cross Country Evidence**

Abstract

The paper employs cross country regression analysis to estimate the effect of democracy and income inequality, adjusting for the level of income and other variables, on country innovation. It finds that both of these variables are of consequence for innovation. Different countries innovate at different rates. Some countries are very creative while other countries are not. Innovation is of vital importance to economic activity. The long term health of the economy depends on innovation, as creativity and innovation are the key drivers of economic growth. Understanding the determinants of creativity and innovation is, therefore, a serious endeavor. While it is common to study the reasons for differences in creativity and innovation across firms and countries by knowledge production function inputs such as dollar expenditure on research and development, looking for more fundamental underlying socio-political variables at the country level that may lead to a more favorable or less favorable environmental conditions for innovation is less common. National socio-political country conditions are not the direct determinants of innovation such as those at the firm level, but, rather, they are the behind the scenes forces influencing the development of these direct components. For instance, greater freedom and democracy may create individuals who are more autonomous, independent, and entrepreneurial. If, at the firm level, certain corporate cultural characteristics are the key to innovation, then some country characteristics will provide a more favorable milieu for their evolution and appearance, while others will not. The purpose of this paper is to focus on two socio-political variables, democracy and income inequality, as potential determinants of innovation. In pursuit of this undertaking, the paper is divided into five parts. The first part looks at potential theoretical reasons why democracy and income inequality and a few other country variables may have relevance for innovation. The second section discusses the measures that are employed in the empirical analysis and identifies data sources. The third part shows the outcomes of regression runs on innovation and democracy and on innovation and income inequality adjusting for the level of economic development and for other variables. The final section concludes.

Key Words: Country Innovation, Creativity, Income Inequality, Democracy
JEL Classification: O5.

Democracy, Income Inequality, and Innovation: Theoretically Predicted Relationships

The relationship between innovation, democracy, income inequality and the three other variables that is hypothesized can be summarized in a single equation accompanied by partial derivatives.

The equation with its associated partial derivatives is as follows.

$$I = f(D, Q, Y, H, D)$$

$$\delta I / \delta D > 0, \delta I / \delta Q < 0, \delta I / \delta Y > 0, \delta I / \delta H > 0, \delta I / \delta D < 0$$

In the equation, I is innovation, D is democracy, Q is income inequality, Y is income, H is happiness, and D is public debt. The partial derivatives of innovation on democracy, income, and happiness are positive, and the partial derivatives of innovation on income inequality and public debt are negative.

One of the key factors that are likely to influence the amount of innovation in society in a positive manner is democracy. Human beings need freedom to be creative and to let their creativity flourish. An inquisitorial environment in which the authorities look at new ideas and new ways of doing things as potential threats to the status quo, and in which people live in fear for their very lives when they step out of line, is not likely to provide a favorable soil for the flowering of human creativity. In addition, in more democratic governments, with established property rights, people are more likely to have a positive incentive to innovate, as they are allowed to reap some of the gains of the benefits from their successful innovations.

Another factor that is likely to influence country innovation is income inequality. Over the entire range of income inequality, the paper theorizes a hump shaped relationship between innovation and income inequality with a positive relationship between innovation and income inequality at very low levels of income inequality and a negative relationship between

innovation and income inequality at higher levels of income inequality.

Although some income inequality is needed in order to provide an incentive for productive activity and innovation, the threshold level for the necessary differentiation between individuals to provide this incentive is fairly low. Beyond this threshold level of inequality, higher levels of inequality are likely to lead to reduced creativity and innovation. Higher levels of income inequality leave more and more of the population in a state of doing all they can merely to exist and to make a living with little or no time, energy, or thought left over for innovation, along with a smaller and smaller privileged elite with an eye only to maintaining their favored position.

In the paper it is assumed that the inequality in incomes of the countries in the world today is beyond their threshold levels of income. As a result the paper hypothesizes that, at present, there is a negative relationship between innovation and income inequality. In addition to democracy and income inequality, there are many other country variables that are likely to influence innovation. Three of these are considered in the paper. They are the level of economic development, the amount of happiness in society, and the extent of public debt. Besides democracy and income inequality, a third factor that is almost certain to be a positive force for innovation is the level of economic development or income per capita of a country. Income is important in a number of respects.

First, sufficient income is necessary in order to provide creative individuals with the necessary leisure time that is crucial to grope, toy around, and develop new concepts and practices.

Second, adequate income is necessary to provide education, human capital, and to inculcate an outlook and an attitude that is conducive to innovation. Third, an acceptable amount of income is required in order to place a society in a position to be able to provide the means for investing in innovation. There are many studies these days looking at the potential determinants of happiness.

Here, there is an opportunity to look at one of its potential consequences. The fourth variable under investigation for its potential effect on innovation is subjective well being, happiness, or life satisfaction of individuals in society.

The paper assumes that happier people, people who are more satisfied with society, are more apt to express themselves, to use their energies and life forces for creative endeavors, that is, they are more prone to promote and to improve the society in which they have found fulfillment.

On the other hand, in contrast, people who are dissatisfied are more likely to want to strike out and to funnel their life energies into destructive endeavors. Although some people, for instance, people that are both unhappy and depressed, may be merely dysfunctional, others, for example, those who are angry and target society as the source of their unhappiness, might look in the direction of revolutionary activities and government overthrow.

Thus, theoretically, it is hypothesized that the relationship between innovation and happiness is expected to be positive. Given the problems around the world today with high levels of public indebtedness, the final factor to be considered is public debt. Higher public debt is likely to be detrimental to innovation. It both weakens the government's ability to make public investment in research and development, and, by crowding out private investment in financial markets, lessens private investment in research and development. Thus, if this is true, and, if there is a negative relationship between economic growth and public debt, as some recent studies have shown, then a potential path by which public debt exerts a negative effect on economic growth may be through public debt's negative effect on innovation.

Background Literature

Furman, Porter, and Stern use panel regression analysis on a dataset consisting of seventeen OECD countries for the twenty year period from 1973 to 1996 to look at potential determinants of innovation as measured by

international patent issues (Furman, Porter, and Stern 2002).

The selection of innovation explanatory variables for their econometrics is theoretically based on a Romer style technological production function that includes, in addition to the traditional Romer type variables such as the number of knowledge workers and the stock of existing knowledge, variables relating to common country-wide innovation infrastructure, to the environment in industrial clusters within nations, and to the linkages within countries between common infrastructure and industrial clusters.

Some of the variables they find to be important for innovation include research and development spending, intellectual property rights protection, share of research performed in the academic sector, and the extent of technological specialization.

Tellis, Prabhu, and Chandy first do a literature review to uncover the main drivers of innovation found in the literature at the country and firm level on innovation for potential incorporation in their empirical analysis (Tellis, Prabhu, and Chandy 2009).

Some of the broad areas they identify include a skilled and educated workforce, particularly in the scientific and technical fields, easily and readily available capital for innovation, government policies to encourage innovation and to foster linkages between educational institutions and business, and religious and cultural values of citizens.

As the major focus of their paper is on corporate culture as a potential determinant of innovation, they develop measures of innovation and of corporate culture (willingness to cannibalize firm assets for innovative development, the extent of future focus, the willingness to take on risk, and the amount of incentives for innovation, product champions, and internal markets) based on a survey they administer to a sample consisting of seven hundred fifty-nine firms in seventeen different countries.

Using a fixed effects regression model on their entire data set, they find that corporate culture

trumps the traditional national and firm variables in the assorted areas of labor, capital, government policy, and national culture in explaining innovation. They believe the reason corporate culture is becoming relatively more important compared to traditional drivers of innovation is that, with globalization, the playing field is becoming more equalized across countries.

Labor economists have considered whether labor market characteristics matter for innovation. For instance, Pieroni and Pompei, using patents as a measure of innovation and job turnover and wages as measures of labor market flexibility, find that higher wages lead to increased innovation in their empirical work on Italian industrial sectors from 1990 through 1996 (Pieroni and Pompei 2008).

In addition to looking at the potential effects of labor market on innovation, Bassanini and Ernst also consider the effect of product market competition on innovation. The results of their regression analysis employing data consisting on eighteen OECD countries for eighteen manufacturing industries suggest that greater product market competition increases innovation (Bassanini and Ernst 2002).

Global integration may also influence innovation. Looking at data for Taiwan, Lin and Lin find that both inward and outward foreign direct investment and imports affect product innovation (Lin and Lin 2010).

Variable Sources

The innovation measure used in the paper is the global innovation index of the Confederation of Indian Industry and INSTEAD for 2008 (Confederation of Indian Industry and INSTEAD 2010). The global innovation index for 2008 is available for one hundred thirty countries and has a potential range between one and seven. The 2008 index is computed by considering ninety four variables in eight different categories such as market sophistication, human capacity and competitiveness.

The variable employed to capture the level of economic development and material prosperity

is per capita real GDP in 2000 U.S. dollars for the year 2005. The data for per capita real GDP is taken from the World Bank (World Bank 2009), and is identified with the variable name GDPPC in the study.

The Economist's Intelligence unit calculates a democracy index that takes into account, among other things, the amount of civil liberties and the degree of political participation (The Economist 2008). The index has a potential range between zero and ten. Higher values of the democracy index indicate greater democracy. The Economist democracy index for 2008 is employed as the measure of democracy in the paper. It is given the variable name DEMOCRACY.

The measure of income inequality is the average, as calculated by the author on the basis of data availability, of the annual Gini indexes for the period 1990 through 2007 reported by the World Bank (World Bank 2009). It should be noted that, because of missing data, there are many countries in which the average is only for a single year. The Gini index ranges from a low value of zero (perfect equality) to a high value of 100 (perfect inequality). It is identified with the variable name GINI.

The world data base on happiness provides a web page providing data on average happiness for one hundred and forty countries (World Data Base of Happiness 2009).

Their data is based on surveys of life satisfaction for various years from 2000 to 2009. The World Data Base of Happiness average happiness is used as a measure of happiness in the study and it is given the variable name HAPPINESS. The variable ranges from a low value of zero to a high value of ten. The measure of public debt, the percentage of public debt to GDP, comes from the dataset on public debt by Jaimovich and Panizza (Jaimovich and Panizza 2008). Its variable name is DEBTTGDP.

Cross Country Regression Results

Table I shows the results of cross country regressions of innovation, as measured by the global innovation index for 2008, on GDP per

capita for 2005 in real 2000 U.S. dollars (GDPPC), on the Economist index of democracy (DEMOCRACY) for 2008, on the average Gini coefficient from 1990 to 2007 (GINI), on happiness based on surveys of life satisfaction from 2000 to 2009 (HAPPINESS), and on the percentage of public debt to GDP (DEBTOGDP).

The table is setup with the variable names of the potential independent variables listed in the first column. Each column following the first column contains the essential results for a single regression equation.

The first row numbers the regression equations while the last two rows provide the r-squared value (RSQ) and the number of observations (N). When a variable enters an equation, then two items appear for that variable for the equation in the body of the table. The first, the top value, is the estimated coefficient. The second, underneath the estimated coefficient in parenthesis, is the individual t-statistic. In addition, if a variable is significant at the ten percent level of significance or better, then it is marked with three asterisks under the individual t statistic. If it is significant at the five percent level or better then it is shown with two asterisks, and, if it is significant at the one percent level or better in an equation, then it appears with a single asterisk.

The table contains five equations. The first two equations are regression equations of innovation on income combined with either democracy (equation (1)) or with inequality (equation (2)). The third equation combines income with both democracy and inequality as explanatory variables. The fourth equation adds happiness to the three explanatory variables of in the third equation, and the fifth equation adds both happiness and public debt to the explanatory variables in equation three.

The results certainly seem to indicate that democracy and income inequality are relevant for country innovation. Both variables have their expected signs in all the equations. Democracy is positive in each of the equations in which it appears, and income inequality is negative. Democracy is significant at the five percent level or better in the equations that it

enters. Income inequality is significant at the ten percent level or better in the equations that it enters. Whether the variables are used singularly as regressors accompanied only by income, or together as regressors in combination with income and the other variables, they have the correct signs and are statistically significant. Democracy and income inequality in combination with the three other explanatory variables explain over seventy seven percent of the variation in the global innovation index in a cross section of one hundred and six countries (equation (5)).

The other three variables, GDPPC, HAPPINESS, DEBTOGDP, also behave as anticipated. Income per capita and happiness are positive and significant at the one percent level or better in the equations in which they appear, and public debt is negative and significant at the five percent level in the single equation in which it enters.

Conclusion

This paper finds that democratic values have a positive effect on innovation and income inequality has a negative effect on innovation when adjusting for the level of economic development and other variables. This means that if democratic values and income equality have intrinsic worth on their own, then fostering policies to promote greater democracy and greater income equality can have a twofold benefit to society. The results cast doubt on those who would promote elitist centralized government or single man government as positive and necessary for economic growth and development. It is also contrary to the position espoused by conservatives, almost always put forth in opposition to policies for achieving greater income equality in society, that reductions in income inequality will reduce innovation by dampening the incentive to innovate. Thus, to the extent that innovation is the primary driver of long-term economic growth and long-term economic growth is the key to higher living standards, the promotion of democratic values and the movement toward greater income equality is favorable for the long-term economic health and the long-term material prosperity of society. However, there is one caution. To the degree that more democratic or more equalitarian societies tend

to be more debt prone, care must be taken, and ways and means must be devised, to keep public debt in check, because, as also shown in the paper, public debt has a negative effect on innovation.

Table-I Cross Country Innovation Regressions

	(1)	(2)	(3)	(4)	(5)
Constant	2.296 (17.35)*	2.999 (14.07)*	2.611 (10.18)*	2.130 (7.801)*	2.229 (8.11)*
Gdppc	.000058 (14.05)*	.000061 (14.94)*	.000054 (10.76)*	.000045 (8.57)*	.000045 (8.08)*
Democracy	.0558 (2.46)**		.0728 (2.58)**	.0613 (2.13)**	.0947 (3.02)*
Gini		-.0094 (-1.95)***	-.0098 (-2.08)**	-.0123 (-2.56)**	-.0140 (-2.93)*
Happiness				.1239 (2.89)*	.1229 (2.88)*
Debtogdp					-.0487 (-2.19)**
RSQ	.724	.728	.740	.770	.778
N	126	114	113	108	106

Note: * indicates one percent level of significance, ** five percent level of significance, and *** ten percent level of significance

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