Does a democratic government attract more foreign direct investment? Evidence from a machine learning approach

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Abstract

This paper aims to uncover the intrinsic effect of democracy on Foreign Direct Investment (FDI). Firstly, I present an approach for measuring democracy indicators based on Support Vector Machines. The output index is continuous on the [0,1] interval for 166 countries in the period between 1981 and 2011. In addition, based on the newly constructed democracy dataset and "difference" GMM estimation strategy, I find a robust positive relationship between democracy and FDI. Finally, the undermining role of natural resources does not exist in my estimation.

1 Methods and Results

1.1 Recalculate democracy using Support Vector Machines

1.1.1 Basic theoretical framework of SVM

The democratization indicator $D_{i,t} \in \mathcal{D} \subseteq \mathbb{R}$ of country i in period t can be expressed as a function of several conditions, i.e.

$$D_{i,t} = F\left(x_{i,t}^1, \ldots, x_{i,t}^m\right) \quad \forall(i,t)$$

However, it is infeasible to have a perfect estimate of the function due to unobserved conditions. The very aim of using support vector regression in this case is to give less penalty on the points which have been correctly categorized but far from the hyperplane.

1.1.2 Algorithm

This paper references the algorithm mentioned in Gründler and Krieger (2016).

Firstly, I need to choose the feature variables for the measurement of democracy. Traditionally, there were two sets of variables to be considered: political participation and political competition. Inspired from Gründler and Krieger (2016), I also include the civil liberty and non-government institutions independence. For political participation, I include altogether three variables: voter turnout (Vanhanen, 2000), rating of political freedom (House, 2014), political oppression and violence indicator (Gibney et al., 2016). I further take advantage of the political competition score in Vanhanen (2000). Besides, the quality of civil liberties is provided by House (2014). At last, independence of the non-government institutions could be found from the INJUD data set in Cingranelli et al. (2014). In sum, there are six different variables in my basic feature space.

Secondly, I construct a sample data set by selecting the country-year pairs which could be definitely categorized as either democracy or autocratic. If the corresponding democracy indicator in Unit (2013) is over 8.0, I would view the country-year pair

as democracy. On the other hand, I classify countries as autocratic if the Economist Intelligence Unit's Democracy Index is 3.0 or below.

Thirdly, I randomly select country-year pairs in the sample data set and create training set.

The fourth step is for the estimation of function F. To better approximate the real function, I use the kernel trick. Gaussian Kernel is taken advantage of.

In the fifth step, I utilize the estimated function F to calculate democracy indicator $D_{i,t} \in [0,1]$ to all of the pairs. I further use bootstrapping to have a robust result.

Figure 1: Democracy in the world, 2011
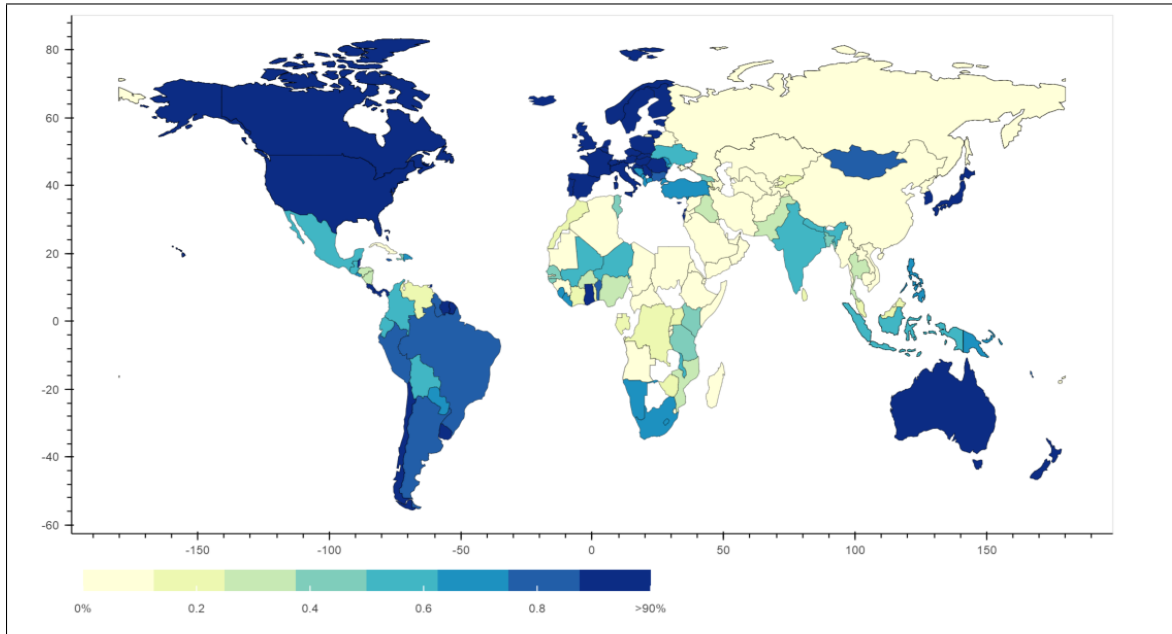
1.1.3 Overview of democracy level in the world

The democracy output covers altogether 166 countries ranging from 1981 to 2011 due to data limitation. Figure 1 presents an overview of democracy level in the world in year 2011. Deeper color represents democracy. The picture manifests a segregation pattern of democracy. Almost all of the countries in Europe, North America and South America have democracy score over 0.8. However, a fair number of developing countries in Africa and Asia are highly autocratic. It could be inferred from the

figure that a country's democracy level is positively correlated with its neighboring countries'.

1.2 Estimating the effect of democracy on FDI inflow

1.2.1 Model specification

A linear dynamic panel data (DPD) model is employed to capture the effect of lagged FDI on current FDI. DPD models contain unobserved panel-level effects that are correlated with the lagged dependent variable, which engenders inconsistent standard estimators. Arellano and Bond (1991) proposed the GMM estimator for DPD models. Referred to as the "difference" GMM estimator, this estimator usually takes the first difference of the data and then uses lagged values of the endogenous variables as instruments.

Blundell and Bond (1998) proposed a more efficient estimator, the "system" GMM estimator to mitigate the poor instruments problem by using additional moment conditions. However, the "system" estimator has a disadvantage that keeps it away from my analysis: too many instruments are used. Sargen tests of the "system" GMM failed with my data set. Thus, I only utilize "difference" GMM estimator as my estimation strategy.

The bench model is as follows:

$$y_{it} = \rho y_{it-1} + \lambda D_{it} + \beta \mathbf{X}_{it} + \theta_i + \epsilon_{it}$$

where y_{it} is the log of net FDI inflow in country i at 5-year period t, D_{it} is the democracy index, and $\mathbf{X}_{it}$ includes all the covariates of the regression.

1.2.2 Variables

The empirical analyses of this paper use a panel data of 166 countries over the period 1981 to 2011. Following the theoretical framework of Li and Resnick (2003), the dependent variable is net FDI as share of GDP. I further use trade/GDP as a measure

of openness and the rate of inflation as a representation of macroeconomic uncertainty. Gross fixed capital formation as a share of GDP and the number of telephones per 100 population are used as the proxy variables to capture the level of infrastructure development in host countries. GDP per capita is a measure of domestic incomes. All else being equal, openness to trade, lower inflation and a better physical infrastructure should have a positive effect on FDI. Higher domestic incomes imply a greater demand for goods and services and therefore make the host country more attractive for FDI. According to Asiedu and Lien (2011), measures of natural resources are employed to capture a country's natural resource export intensity. The descriptive statistics of the variables is reported in Table 1.

Table 1: Summary statistics

	count	mean	std	min	25%	50%	75%	max
FDI	4381	3.78	12.75	-58.32	0.46	1.69	4.30	451.72
DEMOCRACY	4850	0.48	0.39	0.01	0.06	0.47	0.92	0.98
IMPORTS	4291	41.98	24.89	0.00	25.75	36.44	53.55	236.39
EXPORTS	4291	36.26	25.25	0.01	20.19	30.72	46.64	231.19
INFLATION	4032	38.46	473.33	-17.64	2.49	5.72	11.73	23773.13
FIXED CAPITAL	3960	21.75	7.55	-2.42	17.38	21.30	25.30	89.39
FIXED TELEPHONE	4816	14.39	17.14	0.00	1.04	6.69	22.92	74.74
GDP PER CAPITA	4516	10284.54	15887.45	131.65	1030.25	3414.88	11095.57	111968.35
FUEL EXPORTS	3331	16.79	27.94	0.00	0.51	3.47	15.59	99.96
ORES AND METALS EXPORTS	3452	7.53	13.74	0.00	0.54	2.31	6.39	84.19

Note: Apart from democracy, all the other variables come from World Development Indicators. FDI is the net inflows as share of GDP. Imports and exports are imports and exports of goods and services percent of GDP respectively. Inflation is the annual inflation rate. Fixed capital is the share of gross fixed capital formation in GDP Fixed telephone is the number of telephones per 100 people. GDP per capita is in constant 2010 US dollar. Fuel exports is the share of fuel in total merchandize exports, and ores and metals exports is the share of ore and metal in total merchandize exports.

1.2.3 Results

I use the two-step GMM estimator, which is asymptotically efficient and robust to all kinds of heteroskedasticity. There are three main hypotheses I would like to test. (1) Does democracy have a positive effect on FDI? (2) Would natural resources undermine the effect of democracy on FDI? (3) Will different natural resources individually affect FDI? The empirical results are presented in Table 2. I use four models to test these

Table 2: The effect of Democracy on FDI, difference GMM

Dependent variable: FDI/GDP	(1)	(2)	(3)	(4)
LAGGED FDI/GDP	0.544***	0.546***	0.545***	0.544***
	(0.000)	(0.000)	(0.000)	(0.000)
DEMOCRACY	0.649***	1.053**	0.567***	0.596***
	(0.004)	(0.021)	(0.003)	(0.000)
NATURAL RESOURCES	0.764	0.103***		
	(0.457)	(0.002)		
NAT×DEM		-0.071		
		(0.204)		
FUEL EXPORTS			0.029	
			(0.658)	
ORES AND METALS EXPORTS				0.146
				(0.204)
Number of Countries	131	131	133	131
Sargan test(p-value)	0.204	0.190	0.195	0.191
Serial correlation test(p-value)	0.151	0.132	0.159	0.148

Note: p-value in parentheses. * p<0.1, ** p<0.05, *** p<0.01

three hypotheses respectively. The bench model, whose result is shown in column 1, is aimed to test hypothesis 1. In the second model, an interaction term between democracy index and natural resource is constructed as a way to test hypothesis 2. The third and fourth column utilize fuel exports, ore and metal exports respectively as variables to test hypothesis 3.

(1) Does democracy have a negative effect on FDI?

Firstly, I focus on the coefficient of democracy. The result is reported in the first column. Note that $\hat{\lambda}$ is positve and significant at the 1% level. It suggests that all else equal, democracy stimulates the inflow of FDI. I can use an example here to state this positive effect. Considering the two countries that have extremely different levels of democratization in my sample: Saudi Arabia and Czech Republic, the result shows that an improvement in democracy from the level of Saudi Arabia (0.184) to the level of Czech Republic (0.814) will increase FDI/GDP by about 40 percentage point, which is a huge effect. The estimated coefficient of lagged FDI, $\hat{\rho}$, is positive and significant at 1% level, suggesting that current FDI is positively correlated with

future FDI. Note that the effect of one unit increase in the level of current democracy on current FDI is equal to $\hat{\lambda}$, and the long run effect on FDI is $\hat{\lambda}/(1 - \hat{\rho})$. Since $\hat{\lambda} < \hat{\lambda}/(1 - \hat{\rho})$, I could find that past levels of democratization have an impact on current and future FDI flows.

(2) Would natural resources undermine the effect of democracy on FDI?

Asiedu and Lien (2011) hypothesized that natural resources have a negative effect on FDI, which is contradicted by my results. In the column 1, the sign of the coefficient is positive, although it is not significant. It could be inferred from the result that in my data sample, natural resources do not have a direct effect on FDI inflow. As for the undermining effect, Asiedu and Lien (2011) found the evidence that natural resources significantly alter the relationship between FDI and democracy. Thus, I make an interaction term in my model and test if I could get the similar result. The result shows that the interaction term is not significant even at 20% level. The joint significance test of natural resource and the interaction term also shows the jointly insignificance result. The conclusion arrived by Asiedu and Lien (2011) is highly dependent on sample size and estimation methodology. My sample ranges from 1981-2011 as compared with 1982-2007 in their paper. Financial crisis is the most significant shock in this time period, which is one of the explanations for the different results.

(3) Will different natural resources individually affect FDI?

In this paper, the share of fuel in total merchandise exports and the share of ores and metals in total merchandise exports are two individual measurements of natural resources. According to Boschini et al. (2007), different types of natural resources have different effects on the economic growth. The question here revolves around the separate channel of different resources' influence on FDI. Based on the results in the third and fourth column, the estimation coefficients of both variables are not significant. Thus, I cannot find the evidence of separate influence.

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