Measuring Regulatory Barrier Using Annual Reports of Firms

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Introduction

While tariffs and foreign direct investment restrictions drop significantly in past decades, countries adopt a more discreet form of policy barrier: regulation, to protect domestic industries. The World Trade Organization consistently ranks regulatory barrier as the most significant barrier to globalization. However, measuring regulatory barrier in a systematic manner proves to be very challenging, due to two main reasons:

- **Pervasiveness**: Almost all regulations can be used as barrier to globalization.

- **Covertness**: Seemingly non-discriminatory regulation can have discriminatory effects.

The Proposed Approach

I propose to use annual reports submitted by U.S. firms to Securities and Exchange Commission (i.e. 10-K forms) to measure regulatory barriers faced by U.S. firms in other countries. First, I identify sentences in the annual reports that report the existence of barrier in other countries. Second, an dynamic item response model is employed to produce a numerical estimate for the barrier level of different countries.

Text Processing

I use a supervised learning approach to find sentences containing information on regulatory barrier.

Training Set: 3,846 sentences

- "We have difficulty gaining market share in countries such as Japan because of regulatory restrictions and customer preferences."

- "Burdens of complying with a variety of foreign laws, including more protective employment laws affecting our sizable workforce in Germany"

- "Laws and regulations in Japan, Korea and China are particularly restrictive and diffcult."

- "Recent industry and regulatory changes have negatively impacted John Deere's competitive position in the potential high growth Russian markets during the fiscal year."

Classifier:
Bidirectional Encoder Representations from Transformers (BERT)

	Actual True	Actual False
Predicted True	44	48
Predicted False	6	302
False Positive Rate	0.12	
False Negative Rate	0.137	
Total Error Rate	0.135	

The Statistical Model

In a given year t:

	Country 1	Country 2	$\cdots$	Country J
Firm 1	U_{11t}	U_{12t}	$\cdots$	U_{1Jt}
Firm 2	U_{21t}	U_{22t}	$\cdots$	U_{2Jt}
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
Firm I	U_{I1t}	U_{I2t}	$\cdots$	U_{IJt}

The variable U_{ijt} can take three possible values:

$$U_{ijt} = \begin{cases} 3 & \text{firm } i \text{ does not enter country } j \\ 2 & \text{firm } i \text{ enters country } j \text{ \& reports barriers} \\ 1 & \text{firm } i \text{ enters country } j \text{ \& NOT reports barriers} \end{cases}$$

$$\Pr(U_{ijt} = 1) = \underbrace{\Pr(\theta_{jt} - b_{ijt}^E + \epsilon_{ijt}^E < 0)}_{\text{barrier level is less than the entry cutoff}}$$

$$\times \underbrace{\Pr(\theta_{jt} - b_{ij}^R + \epsilon_{ijt}^R < 0)}_{\text{barrier level is less than the reporting cutoff}}$$

$$= \Pr(\epsilon_{ijt}^E < b_{ijt}^E - \theta_{jt}) \times \Pr(\epsilon_{ijt}^R < b_{ij}^R - \theta_{jt})$$

$$= \underbrace{F(b_{ijt}^E - \theta_{jt})}_{\text{probability of firm } i \text{ entering country } j}$$

$$\times \underbrace{F(b_{ij}^R - \theta_{jt})}_{\text{probability of firm } i \text{ NOT reporting barriers in country } j}$$

$$\Pr(U_{ijt} = 2) = F(b_{ijt}^E - \theta_{jt}) \times (1 - F(b_{ij}^R - \theta_{jt}))$$

$$\Pr(U_{ijt} = 3) = 1 - F(b_{ijt}^E - \theta_{jt})$$

I assume that the case where a firm does not enter country j but reports barrier in country j does not exist.

Variables and Priors

Nested Structure:

$$b_{ijt}^E = e^{\beta^\top \mathbf{X}_{ijt}}$$

The covariates vector $\mathbf{X}_{ijt}$ captures factors that affect a firm's entry decision other than the regulatory barrier level. It can be broken down into two components.

$$\mathbf{X}_{ijt} = \begin{bmatrix} \text{Asset}_{it} \\ \text{Asset}_{it} \\ \text{Asset}_{it} \\ \text{Asset}_{it} \end{bmatrix} \circ \begin{bmatrix} \text{Industry Level GDP}_{jt} \\ \text{Internal Conflict Level}_{jt} \\ \text{External Conflict Level}_{jt} \\ \text{Poverty}_{jt} \end{bmatrix}$$

Data Sources:

| Variable Name	Data Source	Unit Level
Asset	BvD Osiris	Firm - Year
Industry Level GDP	Global Insight	Country - Year
Internal Conflict	PRS Group	Country - Year
External Conflict		Country - Year
Poverty		Country - Year

Prior of the main parameter:

$$\theta_{j,1} \sim N(0,1)$$
$$\theta_{j,t} = \theta_{j,t-1} + \xi_{jt}$$
$$\xi_{jt} \sim N(0, 3^2)$$

Other parameters:

$$b_{ij}^R \sim N(0, 10^2)$$
$$\beta \sim N(0, 10^2)$$

Results: Average Barrier
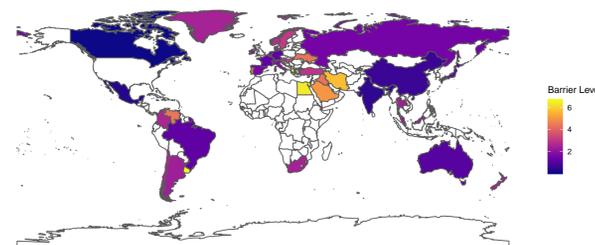
Rank	Country	Barrier	Rank	Country	Barrier
1	Greece	6.606		$\cdots$	$\cdots$
2	Uruguay	6.568	38	Japan	1.08
3	Egypt	6.381	39	China	1.068
4	Costa Rica	5.805	40	India	0.623
5	Iran	5.664	41	Mexico	0.454
	$\cdots$	$\cdots$	42	Canada	0.119

Results: Barrier Change
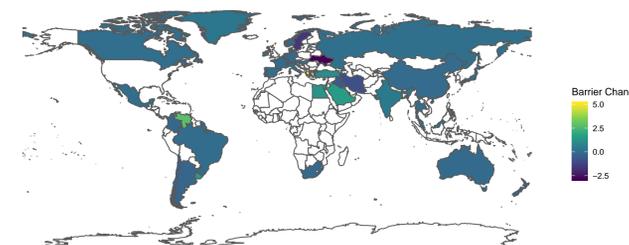
Rank	Country	Change	Rank	Country	Change
1	Greece	5.080		$\cdots$	$\cdots$
2	Venezuela	2.753	38	Iraq	-0.586
3	Costa Rica	1.585	39	Belgium	-0.623
4	Saudi Arabia	1.489	40	Iran	-0.905
5	Uruguay	1.372	41	Sweden	-1.648
	$\cdots$	$\cdots$	42	Ukraine	-2.849

Validation: Industry Composition

Let us decompose the total barrier of the top three countries into industry level barrier.
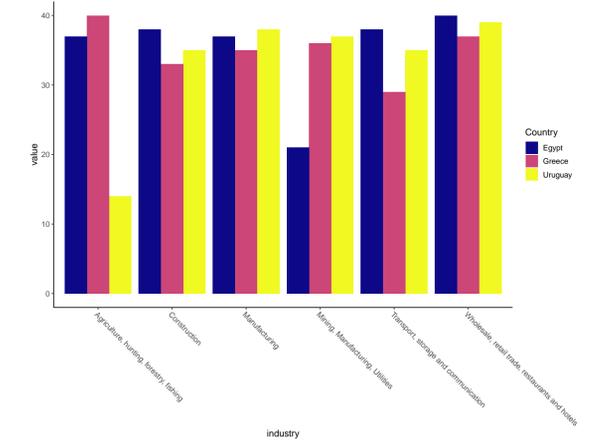
Next, we look at the change of barrier level among the countris with the most dramatic changes.
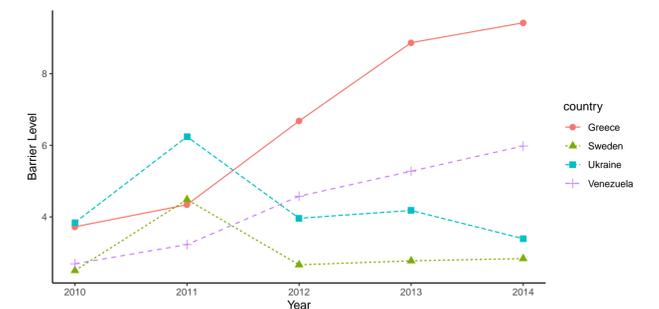
Validation: Correlation

Finally, I correlate the estimated barrier with other important variables: Democarcy Level, Number of Special Trade Concerns, Foreign Direct Investment, Trade. The results are in line with many findings in the related literature.

	Dependent variable:			
	Democracy	STC Count	FDI	Trade
	(1)	(2)	(3)	(4)
Barrier	0.198*	0.020	$-6{,}129.500^*$	$-1{,}287.870^*$
	(0.118)	(0.080)	(3,502.502)	(689.531)
Year FE	✓	✓	✓	✓
Country FE	✓	✓	✓	✓
Observations	185	210	189	210
Note:			*p<0.1; **p<0.05; ***p<0.01	