

# Technical Background Paper – “Economic Dividend from Economic Freedom Simulator”

By

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## 1. Introduction

This paper summarizes the technical aspects underlying *The Economic Dividend from Economic Freedom Simulator*. The simulator is built from data from the Heritage Foundation’s Index of Economic Freedom. The basic idea of *the* simulator is to add new functionality to the data. Specifically, the objective of the simulator is to allow users to perform web-based

- Queries that allow for comparisons of a country’s freedom score to the country’s regional average, world average, and relative to its GDP per capita.
- Simulations to change freedom scores to receive an estimated economic dividend associated with the simulated changes.

## 2. Data and Methodology

In order to build *The Economic Dividend from Economic Freedom Simulator*, we utilize the following variables:

- GDP per capita (constant 2010 US\$)<sup>1</sup>
- GDP per capita (PPP)<sup>2</sup>
- 2018 Index of Economic Freedom<sup>2</sup>

A panel data set is built with the available data. Our dataset consists of 186 countries, for each of which we have 24 observations over time from 1995-2018.

### 2.1. Comparative Analysis

For the comparative analysis part of the *The Economic Dividend from Economic Freedom Simulator*, we only show 2018 data from the Heritage Foundation. The Heritage Foundation distinguishes five geographic regions, which are:

- Europe
- North Africa and the Middle East
- Sub-Saharan Africa
- South and Central America and the Caribbean
- North America

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<sup>1</sup> World Bank (2018): World Bank Development Indicators Database [online], retrieved from <http://databank.worldbank.org/data/source/world-development-indicators> [8/1/2018]

<sup>2</sup> The Heritage Foundation (2018): 2018 Index of Economic Freedom, retrieved from <https://www.heritage.org/index/explore?view=by-region-country-year> [8/1/2018]

When a user chooses a country of interest, the user will be shown the following scores for the selected country, the average of the region to which the selected country belongs, and the world average:

- Overall score
- Property Rights
- Judicial Effectiveness
- Government Integrity
- Tax Burden
- Government Spending
- Fiscal Health
- Business Freedom
- Labor Freedom
- Monetary Freedom
- Trade Freedom
- Investment Freedom
- Financial Freedom

The visualization includes a color scheme for the various scores' range between zero and hundred. The color scheme is as follows:

- $\text{score} < 20$ : Dark red (Very low)
- $20 \leq \text{score} < 40$ : Red (Low)
- $40 \leq \text{score} < 60$ : Orange (Medium)
- $60 \leq \text{score} < 80$ : Yellow (High)
- $80 \leq \text{score}$ : Green (Very High)

In addition to showing the selected country, its corresponding regional average, and world average score, the user is also presented a scatter plot of the natural log of GDP per capita, PPP (x-axis) against the selected score (y-axis). These scatter plots regularly show a positive relationship between GDP per capita and economic freedom. Country scores with a positive (negative) residual can then be interpreted as countries with a relative freedom surplus (deficit).

## **2.2. Estimation of Economic Freedom Dividend**

For the estimation of the impact of economic freedom on economic growth, we use the following variables:

- GDP per capita (constant 2010 US\$)
- Overall score

The simulation follows two steps. In a first step, the user is presented with the opportunity to change the twelve Economic Freedom Indicators that average out to the overall score. Based on the user selection, a new overall score is computed. In order to simplify the user's choice, the various scores for the indicators receive the following values:

- Very low = 10
- Low = 30
- Medium = 50
- High = 70
- Very high = 90

The user's simulated score is then calculated as

$$User\ Score = \frac{\sum_{i=1}^{12} User\ Selected\ Score_i}{12} \quad (1)$$

We then calculate the economic dividend using the following formula

$$Simulated\ GDP\ per\ capita_t = Simulated\ GDP\ per\ capita_{t-1} \times \left( 1 + \tau + \frac{\varphi \left( \frac{User\ Score}{2018\ Score} - 1 \right)}{20} \right) \quad (2)$$

where

$\tau$  = estimated time elasticity of GDP per capita = 0.0229

$\varphi$  = estimated economic freedom elasticity of GDP per capita = 0.0107

Simulated GDP per capita<sub>t=0</sub> = Latest available actual GDP per capita

The parameters  $\tau$  and  $\varphi$  are obtained from the following panel fixed effects regression:

$$GDP\ per\ capita\ (constant\ 2010\ US\$)_i = \beta_0 + \tau \times Time_i + \varphi \times Overall\ Score_i + u_i \quad (3)$$

where

$i$  = Country  $i$

$t$  = Time (year)

Table 1 summarizes the panel fixed effects regression results for equation (3).

Table 1: Panel Fixed-Effects Regression Results for Equation (3)

	Coefficient	Standard Error	t-statistic
$\tau$	0.023***	0.000	57.780
$\phi$	0.011***	0.001	17.550
Cross-Sectional Units	180		
Time Series Length (Min, Max)	1, 22		
n	3,465		
LSDV R <sup>2</sup>	0.993		
Within R <sup>2</sup>	0.586		
F(181, 3238)	2,431 (p=0.000)		
Durbin Watson	0.13		

Note: Constant ( $\beta_0$ ) and fixed effects omitted, \*\*\*=significant at 1%.

In running the regression, we assume that there is a long-term equilibrium relationship between GDP per capita and economic freedom. Because of this assumption, we do not control for serial correlation. Neither does the quality of the data allow for a panel co-integration test. An autoregressive model would also be problematic because of high collinearity between the lagged dependent variable GDP per capita, the overall score, and the fixed effects. Because of economic plausibility and data constraints, we therefore opt for a panel-fixed effects model.

Because we assume that there is a long-term equilibrium relationship between the overall score and GDP per capita, we estimate the time it takes to reach a new equilibrium from the following (panel fixed effects) error correction model:

$$d\_GDP\ per\ capita_i = \beta_0 + \beta_1 \times d\_Overall\ score_i + \alpha \times resid(-1)_i + u_i \quad (4)$$

where

$d$  = one-year difference

resid(-1) = one-year lag of residual from long-run equilibrium relationship in equation (3)

$\alpha$  = the absorptive capacity of a freedom shock in year  $t$

Table 2 summarizes the results from the error correction model. The coefficient of  $\alpha=-0.057$  suggests that roughly five percent of a freedom “shock” in year  $t$  are absorbed by year  $t+1$ . We therefore conclude (conservatively) that it takes approximately 20 years for a change in economic freedom today to become fully absorbed.

Table 2: Error Correction Model to Estimate Absorptive Capacity

	Coefficient	Standard Error	t-statistic
d_Overall Score	0.001**	0.000	2.011
$\alpha$	-0.057***	0.006	-9.789
Cross-Sectional Units	179		
Time Series Length (Min, Max)	2, 21		
n	3,277		
LSDV R2	0.204		
Within R2	0.031		
F(180, 3096)	4.396 (p=0.000)		
Durbin Watson	1.275		

Note: Constant ( $\beta_0$ ) and fixed effects omitted, \*\*\*=significant at 1%, \*\*=significant at 5%.

### 2.3. How the Simulation Works?

While the original freedom scores are continuous, the simulation input interface presents the user with actual performance values that are coded as very low, low, medium, high, and very high with the assigned scores 10, 30, 50, 70, and 90 respectively. The overall average may therefore deviate from the actual overall score, but allows for a simpler and more user-friendly interface. Instead of asking the user to choose a number between, theoretically, zero and hundred, we argue, that changing actual performance indicators in terms of qualitative categories is more intuitive. Every unit change causes the simulation graph to change. Yet, depending on the starting overall average score, it takes a different number of unit changes for a country to move up or down in category. For example, if a country finds itself with an overall average score at the upper limit of a certain category it takes less unit changes to move up and more unit changes to move down into the next category. We argue that such a set-up is meaningful because it is sensitive towards a country's actual economic freedom performance. Yet, however, it still provides an easy and intuitive user interface.