



ECONOMIC GROWTH, ECONOMIC FREEDOM, AND THE ELASTICITY OF SUBSTITUTION

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Abstract: There is convincing empirical evidence that economic freedom has a positive impact on economic growth. However, the transmission channels are still insufficiently uncovered. This paper makes an attempt to close this research gap. It therefore explores the role of a key parameter of the macroeconomic production function, the elasticity of substitution. Contrary to conventional wisdom, recent research has shown that the elasticity of substitution is theoretically positively related to economic growth, which has also been confirmed empirically. Therefore, this paper relates economic freedom to the elasticity of substitution. It can be shown that there is indeed a significantly positive relationship between the two variables. Free economic systems increase the flexibility of the macroeconomic production process and relax the growth limits originating from decreasing marginal products of factor inputs. However, not all areas of economic regulation have the same impact on the elasticity of substitution and thus on growth.

Keywords: Economic Growth, Economic Freedom, Property Rights, Production Function, Elasticity of Substitution

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1. INTRODUCTION

Economic Freedom as measured by the Economic Freedom Index (e. g. Gwartney et al., 2020) has proven an important and significant determinant of economic growth (Altman 2008; Lawson et al., 2020) as well as of subjective human well-being (Gehring, 2013). There is also evidence that the components (area ratings) of the Index (Size of Government, Legal System and Property Rights, Sound Money, Freedom to Trade Internationally, Regulation) exert an unequal impact on growth. Regulation, Sound

Money, and Freedom to Trade are of strong importance whereas a bigger government and a certain extent of labour market regulations seem to have less detrimental growth effects (Altman, 2008). Comprehensive research has also been conducted regarding the origins and determinants of economic freedom (Lawson et al., 2020).

This paper addresses another aspect of the economic freedom-growth nexus. We focus on the microeconomic concept of the production function and one of its key characteristics, the elasticity of substitution between the two production factors, capital and labor. This enables us to explore a specific channel that links economic freedom to production and growth.

2. PRODUCTION FUNCTIONS AND THE ELASTICITY OF SUBSTITUTION BETWEEN CAPITAL AND LABOR

It is well known that a production function relates output to a combination of factor inputs. Output (and inputs) can be firm-specific, but can also be interpreted as a macroeconomic relation that describes aggregate output, and aggregate output growth. One of the key characteristics of a production function is its elasticity of substitution which describes the ease of capital-labor substitution in the case of a factor price change. The elasticity of substitution (EOS) is defined as the percentage change of the capital-labor ratio in case of a one percent change of the wage-rental ratio. Microeconomic theory distinguishes several types of production functions, depending on the ease of factor substitution. The Leontief production function is a fixed proportions function that does not allow for factor substitution. Its capital-labor ratio is constant and the elasticity of substitution is zero. On the contrary, there is limited factor substitution in the case of the well-known Cobb-Douglas production function $q = K^\alpha \cdot L^\beta$ where q denotes output, and K resp. L are capital and labor input quantities. A Cobb-Douglas function is characterized by an EOS = 1. It is not possible to fully substitute one factor for another. A more general functional form is the CES (constant elasticity of substitution) function. The CES function includes the Leontief and Cobb-Douglas functions as special cases and is able to reproduce all possible substitution elasticities within the range of zero to infinite. The latter describes perfect substitutability and implies linear isoquants.

Cobb-Douglas and CES functions have been extensively used in theoretical models of economic growth. However, the EOS has rarely played a noteworthy role. Until the end of the 1980s it was commonly assumed, that the rate of output growth is unaffected by the EOS. This notion was later challenged when a modified ('normalized') version of the CES function was introduced (De la Grandville 1989; Klump and de la Grandville, 2000). Within the framework of this class of CES functions the authors demonstrated that the EOS is indeed positively related to growth. At any given rate of investment and other growth determinants (technical progress, population growth) a higher EOS causes faster growth because easier

capital-labour substitution relaxes the restriction of the diminishing marginal product of capital. This can be interpreted in the sense of an increased efficiency of the 'productive system' (De la Grandville 1989, 479). An increased EOS can also be interpreted in the sense of Schumpeter's dynamic entrepreneur who now faces 'greater possibilities for producing a given level of output with different factor combinations' (Yuhn 1991, 344).

3. ECONOMIC FREEDOM, INSTITUTIONS AND THE ELASTICITY OF SUBSTITUTION

In the narrower (microeconomic) sense the EOS is just a parameter of the production function (Tipper, 2012) but in the broader (macroeconomic) sense the EOS is determined by the economic system of a country and its institutions. These institutions critically affect the flexibility and efficiency of a country's system of production and exchange. Flexibility of relative (goods and factor) prices, the intensity of competition, openness to trade, property rights, regulation, and the role of the government (including the provision of social security) may play a crucial role as well as a functioning monetary system and stable prices (Klump, 1998; Knoblach and Stöckl, 2019).

So far, the relationship between these 'institutional components' and the EOS has not been explored empirically, though there are a few studies linking growth directly to the EOS. Yuhn (1991) compares South Korea to the US and concludes that higher growth in Korea corresponds to a significantly higher EOS. Mallick (2012) estimated macroeconomic EOS values for 90 countries and found a highly significant positive relationship between growth rates and the EOS.

The purpose of this paper is to evaluate how economic freedom and its institutional components affect the EOS. This makes it possible to identify the transmission channels that relate economic freedom to growth. We therefore use the Fraser Institute's Economic Freedom Index (EFI) and its area ratings

- Size of Government,
- Legal System and Property Rights,
- Sound Money,
- Freedom to Trade Internationally, and
- Regulation.

4. DATA AND EMPIRICAL ANALYSIS

Mallick (2012, 686) computed EOS values for 90 countries for the period 1950-2000 as 'period averages'. Mallick's list encompasses most of the countries for which the economic freedom index value is also available. We therefore have a large intersecting set of countries with a sample size of about $n = 75$. Depending on available data for the area ratings the sample size slightly differs. As the EOS is

estimated for the period 1950-2000, we first use the EFI overall and area ratings for 1975. However, as a few early area ratings are somewhat incomplete, we also employ the 1980 and 1985 EFI ratings. Though not perfectly 'periodcentered', the 1980 and 1985 economic freedom indices are certainly more reliable than the 1975 index. Another problem is the frequency distribution of Mallick's EOS estimates. Many of the sample countries exhibit very low elasticities which renders the frequency distribution extremely skewed. This was corrected by taking logarithms of the EOS. Contrary to the original values, the logged values are normally distributed, so are the EFI ratings.

The following table presents the results from a bivariate OLS estimation that relates the logarithm of the EOS to the summary EFI, and its component ratings. All regressions were checked for heteroskedasticity, functional misspecification and normally distributed residuals. Only in a few cases, a correction for heteroskedasticity had to be made (bracketed Newey-West t-stats).

Table 1: Regression results - Determinants of log(EOS)

<i>Independent Variable</i>		1975	1980	1985
Economic Freedom Summary Index	Coefficient	0.2192	0.2442	0.2796
	t-statistic	2.36**	2.86***	3.88***
	R-squared	0.0718	0.1020	0.1656
	n	75	76	78
Size of Government	Coefficient	-0.0250	0.0245	0.0886
	t-statistic	0.32	0.31	1.11
	R-squared	0.0014	0.0013	0.0159
	n	74	76	78
Legal System and Property Rights	Coefficient	0.1402	0.1311	0.1281
	t-statistic	2.26**	2.13**	2.27**
	R-squared	0.0662	0.0579	0.0634
	n	74	76	78
Sound Money	Coefficient	0.1083	0.0965	0.1347
	t-statistic	1.76*	1.73*	2.93***
	R-squared	(2.59**)	(2.61**)	(3.69***)
	n	74	76	78
Freedom to Trade Internationally	Coefficient	0.1073	0.1276	0.1493
	t-statistic	2.31**	3.25***	3.99***
	R-squared	0.0716	0.1276	0.1792
	n	71	74	75
Regulation	Coefficient	0.1513	0.1578	0.2364
	t-statistic	1.41	1.62	2.80***
	R-squared	0.0286	0.0346	0.0958
	n	70	75	76

*, **, *** indicate statistical significance at the 10/5/1 percent level

n = sample size

In the majority of cases there is a statistically significant positive relationship between the EOS and the EFI rankings. As all EFI values are measured on a scale ranging from 0 to 10 there is no need for standardization and the coefficients can be compared directly. The results indicate a strong and significant impact of overall economic freedom on the elasticity of substitution. In general, coefficients and levels of significance increase in the later samples as data coverage becomes more complete.

With respect to the component ratings there are some interesting findings. First, the government size component is consistently insignificant. Bigger governments seemingly do not reduce the flexibility of factor allocation. This finding confirms the results of Altman (2008) who estimated the growth effect directly. An instructive example are two Nordic welfare states with a high government expenditure ratio. Sweden and Norway show remarkably high EOS values (1.19; 0.76) that exceed even the US value (0.63). The 'Legal System and Property Rights' component is also significant. This may be explained by the variable as a prerequisite for doing business and engaging in long term investment projects. The importance of 'Sound Money' is quite trivial. Inflation and inflation variability are likely to distort price signals and thus disturb factor allocation. Excess growth of money supply does not only reduce the EOS but is also responsible for a lower capital-labor ratio (Klump, 2003).

Freedom to Trade is also a strong determinant of the EOS. But the impact of trade on the flexibility of allocation is less straightforward. First, increased competition through imports will make domestic goods production more efficient and is likely to reduce market power, thus leading to lower costs and prices. But this is an argument that is only indirectly related to the allocation of production factors. A direct effect has been formulated by Ventura (1997). Ventura assumes that a final good is produced with two intermediate goods as inputs using a CES production function. The first intermediate is produced with capital alone whereas the second only uses labor as an input. If both goods are traded internationally and domestic and foreign inputs are substitutes, the production technology of the final good can be expressed as a CES function with capital and labor as inputs. In this case, capital and labor are perfect substitutes with an EOS approaching infinity (Knoblauch and Stöckl, 2019). A second argument for greater allocative efficiency through trade is related to an easier technology transfer. Empirical evidence fully supports these hypotheses.

The area 'Regulation' shows mixed results. In the 1975 and 1980 samples, regulation surprisingly does not play a significant role whereas in the 1985 sample it does. This needs further exploration. The most likely explanation is data availability. Whereas in the areas 'Government', 'Money', and 'Trade' data availability for the sub-indicators is generally good, this is not the case in the areas

'Regulation' and 'Legal System'. In most countries, even in many high-income countries there is a lot of missing data for the sub-indices, implying that the 1975 and 1980 area ratings are only crude approximations of the real (but unknown) area ratings. Data coverage continuously improves since 1985 but using later EFI values would not be representative for the EOS estimation period (1950 to 2000). Looking at the 1985 estimates, we can conclude that there is a significant and quite large effect of regulations. This should not be surprising since factor market regulations directly affect the allocation of capital and labor.

5. AREAS OF REGULATION

The area 'Regulation' has three sub-areas, 'Credit Market Regulations', 'Labor Market Regulations', and 'Business Regulations'. The latter refers to the goods market. We shall now concentrate on the credit and the labor market regulations and estimate their specific impact on the EOS. The statistical analysis is based on the 1985 sample, due to less complete data coverage in the 1980 und 1975 rankings. For the capital market regulation sub-area there is an intersecting sample (with EOS and regulation data available) of $n = 75$. The sample covers a wide income range from very poor to very rich countries. However, for the labor market regulation sub-area, data availability is poor. There is concurrent EOS and labor market regulation data only for 19 high income countries, making statistical inference quite speculative. Regressing the log of EOS against the sub-area regulations gives the following results.

Table 2: Regression results - Determinants of log (EOS)

<i>Independent Variable</i>		<i>1985</i>
Capital Market Regulation	Coefficient	0.1209
	t-statistic	3.00***
	R-squared	0.1096
	N	75
Labor Market Regulation	Coefficient	0.0993
	t-statistic	1.00
	R-squared	0.0559
	N	19

*, **, *** indicate statistical significance at the 10/5/1 percent level

Capital market regulation proves a highly significant determinant of the EOS. The coefficient is smaller than the coefficient of overall regulation (0.2175), which is plausible. Surprisingly, labor market regulation is not significant though its coefficient has the expected sign. Because of the small sample size, we cannot

draw a definitive conclusion about the role of labor market regulations. Recent editions of the Economic Freedom Report have expanded the country coverage but there is currently no estimate for the EOS later than 1950 to 2000 that could be combined with the more recent economic freedom indices.

Finally, we compare the EOS-related effects of economic freedom to the overall growth effects as reported by Altman (2008) for the period 1990 to 2004.

Table 3: EOS and Growth

<i>Dependent Variable</i>	<i>EOS (rank) [Rs_q]</i>	<i>growth (rank) [Rs_q]</i>
Independent Variable (coefficient)		
Economic Freedom Index	0.2615 (1) [0.15]	0.8612 (1) [0.36]
Size of Government	0.1049 (5) [0.03]	0.0843 (6) [0.05]
Legal System	0.0983 (6) [0.04]	0.4767 (5) [0.35]
Sound Money	0.1347 (4) [0.10]	0.5485 (3) [0.34]
Freedom to Trade	0.1364 (3) [0.15]	0.7082 (2) [0.33]
Regulation	0.2175 (2) [0.08]	0.5155 (4) [0.22]
Labor Market Regulation	not signif. [0.06]	not signif. [0.03]

The coefficients cannot be compared directly because of the different magnitude of the dependent variable, but the partial impact rankings can. The coefficients of determination should also be broadly comparable, although the sample sizes are different.

A few similarities and differences are remarkable.

1. The overall impact of economic freedom is larger than the component effects. This points to the importance of a comprehensively free economic system and indicates that economic liberalization should be pursued in all sub-areas.
2. The EFI impact on the EOS is smaller than on growth. This is not surprising, as economic freedom theoretically can have an impact on growth via three channels. The first is the elasticity of substitution channel as discussed above. The second is the factor accumulation channel, in particular the investment-to-GDP ratio (Corbi, 2007), and the third is the external effects channel (Bittner, 2001).
3. Regarding the EOS as well as growth, the most important transmission channels of economic freedom are present in the 'trade', 'sound money', and 'capital market regulation' areas. This indicates that a significant fraction of the overall growth promoting effect of economic freedom is indeed caused by an increased flexibility of the production process.

6. CONCLUSION

This paper makes a first attempt to explore the relationship between economic freedom and growth using a mediating factor, the elasticity of substitution between capital and labor. This microeconomic concept describes the ease of factor substitution and is theoretically positively related to growth because a higher elasticity of substitution relaxes the growth-retarding effect of diminishing returns of capital. However, no study exists that links economic freedom to the elasticity of substitution. So far, empirical studies have directly related economic freedom to growth without being able to identify the transmission channels. This paper goes one step ahead. Several institutional factors relevant for the economic freedom to growth nexus are identified. It can be shown that sound money, freedom to trade and capital market regulation are the most important factors that determine the elasticity of substitution as an engine of growth.

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