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Looking for causality of economic freedom and income

Six pairs of kernel regressions: (E_1, y), (E_2, y), (E_3, y), (E_4, y), (E_5, y), (E, y)

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This note looks at the causality between E, the Fraser Institute economic freedom index, and y, income. We consider six E variables: the 5 areas of the index, E_1 to E_5 and the composite E. As usual, causality to income is debated – it is studied by the pairs of a and b graphs on Figure 1 to 6.

The a graphs: E ➔ y. The Fraser Institute (and many others) is into *political advice.* Countries are urged to make reforms giving more economic freedom in order to become wealthier. Consequently, the Fraser group see political decisions as exogenous causing income.

The b graphs: y ➔ E. *Transition theory* claims that in the long run most institutional indices change in a parallel way as a function of income, *ibid* (see references). Thus, much that in the short run looks exogenous is endogenous in the longer run. The analysis uses kernel regressions on unified panel data, which is a technique that reveals common long run trends in the data for country groups.

Table 1. The seven variables and their sources

Variable		Source
E_1	*size*	size of the public sector and the tax burden
E_2	*legal*	quality of legal sector, property rights security, gender adjustment
E_3	*money*	inflation and regulation of banking sector
E_4	*trade*	foreign trade and regulation of foreign exchange, black market rate
E_5	*regulation*	regulation of domestic trade, production, and labor market
E	*total*	economic freedom. Composite index. From the Fraser Institute https://www.fraserinstitute.org
y	*income*	ln gdp that is real GDP per capita. From the Maddison Project https://www.ggdc.net/maddison/maddison-project/home.htm

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Table 2. Descriptive statistics for the seven series analyzed

Variable		Obs	Mean	Std. dev.	Min	Max	Range
E_1	size	4,052	6.558	1.359	0.164	9.556	9.392
E_2	legal	4,150	5.141	1.891	1.050	9.460	8.411
E_3	money	4,023	7.436	1.920	0.000	9.910	9.910
E_4	trade	3,633	6.970	1.670	0.000	9.978	9.978
E_5	regulation	4,050	6.273	1.381	0.559	9.419	8.860
E	total	3,932	6.487	1.220	1.830	9.280	7.450
y	income	3,975	8.926	1.225	5.934	11.389	5.455

The analysis compares pairs of kernel regressions between the six *E*-variables and income. The data is the unbalanced, unified sample of all 3,600 observations for the *E* variables supplemented with income data from the Maddison project:[2] They are listed in Table 1. It is some of the variables used in Paldam and Saardaoui (2026), from now *ibid*.

Kernel regressions on unified data is a method for revealing common long run trends in cross-country data sets as explained in Paldam (2021 and 2024). The kernel regression that explains x by y is written $x = K^x(y, bw)$, where bw is the bandwidth. K^x is a smooth function of bw, so it is normally easy to find the best bw. The program (lpoly in stata) starts by a good estimate.

Kernel regressions require large datasets, so the panels are unified by stacking. One variable is thus one column. The elements in the columns are in the same order. Each kernel regression orders the two columns analyzed by the explanatory variable. The (x, y) vector can be analyzed by two kernel regressions: $x = K^x(y, bw)$ sorting the (x, y) vector by y, while $y = K^y(x, bw)$ sorts the vector by x. The two kernel curves differ due to the sorting. Kernels provide no R^2-scores, but a graph. We use the **R-ratio** to measure how much the range of the curve – indicated vertical arrow at the right-hand side of the graph – explains of the range of the data from Table 2.

Unified data is a mixture of time series and cross-country data. Panel regressions with and without fixed effects show that most of the explanatory power of the analysis is due to the cross-country element. The equivalence hypothesis from transition theory claims that wide cross-country data represents the long run, so that they tell the same story as long time-series, *ibid*.

Kernel pairs may provide causal evidence. If one of the two kernel curves looks as predicted by a theory, it is evidence for that theory, and hence for the causality it implies. It is

[2] OPEC countries are deleted from the sample as they have a different pattern analyzed elsewhere, *ibid.*

strong evidence if the reverse kernel does not look like anything predicted by a theory. It is also possible that both curves in the pair look equally good – this suggests simultaneity. When the correlation between the variables is high there is always some reflection of the best of the two kernel curves on the other.

Tables 3a and 3b give Pearson and Spearman correlations. They are so similar that the distributions of the variables will be disregarded from now.

Table 3a. Pearson correlations between the variables

	E_1 size	E_2 legal	E_3 money	E_4 trade	E_5 regulat.	E total	y income
E_1 size	1						
E_2 legal	-0.095	1					
E_3 money	0.073	0.529	1				
E_4 trade	0.083	0.656	0.681	1			
E_5 regulation	0.114	0.734	0.569	0.710	1		
E total	0.251	0.805	0.819	0.884	0.859	1	
y income	-0.047	0.824	0.549	0.686	0.674	0.748	1

Table 3b. Spearman correlations between the variables

	E_1 size	E_2 legal	E_3 money	E_4 trade	E_5 regulat.	E total	y income
E_1 size	1						
E_2 legal	-0.214	1					
E_3 money	0.003	0.602	1				
E_4 trade	0.014	0.744	0.759	1			
E_5 regulation	-0.006	0.804	0.657	0.758	1		
E total	0.120	0.832	0.848	0.911	0.883	1	
y income	-0.206	0.859	0.667	0.771	0.745	0.808	1

Table 4. A factor analysis of the 7 variables, N = 3,424

	Factor1	Factor2	Factor3
Eigenvalue	4.657	1.161	0.472
Cumulative	0.692	0.864	0.934
Variable	Factor loadings		
E_1 size	0.012	0.974	0.196
E_2 legal	0.879	-0.310	0.281
E_3 money	0.807	0.141	-0.537
E_4 trade	0.887	0.134	-0.090
E_5 regulation	0.902	0.027	0.222
E total	0.983	0.180	-0.012
y income	0.815	-0.212	0.093

The correlation matrices show the well-known result that four variables E_2-E_5 are strongly correlated with each other and (hence) to the total E index. They are also strongly correlated to income. The first area E_1 is largely independent of the other six variables. This is confirmed by Table 4 giving a factor analysis. The total E index loads very strongly to all other components than E_1.

1. E_1, size (of government), r(E_1, y) = -0.05

Figure 1a. $y(E_1)$.
y income explained by
E_1, size.
R-ratio: 1.5/5.5 = 0.27

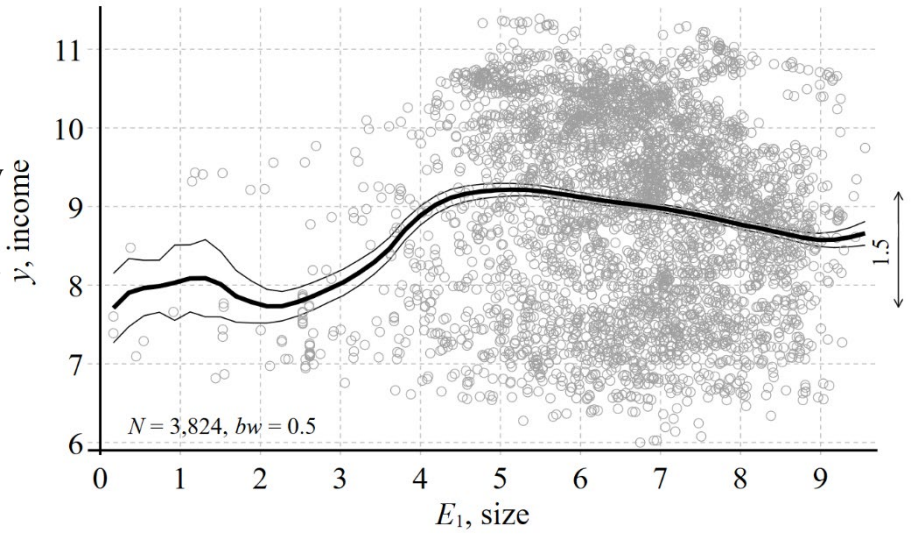
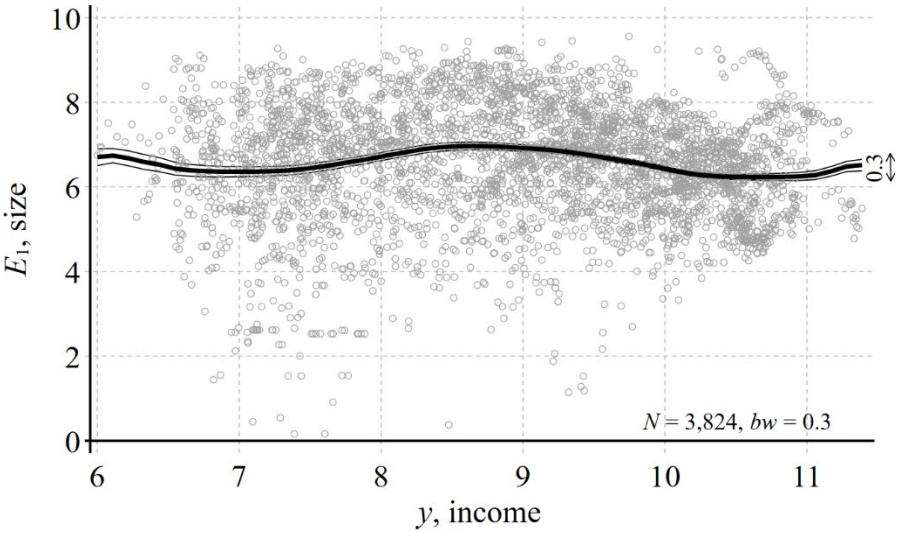


Figure 1b. $E_1(y)$.
E_1 size explained by
y, income.
R-ratio: 0.3/9.4 = 0.03



The pair of kernel regressions confirm that E_1 is largely independent of income. E_1 has a small relation to income in Figure 1a, and income does not explain E_1 in Figure 1b.

Figure 1a show some fluctuations of the kernel curve at low values of the E_1 index, where the data are thin. And a small negative slope of y(E_1) from E_1 in [5, 9] where the data are adequate. However, it is clear that the points distribution is wide here. Thus, the negative slope is hard to believe.

Figure 1b is the closest to a straight horizontal line as any of the 12 kernel lines found in this note.

2. E_2 legal (quality), r(E_2, y) = 0.82

Figure 2a. $y(E_2)$.
y income explained by
E_2 legal.
R-ratio: 3.2/5.5 = 0.58

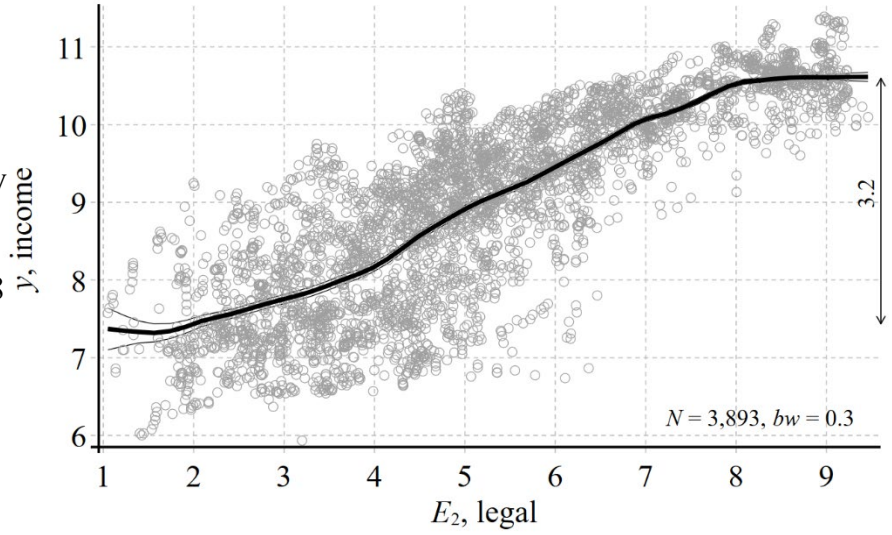
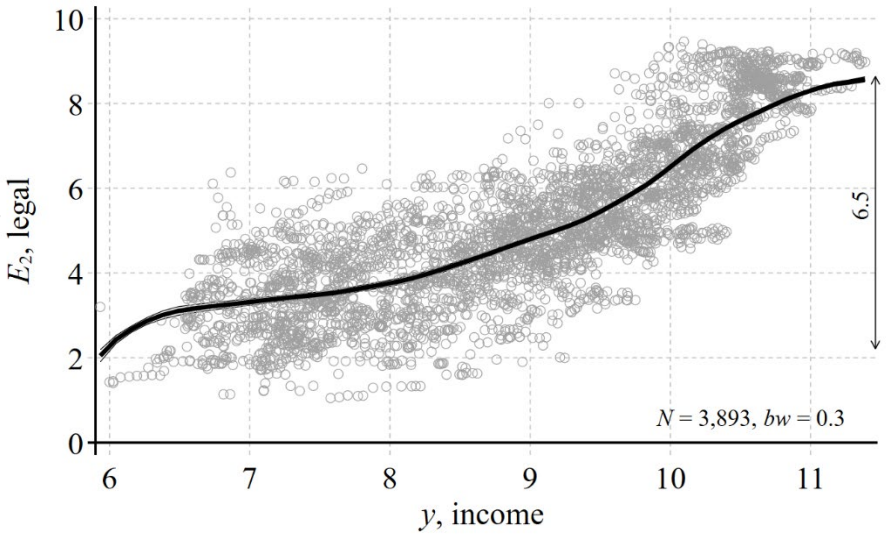


Figure 2b. $E_2(y)$.
E_2 legal explained by
y income.
R-ratio: 6.5/8.4 = 0.77



The quality of the legal system is strongly connected to economic development, but the two graphs look almost equally good, as is likely to be the case when r = 0.82. We have to conclude that the two variables are almost simultaneous.

Perhaps Figure 2a is slightly inferior to Figure 2b, where the curve is smoother, and Ratio is higher, but these points for 2a are not strong. Still, the conclusion is that income is a bit better at explaining legal quality than vice versa. From other work (ibid) we know that state capture, democracy and corruption have very similar transitions. With less authoritarian regimes, less corruption, and less collusion of business and political leaders, the legal system can surely work better. Thus, it is arguable that the quality of the legal system has a substantial endogenous element.

3. E_3 money (sound), r(E_3, y) = 0.55

Figure 3a. $y(E_3)$.
y income explained by
E_3 money.
R-ratio: 2.2/5.5 = 0.40

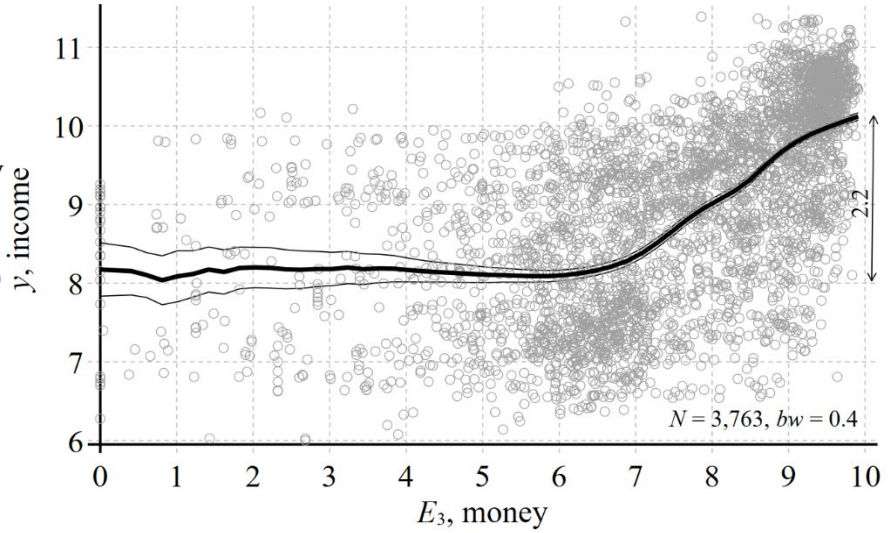
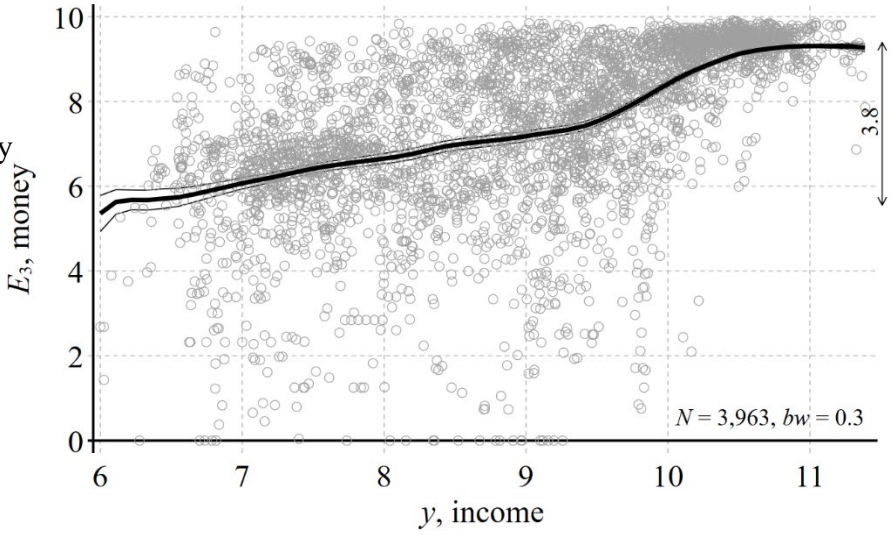


Figure 3b. $E_3(y)$.
E_3 money explained by
y income.
R-ratio: 3.8/9.9 = 0.38



The main factor giving low values for sound money is inflation. We may read the E_3-axis as an indicator of high to low inflation. Sound money is also substantially related to income, but here Figure 3a looks better than Figure 3b.

Figure 3a is difficult to explain as it is constant all the way from E_3 in [0, 6.5]. This is strange as it indicates that high inflation is not more harmful than very high inflation. As we shall see it is part of a pattern.

Figure 3b says that wealthy countries have better control over the monetary control and (herby) less inflation. High income countries have relatively high capital stocks and thus the population resists inflation more. This is likely to explain the nice positively sloped curve on Figure 3a.

4. E_4 trade (international), r(E_4, y) = 0.69

Figure 4a. $y(E_4)$.
y income explained by
E_4 trade.
R-ratio: 2.8/5.5 = 0.51

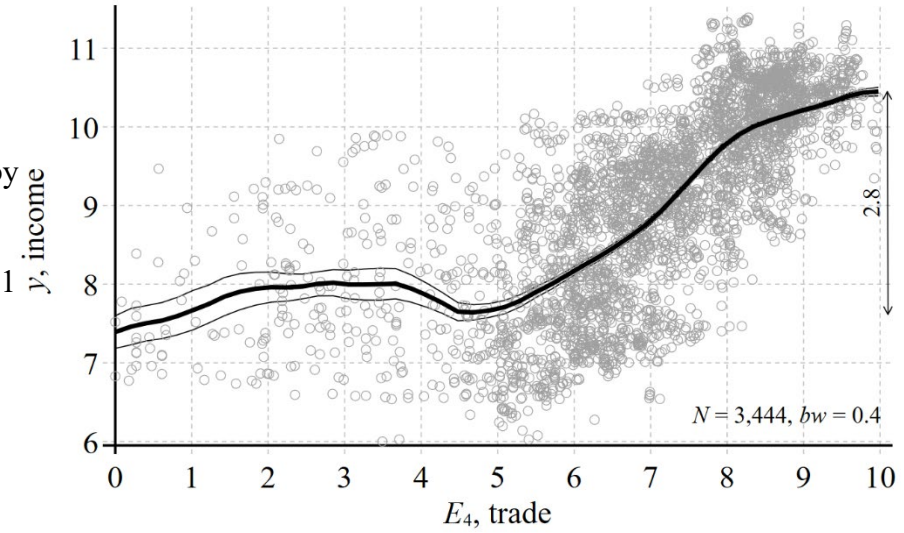


Figure 4b. $E_4(y)$.
E_4 trade explained by
y income.
R-ratio: 3.4/10.0 = 0.34

Four a-figures: Figure 4a like Figures 3a, Figure 5a, and Figure 6a has a long flat section for E4 = [0. 5] where it should be particularly steep. This is taken as a weakness of the a-graphs.

However, the b figures in the four cases make sense. They are all rather smooth and have the same slope throughout. However, the R-ratio is not larger in most cases.

Thus, the causality implication of the two graphs is that the b-graph is better, and thus that the causality from y to the E-variable explains better.

5. E_5, regulation, r(E_5, y) = 0.67

Figure 5a. $y(E_5)$.
y income explained by E_5 regulation.
R-ratio: 2.7/5.5 = 0.49

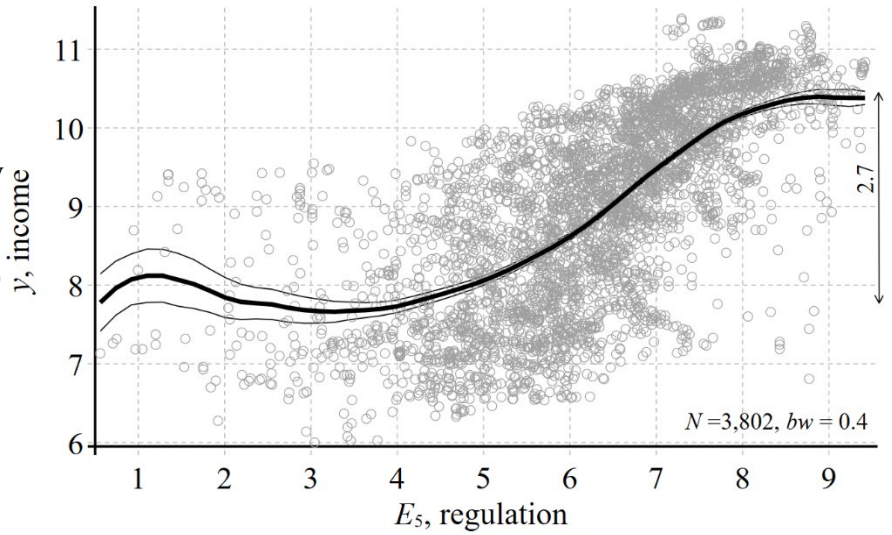


Figure 5b. $E_5(y)$.
E_5 regulations explained by y income.
R-ratio: 3.8/7.5 = 0.51

The regulation area of the index is quite complex. The comparison of the two graphs is much like the one of E_4. It appears that income is a little better at explaining regulation than vice versa.

6. *E*, total (composite index), r(*E*, *y*) = 0.75

Figure 6a. *y*(*E*)
y income explained
by *E* total
R-ratio: 3.1/5.5 = 0.56

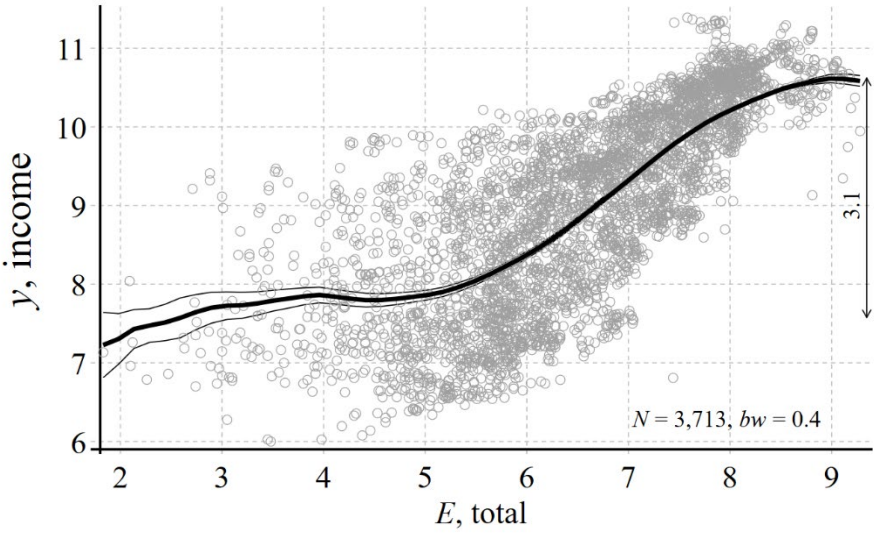
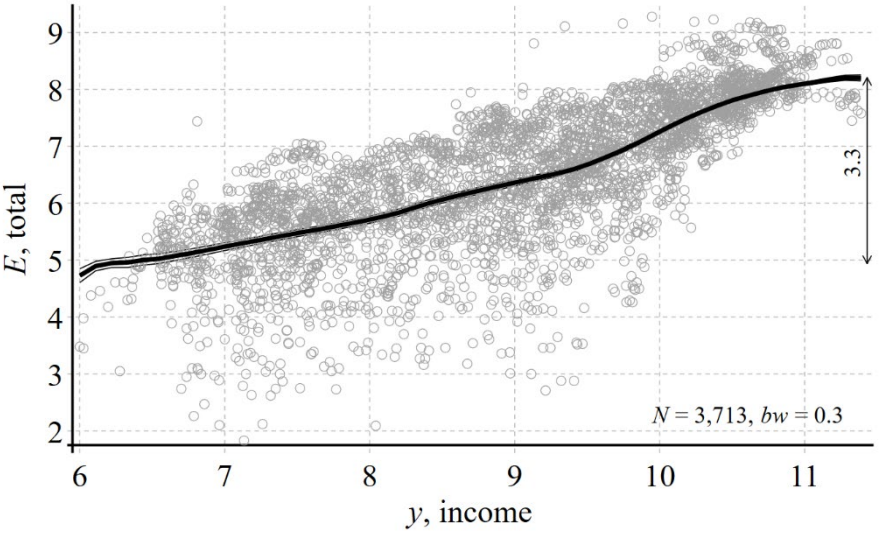


Figure 6b. *E*(*y*).
E total explained by
y income.
R-ratio: 3.3/7.5 = 0.44



The analysis of the five components of the economic freedom index predicts the analysis of the composite index unsurprising.

Figure 6a has a long flat part at low half of the index. I.e. for *E* in [2, 5] there is no effect on income, while *y* causes *E* to rise throughout.

7. Conclusions

The purpose of this note is to see if kernel regressions of pairs with the reverse order of the two variables give causal evidence. The causal evidence is weak, the pairs of variables seems to have a great deal of simultaneity. But if we have to choose, it appears that the main causal direction is from income to the *E*-variables.

References: (MP is Martin Paldam, JS is Jamel Saadaoui

The introduction is based on MP (2021 and 2024). OPEC countries are analyzed in MP and JS (2025 and 2026).

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MP, JS, 2026. The grand pattern in the triplet of political capitalism, state capture and crony capitalism. Pt. available at http://www: martin.paldam/GT-Main2

Note that *ibid* refers to MP (2021, 2024) and MP and JS (2025)