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ECONOMETRIC ANALYSIS OF IMPACT OF RELATIVE LOCATION ON THE GROWTH EFFECTS OF ECONOMIC INTEGRATION. THE CASE OF THE EU

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Econometric Analysis of Impact of Relative Location on the Growth Effects of Economic Integration. The case of the EU

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Abstract:

In the paper we construct two novel indices of relative centrality – peripheriality in order to test whether location has an impact on medium and long-run growth rates of the European Union Member States. We utilize two popular econometric approaches – standard cross-sectional growth regressions as well as dynamic panel data models. The study is undertaken for 27 developed economies (15 EU Member States and 12 non-members) within a period 1960 to 1999. In accordance with the new economic geography models (NEG) our results indicate that relative location within large regional integration arrangement such as the European Union could at least to some extent affect growth effects associated with the process of economic integration. Furthermore, the benefits are found to be asymmetrical between the core and peripheral states. These results, however, need further empirical investigation as they are found to be rather sensitive.

Keywords: economic growth, European economic integration, dynamic panel data models, system GMM estimator, new economic geography

JEL codes: F15, O53, C23

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Introduction

There exists a common belief that economic integration even limited regionally is likely to bring about significant benefits both in the short, medium and in the long-run. The benefits related to economic integration should translate in the long-run into a significant increase in general level of welfare as measured by the real gross domestic product per capita[1]. It is worth to note however that the new growth theory allows not only for the so-called level effects but for permanent shifts in growth rates that could not have been accommodated within the neoclassical growth framework. There exists a substantial theoretical literature dealing with potential growth effects of regional as well as global economic integration. An extensive overview of this literature gives a rather blurred picture – despite commonly accepted beliefs, the growth benefits stemming from economic integration are not unconditional. Various modeling approaches lead to conflicting results and there is no agreement not only on significance or direction but as well on the mere existence of the growth effect of economic integration[2].

Within the literature we have to note a particularly interesting area of theoretical modeling that simultaneously deal with (and determine) economic growth and location in space – this models link new economic growth theory with Krugman's (1991) new economic geography. This approach generates far more realistic outcomes in particular for analyzing long-term consequences of economic integration within a large and heterogeneous regional economic arrangement such as the European Union. For instance a model by Baldwin and Forslid (2000) allows for both positive and/or negative impact on growth rates to occur at the same time. The effects could be asymmetric in nature and thus differ between core states (or region) and peripheral regions in particular if they the integrating block is internally heterogeneous. Depending on specific characteristics of a given regional integration arrangement economic integration could have negative, positive or neutral impact on long-term as well as medium-term growth rates (Brodzicki 2005).

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[1] Real GDP per capita can only be understood as a very rough proxy of general welfare (Helpman 2004).

[2] The models include for instance Baldwin (1989 and 1992), Baldwin and Forslid (2000), Bretscheger and Steger (2004), Deardorff and Stern (2002), Devreux and Lapham (1994), Haveman et al. (2001), Krugman and Venables (1993), Mazumdar (1996), Rivera-Batiz and Romer (1991, 1994), Waltz (1997a, 1997b, 1998), Willenbockel (1998 and 2001).

Looking at some of the facts, we have to note that during last for decades Member States of the European Union had rather varied experience with economic growth. The average rate of growth of real GDP per capita for EU Members States within the period 1960-1999 amounted to 2.8 per cent (the principal source of data is the Heston et al. (2002) data set - Penn World Table PWT 6.1). In the period 1960-1999 among the Member States the United Kingdom and Sweden had the slowest pace of growth (2.01 and 2.05 per cent on average) followed by Denmark (2.13 per cent) and the Netherlands (2.35 per cent). The group of fast growing economies consisted of Ireland (3.85 per cent on average) and Portugal (3.76 per cent), Spain (3.32 per cent) and Luxembourg (3.16 per cent)[3]. All in all we observe clear signs of absolute convergence taking place at the level of Member States which translates into catching-up by initially less wealthy economies. However, at the same time we have to note following Puga (2001) that despite large regional policy expenditures, regional inequalities in Europe have not narrowed substantially but even widened. Income differences across States have fallen, but inequalities between regions within each State have risen. This raises a major issue of effectiveness or even of necessity of current equalization-oriented structural policy of the European Union. The policy sets itself a goal of increasing internal economic, social and spatial cohesion within the Union. Its long-run effectiveness depends to a large extent on the ability to affect the actual growth dynamics of various regions with a core-peripheries divide playing a crucial role.

Several empirical studies on the impact of economic integration on growth in general and of integration within the EU in particular have been conducted so far. The studies have utilized various econometric approaches. These have included: time-series analysis (e.g. Landau 1995, Vanhoudt 1999), standard growth regressions (e.g. Henrekson et al. 1996), static panel data models (e.g. Torstensson 1999, Brodzicki 2003) as well as dynamic panel data models (e.g. Badinger 2001). Potential growth effects have been analyzed both directly and indirectly through investigation of potential linking channels. As in the case of theoretical modeling, results of empirical studies conducted to date are rather inconclusive. Some studies point to existence of positive and statistically significant long-term effect of membership in the European Union either

[3] For several reasons Luxembourg should be treated as an outlier – it had the highest initial level of GDP per capita and had one of the highest average rates of subsequent growth in real GDP per capita.

of direct or more frequently of indirect nature (two-chain effect, for instance Henrekson et al. 1996, Italianer 1994, Torstensson 1999). However at the same time results of other studies speak against existence of significant (permanent) growth effects related to the membership in the EU (for instance Landau 1995, Badinger 2001, Vanhoudt 1999). Some of the studies however identify important level effects (for instance the aforementioned study of Badinger 2001). An overview of empirical literature allow us to conclude that results are sensitive and seem to depend largely on: the sample, methodological approach followed or adopted (cross-section analysis – standard growth regressions, time series analysis, data panel models) as well as to selection of explanatory variables and relations between them, the way in which the integration enters the specification as well as the fact whether the basis principles of the econometric methodology are respected and the account is taken of their limits.

A major drawback of existing empirical literature is the fact that to our knowledge none of the empirical studies conducted so far tried to investigate whether location affects benefits associated with membership. The present paper is meant to fill in this gap. In order to do so we first construct a relative centrality-peripheriality index and than augment with it standard growth regressions utilizing both a standard and a more elaborated econometric approach.

This short empirical paper is organized as follows. The following section presents the indices of relative centrality and peripheriality. The next section sets the indices within cross-sectional growth regression in order to identify potential long-term effects of location on growth. The effects of relativity and centrality are further analyzed in a dynamic panel data setting in the subsequent sections. The final section concludes.

Centrality – peripheriality indices

In order to assess the potential impact of location within a regional economic block on the growth experience of its member states we have to, at a first step, construct an index of centrality-peripheriality that could be further utilized in empirical investigation. The index should reflect relative location of an economy in relation to all the other states in the European Union. It should take into account not only geographic measure of distance (in kilometers) but the scale of economy measured for instance (and preferably) by its gross domestic product[4]. Furthermore, in the construction of an index we have to remember that due to consecutive enlargements of the integrating block of countries the relative location of all states in terms of their centrality/peripheriality within the regional economic arrangement has steadily evolved. The geographic distance between any pair of countries measured in kilometers does not change. Geographic distance between two countries is calculated as the shortest distance between their capital cities measured in kilometers using the „as the crow flies" approach (Cieślik and Ryan 2004). In order to show the impact of economic integration and the expansion of the block the actual geographic distance is modified by an arbitrarily set index of economic integration $\psi_{x\_y,t}$ that decreases the distance by 25 per cent when the two countries form an FTA with or within the EU. Thus $\psi_{x\_y,t}$ takes value of 1 if there is no form of economic integration within or with the EU and 0,75 when there is at least an FTA (we take into account FTAs of the EU with third parties as well as more advanced stages of economic integration for instance within the European Economic Area). The modified distance is calculated for each pair of countries on an annual basis. Then a relative centrality-peripheriality of a given country is measured as a geometric average of integration-adjusted distances from all analyzed countries (including those from outside of the European Union).

The fall in distance is meant to show a general fall in transport and transaction costs in general due to economic integration (this is similar to iceberg costs approach utilized frequently in theoretical literature).

As we are interested in relative measure of centrality or peripheriality we take into account the scale of the economy – in other words the higher the scale of an economy as measured by GDP the more central and less peripheral it is. In other words economic potential measured by real GDP ($GDP_{x,t}$) partially reduces the importance of central or peripheral location in relation to the EU.

Following the above assumptions two indices are constructed: ICP(1) and ICP (2). ICP(1) puts more emphasis on effects of economic integration while ICP(2) puts more emphasis on the scale of the local economy. The exact mathematical formulas are given below:

[4] Another possibility would be to utilize gross domestic product per square kilometer.

[1] $$ICP_{x,t}(1) = \frac{GDP_{x,t}}{(g.av(d_{x,y} \cdot \psi_{x\_y,t}))^4}$$

[2] $$ICP_{x,t}(2) = \frac{GDP_{x,t}}{(g.av(d_{x,y} \cdot \psi_{x\_y,t}))^2}$$

Both indices take the lowest value for small (in terms of GDP size) and peripherally located economies (for instance Greece) and have largest values for large and centrally located economies. As indices are measured on a annual basis each enlargement causes a sudden shift in their values (this occurred as well as an outcome of German unification). Starting from initial EC-6 each consecutive enlargement led to a fall in an average real GDP per capita. The enlargements themselves differed significantly (please refer to Table 1).

In the subsequent analysis we use long-term averages for the period 1960-1999 of the indices ICP (1) and ICP (2) (variables EU_CP1 and EU_CP2) in the cross-sectional analysis and average values of indices of relative centrality-peripheriality ICP (1) and ICP (2) within each of the eight 5yr long subperiods (EU_CP1AV and EU_CP2AV) in the estimation of dynamic data panel models.

Cross-sectional analysis

We commence econometric analysis by estimating a set of standard growth regressions within a cross-sectional setting with the use of standard ordinary least squares estimator. The sample includes 27 advanced countries – 15 member states of the European Union and 12 advanced economies constituting a reference group (in the majority - OECD member states). The period under analysis stretches from 1960 to 1999. The variables enter regression as long-term averages, initial or final values. In order to be comparable with existing studies we utilized a standard set of explanatory variables: lagged value of GDP per capita, investment rate, government spending in relation to GDP, the openness ratio (total trade to GDP – broad liberalization proxy), rate of growth of population and a human capital proxy – log of the average years of schooling. The basic specification in the cross-sectional analysis has been extended by a dummy-variable for the USA that clearly improved a general fit (the USA economy could be considered as a leading global economy with significantly different set of variables determining its growth rates).

The OLS estimates are given in Table 3. In columns P1 to P5 we steadily extend the basic specification. It is worth to note that apart for government spending in relation to GDP all variables seem to have statistically significant impact on the dependant variable (long-term growth rate of real GDP per capita). In columns P6 and P7 this specification has been further extended by addition of variables in interest to us in this particular research paper. Unfortunately, despite their negative sign the coefficients next to both of variables are statistically insignificant (below 10 per cent level) so we cannot draw any sound conclusions. We have to stress that this result holds even if adjustments are made to a set of explanatory variables. The relative location within or in relation to the economic integration arrangement of the European Union does not seem to have a significant impact on long-term growth performance.

The results are thus discouraging and are not in line with postulates of models incorporating new economic geography framework along the core-peripheries divide. The outcome could however be at least partially blame on the econometric methodology. The OLS estimates are severely biased due to the dynamic nature of the growth process. According to Ciecieląg and Tomaszewski (2003) panel data models bring a number of benefits in an econometric estimation of a model in comparison to standard growth regressions approach. Furthermore, the model itself should be dynamic as the relative centrality and peripheriality steadily evolved. Therefore, in order to obtain more accurate results we construct dynamic panel data models and estimate them using more elaborated econometric methodology. Bond, Hoeffler and Temple (2001) proposed to use within this setting a more informative set of instruments provided within the framework of the system GMM estimator developed by Arellano and Bover (1995) and Blundell and Bond (1998). Following their recommendations we have decided to utilize this estimation technique in the current analysis (system GMM estimator is available in STATA's xtabond2 module).

Dynamic data panel models

Dynamic panel data models are considered to constitute a principal tool of empirical analysis in this paper. The sample includes the same 27 advanced countries as described in the previous section. The period under analysis has been divided into eight consecutive subperiods of 5 years each (1960-1964, 1965-1969, 1970-1974, 1975-

1979, 1980-1984, 1985-1989, 1990-1994 and finally 1995-1999)[5]. It gives in total a balanced data set of 216 observations. The use of a two-step system GMM estimator, considered to give unbiased estimates in dynamic data panel setting (Bond et al.), limits the total number of observations for each economy to 7. This gives the total data set of 189 observations.

We first begin by estimation of the basis specification of the model (results are given in Table 4). In columns 1 to 5 the basic specification is gradually extended through addition of consecutive explanatory variables. We have to point out that at least at the 5 percent level of significance, all explanatory variables, apart from the rate of growth of population (N), have statistically significant influence on the growth rate of real GDP per capita. At the same time some of them display unexpected signs. This applies in particular to a human capital proxy – (LNAYS). It is worth to note that consecutive extensions to the basic specification lower the coefficient on lagged GDP per capita level – this implies a higher rate of conditional convergence when more structural variables are included. Coefficient on lagged GDP per capita is statistically significant at 1 per cent level and the variable seems not to be sensitive to changes in the set of explanatory variables. In all cases the impact of the investment rate on growth is statistically significant at the 1 per cent and the coefficient is estimated at 0.9. The impact of government spending as share of GDP (GOV) on growth in models S2 do S4 is statistically significant and as expected the coefficient has a negative sign. Greater openness of an economy as measured by the openness ratio (OPEN – value of trade to country's GDP) seems to improve the long-term rate of growth.

Having obtained the extended basic specification we are ready to further augment it by inclusion of variables of interest to us. Their construction – inclusion of the level of GDP, necessitates a number of tests in order to determine their character in the estimated models. The tests indicate that EU_CP1AV as well as EU_CP2AV should be treated as predetermined and not as endogenous. In columns 6 and 7 an adjusted basic specification has been extended by inclusion EU_CP1AV. We must stress once again that this index gives a greater role to economic integration in relation to the scale of the domestic market. The results are rather inconclusive. In the first case despite a positive sign of the coefficient lack of statistical significance represented by low t-statistics does

[5] This allows for inclusion of human capital proxy – natural logarithm from mean years of schooling, which is given in intervals of 5 years, taken from Barro and Lee (2001).

not allow us to formulate any conclusions on the obtained results. When the openness ratio (OPEN) is included, the level of statistical significance of the specification as given by the F test rises, however, coefficients on variables OPEN and LNAYS are not statistically significant. In this setting the impact of the relative centrality-peripheriality on growth is statistically significant at 1 per cent level and the coefficient points to a negative impact of relative centrality within the European Union. This negative effect is the highest for centrally located and/or large Member States: Germany, France, Great Britain, the Netherlands, Italy and Belgium. With an exception of Switzerland, Norway, Turkey and the USA the effect of relative centrality – peripheriality is marginal for the rest of the economies of the reference group. Among the EU economies it is the smallest for small economies located in the peripheries – Ireland, Greece and Portugal. The results seem to be biased by the fact that most cohesion economies (also at the regional level) in the EU are located in its peripheries – these in turn obtain most of structural funding.

In the next three columns the estimations are repeated with the EU_CP2AV. Once again we have to stress that its construction reduces the role of relative centrality-peripheriality. The value of the variable reflects mainly the scale of a domestic economy and marginalizes the role of location within or in relation to the EU. In all three specifications the coefficients next to the variable of interest to us have a positive sign and are statistically significant at least at the 10 per cent level thus showing a positive and statistically significant impact of the variable on the growth rate of real GDP per capita. We have to note that models in columns 8 and 10 take into consideration the impact of human capital. Model in column 8, however, omits the potential impact of general openness of an economy measured by relation of total foreign trade to GDP.

In comparison to a cross-sectional analysis carried out in preceding section an analysis of dynamic data panel models has proven that relative centrality-peripheriality of an economy within an integrating block can, at least to a certain extent, affect its growth rate. In other words there exists at least partial empirical support for the theoretical hypotheses based on a new generation of models that location can affect the growth effects related to economic integration.

Conclusions

The objective of this paper was to assess whether relative location had an impact on the growth effects related to regional economic integration within the European Union. A positive answer to that question could be considered as a proof of a new generation of models linking endogenous growth and the so-called new economic geography.

The results are rather inconclusive. The cross-sectional analysis of growth regressions does not bring an answer as the coefficients on the variables of interest to us are statistically insignificant. The use of a more elaborated methodology – estimation of dynamic data panel models with the use of a two-step system GMM estimator, brings some statistically significant support for the hypothesis set out in the beginning of the paper. We must stress however, that despite some support for endogenous growth and new economic geography theories in that location within the EU (relative centrality-peripheriality) could impact the growth performance of individual economies, results are sensitive and thus should be treated with caution. This could be partially related to the problem of omitted variables – further extensions are thus necessary.

Future extensions could incorporate larger and more detailed samples – preferably at a regional – at least NUTS-2 level, as the scale of national economies varies greatly between the EU15. In the future the new MS should be considered. It would be also beneficial to further test the sensitivity of the obtained results to changes in the set of explanatory variables as well as to the set of the benchmark group. It seems plausible that the obtained results to a large extent are related to the construction of the relative centrality-peripheriality indices. It would be interesting and worthwhile to construct and test variables based only on purely exogenous determinants such as geographic distance in contrast to the variables constructed in the present study – simultaneously taking into account both the size of the economy and its integration-adjusted distance to other states.

Moreover, in the future the analysis should address the policy and could potentially be extended to judge on the quality of structural policies. This would require introduction of additional variables depicting the scale as well as structure of inflow of structural spending from the common budget. This could be given by intensity of structural funding to real GDP in general or depending on the type of spending – directed at development of infrastructure or accumulation of human capital.

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Table 1 Economic effects of consecutive enlargements of the EU

		I enlargement (1973)	II enlargement (1981)	III enlargement (1986)	IV enlargement (1995)
Population (in mln)	before	193.7	263.1	274.9	351.3
	after	258.0	272.8	323.4	400.5
	change (per cent)	+ 33.2%	+ 3.7%	+ 17.7%	+14.0%
Real GDP (in billions of USD)	before	2 703	4 134	4 701	6 088
	after	3 577	4 246	5 264	6 857
	change (per cent)	+ 32.4%	+ 2.7%	+12.0%	+ 12. 6%
Average real GDP per capita (pre accession =100)	before	100	100	100	100
	after	99.4	99.0	95.2	98.8
	change (per cent)	- 0.6%	- 1.0%	- 4.8%	-1.2%

Source: Own calculations based on PWT 6.1 and PWT 5.2.

Table 2 OLS estimates of long-run growth regressions for the whole sample of 27 states

	(P1)	(P2)	(P3)	(P4)	(P5)	(P6)	(P7)
Stała: C	0.094 (5.76)***	0.094 (5.62)***	0.109 (7.40)***	0.127 (9.31)***	0.155 (9.60)***	0.157 (9.52)***	0.156 (9.43)***
lny0	-0.01 (-5.58)***	-0.01 (-5.45)***	-0.012 (-7.32)***	-0.014 (-9.25)***	-0.018 (-8.91)***	-0.018 (-8.84)***	-0.018 (-8.76)***
INV	0.0086 (2.78)***	0.007 (2.73)**	0.008 (3.74)***	0.007 (3.81)***	0.005 (3.00)***	0.005 (2.86)***	0.005 (2.85)***
GOV		0.00009 -0.052	0.0008 (-0.58)	0.0004 -0.34	-0.0003 (-0.27)	-0.0002 (-0.20)	-0.0003 (-0.22)
N				-0.356 (-3.12)***	-0.334 (-3.32)***	-0.360 (-3.35)***	-0.355 (-3.24)***
OPENK			0.0007 (2.93)***	0.0006 (3.13)***	0.0007 (3.71)***	0.0006 (3.48)***	0.0006 (3.42)***
lnAYS					0.006 (2.62)**	0.006 (2.67)**	0.006 (2.62)**
USAD			0.012 (3.13)***	0.012 (3.13)***	0.011 (3.23)***	0.011 (3.04)***	0.011 (3.16)***
EU_CP1						-0.0088 (-0.75)	
EU_CP2							-0.0029 (-0.55)
R^2	0.610	0.610	0.749	0.831	0.876	0.880	0.878
R^2^	0.577	0.559	0.689	0.780	0.830	0.826	0.824
SE	0.0048	0.0049	0.0041	0.0034	0.0030	0.0031	0.0031
F	18.75	11.98	12.52	16.4	19.15	16.44	16.17
DW	2.33	2.34	1.94	2.1	1.69	1.74	1.72

Source: Own calculations. Estimations carried out in Microfit within the framework of a research grant BW no. 3480-5-0296-4. Comments:

a) Value of t-statistic in brackets.
b) Number of observations – 27
c) Significant at *** - 1 per cent. ** - 5 per cent. * - 10 per cent level of significance.
d) SE – standard errors.
e) Test F for statistical significance of specification.
f) In all cases the residual is spherical.
g) DW – value of DW test.

Table 3 Two-step system GMM estimation's results of dynamic data panel models

	1	2	3	4	5	6	7	8	9	10
LNGDP	-0.0985 (-49.04)***	-0.0926 (40.69)***	-0.0919 (46.65)***	-0.1006 (47.79)***	-0.1120 (-77.76)***	-0.1104 (-71.72)***	-0.0979 (-57.77)***	-0.1081 (-71.96)***	-0.0957 (-62.07)***	-0.1409 (-65.92)***
INV	0.0095 (6.03)***	0.0091 (4.90)***	0.0094 (6.15)***	0.0085 (5.90)***	0.0094 (11.28)***	0.0084 (7.71)***	0.0083 (6.34)***	0.0088 (8.08)***	0.0089 (7.13)***	0.0079 (7.31)***
GOV		-0.0042 (-2.29)**	-0.0031 (-2.76)***	-0.0017 (-1.99)**	-0.0005 (-0.71)	-0.0004 (-0.42)	-0.0015 (-1.07)	-0.0002 (-0.23)	-0.0011 (-0.77)	0.0008 (0.78)
OPENK			0.0002 (1.65)*	0.0004 (-2.53)**	0.0005 (3.49)***		0.0002 (0.71)		0.0001 (0.35)	0.0008 (4.72)***
N				0.4418 (-0.49)	-0.2091 (-0.30)					
LNAYS					-0.0652 (-2.84)***	-0.0370 (-2.24)**	-0.0397 (-1.58)	-0.0414 (-2.59)***		-0.1373 (-8.01)***
EU_CP1AV						0.1079 (1.34)	-0.2598 (-3.04)***			
EU_CP2AV								0.0691 (1.90)*	0.1148 (3.04)***	0.1079 (2.93)***
F test	5189.4	6020.1	3494.6	965.7	3065.57	10907.5	28033.1	7272.2	10301.9	21215.6
Hansen's test	26.42	26.53	26.11	24.54	24.82	25.83	12.73	26.23	22.78	15.61
AB test for AR(1)	0.007	0.007	0.007	0.004	0.006	0.006	0.007	0.006	0.007	0.007
AB test for AR(2)	0.234	0.300	0.282	0.262	0.237	0.249	0.249	0.247	0.264	0.240

Source: Own calculations. Estimations carried out by Maria Blangiewicz in STATA with the use of xtabond2 module within of the research grant BW no. 3480-5-0296-4.
Comments:

a) Value of t-statistic in brackets. In accordance with procedure proposed by Arellano and Bond t-statistics were calculated as a division of coefficients obtained from two-step system GMM estimation by mean errors of estimation of the same model estimated with one-step system GMM estimator.
b) Number of observations – 189; depending on model the number of degrees of freedom varies from 182 to 187.
c) Significant at *** - 1 per cent. ** - 5 per cent. * - 10 per cent level of significance.
d) In a dynamic setting the dependent variable is not the growth rate of real GDP per capita but the level of real GDP per capita. One of the explanatory variables is its lagged value. In order to obtain the convergence parameter we need to subtract one from the coefficient on lagged GDP per capita.
e) Test F for statistical significance of specification.
f) Hansen test of over-identifying restrictions.
g) Arellano-Bond test for first and second order autoregression; Prob values given.

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