# DOES TRADE INTEGRATION LEAD TO BUSINESS CYCLE CONVERGENCE?

by

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**Title of Project** *Does Trade Integration Lead To Business Cycle Convergence?*

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# ABSTRACT

Using the Optimum Currency Area (OCA) criteria and historical data to judge the suitability of a country for joining a monetary union has been a common practice in recent years. Yet, it is far from clear whether these criteria aren't instead endogenous, i.e. OCA criteria are attained *ex post*, rather than *ex ante*. This study argues that more trade intensity, which would result from a monetary union, is likely to bring business cycle convergence and thus it is misleading to judge the suitability of a country for a monetary union based on historical, ex ante correlations of output fluctuations.

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# DEDICATION

**To my wife Tsvety,** for standing beside me no matter what and for heroically putting up with an enthusiastic economist.

**To my parents,** for the unconditional belief and support that they have given me throughout the years.

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# I. Introduction

On January 1st, 1999 eleven European countries[1] irrevocably fixed their exchange rates and thus created a single European currency – the euro. Despite the controversy over whether Western Europe constitutes an Optimum Currency Area (OCA) according to Mundell's criteria (Mundell, 1961), and is thus suitable for adopting a common currency, the euro is already a reality, and only the future and the political will of the member countries will reveal whether it is a viable alternative for Europe or not.

These OCA criteria, later refined by McKinnon (1963) and Kenen (1969), are widely used to determine whether a country is suitable for a monetary union or not. The logic goes like this: if a country is small, relatively open to trade, possesses flexible (especially downwards) wages and prices, mobile labor and capital, fiscal transfers, experiences similar business cycles with its partners and responds similarly to external shocks, then it is more likely to gain from a monetary unification. Hence, if empirical research shows that a country has a certain level of fulfillment of those criteria, then the conclusion is that the country should adopt a common currency and if not, then the country is unsuitable for the currency area. In general, each potential member of a currency union should weigh both the economic and political advantages and disadvantages of joining.

[1] Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Spain. Greece joined on January 1, 2001. See http://www.xe.com/euro.htm.

In the context of the European Monetary Union (EMU) the biggest controversy revolves around the issue of whether Great Britain should join or not. Applying the OCA criteria reveals that Britain would gain from the lower transaction costs associated with the common currency (Buiter et al., 2000), but it is equally, if not more, likely to lose, because of its need for different interest rates to smooth output fluctuations (Minford, 2002).

In brief, countries with more trade linkages and more synchronized business cycles are more suitable for a monetary union, *ceteris paribus*, as they will gain from reduced transaction costs, but will not suffer unemployment because of different business cycles (and the same interest rates). Nevertheless, all of the above reasoning collapses if we apply the famous "Lucas Critique" (Lucas, 1976), which postulates that, in our case, the suitability of a country for a monetary union cannot be judged based on historical data, as its trade linkages and business cycle synchronization are likely to change dramatically once it becomes part of the monetary union. This means that these two OCA criteria are endogenous, i.e. the suitability of a country for a common currency area is determined *ex post*, rather than *ex ante*. In other words, we should not worry a lot whether countries have intense trade linkages and synchronized business cycles, because once they join together, the monetary union itself might eventually cause higher trade intensity and business cycle synchronization.

Theoretically, closer trade resulting from a monetary union[2] can either cause closer business cycles or lead to a more divergent output fluctuations. Thus, it remains an empirical issue to verify whether participation in a monetary

[2] See Rose (2000).

union will cause more intra-industry trade and closer business cycles or whether it will lead to more inter-industry trade, to more specialization and thus, to more divergent cycles.

This study argues that more trade intensity, which would result from a monetary union, is likely to bring business cycle convergence and thus it is misleading to judge the suitability of a country for a monetary union based on historical, ex ante correlations of output fluctuations. Section II briefly reviews the theoretical framework of the issue, section III gives a background on the empirical evidence, section IV describes the data and methodology used to analyze the problem, section V presents the results and implications, section VI presents suggestions for further research and sensitivity analysis and finally, section VII summarizes and concludes.

# II. Theoretical literature review

The OCA criteria (Mundell, 1961, McKinnon, 1963, Kenen, 1969) are still at the base of any discussion regarding monetary unions. These criteria involve:

1. Small countries that are
2. Open to trade and have
3. Flexible internal wages and prices
4. Mobile factors of production (both capital and labor)
5. Fiscal transfer system
6. Diversified exports
7. Synchronized business cycles
8. Similar response to exogenous shocks

The logic is as follows: Consider the real exchange rate relationship that postulates that

$$q = \frac{EP}{P^*}$$

where q is the real exchange rate of the domestic currency, measured in units of foreign currency per unit of domestic currency, E is the nominal exchange rate, measured in units of foreign currency per unit of domestic currency, P is the domestic price level and P* is the foreign price level.

A small and open economy is a price taker; exogenous shocks to P* will feed into the domestic price level, P, because of the larger share of traded goods and services, and it will not need nominal exchange rate adjustment in order to nullify the effect of a change in P* on its real exchange rate, q. Its real exchange rate will not depend on nominal exchange rate adjustment, thus it will gain from the fixed nominal exchange rate, E, of the monetary union, as all the adjustment will take place through the prices (Lafrance and St.-Amant, 1999). Also, the more open the economy, the greater the gains from transaction costs elimination. Flexible wages and prices, mobile factors of production and the availability of fiscal transfers are needed to counter the impact of an asymmetric shock once it occurs, and diversified exports, synchronized business cycles and similar response to exogenous shocks will insure that even if the country is subjected to an asymmetric shock it responds well in the absence of flexible wages, mobile factors of production and fiscal transfers.

The focus of this study, without denying the importance of the other criteria, is on the endogeneity of the second and seventh criterion, as they are (arguably) the most important ones, at least as far as British participation in the euro is concerned (Minford, 2002).

In theory, higher trade integration from a monetary union can result in more divergent business cycles (Krugman 1993). The reason is that reduced transaction costs would lead to increased competition and country specialization in whatever industry it has a comparative advantage. Thus, France will specialize, say, in wine production, while Germany – in car production. An

adverse shock to the car industry will cause unemployment in Germany without affecting France too much, thus the monetary union between them will result in divergent business cycles, requiring different interest rates. Germany will need an expansion of the money supply and lowering of the interest rate in order to stimulate the economy and counter the negative shock. For France, however, a lower interest rate will tend to overheat the economy and produce inflation. Thus, a monetary union and a single interest rate will be more costly for countries with such specialization.

On the other hand, the European Commission (European Commission, 1990) argues that a monetary union will result in more intra-industry trade, thus a shock to the common industry is likely to affect both countries the same way, and thus the trade integration will cause business cycle convergence. Also, the argument goes, it is not necessary that the specialization respect national borders. For example, an industry might occupy the North of Italy and the South of France, so that a shock will affect both countries, and thus lead to synchronized business cycles. The issue therefore is not theoretically clear-cut and calls for an empirical investigation.

# III. Empirical literature review

There are many studies investigating the nature of output correlations: Cohen and Wyplosz (1989) examine the correlation of output between France and Germany and Weber (1991) examines this correlation for other European countries; Bayoumi and Eichengreen (1993a,b) use a VAR to distinguish between demand and supply shocks to output. They combine the results to justify the suitability of a particular country to join a currency union; De Grauwe and Venhaverbeke (1993) find that asymmetric shocks are more common on a regional than on a national level. This supports the proposition that a monetary union is not likely to be costly in terms of de-synchronizing business cycles; Artis and Zhang (1995) find that in the period 1961-1979 most EU countries' output was correlated with the US, but since the European Monetary System (EMS) they were more correlated to Germany, which suggests that a monetary union indeed leads to output correlation; Canova and Delas (1993) find a positive relationship between bilateral trade and output correlation, but the results are sensitive to the de-trending method used; Ricci (1997) finds that a monetary union will cause industrial dispersion, which supports Krugman's view of specialization that leads to divergent business cycles; Imbs (1999) argues that GDP co-fluctuations are caused by sectorial similarity. Brulhart (2000) reports an incompatibility of literature results: studies using trade data find rising intra-

industry trade and thus lack of specialization and output divergence; those based on production data point out to increased specialization (the above is a review by Frankel and Rose, 1997 and Brulhart, 2000).

In brief, most studies do not attempt to endogenize the income correlation and are thus subject to the "Lucas Critique". There is no empirically clear-cut and undisputed answer to whether trade integration leads to more synchronized business cycles. The paper I am basing my study on is by Frankel and Rose (1997), who find a strong positive correlation between trade intensity and output correlation, although their work has been criticized based on omitted variables bias (Brulhart, 2000).

# IV. Data and methodology

In this section I provide some empirical evidence on the relationship between trade intensity and business cycle synchronization, based on the study by Frankel and Rose (1997).

We have two main variables of interest: the real economic activity correlation between two countries over a time period and the average trade intensity between them over the time period. Let me first define the real economic activity correlation. Following Frankel and Rose (1997) I use as a proxy for real activity correlation the real GDP (in million of 1996 US dollars) correlation between country i and country j for the period 1988-1997. I use a panel of yearly data[3] for ten industrialized countries[4] for ten years. Half of the countries became members of the EMU from 1999 and half of them did not. The period chosen does not include 1999 and after as to avoid any influence of the EMU to get into the sample. I get forty-five observations overall, {[(10*10-10)]/2}, reflecting each pair of countries' real GDP correlation (i.e. Australia/Belgium, Australia/Canada, Australia/France and so on). Frankel and Rose (1997) use four different measures for real economic activity, as it is difficult to justify

[3] The data come from the Groningen Growth and Development Centre at http://www.eco.rug.nl/ggdc/index-dseries.html.
[4] Australia, Belgium, Canada, France, Germany (West Germany data before 1990), Italy, Japan, Spain, UK, and US.

theoretically one, which is the best. They find that the results do not depend on the measure chosen, but using different measures is a possible field for further research, as discussed in section VI. The data are transformed in two ways: first I take a natural logarithm of each of the ten countries' observations and second, I de-trend the variable in order to remove the time trend. Frankel and Rose (1997) again use four different de-trending measures to check for robustness, but I confine myself to only one de-trending method - a simple first-differencing. After the transformation we are ready to take the bilateral real GDP correlation over the sample period 1988-1997. Thus, I obtain forty-five observations.

The other main variable is trade intensity. While Frankel and Rose use, again, two different measures for trade intensity, for robustness purposes, they find no influence of the measure used on the results. I use the measure that involves scaling bilateral trade by total trade, instead of by nominal GDP. In other words, the measure used is

$$\mathbf{Trade_{i,j}=(X_{i,j}+M_{i,j})/(X_i+X_j+M_i+M_j)} \qquad \mathbf{(1)}$$

where $Trade_{i,j}$ is the trade intensity concept between country i and j, $X_{i,j}$ is the simple (equal weighted) average (for 10 years) of total nominal commodity exports from country i to country j, $X_i$ is the average (for 10 years) of global nominal exports for country i, M is imports. Thus, higher values of Trade imply higher trade intensity between the two countries. The data[5] cover the ten

[5] The source is: http://dc1.chass.utoronto.ca/trade/world/worlde.html through the SFU library for the bilateral exports and imports and http://dc1.chass.utoronto.ca/cgi-

countries over ten years (same sample period), where the average over the ten-year period is taken. In practice the natural logarithm of Trade is taken. All the measures are in million of nominal US dollars.

The estimated regression therefore becomes:

$$\mathbf{Corrgdp}_{i,j} = \alpha + \beta \mathbf{lnTrade}_{i,j} + \varepsilon_{i,j} \qquad (2)$$

where $Corrgdp_{i,j}$ is the correlation between the natural logarithm of the de-trended real GDP for country i and country j over the period 1988-1997 (forty five observations overall), $lnTrade_{i,j}$ is the natural logarithm of the Trade concept developed earlier and $\varepsilon_{i,j}$ is the error term that captures all other factors (except bilateral trade activity) that influence the real activity correlations, i.e. variability of exchange rates, monetary regime employed, etc.

The parameter of interest is both the sign and size of the $\beta$ coefficient. A positive and economically significant coefficient would mean that higher trade intensity leads to real activity convergence, or, a negative coefficient will mean that the "specialization effect" dominates.

An OLS regression run on (2) is likely to bring biased results, however. Countries tend to link their currencies to their most important trade partners in order to collect the gains from a more stable exchange rate. Thus, adopting the monetary policy of the trade partner is likely to cause closer fluctuation in both income and trade. In other words, common monetary policy (like the European

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bin/imf/ifslookup?DBTYPE=ifs&Topic=542716&query=Lookup+Series for the total exports and imports of commodities.

Monetary System (EMS)) is likely to cause both increased trade intensity and closely correlated business cycles. Therefore, the exchange rate stability, which is part of the error term in (2) is likely to be correlated with the independent variable, the trade intensity, which will create biased coefficients (Frankel and Rose, 1997).

To estimate an unbiased coefficient, therefore, we need to find an exogenous instrument, as highly correlated with the trade intensity concept as possible, and uncorrelated with the error term. The possible candidates for instrumental variables come from the well-known gravity equation (as discussed in Frankel and Rose, 1997) and include: the natural logarithm of the distance[6] between the capitals of two countries and the existence of a common (land) border between the two countries in question (Frankel and Rose use a common language dummy variable as well, but this one turns out not to be significant in my specification, probably because of the smaller sample). While both of these variables are expected to be correlated with trade intensity, it cannot be reasonably expected that they are affected by other factors such as exchange rate stability for example. Thus, at least on theoretical grounds we have two candidates for instrumental variables.

Frankel and Rose (1997) note that the estimation of the standard error of $\beta$ is potentially complicated because our observations can be correlated, so that for example, the French-German observation for trade intensity might be correlated with the French-Belgian, and thus the error term will have non-spherical

[6] Data from http://www.indo.com/distance/

variance-covariance matrix. They ignore such correlations and instead try not to take their precise size too seriously.

# V. Tests and results

First, I use the Hausman Test to test for exogeneity of the trade variable. It is theoretically hypothesized that it should be endogenous, i.e. correlated with the error term, but we need an empirical test. The underlying idea of the Hausman test is to compare two sets of estimates, one of which (the IV estimation) is consistent under both the null (the variable is exogenous) and the alternative (the variable is endogenous) and another that is consistent only under the null hypothesis (the OLS estimation). A large difference between the two sets of estimates is taken as evidence in favor of the alternative hypothesis. We conduct the test by running an auxiliary regression. To carry out the Hausman test by artificial regression, we run two OLS regressions. In the first regression, we regress the suspect variable lnTrade on all instruments and retrieve the residuals. Then in the second regression, we re-estimate (2) including the residuals from the first regression as additional regressor (Eviews Help Menu). The result is:

**Table 1: Hausman Test for Exogeneity**

| ***Dependent Variable: CORRDGDP*** | | | | |
|---|---|---|---|---|
| **White Heteroskedasticity-Consistent Standard Errors & Covariance** | | | | |
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| LNTRADE | 0.179975 | 0.056286 | 3.197499 | 0.0026 |
| **RES_LNTRADE** | **-0.304638** | 0.074433 | -4.092784 | **0.0002** |

| | | | | |
|---|---|---|---|---|
| C | 2.499365 | 0.653574 | 3.824150 | 0.0004 |
| R-squared | 0.214241 | Mean dependent var | | 0.358091 |
| Adjusted R-squared | 0.176824 | S.D. dependent var | | 0.452564 |
| S.E. of regression | 0.410607 | Akaike info criterion | | 1.121979 |
| Sum squared resid | 7.081115 | Schwarz criterion | | 1.242423 |
| Log likelihood | -22.24453 | F-statistic | | 5.725740 |
| Durbin-Watson stat | 2.137808 | Prob(F-statistic) | | 0.006325 |

If the OLS estimates are consistent, then the coefficient on the first stage residuals should not be significantly different from zero. In this case it is significantly different from zero (p-value=0.0002), thus we conclude that OLS is inconsistent and the variable is endogenous, just as theoretically hypothesized. Thus, we have to use the IV estimation procedure to obtain a consistent estimate of the coefficient of interest, $\beta$.

We then need to test whether the (natural logarithm of) distance between countries' capitals, the dummy for a common border and the dummy for common language are suitable as instrumental variables. Thus we run (OLS) the trade variable (in natural logarithm form) on these three variables and get the following result:

**Table 2: Instrumental Variable Test I**

| ***Dependent Variable: LNTRADE*** | | | | |
|---|---|---|---|---|
| ***White Heteroskedasticity-Consistent Standard Errors & Covariance*** | | | | |
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| LNDIS | -0.475503 | 0.155442 | -3.059040 | 0.0039 |
| BORDER | 1.131428 | 0.394225 | 2.870003 | 0.0065 |

| | | | | |
|---|---|---|---|---|
| **LANGUAGE** | **-0.078413** | 0.359078 | -0.218373 | **0.8282** |
| C | -8.113169 | 1.268443 | -6.396161 | 0.0000 |
| R-squared | 0.411332 | Mean dependent var | | -11.89763 |
| Adjusted R-squared | **0.368259** | S.D. dependent var | | 1.397633 |
| S.E. of regression | 1.110869 | Akaike info criterion | | 3.132849 |
| Sum squared resid | 50.59520 | Schwarz criterion | | 3.293441 |
| Log likelihood | -66.48910 | F-statistic | | 9.549585 |
| Durbin-Watson stat | 1.174041 | Prob(F-statistic) | | 0.000066 |

The dummy for language is not only highly insignificant (p-value=. 8282), but it has the "wrong" sign, implying that the presence of common language will decrease the trade between two countries, which is counter-intuitive. This "wrong" sign could be caused by an omitted variable or a small sample size, but I decide to remove it from estimation as the R squared adjusted for a regression without the language dummy increases (see Eviews output below). Otherwise, the other two instruments are significant and have the expected signs – negative for distance and positive for common border. Thus, removing the dummy for language we get the following:

**Table 3: Instrumental Variable Test II**

| ***Dependent Variable: LNTRADE*** | | | | |
|---|---|---|---|---|
| **White Heteroskedasticity-Consistent Standard Errors & Covariance** | | | | |
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| **LNDIS** | **-0.479621** | 0.147786 | -3.245371 | **0.0023** |
| **BORDER** | **1.115394** | 0.372191 | 2.996834 | **0.0046** |
| C | -8.092191 | 1.228290 | -6.588177 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.410830 | Mean dependent var | -11.89763 |
| Adjusted R-squared | **0.382774** | S.D. dependent var | 1.397633 |
| S.E. of regression | 1.098032 | Akaike info criterion | 3.089257 |
| Sum squared resid | 50.63833 | Schwarz criterion | 3.209701 |
| Log likelihood | -66.50828 | F-statistic | 14.64337 |
| Durbin-Watson stat | 1.152732 | Prob(F-statistic) | 0.000015 |

The adjusted R squared from the regression without the dummy for common language increases, thus we decide to use only the two instruments in estimating the β coefficient. The evidence suggests that they are correlated with the trade variable (R squared=. 410830), just what we require for the IV estimation procedure. The coefficients obtained by Frankel and Rose for ***Indis*** and ***border,*** respectively, are: -.45 (standard error=. 03) and 1.03 (standard error=. 14). My estimates are comparable with naturally higher standard errors, as my sample size is smaller

Now we are ready to estimate (2) using Two-Stage Least Squares (2SLS):

**Table 4: Regression Estimation**

| ***Dependent Variable: CORRDGDP*** | | | | |
|---|---|---|---|---|
| **White Heteroskedasticity-Consistent Standard Errors & Covariance** | | | | |
| **Instrument list: BORDER LNDIS** | | | | |
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| **LNTRADE** | **0.179975** | 0.073244 | 2.457184 | **0.0181** |
| C | 2.499365 | 0.853188 | 2.929443 | 0.0054 |
| R-squared | -0.307236 | Mean dependent var | | 0.358091 |
| Adjusted R-squared | -0.337637 | S.D. dependent var | | 0.452564 |

| | | | | |
|---|---|---|---|---|
| S.E. of regression | 0.523418 | Sum squared resid | | 11.78057 |
| F-statistic | 4.174715 | Durbin-Watson stat | | 1.962976 |
| Prob(F-statistic) | 0.047190 | | | |

The coefficient on lnTrade is positive and statistically significant (p-value=. 0181). We can conclude that, based on our data and estimation, an increase in the trade between two countries is likely to bring their business cycles in line. Thus, even if a country experiences different business cycles *ex ante*, this should not prevent the country from joining a monetary union, as the union itself is likely to cause higher synchronization in output fluctuations, and thus reduce the costs of the monetary union. The coefficient is not only significant, but relatively sizeable as well – an increase of Trade by one percent will increase output correlation by approximately .18. Hence, if a common currency leads to more trade, it should also help to integrate business cycles. In that sense these two OCA criteria would be endogenous. The result is comparable to Frankel and Rose's results.

# VI. Suggestions for further research and sensitivity analysis

Before bragging about the discovery of America, however, we need to make sure our results are robust (so that we know for sure that we discovered America, and not, for example, India, as history teaches us Columbus thought he did). The positive coefficient on trade intensity might as well be an outcome of the specific sample used, or the specific measure of trade intensity or output correlation, or the sprecific de-trending method employed. Frankel and Rose (1997) perform a number of different tests for sensitivity and conclude that the results are indeed robust. I hereby review some of those tests as suggestions for future elaboration of my study.

As mentioned above, Frankel and Rose use two different proxies for trade intensity, four different measures of real activity, four different de-trending procedures and four equally sized sample periods for twenty-one industrialized countries. Thus, they have sixteen versions of the dependent variable (four real activity concepts and four de-trending procedures) and two versions of the independent variable (two versions of the trade intensity concept) and estimate thirty-two versions of the regression to check for robustness. Their conclusion is that the positive and significant coefficient on $\beta$ is not affected by these differences and thus the result is robust.

Extending the list of possible instruments to include country membership is the General Agreement on Tariffs' and Trade (GATT) or any regional bilateral fixed exchange rate regime, like the EMR, does not change the results Frankel and Rose (1997) obtain. Nor does adding country population and output. The coefficient on $\beta$ is positive and significant whether or not trade intensity is transformed by taking natural logarithms and whether or not the observations are weighted by country's size. Neither are the results sensitive to the particular sample chosen. The exact choice of countries does not matter – Frankel and Rose (1997) find that using only European data does not alter the outcome. Adding either period-specific or country-specific (or both) fixed effects delivers similar results. The regression is augmented by adding a dummy for whether countries shared a bilateral fixed exchange rate throughout the sample, as Bayoumi and Eichngreen (1993a) argue that tight income correlations are a result not from intensified trade but from the presence of fixed exchange rate. The addition of this dummy variable in equation (2) does not have a significant effect on the size and the sign of $\beta$, nor does it seem to be significant itself (Frankel and Rose, 1997).

# VII. Summary and conclusions

In this study we examine whether increased trade integration causes business cycle synchronization. Theoretically there is not a clear-cut answer to this issue – trade integration can lead to either closer business cycle convergence via more intra-industry trade or to more divergent output co-fluctuations as more trade encourages specialization. We find empirical evidence that supports the former view. Assuming that a common currency leads to more trade integration[7], it should also help bring output fluctuations in line. Therefore, the two OCA criteria would be endogenous. We find a positive and significant coefficient on trade intensity in a Two-Stage Least Squares estimation of real output correlation on trade intensity proxy for ten countries over ten years, using the distance between countries and the presence of common border as exogenous instruments. The study used as a base for this paper suggests that these results are robust (Frankel and Rose, 1997).

The implications from these results are straightforward: a country considering applying for a monetary union should not base its decision *ex ante* on historical data on output correlations, as the influence of entering the monetary union *per se* might dramatically change these correlations. This is an application of the (in)famous "Lucas Critique". The country is more likely to satisfy the two OCA criteria *ex post* than *ex ante* (Frankel and Rose, 1997).

[7] As found by Rose (2000).

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