

ON EQUILIBRIUM REAL EXCHANGE RATES IN EURO AREA: SPECIAL FOCUS ON BEHAVIORAL EQUILIBRIUM EXCHANGE RATES IN IRELAND AND GREECE

K. Plecitá, L. Střelec

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Abstract

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This paper focuses on the intra-euro-area imbalances. Therefore the first aim of this paper is to identify euro-area countries exhibiting macroeconomic imbalances. The subsequent aim is to estimate equilibrium real exchange rates for these countries and to compute their degrees of real exchange rate misalignment. The intra-area balance is assessed using the Cluster Analysis and the Principle Component Analysis; on this basis Greece and Ireland are selected as the two euro-area countries with largest imbalances in 2010. Further the medium-run equilibrium exchange rates for Greece and Ireland are estimated applying the Behavioral Equilibrium Exchange Rate (BEER) approach popularised by Clark and MacDonald (1998). In addition, the long-run equilibrium exchange rates are estimated using the Permanent Equilibrium Exchange Rate (PEER) model. Employing the BEER and PEER approaches on quarterly time series of real effective exchange rates (REER) from 1997: Q1 to 2010: Q4 we identify an undervaluation of the Greek and Irish REER around their entrance to the euro area. For the rest of the period analysed their REER is broadly in line with estimated BEER and PEER levels.

equilibrium exchange rate, BEER, PEER, macroeconomic balance, Ireland, Greece, euro area, cluster analysis, principal component analysis

The plan for the creation of the Economic and Monetary Union in 1999, together with the 1992–1993 crises of the European monetary system, has raised among economist a lively debate about exchange rate misalignments, especially about their sources and implications. When a country becomes a member of the euro area its nominal exchange rate is irrevocably fixed towards euro but its real exchange rate can still change and thus react to real disturbances. According to open macroeconomics, real exchange rate is a very important factor in attaining internal and external balance, mainly in small open economies. Harberger (2004) remarks that *the real exchange rate occupies a very important role – it is the principal equilibrating variable of a country's international trade and payments*. Hence, if one joins

the euro area with an overvalued currency it may undermine competitiveness and lead to lower exports with a negative impact on economic growth. Similarly, joining the euro area with undervalued currency may boost competitiveness and lead to an overheating of the economy. Therefore, persistent real exchange rate misalignments may lead to macroeconomic imbalances and resources misallocation, and elimination of these imbalances, especially in the context of the euro area, which consists of a set of sovereign countries with not fully synchronised economic and political course of events, may be a painful process.

Even though the euro area as a whole seems to be in an overall macroeconomic balance, growing external and internal imbalances can be observed

at the level of individual euro-area member states. Moreover these imbalances have become more pronounced after the 2008 crises. Therefore this paper is focused on intra-area imbalances and real exchange rate misalignments. The objective of this paper is to identify euro-area countries showing substantial macroeconomic imbalances and to compute and examine their real exchange rate misalignment towards the euro.

To our best knowledge existing empirical studies have focused mainly on world macroeconomic imbalances and estimating equilibrium exchange rates for world currencies and, thus leaving the issue of equilibrium exchange rates of individual countries of euro area unheeded. Among the few studies estimating intra-area equilibrium real exchange rates belong Galstyan and Lane (2009), Rusek (2009), Cline and Williamson (2011) and Babecký *et al.* (2010); their findings are compared with our results in the discussion.

To assess the degree of exchange rate misalignment, which is defined as a gap between actual (observed) exchange rate and equilibrium exchange rate it is necessary to estimate the equilibrium exchange rate, for which several concepts are available. The traditional theory of the equilibrium exchange rate is the Purchasing Power Parity (PPP) which explains the movements in equilibrium exchange rates in the long run on the basis of relative prices. Even though the limitations of PPP are well-known (Taylor and Taylor, 2004), PPP is still widely used in empirical research (Siregar and Rajan, 2006). Beyond the PPP, two other major equilibrium exchange rate theories and their various modifications were developed: the Fundamental Equilibrium Exchange Rate (FEER) and the Behavioral Equilibrium Exchange Rate (BEER). The equilibrium exchange rate in FEER is defined as the exchange rate that simultaneously ensures internal and external macroeconomic balance (Williamson, 1994). The internal equilibrium is reached when economy is operating at full employment in a low inflation environment and the external equilibrium is characterized by a sustainable current account. However defining the sustainable position of the current account is highly controversial and subjective in nature (Siregar and Rajan, 2006). In contrast, in the BEER approach the equilibrium exchange rate is consistent with prevailing level of economic fundamentals and rests on the principal of uncovered interest rate parity (Clark and MacDonald, 1998). A comprehensive discussion of the different approaches for estimating equilibrium exchange rate can be found for example in MacDonald (2000). As the BEER approach is said to be suitable for relatively short-time series (Rusek, 2009), as is the case of our euro-area time series, we decided to estimate the equilibrium exchange rate of selected euro-area countries towards the euro area as a whole using the BEER methodology.

MATERIALS AND METHODS

To reveal the similarities and dissimilarities in terms of country-specific economic performance in the euro area in 2010, a dataset for all euro-area member states and euro area as a whole, based on the concept of macroeconomic balance, was created. Data for this dataset were obtained from the Eurostat database and subsequently standardized. Internal balance is assessed using variables of economic growth, inflation, unemployment, government balance and debt; and external balance on the basis of trade balance and real effective exchange rate. In order to check for the existence of homogenous groups and outliers within the euro area, the Hierarchical Clustering Technique (Meloun and Militký, 2004) is used. To ensure homogenous groups of countries with minimal variance the Ward's method for merging clusters is applied. Further, Principal Component Analysis (Meloun and Militký, 2004) is applied to determine main economic constructs affecting/distinguishing the euro-area countries. On the basis of the results of Principal Component Analysis an evaluation of the position of the euro-area countries from the viewpoint of the macroeconomic balance is carried out and countries displaying macroeconomic imbalance are selected for the subsequent BEER analysis.

The empirical estimations of the BEER model in this paper draw heavily on Clark and MacDonald (1998). The BEER approach produces estimates of equilibrium real exchange rate which incorporate both short run and long run economic fundamentals. Based on the literature, the BEER is determined by following set of economic variables:

$$BEER = f((r - r^*), TNT, TOT, NFA, DEBT), \quad (1)$$

where $(r - r^*)$ is the real interest rate differential that represents the uncovered interest rate parity, r is the domestic real interest rate and r^* is the foreign real interest rate (i.e. euro area's in our study). An increase in the real interest rate differential is expected to lead to an appreciation of the real exchange rate. The real interest rates were calculated using nominal interest rates from 10-year government bonds, which were deflated using HICP inflation rates. Data source: Eurostat.

TNT is the relative price of non-traded goods in domestic economy relative to the foreign ratio of non-traded goods. The *TNT* variable is used as a productivity proxy stemming from the Balassa-Samuelson effect and measures the impact of productivity on the real exchange rate. An increase in the *TNT* should lead to appreciation of the real exchange rate. The relative price of non-traded goods was computed as a ratio of consumer price index (HICP) and producer prices in manufacturing (PPI). Data source: OECD Stat.

TOT represents terms of trade of domestic economy relative to terms of trade of foreign economy. An increase in *TOT* should improve trade

balance and therefore lead to appreciation of real exchange rate. The terms of trade were computed as the ratio of the export to import indexes. Data source: Eurostat.

NFA stands for net foreign assets, that are determined by the attitude of the public and private sector towards savings and investment. The impact of *NFA* on real exchange rate is ambiguous, i.e. increase in net foreign assets can lead either to appreciation or depreciation of real exchange rate depending on other circumstances (for more details see Maeso-Fernandez *et al.* (2002)). *NFA* is computed as a ration of the stock of net foreign assets to gross domestic product. As data on *NFA* are available only on yearly bases, they needed to be transformed (approximated) into quarterly data. Data source: World Bank.

DEBT is the ratio of domestic government debt to foreign government debt. *DEBT* should capture the higher risk of holding domestic assets associated with higher level of indebtedness. Therefore an increase in *DEBT* leads to depreciation of the real exchange rate. Data source: Eurostat.

The behavioural equilibrium real exchange rate (*BEER*) is estimated on the basis of the real effective exchange rate of the domestic currency to the euro/ecu (*REER*) which is computed from nominal exchange rate (expressed as a foreign currency price of a unit of domestic currency) deflated by the ratio of domestic and foreign price indexes (*HICP*). Data source: Eurostat.

Econometric estimation is based on linear semi-logarithmic form expressed as

$$\log REER_t = \alpha_0 + \alpha_1 NFA_t + \alpha_1(r - r^*)_t + \alpha_2 \log TOT_t + \alpha_3 \log TNT_t + \alpha_4 \log DEBT_t + \varepsilon_t, \quad (2)$$

where \log denotes a logarithm and ε_t is the error term.

Before applying the Johansen (1995) cointegration method, stationarity of the variables analysed is tested via the Augmented Dickey Fuller (ADF) unit root test, because at least some (but not necessarily all) of the variables entering the Johansen cointegration method must be nonstationary (Clark and MacDonald, 1998). And cointegration vectors on the basis of the Trace test statistic are identified. In the next step equation (2) is estimated and

statistically insignificant coefficients are removed by applying sequential elimination methods. Consequently, these restricted models for selected countries are used for estimation of the behavioural equilibrium exchange rate. Moreover two types of equilibrium exchange rates are computed: the medium-run *BEER* and the long-run *BEER* called *PEER* (permanent equilibrium real exchange rate). The medium-run *BEER* values are estimated, when current (actual) values of explanatory variables are used in the cointegration relationship. It is, however, possible, that the current values of economic fundamental may depart from their sustainable levels during period analysed. Therefore the *PEER* values are estimated using equilibrium values of explanatory variables, which are obtained from the Hodrick-Prescott filter (Hodrick and Prescott, 1997).

In the last step current and total misalignments of the real effective exchange rates are computed. Current misalignment is given by the current values of explanatory variables and is obtained as the difference between actual *REER* and estimated equilibrium *BEER* values. Total misalignment is defined as a gap between actual *REER* and estimated long-run *PEER* values.

RESULTS AND DISCUSSION

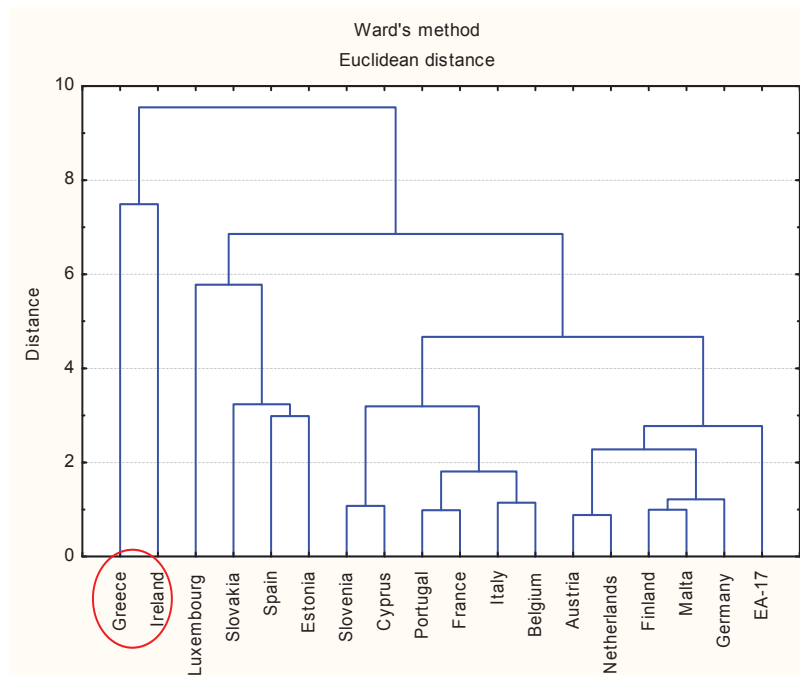
Macroeconomic performance of the whole euro zone (EA-17) and its individual member states in terms of internal and external macroeconomic balance in the year 2010 is displayed in Fig.1. There are two apparent outliers in this dendrogram – Greece and Ireland, which economic performance in 2010 was diametrically different from the others (for a comparison with the EA-17 performance see Tab. I).

Even though the Cluster Analysis grouped the euro-area countries according to their degrees of similarity (see Fig. 1), it is not possible to identify the main variables which have helped to create these clusters. Moreover from the results of the Cluster Analysis one can not recognize whether these two outliers, i.e. Greece and Ireland, are the only two euro-area countries in overall macroeconomic balance or vice-versa. Therefore the Principal Component Analysis was applied to identify the most important factors that distinguish

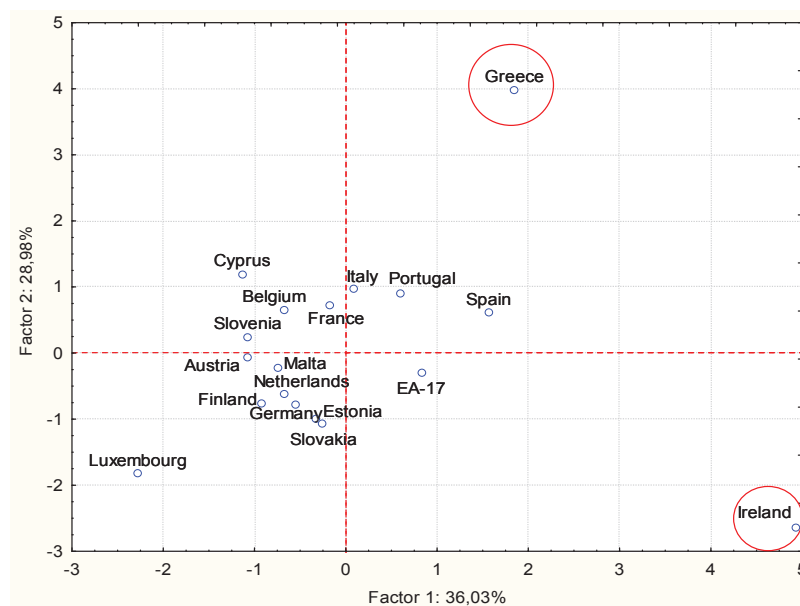
I: Macroeconomic performance in 2010

	EA-17	Ireland	Greece
Consumer prices (%) *	1.6	-1.6	4.7
Gross domestic product (%) *	1.9	-0.4	-3.5
Unemployment rate (%)	10.1	13.7	12.6
Real effective exchange rate (%) *	-7.5	-9.9	-3.9
Trade balance (% of GDP)	1.3	19.1	-8.9
Budget balance (% of GDP)	-6.2	-31.3	-10.6
Government debt (% of GDP)	85.4	94.9	144.9

Note: * change on previous year
Source: Eurostat



1: Similarities in macroeconomic development in 2010 among the euro area countries



2: Similarities in macroeconomic development in 2010 among euro area countries

the position of single countries. The Principal Component Analysis helped to reduce the originally 7 dimensional space into 2 dimensions, which capture 65% of overall variability among euro-area countries. In Fig. 2 is depicted the mutual position, i.e. similarity or dissimilarity, of the euro-area countries within the framework of Factor 1 and Factor 2. The main variables which affect the position of the countries within the scope of Factor 1 are soundness of public finances and appreciation/depreciation of the real effective exchange rate (positive values of Factor 1 thus characterize

countries with large public deficits and debts and above average depreciation of REER and vice-versa). The main variables which affect the position of the countries within the scope of Factor 2 are trade balance and inflation (positive values of Factor 2 illustrate large deficit in trade balance and above average inflation and vice-versa).

On the basis of the Principal Component Analysis Greece and Ireland can be also identified as two distinct outliers. From their position in Fig. 2 can be gathered, that both these countries share the same main difference towards the rest of the euro-area

II: ADF unit root tests for variables in BEER models

	Greece		Ireland	
	statistic	p-value	statistic	p-value
l_REER	-2.6899	0.2408	0.3586	0.9989
l_TOT	-3.3908	0.0526	-2.2831	0.4427
l_TNT	-3.4196	0.0487	-1.4582	0.8437
l_DEBT	-2.3873	0.3862	-0.1958	0.9932
NFA	-1.0798	0.9309	-1.0282	0.9386
r - r*	0.7331	0.9997	0.2397	0.9983

III: Trace statistics of cointegration vectors

$H_0: r$	Greece		Ireland	
	Trace	p-value	Trace	p-value
0	98.0490	0.0326	127.4500	0.0000
1	60.9010	0.2091	68.1280	0.0658
2	29.8450	0.7280	40.2920	0.2141
3	15.1970	0.7708	20.6680	0.3894
4	6.6492	0.6241	8.3330	0.4378
5	0.0043	0.9477	1.5727	0.2098

countries – higher government deficits and debts and slump in economic growth. What distinguishes these two countries from each other and also from the rest of the euro-area countries is their trade balance and shifts in their real effective exchange rates. Ireland had experienced a large surplus of trade balance and almost 10% depreciation of its real effective exchange rate to its main trading partners. Greece on the other hand had an above average trade deficit and its real effective exchange rate had depreciated only slightly.

Because economic performance of Greece and Ireland differed substantially from the rest of the euro area and exhibited large macroeconomic imbalances, misalignments of their actual real effective exchange rates to the euro were estimated.

Preliminary unit root tests (results of the ADF tests are in Tab. II) applied to the data suggest that most

series are nonstationary, i.e. are I(1). Therefore, we applied the Johansen cointegration method. The estimated values of the Trace statistics are reported in Tab. III. On the basis of the Trace statistics and p-values, there would appear to be up to one cointegration vector.

Further equation (2) was estimated and the results for Greece and Ireland are reported in Tab. IV. Some of the coefficients estimated were found to be statistically insignificant, therefore in the next step we used sequential elimination methods to estimate the country-specific restricted models.

The medium-run BEER for Greece is estimated on the basis of the following restricted model (standard errors in parenthesis):

$$\log REER = \underbrace{4.61496}_{(0.00381)} + \underbrace{0.0106533(r - r^*)}_{(0.00218)} + \underbrace{0.571571 \log TOT}_{(0.16756)} - \underbrace{0.526677 \log TNT}_{(0.075422)} \quad (3)$$

All of the variables entering the restricted model for Greece (3) are statistically significant and have the correct sign, apart from the TNT sign, which is negative. Indeed, the TNT is an imperfect measure of relative non-traded prices and can be affected by various factors unrelated to the Balassa-Samuelson framework (for more detailed discussion see for example Engel (1999) and Schnatz *et al.* (2003)); therefore Rusek (2006) argues that the sign of TNT can be both positive and negative and depends on the data. Hence we did not exclude this variable from our estimated model.

BEER values for Ireland are obtained from the following restricted model (standard errors in parenthesis):

$$\log REER = \underbrace{4.59066}_{(0.01694)} + \underbrace{0.00721353(r - r^*)}_{(0.00228)} + \underbrace{0.389404 \log TNT}_{(0.17325)} - \underbrace{0.0786742 \log DEBT}_{(0.02038)} \quad (4)$$

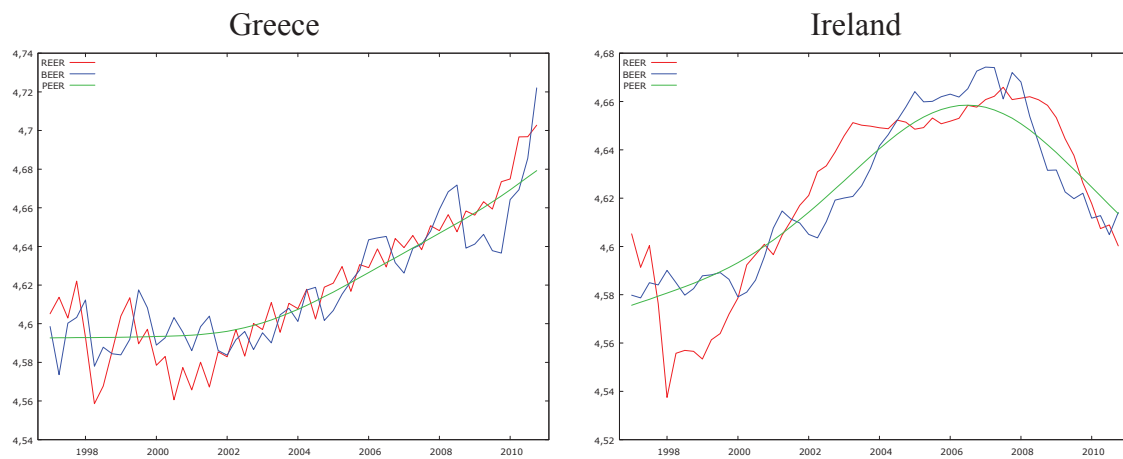
All of the variables entering the restricted model for Ireland (4) are statistically significant and have the expected sign.

In order to generate the long-run PEER for Greece and Ireland smoothed values of explanatory variables (from the Hodrick-Prescott filter) were substituted into the estimated equation (3), respectively (4). Fig. 3 plots the BEER and PEER estimates for Greece and Ireland alongside with their actual REER values during the period 1997: Q1 – 2010: Q4.

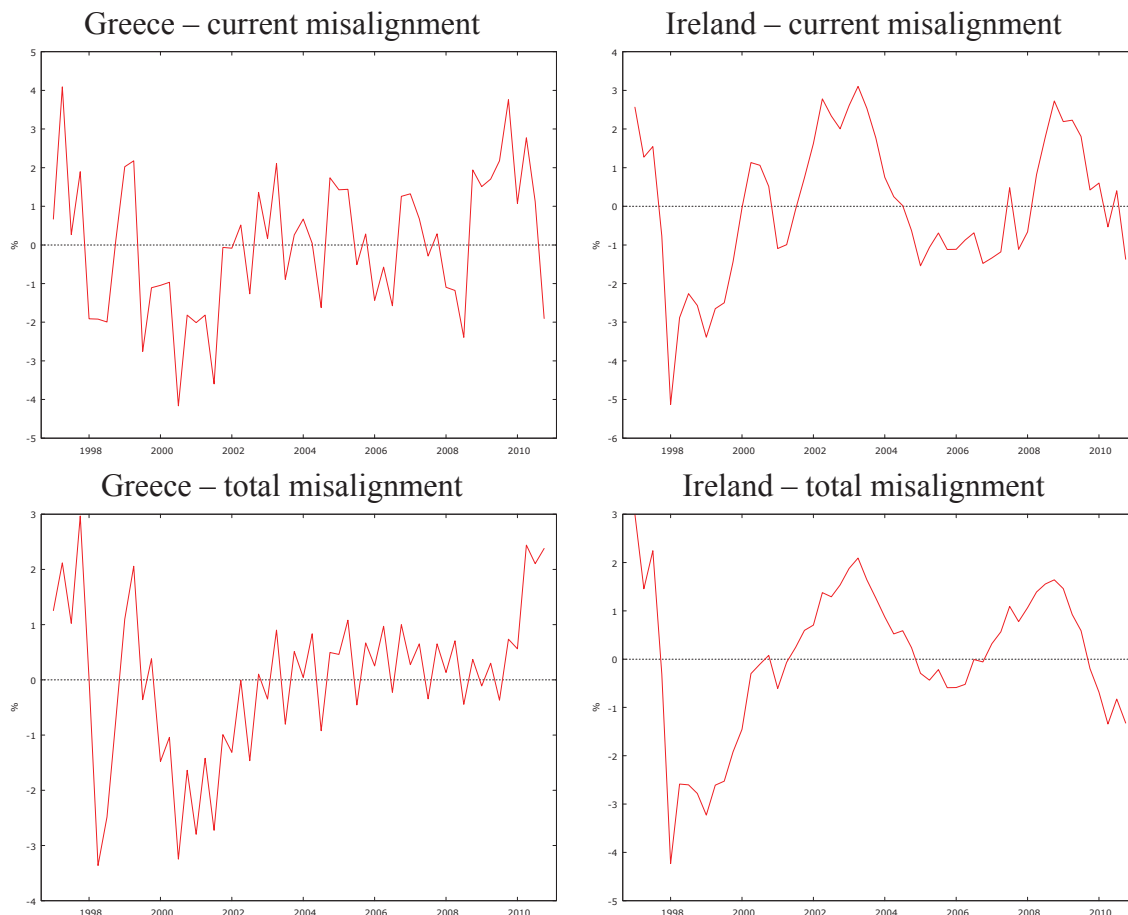
As can be seen from the Fig. 3, in the case of Greece the difference between the actual real effective exchange rate to the euro (REER) and its medium-run and long-run equilibrium values is neither large nor persistent. Actual Greek REER values are quite unsteady at the beginning of the observed period

IV: Estimates of log REER

	Greece		Ireland	
	coefficient (st. error)	p-value	coefficient (st. error)	p-value
const	4.5889 (0.02376)	0.0000	4.5831 (0.01911)	0.0000
NFA	0.0345 (0.13335)	0.7972	-0.0102 (0.09487)	0.9149
r - r*	0.0107 (0.00289)	0.0005	0.0071 (0.00389)	0.0729
l_TOT	0.5617 (0.17117)	0.0019	-0.1878 (0.20903)	0.3734
l_TNT	-0.4205 (0.11801)	0.0008	0.3297 (0.19066)	0.0899
l_DEBT	0.0683 (0.06115)	0.2694	-0.0861 (0.03182)	0.0093



3: Plot of the (logarithm of the) actual REER, medium-run BEER and long-run PEER for Greece and Ireland to the euro



4: Current and Total misalignments for Greece and Ireland to the euro

but from the year 2000 they are following a steady appreciation trend. In addition, an appreciation tendency is apparent in the PEER series from 2001, however this upward trend is not visible in the BEER values until 2002. In comparison with Greece, the actual REER series of Ireland is smoother and after its initial correction it is broadly in line with its equilibrium BEER and PEER values. Despite the

initial growth of all the Irish series, in the last third of the period analysed the PEER series reversed this growth trend and started depreciation which was followed by a downturn of BEER and REER.

Fig. 4 shows the differences between the actual REER series and the estimated BEER and PEER values, respectively. Around the year 2001, when Greece entered the euro area, the REER was

undervalued to euro according to the BEER and PEER, and this undervaluation was corrected already in 2002. Hereafter the REER remained close to its equilibrium, however towards the end of the period analysed was overvalued both in the BEER and PEER sense. In the case of Ireland the current and total misalignment are circa of the same magnitude and are more persistent than in Greece. Ireland, as well as Greece, entered the euro area (this time in 1999) with an undervalued REER but this undervaluation was amended in 2000; afterwards periods of overvaluation and undervaluation were changing, and the Irish REER ended the year 2010 in undervaluation to the euro.

For Greece's membership in the euro area large and persistent current account deficits, debt accumulation and rise in labor costs have been typical. Therefore the results from our BEER and PEER analysis, which suggest that the Greek REER has been more or less consistent with its underlying fundamentals over period analyzed could be striking. However it must be noted that we focus only on the Greek equilibrium towards the euro area, therefore the Greek equilibrium exchange rate towards the rest of the world may look different. Moreover, as noted by Siregar and Rajan (2006), the BEER and PEER equilibriums are from definition not consistent with the typical notion of macroeconomic balance, i.e. simultaneous achievement of internal and external equilibrium, but they are consistent with prevailing levels of macroeconomic fundamentals, respectively with their equilibrium levels. Several authors, applying normative approaches for estimating equilibrium exchange rates consistent with the macroeconomic balance, find Greece's real effective exchange rate (towards a broader group of countries) to be significantly overvalued. For example Babecký *et al.* (2010) point out that the Greek REER has been overvalued by 20–30% over the period 1999–2009. And Cline and Williamson (2011) state that the Greek REER needs to depreciate by 27% to restore macroeconomic balance in the framework of the FEER model.

The macroeconomic imbalance of Ireland as described in the previous part of this paper stems from the 2008 crisis, when Ireland entered into a recession with a subsequent effort to stabilise its national banking sector, which led to large government deficits and debt accumulation. While in euro area, the current account position of Ireland

has shown mean reverting tendencies. In contrary to the steady appreciation of the Greece's REER (see Fig. 3), the Irish REER and its medium-run and long-run equilibrium values set to a depreciation trend around the year 2008, which may help to bring the Irish economy back to its equilibrium. Galstyan and Lane (2009) find the Irish real effective exchange rate to be slightly undervalued in the period 1999–2004 and overvalued in 2005, which is in line with our results. Moreover a paper by Cline and Williamson (2011) concludes that the current real effective exchange rate of Ireland is consistent with the state of macroeconomic balance.

Finally, there is scope for additional research in this area. As noted in the beginning of this paper there are different models for estimating equilibrium exchange rates, which are based on diverse sets of variables and economic assumptions, and this paper is based on the BEER approach. To enable us to draw more robust conclusions about the equilibrium real exchange rates for Greece and Ireland during their membership in the euro area we need to apply also the other approaches which will be the focus of our further research.

CONCLUSIONS

Our aim in this paper has been to identify euro area countries with large macroeconomic imbalances and to estimate their equilibrium exchange rates towards the euro. As two countries displaying the largest macroeconomic imbalances among the euro-area countries in 2010 have been classified Greece and Ireland. To estimate the equilibrium real exchange rate the behaviour equilibrium exchange rate (BEER) approach based on Clark and MacDonald (1998) has been applied. Moreover to eliminate the effect of temporary shocks on the equilibrium exchange rate the permanent equilibrium exchange rate (PEER) has been computed. In particular, we find that the actual real effective exchange rates (REER) of Greece and Ireland towards the euro are broadly in line with their equilibrium BEER and PEER levels. Both Greece and Ireland entered the euro area with an undervalued REER, but this misalignment has been corrected after one year. The Greek REER, BEER and PEER have been appreciating during the period analysed, i.e. 1997: Q1 – 2010: Q4. In contrary, the REER, BEER and PEER of Ireland have changed their growth trend and started a depreciation path after the year 2008.

SUMMARY

Even though the euro area as a whole has been in a macroeconomic balance since its creation in 1999, intra-area imbalances have been widening since then. Moreover, these imbalances have become more pronounced after the 2008 crises. Open macroeconomics considers real exchange rate as a very important factor in attaining internal and external balance. According to various empirical studies, persistent real exchange rate misalignments are said to lead to macroeconomic imbalances

and resources misallocation. When euro area countries abandoned their national currencies and adopted the common currency euro they have lost one important instrument for real exchange rate adjustment. Therefore in the first part of this paper we use the Cluster Analysis and Principal Component Analysis to select the euro-area countries displaying large internal and external macroeconomic imbalances. Using data about internal and external macroeconomic performance of euro-area countries for the year 2010, Greece and Ireland have been chosen as the two countries displaying the highest levels of intra-area economic imbalances. For that reason, the second part of this paper is devoted to estimation of the Greek and Irish equilibrium real exchange rates towards the euro. Using quarterly time series from 1997: Q1 to 2010: Q4 the medium-term BEER and long-term PEER values are estimated. Afterwards the degree of current and total misalignment for Greece and Ireland from BEER, respectively PEER, is computed to gather how large change in the real exchange rate would be needed to bring their real exchange rates back to their equilibriums associated with underlying fundamentals.

In particular, we find that the actual real effective exchange rates of both Greece and Ireland towards the euro are broadly in line with their equilibrium BEER and PEER levels – with one exception around their entrance in the euro area, when both countries had an undervalued real exchange rate. The Greek REER, BEER and PEER have been appreciating during the period analysed, in contrary, the REER, BEER and PEER of Ireland reversed their growth trend and moved towards a depreciation path after the year 2008.

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REFERENCES

- BABECKÝ, J., BULÍŘ, A. and ŠMÍDKOVÁ, K., 2010: Sustainable Real Exchange Rates in the New EU Member States: What did the Great Recession Change? IMF Working paper WP/10/198, International Monetary Fund. [cit. 2011-10-20]. Cited from <http://www.imf.org/external/pubs/ft/wp/2010/wp10198.pdf>.
- CLARK, P. B. and MACDONALD, R., 1998: Exchange Rates and Economic Fundamentals – A Methodological Comparison of BEERs and FEERs. IMF Working Paper WP/98/67, International Monetary Fund. p. 38.
- CLINE, W. R. and WILLIAMSON, J., 2011: The Current Currency Situation. Policy Brief. Washington, DC: Peterson Institute for International Economics, p. 13. [cit. 2011-11-19]. Cited from <http://www.piie.com/publications/pb/pb11-18.pdf>.
- ENGEL, C., 1999: Accounting for U.S. Real Exchange Rate Changes. *Journal of Political Economy*, Vol. 107, No. 3, p. 507–538.
- GALSTYAN, V. and LANE, P. R., 2009: Fiscal Policy and International Competitiveness: Evidence from Ireland. *The Economic and Social Review*, Vol. 40, No. 3, p. 299–315.
- HARBERGER, A. C., 2004: The Real Exchange Rate: Issues of Concept and Measurement. p. 19. [cit. 2011-10-20]. Cited from <http://www.imf.org/external/np/res/seminars/2004/mussa/pdf/haberg.pdf>.
- HODRICK, R. J. and PRESCOTT, E. C., 1997: Postwar U.S. Business Cycles: An Empirical Investigation. *Journal of Money, Credit and Banking*, Vol. 29, No. 1, p. 1–16.
- JOHANSEN, S., 1995: Identifying restrictions of linear equations with applications to simultaneous equations and cointegration. *Journal of Econometrics*, Vol. 69, No. 1, p. 111–132.
- MACDONALD, R., 2000: Concepts to Calculate Equilibrium Exchange Rates: An Overview. Frankfurt am Main: Deutsche Bundesbank, p. 70.
- MAESO-FERNANDEZ, F., OSBAT, C. and SCHNATZ, B., 2002: Determinants of the Euro Real Effective Exchange Rate: A Beer/Peer Approach. *Australian Economic Papers*, Vol. 41, No. 4, p. 437–461.
- MELOUN, M. a MILITKÝ, J., 2004: *Statistická analýza experimentálních dat*. 1. vydání, Praha: Academia, 953 p. ISBN80-200-1254-0.
- RUSEK, A., 2009: Real Effective Exchange Rate for the Euro: Equilibrium and Misalignment. In: RUSEK, L. LACINA and J. FIDRMUC: *The Economic Performance of the European Union: Issues, Trends and Policies*. London: Palgrave Macmillan, p. 262. ISBN978-0-230-22227-4.
- SCHNATZ, B., VIJSELAAR, F. and OSBAT, C., 2004: Productivity and the Euro-Dollar Exchange Rate. *Review of World Economics*, Vol. 140, No. 1, p. 1–30. ISSN 16102878.
- SIREGAR, R. and RAJAN, R., 2006: Models of Equilibrium Real Exchange Rates Revisited: A Selective Review of the Literature. University of Adelaide, Centre for International Economic Studies. [cit. 2011-03-19]. Cited from <http://www.adelaide.edu.au/cies/papers/0604.pdf>.
- TAYLOR, A. M. and TAYLOR, M., P., 2004: The Purchasing Power Parity Debate. *Journal of*

Economic Perspectives, Vol. 18, No. 4, p. 135–158. [cit. 2011-03-19]. Cited from http://www.ssc.wisc.edu/~mchinn/taylor&taylor_PPP_JEP.pdf.

WILLIAMSON, J., 1994: *Estimating Equilibrium Exchange Rates*. 1st ed. Washington DC: Peterson Institute of International Economics. ISBN 0-88132-076-5.

Address

Ing. Klára Plecítá, Ústav financí, Ing. Luboš Střelec, Ph.D., Ústav statistiky a operačního výzkumu, Mendelova univerzita v Brně, Zemědělská 1, 613 00 Brno, Česká republika, e-mail: klara.plecita@mendelu.cz, lubos.strelec@mendelu.cz

