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Sustainability of balancing item of balance of payment for OECD countries: evidence from Fourier Unit Root Tests

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Abstract. *In this paper, the sustainability of the balancing item of balance of payments is examined for 33 OECD (Organization for Economic Co-operation and Development) member countries. The sample period of each country is dependent upon the availability of data and Fourier unit root tests are employed in analysis. According to the empirical analysis the balancing item of balance of payments is sustainable for Australia, Canada, Hungary, Norway, Switzerland and United States. The results also show that nonlinearity is essential characteristic for the balancing item of balance of payments.*

Keywords: Balancing item of balance of payments, net errors and omissions, sustainability, Fourier unit root test, nonlinearity.

JEL Classification: C22, F32.

1. Introduction

The balance of payments is defined in the International Monetary Fund's *Balance of Payments Manual* as the statistical statement, which summarizes the economic transactions of an economy with the rest of the world in accordance with the double entry system over a specific time period. According double entry system every transaction is recoded with two equal valued entries, which are a credit and a debit entry. Thus in principle, the total recorded credit is identical to the total recorded debit, and consequently the credit and debt accounts should balance. However, in practice, there is generally a difference between two accounts and in order to eliminate the imbalances the difference is added as a balancing item. The balancing item is called as the net errors and omissions, which consists of the transactions that are either recorded incorrectly (errors) or not recorded at all (omissions) (Mishra et al., 2008, pp.190).

Özekicioğlu and Taştan (2013) assert that the economic conditions of a country determine the sign of the balancing item, namely as a compensator factor the balancing item has a positive sign in economies with positive economic conjuncture and expectations and a negative sign with the instable economic conditions. Moreover as mentioned by Tang and Lau (2009), since serious and systematic errors will cause persistently large positive or negative balancing items, through both policymakers and investors eyes the size of balancing item can be considered as an important indicator about the reliability and accuracy of balance of payments statistics. However, the authors also noted that large positive and negative errors may be offsetting, thus small balancing items is not necessarily imply the presence of small errors and omissions. In this context, the sustainability of the balancing item should be examined rather than the size or sign of it. Because, if balance of payments statistics are reliable and accurate, then net errors and omissions should be a stationary time series with mean reversion to zero (Lin and Wang, 2009, pp. 2739).

There exists a limited literature that has studied the sustainability of the balancing item of the balance of payments. Tang (2007) has examined sustainability of the balancing item of G7 countries via unit root tests with unknown level shift and found that France, Germany, Italy and Japan have sustainable balancing item. Mishra, et al. (2008) assert that the balancing item of the balance of payments in Australia is sustainable for the period consisted from the first quarter 1960 to the second quarter 2006, furthermore it has a non-linear behavior. They have reached this conclusion by applying an unrestricted two-regime threshold autoregressive model with an autoregressive unit root. Tang and Lau (2008) have analyzed the sustainability of the balancing item in Asian economies. According to the analysis results for 5 out of 13 Asian countries, which are Bangladesh, Indonesia, Korea, Malaysia and Singapore the balancing item of the balance of payments is sustainable. Tang and Lau (2009) have investigated the sustainability of the balancing item for OIC (Organization of the Islamic Conference) member countries. The authors have used standard univariate unit root tests, panel unit root tests and series specific panel unit root test. They found that the sustainability condition for Albania, Cote d'Ivoire,

Indonesia, Kuwait, Malaysia, Mozambique, Pakistan, Tunisia, and Uganda is met. Özekicioğlu and Taştan (2013) have tested the sustainability of the balancing item of the balance of payments for Turkey by using the data, which cover the period 1950-2012. They have used one and two break Lagrange multiplier unit root tests. According to the test results the balancing item is sustainable for Turkey in that period.

The aim of this study is to examine the sustainability of balancing item of balance of payments in OECD member countries via Fourier unit root tests, which considers both nonlinearity and structural breaks.

2. Conceptual framework

Tang (2007) has developed a simple framework in order to analyze the sustainability of balancing item. Since the balancing item (BI) of payments is the difference between the total recorded credit (C) and total recorded debit (D), the following regression equations can be written:

$$C=\alpha D+BI \quad (1)$$

$$D=\beta C-BI \quad (2)$$

Where α and β are restricted to be equal to one. Both in (1) and in (2) the balancing item is considered as the residuals term of the related regression. For the sustainability of the balancing item, the total credit transactions and total debit transactions should be cointegrated. In the context of the cointegration approach of Engle and Granger (1987), a cointegration relationship between the total credit transactions and the total debit transactions would be exist if only the balancing item is stationary. Thus, the sustainability of the balancing item can be determined by testing directly its stationary with the unit root tests.

3. Econometric methodology

Christopoulos and León-Ledesma (2010) propose unit root tests that deal with both exponential smooth transition autoregressive (ESTAR) type nonlinearity and structural breaks of unknown number, duration and form. As in Becker et al. (2006) proposed tests are based on a Fourier function that can model sharp and gradual breaks by approximating the deterministic components of the model. Christopoulos and León-Ledesma (2010) consider the following model:

$$y_t=\delta_0+\delta_1 \sin\left(\frac{2\pi kt}{T}\right)+\delta_2 \cos\left(\frac{2\pi kt}{T}\right)+v_t \quad (3)$$

Where $v_t \sim N(0, \sigma)$, t is a trend term, T is the sample size and $\pi=3.1416$. And k denotes the frequency of the Fourier function. While h_t is assumed to be a stationary process with zero mean, in (3) the null hypothesis of unit root can be defined as;

H_0:$v_t=\mu_t$, $\mu_t=\mu_{t-1}+h_t$,

and relevant test statistic can be calculated by following three-step procedure explained below:

In first step (3) is estimated by ordinary least squares (OLS) for each integer value of k from 1 to 5 and the optimal frequency of the Fourier function (k^*) is determined by selecting the one that yielding the minimum value of the residual sum of squares. Since high frequencies are not associated with structural breaks, low frequencies should be preferred to test stationarity versus nonstationarity (Becker et al., 2006, pp. 388). Then using the selected frequency, the OLS residuals are computed as follows:

$$\hat{v}_t=y_t-\hat{\delta}_0+\hat{\delta}_1 \sin\left(\frac{2\pi k^* t}{T}\right)+\hat{\delta}_2 \cos\left(\frac{2\pi k^* t}{T}\right) \tag{4}$$

In the next step, one of the following models is used to test for a unit root on the first steps residuals:

$$\Delta v_t=\alpha_1 v_{t-1}+\sum_{j=1}^{p} \beta_j \Delta v_{t-j}+u_t \tag{5}$$

$$\Delta v_t=\lambda_1 v_{t-1}^3+\sum_{j=1}^{p} \beta_j \Delta v_{t-j}+u_t \tag{6}$$

In both (5) and (6), u_t is a white noise error term. Model (5) and (6) are called as Fourier-ADF (FADF) test and Fourier-KSS (FKSS) test, respectively. Both tests can be used to test for a unit root in the original series after removing the breaks in the deterministic component. But the two tests differ from each other in the context of adjustment mechanism. The former assumes linear adjustment toward equilibrium, whereas the latter assumes that the adjustment speed is nonlinear. In the FADF test H_0:$\alpha_1=0$ is tested against H_1:$\alpha_1\neq0$ and in the FKSS test H_0:$\lambda_1\neq0$ is tested against H_1:$\lambda_1<0$ by using t-statistic. Appropriate critical values for these test statistics are tabulated in Christopoulos and León-Ledesma (2010) for different values of k^*.

If in step two the unit root null hypothesis is rejected, then in the third step it is possible to test the presence of unknown temporary breaks, namely H_0:$\delta_1=\delta_2=0$ against H_1:$\delta_1=\delta_2\neq0$ in (3) using the F-test $F_\mu(\tilde{k})$. The rejection of the null hypothesis means that the variable is stationary around a breaking deterministic function. Critical values for $F_\mu(\tilde{k})$ are tabulated in Becker et al. (2006).

4. Data and empirical results

The quarterly balancing item (net errors and omissions) of balance of payments accounts data of 33 OECD member countries have constituted the data set of this study. The countries have included in the study are Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Luxembourg, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom and United States. The data that measured in terms of million US Dollars have been obtained from the official website of OECD. The sample periods are dependent upon the availability of data. The end date is 2015:1 for seven countries and 2014:4 for other countries, but the start date varies based on available data. The sample periods are provided in Table 1. As pointed by Tang (2007) the balancing item is not an economic variable and because of the information lose, the actual patterns of the balancing item cannot been captured by using real data. Therefore, the analysis is conducted with nominal data.

The sustainability of balancing item was examined essentially via Fourier unit root tests in this study, but for the comparison purpose, the Augmented Dickey-Fuller (ADF) unit root test was also employed. Both constant and linear trend inclusive models were used in the ADF unit root test. The optimal lag orders of the FADF, FKSS and ADF unit root tests are determined according to the Bayesian information criterion (BIC). Optimal frequency of the FADF and FKSS models were determined by minimizing the residual sum of squares and the search was conducted for integer frequency values, 1 to 5. Unit root tests results are given in Table 1.

Table 1. *Unit root test results*

Countries	Sample Period	k^*	$F_\mu(\tilde{k})$	ADF	FADF		FKSS	
Australia	1960:1-2014:4	1	93.45***	-2.71	-2.15	(5)	-3.66**	(5)
Austria	2006:1-2014:4	1	4.19*	-3.73**	-3.52*	(5)	-1.02	(3)
Belgium	2008:1-2014:4	2	2.50	-5.34***	-6.34***	(2)	-0.15	(3)
Canada	1981:1-2015:1	2	42.31***	-1.50	-1.70	(4)	-5.13***	(0)
Chile	2003:1-2015:1	1	12.04***	-3.47*	-4.43***	(4)	-2.63	(4)
Czech Republic	1993:1-2014:4	1	3.02	-2.29	-3.09	(3)	-2.31	(3)
Denmark	2005:1-2014:4	1	14.68***	-2.80	-2.40	(4)	-3.01	(4)
Estonia	1993:1-2014:4	1	22.21***	-3.00	-4.37**	(5)	-2.82	(0)
Finland	1995:1-2014:4	1	25.54***	-1.67	-2.37	(3)	-2.65	(4)
France	1999:1-2014:4	1	22.28***	-2.67	-2.80	(4)	-0.75	(4)
Germany	1991:1-2014:4	1	131.50***	-2.61	-1.60	(4)	-0.20	(4)
Greece	2009:1-2014:4	1	10.97***	-1.15	-2.23	(5)	0.36	(5)
Hungary	1995:1-2014:4	1	57.05***	-1.32	-2.31	(4)	-3.26*	(4)
Iceland	1995:1-2014:4	1	28.13***	-2.14	-5.30***	(0)	-2.06	(1)
Ireland	2002:1-2014:4	1	98.46***	-0.62	-4.55***	(0)	-2.89	(0)
Israel	1995:1-2015:1	1	20.43***	-2.65	-1.38	(3)	1.02	(3)
Italy	1995:1-2014:4	1	42.91***	-0.83	-2.56	(4)	-1.25	(4)
Japan	2009:1-2015:1	1	30.23***	-2.93	-5.18***	(0)	-1.09	(1)
Korea	1980:1-2015:1	1	18.09***	-1.74	-1.52	(4)	0.04	(4)

Countries	Sample Period	k^*	$F_\mu(\tilde{k})$	ADF	FADF	FKSS
Luxembourg	1995:1-2014:4	1	8.29***	-9.16***	-10.57***(0)	-1.83(3)
Netherlands	2008:1-2014:4	1	26.83***	0.84	-3.51(0)	-3.08(0)
New Zealand	1971:1-2014:4	1	20.75***	-3.19**	-2.99(6)	-2.70(6)
Norway	2005:1-2015:1	2	4.24*	-4.16**	-4.96***(0)	-3.97***(0)
Poland	2004:1-2014:4	1	20.04***	-2.40	-3.86**(4)	-2.70(0)
Portugal	1996:1-2014:4	1	44.96***	-1.10	-2.09(4)	-2.07(4)
Slovak Republic	2008:1-2014:4	1	9.34***	-3.78**	-3.70*(1)	-2.55(1)
Slovenia	1994:1-2014:4	2	18.30***	-1.19	-1.68(4)	-1.17(4)
Spain	1995:1-2014:4	1	77.44***	-1.73	-3.35(4)	-1.98(4)
Sweden	2003:1-2014:4	2	15.07***	-3.93**	-2.79(1)	-1.74(1)
Switzerland	2000:1-2014:4	2	13.17***	-4.31***	-4.89***(0)	-3.81**(0)
Turkey	1992:1-2015:1	1	63.71***	-3.40*	-3.01(5)	-2.43(5)
United Kingdom	1999:1-2014:4	1	9.88***	-2.11	-1.76(4)	-1.39(1)
United States	1960:1-2014:4	1	173.16***	-2.37	-2.36(4)	-3.71**(4)

Notes: (1) *, ** and *** show significance at 10%, 5% and 1% levels, respectively. (2) Optimal lag lengths determined by using BIC are given in parentheses.

As seen in Table 1, according to ADF unit root tests the null of a unit root is rejected for ten countries (Austria, Belgium, Chile, Luxembourg, New Zealand, Norway, Slovak Republic, Sweden, Switzerland and Turkey). In other words, 10 out of 33 the OECD countries have stationary balancing items. When the results of Fourier unit root tests are considered, first it can be seen that the optimal frequency (k^*) is determined as 1 for the majority of the countries and 2 only for six countries which are Belgium, Canada, Norway, Slovenia, Sweden and Switzerland. Next, the Fourier unit root tests are provides conflicting results about the stationary of the balancing item of balance of payments. FADF test results indicate that for 21 out of the 33 OECD countries the null hypothesis of a unit root cannot be rejected even at 10% significance level. The 12 countries of which the balancing item of balance of payments is stationary are Austria, Belgium, Chile, Estonia, Iceland, Ireland, Japan, Luxembourg, Norway, Poland, Slovak Republic and Switzerland. The results of FKSS test, which considers nonlinearity, show that only for 6 OECD countries the sustainability condition of the balancing item is met. The unit root null hypothesis can be rejected for Australia, Canada, Hungary, Norway, Switzerland and United States at the 10% significance level or better. When the results of ADF, FADF and FKSS unit root test are evaluated as a whole, only Norway and Switzerland have a sustainable balancing item. Since ADF and FADF tests may be misleading in the presence of structural break and nonlinearity, respectively, the results of FKSS unit root test is more reliable. In addition, as asserted by Lin and Wang (2009) and Tang (2009) nonlinearity is a common characteristic of the balancing item series. Thus based on the FKSS test results it is concluded that the sustainability hypothesis is valid for Australia, Canada, Hungary, Norway, Switzerland and United States. Additionally, the F-test ($F_\mu(\tilde{k})$) rejects the null of constant mean and the results of which indicate that at least one frequency component must be included in estimated models for these countries.

5. Conclusions

The main goal of the current study was to analyze the sustainability of the balancing item of balance of payments for OECD member countries. For that purpose FADF and FKSS unit root tests were used. Both tests can model structural breaks of unknown number, duration and form. Moreover, unlike FADF test, FKSS test also considers nonlinearity. Despite conflicting results are obtained from applied unit root tests, the results of this empirical analysis show that the balancing item of balance of payments is stationary around a breaking deterministic function for Australia, Canada, Hungary, Norway, Switzerland and United States. Therefore, the balancing item of Australia, Canada, Hungary, Norway, Switzerland and United States is sustainable. The findings of this study are consistent with the work of Mishra et al. (2008) which consider nonlinearity for Australia, but not support the works of Özekicioğlu and Taştan (2013) for Turkey, Tang and Lau (2008) for Korea and Tang (2007) for France, Germany, Italy and Japan. The results of this study differ from mentioned studies most likely because of neglected nonlinearity or different sample periods. Nevertheless, it is noted that nonlinearity is essential characteristic for the balancing item of balance of payments, thus it should be considered while examining the sustainability of the balancing item of balance of payments.

References

Becker, R., Enders, W. and Lee, J., 2006. A stationarity test in the presence of an unknown number of smooth breaks. *Journal of Time Series Analysis*. Vol. 27. No. 3. pp. 381-409.

Christopoulos, D.K. and León-Ledesma, M.A., 2010. Smooth breaks and non-linear mean reversion: Post-Bretton Woods real exchange rates. *Journal of International Money and Finance*. Vol. 29. No. 6. pp. 1076-1093.

Engle, R.F. and Granger, C.W.J., 1987. Cointegration and error correction: representation, estimation and testing. *Econometrica*. Vol. 55. pp. 251-76.

International Monetary Fund (IMF), 1993. International Monetary Fund's Balance of Payments Manual, 5 th Edition, IMF. Accessed at http://www.imf.org/external/pubs/ft/bopman/bopman.pdf (07.09.2015).

Lin, M. and Wang, H., 2009. What Causes the Volatility of the Balancing Item? *Economics Bulletin*. Vol. 29. No. 4. pp. 2738-2748.

Mishra, V., Smyth, R. and Tang, T.C., 2008. Is the balancing item for Australia sustainable? Evidence from a threshold autoregressive model with an autoregressive unit root. *Australian Economic Papers*. Vol. 47. No. 2. pp. 190-198.

Özekicioğlu, H. and Taştan, S., 2013. Financing and Sustainability of Net Errors and Omissions Item In Turkey. *Journal of Entrepreneurship and Development*, Vol. 8. No. 2. pp. 132-140.

Tang, T.C., 2007. Sustainability of balancing item of balance of payments accounts: fresh empirical evidence for G7 countries. *Applied Economics Letters*. Vol. 14. No. 4. pp. 251-254.

Tang, T.C., 2009. Testing for Non-linearity in the Balancing Item of Balance of Payments Accounts: The Case of 20 Industrial Countries. *Economic Issues*. Vol. 14. No. 2. p. 107.

Tang, T.C. and Lau, E., 2009. An empirical investigation on the sustainability of balancing item of balance of payment accounts for OIC member countries. *Journal of Economic Cooperation and Development*. Vol. 30. No. 1. pp. 1-16.

Tang, T.C. and Lau, E.P.H., 2008. An empirical investigation on sustainability of balancing item in Asian countries. *Applied Economics Letters*. Vol. 15. No. 2. pp. 117-123.