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'Net Errors and Omissions' of Balance of Payments and Its Sustainability: A Survey of Literature

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Abstract

This survey covers 18 studies on 'net errors and omissions' (NEO) or balancing items. Three groups have been classified by research interest (i) NEO sustainability; (ii) 'sources' or 'factors' of determining NEO behaviour; and (iii) components of NEO (i.e. nonlinearity). This survey focuses on the first group. 40% of the sample countries examined by the literature shows sustainable NEO. The meta-analysis recommends the method, region, and income "common factors" are found to have mixture implication on sustainable NEO.

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1. Introduction

As defined by the World Bank, 'net errors and omissions' (NEO) is a residual variable needed to ensure that accounts in the BoP (Balance of Payments) statement sum to zero, or the balance on the financial account minus the balances on the current and capital accounts. In fact, the imperfections in source data and compilation of the BoP accounts contribute to the NEO.[1] There is a limited economics-related studies either theoretical or empirical analyses on the characteristics of NEO including its impact on the quality of the reported balance of payments statistics, and the 'sources' of NEO. A seminal work on this field is Duffy and Renton (1971). A follow-up study is by Fausten and Brooks (1996) for the Australian case study. More attentions have been received by other researchers among them are Adetiloye, Ayca, Forss, Karlsson, Hooy, Kilibarda, Lin, Wang, Mishra, Pickett, Salo, Siranova, Smyth, Tang, Tombazos, and so on.

Indeed, there is a crude conceptual insight on the connection between NEO and economic conditions such that sustainability is affected. The size of NEO reflects the quality of a country's BoP statistics in which the quality of policy formulation that is based on improved (revisions) statistics available, in order to spur economic growth. However, this hypothesis remains vacuum in the literature either theoretical or empirical. According to Fausten and Brooks (1996, p. 1311), "*...the degree or nature of economic interaction between the domestic economy and the rest of the world changes shifts or breaks would be expected in the behaviour of the balancing item".* In search of [NEO] sustainability, their *ad hoc* regression results are inconclusive on the impacts of exchange rate volatility and the degree of economic openness on NEO. Also, this survey finds that economic condition - proxied by income group, has no role on the NEO sustainability. This survey, in place aims to provide comprehensive on the deep and depth NEO research.

This survey reviews all available past studies on 'net errors and omissions' (NEO) or balancing item of balance of payments (hereafter, BoP), especially on its sustainability. From the BoP perspective, 'sustainability' ('sustainable') is a condition that the deficits in the BoP accounts does not cause rapid changes to the macroeconomics, or require policy actions to correct it due to large and persistence occurrence in the long-run.[2] In regard to NEO, sustainable informs that the deficiencies (i.e. –NEO or +NEO) of a country will be *naturally* ratified or disappear in the long-run (equilibrium) that there is improvement of double-entry (reporting) system for the revisions of BoP data after initial publication, mainly due to, such as the improvement of institution factors (Fausten and Brooks,1996).[3] It is expected to have sustainable NEO because it tells about the '*reliability'* of the BoP statistics which are deemed to provide signal about likely directions of economic policy that "Their importance in the public and policy arena is, *ipso facto,* transmitted to the balancing item (NEO) because that statistic is generated by the factual and systemic imperfections, the *errors and omissions* that permeate the BoP statistics" (Fausten and Brooks, 1996 p. 1303). A review article by Blomberg et. al. (2003) about the size of Swedish NEO and its impacts on the reliability of BoP data for policies decision making during the study period 1991 to 2002.

This survey also contributes a meta-analysis on the "common factors" such as sample size and frequency, testing method, geographical distribution and nation income level, those are observed to be relevant in determining whether the NEO is sustainable. The data are extracted from

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[1] Visit, http://data.worldbank.org/ and http://datahelp.imf.org/, respectively.

[2] For example, Baharumshah et al. (2003) found that the current account of ASEAN-4 countries (Indonesia, Malaysia, the Philippines, and Thailand) are sustainable implies that there is improvement of current account imbalances (surplus) mainly due to the large currency depreciations post 1997 Asian financial crisis.

[3] Fausten and Brooks (1996) highlighted that there is a gradual secular shift from current transactions ('leads and lags') to capital transactions ('hot money') in response to the institutional changes i.e. liberalisation and deregulation of Australian financial markets from 1970 throughout mid 1980s had causes noticeably difference in its time pattern compared to another four industrialised countries namely Germany, Japan, the U.K. and the U.S.

the articles reviewed. This survey also discovers the importance of studying the 'sources' that explaining the size of NEO.

Next section is a comprehensive review of the past studies available on NEO including its sustainability. It is followed by a meta-analysis on a set of "common factors" on the sustainability of NEO. It is complemented by a frequency report on the "sources' those affecting (determining) the NEO. The last section is conclusion.

2. The Past Studies

The literature search has identified 21 related studies on NEO (balancing items). They are basically categorised into three groups by: (i) whether the NEO is sustainable; (ii) empirically studying the 'sources' or 'factors' determining the behaviour of NEO; and (iii) abstracting the characteristics (components) of the NEO behaviour. The past studies on these groups are tabled in **Appendix A**, with a short summary of the findings. In brief, there are a total of 6 studies on the first group which has empirically tested the hypothesis that NEO is sustainable. A seminar work is by Tang (2007) who looked at the sustainability hypothesis of NEO for the G7 countries. The augmented Dickey–Fuller (ADF) unit root tests with unknown level shifts reveal positive finding. This hypothesis has been tested by the author and others by applying different (newly) testing methods (Seemingly Unrelated Regressions ADF panel unit root tests, Fourier-KSS FKSS stationary tests, and so on), and of other countries (groups) such as 23 OIC, 33 OECD countries and so on. In fact, these studies are either single country study, group- or regional-base, which is not generalizable. The second group of studies compromise 12 studies those have identified and examined empirically the possible 'sources' that help in explaining the NEO, in particular, from the macroeconomics perspective. A seminal work is by Duffy and Renton (1971) on the explanatory relationships for the NEO of the U.K.'s BoP accounts for the period 1958Q3-1967Q3. Similarly, inconclusive for the 'sources' in explaining the size of NEO, to some extent, is country specific, and testing method (see, Table 5). The last group of 3 NEO studies looks at the 'statistical' characteristics of the variable, in particular the nonlinearity component. Nonlinearity on NEO is first tested by Hooy and Tang (2007) for the Australian NEO volatility. The latest is from Taştan's (2015) that nonlinearity is essential characteristic for the balancing item of BoP of 33 OECD countries.

3. "Common Factors" and NEO Sustainability

The empirical findings collected from the past studies on the sustainability of NEO of BoP accounts allow further investigation on the "common factors" grouped by sample size, testing methods, geographical regions, and income levels in attempt to explain their findings. For example, Tang's (2015) study has empirically identified and tested a set of "common factors" in determining the cointegration of Japan's aggregate import demand function. He found that sample size, testing approach, and activity variable are important "common factors". Meta-analysis is an approach that uses statistical methods to combine the scientific results from a group of related studies in order to identify their common characteristics. This section provides a preliminary understanding on the "common factors" determinant on the finding in the past studies on NEO sustainability. The definitions of "common factors" used in the meta-analysis are shown in Table 1. These particular moderator variables are chosen because the data can be collected from the respective articles, while additional variables i.e. regions, and income groups can be added from the information available from the World Bank. Indeed, a few of candidates for moderators that have been excluded such as institutional quality, financial liberalization, trade openness, and so on, in which their data are publicly available. For simplicity reason, this review does not add other candidate "common

factors" as it may make the analysis more complicated since their correlations remain unclear from the either empirical or theoretical perspective.

The data used in meta-analysis are based on the 6 published research articles on whether the NEO are sustainable or otherwise. They have studied a total of 68 individual countries yielding 238 observations (N) for this analysis. More precisely, the 238 "observations" refer to the "findings" of sustainability from the respective tests - for example, Tang and Lau's (2008) study employed 24 countries with 4 tests (ADF, PP, KPSS and SURADF) which yields 96 "observations". Table 2 describes the frequency (converted into percentage) of the "common factors" cross-tabling with the NEO sustainability (SUS and Not SUS). Overall, the averaged sample size is 59 time-series observations in which half of them (45.8%) are on quarterly basis (see the fourth column of Table 2). Most of the commonly employed testing methods are the unit root with both non-linearity and structural break i.e. the exponential smooth transition autoregressive (ESTAR) model with Fourier function (M_ESTAR, 41.5%) and the stationary test (M_KPSS, 30.2%). It is observed that most studied countries are those in East Asia & Pacifica region, and Europe & Central Asia regions, about 62%. The least concerned countries are geographically located in Latin America & Caribbean, and North America regions. Also, 54.6% of the total observations are from the high income nations. Clearly, a considerable attention has also been given for lower income countries in this topic, i.e. NEO sustainability.

Table 1 Definition of "common factors"

Variable	Description (measurement)
SUS	Finding of sustainable NEO (1=Sustainable; 0=Unsustainable)
SIZE	Sample size used in time series
QD	Data frequency used (1=Quarterly; 0=Otherwise)
M_SB	Method: unit root with structural break (1=Yes; 0=No)
M_SUR	Method: panel based SUR (Seemingly Unrelated Regressions) augmented Dickey–Fuller test (1=Yes; 0=No)
M_KPSS	Method: Unit root for null hypothesis of stationary (1=Yes; 0=No)
M_ESTAR	Method: Unit root with non-linearity & structural break (1=Yes; 0=No)
R_SSA(1)	Sub-Saharan Africa region (1=Yes; 0=No)
R_EAP	East Asia & Pacific region (1=Yes; 0=No)
R_ECA	Europe & Central Asia region (1=Yes; 0=No)
R_LAC	Latin America & Caribbean region (1=Yes; 0=No)
R_MENA	Middle East & North Africa region (1=Yes; 0=No)
R_SA	South Asia region (1=Yes; 0=No)
R_NA	North America region (1=Yes; 0=No)
INC(2)	Income level (1=Low; 2=Lower-middle; 3=Upper-middle; 4=High)

Notes: (1) Geographic regions groupings are based on the regions used for administrative purposes by the World Bank. (2) Income is measured using gross national income (GNI) per capita, in U.S. dollars, converted from local currency using the World Bank Atlas method.

In term of the NEO sustainability, it shows that only 39.5% (or 94) out of 238 observations has positive finding in which NEO is sustainable (see, SUS, n1). A few of the observed studies feature the use of larger sample size (66 observations) than unsustainable results (55 observations). It also contributed by the use of unit root with non-linearity and structural break (i.e. ESTAR, 34%). Indeed, regional factor can explain the NEO sustainability, in which both regions of East Asia & Pacific, and Europe & Central Asia accounted for 26.6% and 29.8% observations, respectively. It is interesting to note that income level is an important "common factor" in the sustainable NEO (52.1%). 144 observations (or 60.5%) (see, Not SUS, n2) of their NEO is unsustainable. Beside ESTAR method (45.3%), the stationary test (KPSS) also an important "common factor" which is about 34% fail to support sustainable NEO. East Asia & Pacific, and

Europe & Central Asia region still are the major contributors for non-sustainable NEO in which constitutes 65.3% of the 144 obs4ervations. One need to take note is that unsustainability in South Asia region is higher (at 16%) than its sustainable NEO (6.4%). On the other hand, majority of them (n2) are high income countries (56.3%). From these descriptive observations, we found that the "common factors" is identical in testing both the sustainable (n1) and unsustainable (n2) NEO.

A more systematic approach will help for a better understanding of the importance of these "common factors" in determining the finding of NEO sustainability. The method employed in this study is binary model with both logit and probit estimators, in which they are conventional in meta-analysis. For the case that the dependent variable, SUS is a binary variable that take two values i.e. 0 for unsustainable NEO, and 1 for sustainable NEO, the binary model appears appropriate with estimating the impact of the 'common factors' determining the probability that NEO actually sustainable.

Table 2 Frequencies analysis of NEO sustainability and "common factors" (in percentage, %)

"Common factors"	SUS (n1 = 94)	Not SUS (n2 = 144)	Total (N = 238)
SIZE[#]	*65.61*	*54.60*	*58.95*
QD	40.43	49.31	45.80
M_SB	16.98	0	5.66
M_SUR	26.42	20.75	22.64
M_KPSS	22.64	33.96	30.19
M_ESTAR	33.96	45.28	41.51
R_SSA	11.70	2.78	6.30
R_EAP	26.60	25.69	26.05
R_ECA	29.79	39.58	35.71
R_LAC	2.13	2.78	2.52
R_MENA	19.15	10.42	13.87
R_SA	6.38	15.97	12.18
R_NA	4.26	2.78	3.36
High income	52.13	56.25	54.62
Upper-middle income	15.96	17.36	16.81
Lower-middle income	23.40	22.92	23.11
Low income	8.51	3.47	5.46

Note: [#] the reported values are in average (i.e. mean), while other values refer to the percentage of the frequencies.

Tables 3 and 4 reports the empirical results of meta-analysis using the logit and probit model.[4] Basically, the probit model is used to model dichotomous in which the inverse standard normal distribution of the probability is modelled as a linear combination of the predictors. The model produced results similar to the logit model, as seen from the estimation outcomes. Both of the model link functions yield very similar outputs when given the same inputs. The choice of probit versus logit depends largely on individual preferences and also the influence by disciplinary tradition. For instance, economist seem far more used to probit analysis while researchers in psychometrics rely mostly on logit models. Based on the analysis by Hahn and Soyer (2005, p. 4), there are two exceptions which could differentiate the two models, i.e. logit is better in the case of "extreme independent variables" (occurs at the upper or lower extreme of an independent variable), and probit is better in the case of "random effects models" with moderate or large sample sizes.

The logit regression estimates (see, Table 3) of equations (1) to (13) are based on bivariate framework that tests the individual influence of one "common factor". Majority of the computed ρ-

[4] M_SB is excluded from the analysis due to computational complication using the Eviews statistical software, i.e. "Quasi-complete separation: M_SB>0 perfectly predicts binary response success".

values are statistically significant at least 0.10 level such as equations (4), (5), (6), (10) and (11). The first two equations (4 and 5) indicate that stationary KPSS test, and ESTAR model (non-linearity and structural break) have a negative estimated coefficient (i.e. -0.82 and -0.75, respectively), in isolation, do seem to decrease the likelihood of sustainable NEO outcome.[5] The remaining results suggest geographically the regions of Sub-Saharan Africa, and Middle East and North Africa, indicate that as these regions are used, the NEO sustainability increases; but it is not the case for the South Asia region (i.e. estimated coefficient, -1.03). The "common factors" of sample size, data frequency, SUR panel method, some regions (EAP, ECA, LAC and NA), and country's income level are not the favourable "common factors" for a probable of occurring sustainable NEO.

The equations (14), (15) and (16) are based on a set of "common factors" jointly regressed. The estimated equation (14) i.e. the methods-used "common factors" show that the use of ESTAR model does predict the decreasing likelihood of obtaining sustainable NEO result as adoption of the model getting frequent. Contrary to equations (1) and (2), the "common factors" of sample size (equations 15 and 16) are statistically significant (at least 0.10 level) with estimated coefficient of 0.01 – when sample size is increased (by one observation), the probability of NEO sustainability increases i.e. the odds ratio increases by 1%. Again, the logit regression (equation 16) indicate that there is statistically insignificant for the income "common factor". Again, a robustness check show that income "common factor" is statistically insignificant in equations (14), ESTAR turns into insignificant, and at the same time the other "common factors" remains insignificant. Table 4 reports the alternative estimator i.e. probit regression estimates for robustness check, and their results impersonate the former logit's findings.

Undoubtedly, the results tell that the existing empirical literature ignores the influence of "common factors" which may give inappropriate inference on the NEO sustainability. Robustness check is crucial, given some "common factors" are bias toward sustainable NEO (i.e. sample size, and region), while others such as testing method biases toward unsustainable. But, this concern has not received considerable revision, and has been abandoned by the past studies, hence their findings are not generatable.

Table 5 "Common factors" and the 'sources' of NEO

Country	Freq.	*Data*	Freq.	*Method*	Freq.
Australia	4	Quarterly	12	VAR causality	8
Croatia	1	Monthly	2	OLS	4
Japan	3	Yearly	1	Cointegration test	1
Norway	1			Descriptive analysis	2
Slovakia	1				
South Africa	1				
Sweden	2				
the Philippines	1				
the U.K.	1				
	15		15		15

[5] More technically, for example the M_KPSS "common factor" -0.82 is log-odds, and exponentiated it to be 0.44, which implies that the sustainable NEO occurring is lower than the baseline i.e. the odds ratio actually decreases by about 56%. In other word, the negative coefficient (-0.82) indicates that as the use of M_KPSS, the probability of observing sustainable NEO decreases.

Table 6 Frequency analysis of the 'sources' of NEO

'Source':	Freq.	% (of 95)	Significant at 0.10	% (of 26)
FDI incl. portfolio	16	17	6	23
Income including foreign income	11	12	3	12
Exchange rates	9	9	2	8
Trade (imports; exports)	8	8	2	8
interest rate (differential)	7	7	2	8
Openness (Trade; Economic)	7	7	2	8
Money supply	5	5	1	4
Accounts balance including liabilities	5	5	0	0
Lagged balancing item	5	5	2	8
Services	5	5	2	8
Seasonal factors	4	4	1	4
Transfers	3	3	0	0
Foreign demand	3	3	0	0
Government spending	2	2	0	0
Reserve Bank	2	2	0	0
Net total invisibles	1	1	1	4
Institutional	1	1	1	4
Reserves assets	1	1	1	4
Total	95		26	

On the other hand, there are 12 published research studies had published their empirical results of the factors ('sources' or 'explanators') explaining the *size* (value) of NEO. Tables 5 and 6 describe a frequency summary of the 'popularity' of those factors. This is the largest group of NEO study. Given the nature of these studies, frequency analysis appears to be appropriate on the tested 'sources' those are the most widely employed and significant (as reported by the studies).[6] Only nine countries are being studied with 15 observations (analyses) – study like Lin and Wang (2009) have considered four countries (Norway, Sweden, the Philippines, and South Africa). Among them, Australia is the most chosen country for NEO study than by Japan, and Sweden. Perhaps, it is an interesting research topic for other 'omitted' countries from above, for example, the U.S. Also, it informs that quarterly data (time series) is eventually considered in analysis. The VAR non-causality tests are the conventional testing method than by OLS regression.

Table 6 clusters the examined factors into 18 'sources'. They had been tested for 95 times, but only 26 (27%) are statistically at 0.10 level. Real sector variables (FDI, income, exchange rate trade, openness) are important sources to be examined. FDI is the most important variable in explaining the NEO - it covers 17% of the 'sources' being tested, and 23% (6 out of 26) is statistically significant. It explains the recent financial liberalization that allows more free movements of capital flows, in particularly, short term portfolio flows which increasing the possibility of unreported flows due to 'timing error'. Only 3 out of 11 income variables being tested are statistically significant. Money supply has been tested for 5 times, but only one study shows significant. Government spending is rarely considered by the past studies (i.e. 2 times tested but insignificant). Only Fausten and Brooks (1996) have considered role of institutional changes in influencing the NEO.

[6] The previously employed method either logit or probit model is not feasible for this group of studies that has modelled the NEO behaviour with a set of macroeconomic variables and by the BoP components. The statistically significance of these factors reveal their relevant.

All the sources, except for FDI and income are at most 8% of their test is significant at 0.10 level. However, other sources included such as account balance including liabilities, transfers, foreign demand, government spending, and bank reserve are insignificant in their studies. Lastly, for the studies those looking at the NEO characteristics are limited - only 3 studies are available in the literature (Hooy and Tang, 2007; Tang, 2009; Taştan, 2015). Meta-analysis is infeasible as their findings are unity that nonlinearity is a 'silent' characteristic of NEO for the countries examined (see *iii. Statistical characteristics* in Appendix A).

4. Conclusion

This survey reviews a vast of empirical studies concerning the topics relating to NEO or balancing items of BoP, particularly the sustainability of NEO. What we have learned from these studies? This survey notes that the past NEO studies are still insufficient. They have scoped the NEO on its sustainability, nonlinearity, and a set of 'sources' determining the size of NEO. Perhaps, it is considerably a potential research topic in the literature of open economy macroeconomics. A preliminary observation from the meta-analysis reveal that 40% of the sampled countries examined in the past studies supports sustainable NEO. The meta-analysis also suggests that the method "common factor" KPSS tests and ESTAR model has negative implication on the sustainability of NEO. However, the region "common factor" yields a favourable outcome on supporting NEO sustainable, namely Sub-Saharan Africa, and Middle East and North Africa. Meanwhile, the South Asia region is found to be unfavourable. Surprisingly, the income is not a "common factor" in this matter, hence it opens for further investigation. As observed that studies on the NEO sustainability remain 'ungeneralizable', in fact, the studies are based on country-specific (i.e. Australia, Japan and so on) and on regional or group base (i.e. Asia, OIC, and OCED countries). Other branch of studies identifies and examines a set of *ad-hoc* 'sources' those determine the NEO behaviour, such as the components of BoP, and macroeconomic variables - short term monetary flows, interest differential, exchange rate volatility, economic openness, net international position, tourism, and capital flight. The last group of NEO studies undoubtedly confirms the nonlinearity component in NEO.

This review inspires the NEO literature heading towards so as to maintain progress in research on this topic. Firstly, only typical variables (common factors and sources) are repeatedly tested by the studies, while some potential variables which are determinative to the NEO sustainability as well as its size should be taken into account for future research intensively. For example, institutional quality remains a silent and empirically untested in the literature - better institution quality (legal, political, and economic), higher efficiency in reporting system which may reduce the size of NEO in the initial publication as well as improvement in the sequentially revisions by the statistical agencies. Financial liberalisation (openness) is another potential variable for the NEO literature. More open an economy to her financial market, higher the financial assets transacted (financial flows) which may induce NEO volatility. This variable remains untested. Secondly, and more technically, this survey offers an input that to consider interaction term(s) for comprehensiveness. For example, between financial openness and economic growth - finance led growth. By the same token, possible threshold(s) are important to be estimated, i.e. NEO is expected to be sustainable or small for a country with good institutional quality, and well-developed financial market. The estimated thresholds have important implication for policy. Lastly, further research looks at the impacts of NEO (i.e. as an independent variable) on macroeconomic models, is feasible. Let say, to include the information of NEO in modelling a country's exchange rate volatility, and more interestingly, to estimate the underground economic. NEO may capture 'unrecorded' and 'missing' information of real sector and financial sector.

Table 3 Binary Logit regression results

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
SIZE	0.00														0.01**	0.01**
	(0.13)														(0.03)	(0.03)
QD		-0.36													-0.49	-0.33
		(0.18)													(0.27)	(0.52)
M_SUR			-0.03											-0.34	-0.29	-0.30
			(0.94)											(0.38)	(0.47)	(0.46)
M_KPSS				-0.82**										-0.60	-0.61	-0.62
				(0.02)										(0.14)	(0.14)	(0.13)
M_ESTAR					-0.75**									-0.59*	-0.43	-0.42
					(0.02)									(0.10)	(0.35)	(0.36)
R_SSA						1.54**										
						(0.01)										
R_EAP							0.05									
							(0.88)									
R_ECA								-0.44								
								(0.12)								
R_LAC									-0.27							
									(0.76)							
R_MENA										0.71*						
										(0.06)						
R_SA											-1.03**					
											(0.03)					
R_NA												0.44				
												(0.54)				
INC													-0.15			-0.13
													(0.26)			(0.52)
Constant	-0.64***	-0.27	-0.42***	-0.28*	-0.23	-0.52***	-0.44***	-0.28*	-0.42***	-0.53***	-0.32**	-0.44***	0.06	-0.11	-0.35	-0.03
	(0.00)	(0.14)	(0.00)	(0.06)	(0.13)	(0.00)	(0.01)	(0.09)	(0.00)	(0.00)	(0.02)	(0.00)	(0.89)	(0.52)	(0.15)	(0.96)
McFadden R-squared	0.01	0.01	0.00	0.02	0.02	0.02	0.00	0.01	0.00	0.01	0.02	0.00	0.00	0.03	0.04	0.04

Notes: The reported values are estimated coefficients, and the values in parentheses are ρ-values (based on z-statistic). ***, **, and * denote significance difference from zero at the 1%, 5%, and 10% levels, respectively.

Table 4 Binary Probit regression results

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
SIZE	0.00														0.00**	0.00**
	(0.14)														(0.03)	(0.03)
QD		-0.22													-0.30	-0.20
		(0.18)													(0.27)	(0.52)
M_SUR			-0.02											-0.21	-0.19	-0.19
			(0.94)											(0.38)	(0.46)	(0.45)
M_KPSS				-0.50**										-0.37	-0.39	-0.39
				(0.02)										(0.13)	(0.11)	(0.11)
M_ESTAR					-0.46**									-0.36*	-0.25	-0.25
					(0.02)									(0.09)	(0.36)	(0.37)
R_SSA						0.95***										
						(0.01)										
R_EAP							0.03									
							(0.88)									
R_ECA								-0.27								
								(0.12)								
R_LAC									-0.17							
									(0.75)							
R_MENA										0.44*						
										(0.06)						
R_SA											-0.62**					
											(0.03)					
R_NA												0.28				
												(0.54)				
INC													-0.09			-0.08
													(0.26)			(0.53)
Constant	-0.40***	-0.17	-0.26***	-0.17*	-0.15	-0.33***	-0.27***	-0.17*	-0.26***	-0.33***	-0.20**	-0.28***	0.04	-0.07	-0.21	-0.02
	(0.00)	(0.13)	(0.00)	(0.06)	(0.13)	(0.00)	(0.00)	(0.09)	(0.00)	(0.00)	(0.02)	(0.00)	(0.90)	(0.52)	(0.16)	(0.96)
McFadden R-squared	0.01	0.01	0.00	0.02	0.02	0.02	0.00	0.01	0.00	0.01	0.02	0.00	0.00	0.03	0.04	0.04

Notes: As per Table 3.

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Appendix A. Summary of past studies on NEO

Study	Countries	Key findings
i. NEO Sustainability		
Tang (2007)	G7 countries	Augmented Dickey–Fuller (ADF) unit root tests suggest that the NEO of all the G7 countries are sustainable – Canada, France, Germany, Italy, Japan, the U.K., and the U.S.
Tang and Lau (2008)	13 Asia countries	Conventional time series unit root tests failed to draw a consistent finding on the NEO sustainability. Seemingly Unrelated Regressions ADF (SURADF) panel unit root tests support for Singapore, Bangladesh, Indonesia, Korea, and Malaysia but not the case for Maldives, Mongolia, Myanmar, Nepal, Pakistan, the Philippines, Sri Lanka, and Thailand.
Tang and Wong (2008)	Malaysia	NEO is sustainable from four types of tests – ADF, Phillips-Perron (PP), Kwiatkowski-Phillips-Schmidt-Shin (KPSS), and Elliott-Rothenberg-Stock DF-GLS test.
Mishra et al. (2008)	Australia	NEO is sustainable under the unrestricted two-regime Threshold Autoregressive (TAR) model.
Tang and Lau (2009)	23 OIC countries	SURADF tests empirically support only 9 out of 23 sampled OIC countries that their NEO is sustainable – Albania, Côte d'Ivoire, Indonesia, Kuwait, Malaysia, Mozambique, Pakistan, Tunisia, and Uganda.
Taştan (2015)	33 OECD member countries	ADF show that 10 out of 33 the OECD countries have stationary NEO (Austria, Belgium, Chile, Luxembourg, New Zealand, Norway, Slovak Republic, Sweden, Switzerland, and Turkey). Under the Exponential Smooth Transition Autoregressive (ESTAR) Models, the Fourier-ADF (FADF) test shows NEO is sustainable for 12 countries (Austria, Belgium, Chile, Estonia, Iceland, Ireland, Japan, Luxembourg, Norway, Poland, Slovak Republic, and Switzerland); and only 6 countries from the Fourier-Kapetanios, Shin and Shell (FKSS) tests, namely Australia, Canada, Hungary, Norway, Switzerland, and the U.S. A consistent finding of these tests (i.e. ADF, FADF, and FKSS) observed only for Norway and Switzerland. Nonetheless, FKSS stationarity test is more reliable than of ADF and FADF.
ii. Sources of NEO		
Duffy and Renton (1971)	The U.K.	Major 'errors' (and omissions) were identified by the principal components (exports and re-exports of goods, imports of goods, net total invisibles, net private investment abroad and in the U.K., the net change in external Sterling liabilities, miscellaneous capital, and the overall monetary balance), the determinants of unidentified monetary flows (the Sterling-Dollar exchange rate, and the U.K. covered interest differential – with the U.S.) as well as the one-quarter lagged NEO, which proxies the timing errors in the recording of transactions.
Fausten and Brooks (1996)	Australia	Ordinary least squares (OLS) estimator suggests that the size of the NEO is mainly determined by the variability of the current and capital accounts components such as merchandise trade, services, income payments, unrequited transfers, general government, Reserve Bank, direct

		investment, and portfolio investment. there is a gradual secular shift from current transactions ('leads and lags') to capital transactions ('hot money') in response to the institutional changes i.e. liberalisation and deregulation of Australian financial markets from 1970 throughout mid 1980s had causes noticeably difference in its time pattern compared to another four industrialised countries namely Germany, Japan, the U.K., and the U.S. The macroeconomic variables i.e. exchange rate, and economic openness also causes the variability of the Australian NEO.
Tombazos (2003)	Australia	Commenting on the Fausten and Brooks' (1996) work, he opined that the asymmetric sample of the Australia's NEO as more likely impressionistic, instead of the factual accuracy promoting revisions that statistically consistent and meaningful.
Blomberg et al. (2003)	Sweden	Net export in foreign trade, households' direct investment abroad, securities trading with other countries, and the banking sector's transactions abroad are overestimated. Short term capital movement is another factor raising the monthly fluctuations of NEO.
Fausten and Pickett (2004)	Australia	The Bayesian methods of testing (based on classical methods of Bai and Perron (1998)) for multiple structural changes revealed that the changes in the institutional and policy environment justified the structural instability of the NEO behaviour. Besides, the financial sector transactions such as overseas investment are the major source in the NEO evolution support the assertion of gradual secular shift from the current sector transactions.
Tang (2005)	Japan	Subset vector autoregression (VAR) approach for Granger non-causality, impulse responses function, and variance decomposition tests reveal that Japan's NEO is influenced by exchange rate volatility as well as its past information i.e. 'timing error', although it is small.
Tang (2006a)	Japan	Subset VAR, Granger non-causality, impulse responses function, and variance decomposition tests support the influence of economic openness on the NEO which reflects the reliability of Japan's BoP accounts statistics, although its impact is small.
Tang (2006b)	Japan	Granger non-causality tests documents that the past values of service credit, change of service debit, change of income credit, change of portfolio investment assets, and portfolio investment liability does individually cause the current Japan's NEO behaviour. Based on the forecast error proportions (subset VAR), the study found that NEO is explained by 'timing errors' in the recording of transactions in BoP accounts.
Lin and Wang (2009)	Norway, Sweden, the Philippines, and South Africa	The estimated OLS regressions inform that the factors of NEO behaviour are varying i.e. trade openness for Norway; seasonal factors such as weather, vacation, and holidays for Sweden; timing errors for South Africa; and none for the Philippines. In fact, timing errors (lagged NEO) fail to support Tang's (2006b) studies.
Vukšić (2009)	Croatia	In general, there is very large amount of unrecorded seasonal accumulation of foreign cash surplus resulting a negative NEO value, likely due to unreported or understated revenue from foreign tourists spending as well as loopholes

		in the tax collection mechanism for income generated within the shadow economy.
Tang (2013)	Australia	From the perspective of BoP constraint approach, the empirical estimates that both the exchange rate, and real interest rate are key 'drivers' in explaining the Australian NEO pattern. Meanwhile, real GDP is the only significant 'driver' under the income-expenditure approach. Also, real GDP, foreign income, foreign interest rate, domestic interest rate, and exchange rate has either directly or indirectly (individually) causes errors and omissions over the sample period.
Širaňová (2016)	Slovakia	Autoregressive Distributive Lag (ARDL) bounds tests reveal that dependent variables of goods credit and debit, services credit and debit, income-employees credit, FDI abroad debit, other investments long term credit and debit, GDP, and GDP world nominal are statistically significant in affecting the NEO behaviour. The findings show promising evidence of significant long-term causal relationship in bivariate regression (based on Engle-Granger two-step procedure cointegration approach) and those variables are cointegrated. All variables but import of services are statistically significant for possible NEO determinants.
iii. Statistical characteristics		
Hooy and Tang (2007)	Australia	NEO volatility could be well captured by the Generalised Auto-Regressive Conditionally Heteroscedastic (GARCH) model. However, it is better interpreted in Asymmetric Component Generalized Autoregressive Conditional Heteroscedasticity (AC-GARCH) model which takes into account both asymmetric and permanent transitory volatility behaviours of the time series. The impact of the NEO volatility shocks took some time to be digested in the Australian economy.
Tang (2009)	20 industrial countries	Non-linearity methods are explored in assessing the accuracy of the NEO of BoP statistics via five forms of non-linearity tests, namely McLeod-Li test, the bicorrelation test, the Tsay test, the Engle LM test, and the BDS test. Except for Denmark, Finland, Netherlands, and Norway, the hidden structure i.e. non-linearity is found for the rest of the 16 industrial countries (New Zealand, the U.S., the U.K., Portugal, Iceland, Sweden, Greece, Ireland, Canada, Australia, Japan, Germany, Austria, Italy, France, and Spain).
Taştan's (2015)	33 OECD member countries	Nonlinearity is essential characteristic for the balancing item of BoP of the OECD countries.