New Perspectives on the ‘Net Errors & Omissions’ in Balance of Payment Accounts: An Empirical Study - Australia

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Abstract
This study aims to identify and examine the potential economic factors that determining the ‘net errors & omissions’ (EO) in balance of payment accounts. Two structural specifications are derived from the balance of payments (BoP) constraint, and open economy macro equilibrium (income-expenditure approach), respectively. There are some positive findings. The empirical results obtained from the Australian data show real GDP, foreign income, foreign interest rate, domestic interest rate, and exchange rate have either directly or indirectly caused EO over the sample period 1960-2010. Also, a reverse direction is obtained from EO to domestic interest rate. This study is considered as an important reference for further research.

Keywords: Australia; Balance of payment; Causality; Net errors and omissions
JEL code: F32; F41

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1. Introduction

News of new balance of payments (BoP henceafter) statistics announcement and released by the local government authorities is crucial for practitioners (i.e. investors and policy makers) and academic economists for analyzing and forecasting the directions of a country’s economic performance as well as to formulate economic policy. Also, the significance of the balance of payments statistics as a base for monetary and foreign exchange policy has varied considerably over time. The uncertainty created by ‘errors’ and ‘omissions’ can affect the use and interpretation of economic and financial statistics where the balance of payments contributes a base. Therefore, the quality (or reliability) of BoP statistics is a core concern.

Broadly speaking, the net ‘errors and omissions’ (EO henceafter) is one of the indicators that can be utilized to validate the quality of the BoP statistics. As documented by (Fausten & Brooks), “…balance of payments statistics, and their reliability, are matters of public interest. Their importance in the public and policy arena is, ipso facto, transmitted to the balancing item because that statistic is generated by the factual and systemic imperfections, the errors and omissions, that permeate the balance of payments statistics’ (Fausten & Brooks, 1996, p. 1303). More generally, the ‘errors’ refer to the transactions are recorded incorrectly while, the ‘omissions’ are the transactions are not recorded at all (Fausten & Brooks, 1996, p. 1303). As alerted in the IMF Balance of Payments Manual¹, a balancing item is considered ‘too big’ if it exceeds 5% of the sum of gross merchandise imports and exports. By and large, small values of EO do not indicate that the BoP statistics are reliable, and vice versa; as small EO values are compatible with very large absolute errors and omissions on each side of the ledger; and it [small EO] can suddenly explode without any change in statistical procedure or economic behaviour (Fausten & Brooks, 1996, p. 1304).

Conceptually speaking, it is ideally to assume that the total recorded debit does always equal the total recorded credit of a country’s balance of payments accounts. However, it is always not the case in the ‘real world’ which is not a perfect place that the BoP accounts are subjected to the ‘adding up’ problem - both the total recorded debit and credit are not recorded with the same monetary amounts. According to the double entry bookkeeping principle, a numeric value of EO (or balancing item) is technically added to justify the equality between total recorded debit and credit columns – it is obtained simply by calculating the difference between total recorded credit transactions and total recorded debit transactions

per time period. The reported sign (positive or negative) of EO can be interpreted as follows. A positive EO may indicate the under-recording of credits (capital inflows, exports of goods and services or other current account receivables) or the overstating of debits (capital outflows, imports of goods and services or other current account payables), or both. By the same token, a negative sign of EO may indicate under-recording of debits (i.e. capital outflows or current account debits) and/or overstating of credits (i.e. capital inflows or current account receivables), see (ABS, section 2.14).² If the EO is predominantly in one direction, this suggests that errors and omissions are occurring systematically rather than randomly. Intuitively, the “leads and lags” in trade may have been the dominant source of recording errors - with the progressive dismantling of exchange controls and financial liberalization and securitization, “hot money” flows and “off-balance-sheet” transactions are likely to have assumed increasing importance as determinants of errors and omissions in the balance of payments records (Tang & Fausten, 2012, p. 235).

This study is motivated by a need to investigate the nature of the impact of economic variables on the ‘emotions’ of EO in BoP. (Tombazos, 2003) has delivered a ‘strong’ view that data of balancing item (EO) that incorporates excessively a dynamically asymmetric concentration of revisions and are therefore unsuitable for statistical analysis. From the academic economists’ perspective including practitioners, however, EO is a potential research area or topic because it has important policy implications, especially in light of the recent literature emphasizing the role of economic influences on EO as the main driver of quality of BoP statistics, which is crucial for evaluating the appropriateness economic policy. By the same token, the published EO statistics are not just a numerical figure to ratify the double entry bookkeeping principle, but it may contain some ‘hidden’ information for the relevant markets – goods and services, and financial. For examples, two ‘casual’ articles (Blomberg, Forss, & Karlsson, 2003) and (Vukšić, 2009) relating the currency deregulation and the large

expansion in the financial flows to EO\(^3\), and unreported income from tourists can be ‘captured’ by EO\(^4\), respectively.

There is very little knowledge about the sources of errors in the balance of payments accounts (Duffy & Renton, 1971, p. 451). Surveying a vast empirical literature, we are aware of that analyzes the role of economic influences on EO (or balancing item) in a country’s balance of payments accounts is indeed limited, and has been overlooked by researchers.\(^5\) In general, the key economic variables identified by them - monetary balances (Duffy & Renton, 1971), exchange rate (Duffy & Renton, 1971); (Fausten & Brooks, 1996), exchange rate volatility (Tang, 2005), interest differential (Duffy & Renton, 1971), and economic openness (Fausten & Brooks, 1996) (Tang, 2006a) (Lin & Wang, 2009) are considered ad hoc as they are not systematically derived from theory. In this context, the correlation between these ad hoc factors and EO may not reveal the true structural relationship as informed by economic theory. Fuelling this study is the fact that the empirical evidence for economic influences generating positive results for EO determination is plausible. This is the key issue we need to contend with. Hence, this study is a first attempt at examining the structural relationships between EO and a set of economic variables that derived from the two simple theoretical frameworks, namely BoP constraints and from open economy macro equilibrium, see (Tang & Fausten, 2012). Formal time series econometric methodology is employed for the Australian data for empirical illustration, and their findings are positive.

This study is organized as follows: in Section 2, an overview of the literature is provided with the nature of the studies. In the Section 3, two structural specifications are derived from the BoP constraints and from the open economy macro equilibrium via income-expenditure

\(^3\) An article published by Sveriges Riksbank Economic Review (Blomberg, Forss, & Karlsson, 2003) documented that the EO has increased significantly for some years now, and an international comparison shows that the Swedish errors and omissions item is considerable. The article analyzed the factors contributing to this item and discusses how it affects the interpretation of the balance of payments statistics and other economic statistics. Factors which have most probably contributed to the rapid increase in EO at the end of the 1980s and beginning of the 1990s are the currency deregulation and the large expansion in the financial flows in particular in the form of securities and short-term transactions that followed on from this.

\(^4\) A newsletter from Croatia, Institut Za Javne Financije (Vukšić, 2009) evaluated the size of unreported income from foreign tourists using EO statistics. The large amounts of unrecorded accumulation of foreign cash from foreign tourist spending are largely related to shadow economy in tourism, i.e. to unreported – and therefore untaxed – income from foreign tourists. A relatively high correlation (0.95) is also illustrated between two variables with exception for 2001 which saw a fall of the EO value and a significant rise in tourism income provides a basis for some conclusions in the interpretation of the EO item in Croatia.

\(^5\) Section 2 reviews the relevant studies those examined the EO (or balancing items).
approach, respectively. Section 4 reports the empirical results of multiple (OLS) regressions, and Granger causality tests. In the final section, some concluding remarks are delivered.

2. Literature Review

Literature survey shows that the empirical studies on the relevant topics of EO (or balancing items) are extremely few. Among the authors are Duffy, Renton, Fausten, Brooks, Pickett, Tombazos, Lin, Wang, Blomberg, Forss, Karlsson, Vukšić, and Tang. Also, we observed that there is insufficient theoretical specification(s) and empirical evidence to build better understanding and new knowledge on the nature of the EO in country’s balance of payments accounts. Nevertheless, their studies contribute valuable insights to academic economists who plan to further investigate the potential issues of EO.

A seminal work (Duffy & Renton, 1971) explored empirically the explanatory relationships for the balancing item of U.K. balance of payments accounts. Major ‘errors’ (and omissions) were identified by the principal components of the balance of payments accounts, and included some determinants of unidentified monetary flows. The right-hand side variables are 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, the overall monetary balances, spot exchange rate, interest differential, and one-quarter lagged balancing item (proxies the timing errors in the recording of transactions). A set of estimated regressions based on the sample 1958-1976 show the major errors to be identified, especially by the principle components of the balance of payments accounts. However, the two macroeconomic variables, the U.K.-U.S. covered interest rate differential does not appear to be ‘significantly’ in explaining the movements of balancing item; and the exchange rate has an economically implausible sign. The lagged variable of balancing item contributes significantly revealing that the U.K.’s ‘errors and omissions’ arises from timing errors in the recording of transactions.  

However, it is interesting to note that no extensive research among scholars on the topic of ‘net errors & omissions’ (or balancing item). This research area is in vacuum for a quarter of century. In 1996, (Fausten & Brooks, 1996) studied Australia’s balancing item of balance of

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6 Some of the past studies used the term balancing item, hence we use them interchangeably for this section.
7 They (Duffy & Renton, 1971, p. 461) noted that “…in a way that is meaningful from an economic point of view – for the “significant” and negative coefficient on the lagged first differences of the balancing item suggests that this item accounts for timing errors in the recording of transactions”. 

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payments accounts with both descriptive and data-driven approaches. However, Duffy’s work does not appear in their study for review. A causal inspection of the balancing item time series for Australia, Germany, Japan, U.K. and U.S., shows the variability of the balancing item can be understand from the time pattern of institutional changes that results a gradual secular shift from current transactions (‘leads and lags’) to capital transactions (‘hot money’) in response to the liberalization throughout the 1970s of world financial markets, together with deregulation of Australian financial markets in the mid-1980s. Other qualitative factor is the country-specific traits and the particular timing of financial deregulation in Australia (Fausten & Brooks, 1996, p. 1304). Of the data-driven approach, balancing item is potentially explained by the gross transactions flows of the principle components of the balance of payments accounts - similar idea to Duffy, mainly merchandise trade, services, income payments, unrequited transfers, general government, Reserve Bank, direct investment and portfolio investment. The preliminary regression results show the current account variables have a role to play in the determination of the balancing item for the quarterly observations 1959(4) to 1992(3). Also, the capital (financial) account variables are important drivers. However, the study fails to support the view that recording mistakes constitute a major source of the balancing item. The supplementary experiments show that the exchange rate and economic openness do not explain the Australian balancing item.

Few years later, (Tombazos, 2003) commented (Fausten & Brooks, 1996)’s study. The study developed and empirically evaluated a model of the process of revisions of balance of payments data. He found dynamically inconsistent time series of the balancing item, such as that employed by Fausten and Brooks are bound to generate an artificial impression that it follows an ‘explosive’ time trend, therefore unsuitable for statistical analysis. Using balance of payments statistics revisions (Fausten & Pickett, 2004) re-examined the ‘drivers’ of Australian balancing item as initially reported by (Fausten & Brooks, 1996). They reported that only limited evidence of convergence of measured to true magnitudes of cross-border transactions. Empirical results show there is robust evidence of structural instability of the balancing item, and the financial sector transactions appear increasingly to constitute the major source of misreporting of balance of payments outcomes.8

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8 They considered the statement made by (International Monetary Fund, 1987) that the global incidence of errors and omissions recognized by debtor countries but not by creditors (p.2). IMF also identified persistent overrecording of debits in the shipping and transportation accounts and in the reporting of official unrequited transfers. Hence, (Fausten & Pickett, 2004) included capital transfers, net direct investment flows, net portfolio flows, and net other investment flows as explanatory variables.
Following (Fausten & Brooks, 1996), (Tang, 2005) examined the role of exchange rate volatility in explaining the balancing item for Japan’s balance of payments accounts. He employed subset VAR (vector autoregression) approach, Granger causality test, impulse responses function, and variance decomposition. The finding is positive although small. In addition, (Tang, 2006a) has empirically investigated other macroeconomic variable – economic openness, its influence on Japan’s balancing item. Using similar methods from (Tang, 2005), his results support the hypothesis that economic openness does influence Japan's balancing item. Based on the past studies (Duffy & Renton, 1971) and (Fausten & Brooks, 1996), (Tang, 2006b) also included the first differenced lagged balancing item and a set of principle components of balance of payments as potential explanatory variables to analyze the balancing item for Japan’s balance of payments accounts. The causality results show that the services credit, services debit, income credit, portfolio investment assets, and liability do solely Granger-cause the variation of balancing item. The data-driven regression supports the components accounts as well as the timing errors the main sources of statistical discrepancy for the balance of payments accounts. (Lin & Wang, 2009) extended the previous studies by examining simultaneously the role of timing errors, capital flows, and economic openness on the balancing item for four countries – Norway, Sweden, the Philippines, and South Africa. The estimated multiple regressions show that the factors (or drivers) of the balancing item are different among the four countries - trade openness for Norway, seasonal factor for Sweden, all the variables for South Africa (except for timing errors), and none for the Philippines. The timing errors fail to explain the balancing item in each the sampled country.

Another group of studies looks at the nature of balancing item – its sustainability. Some of the earliest work by (Tang, 2007a) runs the unit root tests with an assumption of unknown level shift (or break date) for the G7 countries (Canada, France, Germany, Italy, Japan, U.K., and U.S.). The results provide empirical support that balancing item of the country’s balance of payments accounts are sustainable (stationary). Applying other testing method - rolling ADF unit root tests, (Tang, 2007b) confirmed that 19 out of 20 industrial countries have sustainable balancing item, but unstable over the rolling windows of the sample period. On the other hand, (Tang, 2008) showed that the size of the balancing items for all the 18 industrial

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9 The sampled countries recorded more than 20% of the observations exceed the IMF’s 5% criterion of ‘smallness’. The explanatory variables are the lagged term of the balancing item, spot exchange rate
countries are technically ‘too big’. The unit root tests (with level shifts) revealed that the balancing items are sustainable for the most of the countries, except for Iceland, Denmark, Japan, Italy, France, and Spain. Also, (Mishra, Smyth, & Tang, 2008) found that the balancing item of the balance of payments in Australia is characterized by a non-linear (see (Tang, 2009)), but stationary, series meaning that the balancing item is sustainable. (Tang & Lau, 2008) examined the sustainability of balancing item in Asian economies. The conventional unit root tests (includes the standard panel tests) are inconclusive. However, the series-specific panel unit root tests consistently show that five countries’ balancing item is on the sustainable path (Singapore, Bangladesh, Indonesia, Korea, and Malaysia). Other countries (Maldives, Mongolia, Myanmar, Nepal, Pakistan, the Philippines, Sri Lanka and Thailand), have her unsustainable balancing item of balance of payments accounts.

Using OIC (Organisation of the Islamic Conference) member countries’ balance of payments accounts, (Tang & Lau, 2009) showed that the series specific panel unit root test (SURADF unit root tests) suggest that only 9 out of 23 sampled OIC member countries have their balancing item sustainable, namely Albania, Coted’Ivoire, Indonesia, Kuwait, Malaysia, Mozambique, Pakistan, Tunisia, and Uganda.

The next nature of balancing item that had been examined is its non-linear component. The non-linearity of financial and economic time series is becoming a fundamental issue both at the theoretical and empirical level. (Tang, 2009) applied equally to the balancing item of balance of payments accounts. An autoregressive, AR(p) model is employed by Tang in order to remove any linear structure from the balancing item series. A battery of non-linearity tests showed the presence of non-linear dependencies in the balancing item series for 16 out of the 20 industrial countries. An implication is that the non-linear dynamics of these balancing item series should be incorporated in the modelling and forecasting exercises. By the same token, (Tang & Hooy, 2007) exploded the possibility of fitting a pure time series model to explain the balancing item of Australia’s balance of payments accounts. They found that Australia’s balancing item can be explained well by a pure time series model. The volatility of balancing item series has a significant role in explaining the balancing item. Also it is better captured by an Asymmetric-Component GARCH (AC-GARCH) model which takes into account both asymmetric and permanent-transitory volatility of the time series. The Australian balancing item was found to have a long memory in digesting shocks.
3. Analytical Framework

This section proposes two empirical specifications (structural equations) for EO from the balance of payment (BoP) constraint and the open economy macro equilibrium, respectively. It follows the methodology employed by (Tang & Fausten, 2012) which examined the interdependence hypotheses – current and capital accounts interdependence.

In principle, the balance of payments (BoP) constraint dictates that the *ex post* Balance of Payments identity is given by:

\[ \text{BoP} = \text{CA} + \text{FA} \equiv 0 \]

where CA stands for current account. In conformity with current nomenclature and practice the financial account (FA) is emphasized instead which assimilates private capital flows and official reserve transactions (i.e. \( \text{FA} \equiv \text{KA} + \Delta IR \)). Both current account and financial account are the true balances of transaction flows on current and financial accounts. Conceptually speaking, equation (1) is not purely a double entry bookkeeping principle but it does explain the relevant economic behaviour (interdependence) between both the balances, see (Fausten, 1989-90). Current account imbalances can be financed either in private capital markets or by official reserve flows (\( \Delta IR \)). Conversely, any attempt by the authorities to build up their net foreign asset holdings requires commensurate current account surpluses unless they acquire those foreign assets from private domestic holdings.

Following (Fausten & Pickett, 2004, p. 111) the balance of payments accounts *report* the measured quantities.

\[ \hat{\text{CA}} + \hat{\text{FA}} + \text{EO} \equiv 0 \]

where the ‘\(^\wedge\)’ denotes measured quantities, and EO is the ‘net errors & omissions’. Following Fausten and Pickett, solving equations (1) and (2) simultaneously for EO yields equation (3).

\[ \text{EO} \equiv (\text{CA} - \hat{\text{CA}}) + (\text{FA} - \hat{\text{FA}}) = \text{EO}_{\text{CA}} + \text{EO}_{\text{FA}} = \sum_i \varepsilon_i + \sum_i \nu_i \]

The ‘net errors & omissions’ (EO) are composed of the sum of discrepancies between true and measured transactions balances on current (CA) and financial accounts (FA). Hence, the errors and omissions either from current (EO\text{CA}) or from financial accounts (EO\text{FA}), or both simultaneously contribute to the total ‘net errors & omissions’ (EO). The discrepancies may consist of systematic errors (\( \varepsilon \)) and of unsystematic errors (\( \nu \)). For simplicity, it is assumed that unsystematic errors are independently and identically distributed with zero mean and
constant variance so that the ‘net errors & omissions’ (EO) represent the systematic errors (Fausten & Pickett, 2004, p. 111).

BoP Constraint

Equation (1) captures the BoP constraint framework. Assuming (in practice) the true values of CA and FA are unknown, but only available the reported values from the balance of payments statistics (denoted with ‘^’) i.e. CA = \( \hat{CA} + EO_{CA} \), and FA = \( \hat{FA} + EO_{FA} \). Re-arranging equation (2) for EO yields

\[
EO = -\hat{CA} - \hat{FA}
\]  

(4)

For simplicity, the values of EO are assumed in positive sign indicating under-recording of credits or the overstating of debits, or both. Conversely, the current account balance CA = X - M (where X is exports of goods and services, and M is imports), and the financial account balance FA = DI + PI + OI + \( \Delta IR \) (where DI is net direct investment flows, PI is net portfolio flows, OI is other investment flows, and \( \Delta IR \) is change in reserve asset holdings) are in deficits, see (Tang & Fausten, 2012).

Builds on the composite nature of the component balances, the deficits of both current account (-CA) and financial account (-FA) are offset by a positive value of EO. The BoP constraint suggests that ‘net errors and omissions’ (EO) can be explained by a set of behavioural variables that determine current account (CA), and financial account (FA). Identify the relevant behavioural relationships that underlie the determination of current account and financial account variables.

\[
EO = -\hat{CA}(y, e^+, y^*(+), r^+, r^*(\cdot)) - \hat{FA}(r^+, r^*(\cdot))
\]  

(5)

where \( y \) is domestic output or GDP; \( e \) is nominal exchange rate expressed by “No. of LX/1FX” (LX is local exchange and FX is foreign exchange); The foreign income is denoted as \( y^* \); and \( r \) and \( r^* \) represent domestic and foreign interest rates, respectively.

Conventionally, economic theory states that the current account (CA) is positively explained by exchange rate (\( e \)), and foreign income(\( y^* \)), while the domestic income (\( y \)) has negative

10 If the balancing item is predominantly in one direction (i.e. generally positive or negative), this suggests that errors and omissions are occurring systematically rather than randomly (ABS, section 2.14). http://www.abs.gov.au/AUSSTATS/abs@.nsf/Latestproducts/98382A262D7DFDDFC25697E0018FDB0?openDocument (Accessed at 15.7.2013)
The financial account balance (FA) is positively explained by domestic interest rates (r), but negatively related to foreign interest rates (r*). It is to say that 
\[
\frac{dE_O}{dy} = \frac{dCA}{dy} > 0, \quad \frac{dEO}{de} = \frac{dCA}{de} < 0, \quad \frac{dEO}{dy} = \frac{dCA}{dy^*} < 0, \quad \frac{dEO}{dr} = \frac{dFA}{dr} < 0, \quad \text{and} \quad \frac{dEO}{dr^*} = \frac{dFA}{dr^*} > 0.
\]
Both y and r* variables are expected to have a positive impact on a country’s EO by either current account or financial account. The e, y*, and r have negative impact on EO.\(^{11}\)

Open Economy Macro Equilibrium: Income-expenditure approach

The alternative approach to understand the EO determination is informed by the general equilibrium perspective of two-sector open economy, namely income-expenditure approach. It ‘complements’ the former approach (BoP constraint) which is essentially based on accounting relationships by incorporating relevant structural relationships. From national income-expenditure approach the current account balance (CA) is equivalent to the national saving minus investment balance

\[
CA = S^n - I
\]

In a closed economy, total national savings, \(S^n\) is fully utilised to domestic investment, I. However, in an open economy national saving can be invested at home or abroad that the relationship between savings and investment can be rewritten as \(S^n = I^d + I^f\) where \(I^f = CA = -FA\). Foreign investment \((I^f)\) is reflected in the acquisition of foreign assets \((FA < 0)\) and commensurate transfers of domestic real resources to users abroad \((CA > 0)\) (see Fausten, 1989-90). The two main component accounts (CA and KA accounts) of the balance of payments enter into the relevant market clearing conditions of an open economy. The current account balance represents the excess supply of domestic output while the balance on capital account reflects the excess demand for bounds or, in the contemporary emphasis on the financial account, the excess demand for assets (Tang & Fausten, 2012, p. 236).

The structure of this interdependency is conceptually informed by the recognition that any economic disturbance and its response are not restricted to a particular subset of markets (Tang & Fausten, 2012, p. 230). Accordingly, all transactions in goods and services are mediated by financial instruments of one kind or another. In view of the interdependence between the current account and capital account, equation 4 in Fausten and Pickett (2004, p. 111) can be rewritten as \(S^n - I = CA = FA + EO = -FA = -(FA + EO)\). In (Fausten & Pickett, \(^{11}\) The exchange rate (e) is expressed as “No. of LX/1FX”, so e drops with an appreciation of home currency (local exchange), rises the EO (positively related to appreciation of home currency).
have conceptually introduced some macroeconomic structure i.e. savings-investment balance into the EO determination, but no further empirical work as they raised a concern that “Since that type of reduced form does not discriminate between the alternative interpretations of the saving-investment balance it is unlikely to isolate the dominant source of E&O (errors and omissions)” (Fausten & Pickett, 2004, pp. 111-2). Accordingly, the estimated parameters of $S^n$ and $I$ are not adequately explaining the ‘emotions’ of EO. However, the so-called ‘interpretations’ issue can be tentatively handled by modelling the behaviour of $\tilde{S}(.)$ and $\tilde{I}(.)$ from the general equilibrium perspective: we apply the income-expenditure approach.

Substituting equation (6) onto equation (4) yields $EO = -\tilde{S}(.), \tilde{I}(.) - \tilde{F}A(.)$. The requirements in the goods market (income-expenditure approach) suggest that EO can be explained by a set of behavioural variables that determine national saving ($S^n$), private investment ($I$), and financial account (FA). Identify the relevant behavioural relationships that underlie the determination of national saving, private investment, and financial account. $EO = -\tilde{S}(y^+, r^+) + \tilde{I}(r^-) - \tilde{F}A(r^+, r^-)$ (7)

Economic theory suggests that national saving ($S^n$) is positively explained by households’ disposable income ($y$), and domestic interest rate ($r$). Domestic investment ($I$) is negatively related to domestic interest rate ($r$), and the financial account balance (FA) is positively explained by domestic interest rate ($r$), and negatively related to foreign interest rate ($r^*$). Hence, it is to say that $\frac{dEO}{dy} = \frac{dS^n}{dy} < 0, \frac{dEO}{dr} = \frac{dS^n}{dr} = \frac{dI}{dr} < 0$, and $\frac{dEO}{dr^*} = \frac{dFA}{dr^*} > 0$. Both $y$ and $r$ has negative impact on a country’s ‘net errors and omissions’, while the $r^*$ has positive sign.

4. Empirical Illustrations

This section reports the empirical results of ‘net errors & omissions’ (EO) equations those are theoretically derived and outlined in the previous section with the Australian data. The standard time series methods, namely OLS linear regression, and multivariate Granger causality approach are employed since they (in particular, the latter) are econometrically sound, have been widely used in a variety of different contexts, and have some intuitive appeal. Figure 1 shows the ‘emotions’ of the EO in the Australian BoP accounts over the past decades, 1960-2010. The reported EO values are small or less volatile in between 1960s, and early 1970s. It is noted that Australia introduced the Australian Dollar (A$) pegged to US Dollar (US$) from 1946 to 1971 under the Bretton Woods system, until September 1974.
trade weighted index took place until November 1976. By the same token, small volumes of international transactions, especially from the capital (financial) account in the early 1970s may explain the small ‘errors’ and omissions’. A substantial negative EO is occurred in late 1980s, in which the Australian exchange system is under managed floating from December 1983 to present. In 1990s until 2010, the EO values are more volatile, but in a predictable pattern (with a given range). Of course, other fundamental and non-fundamental factors as described early in the literature review are correlated with the ‘emotions’ of EO.

Figure 1 Plot of the Australian ‘Net Errors & Omissions’ for the Period 1960Q1-2010Q2 (in A$ billions), OECD Main Economic Indicators
The sample covers quarterly observations between 1960 (Q1) and 2010(Q2). The core variables are listed and described as follows.

1. *Net errors & omissions* (lnEO): The data are obtained from OECD Main Economic Indicators. It is reported in local currency A$ (in billions). Nominal values are converted into real terms by GDP deflator. The ‘ln’ is natural logarithm (a constant value is added to generate positive values).


3. *Real interest rate*, (r): It is proxied by the Australian long-term government bond yield (% p.a). Real interest rate is adjusted by domestic inflation rate. The data source is similar to 2.
4. **Real exchange rate**, (ln e): The variable is quoted as US$ per A$. Nominal exchange rate is multiplied by a price ratio, Australia’s GDP deflator per US’s GDP deflator. The raw data are obtained from International Financial Statistics, IMF.

5. **Foreign real interest rate**, (r*): Same as calculation in 3. The “foreign” interest rate is proxied by US long-term government bond yield. Nominal values are converted into real terms by US inflation rate. The data are collected from the source as in 2.

6. **Foreign real GDP**, (ln y*): As noted in 5, the “foreign” is proxied by US. The data of US GDP volume constant prices are directly obtained from International Financial Statistics, IMF.

**Table 1 Summary Statistics for the Australian Net Errors & Omissions, 1960Q1-2010Q2.**

| Statistic          | Value  
|--------------------|--------
| Mean               | -0.05 (A$ billions) |
| Median             | -0.04 (A$ billions) |
| Maximum            | 0.62 (A$ billions)  |
| Minimum            | -1.65 (A$ billions) |
| Standard Deviation | 0.35 (A$ billions)  |
| Skewness           | -0.88   |
| Kurtosis           | 6.02    |
| Jarque-Bera        | 102.36  |
| (Probability)      | (0.00)  |
| Observations       | 202     |

Table 1 reports the summary statistics of the Australian ‘net errors & omissions’ over the past decades 1960-2010. On average, the Australian EO is reported in negative sign, -A$0.04 billions (median), which may conceptually suggest under-recording of debits (capital outflows or current account debits) and/or overstating of credits (capital inflows or current account receivables). The largest negative EO is in 1986Q1 with A$1.65 billions but, in 1984Q1 and Q4 largest positive EO are recorded around A$0.62 billions, respectively. The Jarque-Bera statistic (with low p-value) suggests that the ‘net errors and omissions’ is non-normally distributed.

The OLS estimated parameters with respect to the structural equations (5) and (7) of BoP constraint and income-expenditure approach are reported in Tables (2) and (3). Equation (A) (or A’) is full-sample, while Equations (B1) (or B1’) and (B2) (or B2’) examine the role of progressive liberalisation of capital markets since 1989. The remaining equations (C), (D) and (E) (or C’, D’ and E’) are based on the sub-periods of different exchange rate regimes implemented by Australia’s central bank. Of equation (A) in Table 2, none of the
independent variables supports the theory at the 10% level of significance, except for the constant term suggesting some unexplained (or unidentified) sources of ‘errors and omissions’ over the sample period – a fixed value of EO that always exists in Australia’s BoP accounts. Equations (B1) and (B2) are established in order to recognise explicitly the rapid globalization of the capital markets in the late-1980s and until the mid-1990s domestic real interest rate (r) statistically significant at 1.7 to -1.8 in negative sign theory. Under the managed floating system started from 6 December 1983 to present, the real exchange rate plays a significant role in determining EO that an appreciation of A$ (with increase of US$ per A$), worsens (increases) the Australian ‘net errors and omissions’ position (equation E). This finding is contrary to early study by (Fausten & Brooks, 1996) that exchange rate has no explanatory power for the Australian balancing item. This empirical finding is found to be consistent with the BoP constraint’s predication.12

A more simplified structural EO equation derived from the income-expenditure approach of general equilibrium perspective, only included the role of y, r and r*. Both exchange rate (e) and foreign income (y*) are excluded. The results are found to be similar to the BoP constraint, none of the variables is statistically significant at 10% level, expect for the constant term (equation A’) over the full sample period. Also, it is the case for other equations (C’, D’ and E’) those takes the exchange rate regimes into account. The progressive globalization ( liberalisation) of capital markets started in late 1980s changes the results. The Australian income (lny) has a negative impact on EO as showed in equation (B2’).

| Table 2 Regression Results of Equation (5) – BoP Constraint |
|------------------|--------------------|----------------|--------------------|----------------|--------------------|----------------|
| Regression:      | A          | B1         | B2         | C        | D        | E        |
| ln y             | 0.132      | 0.140      | -0.561     | -0.172   | -0.694   | -0.796   |
| (0.460)          | (0.636)    | (0.303)    | (0.686)    | (0.739)  | (0.173)  |
| ln e             | 0.000      | 0.260      | 0.523      | -0.200   | -1.759   | 1.034*   |
| (0.999)          | (0.263)    | (0.364)    | (0.640)    | (0.608)  | (0.093)  |
| ln y*            | -0.090     | -0.257     | 0.425      | 0.249    | -0.361   | 0.872    |
| (0.481)          | (0.196)    | (0.486)    | (0.600)    | (0.832)  | (0.159)  |
| r                | 0.793      | 1.665*     | -1.760*    | -1.229   | 5.138    | -0.428   |
| (0.157)          | (0.064)    | (0.070)    | (0.390)    | (0.245)  | (0.723)  |
| r*               | -0.287     | 0.661      | 0.181      | -0.394   | -0.705   | 1.493    |
| (0.687)          | (0.5147)   | (0.885)    | (0.838)    | (0.711)  | (0.489)  |

12 In the previous section, the exchange rate, e is expressed as “No. of LX/1FX” with an expected negative sign on EO \( \frac{dEO}{de} =-\frac{dCA}{de} < 0 \). To say, an appreciation of local exchange (LX) with a drop of e, rises the EO. The Australian [real] exchange rate employed in this empirical section is reversely quoted as US$/A$. So, e rises with appreciation of A$ has positive impact on EO.
Table 3 Regression Results of Equation (7) - Income-Expenditure Approach

<table>
<thead>
<tr>
<th>Regression:</th>
<th>A</th>
<th>B1</th>
<th>B2</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iny</td>
<td>0.019</td>
<td>-0.048</td>
<td>-0.129*</td>
<td>0.015</td>
<td>-0.846</td>
<td>0.057</td>
</tr>
<tr>
<td></td>
<td>(0.416)</td>
<td>(0.437)</td>
<td>(0.059)</td>
<td>(0.886)</td>
<td>(0.581)</td>
<td>(0.598)</td>
</tr>
<tr>
<td>r</td>
<td>0.590</td>
<td>0.455</td>
<td>-0.893</td>
<td>-0.060</td>
<td>3.427</td>
<td>0.831</td>
</tr>
<tr>
<td></td>
<td>(0.253)</td>
<td>(0.570)</td>
<td>(0.225)</td>
<td>(0.952)</td>
<td>(0.284)</td>
<td>(0.432)</td>
</tr>
<tr>
<td>r*</td>
<td>-0.483</td>
<td>-0.060</td>
<td>-1.142</td>
<td>0.487</td>
<td>0.606</td>
<td>-1.328</td>
</tr>
<tr>
<td></td>
<td>(0.485)</td>
<td>(0.953)</td>
<td>(0.268)</td>
<td>(0.775)</td>
<td>(0.632)</td>
<td>(0.369)</td>
</tr>
<tr>
<td>Constant</td>
<td>1.470***</td>
<td>1.763***</td>
<td>2.366***</td>
<td>1.490***</td>
<td>5.582</td>
<td>1.279**</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.002)</td>
<td>(0.446)</td>
<td>(0.043)</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>-0.001</td>
<td>-0.016</td>
<td>0.025</td>
<td>-0.053</td>
<td>0.014</td>
<td>-0.000</td>
</tr>
</tbody>
</table>

| Sample period | 1960Q1- | 1960Q1- | 1989Q1- | 1960Q1- | 1976Q4- | 1983Q4-
|---------------|---------|---------|---------|---------|---------|---------|

Notes: Similar to the notes documented in Table 1.

Multivariate VAR Granger causality

The empirical investigation can be carried out by Granger causality approach. In a more complicated but appropriate to present topic, causality approach helps to empirically identify the possible linkages among a set of variables - in Granger’s reading, “the X causes Y”. According to (Granger, 1988, p. 200), the cause occurs before the effect, and the causal series contains special information about the series being caused that is not available in the other available series. A multivariate VAR(8) system is employed in which taking all variables into account, simultaneously i.e. \( EO, y, e, y^*, r \) and \( r^* \), and \( EO, y, r \) and \( r^* \) for the equations (5) and (7), respectively. All of the equations from the VAR(8) system are not reported here.\(^{13}\) Their

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\(^{13}\) The computed statistics of the Granger causality/block exogeneity tests (by Eviews 7) are not reported here, but they are available upon request. Also, the conceptual framework of the tests is not illustrated here since it has been widely followed by researchers and well-documented in the literature. For simplicity, let assume all...
findings of Granger causality are summarized and illustrated by diagrams Figures 2 and 3 for the equations (5) and (7), respectively.

Figure 2 Granger Causality Test – BoP Constraint

From the patterns observed in Figure 2, the findings can be grouped into direct and indirect causation from the candidate variables to EO, and they are tabulated in Table 4. Let ‘-->’ stands for ‘does Granger-cause’, the $y$, $y^*$, and $e$ have directly caused the Australian ‘net errors and omissions’ over the full sample period of 1960Q1-2010Q2. They ($y^*$, and $e$) and other variables $r^*$ and $r$ have indirect causation on EO through different (two) transmission channels of real sector (real GDP) and financial sector (domestic interest rates). The causality results are richer than of OLS regressions’ as outlined in Tables (2) and (3) which consider only the direct effect and the other variables are assumed to be constant. Also, it may suggest an interaction term(s) among the relevant variables to be added onto the OLS regression equations (Tables 2 and 3). For example, the exchange rate ($\ln e$) is statistically insignificant in OLS regression (A) (Table 2) or no effect on EO. But, the causality tests suggest a direct

variables are stationary time series. A lag structure of 8 is included onto VAR($d$) system by given a view that EO is a matter of timing (errors) phenomenon (Tang, 2006b). For the VAR system of $EO$, $y$, $e$, $y^*$, $r$ and $r^*$, the LR (sequential modified LR test statistic) suggests 8 lags, while 2 lags by FPE (Final prediction error), AIC (Akaike information criterion), and HQ (Hannan-Quinn information criterion). SC (Schwarz information criterion) suggests 1 lag. The AIC, FPE, and LR suggest 8 lags, while 1 lag by SC and HQ for the VAR system of $EO$, $y$, $r$ and $r^*$. 

17
causal link from exchange rate to EO, and indirectly through real GDP; or interest rate and real GDP. Interestingly, the causality results show the EO does Granger-cause the domestic real interest rate, \( r \). It implies that the past values of EO have relevant information to understand (predict) the current Australia’s interest rate movements. Hence, ‘net errors and omissions’ of balance of payment accounts is not just a number to fulfil the double entry bookkeeping principle.

**Table 4 Summary of the Multivariate Granger Causality Tests – Figure 2**

**Direct causation:**
- Real GDP -> EO
- Foreign GDP -> EO
- Real exchange rate -> EO

**Indirect causation:**
- Foreign GDP -> real GDP -> EO
- Foreign GDP -> real interest rate -> real GDP -> EO
- Foreign interest rate -> real GDP -> EO
- Foreign interest rate -> real interest rate -> real GDP -> EO
- Real interest rate -> real GDP -> EO
- Real exchange rate -> real GDP -> EO
- Real exchange rate -> real interest rate -> real GDP -> EO

![Granger Causality Test – Income-Expenditure Approach](image.png)
Figure 3 exhibits the causal linkages among $r^*$, r, ln y, and lnEO. The Granger-causality results from the income-expenditure approach show only real GDP causes the Australian EO of balance of payment accounts. This appears contrary to the former approach (BoP constraint) that both domestic and foreign interest rates have indirect impact on EO. A causal linkage is found from real GDP to interest rate; and from foreign interest rate to the Australian interest rate.

5. Concluding remarks
In this study, we have analytically and empirically explored the potential role of economic influences on the ‘net errors and omissions’ (EO) behaviour. Two structural equations are theoretically derived from the BoP constraint and open economy macro equilibrium. The first approach - BoP constraint proposes a structural equation that considers real GDP, exchange rate, interest rates, foreign GDP, and foreign interest rates as explanatory variables to EO. A more simplified model derived from income-expenditure approach takes only real GDP, and domestic and foreign interest rates into consideration of the EO modelling. The OLS regressions suggest exchange rate and real interest rate are important determinants to Australia’s EO from the BoP constraint approach, while only real GDP is significant variable in the income-expenditure approach with the sub-periods of different exchange rate regimes. More positive findings are obtained from the multivariate Granger causality tests. Consistently, real GDP does cause the EO from both approaches. Foreign income and exchange rate have direct and indirect causation on EO, while domestic interest rate and foreign interest rate also influence the EO indirectly. A surprising finding is that the past EO contains useful information on the current interest rate. It adds to the empirical literature a variable has to been considered in modelling the interest rate. This study is important from several perspectives - (1) the potential role of economic influences on the ‘emotions’ of EO have been identified systematically from the BoP constraint and income-expenditure approach rather than of ad hoc approach as the existing studies without theoretical foundation; (2) the positive findings from the Australian data offer new knowledge to the existing literature, and some sensible policy implications – formulating the economic policy based on the quality of the BoP statistics; and (3) it supports the existing augment that EO is not just a number - balancing item to ratify the double entry bookkeeping principle, or to tell the accuracy of the balance of payment accounts statistics, it can be taken into account as a ‘new’ variable (determinator) of domestic interest rate by practitioners.
There is need for more research on different circumstances on the EO that continuously contribute to the existing literature. A few of suggestions are casually proposed for further research. First, the income-expenditure approach from the general equilibrium perspective only captures the real sector – market for goods (and services), ignoring the financial market. Further research can be considered for exploring the role of financial sector influences on the EO that is to apply the so-called portfolio balance approach in a “monetised” economy – takes both bond and money markets into account. Second, the further consideration is to abstract the ‘hidden’ information of the EO variable by the mean of investigating the EO influences on other variables (interest rate in this study) or phenomenon (unreported income from tourism) for better predication or policy modelling. Third, the derived structural equations of EO can be applied to other countries or a group of countries in a return of more confirmative findings. Forth, this study only employed the standard OLS regression and multivariate Granger causality tests. Other relevant time series testing methods can be applied by researchers – such as cointegration tests [with or without structural break(s)], impulse response functions, and variance decomposition. Also, the panel data approach is a potential framework to examine the EO behaviour with takes the time effects and countries effects into account.

References


