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TIMELY INDICATORS FOR ASSESSING CAPITAL FLOWS IN EMERGING ASIA

Key points:

- *Information about the size and direction of cross border capital flows are important for market surveillance and policy deliberation, as any abrupt and massive capital movement could affect not only financial market stability, but also cause disruption to the proper functioning of banking system and other real sectors of economy.*

- *The balance of payments (BoP) statistics is commonly used to monitor cross border capital flows. Despite its comprehensiveness and the distinctive information content about capital flows, the long time lag in the availability of the BoP statistics renders timely surveillance and policy deliberation difficult. This is particularly true for emerging Asian economies, in which the time lag in the release of the BoP statistics is mostly six weeks or more.*

- *This paper attempts to construct two more timely indicators of aggregate cross border capital flows in emerging Asia as a whole based on information available within four weeks after quarter-end. The first indicator tracks the net balance of the financial account in the BoP statistics, which is the conventional focus of policymakers for market surveillance. The second indicator tracks the gross capital flows from non-residents.*

- *The proposed indicators outperform the conventional capital tracker and the purely statistical time series model, giving policymakers more timely assessment on quarterly capital flows in emerging Asia with a lag of four weeks.*

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I. INTRODUCTION

Information about the size and direction of cross border capital flows are important for market surveillance and policy deliberation, as any abrupt and massive capital movement could affect not only financial market stability, but also cause disruption to the proper functioning of banking system and other real sectors of economy. In particular, the financial imbalances in the emerging Asia, built up by the unprecedented scale of capital inflows to the region in recent years, warrant close monitoring by policymakers. In light of this, policymakers in the region will need to develop more timely indicators for their surveillance work.[1]

To monitor cross border capital flows, the balance of payments (BoP) statistics is commonly used in the literature as its financial and capital accounts capture the cross-border capital flows between residents and non-residents.[2] However, despite its comprehensiveness and the distinctive information content about capital flows, the long time lag in the availability of the BoP statistics renders timely surveillance and policy deliberation difficult. This is particularly true for emerging Asian economies, in which the time lag in the release of the BoP statistics is mostly six weeks or more (Table 1).

Table 1: Time lag of the balance of payment statistics

	Highest available frequency	Time lag in data availability
China	Quarterly	6-7 weeks
Hong Kong	Quarterly	11 weeks
Indonesia	Quarterly	6-7 weeks
Malaysia	Quarterly	6-7 weeks
The Philippines	Quarterly	10-11 weeks
Singapore	Quarterly	7-8 weeks
South Korea	Monthly	4 weeks
Thailand	Monthly	8 weeks

Sources: CEIC and national sources.

[1] In fact, many central banks in the region have stated their concern over excessive capital flows explicitly in their policy statements recently. For instances, the central banks of Indonesia, Korea and Thailand have stated their concerns over the direction and size of cross-border capital flows in recent policy statements.

[2] The BoP statistics consist of two broad accounts: (1) the current account, which covers transactions of goods and service, as well as factor income and current transfers; and (2) the financial and capital account, which covers transactions involving financial claims and liabilities, as well as capital transfers.

This paper attempts to construct two more timely indicators of aggregate cross border capital flows in emerging Asia as a whole based on information available with shorter delay. The first indicator tracks the net balance of the financial account in the BoP statistics, which is the conventional focus of policymakers for market surveillance. Furthermore, given the substantial increase in gross capital flows over the past few years, it is increasingly evident that keeping an eye on the net flows alone would miss out important information for surveillance.[3] For instance, a reduction in net capital inflows could be driven by a reduction in the purchases of domestic assets by foreigners or by an increase in the purchases of foreign assets by domestic agents. In recent studies, however, the focus is more on deriving timely information about gross capital outflow from non-residents rather than that from residents as an abrupt reversal of the former rather than the latter capital flows could destabilise the financial system and the real sector of domestic economy (Broner et al. (2013)). Thus, for surveillance and financial stability monitoring purposes, it is important to have an indicator that aims at tracking the gross capital flows from non-residents (i.e. change in liability to non-residents in the financial account) as this information could help policy maker to improve the understanding of the situation and formulate appropriate policy responses. To address this need, this paper also attempts to construct another indicator that can timely track the gross capital flows from non-residents.

The derivation of the indicators in this study is based on the model proposed in Miao and Pant (2012), which estimated net capital flows in several groups of emerging market economies using conventional tracker of capital flows.[4] Following a similar approach, we modify the model by including more timely variables such as the monthly BoP statistics that are available in the region (South Korea and Thailand) to enhance the performance of the indicator.[5]

In terms of timeliness, our indicators have an advantage over the quarterly models of indicators in Miao and Pant (2012) that require input of monthly explanatory variables for the whole quarter (i.e. data from the first month up to the third month of the quarter). Given that some monthly explanatory variables, such as merchandise trade balance, might come with significant delay in

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[3] The importance of tracking gross capital flows is emphasized by many recent studies, for examples, Broner et al. (2013), Borio and Disyatat (2011), Obstfeld (2012) and Shin (2012).

[4] The conventional tracker of capital flows is the difference between the change in foreign reserves and the merchandise trade balance. See appendix for details.

[5] Aggregate value of the available monthly BoP statistics has been used in other studies to track regional capital flows. For example, Koepke and Mohammed (2014) uses regional aggregate monthly portfolio flows in the BoP statistics which are available in some emerging market economies (EMEs) to estimate a tracker of portfolio flows in all EMEs.

some EMEs, using these variables for the whole quarter would incur time lag that are not very much shorter than the availability of the BoP statistics and therefore does not serve the purpose of providing timely indicator of capital flows. In view of this, only information available within four weeks after the end of a quarter are used in this study, so that the indicators can be updated with a shorter time lag than that of the BoP statistics.[6]

It is also worth noting that the objective of this study is to provide indicators of capital flows rather than to estimate the determinants of capital flows. While the identification of the drivers of capital flows and the quantification of the economic relationships between capital flows and individual explanatory variables are of importance in the literature, our approach focuses more on the forecasting performance of the estimated model. Such objective is considered to be more practical for researchers whose aim is to provide indicators of capital flows. The less emphasis on the economic linkage between capital flows and explanatory variables offers greater flexibility for researchers to choose variables that may be ignored by economic theory but contain rich statistical information for forecasting the capital flows.

Details of the indicators of both net capital flows and gross capital flows from non-residents and their derivation will be discussed in the next two sections. We conclude the findings and discuss how the indicators can be used for surveillance in the last section.

II. THE INDICATOR FOR NET CAPITAL FLOWS

Model and estimation

We construct an indicator of the quarterly net balance of financial account (FA) for emerging Asia in aggregate terms[7] by estimating the following equation:

$$FA_t = \beta_0 + \beta_1 TRACK_t + \beta_2 MFA_t + \beta_3 BKNFA_t + \beta_4 RV_t + \beta_5 QE_t \times FED_t + \varepsilon_t \quad (1)$$

[6] As such, some variables that are included in the estimation do not cover the whole quarter (e.g. data of only the first two months of a quarter). Details will be discussed in the section for modelling.

[7] In this study, emerging Asia refers to a group of eight Asian economies, including China, Hong Kong, Indonesia, Malaysia, the Philippines, Singapore, South Korea and Thailand.

where:
$TRACK$ is the conventional capital tracker, which is the difference between the aggregate change in foreign reserves and the aggregate merchandise trade balance of the economies in the study;

MFA is the sum of the monthly net balance of financial account in the region available for that quarter. This sum is used as an explanatory variable to reflect the general trend of capital flows in the region;[8]

$BKNFA$ is the regional aggregate of the change in banking sector net foreign asset, which contains information about banking flows. For example, an increase in the region's banking sector net foreign asset indicates capital outflows from the region's banking sector, and vice versa;

RV is the measure of relative volatility between the equity markets in the region and the US, which gauge the sentiment of investors towards the region relative to that towards the US; in particular, it is the logarithm of the ratio of the VIX index and the GARCH-implied variance of the return of MSCI all countries Asia ex-Japan index.[9] Therefore, by construction, the ratio increases when the US market is more volatile than the region's markets. In that case, for example, investors may reallocate their investments, shifting funds from the US to the region, and resulting in capital inflows to the region;

QE is a binary variable which equals to 1 at time t when the US Fed implemented quantitative easing policy and 0 otherwise; FED is the change in asset of the US Fed; this interacting dummy variable captures the unconventional pattern of capital flows due to the accommodative monetary policy in the US.

As shown in Table 2, not all the monthly data ($TRACK, MFA, BKNFA$) are available within four weeks after the quarter-end.[10] For instance, on 28 July, the Q2 data available for Hong Kong are: (1) trade balance in April, May and June; (2) foreign reserves in April, May and June and (3) banking sector net foreign asset in April. Meanwhile, for Indonesia, the following data are available: (1) trade balance in April and May; (2) foreign reserves in April, May and June and (3)

[8] Among the eight Asian economies included in our sample, only South Korea and Thailand have published the net balance of financial account in monthly frequency. Therefore the variable MFA in our estimation is the sum of the net financial account balance of the South Korea and Thailand.

[9] Variance of daily return of the MSCI index is estimated by a GARCH (1,1) model.

[10] Change in asset of the US Fed is available weekly with only one week delay, while the financial market data (VIX and MSCI index) are available on real time basis.

banking sector net foreign asset in April and May. Similar pattern is also observed in other quarters in a year. Table 3 summarises all the data that are available within the four-week limit in the regional economies in our estimation.

Table 2: Time lag of monthly variables

	Financial account	Trade balance	Change in Foreign reserves	Chang in banks' NFA
	(number of weeks)			
China	-	4-5	3	6
Hong Kong	-	3-4	1-2	11
Indonesia	-	4-5	1-2	6-7
Malaysia	-	5-6	1	4-5
The Philippines	-	5-6	1	4-5
Singapore	-	2-3	1-2	4-5
South Korea	4-5	1	1	5-6
Thailand	8-9	3-4	1	4-5

Sources: CEIC and national sources.

Table 3: Availability of monthly variables in Equation (1) within four weeks after the quarter-end

	Monthly financial account balance (*MFA*)			Trade balance			Change in foreign reserves			Capital tracker (*TRAKCER*)			Change in banks' NFA (*BKNFA*)		
	M1	M2	M3	M1	M2	M3	M1	M2	M3	M1	M2	M3	M1	M2	M3
China				■	■		■	■	■	■	■		■	■	
Hong Kong				■	■	■	■	■	■	■	■	■	■		
Indonesia				■	■		■	■	■	■	■		■	■	
Malaysia				■	■		■	■	■	■	■		■	■	
The Philippines				■	■		■	■	■	■	■		■	■	
Singapore				■	■	■	■	■	■	■	■	■	■	■	
South Korea	■	■		■	■	■	■	■	■	■	■	■	■	■	
Thailand	■			■	■	■	■	■	■	■	■	■	■	■	

Notes:
1. M1, M2 and M3 represents the first month, second month and third month of the quarter respectively. For instance, M1 represents April for Q2.
2. The highlighted box indicates data of the corresponding month is available.

Sources: CEIC and national sources.

Equation (1) for emerging Asia is estimated by OLS regression. To do a robustness check on the results, we also estimate the equation with a smaller sample that excludes China in order to isolate the potential dominant effect of capital flows in China on the region. The estimation results are shown in Table 4.

Table 4: Estimation results of Equation (1) (Indicator of net capital flows)

Dependent variable: Net balance of financial account in the BoP statistics Sample period: Q1 2003–Q3 2015 (51 quarters)		
	Emerging Asia	**Emerging Asia (ex-China)**
Constant	-265870.80***	-70203.95**
Conventional capital tracker	0.32***	0.41***
Monthly net balance of FA (S. Korea and Thailand)	2.90***	1.57***
Change in banks' net foreign asset	-0.61***	0.03
Relative stock market volatility	23333.18***	4963.86*
$\boldsymbol{QE}$ **× Chang in Fed's asset**	0.10***	0.00
Adjusted $\boldsymbol{R^2}$	*0.85*	*0.82*

Note: *** and ** denote statistical significance at the 1% and 5% level of confidence respectively.
Source: HKMA staff estimation.

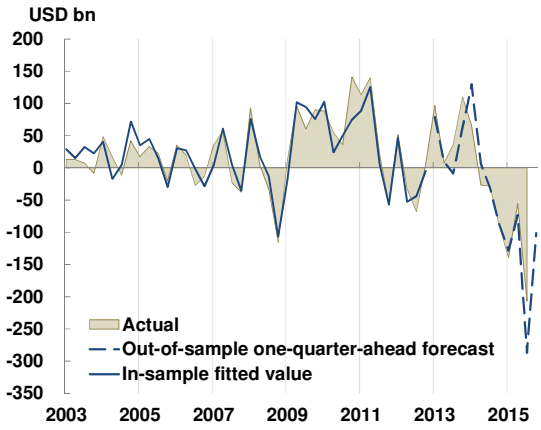
As shown in Table 4, most of the estimated coefficients in both country groups are significant at the 1% level and their signs are consistent with expectation. For instance, investors tend to invest more in the region when the regional markets are relatively less volatile; and net capital inflows increase when bank's net foreign asset rises. The large R-squared in both estimations also indicate good fitness of the equation.

Out-of-sample forecasts

To evaluate the performance of the indicator, we perform rolling estimations to get a set of one-quarter-ahead out-of-sample forecasts. The size of the rolling sample is 10 years (i.e. 40 quarters), with the first sample running from Q1 2003 to Q4 2012 and the first one-quarter-ahead forecast is for Q1 2013. The sample is rolled one quarter forward in a new round of estimation and therefore we

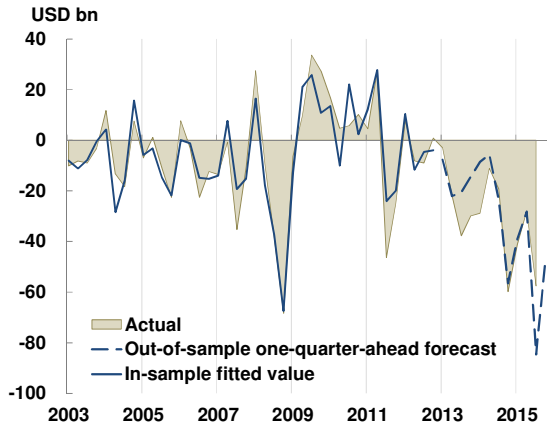
get the out-of-sample forecast for each quarter from Q1 2013 to Q4 2015. As shown in Charts 1 and 2, the indicator implied by Equation (1) tracks very well with the net capital flows in both country groups. According to the estimation based on the latest available data, our indicators suggest that the region continued to see substantial net outflows in Q4 2015, albeit smaller than the outflows in Q3.

Chart 1: One-quarter-ahead forecast of net capital flows (Emerging Asia)



Note: The in-sample period is Q1 2003 to Q4 2012, while the out-of-sample forecast period is Q1 2013 to Q4 2015.
Sources: CEIC and HKMA staff estimates.

Chart 2: One-quarter ahead forecast of net capital flows (Emerging Asia ex-China)



Note: The in-sample period is Q1 2003 to Q4 2012, while the out-of-sample forecast period is Q1 2013 to Q4 2015.
Sources: CEIC and HKMA staff estimates.

For comparison, the forecast performance of the indicator is assessed against that of three different benchmarks: (1) the conventional capital tracker, (2) a model with the conventional tracker as the only explanatory variable[11] and (3) the best fitting ARIMA model. In terms of forecast accuracy, as measured by a smaller normalised root-mean-square error (NRMSE)[12], the indicator of net capital flows implied by Equation (1) outperforms the forecast from these benchmarks significantly (Table 5).

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[11] The tracker-only-equation is: $FA_t = b_0 + b_1 TRACK_t + e_t$

[12] The NRMSE is calculated by dividing the root-mean-squared error (RMSE) by the range of the underlying data series (i.e. difference between the maximum and minimum values). The smaller NRMSE indicates better performance. Compared to the RMSE, the unit-free NRMSE facilitates comparison between different datasets and models. There is no consistent means of normalization in the literature; other versions of NRMSE include those which use the standard deviation or the average value of the underlying series as the means of normalisation. For instance, in the evaluation of the forecasting performance of their model of capital flows, Claessens, et al. (1995) derived the NRMSE by dividing the RMSE by the standard deviation of the underlying data series. An advantage of using the range to normalize the RMSE is that it can avoid the distortion generated by a zero mean of the underlying data series, which is possible for the data series of capital flows which contains both positive and negative values. Other versions of NRMSE and the RMSE have also been calculated. They also indicate that our indicators outperform the benchmarks.

Table 5: Normalised root-mean-squared error of one-quarter-ahead forecasts of net capital flows
(Forecast period: Q1 2013–Q3 2015)

	Emerging Asia	Emerging Asia (ex-China)
Equation (1)	11.3%	12.4%
Conventional capital tracker	34.5%	26.6%
Equation (tracker only)	12.7%	19.1%
Best fitting ARIMA model[1]	25.8%	22.4%

Note:
1. The best fitting ARIMA model for net capital flows in both country groups is MA(1).
Source: HKMA staff estimation.

III. THE INDICATOR FOR GROSS CAPITAL FLOWS FROM NON-RESIDENTS

Model and estimation

Similar to the indicator for net flows, the indicator of gross flows from non-residents is estimated based on variables which are analogous to those in Equation (1) but more related to the change in liability to non-residents. However, considering the non-stationarity nature of the gross flows and the explanatory variables, it is more appropriate to estimate the indicator of gross flows by an error correction model as follows.[13]

$$\Delta LIA_t = \gamma_0 + \theta e_{t-1} + \gamma_1 \Delta MLIA_t + \gamma_2 \Delta EXPORT_t + \gamma_3 \Delta BKFL_t + \omega_t \quad (2)$$

$$e_t = LIA_t - (b_0 + b_1 MLIA_t + b_2 EXPORT_t + b_3 BKFL_t) \quad (3)$$

where:
LIA is the change in liability to non-residents in the financial account, which represents the gross capital flows from non-residents;

$MLIA$ is the sum of available figures of monthly gross capital flows from non-residents in the financial account of South Korea and Thailand;

[13] Results of ADF tests for unit roots on the gross capital flows and the explanatory variables are available upon request.

$EXPORT$ is the value of merchandise exports of the region which is analogous to the conventional tracker in Equation (1) but tracking only the part on gross receipt;

$BKFL$ is the regional aggregate of the change in banking sector foreign liability. For example, an increase in the region's banking sector foreign liability is likely to be the result of gross capital inflows from non-residents to the region's banking sector, and vice versa, and;

Δ is the difference operator.[14]

In this set up, equation (2) captures the short-run dynamics while equation (3) represents the long-run relationship, with θ indicating the speed of error correction. Using the Engle-Granger two-step method, the estimated results of the error correction model is summarised in Table 6.[15]

As shown in Table 6, most of the estimated coefficients are significant at the 1% level, with signs consistent with expectation. For instance, gross capital flows increase when the change in bank foreign liability rises, while the monthly capital flows figures of South Korea and Thailand also positively correlated with the quarterly regional aggregate flows. The error correction parameters in both short-run equations are negative and between zero and minus one in both estimations, suggesting a mean-reverting error correction process. Moreover, the Engle-Granger test statistics derived from the long-run equations indicate that variables in the long-run equations are cointegrated.

[14] Availability of the monthly variables in Equation (2) and (3) is analogous to that in Equation (1). For examples, the availability of merchandise exports is the same as that of the trade balance; while the banks' foreign liability is released with the banks' net foreign asset.

[15] Equation (2) is estimated by OLS regression while Equation (3) is estimated by FMOLS regression.

Table 6: Estimation results of Equations (2) and (3) (Indicator of gross capital flows)

Dependent variable: Difference in the change in liability to non-residents in the BoP statistics **Sample period: Q1 2003–Q3 2015 (51 quarters)**		
	Emerging Asia[1]	**Emerging Asia[1] (ex-China)**
Short-run dynamics: Equation (2)		
Constant	3720.53	1456.12
Change in monthly gross capital flows from non-residents (S. Korea and Thailand)	3.40***	2.59***
Change in exports	0.11	-0.04
Difference in the change in the banks' foreign liability	1.40***	0.89***
Error correction term	-0.80***	-0.96***
Adjusted R^2	*0.78*	*0.79*
Long-term relationship: Equation (3)		
Monthly gross capital flows from non-residents (S. Korea and Thailand)	3.10***	2.74***
Exports	0.25***	0.26***
Change in banks' foreign liability	1.37***	0.76***
Engle-Granger τ ***(p-value)***	*-5.50 (0.00)*	*-6.44 (0.00)*
Engle-Granger z ***(p-value)***	*-38.93 (0.00)*	*-45.91 (0.00)*

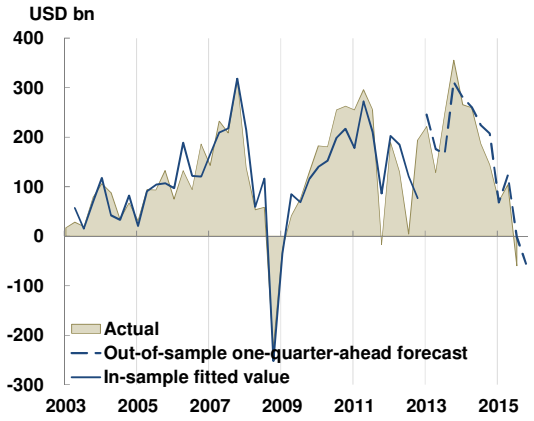
Notes:
1. Due to the lack of data of liability to non-residents, Malaysia is excluded in both country groups.
2. *** denote statistical significance at the 1% level of confidence.

Source: HKMA staff estimation.

Out-of-sample forecasts

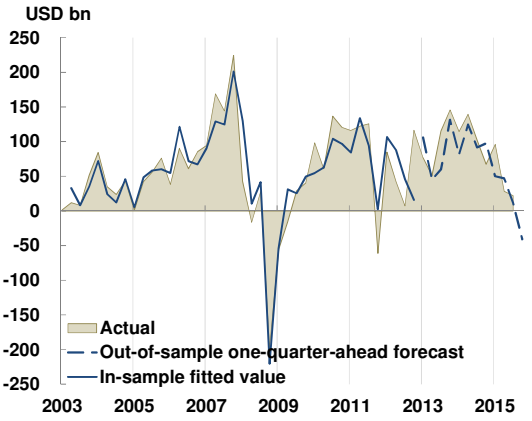
Similar to that for the indicator of net capital flows, we perform rolling estimations to get a set of one-quarter-ahead out-of-sample forecasts of gross capital flows. The size of the rolling sample is 10 years, with the first sample running from Q1 2003 to Q4 2012 and the first one-quarter-ahead forecast is for Q1 2013. The sample is rolled one quarter forward in a new round of estimation and therefore we get the out-of-sample forecast for each quarter from Q1 2013 to Q4 2015. As shown in Charts 3 and 4, the out-of-sample forecasts for both country groups track the gross capital flows reasonably well. According to the estimation based on the latest available data, our indicators suggest that the region continued to see substantial gross capital outflows from non-residents in Q4 2015.

Chart 3: One-quarter-ahead forecast of gross capital flows (Emerging Asia)



Note: The in-sample period is Q1 2003 to Q4 2012, while the out-of-sample forecast period is Q1 2013 to Q4 2015.
Sources: CEIC and HKMA staff estimates.

Chart 4: One-quarter ahead forecast of gross capital flows (Emerging Asia ex-China)



Note: The in-sample period is Q1 2003 to Q4 2012, while the out-of-sample forecast period is Q1 2013 to Q4 2015.
Sources: CEIC and HKMA staff estimates.

Unlike net capital flows, there is no commonly used tracker or predictor for gross capital flows. Therefore, to evaluate the forecast performance, the indicator is compared with the best fitting ARIMA model. The results show that our indicator of gross flows outperforms the ARIMA model in both country groups (Table 7).

Table 7: Normalised root-mean-squared error of one-quarter-ahead forecasts of gross capital flows
(Forecast period: Q1 2013–Q3 2015)

	Emerging Asia	Emerging Asia (ex-China)
Equations (2) and (3)	8.8%	7.7%
Best fitting ARIMA model	18.5%	10.8%

Note:
1. The best fitting ARIMA model for gross capital flows in both country groups is ARIMA(0,1,4).
Source: HKMA staff estimation.

IV. CONCLUSION

Using variables with shorter time lag and higher frequency, this study provides more timely indicators for (1) net capital flows and (2) gross capital flows from non-residents. The proposed indicators outperform the conventional capital tracker and the purely statistical time series model, giving policymakers more timely assessment on quarterly capital flows in emerging Asia with a lag of four weeks. In practice, the indicators are designed to be updated quarterly, at the end of April, July, October and January, to provide indication on net and gross capital flows in the region in Q1, Q2, Q3 and Q4 respectively.

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APPENDIX

Conventional tracker of capital flows

Given the significant time lag of the BoP statistics, there are several proxies of capital flows in the literature.[16] Among them, the difference between the change in foreign reserves and the merchandise trade balance is the most commonly used proxy for the net balance of financial account. This is derived from the BoP identity:

$$\Delta REV = CA + FA + ERR$$
$$\therefore FA = \Delta REV - CA - ERR$$
$$= \Delta REV - (TRADE_{GOODS} + TRADE_{SERV} + INCOME + TRANS) - ERR$$

where:
REV represents foreign reserves;
CA is current account balance;
FA is financial account balance;
ERR is errors and omission;
$TRADE_{GOODS}$ and $TRADE_{SERV}$ are trade balances of goods and services respectively; $INCOME$ is net factor income, and;
$TRANS$ is net cash transfer.

Since the change in foreign reserves and the trade balance of goods are typically available at monthly frequency and usually with short time lag, it is common in the literature to track the financial account balance by the difference between the change in foreign reserves and the trade balance of goods:

$$TRACK = \Delta REV - TRADE_{GOODS} \quad \text{(A1)}$$

where $TRACK$ is the conventional capital tracker.

[16] For instances, the change in foreign reserves have been used to proxy capital flows in earlier years when the current balance is relatively small in many EMEs.