CAPITAL FLIGHT`S MAGNITUDES ESTIMATION: AN APPLICATION OF PRINCIPAL COMPONENT ANALYSIS (PCA)

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Abstract
Available statistics from the existing studies have confirmed continuous and outward movement of financial resources (capital) from Africa to the rest of the world in a phenomenon known as capital flight, despite the outright lack or inadequacy of the resources in the continent. Also, while only one method (world bank residual) was mostly used for capital flight`s magnitude computation in the available previous studies, none of the methods adopted for the computation totally capture the complete essence of what capital flight stands for.. The need to fill these gaps is what motivates this study, which does not only used some of the available methods to estimate the magnitudes of capital flight individually but also combined them into various composites through the application of Principal Component Analysis (PCA). To achieve this, the trade data from different sources were employed for the computation of capital flight statistics for the 54 African countries over 1985 - 2020 periods.

The results obtained indicated that the magnitudes of capital flight were successfully computed with the three basic methods that have been used previously in the literature as well as the four possible combinations of the three basic methods with the aid of PCA. Furthermore, the findings revealed that there are variations in the values of mean of capital flight computed under the seven methods adopted, thereby underscoring the desirability of adopting the four PCA-derived methods of capital flight computation introduced by this study as well as the three methods previously used in the literature as valid means of capital flight estimation.

Keywords: Capital Flight, Principal Component Analysis (PCA), Trade Data, African Countries.

1.0 Introduction

Over the years, several billions of dollars have been siphoned out of supposedly weaker economies (developing nations) to stronger economies (developed nations) through different methods and connivance of international bank officials (Ndikumana *et al*, 2015; Kiss and Isaac 2018; Ndikumana and Boyce, 2019 among others). Although the methods adopted are tricky and the identities of perpetrators are usually concealed through the use of proxies, nevertheless the researchers and international finance management organizations (Cuddington, 1987; World Bank, 2010; Ndikumana *et al*, 2015; among others) have come up with several ways of estimating the magnitudes of capital flight. However, none of the available methods of capital flight computation (Cuddington`s direct method, Asset`s method, World Bank`s Residual method, Trade Mis-invoicing method, Morgan Guaranty Trust method and Dooley`s method) from previous studies totally capture the complete essence of what capital flight stands for. In the same manner, each of the available method of capital flight estimation in the previous studies can be said to be a mere approximation because there is no single individual method of estimating capital flight in the existing studies that can be regarded as being the sole best method in the sense of capturing all the qualities that capital flight is intended to stand for. This is as a result of the failure of the existing studies to comprehensively consider various definitions of capital flight phenomenon and its different estimation methods before venturing into the estimation of the magnitude of capital flight.

The need to fill the above identified gaps in the existing empirical studies is what therefore motivates the present study, which does not only use the available capital flight`s estimation methods in the existing studies to estimate the magnitudes of capital flight but also innovates a scientific method (through the application of Principal Component Analysis) to combine them into various composites.

Hence, this study aims not only to capture the essence or nature of capital flight in each of all the available methods of computation in the existing literature by combine these "essence" or "nature" into a single composite capital flight indicator, scientifically through the application of Principal Component Analysis (PCA) but also to show whether the seven variants of capital flight estimated under the different estimation methods correlate with one another.

The rest of the paper is organized as follows: the review of the relevant literature is done in the second section while the third section deals with the methodology. The presentation and discussion of the results obtained from data analysis is considered in the fourth section while the conclusion and recommendations of the paper is discussed in the fifth section.

2.0 Literature Review

2.1 Conceptual Literature Review

In accounting and corporate finance studies, capital refers to sources of funding or finance and in this regard, it can be classified as borrowed capital and equity capital. But, in Economics, capital is referred to as that important physical or non-human factor of production or input that is used for production purposes. But, in the context of this study, capital that is referred to, unless the contrary is explicitly stated, are the funds, sources of or flows of finance that can be used to acquire other capital or inputs and not capital or goods that already constitute a factor of production or an input that is used in the production process.

Also, different scholars have come up with different definitions of capital flight, but the basic ingredient in any of such definitions is that any capital outflow that retards, punctures, inhibits and decreases the economic growth and thereby leads to more uncertainty in the domestic economy is regarded as capital flight, while acknowledging the fact that there is nothing whatsoever that is preventing investors from holding any asset or choosing the location where they want the asset or investment to be.

Cuddington (1986) narrowly defines capital flight as a short-term speculative outflow from a country. This definition is very similar to the hot money definition of capital flight, which regards it as the short term acquisition of foreign asset or investment that can give higher returns than what is obtainable in the domestic economy with a minimum level of associated risk and the quick repatriation of the capital back to the country of origin when the incentive for keeping the capital abroad is no more available. On the other hand, Dooley (1986) is of the opinion that what brings about capital flight is the presence of some risk factors (such as expected depreciation or devaluation of the domestic currency, hyperinflation, etc) that can bring about the partial or total loss of capital. An owner of capital will then take out such capital from such risky environment to a less risky environment until the threat or danger is removed before such capital will be repatriated back. That is, capital may be taken out not only when it is in the pursuit of higher returns (as defined by Cuddington, 1986) but also when the situation at home is no more favorable as a result of hyper-inflation, exchange rate depreciation and/or low interest rate.

Khan and Haque (1987) narrowly define capital flight as the normal gross private short term capital flow in addition to net errors and omissions in the country's balance of payments (BoPs). It is noteworthy to note that while Cuddington (1986) regarded capital flight as a speculative outflow, Khan and Haque refer to it as a normal outflow. Also, the portfolio diversification can only be regarded as capital flight if the following conditions are met:

a) if the diversification is speculative and not a normal or conventional investment

b) if the investment is illegal; and

c) when the return to the investment is kept abroad and neither reported nor returned to the domestic economy.

As a result of some of the flaws identified in the narrow definitions of capital flight by Cuddington (1986) and Khan and Haque (1987), capital flight is broadly defined by Ndikumana and Boyce, (2019) as the outflow of residents' capital which, if invested in the domestic economy, would yield a high return. In a similar vein, Ajayi (1992) and Oloyede (2002) broadly regard capital flight as all private capital outflows (whether portfolio or equity investment) from developing countries. Also, the reported and unreported acquisition of foreign assets by non-bank private sector and some elements of public sector are included in the broad definition of capital flight by Morgan Guaranty Trust Company (1986).

Going by the above definitions of capital flight, it can therefore be concluded that any capital that leaves capital deficient countries for any purposes (including investment) can be regarded as capital flight The Principal Components Analysis (PCA) was designed in 1901 by Karl pearson (Pearson, 1901) and was further formalised by Harold Hotelling (Hotelling, 1933). It is summarily described by Jaadi (2019), as cited by Noah (2022), as the process of transforming a large number of correlated variables into uncorrelated smaller variables which are known as principal components. The PCA technique does this by reducing the dimensionality of the data and at the same time preserving as much as possible the variations in the original data set in question.

2.2 Empirical Literature Review

Ndikumana and Boyce (2003), Makochekanwa (2007), Okoli (2008), Ali and Walters (2010), Ndikumana and Boyce (2011), Al-Fayoumi, Al-Zoubi, and Abuzayed (2012), Ndikumana, Boyce and Ndiaye (2014), Muchai and Muchai (2016) and Nwagi (2019) investigated the determinants of capital flight in countries within African continent using portfolio choice theory as the framework and World Bank`s residual method as capital flight estimation method. In the same vein, Assibey, Domfeh and Danquah (2017) investigated the effect of corruption and other institutional governance indicators on capital flight in thirty two countries in Sub-Saharan Africa over the period 2000-2012 with Capital flight data that was also computed with World Bank`s residual method. Similarly, Ogbeide-Osaretin and Efe (2020) investigated the determinants of capital flight from Nigeria by using ARDL method to estimate the models with the data on explanatory variables that were sourced from the WDI and capital flight data that was estimated with the World Bank`s residual method. Furthermore, Asongu and Nnanna (2020) examined the use of governance tools to fight capital flight from a panel of thirty-seven African countries from 1996 to 2010. Capital flight data that was computed with the World Bank`s residual method by Boyce and Ndikumana (2012) was adapted while data on governance variables were obtained from the World Bank Governance Indicators and data on macroeconomic control variables were sourced from the African Development Indicators of the World Bank.

The Principal Component analysis (PCA) was employed to bundle six governance indicators into economic, institutional and political governances before employing GMM as the estimation technique.

On studies outside African continent, Hermes and Lensink (2001), Beja (2006), Alam and Quazi (2013) and Shabani and Parang (2019) investigated the determinants of capital flight from countries in Asia continents using GMM method, ARDL, FE and RE estimation method while capital flight magnitude data were computed with World Bank`s residual method. In the same vein, Ahmad and Sahto (2015) undertook a study aimed at investigating the link between capital flight and its postulated determinants (viz: foreign direct investment, external debt, exchange rate, foreign reserves, gross domestic product growth, and inflation) in Pakistan, using time series data, covering the period from 1971 to 2011 that were obtained from the World Bank`s WDI. The World Bank`s residual method was also used to estimate the magnitude of capital flight and the Johansen's Co-integration technique, together with the Granger Causality test method, were employed to test whether there was an existence of a long-run relationship between capital flight and its determinants.

Conclusively, it is clearly seen that almost all the previous studies reviewed used only one method (World Bank`s Residual method) for the computation of the magnitudes of capital flight out of the five or even more capital flight`s estimation methods that are available in the literature, while none of the studies (to the best of the knowledge of this researcher) used the three methods separately, not to talk of a combination of the capital flight figures by using a suitable method of combining them as done in this study.

3.0 Methodology

3.1 Methods of Capital Flight`s Magnitude Computation Available in the Literature

This study used the three methods of measurement of capital flight (viz: Cuddington`s direct method (Hot-money method), World Bank` residual indirect method and Trade mis-invoicing indirect method) for the computation of capital flight statistics out of the six capital flight computation methods available in the literature reviewed.

One of the direct methods of capital flight measurement, which is the one adopted in this study, is the Cuddington`s narrow or balance of payments approach. This approach regards capital flight as hot money speculative short term capital outflow rather than see it as private sector acquisition of external claims. The method estimates capital flight by summing up the hot money flows and the Balance of Payment (BoP) statistical discrepancies or what is known as errors and omission that are due to unrecorded short term capital flows. This is usually referred to as "hot money" method of capital flight measurement. It is the unrecorded short term capital outflow. It is also the short term foreign asset acquisition from non-banking private sector. It is presumed that the short term capital outflow is usually because of unfavourable risky situation in the economy of capital deficient countries. The hot money usually comes back to the domestic economy when the unfavourable situation becomes favourable and the risky situation abates. Cuddintong`s capital flight is calculated by adding the errors and omissions to the short term foreign asset acquisition from non-banking private sector. This can be represented as follows:

$$CFC = EO + SCONB \quad (1)$$

where: CFC= Capital flight computed by Cuddintong`s capital flight method, EO = Errors and Omissions of BoP data that are not due to random and measurement errors associated with data collection, SCONB = Short term capital outflows by the non-bank public (other short term capital associated with other sectors excluding the official sector and banks).

Errors and Omissions (EO) data are BoP data and are sourced from International Monetary Fund (IMF) database of the IMF while Short term capital outflows by the non-bank public (SCONB) data are sourced from World Bank database of the World Bank.

Indirect methods of measuring capital flight (World Bank` residual and Trade mis-invoicing aong others) use some other variables that are obtained indirectly to compute capital flight statistics, unlike the direct methods that use the data that are obtained directly for the same purpose. The indirect methods also measure capital flight more broadly than the direct methods. World Bank`s residual method as one of indirect methods, measures private claims of the private sector by considering the discrepancies between sources of capital (inflow) and uses of capital (outflow).The balance between the inflow and outflow is regarded as the residual or missing money. In the same manner, the Trade mis-invoicing method although is not concerned with sources and uses of capital, as it is based on the current account as opposed to capital account transactions of BoP, it is nevertheless regarded as another indirect method that is covered in the study. These two indirect methods are further discussed below.

(a) World Bank Residual Method: The World Bank`s (1985) residual or missing money indirect method of measuring capital flight is used by considering the balance of payments (BOP) of each country's official record of inflows and outflows of foreign exchange. These BoP data are usually compiled annually by the IMF on the basis of reports from the Central Banks of its member countries. The 'current account' of the BoP records international flows arising from trade in goods and services, interest payments and unrequited transfers (transactions that do not lead to future claims on resources). The capital account records flows of loans, investments and other financial transactions that entail future claims. Outflows of foreign exchange to the rest of the world, such as debt service or payments for imports, are recorded as debits (denoted by a negative sign) while inflows, such as loan disbursements or payments for exports, are recorded as credits (with a positive sign).

The World Bank residual method appears to give a rather straightforward calculation of capital flight, and this may be responsible for its being the most widely accepted and applied method in the literature. The method not only considers all private capital outflows as capital flight, it also compares the sources and uses of such capital flows. This suggests that for the non-existence of capital flight, the sources must be equal to the uses of capital inflows. The net increase in external debt and the net inflow of foreign investment are regarded as sources of fund and are compared with the current account deficits and additions to foreign reserves that are regarded as uses of fund. If the sources exceed the uses of capital inflows, the difference is termed capital flight.

In other words, the World Bank residual measurement of capital flight represents the difference between sources of capital (current external borrowing, current inflow of foreign direct investment, and exports of goods and services) and uses of capital (outflow of foreign direct investment, imports of goods and services, and official foreign reserves change). Mathematically, the World Bank residual measurement of capital flight can be written as follows:

$$CFR = CXB + NFDI - CAD - COFR \quad (2)$$

where:

CFWB = Capital flight measurement by the World Bank method, CXB = Change in external debt sourced from World Bank database of the World Bank, NFDI = Net foreign direct investment sourced from IMF database of the IMF, CAD = Current account deficit IMF database of the IMF, and COFR = Change in official foreign reserves IMF database of the IMF.

It is to be noted that this measure does not differentiate between regular and lawful outflow of capital searching for better risk-return tradeoff from hot money transfers of capital searching for speculative opportunities.

Data on CXB and NFDI were sourced from WDI database of the World Bank while that of CAD and COFR were sourced from annual IMF's Balance of Payments Statistics publications.

b). Trade Mis-Invoicing Indirect Method

Another method through which capital flight can be perpetrated is by mis-invoicing of both exports and imports. When exporters understate the value of their export revenues, they often retain abroad the difference between the actual value and the declared value. Similarly, when importers send extra foreign exchange abroad, ostensibly to pay for imports, the excess (minus a commission for their complicit partners) is often deposited in designated foreign bank accounts.

For each country under study, the extent of capital flight perpetrated by trade mis-invoicing method is estimated by comparing the export and import data provided by the country with the corresponding import and export data of its developed trading partners. Both sets of figures are reported in the annual IMF`s Direction of Trade (DOT) Statistics publications. As it is assumed, in common with previous studies on the subject, that the trade data provided to the IMF by the industrialised countries are relatively accurate, the discrepancy between these figures and the data from their African trading partners is taken to yield a measure of trade mis-invoicing.

Therefore, export mis-invoicing for an African country in each year with its major industrialised import partners is computed as follows:

$$DXIC = PMIC – XIC\ (CIF) \qquad (3)$$

where:

DXIC = export discrepancies between the actual export and the declared export, PMIC= the c.i.f. value of imports from the African country as reported by the major industrialised import buying partners, XIC = the f.o.b. value of the African country's exports to industrialised countries as reported by the African country, CIF = the c.i.f/f.o.b ratio or factor, representing the costs of freight and insurance ratio, for converting the XIC into what it would have been if also expressed in c.i.f. terms (bearing in mind that, while imports are reported c.i.f basis in the data source, exports are recorded there on f.o.b basis). As each African country also exports to countries other than its major industrialised import partners, the resulting DXIC has to be grossed up by the ratio of total exports to that of export supply to only the major import partners in order to arrive at the adjusted DXIC that is employed in the study. For instance, if exports to the chosen major industrialised import partners are 80% of the total in a particular year so that other import partners account for the remaining 20%, the preliminary DXIC figure is to be gross up by using 0.8 to divide it, in order to arrive at the adjusted DXIC figure Also, the import mis-invoicing for an African country in each year with its major industrialised export or supplying countries is computed as follows:

$$DMIC = PXIC(CIF) – MIC \qquad (4)$$

where:

DMIC = import discrepancies between the actual import and the declared import, PXIC= the f.o.b value of exports to the African country as reported by the major industrialised export supplying partners, MIC = the African country's imports from industrialised countries as reported by the African country, CIF = the c.i.f /f.o.b ratio or factor(representing the costs of freight and insurance ratio), for converting the PXIC into what it would have been if also expressed in c.i.f terms (bearing in mind that, while imports are reported on a c.i.f basis in the data source, exports are recorded there on an f.o.b. basis). As each African country also imports from countries other than its major industrialised export partners, the resulting DMIC has to be grossed up by the ratio of total imports to that of import from only the major export partners, following the same approach described above for the process of arriving at the adjusted DXIC, in order to arrive at the adjusted DMIC that is employed in the study.

Therefore, total trade mis-invoicing for both export and import of an African country with its trading partners can be written as: the Adjusted DXIC + the Adjusted DMIC

It is to be noted that data on PMIC, XIC, PXIC, MIC, c.i.f. and f.o.b. were sourced from IMF`s annual Direction of Trade (DOT) Statistics publications. In most cases, there were about fifteen major industrialised import and export partners that were considered for each African country and they accounted for about 80% of each African country`s exports and imports.

3.2 Principal Components Analysis (PCA) as a Method of Capital Flight`s Magnitude Computation

The Principal Components Analysis (PCA) is summarily described by Noah (2022), as the process of transforming a large number of correlated variables into uncorrelated smaller variables which are known as principal components. The PCA technique does this by reducing the dimensionality of the data and at the same time preserving as much as possible the variations in the original data set in question. It is applied in this study because each of the available method of capital flight computation is a mere approximation, since none of them can totally capture the complete essence of what capital flight stands for. It is therefore advisable to combine them using a more scientific method like PCA rather than used a crude method of combination, like what was done by Ndikumana (2012). What the PCA does is to combine the essence of capital flight in each method and marry them together in a single row. The PCA will give outputs of the weights of the different underlying variables and these generated weights will be used to compute or generate a composite which is a linear combination of the existing ones.

In this study, PCA is used to derive four additional variants of capital flight from the magnitude of the three variants of capital flight that are computed with Hot-money method (HOT), World Bank method (WB) and Trade Mis-invoicing method (MISINV). The four new variants of capital flight resulting from the four possible combinations of these HOT, WB and MISINV through the use of PCA technique are:

a. HWM – This is obtained by combining HOT, WB and MISINV variants of capital flight.

b. HM – This is generated from the combination of HOT and MISINV variants of capital flight.

c. HW - This is generated from the combination of HOT and WB variants of capital flight

d. MW – It is obtained from the combination of WB and MISINV variants of capital flight.

The acronym HWM stands for composite that is PCA-derived from the combination of HOT, WB and MISINV while HM denotes the composite that is PCA-derived from the combination of HOT and MISINV. Similarly, the acronym HW represents the composite that is PCA-derived from the combination of HOT and WB while MW stands for the composite that is PCA-derived from the combination of MISINV and WB. On the whole, this yields a total of seven methods of deriving the magnitudes of capital flight in this study.

It is applied in this study because each of the available method of capital flight computation is a mere approximation, since none of them can totally capture the complete essence of what capital flight stands for. It is therefore advisable to combine them using a more scientific method like PCA rather than used a crude method of combination, like what was done by Ndikumana (2012). What the PCA does is to combine the essence of capital flight in each method and marry them together in a single row. The PCA will give outputs of the weights of the different underlying variables and these generated weights will be used

to compute or generate a composite which is a linear combination of the existing ones.

3.3 Sources of Data

The study employs trade data that were sourced from International Monetary Fund (IMF), Direction of Trade Statistics (DoTS) Statistics publications, IMF`s Balance of Payments (BoP) Statistics publications and International financial Statistics (IFS) Statistics publications for the computation of capital flight statistics for the 54 African countries over 1985 - 2020 periods. The period of 1985 – 2020 was chosen because the trade data needed for the computation of the capital flight statistics were available mostly from 1985 upward.

4.0 Results and Discussions

By applying the seven methods to trade data from the sources mentioned above for the 54 African countries over 1985 - 2020 periods, the magnitudes of capital flight obtained are as presented in the Tables below and subsequently discussed immediately after some clarifications on the occurrence of positive and negative numerical values in the estimation of capital flight statistics.

4.1 Dealing with the Positive and Negative Numerical Values of the generated Capital Flight Statistics

In principle, the numerical values of capital flight statistics are supposed to be positive, with any negative values signifying a sort of reverse capital flight, i.e. "inward" or "in-bound" capital flights from abroad. But, because of its policy insignificance, if not irrelevance, the concept or idea of reverse capital flight virtually has no space in the literature. However, in virtually all estimation or generation of capital flight statistics that have previously been reported, occasional negative values often existed in conjunction with predominantly positive ones, just as it is the case with the ones generated and reported in the present study. There are two possible and non-mutually exclusive interpretations that can be accorded such negative values when they occur. The first is that it can be a sort of reverse capital flight, which should be a desirable thing.

The second possible interpretation, which is the one that is likely to be applicable to many instances of occurrence of negative values, is that it is due to imperfections and lack of precision in the existing methods of generating capital flight statistics from the already imperfect underlying balance of payments and/or external trade data. It is such imperfections in the existing methods that often produces divergent values of capital flight, depending on the method being adopted. Given that some negative capital flight statistics normally occur in the midst of predominantly positive ones, one possible way of dealing with the situation is to eliminate or do away with those observations and instances characterised with negative values and confine the analysis to only those instances with positive values. However, such a "truncated" data can often lead to an avoidable loss of information embedded in those eliminated observations and such an approach is thus hardly adopted in the empirical literature on capital flight.

The alternative approach, which is the one adopted in this study, in common with virtually all previous capital flight empirical studies that the present author is aware of, is to make use of all the capital flight statistics, irrespective of whether they are positive or negative. This approach is able to make a fuller use of information embedded in not just positive values, but also in the negative values, of capital flight statistics. After all, there is no known threshold of the negative capital flight statistics below which it is due to genuine existence of reverse capital flight concept and above which it is due to the imprecision and imperfections in the methodology adopted in generating the statistics from the already inherently imperfect BOP and/or external trade data. Making use of both positive and negative values addresses such a situation. In the final analysis, what is more important is that the generated capital flight statistics are order- or rank-preserving (i.e., it is the algebraic ranking of the magnitudes of dollars or monetary values that matters and not the absolute values as such).

4.2 The Results of Capital Flight Magnitude Computation with the Seven Methods

The results in Table 1 below showed the magnitudes of capital flight in real values, in 2020 constant US$ billions, from 1985 to 2020 for all the 54 African countries. As pointed out above, they were computed with HOT, WB, MISINV, HWM, HM, HW and MW methods of deriving capital flight magnitudes. In the same vein, the results in Table 2 revealed the magnitudes of capital flight that were computed with the aforementioned seven methods and expressed as percentages of GDP, instead of being expressed in 2020 constant US$ billions as in Table 2. The discussion and evaluation of the results in Tables 1 and 2 were carried out following the presentation of each of the tables.

Table 1: Capital Flight by Countries: 1985-2020 mean Values in 2020 constant US$ Billions, computed under the Seven Methods of HOT, WB, MISINV, HWM, HM, HW and MW

	Countries	HOT	WB	MISINV	HWM	HM	HW	MW
1	**Algeria**	-9.75	1.52	4.72	2.82	2.28	2.00	4.95
2	**Angola**	-7.58	9.61	12.6	8.59	3.83	6.36	15.19
3	**Benin**	-6.31	0.11	0.15	0.22	0.19	0.19	0.18
4	**Botswana**	-6.23	0.27	-1.1	-1.11	-1.46	-0.94	-0.93
5	**Burkina Faso**	-5.98	0.11	-0.59	-4.99	-5.98	-5.01	-0.51
6	**Burundi**	-1.28	0.12	0.32	0.53	0.54	0.48	0.34
7	**Cameroon**	-0.82	0.09	0.92	1.13	1.26	0.99	0.89
8	**Cape Verde**	-0.34	0.01	0.38	0.15	0.16	0.08	0.36
9	**Central African Republic**	-0.3	0.07	0.19	0.08	0.05	0.05	0.2
10	**Chad**	-	1.66	0.23	1.54	0.77	1.51	0.81
11	**Comoros**	-	-	0.04	0.08	0.1	0.08	0.04
12	**Congo, Dem.Rep.**	-	-1.19	0.78	0.26	1.04	0.14	0.31
13	**Congo, Rep.**	-	3.88	1.37	5.17	3.65	4.98	2.66
14	**Cote d'Ivoire**	-	0.55	-2.59	4.85	5.46	5.43	-2.23
15	**Djibouti**	-	0.53	1.84	1.91	1.89	1.61	1.91
16	**Egypt**	-	2.8	0.42	4.74	3.85	4.74	1.39
17	**Equatorial Guinea**	0.01	-	2.32	0.41	0.44	-	2.17
18	**Eritrea**	0.02	-	-	-	-	-	-
19	**Eswatini**	0.8	0.43	0.64	1.06	0.88	0.23	0.49
20	**Ethiopia**	0.04	-	8.18	5.39	6.21	4.02	7.65
21	**Gabon**	0.04	0.39	0.94	0.09	-0.16	-0.08	1.02
22	**Gambia**	0.06	0.08	0.19	0.18	0.16	0.15	0.21
23	**Ghana**	0.09	-0.6	8.98	5.4	6.59	3.9	8.18
24	**Guinea**	0.09	-0.44	4.05	1.39	1.83	0.69	3.63

25	**Guinea-Bissau**	0.13	0.41	-0.13	5.14	5.85	5.28	0.02
26	**Kenya**	0.16	-1.77	1.11	1.47	2.84	1.33	0.41
27	**Lesotho**	0.21	-0.29	0.43	0.1	0.29	0.02	0.3
28	**Liberia**	0.32	-0.92	1.97	-0.11	0.41	-0.45	1.51
29	**Libya**	0.36	-0.85	5.61	-7.52	-8.52	-8.71	4.94
30	**Madagascar**	0.49	-0.06	3.98	0.68	0.75	-0.03	3.7
31	**Malawi**	0.55	-3.26	4.24	3.82	6.5	3.18	2.8
32	**Mali**	0.66	0.03	0.91	0.63	0.71	0.48	0.85
33	**Mauritania**	0.84	-0.19	1.75	1.12	1.41	0.83	1.57
34	**Mauritius**	0.74	-1.51	2.91	-0.27	0.57	-0.79	2.18
35	**Morocco**	0.91	0.01	6.67	1.89	2.08	0.72	6.24
36	**Mozambique**	1.09	0.18	1.38	2.93	3.33	2.75	1.35
37	**Namibia**	1.10	-1.72	0.45	-1.08	-0.21	-1.17	-0.19
38	**Niger**	1.11	-0.05	1.02	0.42	0.51	0.24	0.94
39	**Nigeria**	1.34	11.29	2.74	14.52	10.03	14.21	6.57
40	**Rwanda**	1.41	-5.32	0.55	-9.01	-7.34	-9.25	-1.38
41	**Sao Tome and Principe**	1.48	-	0.19	0.08	0.09	0.05	0.18
42	**Senegal**	1.57	0.22	0.02	0.42	0.36	0.42	0.1
43	**Seychelles**	1.63	-0.01	0.51	0.09	0.1	-0.01	0.47
44	**Sierra Leone**	2.68	-1.36	1.36	3.92	5.48	3.79	0.79
45	**Somalia**	3.13	-	0.35	0.06	0.07	-	0.33
46	**South Africa**	3.84	-	-1.87	-1.01	-1.16	-0.69	-1.75
47	**South Sudan**	3.45	-	-	-	-	-	-
48	**Sudan**	4.75	-6.57	6.77	-7.51	-4.92	-8.84	3.99
49	**Tanzania**	4.98	0.01	0.25	1.16	1.36	1.14	0.24
50	**Togo**	5.32	-0.06	1.94	0.35	0.41	0	1.79
51	**Tunisia**	5.98	-0.13	9.24	2.93	3.34	1.31	8.59
52	**Uganda**	6.06	0.99	10.18	2.89	2.57	1.09	9.87
53	**Zambia**	7.02	5.11	0.75	-2.3	-5.98	-2.56	2.52
54	**Zimbabwe**	9.69	7.28	0.09	9.7	6.91	9.81	2.67
	Average	0.75	0.39	2.12	1.21	1.14	0.84	2.11

Source: Author`s Computation, 2022.

Explanatory Notes: The acronyms HOT, WB, MISINV, HWM, HM, HW and MW respectively stand for the average values of capital flight computed with Hot-Money method, World Bank method, Trade Mis-invoicing method, HWM method, HM method, HW method and MW method respectively.

Columns 2 to 8 of Table 1 showed the average values of capital flight computed with each of HOT, WB, MISINV, HWM, HM, HW and MW methods of capital flight for all the fifty-four countries in Africa, averaged over the period of 1985 to 2020, with the values being 0.75, 0.39, 2.12, 1.21, 1.14, 0.84 and 2.11 billion dollar respectively. Similarly, the results further showed that capital flight computed with the aforementioned seven methods ranged from the MISINV method that yielded the highest average value of 2.12 billion dollar to the WB method of capital flight computation that yields the lowest mean value of 0.39 billion dollars.

The results in the second column of Table 1 revealed that, based on the Hot-money method (HOT) of capital flight computation, Nigeria has the highest mean value of 9.69 billion dollars while Libya has the lowest mean value of -9.75 billion dollars. Similarly, under the World Bank (WB) method of computation of capital flight, Tunisia has the lowest mean value of -0.01 billion dollars while Tanzania has the highest mean value of 11.29 billion dollars. In the same manner, under the Trade Mis-invoicing (MISINV) method, Rwanda has the highest mean value of 12.6 billion dollars while Djibouti has the lowest mean value of -0.02 billion dollars. Also, Tanzania, with 14.52 billion dollars mean value, and Mozambique, with 0.06 billion dollars mean values of capital flight, were respectively the countries with highest and lowest capital flight values when HWM is used as capital flight computation method as shown in the fifth column of Table 4.1a. On the other hand, in the sixth column of the same table when HM is used as the computation method, Tunisia, with 0.1 billion dollars, and Tanzania, with 10.03 billion dollars were countries with the lowest and the highest values of capital flight.

The results in the seventh column of Table 1 indicated that Angola, with 14.21 billion dollars, and Tunisia, with -0.01 billion dollars, were countries with the highest and the lowest values of capital flight when HW is used as the method of computation. On the other hand, the results in the eighth column of the same table showed that Rwanda, with 15.19 billion dollars, and Gambia, with 0.02 billion dollars, respectively have the highest and the lowest values of capital flight computed with the MW method. Finally, the average of average values of capital flight computed with each of the seven methods in Columns 2 to 8 of Table 4.1a were given as 0.75, 0.39, 2.12, 1.21, 1.14, 0.84 and 2.11 billion dollars respectively.

It can therefore be inferred from the foregoing that capital flight is a phenomenon that is being experienced by majority of the fifty-four countries in the continent for the period of 1985 to 2020 that the study covers. Also, there are variations in the values of mean of capital flight computed under the seven methods of computation adopted in this study. But it is to be pointed out that there is no guidance in the literature as to which of these alternative computation methods provides the superior estimates, thus underscoring the desirability of combining the three basic estimates (derived under the HOT, WB and MISINV methods) variously into HWM, HM, HW and MW through the scientific method of the PCA, as it is done in this study.

Table 2: Capital Flight by Countries: 1985-2020 Average of Capital Flight by Countries, expressed as a Percentage of GDP, computed under the Seven Methods of HOT, WB, MISINV, HWM, HM, HW and MW

	Countries	HOT	WB	MISINV	HWM	HM	HW	MW
1	**Algeria**	8.25	8.9	7.62	6.5	3.34	1.7	8.97
2	**Angola**	1.47	9.55	2.52	8.53	3.81	6.32	5.09
3	**Benin**	0.17	0.12	0.16	0.24	0.21	0.21	0.2
4	**Botswana**	-5.4	5.01	-3.06	-1.58	3.73	3.76	-3.24
5	**Burkina Faso**	6.98	1.88	-1.06	-1.1	-1.98	-2.44	-2.7
6	**Burundi**	4.3	1.05	2.81	4.65	4.74	4.21	2.98
7	**Cabo Verde**	8.09	0.9	3.16	3.49	4.38	7.19	2.36
8	**Cameroon**	3.85	0.31	3.19	3.92	4.37	3.43	3.09

9	**Central African Republic**	0.39	2.71	7.36	3.1	1.94	1.94	7.75
10	**Chad**	1.72	4.05	3.33	2.31	1.16	2.88	1.74
11	**Comoros**	2.61	0	5.6	1.21	4.01	1.21	5.6
12	**Congo, Dem. Rep.**	0.01	0.01	0.4	0.02	0.01	0.01	0.78
13	**Congo, Rep.**	8.38	-1.96	7.18	2.39	9.58	1.29	2.86
14	**Cote d'Ivoire**	5.68	1.42	-1.7	2.55	4.13	4.05	-2.77
15	**Djibouti**	5.42	8.71	6.95	7.42	6.72	6.83	7.42
16	**Egypt**	0.59	0.43	0.64	0.72	0.59	0.72	0.21
17	**Equatorial Guinea**	0	0	1.94	5.47	5.87	0	8.94
18	**Eritrea**	0	0	0	0	0	0	0
19	**Eswatini**	0	0.22	0.93	0.47	0.54	0.19	0.16
20	**Ethiopia**	3.9	0	6.72	4.43	5.1	3.3	6.28
21	**Gabon**	-2.63	3.02	7.27	0.7	-1.24	-0.62	7.89
22	**Gambia**	2.03	1.25	2.96	2.81	2.5	2.34	3.28
23	**Ghana**	0.42	-0.51	0.77	0.46	0.56	0.33	0.7
24	**Guinea**	3.09	-1.25	1.49	3.94	5.19	1.96	10.29
25	**Guinea-Bissau**	1.65	4.16	-1.32	5.13	9.33	5.55	0.2
26	**Kenya**	0	0	0	0	0	0	0
27	**Lesotho**	5.4	-2.46	1.06	2.57	7.46	0.51	7.72
28	**Liberia**	1.5	-4.47	3.81	-1.12	5.36	-2.86	6.57
29	**Libya**	-2.51	-1.88	2.38	-1.59	-1.8	-1.22	10.9
30	**Madagascar**	0	-0.15	9.63	1.64	1.81	-0.07	8.95
31	**Malawi**	1.82	-1.02	1.33	1.2	2.04	1	0.88
32	**Mali**	5.1	0.28	8.34	5.84	6.58	4.45	7.88
33	**Mauritius**	0.19	-1.04	7.05	-2.51	5.3	-1.34	10.27
34	**Mauritania**	2.1	-2.09	9.24	2.32	5.51	9.13	7.27
35	**Morocco**	1.13	0.01	8.94	2.53	2.79	0.97	8.37
36	**Mozambique**	2.63	0.73	5.57	1.82	3.44	1.1	5.45
37	**Namibia**	-1.57	-2.01	2.35	5.65	-1.1	-2.12	-0.99
38	**Niger**	4.01	-0.63	2.78	5.26	6.39	3.01	1.77
39	**Nigeria**	0.46	0.54	0.13	0.7	0.48	0.68	0.31
40	**Rwanda**	-3.92	-4.76	4.42	-2.41	8.99	-2.34	-1.09
41	**Sao Tome and Principe**	3.51	0	2.77	8.01	2.26	1.25	4.52
42	**Senegal**	2.28	1.39	0.13	2.66	2.28	2.66	0.63
43	**Seychelles**	0	-0.62	3.51	5.56	6.18	-0.62	9.03
44	**Sierra Leone**	3.68	-0.94	0.94	2.71	3.79	2.62	0.55
45	**Somalia**	0	0	2.27	2.1	2.45	0	1.57
46	**South Africa**	-0.11	0	-0.25	-0.14	-0.16	-0.09	-0.24
47	**South Sudan**	0	0	0	0	0	0	0
48	**Sudan**	-0.33	-0.34	0.35	-0.39	-0.26	-0.46	0.21
49	**Tanzania**	1.73	0.01	0.32	1.5	1.76	1.48	0.31

50	**Togo**	0.8	-1.21	3.02	7.04	8.25	0	6
51	**Tunisia**	2.73	-0.22	5.49	4.91	5.6	2.2	4.4
52	**Uganda**	0.32	0.48	4.89	1.39	1.23	0.52	4.74
53	**Zambia**	-0.3	0.24	0.36	-0.11	-0.28	-0.12	0.12
54	**Zimbabwe**	0.75	0.78	0.96	1.03	0.74	1.05	0.28
	Average	1.71	0.56	2.91	2.33	3.07	1.44	3.41

Source: Author`s Computation, 2022.

Explanatory Notes: The acronyms HOT, WB, MISINV, HWM, HM, HW and MW respectively stand for the average values of capital flight that are expressed as a percentage of GDP and computed with each of Hot-Money method, World Bank method, Trade Mis-invoicing method, HWM method, HM method, HW method and MW method respectively**.**

The mean values of capital flight expressed as a percentage of GDP for all the fifty-four countries from 1985 to 2020 were presented in Columns 2 to 8 of Table 2. It can be seen from the table that 1.71%, 0.56%, 2.91%, 2.33%, 3.07%, 1.44% and 3.41% were the average of capital flight (computed with each of HOT, WB, MISINV, HWM, HM, HW and MW method) when expressed as percentages of GDP respectively. The results in Table 2 further showed that the MW method of capital flight computation, with 3.41%, has the highest capital flight when expressed as a percentage of GDP while WB method, with 0.56%, provides the lowest percentage. In addition, Congo Republic with 8.38% and South Africa with -0.01% were countries with the highest and the lowest magnitudes of capital flight computed with HOT method and expressed as a percentage of GDP. In the same vein, Angola with 9.55% and Rwanda with -4.76% were countries with the highest and the lowest values of capital flight when computed with WB Method and expressed as percentages of GDP.

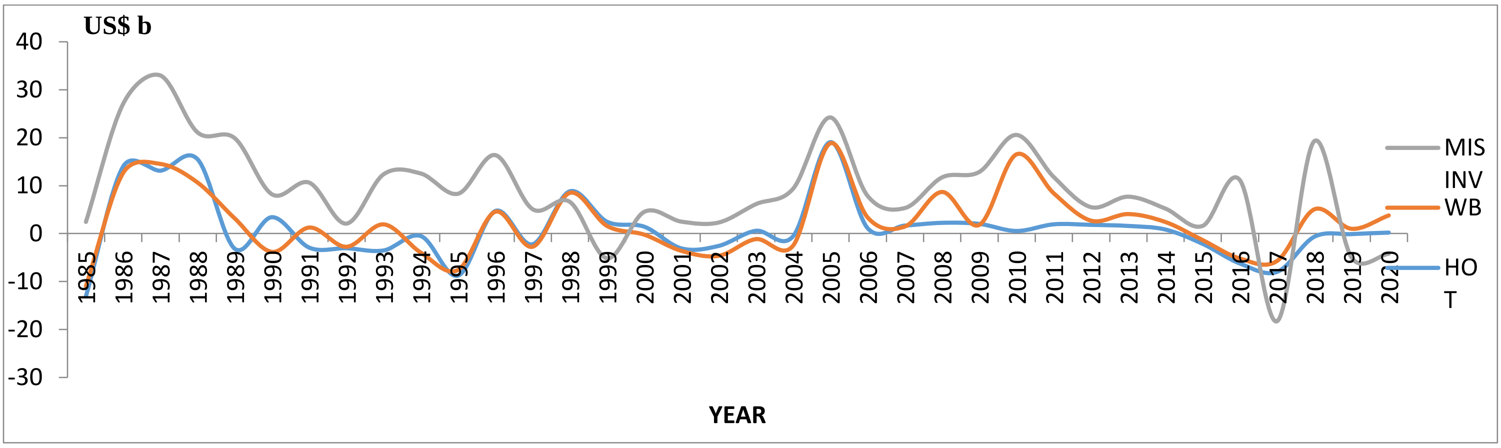
It was also revealed from the Table 2 that Burundi, with 9.63%, and Burkina Faso, with -1.06%, were countries with the highest and the lowest capital flight magnitudes when computed with MISINV and expressed as a percentage of GDP while Rwanda, with 8.53%, and Equatorial Guinea, with -0.01%, were countries with the highest and the lowest capital flight magnitudes that are computed with HWM method and expressed as a percentage of GDP. Similarly, Madagascar, with 9.58%, and Seychelles, with 0.01%, were the countries with the highest and lowest values of capital flight that are computed with the HM method and expressed as percentages of GDP while Somalia, with 9.13%, and Seychelles, with 0.01, were the countries with the highest and lowest magnitudes of capital flight that are computed with the HW method and expressed as a percentage of GDP. Finally, Senegal, with 10.09%, and Egypt, with -0.24%, were countries with highest and lowest magnitudes of capital flight when computed with the MW method and expressed as percentages of GDP.

4.3 Comparison of Temporal Movement of Capital Flight Computed under the Three Basic Methods of HOT, WB and MISINV

In Figure 1a were presented separate line charts for 1985 to 2020 period in respect of the three basic variants of capital flight that were computed through the WB, HOT and MISINV methods and expressed in 2020constant US$ billions and also consolidated across the 54 countries covered by the study. In Figure 1b, corresponding charts are presented for the same period and for the same WB, HOT and MISINV variants, except that the capital flight statistics were now expressed as percentages of GDP and then averaged across the 54 countries.

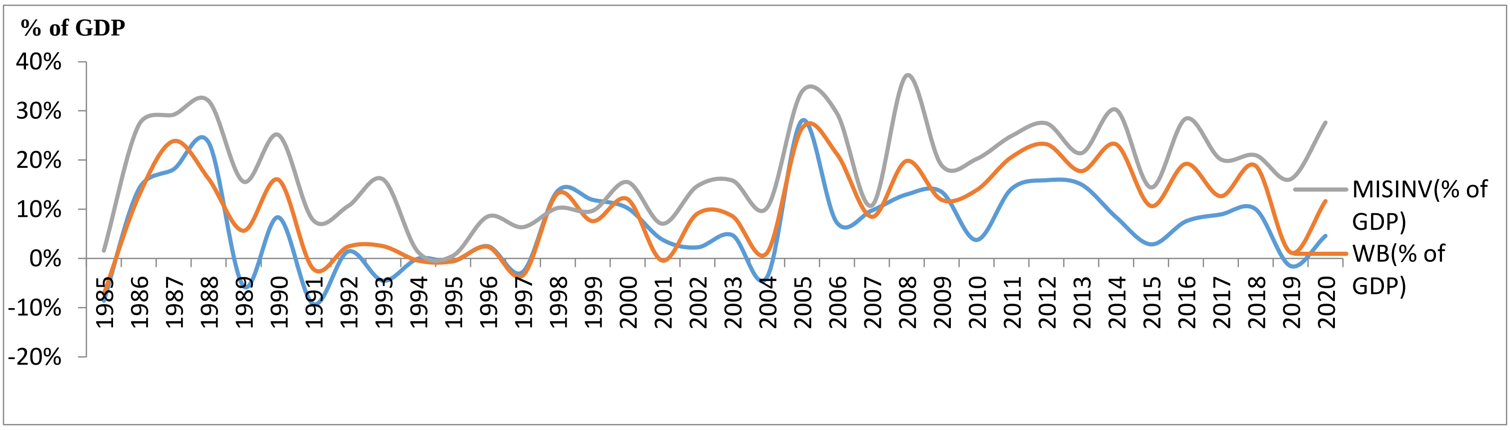
A paramount objective of presenting these two sets of charts is to see the extent of co-movements of the three basic variants over the period covered by the study. This issue is discussed after presenting the charts.

Figure 1a: Comparative Trend Charts over the 1985 to 2020 Period (averaged over the 54 Countries) of Capital Flight (in 2020 constant US$ billion) computed under the Three basic Methods of HOT, WB and MISINV



Source: Author`s Computation, 2022

Figure 1b: Comparative Trend Charts over the1985 to 2020 Period (averaged over the 54 Countries) of Capital Flight (expressed as Percentages of GDP) computed under the Three basic Methods of HOT, WB and MISINV



Source: Author`s Computation, 2022

It can be seen from the line charts in Figure 1a that capital flight computed under the three basic methods of HOT, WB and MISINV exhibited steady upward and downward movements in the same direction throughout the period of 1985 to 2020 that the study covers. It started with upward movement of the three variants of capital flight from 1985 to 1987, after which a short downward movement was experienced in 1988. From 1989 to 2004, the three variants of capital flight exhibited successive downward and upward movements, with the downward movement being more pronounced. This was followed by a more pronounced upward movement in the three variants of capital flight from 2005 till 2017 when there was a more pronounced downward movement which was immediately followed by another round of upward movement.

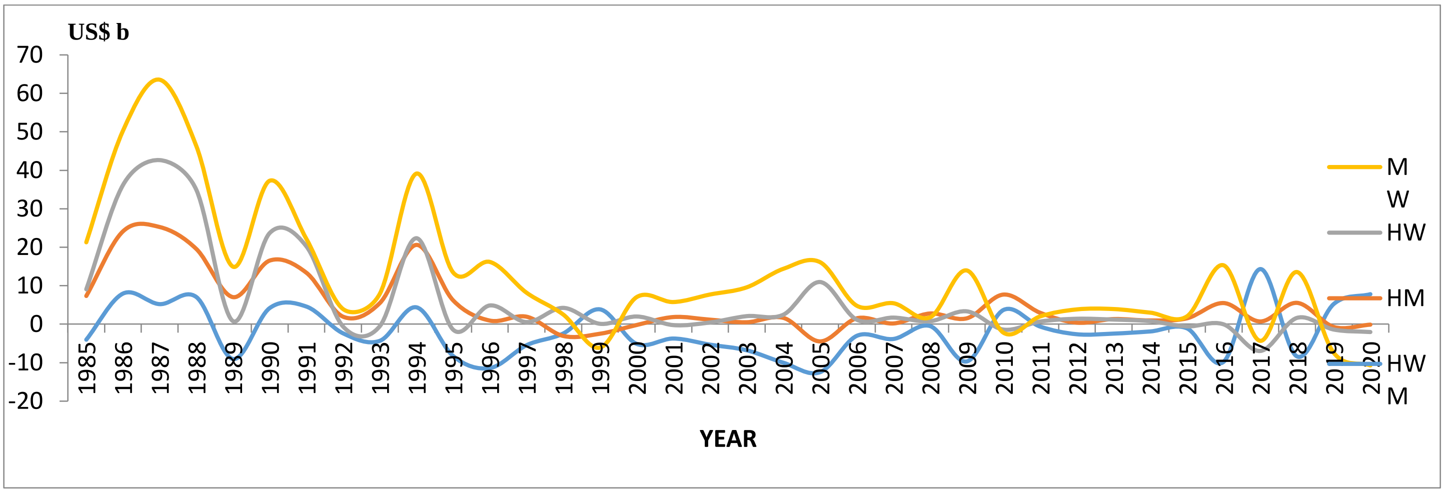
Similarly, the line charts in Figure 1b reveal that the capital flight computed under the three methods and expressed as percentage of GDP consistently exhibited ups and downs movements in the same direction throughout the period of 1985 to 2020 under consideration in this study. From 1985 to 1988, there was an upward movement of the variants of capital flight. This was followed by a yearly interchanging ups and downs movement from 1989 to 2003. From 2004 to 2006, there was an upward movement which was interrupted in 2007 before they started rising together again in 2010 when they experienced another round of downward movement. From 2010 to 2020, the three variants of capital flight were rising and falling together.

4.5 Comparison of Temporal Movement of Capital Flight Magnitudes that are PCA derived Composites of the above Three basic Capital Flight Indicators

Figure 2a contains separate line charts for 1985 to 2020 period in respect of the four variants of capital flight composites that were PCA-derived through all possible combinations of the above three basic capital flight methods (HOT, WB and MISINV), with these four variants being denoted as HWM, HM, HW and MW and expressed in 2020constant US$ billions and also consolidated across the 54 countries covered by the study. In a similar manner, corresponding charts were presented in Figure 4.16b for the same period and for the same HWM, HM, HW and MW variants, except that the capital flight statistics were now expressed as percentages of GDP and then averaged across the 54 countries.

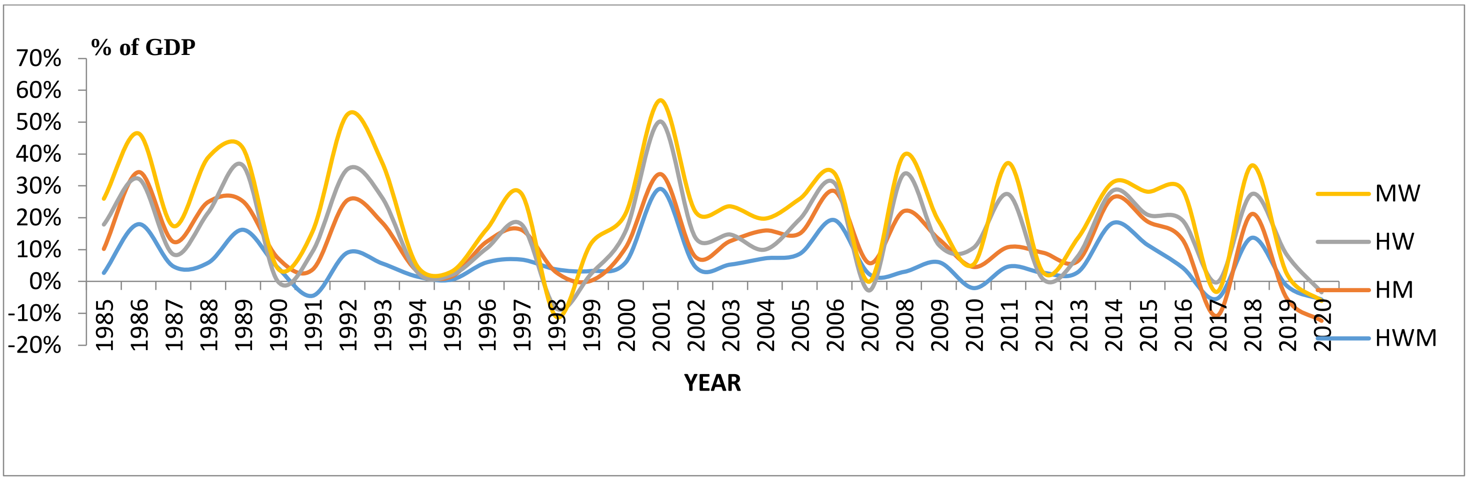
The essence of presenting these two sets of charts in Figures 2a and 2b is to see the extent of co-movements of the four PCA-derived variants of capital flight over the period covered by the study. The discussion and evaluation of the charts are done after their presentation.

Figure 2a: Comparative Trend Charts over the 1985 to 2020 period, averaged over the 54 Countries, of Capital Flight, in 2020 constant US$billion, that are PCA-derived composites formed from Four Different Combinations of the Three basic Capital Flight Indicators



Source: Author`s Computation, 2022

Figure 2b: Comparative Trend Charts over the 1985 to 2020 period, averaged over the 54 Countries, of Capital Flight, expressed as Percentage of GDP, that are PCA-derived composites formed from Four Different Combinations of the Three basic Capital Flight Indicators



Source: Author`s Computation, 2022

It is shown in the line charts in Figure 2a that the four PCA-derived variants of capital flight were consistently rising and falling together throughout the period of 1985 to 2020 covered by the study. Upward movement was first observed in the four variants of capital flight shown in the line charts in the same direction from 1985 to 1988, and this was followed by a downward movement till 1989 before they started rising together again from 1989 to 1992. There was downward movement again from 1992 to1993, which was followed by an upward movement of the four charts from 1993 to 1994. So, for the period of 2000 to 2003, the four charts were consistently falling after which they resumed yearly ups and down movement till year 2020.

In the same vein, the line charts in Figure 2b reveal that PCA-derived capital flight variants computed by HWM, HM, HW and MW methods and expressed as percentage of GDP for each of the fifty-four African countries exhibited consistent yearly ups and downs movements in the same direction throughout the period under consideration. They first started rising together from 1985 to 1986, before they fell in 1987. They rose again from 1988 till 1989 before they started falling again from 1990 to 1991. In the same vein, there was an upward movement of the four line charts from1992 to 1994, which was followed by another round of downward movements from 1995 to1997. Although, downward movement was experienced by the four variants in 1988, this was immediately followed by upward movements from 1999 till 2001. Another downward movement in 2002 was followed by upward movements from 2003 to 2006. Similarly, after a slight downward movement in 2007, the four charts show an upward movement from 2008 to 2010, after when another downward movement that did not last beyond that year was experienced. In the same vein, the four charts exhibited an upward movement from 2010 to 2012 and this was followed by a short downward movement in 2013 before it continues with another upward movement from 2013 to 2017. The four line charts exhibited an upward movement again from 2017 to 2019 before it wass ended in 2020 with a downward movement.

5.0 Conclusion and Recommendations

The empirical results indicate that the magnitudes of capital flight were successfully computed with the three basic methods (Hot Money method, World Bank method and Trade Mis-invoicing method) that have been used previously in the literature as well as the four possible combinations (denoted by HWM, HM, HW and MW methods) of the three basic methods with the aid of Principal Component Analysis (PCA). Thus, on the whole seven methods were used to estimate magnitude of capital flight in this study, thereby yielding the corresponding seven variants of capital flight statistics that are separately analysed in the study. Accordingly, the highest mean values of capital flight in US$ billion were provided by MISINV method, followed by HOT and WB methods in that order, while the highest mean values of capital flight expressed as percentages of GDP were also given by MISINV followed by HOT and WB. Also, empirical evidence on whether the seven variants of capital flight estimated under the different estimation methods correlate with one another show that the seven variants of capital flight correlated with one another. It therefore implies that that the seven alternate measures of capital flight were related, although they are still distinct and complimentary.

Following from the above major findings, it can be broadly concluded that the values of mean of capital flight as percentage of GDP computed under the seven methods of computation adopted in this study vary together but not exactly. A major contribution of this study to knowledge is in the introduction of PCA as a way of scientifically combining different measures of capita flight into a composite capital flight indicator.

It is to be noted that as a result of inherently imperfect BoP and external trade data, occasional negative values of capital flight statistics often existed in conjunction with the predominantly positive ones, just as it is with the capital flight statistics that have been previously computed and reported. Although, the reasons for this has been explained in the study, but when better BoP and external trade data become available, it is suggested as a direction for future studies to generate capital flight statistics with the PCA-derived capital flight computation method that is introduced in this study and see whether the results will differ from what is obtained in this present study and previous one.

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