Air Freight Economic Factors of Demand in Egypt
العوامل الاقتصادية للطلب على الشحن الجوي في مصر

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Abstract

In Egypt international freight relies mainly on maritime transport, which requires studying of main economic factors of air freight for its enhancement. The paper investigates main economic factors of air freight in Egypt, during the period 1982 till 2019. The paper is investigating the interaction between short and long run variables using VECM "Vector error correction model". The analysis found long run equilibrium relationship among model variables. Short run dynamics found that exports and GDP are positively significant, while inflation and exchange rate are negatively significant to air freight which goes with economic literature. Further analysis of dynamics among studied variables carried using IRF "Impulse Response Function" finding same results of VECM. Variance decomposition carried which found that the highest contribution to air freight changes is exchange rate and exports followed by inflation and the weakest is GDP. The findings contribute to literature of air freight demand.

Keywords: VECM, GDP, trade, air freight, Egypt

المستخلص

النقل الدولي للبضائع في مصر يعتمد على النقل البحري مما يستلزم دراسة عوامل الطلب على النقل الجوي للبضائع للعمل على زيادة الطلب عليه حيث يعد من وسائل النقل الهام المحفزة للتجارة الدولية. تقوم الدراسة الحالية بتحديد العوامل الاقتصادية الرئيسية للطلب على النقل الجوي للبضائع في مصر خلال الفترة من 1982 حتى 2019. تستهدف الدراسة تحليل التفاعل بين المتغيرات في الاجلين الطويل والقصير من خلال تقدير نموذج متجه تصحيح الاخطاء VECM . كشفت الدراسة عن وجود علاقة في الاجل الطويل بين المتغيرات محل الدراسة. وجد التحليل قصير الاجل علاقة معنوية موجبة بين النقل الجوي للبضائع وكلا من الدخل القومي الاجمالي والصادرات وعلاقة معنوية سالبة لكلا من مستوى الاسعار ومعدل سعر الصرف بما يتماشي مع النظرية الاقتصادية. كما تم تحليل العلاقة الديناميكية بين متغيرات الدراسة من خلال تقدير دالة الاستجابة IRF وتحليل التباين لعوامل الطلب، وجاءت النتائج مدعمة لنتائج تقدير VECM في الاجل القصير. ووفقا لتحليل VEFD المتغيرات الاقوى تأثيرا سعر الصرف والصادرات يليها مستوي الاسعار والدخل القومي الاجمالي.

الكلمات المفتاحية: النقل الجوي، النمو، الطلب، نقل البضائع، الصادرات.

Introduction

Second World War caused a rapid increase of air freight transport supporting war efforts. More than 650000 tons of cargo carried by air between India and China from 1942 till 1945, and between 1948 and 1949 the largest air cargo in history lifted to support Berlin blockage. Since then air transport has been arranged by worldwide agreements which reinforced the international standards.

Development of air transport industry considers one of the main improvements in the twenty first century and one of the main factors of fast and reliable transportation mean. In the modern era, air transportation is a necessary mode of transportation due to its efficiency.

By 2012 air freight industry supported by 1738 freighters worldwide, 37% of them large freighter more than 80 tons air crafts, 36% medium size carry between 40 to 80 tons, and the standard size were 274% which carry capacity less than 45 tons (Kiboi *et al.*, 2017).

In Egypt air transportation started in 1932 by establishment of Misr Airlines which carried in 1935 around 21830 kg of cargo flying 675067 KM. The study objective is identifying the main economic factors of air freight in Egypt during the period 1982 till 2019. Problem of study that air freight sector in Egypt needs further study as more than 99% of international freight depends on maritime transportation only.

The paper uses deductive approach deriving economic hypotheses. First hypothesis; exchange rate, and WPI "wholesale price index" as proxy of inflation rate both affect air freight negatively. Second hypothesis; exports as proxy of international trade and GDP affect air freight positively. The hypotheses examined empirically deploying Vector error correction model (VECM) for investigating economic factors of air freight through testing Further analysis carried using IRF "Impulse Response Function", and “Variance decomposition”.

The remaining of paper is covering brief discussion of air freight transportation in Egypt followed by main factors of air freight then theoretical and literature background, followed by presentation of data description employed in the model and explanation of methodology, followed by results of empirical analysis, then ending with conclusion.

Air Freight in Egypt

Air freight or transporting goods using air crafts mainly specialized in high value and light weight goods also perishable and short-lived goods, as fruits, and seafood which can't be preserved for long time (Feng & Yang, 2019).

Demand on Air freight recently increased due to the following main reasons:

First: development of microelectronics industry as medical equipment and products which raised air freight demand around 80 to 90%. High technology products accounts for a third of air freight and expected to increase in future.
Second: just in time philosophy which required products to reach markets quickly.
Third: increase in aircraft hull size and improvement of cargo handling systems and more efficient air cargo networks lead to reduction of costs and raised operational efficiency of air transport (Bozan, 2019).
In 1960s, air transport witnessed congestion in air traffic which induced companies looking for larger capacity airplanes. In 1970s, air industry developed massively by introducing large capacity air planes carrying larger volume with lower cost which increased demand on air transport (Kiobi *et al*, 2017).
Fourth: rapid growth of e-commerce cross-border transactions increased number of air parcels for example increased in China from 1.3 in 2010 to 6.9 trillion yuan in 2017 (Feng & Yang, 2019).
In Egypt, According to Boeing projects air freights fleet expected to increase by 60% from 2010 freighter in 2019 to 3260 in 2039, as air freight expected to grow by 4.1%. Air cargo traffic expected to more than double expanding from 264 billion in 2019 to reach 578 billion RTK (revenue ton-kilometer) in 2039.
Middle East share in air cargo increased from 4% in1999 to 13% in 2019 due to expanding their fleet of wide body passenger and freighter. International air traffic raised 9.8% between African countries from 2009 till 2019 with strong growth in cargo capacity in Egypt, represented 15% of international air freight in Africa in 2019 (Boeing, 2019).
According to IATA Egypt's connections to Middle East was the fastest growing in the last five years. IATA 2019 report stated that Egypt's air cargo facilitation through customs and borders regulations ranks 78th out of 124 countries according to ATFI "Air Trade Facilitation Index" and 43rd of 135 countries according to EFFI "e-Freight Friendliness Index".
The "Enabling Trade Index" ETI ranks Egypt 116th of 136 countries for free flow of goods across borders towards destination. The development of air freight sector in Egypt needs further study as more than 99% of international freight depends on maritime transportation only (OECD, 2020).

Main Factors of Air Freight Demand

The main factors affecting air freight demand in literature are GDP "gross domestic product", international trade and inflation. GDP as an indicator of economic growth has positive impact on air freight, trade increases with higher GDP levels which increase air freight traffic internationally.
Important factors affect air freight is inflation as higher level of prices of goods reduces purchasing power of money the reduce demand of goods and services.

Worldwide data shows from 1990 to 2018 GDP tripled by rate of 279% and in same period demand of FTK "Freight Ton Km" as an indicator of air freight also tripled by rate of 239%. At same period import and export data increased by 4.5% and inflation rate decreased by approximately 70% (Alici & Akar, 2020).

That shows the importance of investigating the impact of price level on air freight demand using WPI and the impact of exchange rate as higher local currency value in comparison to other countries will make local goods and services more expensive relative to other countries which reduce exports and suppose to have negative impact on air freight. The study also is investigating impact of GDP and exports on air freight which supposed to affect air freight positively.

Literature Review

Based on Porter (2008), competitive advantage theory attractiveness and competitiveness of global economy identified upon main attribute. The factors of production that is divided into general factors consist of land, natural resources and unskilled labor, and the specialized factors consist of infrastructure, capital, and skilled labor. Those factors combination determines country's competitive advantage in the global economic environment and influences freight needs, then air transportation in turn affects these attributes through a set of enabling mechanisms (Porter, 2011). This shows the importance of air transport to nations' economies, which require further study of the main factors of air freight demand in Egypt as an important source of country's competitive advantage.

To study main economic factors of air freight demand it's important to refer to neo-Keynesian Aggregate demand AD model which assumes negative **relationship between AD and price level according to three effects. First is wealth effect** as the purchasing power of money decline due to increased price level. **Second, Net exports effect**, in which higher price level, will reduce exports. **Third is the interest rate effect**, at higher price level, demand on loans increase to fulfill their requirement, which raise **interest rate and decline AD** (Parkin, 2014).

Empirical literature showed the importance of (GDP) and trade impact on Air freight as the study of Kasarda & Green (2005) studying the relation between air freight and both GDP per capita and trade in 63 countries. Also found bi- directional relationship between "GDP per capita and air freight". As well as positive significant relationship between industrial production and air freight as it increase exports. Yao (2005) using Granger causality and IRF "impulse response function" both confirmed a significant relationship between air freight and production of firms as well as input inventory and found mutual causality between "air freight demand and economic growth". Chang & Ying (2008) found strong relationship between GDP and air freight in Africa from 1970 to 2012. There is strong causality between air freight and

trade as stated by Chiming (2008) states "GDP per capita, industrial added value, import and export" have significant impact on air transport.

Chang & Chang (2009) found bilateral relationship between "air freight and GDP growth" in Taiwan. Piecyk & McKinnon (2010) stated that demand of freight is mainly influenced by amount of produced and consumed goods. They argued that national economy expansion, increases overall demand of goods and services.

Aderamo (2010), studying air transport demand in Nigeria, results found that GDP, Inflation Rate and CPI are significant. Kupfer *et al*. (2011), studying Europe and Asia from 1983 to 2007, using pooled regression found strong positive relation between exports and air freight.

Yaru & Lina (2012) stated that economic development has a positive impact on air freight. Suryani *et al* (2012) studying Taiwan airport found strong effect on air freight demand. Yaru *et al.* (2012) state that economic development, domestic and international demand has statistical significant positive impact on air freight.

Chi & Baek (2013) studying air passenger and freight demand in USA found that economic growth has significant impact on both. Button & Yuan (2013) investigate causality between air freight and economic development in USA found that air freight stimulates economic development.

Yumeng (2015) found that foreign trade, GDP per capita and tourism have statistical significant impact on air transport. Hakim & Merkert (2016) found significance impact of GDP on air freight demand in short run while studying Asian countries from 1973 to 2014. Kiobi *et al*. (2017) studying economic determinants of air cargo in ten airlines investigated impact of "GDP, GDP per capita and interest rate". The study found positive significance impact of GDP growth rate and GDP per capita, which facilitate favorable business growth environment that raise exports and imports then raise demand of air freight transport.

Kupfer *et al*. (2017) including additional variables to model as cargo efficiency found that export strongly affect air freight demand. Zhang & Graham (2018) studying eight emerging countries from 1992 to 2014 found that GDP and exports are driving forces of air freight. In addition, literature confirms that travelling increases at high trade regions or countries (Kiraci and Battal, 2018).

Kiracı & Battal (2018), studying variables affecting air freight in Turkey from 1983 to 2015 using VAR analysis, creating 2 models for air passenger and air cargo which used explanatory variables as "foreign trade volume, industrial production index and foreign direct investment". The model found that GDP and industrial production index are statistically significant.

Cahyadin & Sarmidi (2019) found long-run co-integration between "export volume, labor force, external debt, and economic growth". Feng & Yang (2019) studied air transport development in China and found that airports number, GDP per capita,

imports and exports have positive significant impacts on air passenger and air freight.

Bozan (2019) studying Far East and Turkey from 2008 till 2018 found that “GDP per capita” has influence on air freight demand. Alıcı and Akar (2020) studied air cargo in thirteen countries from 1980 to 2018 found that GDP affects air freight positively. İnan & Gökmen (2021) found a statistically significant relationship among air passenger and GDP.

Reviewing literature it's obvious that there are large scale of literature studying the relationship between air freight and GDP indicators and less literature studying export impact on air freight demand and very little papers studying impact of inflation. The current study will contribute to the existing literature by investigating impacts of inflation and exchange rate which also affect price level of exports. Also contribution to air freight literature in Egypt as there is no studies including air freight demand factors in Egypt which consider important as mostly international freight use maritime transport.

Data and Model Specification

The study will estimate "Vector error correction model" VECM investigating the economic factors of air freight in Egypt during the period from 1982 till 2019. Based on aggregate demand model price level should affect demand negatively the model use WPI "wholesale price index" as proxy of price level of goods, as assumed by economic theory rising inflation rate will affect exports negatively which will reduce air freight demand. GDP shows gross production level which supposed to affect the trade and air freight positively. Exchange rate expected to have negative impact on air freight as if local currency value is high relative to other countries local goods will consider more expensive than other countries which will reduce demand of exports that expected to reduce air freight demand. Trade supposed to have positive impacts as rising trade volume will raise international shipping modes which include air transportation the model use exports as proxy of trade.

All variables must be stationary of first level to use “Vector error correction model" VECM method; variables need to be checked for stationarity using unit-root test of “Augmented Dickey Fuller (ADF)”, and “Philips-Peron (PP)”. Then specifying the optimal lag length using “lag length criteria” and carrying diagnostics tests of VECM as “Breusch-Godfrey Serial Correlation Test”, residuals will be tested using “Breusch-Pagan-Godfrey Heteroskedasticity Test, and normality test”, and stability test using “inverse roots test” in which all inverse roots should be included inside the unit circle.

Then co-integration test used to examine co-integrated movement among variables in long run using Johansen and Juselius (1992) methodology, if variables found to be co-integrated further examination of dynamics relate variables can be carried

using VECM methodology combining short and long run dynamics among studied variables. VECM can be written as follow.

$$\Delta y_t = \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \ \Delta y_{t-i} \ + \ \varepsilon_t \quad \text{(equ.1)}$$

y_t is "vector of included variables", Δ is "difference operator", Γ is short run coefficients matrix, p is lag length. Matrix Π is the product of 2 matrices $\Pi = \alpha\beta$, β matrix of "stationary long run relationships" and α is "matrix of error correction terms". Second term of the equation presents short run dynamics as Γ is "coefficient vector of lagged first difference of variables" Δy_{t-i}, i indicate VECM number of lags, ε is white noise error term.

As stated by Stock & Watson (1988) "If variables are co-integrated there exists at least one linear combination among them which is stationary, determined by coefficients of β matrix". Time series used usually expressed in logarithm to be able to interpret β matrix as "long run elasticities". To identify causality direction ECT "error correction terms" is analyzed (α), which reveals speed of adjustment in which variables adjust to any deviations from long run equilibrium (Batool and Goodman, 2021).

Long run causality checked by usage of t-test for significance of adjustment speed in error correction term ECT.

Then short run causality is checked by deploying standard Wald statistic and granger causality test to determine causality direction. Granger causality as mentioned by Batool and Goldman (2021), "measures weather the current and past values of variable y_t help to improve the forecast of future values of variable z_t".

Assessing variables responsiveness intensity to shocks in short and long run using "impulse response function" IRF analysis, "shocks denoted as one standard deviation in innovations the effect also transmitted to other endogenous variables through VECM dynamic structure, as IRF track effect of shocks on each innovation overall endogenous variables in the VAR system.

If innovation is simultaneously uncorrelated IRF can be directly interpreted so Cholesky decomposition is applied for making IRF innovations uncorrelated as they are usually correlated" (Mehmood *et al.*, 2013). IRF traces the impact of each variable in the model to one shock on current and future values; it identifies responsiveness of dependent variable in VECM to a shock on error term. Further analysis of variables dynamics will be carried using "variance decomposition" VDC "which break down variance of unanticipated changes in dependent variable according to the contribution of each variable's innovation" (Enimola, 2010). Applying VDC approach based on VECM for comparing influence magnitude among included variables in the model through the studied period.

Based on the above the current research will estimate VECM model for identification of short and long run dynamics that relate variables as shown in

equation (2) air freight as target variable and explanatory variables as "exchange rate, WPI, exports, and GDP".

$$\Delta \text{LNAIRFR}_t = \alpha_0 + \sum_{i=1}^{p} \alpha_1 \text{LNAIRFR}_{t-i} + \sum_{i=1}^{p} \alpha_2 \Delta\text{LNEXCH}_{t-i} + \sum_{i=1}^{p} \alpha_3 \Delta\text{LNEXP}_{t-i} + \sum_{i=1}^{p} \alpha_4 \Delta\text{LNGDP}_{t-i} + \sum_{i=1}^{p} \alpha_5 \Delta\text{WPI}_{t-i} + \varphi ECT_{t-1} + \varepsilon_t \quad \text{(Equ.2)}$$

Variables defined as shown in table (1) in addition to descriptive data of each variable. ECT "refers to error correction term relates to the fact that the deviation from long run equilibrium is corrected gradually through series of partial short run adjustments", its coefficient (φ_i) is the speed of adjustment it measures speed at which dependent variables bounce back to equilibrium after a change in independent variable. ε_t is white noise error terms. Short run dynamics captured by coefficients (α_i) of explanatory variables.

Table 1: Variables Abbreviation and measurement indicators

variable	Indicator	Max.	Min.	Std. Dev.	Jarque-Bera	Prob.	Obs.
LNAIRFR	"Air transport freight -million ton-km"	6.181	3.980	0.559	1.821	0.402	38
LNEXCH	"Official exchange rate"	2.878	-0.357	0.955	1.943	0.378	38
LNEXP	"Exports of goods and services"	25.226	22.661	0.782	3.019	0.221	38
LNGDP	"Gross Domestic Product constant"	26.710	25.030	0.495	2.382	0.304	38
WPI	"Wholesale price index"	126.777	6.488	39.975	3.470	0.176	38

Source: Author's Estimation "Ln" stands for logarithm

Model Estimation

To avoid "spurious correlation" time series has to be stationary of same order or integrated of same order, in case of integrated of same order it can be modelled by VECM. The most commonly used stationary test are "Augmented Dickey-Fuller (ADF)" and "Philips-Peron (PP)" which are employed as shown in table (2), all examined series are I (1) integrated of first order.

Table 2: Unit Root Tests for stationarity

Variable	PP		ADF		Integration order
	Level	Differenced	Level	Differenced	
LNAIRFR	-2.1657	-11.7495	-2.0251	-7.0643	I(1)

	(0.2216)	(***0.0000***)	(***0.2753***)	(***0.0000***)	
LNEXCH	-0.6014 (***0.8583***)	-2.999 (***0.0445***)	-0.6014 (***0.8583***)	-3.4524 (***0.0154***)	I(1)
LNGDP	-1.2254 (***0.6531***)	-3.6706 (***0.0089***)	-0.7157 (***0.8291***)	-3.2259 (***0.0273***)	I(1)
WPI	-0.0733 (***0.9445***)	-4.0726 (***0.0034***)	0.0432 (***0.9562***)	-3.9845 (***0.0042***)	I(1)
LNEXP	0.1095 (0.9623)	-5.0307 (0.0002)	0.1794 (0.9675)	-5.0721 (0.0002)	I(1)

Source: Author's Estimation

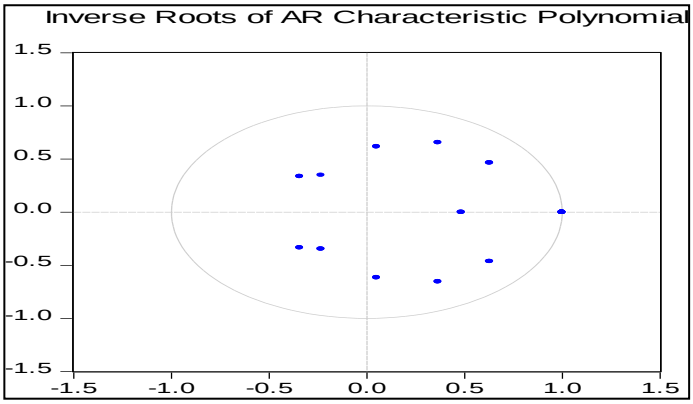
The appropriate lag length, using optimal lag length criteria is the second lag as shown in table (3), which confirmed by diagnostics test that carried based on VECM as "Breusch-Godfrey Serial Correlation Test, Breusch-Pagan-Godfrey Heteroscedasticity Test, and normality test" which shows that the model is free of Heteroscedasticity and autocorrelation problems and normally distributed at second lag. Also the model found to be stable using inverse roots test as shown in figure (1). Co-integration test examined co-movement in long run of studied variables using Johansen and Juselius (1992) methodology indicated as shown in table (4) evidence of long run relationship among the model's variables, based on second lag as found by "trace test and Max-eigenvalue" which found 2 co-integrated equations for simplicity the model is specified with only one co-integrated equation, imposing restriction of one long run relationship.

Table (3) Lag length Criteria and Diagnostics tests results

Lag	Lag length Criteria						Serial Correlation LM Tests		Jarque-Bera	Heterosk. Chi Sq.
	LogL	LR	FPE	AIC	SC	HQ	LRE	p-value	p- value	p- value
1	69.926	342.740	0.000	-2.281	-0.948*	-1.821	18.798	0.828	0.000	0.025
2	101.959	43.931*	0.000	-2.683	-0.239	-1.840	25.007	0.501	0.423	0.163

Source: Author's Estimation

Figure (1): Inverse Roots



Source: Author's Estimation

Table (4) Co-integration Rank Test

Hypothesized		Trace			Max-Eigen		
No. of CE(s)	Eigen-value	Stat.	Critical-Value	Prob.**	Statistic	Critical-Value	Prob.**
None *	0.774	100.715	69.818	0	52.153	33.876	0.0001
At most 1 *	0.550	48.561	47.856	0.0428	27.988	27.584	0.0444
At most 2	0.321	20.572	29.797	0.3848	13.585	21.131	0.4000
At most 3	0.152	6.987	15.494	0.5791	5.779	14.264	0.6417
At most 4	0.033	1.208	3.8414	0.2716	1.208	3.841	0.2716
Trace test and Max-eigenvalue test indicates two co-integrating equations at 0.05 level							

Source: Author's Estimation

VECM employed for further identification of the dynamics that relate variables. VECM estimated for short and long run dynamics with air freight as target variable and explanatory variables as "exchange rate, WPI, exports, and GDP". Shown in equation (4) and ECT shown in equation (5):

$$\Delta LNAIRFR_t = -0.44\ ECT_{t-1} + 0.40\ \Delta LNAIRFR_{t-1} + 0.07\ \Delta LNAIRFR_{t-2} - 0.51\ \Delta LNEXCH_{t-1} + 0.03\ \Delta LNEXCH_{t-2} + 1.85\ \Delta LNEXP_{t-1} + 0.88\ \Delta LNEXP_{t-2} - 1.4\ \Delta LNGDP_{t-1} + 8.15\ \Delta LNGDP_{t-2} - 0.02\ \Delta WPI_{t-1} + 0.02\ \Delta WPI_{t-2} - 0.31 \quad \text{(Equ. 3)}$$

$$ECT_{t-1} = LNAIRFR_{t-1} - 0.161\ LNEXCH_{t-1} + 1.76\ LNEXP_{t-1} - 1.72\ LNGDP_{t-1} - 0.028\ WPI_{t-1} + 10.996 \quad \text{(Equ. 4)}$$

R squared (coefficient of determination) shows that almost 66 percent of total variations in air freight explained by explanatory variables. P-value of F-statistics is significant at 1% which shows that data is fitted good, and Durbin-Watson statistic

is almost 2 which shows that the model is free of serial correlation, which also confirmed by diagnostics tests in table (3).

ECT in table (5) indicates long run relationship among variables as the coefficient is with correct sign (-0.44) and statistically significant at 5% confidence level, any deviation from long run equilibrium will be corrected at rate 44%.

Short run dynamics captured by coefficients of explanatory variables as shown in table (5) coefficients of independent variables shows that exchange rate is negative statistically significant at 5% confidence level to air freight as expected from literature as reduction of exchange rate of local currency will make local prices of goods and services relatively cheaper than other countries which will raise exports that induce increase in air freight as international transportation mean.

Exports found to be positive significant at 5% confidence level which goes with literature as higher level of exports will raise demand on airfreight. That goes with empirical literature Kiobi *et al.* (2017) study found positive significance impact of GDP growth rate, which facilitate favorable business growth environment that raise exports and imports then raise demand of air freight transport which also goes with the model estimates which found that GDP is positive statically significant at 1% confidence level to air freight which goes with economic theory.

Increased gross production will raise international trade and then international transportation, also goes also with empirical literature as found also by Kiracı & Battal (2018). WPI as proxy of inflation found to be negative statistically significant at 1% confidence level to air freight which goes with economic theory that there is negative relationship between prices and demand.

These findings confirmed also through using Wald Statistics and granger causality test as shown in tables (6 and 7) which both found that in short run there is unidirectional causality from Exchange rate, Exports, GDP and WPI to air freight at 5% confidence level.

Table (5) VECM Estimation

	Coef.	**Std. Err**	**t-Stat.**	**Prob.**
ECT	-0.44012	0.187915	-2.34215	0.0291
D LNAIRFR(-1)	0.400507	0.265995	1.505691	0.1458
D LNAIRFR(-2)	0.074644	0.16648	0.448364	0.6581
D LNEXCH(-1)	-0.51237	0.198791	-2.57743	0.0176
D LNEXCH(-2)	0.037982	0.22031	0.172405	0.8648
D LNEXP(-1)	1.850334	0.538297	3.437388	0.0025

D LNEXP(-2)	0.880521	0.416433	2.114437	0.0466
D LNGDP(-1)	-1.43258	2.191155	-0.6538	0.5203
D LNGDP(-2)	8.152072	2.452919	3.323417	0.0032
D WPI(-1)	-0.02589	0.006672	-3.88123	0.0009
D WPI(-2)	0.029036	0.008009	3.625377	0.0016
C	-0.31586	0.174684	-1.80815	0.0849
R-squared	0.660976	Durbin-Watson stat		1.9295
F-stat.	2.146627	Prob. (F-stat.)		0.059

Source: Author estimation. D is first difference

Table (6) Wald Statistic Results

Wald statistic results				
Dependent variable: D(LNAIRFR)				
Variable	F-stat.		Chi-square	
	value	Prob.	value	Prob
LNEXCH	3.737	0.0409	7.473	0.0238
LNEXP	6.288	0.0072	12.576	0.0019
LNGDP	5.533	0.0117	11.066	0.004
WPI	9.842	0.001	19.684	0.0001

Source: Author's estimation

Table (7) VEC Granger Causality

Dependent variable: D(LNAIRFR)			
Excluded	Chi-sq	df	Prob.
D(LNEXCH)	7.473	2	0.0238
D(LNEXP)	12.576	2	0.0019
D(LNGDP)	11.066	2	0.004
D(WPI)	19.684	2	0.0001

Source: Author's estimation

Impulse Response

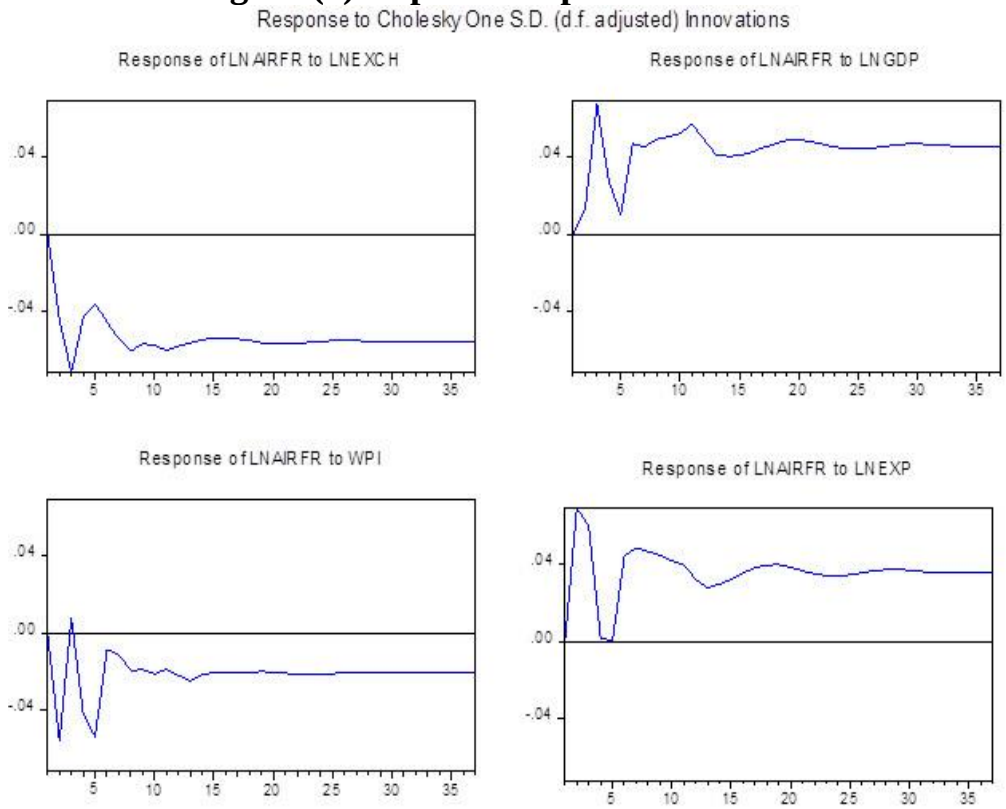
The results are checked further with IRF "Impulse-Response functions" based on VECM. IRFs identify responsiveness of dependent variables in the VECM due to a

shock on error term “it traces effect of one-time shock to one of innovations on current and future values of dependent variables". The results of IRFs for 37 years on yearly basis in Figure (2) showing a one standard deviation shock to exchange rate and WPI each causes significant decreases in air freight over the 37 studied years, while one standard deviation shock to GDP and exports each causes significant increases in air freight over the 37 studied years.

Variance Decomposition

To compare extent of contributions of time series FEVD “Forecasting error Variance decomposition” based on VECM gives "the percentage of unexpected variation in each variable that is produced by shocks from other variables comparing magnitude influence among studied variables". FEVD results at table (8) shows that in first year 100% of forecast error variance in air freight is explained by itself further we move in future over long run influence decreased to 63% while influence of other variables become stronger in predicting air freight, contribution of exchange rate on predicting air freight increased to reach almost 12%, exports contribution increased to reach almost 11%, followed by WPI contribution increased to reach almost 10% and the weakest contribution is GDP which increased to reach almost 4%.

Figure (2) Impulse Response Functions



Source: Author estimation

Table (8): Variance Decomposition of LNAIRFR

Period	S.E.	LNAIRFR	LNEXCH	LNEXP	LNGDP	WPI
1	0.137224	100	0	0	0	0
2	0.229455	80.12542	4.549769	0.051787	0.291897	14.98113
3	0.261646	78.98188	8.527616	0.188387	0.662254	11.63987
4	0.307947	63.6826	9.646854	16.73211	0.518429	9.420005
5	0.329818	63.69739	8.674345	18.64096	0.630451	8.356851
6	0.364039	65.87675	7.987681	17.52739	0.534099	8.074077
7	0.40141	58.54127	7.759205	23.25006	2.031895	8.417567
8	0.419658	55.16805	8.026125	21.50385	4.120787	11.18118
9	0.431932	53.82725	8.511283	21.80497	5.036013	10.82049
10	0.449721	55.12163	9.643371	20.11892	4.648383	10.46769
11	0.467323	56.13068	10.13351	18.76426	4.401996	10.56955
12	0.480688	56.83812	10.29392	18.04956	4.312533	10.50586
13	0.491705	56.73854	10.35928	18.41383	4.408026	10.08032
14	0.506572	56.61838	10.16199	19.25243	4.294105	9.673098
15	0.5212	57.67914	9.976676	18.90287	4.130144	9.311173
16	0.535586	59.02025	10.04476	17.91373	3.941975	9.07928
17	0.54725	59.55765	10.18333	17.16911	3.93822	9.151686
18	0.557738	59.76321	10.22577	16.68914	4.025309	9.296578
19	0.567725	60.12491	10.34475	16.10968	4.095664	9.32499
20	0.579147	60.24334	10.53041	15.55056	4.16061	9.515083
21	0.589817	60.19042	10.71773	14.99719	4.314262	9.7804
22	0.599379	60.22869	10.94238	14.57377	4.408927	9.846239
23	0.608872	60.37423	11.15306	14.25341	4.419389	9.799909
24	0.619003	60.64258	11.25144	13.99993	4.374931	9.731118
25	0.629119	61.03243	11.29093	13.75651	4.315414	9.604725
26	0.638919	61.3985	11.32201	13.53776	4.266533	9.475193
27	0.648626	61.66431	11.31371	13.40694	4.238516	9.376527
28	0.658276	61.98267	11.29601	13.22892	4.204596	9.287794
29	0.667732	62.3568	11.32005	12.91414	4.171497	9.237511
30	0.677002	62.61634	11.36732	12.57622	4.169066	9.271053
31	0.685804	62.76307	11.42681	12.26822	4.203592	9.33831
32	0.694263	62.86595	11.5121	11.98183	4.246679	9.393438
33	0.702683	62.94647	11.60867	11.708	4.285765	9.451104
34	0.711088	63.03457	11.69863	11.4579	4.314058	9.494846
35	0.719374	63.14881	11.78464	11.24304	4.325662	9.497861
36	0.727611	63.27507	11.85428	11.07461	4.322968	9.473069
37	0.73591	63.41792	11.89207	10.95326	4.308394	9.428358

Source: Author estimation

Conclusion

Air freight consider important attribute of county's competitive advantage based on Porter (2008), which shows the importance of studying air freight specially in Egypt as 99% of international freight in Egypt relies only on maritime transport. That

reduces the economic impact of Air freight that stressed on the importance of studying the main economic factors of air freight demand in Egypt.

Based on neo-Keynesian Aggregate demand AD model the study focused on investigating the impact of price level on demand of air freight using WPI as indicator of inflation. Impact of exchange rate as higher local currency value in comparison to other countries will make local goods and services more expensive relative to other countries which reduce exports.

In addition to studying GDP and exports impact which supposed to have positive impact on air freight demand due to increase domestic production which increase exports.

Using VECM approach found long run relationship between the studied variables, any deviation from long run equilibrium will be corrected at rate of 44%.

Short run dynamics captured by coefficients of explanatory variables shows that exchange rate is negative statistically significant as expected from literature as higher local currency value will raise local goods prices which reduce the demand on exports followed by air freight demand.

Exports found to be positive significant at which goes with literature as higher level of exports will raise demand on airfreight. That goes with empirical literature Kiobi *et al.* (2017) study found positive significance impact of GDP growth rate, which facilitate favorable business growth environment that raise exports and imports. That raise demand of air freight transport which also goes with the model estimates which found that GDP is positive statistically significant which goes with economic theory as increased gross production will raise international trade and demand on air freight.

WPI as proxy of inflation found to be negative statistically significant which goes with economic theory. These findings confirmed also through using Wald Statistics and granger causality showing unidirectional causality from Exchange rate, Exports, GDP and WPI to air freight.

The model further examined using IRF for 37 years on yearly basis a one standard deviation shock to each of exchange rate and WPI cause significant decreases in air freight, while shock to GDP and exports cause significant increases in air freight.

FEVD carried based on VECM which shows that 63% of air freight explained by its own innovative shocks followed by contribution of exchange rate of contribution rate of 12%, followed by exports contribution rate of 11%, then WPI with contribution rate of 10%, and the weakest contribution rate is GDP of 4%.

The findings of the study contribute to determination of factors affecting air freight demand, which is beneficial, to air freight industry and policy makers, contributing as well to the literature of air freight demand.

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