Examining The Impact of Socioeconomic Factors on Transportation: Empirical Evidence from Egypt 1980-2020

Presented by

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Abstract

Transportation facilitate mobilization that is a main need for human daily life transferring people or goods both locally and internationally. Transportation is fundamental for economic activities and social development as found by literature, which stressed on the importance of studying this relationship also in the opposite direction. The current study is investigating the effect of socioeconomic variables on transportation using air transport employing vector error correction model (VECM). Two models are estimated, investigating socioeconomic variables (employment, income and population)impact on air passenger transport at first model in addition to cost or airfaresusing oil prices and infrastructure, and impact on air freight in second model in addition to customs as control variable and cost or freight rates.The analysis found that income and population have positive significant impact at both models, cost has negative impact at both models, employment is significant only at first model, customs have negative significance impact at second model and infrastructure has positive impact at first model. The results suggestreduction and stabilization of air fares and freight rates and customs, also, results show the importance of infrastructure development.

Keyword: Passenger transport, freight, employment, population, income, VECM.

1. Introduction

Transportation facilitate mobilization which is a main need for human daily life for transferring people from a place to another (passenger), or transferring goods(freight), both domestically and internationally. Transportation is fundamental for economic activities and social development.

Transportation developed through years according to technological development which improved its speed, comfort and reliability, that improved society and life quality. limited mobility considers an obstacle to social and economic development, as mobility consider a catalyst for development as it adds to employment, which raise income at society. Regarding economic activities, it facilitates effective movement of workers, goods and different services, that reduce distribution costand time, transportation is also, a social need as it offers access to leisure and social activities.

Transportation is constrained by factors such that infrastructure, and income levels, usually there is correlation between transportation and income levels. Expanded transportationfacilitate social interactions specially over long distances that increased with the growing of air transport.

The majority of literaturestudied theeffects of transportation on socioeconomic indicators where the findings indicated that it had a significant impact on them.This shows the importance of the current study trying to fill the gap in literature of studying the opposite directionexamining the impact of socioeconomic variables on transport.

The current study main objective is to examine effect of socioeconomic factors mainly employment, income and population on transport for both

passenger and freight in Egypt with taking in consideration cost, infrastructure and customs, from 1980 to 2020.

The study main hypotheses are; first; unemployment, oil prices as indicator of costs or airfares and customs affect air transport negatively. Second; suggest positive impact of population, income and infrastructure on air transport positively. The hypotheses examined empirically deploying Vector error correction model (VECM) for studying impact of socioeconomic variables on freight and passengerusing air transport as indicator of transportin Egypt, due to data availability, with studying data dynamics deploying impulse response function and Forecasting error variance decomposition (FEVD).

The rest of paper covers at second section literature review, followed by covering development of transport in Egypt at third section. Fourth section presents data description and model specification, then discussing empirical results at fifth section, and ending by conclusion and recommendations.

2. Literature Review

An essential aspect that stimulates economic activity in any economy is transportation (Ali, Bpakhsh, & Yasin, 2023). The transportation industry and the economy are both influenced by two-way relationships. The ability to accumulate resources that can be used to improve the capacity of the current infrastructure is finally made feasible by economic expansion. At the long term, it encourages expansion of several industries, including air transport industry (Vittek et al., 2020). The air transportation sector significantly affects the economy both via its operations and as a channel for other sectors. The employment, income, and capital investments that are often produced while

providing air transportation services are one level of the economic effect. The benefits of the dynamic economic twist, notably the inward investment that air transportation generates, are at another level (Dimitrios& Maria, 2018). At the same time, transportation is impacted by these economic indicators. However, there aren't many studies that examine how all socioeconomic variables affect transport as the different studies used one only variable mainly concentrating on the GDP effect. Fernandes & Pacheco (2010) studied relationship among GDP and air passenger, found uni-directional causality from GDP to air transport.Marazzo*et al.,* (2010) for instance, examined the connection between the increase in the Brazilian GDP between 1966 - 2006 and demand of air transport. The results point to a cointegration among GDP and air travel, also analysis of IRF demonstrates positive impact of GDP on air travel. The GDP, on the other hand, responds to a shift in the demand for air travel more gradually and moderately. Brida*et al*., (2016) studied impact of air travel in Italy between 1971 and 2012 found that air transport affects GDP. Ali, Bakhsh, & Yasin (2023) examined nexus among aviation and economic growth in BRICS countries from 1993 to 2019 using air passengers and freight employing VECM, the findings indicated that air transport had long-term, unidirectional causal associations to economic growth and a short-run impact of air travel.

Few studies examined the impact of socioeconomic variables on transportation; demand of transportation depends on socioeconomic status which might cause mobility gaps among different income level. Also, gender gaps might exist as women usually less mobile according to their work

choices and social jobs as taking care of their families specially in developing economies. Mobility gaps exist specially in long distances, air transport facilitated high level of mobility but still huge proportion of population around the world have less mobility. Age also affect usage of transportation modes as older people need more comfortable mode and on same time, they have less income (Rodrigue, 2020). The current study will examine three socioeconomic variables based on literature (income, employment, population).

Income level can be measured by GDP per capita which has effect on demand of transportation, as stated by Steiner (1967) that income has positive impact on air traffic. Also, some studies used GDP for measuring income as Graham (2000), which stated that air transport is more preferable by middle-income and high-income level population segment. Higher income level raise mobility of people using faster and more luxurious transportation mode as air transport (Schafer & David, 2000). Karlaftis (2008) stated positive impact of income levels on air passenger, Baker *et al.* (2015) study concluded existence of positive association among GDP per capita and air transportation.

Populationas discussed by literature affects transport positively as higher number of population requires more available transport means. Fridström and Thune-Larsen (1989), also, study of Demirsoy (2012) concluded that income and population are among main demand factors of air transport, also as discussed by Rodrigue (2020).

Employment supposed to affect transportation, as more people employed means higher demand on transport to facilitate reaching their desired places

locally using domestic transport modes and internationally as air transport**(**Rodrigue**,** 2020). Ishutkina and Hansman (2008) discussed the importance of transportation availability that raises mobility which increases economic activities that raise employment and income. This shows the two-way relationship among air transportation and economy (Demirsoy, 2012). Also, some literature studied nexusamong employment and air transportation as Vijver*et al*. (2015) examined link among air transportation and economic growth in Europe. The study used employment as proxy for regional development, which found bi-directional relationship. Küçükönal & Sedefoğlu (2017) studied nexus among socioeconomic factors and air transportation;found that GDPand employment are among major factors increasing demand of air transport in OECD countries from 2000 to 2013.

In addition to socioeconomic variables the study adds control variables that affect the impact of studied variables on transportation which are costs of transportation or airfares using oil prices, as well as, infrastructure and customs as proxy of regulations affecting transportation.

Airfares or Cost of using transport is an important factor but it isn't easy to get its data, literature use oil prices as an indicator. Based on role of demand there is inverse impact of prices on demand (Parkin, 2014). Higher costs expected to reduce demand on transportation by passengers, as well as, freight, as it will negatively affect domestic production depending on imported raw materials or intermediate goods which raise domestic prices and consequently exports prices that can reduce exports and reduce also, local demand which in turn will negatively affect international trade and demand on

transportation. Also, unstable transportratesled to unpredictable domestic goods prices which in turn will affect sustainability of demand ontransport (IATA, 2022). Regmi (2009) investigated nexus among air transportation and tourism in Nepal, found travel cost among other factors effective for air transport.

Development of infrastructure enhances life quality, as discussed by Hansman (2008) transportation development facilitates faster and more efficient arrival of raw materials and intermediate goods, which stimulates economic activity and raise employment that subsequentlyraises demand on transportation. This cycle requires some exogenous factors for its success as infrastructure and regulations (Demirsoy, 2012). Estache*et al*. (2013) found that each US$1 billion invested in construction of roads and bridges would generate 350,000 direct jobs, also contribute to jobs in long run causing positive impact on economic growth. Also, Yogo & Verdier-Chouchane (2015) stated that each 1% improvement in infrastructure generates 1.42% increase in economic competitiveness.

3. Transportation in Egypt

Based on World Bank (2018) Egypt faced imbalances on macro and microeconomic levels which let the Government to follow economic reform policies of key aspects of economic legislation reforms and infrastructure development including transportation.

Transportation is a major sector for economic development through integrated transportation network connecting domestic and international transport to fulfill needs of growing population. Also, fulfilling production needs through

efficient and fast routes connecting domestics and global markets for arrival of inputs and supportive services for industrial sector. Egypt faced financing gap, regarding transportation sector the gap is US$177 billion which shows the importance of shifting towards private or commercial finance. World Bank suggest turning to Public Private Partnerships (PPPs) for financing the gap or through private finance. PPP would increase revenues through user fees and putting incentives to operators for example when they maintain or develop roads at specific quality which help users and government as well. Expanding private finance rolerequires financial independence through adjustment of tariffs structure to create revenue streams for improvements of operational efficiency.Short term plan for transportation development includes development of railways both passenger and freight through private investment and PPP. Also, developing inland waterways through expanding its capacity, and raising its efficiency, as well as, removing bottlenecks, also the plan include development of urban transportation (World Bank.2018).

According to Egyptian government, transportation is one of the main priority sectors selected to allow Egypt to be a global trading hub through development of multimodal freight transport include seaports, airports, rivers and railways, as well as, development of logistics infrastructure; and urban transport, include the following:

- Development of transport strategy towards a sustainable coordination among all transport modes.
- Accomplishment of national road network
- Expansion of railway network based on 10 years plan

- Involving private sector to share in development of container terminals, inland waterways, railway, ports, and transit.

Egypt vision is expanding and integrating smart transport networks for meeting the growing needs for mobilization connecting remote societies to jobs, and markets (EU, 2011). That allow reaching larger efficiency, for passengers through linking airports, seaports, railways, and internal mobility through busses and metro allowing integrated travel routes, and for freight, Egypt requires reliable, low costs freight corridors (Egypt Transport Ministry, 2012). Based on World Bank (2018) Egypt's geographiclocation offer two opportunities for being a trade hub of Middle East region. First depends on Suez Canal connecting Asia to Europe, second depends on land trade between Eastern and western countries. Investment needed to achieve those opportunities including (i) developing and raising efficiency of seaports, creating dry ports, and free zones areas, as well as, logistics centers; (ii) improvement of inland transport as railway and road transport for connectivity to Ports (iii) raising cargo capacity of air transport.

Air transport mainly focus on passenger for tourism, as 80% of tourists come to Egypt using air, the reduction of demand by passengers after 2011 lead to ignoring air freight, while Egypt's location offers opportunities towards air freight transport, which require further development of air transport. Cairo International Airport (CAI) handles 99% of total air freight volume, which is increasing annually by 16% since year 1997. Current capacity for passenger terminals is enough but freight terminal doesn't have

enough capacity for meeting current demand, investment should target raising cargo handling capacity.

The Government put Airport Master Plan in 2017 financed by Public Private Infrastructure Assistance Facility (PPIAF) and managed by World Bank, focusing on air cargo transportation, as well as, passenger transportation.The plan includes increasing capacity of existing places and developing new locations, and optimizing operations to match airports with targeted economic and financial viability of investments, and sustainability of Egyptian aviation sector.

Despite Egypt's unique geographical location, it isn't yet an air freight regional or international hub. Freight volume is around 300,000 tons per year, 80% of it carried by passengers, in comparison to 2.2 million tons of air cargo traffic in Middle East in 2017, thus shows missing opportunity for Egypt. Currently, a PPIAF-funded plan will help for developing airport network in Egypt.

According to IMF working age population in Egypt will increase 20% of total labor force of 80 million by 2028which needs supportive and adequate transportation means(World Bank, 2018). Fast and efficient mobilization is needed for reaching jobs and fast access to markets for different goods and services. Also, fast and efficient across borders mobilization is required for movement of goods for supporting exports and trade. This shows the importance of population and employment on transportation which will be further examined.

4. Empirical Analysis

4.1 Data Description

The study estimates twomodels investigating impact of social economic variables on transportationin Egypt from 1980 to 2020.First model examining the impact of socioeconomic variables on air passenger, and its impact on air freight at second model. The model's independent variables as defined at table (1) selected based on literature as follows.

- **Employment** using unemployment as an indicator which supposed to have negative relationship as higher employment requires more transport to facilitate reaching work.
- **Income level** measured by GDP per capita as mentioned by Steiner (1967) stated positive impact of income on air traffic. Also, Karlaftis (2008) stated positive impact of income levels on air passenger,Baker *et al.* (2015) found positive significanceof GDP per capita to air transportation.
- **Population** based on literature has positive impact on transportation as mentioned by study of Demirsoy (2012).
- **Oil prices** measuring the cost of using transport as air fares supposed to affect transport negatively.
- **Infrastructure** measured by gross capital formation as control variable. Based on literature as Demirsoy (2012) the relationship between socioeconomic variables and transportation requires some factors to be accomplished include infrastructure and regulations

- **Customs**measuring regulations used as control variable and supposed to affect transport negatively.

Table 1: Variables Definitions

Variable	Indicator	Source
LNAIRF	Air freight Transport	WB
LNAIRP	Air transport, passengers	WB
LNGDPC	GDP per Capita (Constant)	WB
LNCUSTOMS	Customs and other import duties	WB
LNGCF	Gross capital formation (% of GDP)	WB
LNPOPG	Population growth (annual %)	WB
LNUNEMP	Unemployment (% of total labor force)	WB
LNCOST	Crude oil spot prices	S & P Global INC.

Source: collected by author WB: World Bank

Table 2: Descriptive Analysis

Variable	Mean	Maximum	Minimum	Std. Dev.	Observations
LNAIRP	15.375	16.396	14.522	0.540	41
LNCOST	3.494	4.692	2.510	0.675	41
LNCUSTOMS	22.687	24.234	21.012	0.928	41
LNGCF	23.912	25.056	22.841	0.603	41
LNAIRF	5.258	6.181	3.381	0.680	41
LNGDPC	7.807	8.252	7.271	0.278	41
LNPOPG	0.805	1.013	0.550	0.129	41
LNUNEMP	2.138	2.576	1.273	0.333	41

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

4.2 Diagnostics Tests

First: before model estimation data have to be tested for stationarity to ascertain that the employed data are integrated of first order. Two-unit root

tests employed as results may differ. Augmented Dickey – Fuller test (ADF) (Dikey and Fuller, 1979), Philips and Perron test (PP, 1988) are employed.

Second: determining optimal lag length for estimation using "Akaike info criterion AIC", "Schwarz Information Criterion SIC", "Hannan-Quinn Information Criterion HQC".

Third: model has to be examined for long-run co-integration relationship among studied variables employing Johansen - Juselius(1992) test, if data found to be cointegrated long run dynamics can be carried using VECM.

Fourth: serial correlation using Breusch-Godfreytest that shows if there is no serial correlation in the long run relationship among model's variables.

Fifth: testing data for Heteroskedasticity using Breusch-Pagan-Godfrey (BPG) test andAutoregressive Conditional Heteroscedasticity (ARCH) test to check existence of ARCH problem.

Sixth: checking goodness of data using inverse roots stability test to examine stability of long-run coefficients, as well as, using Jarque-Bera(JB) normality test to check if data is normally distributed.

4.3 Model Specification

VECM model estimating short run and long run relationship among data, which is written in the following general form, first part shows long run dynamics while the second is short run dynamics.

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

y_t: variables vector Δ : difference operator p: lag length

Γ : matrix of short run coefficients Π :product of two matrices

$$\Pi = \alpha\beta$$

β : Long run relationships matrix

α : Error correction terms (ECT) matrix it reveals speed of adjustment to deviations from long run equilibrium

Δy_{t-i} indicates VECM lags εt :white noise error

Two models estimated using the above approach first model investigating the impact of socioeconomic variables, in addition to cost and infrastructure as control variable on air passenger as shown in equation (2), and the second model investigating socioeconomic variables, in addition to cost and customs as control variables on air freight as shown in equation (3)

$$\Delta \text{LNAIRP}_t = \alpha_0 + \sum_{i=1}^{p} \alpha_1 \text{LNAIRP}_{t-i} + \sum_{i=1}^{p} \alpha_2 \Delta\text{LNGCF}_{t-i} + \sum_{i=1}^{p} \alpha_3 \Delta\text{LNPOPG}_{t-i} + \sum_{i=1}^{p} \alpha_4 \Delta\text{LNCOST}_{t-i} + \sum_{i=1}^{p} \alpha_5 \Delta\text{LNGDPC}_{t-i} + \sum_{i=1}^{p} \alpha_6 \Delta\text{LNUNEMP}_{t-i} + \varphi\, ECT_{t-1} + \varepsilon_t \quad (2)$$

$$\Delta \text{LNAIRF}_t = \alpha_0 + \sum_{i=1}^{p} \alpha_1 \text{LNAIRF}_{t-i} + \sum_{i=1}^{p} \alpha_2 \Delta\text{LNCUSTOMS}_{t-i} + \sum_{i=1}^{p} \alpha_3 \Delta\text{LNPOPG}_{t-i} + \sum_{i=1}^{p} \alpha_4 \Delta\text{LNCOST}_{t-i} + \sum_{i=1}^{p} \alpha_5 \Delta\text{LNGDPC}_{t-i} + \sum_{i=1}^{p} \alpha_6 \Delta\text{LNUNEMP}_{t-i} + \varphi\, ECT_{t-1} + \varepsilon_t \quad (3)$$

(φ_i) is ECT coefficient

(α_i) Short run coefficients of independent variables

Based on VECM variables responsiveness to shocks tested employing impulse response function (IRF), that traces effects of innovation shock to a variable on the response of other variables in the system(Mehmood *et al.*, 2013). Also, variables dynamics analyzed employing forecast error variance decomposition (FEVD)based on VECM comparing relative influence strength of each innovation in affecting studied variables in the system.

5. Model Estimation

5.1 Diagnostics Tests Results

First, data stationarity tested using ADF and PP test; the results shown at table (3) indicates that all variables are integrated of first order I (1).

Second: optimal lag length tested as shown in table (4) shows that second lag is the proper lag length for both models.

Third: model examined for long-run co-integration relationship among studied variables. The results as shown at table (6) found long run co-integration among studied variables of both models, trace test found 2 co-integrated equations, and 1 equation according to Max-eigenvalue. This result shows long cointegration and the appropriateness of carrying VECM approach.

Table 3: Unit Root Test Results

Indicator	**PP**		**ADF**		**Result**
	Level	First Difference	Level	First Difference	
LNAIRF	-2.1657 **(0.2216)**	-11.7495 (**0.0000)**	-2.0251 (**0.2753)**	-7.0643 (**0.0000)**	I(1)
LNAIRP	-1.7442 (0.402)	-1.7442 (**0.0000)**	-1.7976 (0.3764)	-6.1958 (**0.0000)**	I(1)
LNGDPC	-1.4705 (0.5383)	-3.9124 (0.0044)	-0.9767 (0.7518)	-4.0388 (**0.0000)**	I(1)
LNCUSTOMS	-0.7149 (0.8134)	-6.2808 (**0.0000)**	-0.7156 (0.8313)	-6.2809 (**0.0000)**	I(1)
LNGCF	**-0.5732 (0.8655)**	**-6.9761 (0.0000)**	-0.7992 (0.8087)	**-5.9558 (0.0000)**	I(1)
LNPOP	-0.4315 (0.894)	-2.2377 (0.026)	-0.9936 (0.7464)	-2.2029 (0.0282)	I(1)
LNUNEMP	-1.9832 (0.2828)	-5.1934 (0.0001)	-2.2687 (0.1868)	-5.2348 (0.0001)	I(1)
LNCOST	-1.0101 **(0.7396)**	-5.7858 **(0.0000)**	-1.01010 **(0.7396)**	-5.7830 **(0.0000)**	I(1)

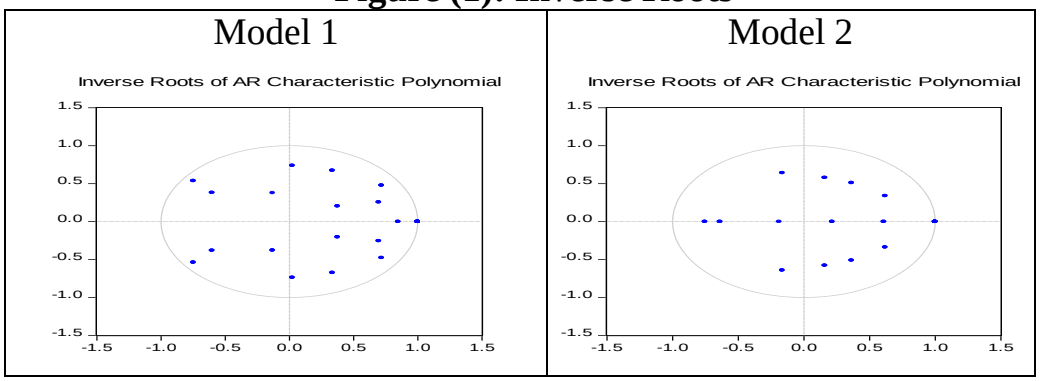
Source: Author's Estimation

Fourth: data tested for serial correlation showing that data is free of serial correlation at second lag of first model and at both two lags of second model as shown in table (4).

Fifth: data tested for Heteroscedasticityand ARCH which shows that bothmodelsdon't suffer from a Heteroscedasticity problem, neither ARCH problem as shown in table (5).

Sixth: data checked for stability using inverse roots test which shows that both modelsare stable as shown in figure (1). Also, as shown in table (5) the data is normally distributed at both models.

Figure (1): Inverse Roots



Source: Author's Estimation

Table (4) Lag length and Serial Correlation Test

Lag	LogL	LR	FPE	AIC	SC	HQ	LM Test
Model 1							
1	249.4133	352.533	6.73e-12	-11.54807	-10.2552*	-11.0880	0.0499
2	286.6980	52.9836*	3.79e-12*	-12.1946*	-9.82444	-11.3513*	0.9704
3	308.420	25.1524	5.47e-12	-12.0221	-8.57458	-10.7955	0.8391
Model 2							
1	273.8502	NA	1.50e-13	-12.5184	-	-	0.9259
2	320.2308	63.4681	9.76e-14*	-	-9.9619	-11.9608	0.1460
3	348.7298	29.9989	2.07e-13	-12.6699	-8.0157	-11.0140	0.7720

Source: Author's Estimation

Table (5) Diagnostics Tests Results

Model	Normality Test JB p.value	BPG Heterosk. Test F-Stat p.value	ARCH F-Stat p.value
1	0.6890	0.1943	0.2536
2	0.2387	0.3982	0.8355

Source: Author's Estimation

Table (6) Co-integration Test

Model1							
Hypothesized		Trace			Max-Eigen		
No. CE(s)	Eigen-V.	Stat.	Critical-V.	P.	Stat.	Critical-V.	P.
None *	0.654901	116.1408	95.75366	0.001	40.42915	40.07757	0.0456
At most 1 *	0.522546	75.71164	69.81889	0.0157	28.0929	33.87687	0.2092
At most 2	0.422957	47.61874	47.85613	0.0526	20.89389	27.58434	0.2827
At most 3	0.327319	26.72485	29.79707	0.1085	15.0664	21.13162	0.2843
At most 4	0.232466	11.65845	15.49471	0.1741	10.05377	14.2646	0.2084
Model 2							
None *	0.793846	137.4247	95.75366	0.0000	60.00699	40.07757	0.0001
At most 1 *	0.567288	77.41766	69.81889	0.0109	31.83198	33.87687	0.0860
At most 2	0.410867	45.58569	47.85613	0.0805	20.10595	27.58434	0.3339
At most 3	0.369990	25.47974	29.79707	0.1450	17.55675	21.13162	0.1473
At most 4	0.143222	7.922983	15.49471	0.4737	5.873911	14.26460	0.6295
Trace test indicates 2 co-integrating					Max-eigenvalue test indicates 1 co-integrating		

Source: Author's Estimation

5.2 Model Estimation Results

First model: R-squared shows almost 94% of total variations in dependent variable explained by independent variables. Significance of F-stat.shows that data is well fitted.ECT as shown at table (7) has the correct negative sign and significant (-0.849) which indicates that any deviation from long-run equilibrium will be converged back to equilibrium by rate of almost 85%, the convergence to equilibrium will be completed within almost 1.2years.Short

run coefficients indicates that GCF as indicator of infrastructure is positively significant to air passenger which goes with literature. Population and income measured by GDP per capita also found to be positively significant which goes with literature as Demirsoy (2012) concluded that both income and population among the major air transport factors. Unemployment is negatively significant which shows that higher employment level will raise transportation going with Rodrigue (2020) and Küçükönal & Sedefoğlu (2017). Also, costs are negatively significant which going with demand role of inverse relationship between price and demand. Sedefoğlu (2017) found that GDPand employment are among major factors increasing demand of air transport.

Second model: R-squared indicates that 78% of total variations in dependent variable explained by independent variables. F-stat significance identifies that data is well fitted.ECT as shown at table (8) has the correct negative sign and significant (-0.963) which shows that any deviation from long run equilibrium will be corrected at rate of almost 96%, the convergence to equilibrium will be completed within almost one year. Short run coefficients show population is positively significant which shows that increasing population increase the importance of transportation as more people means higher demand on goods which raise demand on transportation. GDP per capita is positively significant showing that increasing income will raise demand on goods which subsequently increase importance of air freight. Income at both models is positively significant going with Graham (2000). Costs and customs have negative impact on air freight which increase the cost of final goods, include imported inputs or final goods imported from abroad which reduce demand on goods and subsequently demand on air freight.

Table (7) First ModelEstimation

	Coef.	Std. Err	t-Stat.	Prob.
ECT	-0.849129	0.138193	-6.144510	0.0000
D(LNAIRP(-1))	0.136141	0.197517	0.689261	0.4961
D(LNAIRP(-2))	0.342117	0.197161	1.735215	0.0933
D(LNGCF (-1))	0.961298	0.307327	3.127929	0.0040
D(LNGCF(-2))	1.226116	0.180909	6.777528	0.0000
D(LNPOPG(-1))	1.871089	0.970114	1.928732	0.0633
D(LNPOPG(-2))	1.619574	0.412450	3.926717	0.0005
D(LNCOST(-1))	-0.229899	0.105813	-2.172702	0.0376
D(LNCOST(-2))	-0.045367	0.172928	-0.262346	0.7953
D(LNGDPC(-1))	7.234389	1.279905	5.652286	0.0000
D(LNGDPC(-2))	-0.563381	2.481700	-0.227014	0.8223
D(LNUNEMP(-1))	-0.303849	0.171646	-1.770211	0.0872
D(LNUNEMP(-2))	-0.064426	0.370603	-0.173841	0.8634
C	-7.765945	2.869723	-2.706166	0.0113
R Squared	0.944	Durbin-Watson		2.039
F-statistics	45.54	P. (F-stat.)		0.0000

Source: Author estimation

Table (8) Second ModelEstimation

	Coef.	Std. Err	t-Stat.	Prob.
ECT	-0.963811	0.257886	-3.737358	0.0010
D(LNAIRF(-1))	0.844767	0.125903	6.709667	0.0000
D(LNAIRF(-2))	0.101800	0.141511	0.719378	0.4789
D(LCUSTOMS (-1))	-0.539384	0.287605	-1.875430	0.0730
D(LCUSTOMS (-2))	0.405310	0.273272	1.483173	0.1510
D(LNPOPG(-1))	56.21360	17.08971	3.289324	0.0026
D(LNPOPG(-2))	1.350419	1.370499	0.985348	0.3343
D(LNCOST(-1))	-0.149430	0.076622	-1.950219	0.0609
D(LNCOST(-2))	-0.281440	0.129329	2.176165	0.0396
D(LNGDPC(-1))	5.906057	1.061379	5.564514	0.0001
D(LNGDPC(-2))	3.303676	0.838374	3.940577	0.0013
D(LNUNEMP(-1))	-0.159973	0.190958	-0.837739	0.4104
D(LNUNEMP(-2))	-0.287066	0.178680	-1.606590	0.1212
C	0.055826	0.056305	0.991492	0.3313
R-squared	0.788447	Durbin-Watson		1.952
F- statistics	3.139448	P. (F-stat.)		0. 007394

Source: Author estimation

5.3 Impulse Response Function

Figure (2) shows first model IRF analysis based on VECM of studied variables from 1980 to 2020 on yearly basis, tracing the response of air passenger to unanticipated changes in studied variables. Response of air passenger to a unit shock in GDP per capita is negative permanent response and significant reached -0.010 at 5th year then reached -0.004 at year 19 and stayed around this value till end of the period. Response of air passenger to a unit shock in cost is permanent negatively significant reached -0.0323 at 4thyear then reduced to reach -0.0015 at 10thyear then reached 0.0094 at year 19 to stay around this value till end of the period. The response of air passenger to a unit shock in unemployment is permanent negatively significant reached -0.0344 at 7th year then reached -0.0021 at 13th year to stay around this value till end of the period.Response of air passenger to a unit shock in population is permanent positive significant reached 0.0456 at 6th year then reached 0.033 at year 20 to stay around this value till end of the period.Response of air passenger to a unit shock in GCF is permanent negatively significant reached -0.052 at 5th year then reached -0.029 at year 22 to stay around this value till end of the period.

Figure (3) shows second model IRF analysis based on VECM of the studied variables from 1980 to 2020 on yearly basis, tracing response of air freight to unanticipated changes in studied variables. Response of air freight to a unit shock in GDP per capita is negatively significant till 2nd year then become positive significant reached 0.068 at 7th year then reached 0.063 at year 16 showing positive permanent response around this value till end of the

period. The response of air freight to a unit shock in cost is permanent negative significant reached -0.104 at 5th year then reached -0.084 at 17th year to stay around this value till end of the period. Response of air freight to a unit shock in unemployment is permanent negatively significant reached -0.0665 at 9th year then reached -0.065 at 15th year to stay around this value till end of the period. Response of air freight to a unit shock in population is permanent positively significant reached 0.111 at 3rdyear then reached 0.0830 at 9thyear to stay around this value till end of the period. Response of air freight to a unit shock in customs is negatively significant till 2nd year at -0.031, then become positive to reach 0.056 at 7th year then reached 0.055 at 12thyearto stay around this value showing permanent positive response till end of the period.IRF results of both models indicatethat the time series is responsive to different shocks showing fast adjustment towards equilibrium.

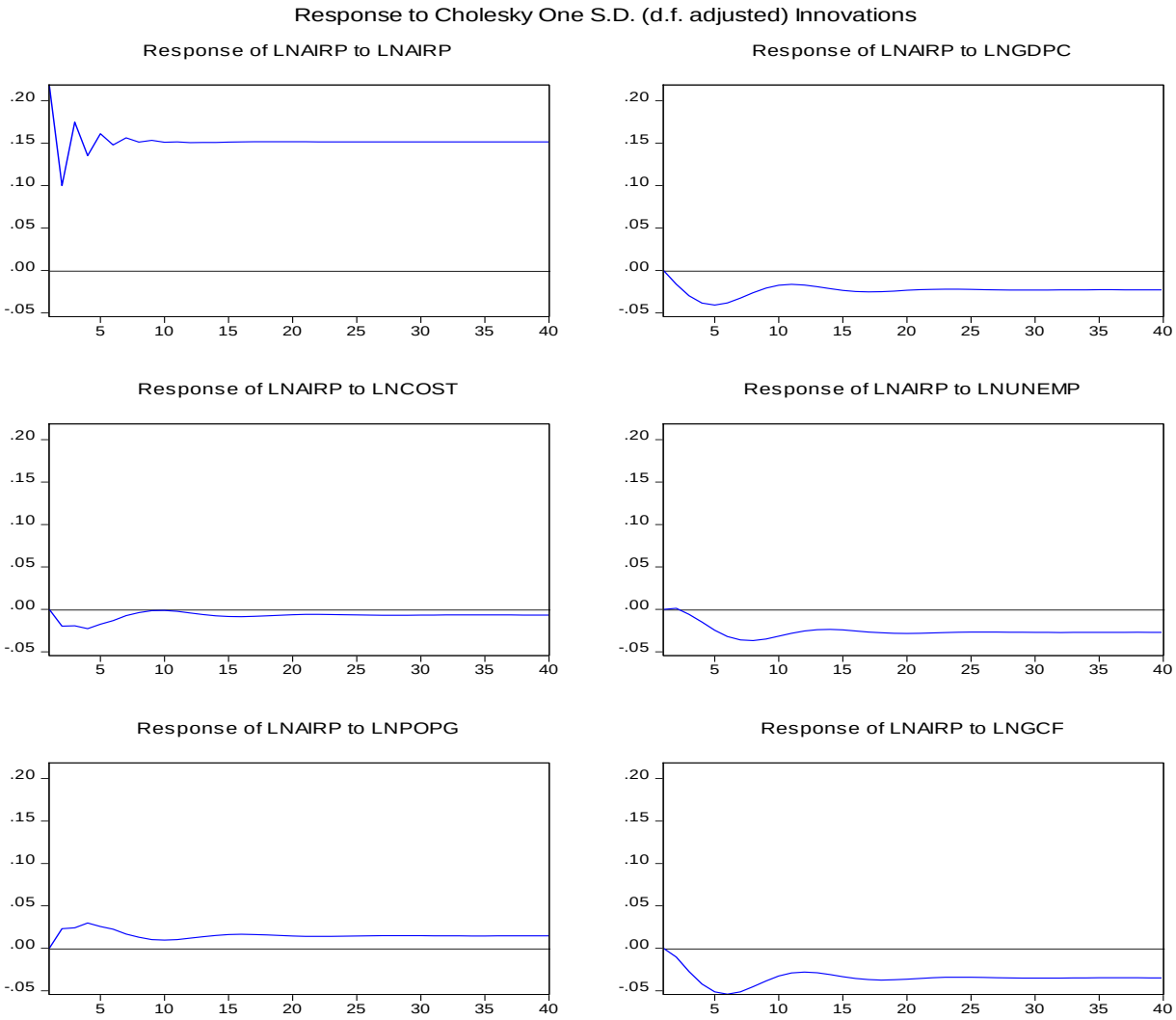
5.4 Variance Decomposition

FEVD shows relative importance of each innovation impact on studied variables.Table (9) shows FEVD results of first model showing that at first year 100% of FEVD in dependent variable explained by itself, the influence decreased to reach 55.7% at 10thyear then reduced gradually to 27.8% by end of the period. Contribution of GDP per capita increased from 1.6 at second year to reach 18.9% at 14th year then reduced slightly to 16.8% by end of the period. Cost contribution increased from 0.3% at second year to 2.5% at 14th year then increased gradually to 11.6% by end of the period. Unemployment contribution increased from 0.4% at second year increasing gradually to 9.9% at 16th year then increased gradually to 13.6%by end of studied period.

Population contribution increased from almost 1.7% at second year then increased gradually to 17.1% by end of studied period. GCF contribution increased from 0.5% at second year to 10% at 10^{th} year then increased slightly to 14.2% at year 17then decreased slightly to 12.8% till end of the period. Showing the most importantvariable is population followed by GDP per capita, then unemployment.

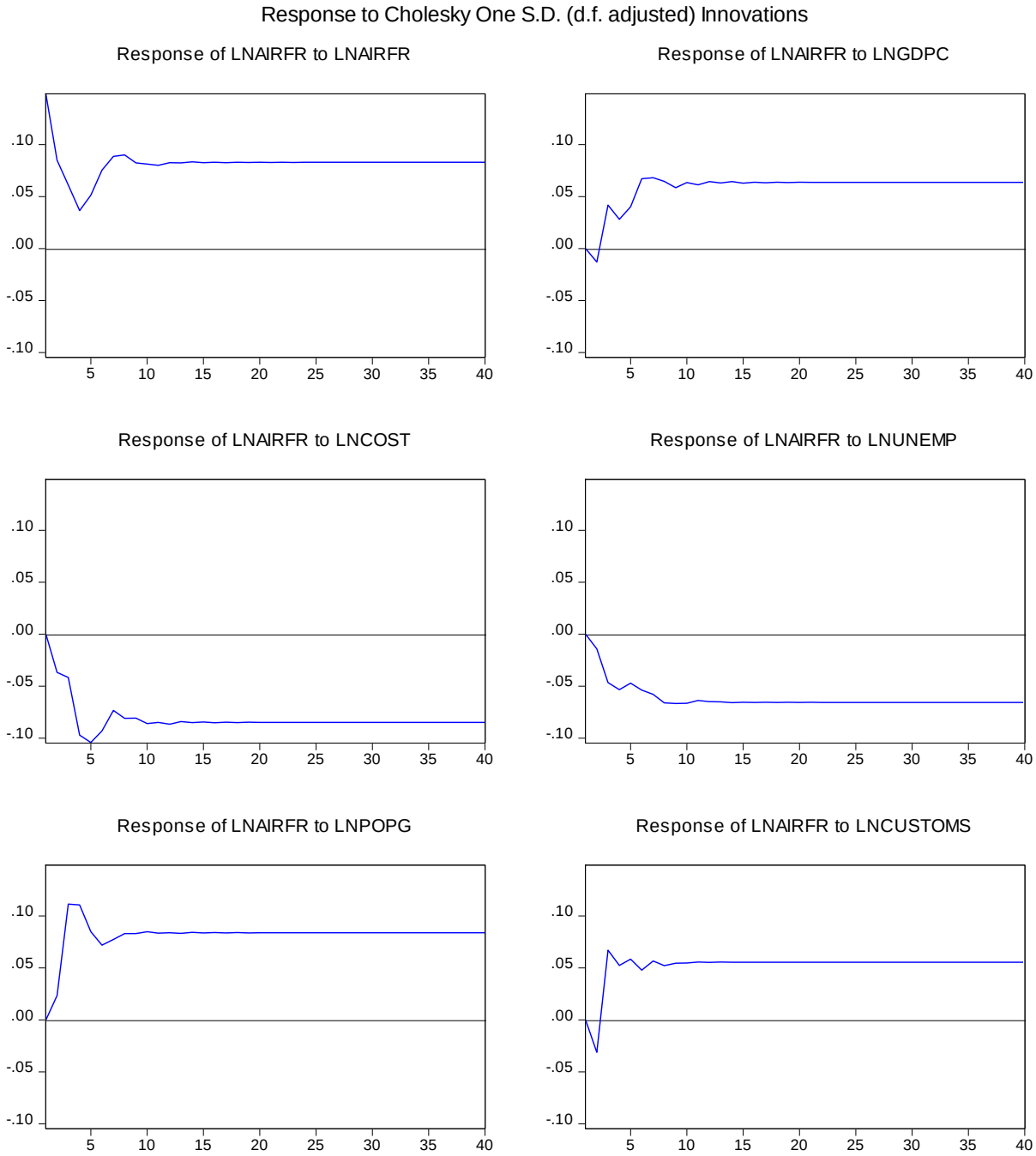
Table (10) shows FEVD results of second model showing that at first year 100% of FEVD in dependent variable explained by itself, the influence decreased to 56.1 at 3^{rd} year then to 29 at 6^{th} year then reduced gradually to reach 22.3% by end of period. Contribution of GDP per capita increased from 0.5% at second year to reach 11.7% by end of period. Cost contribution increased from 4.12% at second year to 14.1% at fourth year then increased gradually to 21.9% by end of the period. Unemployment contribution increased from 4% at third year increasing gradually to 12.4% by end of studied period. Population contribution increased from almost 1.7% at second year to 28.5 at fourth year then decreased slightly to reach 22% by end of studied period, while customs contribution increased from 3% at second year to 10% at 5^{th} year then decreased slightly to 9.4% at year 28 to stay permanent till end of the period. Showing the most important variables is population followed by cost, then unemployment.

Figure (2) IRF of First Model



Source: Estimated by Author

Figure (3) IRF of Second Model



Source: Estimated by Author

Table (9) Variance Decomposition– First Model

Period	S.E.	LNAIRP	LNGDPC	LNCOST	LNUNEMP	LNPOPG	LNGCF
1	0.203883	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.213478	95.27934	1.603730	0.308258	0.463607	1.757664	0.587401
3	0.230725	90.28390	1.505030	0.290531	2.608949	4.511124	0.800465
4	0.244260	83.48026	1.527438	0.397423	5.696097	8.104052	0.794733
5	0.254491	77.53468	2.045944	0.461189	7.334738	11.79480	0.828645
6	0.262330	73.38587	2.856554	0.542700	8.060242	14.37350	0.781132
7	0.269411	69.87369	4.566653	0.596479	8.180236	15.57677	1.206173
8	0.279381	65.85718	7.248537	0.606335	7.919852	15.33213	3.035964
9	0.295619	60.82133	10.60101	0.609144	7.386730	13.97256	6.609222
10	0.318323	55.78597	13.82331	0.654520	6.829156	12.14007	10.76697
11	0.344536	51.84849	16.26667	0.824017	6.558295	10.42192	14.08060
12	0.370279	49.19680	17.82855	1.183829	6.731317	9.125007	15.93449
13	0.392776	47.43713	18.66737	1.758285	7.319477	8.334490	16.48325
14	0.411076	46.06881	18.99714	2.520661	8.173447	8.041806	16.19814
15	0.425609	44.77501	18.99978	3.394037	9.096977	8.190433	15.54376
16	0.437327	43.46335	18.82400	4.276015	9.918219	8.679858	14.83856
17	0.447071	42.18923	18.59192	5.075166	10.54203	9.377420	14.22423
18	0.455427	41.03830	18.39511	5.739529	10.95837	10.14714	13.72155
19	0.462941	40.04620	18.28941	6.258628	11.20712	10.87649	13.32215
20	0.470346	39.19032	18.29395	6.646155	11.33472	11.48684	13.04802
21	0.478548	38.42701	18.39465	6.923780	11.37509	11.93404	12.94542
22	0.488354	37.72732	18.55237	7.117207	11.35749	12.21039	13.03522
23	0.500160	37.08291	18.71627	7.259759	11.32057	12.34672	13.27377
24	0.513825	36.48817	18.84016	7.392030	11.31172	12.40512	13.56280
25	0.528793	35.92401	18.89458	7.553197	11.37108	12.45941	13.79773
26	0.544368	35.35967	18.87042	7.769679	11.51520	12.57243	13.91261
27	0.559945	34.76740	18.77537	8.048852	11.73307	12.78096	13.89435
28	0.575135	34.13575	18.62761	8.380468	11.99480	13.09196	13.76941
29	0.589774	33.47245	18.44951	8.743433	12.26537	13.48787	13.58137
30	0.603869	32.79794	18.26247	9.113897	12.51614	13.93638	13.37317
31	0.617553	32.13552	18.08322	9.471500	12.73011	14.40089	13.17876
32	0.631035	31.50399	17.92170	9.802535	12.90178	14.84883	13.02117
33	0.644564	30.91484	17.78064	10.10053	13.03411	15.25697	12.91291
34	0.658372	30.37274	17.65668	10.36545	13.13534	15.61378	12.85600
35	0.672632	29.87687	17.54250	10.60235	13.21644	15.91951	12.84234
36	0.687417	29.42198	17.42934	10.81963	13.28909	16.18406	12.85590
37	0.702696	28.99937	17.30946	11.02694	13.36359	16.42337	12.87727
38	0.718360	28.59849	17.17770	11.23298	13.44697	16.65483	12.88904
39	0.734264	28.20921	17.03218	11.44361	13.54185	16.89317	12.87999
40	0.750262	27.82405	16.87411	11.66106	13.64658	17.14761	12.84660

Source: Author Estimation

Table (10) Variance Decomposition – Second Model

Period	S.E.	LNAIRF	LNGDPC	LNCOST	LNUNEMP	LNPOPG	LNCUSTOMS
1	0.148512	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.180286	90.05854	0.510301	4.124820	0.599834	1.694384	3.012117
3	0.242394	56.19908	3.254853	5.222889	4.006443	21.99419	9.322545
4	0.296780	39.00399	3.073617	14.18241	5.894629	28.52056	9.324795
5	0.340551	31.90586	3.724973	20.12132	6.378530	27.84482	10.02450
6	0.380977	29.41615	6.078055	22.02742	7.084315	25.80071	9.593350
7	0.418994	28.80053	7.677749	21.25819	7.758810	24.74647	9.758249
8	0.456443	28.16660	8.476473	21.04219	8.626629	24.16064	9.527466
9	0.489224	27.35490	8.810084	21.02681	9.359821	23.91522	9.533177
10	0.521463	26.50127	9.239708	21.22288	9.858770	23.68994	9.487430
11	0.550786	25.86622	9.520832	21.39111	10.16847	23.52453	9.528846
12	0.579743	25.37753	9.828846	21.53477	10.42622	23.32118	9.511466
13	0.606755	25.01270	10.05411	21.57186	10.66464	23.17158	9.525112
14	0.633207	24.70437	10.26671	21.60293	10.87057	23.03982	9.515600
15	0.658143	24.44541	10.41591	21.63567	11.04668	22.93908	9.517241
16	0.682493	24.21396	10.56411	21.67145	11.19635	22.84365	9.510482
17	0.705785	24.01402	10.68414	21.69698	11.32677	22.76611	9.511986
18	0.728521	23.83783	10.79774	21.72214	11.44003	22.69332	9.508938
19	0.750434	23.68434	10.89223	21.74296	11.54180	22.63009	9.508584
20	0.771826	23.54716	10.98145	21.76119	11.63226	22.57165	9.506289
21	0.792568	23.42471	11.05799	21.77684	11.71381	22.52095	9.505701
22	0.812835	23.31361	11.12899	21.79187	11.78695	22.47442	9.504158
23	0.832567	23.21293	11.19170	21.80532	11.85354	22.43298	9.503521
24	0.851874	23.12100	11.25005	21.81774	11.91389	22.39483	9.502493
25	0.870731	23.03712	11.30249	21.82901	11.96918	22.36030	9.501902
26	0.889204	22.96009	11.35126	21.83943	12.01981	22.32832	9.501089
27	0.907289	22.88923	11.39574	21.84889	12.06655	22.29906	9.500526
28	0.925030	22.82371	11.43716	21.85768	12.10968	22.27190	9.499871
29	0.942430	22.76303	11.47532	21.86580	12.14970	22.24681	9.499354
30	0.959519	22.70660	11.51095	21.87337	12.18686	22.22341	9.498804
31	0.976306	22.65404	11.54404	21.88041	12.22151	22.20166	9.498343
32	0.992812	22.60493	11.57504	21.88699	12.25386	22.18131	9.497876
33	1.009046	22.55897	11.60398	21.89314	12.28416	22.16228	9.497464
34	1.025024	22.51584	11.63119	21.89892	12.31257	22.14441	9.497059
35	1.040756	22.47531	11.65673	21.90435	12.33929	22.12763	9.496692
36	1.056254	22.43713	11.68081	21.90947	12.36444	22.11181	9.496337
37	1.071528	22.40112	11.70350	21.91430	12.38817	22.09690	9.496009
38	1.086587	22.36709	11.72496	21.91886	12.41060	22.08280	9.495695
39	1.101440	22.33488	11.74526	21.92317	12.43182	22.06947	9.495400
40	1.116096	22.30435	11.76450	21.92726	12.45194	22.05682	9.495119

Source: Author Estimation

6. Conclusion and Recommendation

Majority of literaturestudied effects of transportation on socioeconomic indicators while the current study investigated impact of socioeconomic factors on transportation in Egypt during the period from 1980 to 2020 using air transport as an indicator due to data availability for air passenger and freight with taking in consideration cost, infrastructure and customs as control variables.

Two modelsestimated empirically using VECM for studying impact of socioeconomic variables on air passenger at first model and on air freight at second model. ECT at both models had the correct negative sign and significant which shown that any deviation from long-run equilibrium will converge back to equilibrium.Also, IRF results of both models indicate the time series is responsive to different shocks showing fast adjustment towards equilibrium.

At both models GDP per capita is positively significant that goes with Graham (2000) which stated that air transport is more preferable by middle-income and high-income level. Also, at both model population is positively significant which goes with Demirsoy (2012) concluded that income and population are among major demand factors of air transport.Cost is negatively significant at both models which go with demand role of inverse relationship between price and quantity demanded, and customs is negatively significant at second model.

Atfirst model GCF as proxy of infrastructure is positively significant to air passenger which goes with literature. Unemployment is negatively significant

at first model and insignificant at second model, which shows that higher employment level will raise demand on passenger transportation which goes with literature as Rodrigue (2020) and Küçükönal & Sedefoğlu (2017).

FEVD for first model shown relatively the most important variableis population followed by GDP per capita, unemployment, infrastructure then cost. While second model shows relatively the most important variable is population followed by cost, unemployment, GDP per capita, then cost.

The findings of the study contribute to transportation literature, which is beneficial to the industry and policy makers. Cost is important to be considered by policy makers due to its negative impact on both air freight and passenger which can affect consequently international trade. Freight cost is a part of final goods prices; higher air freight rates will affect domestic product prices due to its impact on the imported raw material and different imported parts included in production of goods domestically which will then affect prices of exports. Also, it's recommended to have stabilized freight rates which can lead to sustainable growth of air freight demand which will reflect on international trade and domestic production.

Positive significance ofinfrastructure shows its importance to transportation which requires further development of transportation infrastructure, which could include private sector and PPFsto fill the finance gap assuggested by World Bank. Customs negative impact on air freight shows the importance of reducation of customs and other import duties to enhance demand of air freight in Egypt.

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دراسة تأثير العوامل الاجتماعية والاقتصادية على النقل: أدلة تجريبية من مصر 1980-2020

المستخلص:

يسهل النقل التعبئة التي تعد حاجة رئيسية للحياة اليومية للإنسان لنقل الأشخاص أو البضائع محليا ودوليا. النقل أساسي للأنشطة الاقتصادية والتنمية الاجتماعية كما وجدت الأدبيات التي اظهرت على أهمية دراسة هذه العلاقة أيضا في الاتجاه المعاكس. تبحث الدراسة الحالية تأثير المتغيرات الاجتماعية والاقتصادية على النقل باستخدام نموذج متجه تصحيح الأخطاء، لتقدير نموذجين يبحثان تأثير المتغيرات الاجتماعية والاقتصادية (العمالة والدخل والسكان) على نقل الركاب الجوي في النموذج الأول بالإضافة إلى التكلفة باستخدام أسعار النفط والبنية التحتية باستخدام إجمالي تكوين رأس المال،ودراسة والتأثير على الشحن الجوي للبضائع في النموذج الثاني بالإضافة إلى الجمارك والتكلفة. ووجد التحليل أن الدخل والسكان لهما تأثير إيجابي معنوي في كلا النموذجين، في حين أن العمالة تأثيرها معنوي في النموذج الاول،والتكلفة والجمارك لهما تأثير سلبي معنوي. وتشير النتائج إلى تخفيض واستقرار أسعار النقل والجمارك، وتبين أهمية تطوير البنية التحتية.

كلمات مفتاحية: نقل البضائع – نقل الركاب – الدخل- البنية التحتية – السكان.