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Evaluating Subsidy in Egyptian Railway Sector

Dr. Haytham N. Zohny
Assistant Professor of Railway Engineering,
Public Works Department,
Faculty of Engineering, Ain Shams University
Cairo, Egypt

***Abstract*— Subsidy is the most important economic issues that arise when discussing the general budget annually. It is important to minimize the governmental subsidy to Egyptian National Railway (ENR). To attain this aim, three models suggested to estimate the revenue for ENR for long distances passenger, short distances passenger and freight transport services. They are function of operating units (passenger. kilometers) for passenger trains or (ton. kilometers) for freight ones. The subsidy then predicted after estimating the operating costs. Finally, the paper discussed four suggested scenarios to decrease the gap between the revenue and the operating costs**

Keywords*— *Operating costs, Egyptian National Railway, Revenue, Subsidy, Standard cost.

I. INTRODUCTION

Subsidy is a form of financial aid or support extended to an economic sector. Because of its social and economic benefits, many countries offer subsidies to their railways.

Governmental subsidy to Egyptian National Railway (ENR) is likely to remain significant. It continuously even increases. Any lowering would come from restructuring the way by which the sector operates. Although it is difficult to estimate the continued fiscal implications of the unreformed sector with any precision.

This paper proposes a model to predict the direct subsidy provided to railway sector, as the subsidy is the difference between the revenue and the operating costs, based on the data offered from the financial department of ENR.

II. TRANSPORTATION TYPES IN ENR

Railways play a valuablet role in carrying both passenger and freight: [1]

A. Passenger Transport

ENR divided the passenger transport according to trip distance as follows:

- Short distances (Trip distance < 100 km.hr)
- Long distances (Trip distance > 100 km.hr)

B. Freight Transport

Transportation for freight is carried out by two methods:
a. Unit trains they carry only one product from the origin to the destination and represent about 85% of the total freight trains number.

b. Mixed trains they carry different types of products in one trip and represent about 15% of the total freight trains number.

III. COSTS DEFINITIONS

Generally, costs are classified into rail network infrastructure, train operations, and corporate overheads.

Costs for the railway infrastructure network include: costs for track, engineering structures such as bridges and tunnels, train signaling, communications systems, power supply in electrified sections, and terminal infrastructure.

Train operating costs include: diesel fuel or electrical energy, locomotive capital depreciation or leasing cost, locomotive maintenance, labors, rolling stock wagons or railcars depreciation or leasing cost, and rolling stock maintenance.

Corporate overhead costs: These include most railway headquarters functions such as Board and executive management, finance, legal, security, and personnel functions.

Costs can be divided into Fixed and variable costs.
Fixed costs are those that do not directly change with service levels in the short and medium term.

Variable costs are those where the cost of the function is dependent on the volume of activity.

Standard costs are realistic estimates of costs based on analyses of both past and projected costs and operating conditions.

IV. OPERATING COSTS CALCULATION

The following models will be used to calculate operating costs for the three transport types from [1]:

For long distances passenger:

$$Ct = 0.0027*PL2 + 11.108*PL + 652920$$

where: PL- no. of (pass. Km) for long distances in millions, C – costs in thousand

For short distances passenger:

$$Ct=.0023*PS2 +11.823*PS + 426341$$

where: PS – no. of (pass. Km) for short distances in millions, C – costs in thousand L.E

For freight transport:

$$Ct = 0.0071*F2 + 213.434*F + 29250$$

where: F – no. of (Ton. Km) for freight in millions, C-costs in thousand L.E

International Journal of Engineering Research & Technology (IJERT)
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Vol. 6 Issue 03, March-2017

V. ESTIMATING REVENUE

Revenue is due to one of the following sources as shown in table (1):

- Revenue from passenger traffic (short and long services)
- Revenue from freight traffic
- Miscellaneous revenue from non-transport traffic

The following methodology was applied to estimate revenue and deriving equations for each service linking revenue as function of operating units:

- Pass.km (for long and short distances passenger services)
- Ton.km (for freight transport services)

Firstly, revenue elements will be classified into variable and fixed as shown in table (1).

Table (1): Revenue elements according to UAS for ENR

ITEM	Revenue Elements	Variable/Fixed
(1)	Sold services	Variable
	Internal artifacts	Variable
	Operation revenue for other	Variable
	Freight transport revenue	Variable
(2)	Other subsidies	Fixed
(3)	Financial investments	Fixed
(4)	Miscellaneous revenue	Fixed
	Corporate profits	Fixed
	Operating surplus	Fixed

Source: ENR (financial department) – final account

Secondly, applying this classification on the three services as shown in tables (2), (3) and (4)

Thirdly, for variable revenue (which depends on the operating units) revenue equations were developed by the use of regression analysis as shown in fig. (1), fig. (2) and fig. (3)

For long distances passenger:

$$Y = 54.63*X + 3225.2 \quad \ldots\ldots \quad (R^2 = 0.9515)$$

where: Y = Variable Revenue in thousand L.E & X = (pass. Km) for long distances in millions.

For short distances passenger:

$$Y = 51.968*X + 23436 \quad \ldots\ldots \quad (R^2 = 0.9175)$$

where: Y = Variable Revenue in thousand L.E & X = (pass. Km) for long distances in millions.

For freight transport:

$$Y = 122.46*X + 5918.5 \quad \ldots\ldots \quad (R^2 = 0.9861)$$

where: Y = Variable Revenue in thousand L.E & X = (Ton. Km) for freight in millions.

For fixed revenue (which independent on the volume of traffic will be proposed as the average of revenue within 2008-2009 to 2014-2015 and then they were added as the model constants.

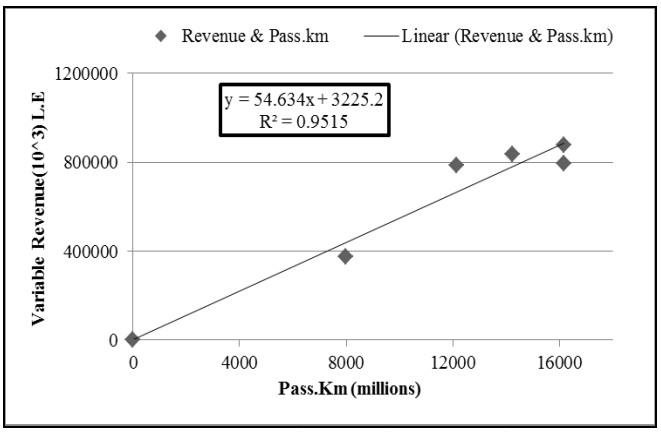

Figure (1): Variable revenue as a function of the pass.km for long distances passenger

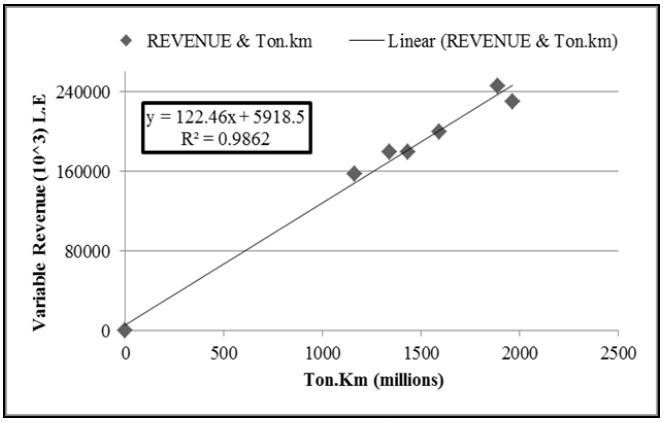

Figure (2): Variable revenue as a function of the pass.km for short distances passenger

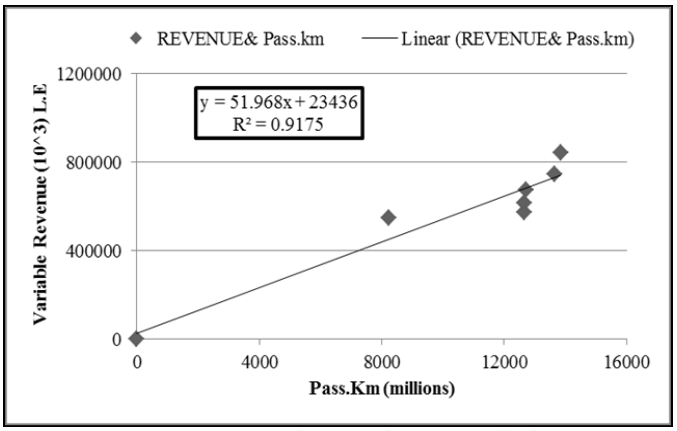

Figure (3): Variable revenue as a function of the Ton.km for freight transport

Finally, models for revenue can be obtained for the three services as following:

For long distances passenger:

$$RL = 54.634*PL + 154648.20 \quad \ldots.. \quad (R2=0.9515)$$

where: PL- no of (pass. Km) for long distances in millions, RL – Revenue for long distances passenger services in thousand L.E

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 6 Issue 03, March-2017

For short distances passenger:

RS = 51.968*PS+ 125223 …… (R2=0.9175)

where: PL- no of (pass. Km) for long distances in millions, RS – Revenue for short distances passenger services in thousand L.E

For freight transport:

RF = 122.46*F+ 183447.50 …… (R2=0.9862)

where: F- no of (Ton. Km) for freight transport in millions, RF – Revenue for freight transport in thousand L.E

VI. SUBSIDY PREDICTIONS

The difference between costs and revenues represent the fiscal deficit needs to be paid annually from the government, that we named subsidy.

Predict the subsidy in the future required estimating the costs and revenues in future for each service. Revenues were predicted with assuming that (Stability of tariffs, and Independent on the inflation rate).

Table (5), (6), (7) shows the estimated revenue and subsidy from (2015/2016) to (2019/2020) and Fig. (4) shows the Predicted annual costs, revenue and subsidy from (2015-2016) to (2019-2020) for Railway sector

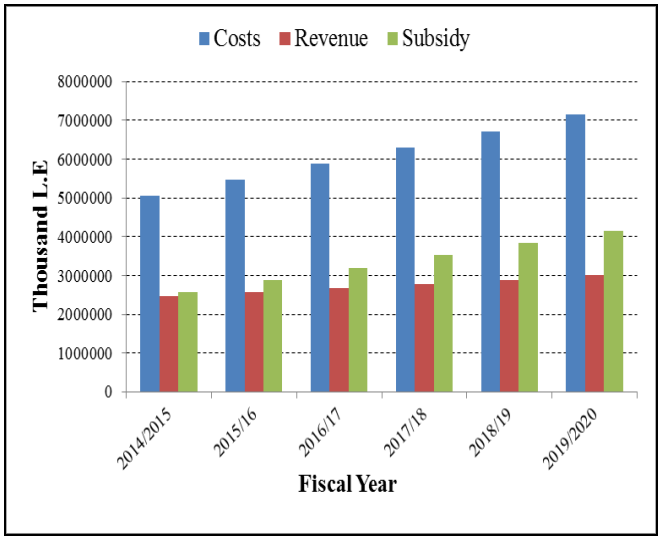

Figure (4): Predicted annual costs, revenue and subsidy from (2014-2015) to (2019-2020) for Railway sector

VII. REDUCTION OF SUBSIDY

Factors affecting the value of subsidy can be summarized as follows [2]:

- Transportation costs, whether fixed or variable
- Transport tariffs as main sources of revenue
- Social and economic conditions

Four alternatives in the three services were applied:

Alternative (1): Increase the tariffs with annual percentage to reach to the balance between the cost and revenue during five years.

Alternative (2): Increase the tariffs with annual percentage to reach to the balance between the cost and revenue during ten years.

Alternative (3): Decrease the cost (standard costs) to try to reach to the balance between the cost and revenue.

Alternative (4): Increase the tariffs with annual percentage and decrease the costs (standard costs) to reach to the balance between the cost and revenue during five years.

Tables (8), (10) and (12) shows the applying of the four alternatives in the three services, while tables (9), (11) and (13) shows the average proposed tariffs

NOTE: After reaching to the balance between costs and revenue the annual increase will be equal to the special inflation rates in costs.

Table (2): Revenue classified as variable and fixed in thousand L.E for long distances passenger from 2008-09 to 2014-15

Revenue	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Variable	784290	833748	1648177	876300	793144	375712	1055215
Fixed	176068	292855	186829	105354	73699	73735	119613

Table (3): Revenue classified as variable and fixed in thousand L.E for short distances passenger from 2008-09 to 2014-15

Revenue	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Variable	744590	843452	615794	570739	673365	547240	675831
Fixed	123869	115237	181456	88565	43055	58538	112430

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 6 Issue 03, March-2017

Table (4): Revenue classified as variable and fixed in thousand L.E for freight transport from 2008-09 to 2014-15

Revenue	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Variable	200011	245550	229652	179510	156876	178906	326112
Fixed	683255	134221	136594	59708	33266	18130	193966

Table (5): Estimated cost, revenue and subsidy for long distances passenger service in thousand L.E from 2015/2016 to 2019/2020

Item / Fiscal year	Cost	Revenue	Subsidy
2015/16	2631077	1229353	1401723
2016/17	2820936	1283878	1537058
2017/18	3010184	1338403	1671781
2018/19	3198431	1392927	1805503
2019/2020	3385286	1447452	1937833

Table (6): Estimated cost, revenue and subsidy for short distances passenger service in thousand L.E from 2015/2016 to 2019/2020

Item / Fiscal year	Cost	Revenue	Subsidy
2015/16	2027428	802098	1225329
2016/17	2190402	822580	1367821
2017/18	2360416	849707	1510709
2018/19	2538549	883478	1655071
2019/2020	2725928	923893	1802035

Table (7): Estimated cost, revenue and subsidy for freight transport service in thousand L.E from 2015/2016 to 2019/2020

Item / Fiscal year	Cost	Revenue	Subsidy
2015/16	809566	542935	266631
2016/17	869412	565792	303620
2017/18	929177	588649	340528
2018/19	988733	611506	377227
2019/2020	1047953	634364	413590

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 6 Issue 03, March-2017

Table (8): Proposed some alternatives to stop subsidy during certain period for long distances passenger

Item \ Fiscal year	2015/16	2016/17	2017/18	2018/19	2019/20
Cost (10^3 L.E)	2631077	2820936	3010184	3198431	3385286
Revenue (10^3 L.E)	1229354	1283878	1338403	1392928	1447453
Subsidy (10^3 L.E)	1401723	1537058	1671781	1805503	1937833
Alternative (1)					
Percentage of increase in tariffs	27%	27%	27%	27%	27%
Modified Revenue	1561279	1977173	2422510	2897290	3401513
Modified Subsidy	1069798	843764	587675	301141	-16228
Alternative (2)					
Percentage of increase in tariffs	15%	15%	15%	15%	15%
Modified Revenue	1413757	1669042	1940684	2228684	2533042
Modified Subsidy	1217320	1151894	1069500	969746	852244
Alternative (3)					
*Standard Costs	1650722	1782167	1918703	2062492	2218114
Modified Subsidy	421368	498288	580300	669565	770662
Alternative (4)					
*Standard Costs	1650722	1782167	1918703	2062492	2218114
Percentage of increase in tariffs	12%	12%	12%	12%	12%
Modified Revenue	1376876	1592009	1820228	2061533	2315924
Modified Subsidy	273846	190158	98474	959	-97810

*Source: [3]

Table (9): Proposed tariffs in L.E/pass.km according to the four alternatives for long distances passenger

Fiscal year / Alternatives	2015/2016	2016/2017	2017/2018	2018/2019	2019/2020
(1)	0.0675	0.0864	0.0992	0.1139	0.1287
(2)	0.0630	0.0712	0.0794	0.0876	0.0958
(3)	0.0538	0.0537	0.0536	0.0536	0.0535
(4)	0.0753	0.0771	0.0790	0.0811	0.0835

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 6 Issue 03, March-2017

Table (10): Proposed some alternatives to stop subsidy during certain period for short distances passenger

Item \ Fiscal year	2015/16	2016/17	2017/18	2018/19	2019/20
Cost (10^3 L.E)	2027428	2190402	2360416	2538549	2725928
Revenue (10^3 L.E)	802098	822580	849707	883478	923893
Subsidy (10^3 L.E)	1225329	1367821	1510709	1655071	1802035
Alternative (1)					
Percentage of increase in tariffs	39%	39%	39%	39%	39%
Modified Revenue	1116521	1467483	1848962	2268771	2734724
Modified Subsidy	910907	722918	511454	269778	-8795
Alternative (2)					
Percentage of increase in tariffs	22%	22%	22%	22%	22%
Modified Revenue	978560	1184516	1410513	1660938	1940176
Modified Subsidy	1048868	1005886	949903	877611	785753
Alternative (3)					
*Standard Costs	1607782	1670828	1728808	1786146	1846339
Modified Subsidy	805684	848247	879101	902668	922446
Alternative (4)					
*Standard Costs	1607782	1670828	1728808	1786146	1846339
Percentage of increase in tariffs	20%	20%	20%	20%	20%
Modified Revenue	962518	1151612	1359531	1590260	1847786
Modified Subsidy	645264	519215	369277	195886	-1447

*Source:[3]

Table (11): Proposed tariffs in L.E/pass.km according to the four alternatives for short distances passenger

Fiscal year / Alternatives	2015/2016	2016/2017	2017/2018	2018/2019	2019/2020
(1)	0.0748	0.0958	0.1167	0.1376	0.1583
(2)	0.0656	0.0773	0.0891	0.1007	0.1123
(3)	0.0538	0.0537	0.0536	0.0536	0.0535
(4)	0.0645	0.0752	0.0858	0.0964	0.1070

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 6 Issue 03, March-2017

Table (12): Proposed some alternatives to stop subsidy during certain period for freight transport

Item \ Fiscal year	2015/16	2016/17	2017/18	2018/19	2019/20
Cost (10^3 L.E)	809566	869412	929177	988733	1047953
Revenue (10^3 L.E)	542935	565792	588649	611506	634364
Subsidy (10^3 L.E)	266631	303620	340528	377227	413590
Alternative (1)					
Percentage of increase in tariffs	15%	15%	15%	15%	15%
Modified Revenue	624375	735530	853541	978410	1110136
Modified Subsidy	185191	133882	75635	10323	-62183
Alternative (2)					
Percentage of increase in tariffs	8%	8%	8%	8%	8%
Modified Revenue	586370	656319	729925	807188	888109
Modified Subsidy	223196	213093	199252	181545	159844
Alternative (3)					
*Standard Costs	647726	694926	742142	789269	836178
Modified Subsidy	104791	129134	153493	177763	201814
Alternative (4)					
*Standard Costs	647726	694926	742142	789269	836178
Percentage of increase in tariffs	8%	8%	8%	8%	8%
Modified Revenue	586370	656319	729925	807188	888109
Modified Subsidy	61356	38608	12217	-17919	-51931

*Source: [3]

Table (13): Proposed tariffs in L.E/ton.km according to the four alternatives for freight transport

Fiscal year \ Alternatives	2015/2016	2016/2017	2017/2018	2018/2019	2019/2020
(1)	0.1431	0.1617	0.1802	0.1986	0.2171
(2)	0.1344	0.1443	0.1541	0.1639	0.1737
(3)	0.1245	0.1244	0.1242	0.1242	0.1241
(4)	0.1344	0.1443	0.1541	0.1639	0.1737

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 6 Issue 03, March-2017

Table (14) summarize the results of applying the four proposed alternatives to decrease the gap between the costs and revenue in ENR

Table (14): Percentage of decreasing subsidy from (2015-2016) to (2019-2020) for Railway sector to the four alternatives

Fiscal year / Alternatives	2015/2016	2016/2017	2017/2018	2018/2019	2019/2020
(1)	26%	49%	70%	88%	100%
(2)	14.5%	27%	38%	48%	58%
(3)	55%	54.3%	54%	53.7%	53.4%
(4)	68%	79%	89%	97%	100%

VIII. CONCLUSION

Reaching to the balance between the costs and revenue, the tariffs will be recommended in such case that the actual costs should be equal to the revenue taking into consideration the special costs inflation rate for each service from studying the four-proposed alternative we can conclude that the most appropriate one is to reduce the actual costs to standard costs

Decrease the gap between the costs and revenues needs to take some action such as:

- Increase revenues through increased the transport tariffs during a certain period but, taking into consideration Social and economic conditions and competition other transport means.
- Rationalize of costs in order to try to get to the standard costs (The great deviation between the actual costs and standard ones is due to: extravagant in the used materials, using redundant labor, more than the required, and uneconomical use of available energies as well as neglecting both track and rolling stock maintenance).
- Reduce some of the ticket exceptions.
- Increase revenues due to the club, hospital and advertising in the stations and inside trains.

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