Airport Cluster in Mexico City, a spatial approach using a regionalized input-output matrix from the top-down approach*[1].

(23rd IIOA Conference in México City)

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Abstract

The operation of airport clusters and services facilitates the performance of activities jointly around a key economic activity, the airport infraestructure, characterized by linkages and economic complementarities in the production process, causing an economic and spatial agglomeration processes and a spill of valued added. A new airport will be constructing for Mexico city and its region. Therefore it is on debate its economic and social impacts over the city and on the location site. Thus, the purpose of this research is to analize and to characterize the main economic impacts generated in local and regional levels by the New International Airport in Mexico City (NIAMC), through a regionalized input-output matrix and its spatial entailment at the place where the new project will be located. The metodology has four steps: 1. Identification and delimitation of the economic and spacial functionality of the airport, considering the principal market area and its inmediate influence area. Using mainly a flows index of passengers clasified by origin and destination. 2. Identification of value chains associated to airport services and its related activities, starting into the build airport stage. This analysis it will be complemented with an economic and demographic characterization in the zone, where the new airport will be located. 3. The construction of the regionalized input-output matrix, take into account as a main ingredient the airport value chain and its economic activities related, leaving aside the rest of the economic activities of the region as an aggregate, using the top-down approach based on the methods of location coefficients of Flegg and in the RAS methodology, in order to adjust the national input-output table to the region. 4. The analysis of economic linkages and regional and local impacts from the airport cluster of México City will be done by the application of linkages index and multipliers analysis at diferent spatial levels:the region, the city and the location site.Finally, It is worth mention that it is assume that the top-down approach for the construction of the regional and local tables is more suitable than the bottom-top approach, due to despite that the main airport value chain activities and their linkages are located in the site, the economic activities of the inmediate area of influence are mainly related with dwelling of low income population and food industry production. The outcome of the essay is addressed to give empirical evidence of the economic and social impact of great investments projects concern to national or regional basis on local areas, through the construction a regional and local input output tables, as well as to develop this methodology, in order to contribute to public policy decisions

Keywords: cluster, airport services, productive requirements, regional impacts, region.

1. Introduction

The need for the creation of NIAMC lies mainly in that it has reached a saturation point, presenting efficiency problems, delays, costs and risk of accidents, and implementation of improvements in terminal 1 and terminal 2 have not been sufficient . The decision to build a new airport for Mexico City was considered in 1970, however it is until 2014 when the decision was adopted.

The new project will throw results in the long term and whose period of operation of 50 years, estimating a flow of 37 to 120 million passengers. The construction and operation stages ranging from 2015 to the year 2062. Noting that the location of the new airport will be on federal land in the former glass of Lake Texcoco, given the availability of land, physical characteristics, the amount of investment in infrastructure, as well as economic, social and environmental costs at national, regional and local levels.

In the first instance the conception occurs and methodologies for the delimitation of NAICM and the development of input-output matrices. The third section briefly outlined the background and characterization NAICM. The fourth section identifies and defines the area of impact of NAICM. Later production chains are identified in the stage of construction and operation. Sixth results of the projection of the input-output matrices are shown to assess the stages of construction and operation of NAICM. Finally a brief analysis of chains for these stages, followed by the conclusions presented.

Importantly, this research effort required so the authors want to acknowledge the invaluable support of researchers Krista Zafra and Gustavo Sánchez, and acknowledge the support of the students Adrian Garcia, Alejandra Ibañez and Sergio Rodriguez.

2. Desing and methodology used

Functional Economic Regionalization

Economic concentration shown by an spatial approach, the formation of principal nodes and influenced areas, those formations are determined by their economic activities and the interactions between them. A principal node is defined as the place where the greatest economic concentration (as an added value, total gross output and employment) and demographic exist, besides having good infrastructure and transport networks (absorbing increasingly population and commercial flows) and specialized services to responds and improve the standard of living of the population. These welfare standards have an impact on neighboring sites to the dominant node; it is called area of influence and whose complementarity is given by market, competition and direct connections. The conformation between the dominant node or nodes and their respective areas of influence, make economic and functional spatial units, which in turn comprise regions.

Hence, the delimitation of the regions is given by the integrated structure of the key nodes and their economic functions, which give an idea of the economic growth and development in space; as well as considering the physical characterization of space. With this approach, economic activities , as well as growth and development in Mexico is not homogeneous, so its necessary a regionalization that obey economic and functional criteria, instead of only using political and administrative criteria (in the Mexican case by entities is required states and municipalities) that do not allow observing economic relations integrally.

The interactions analysis between integrating nodes, is done by a Gravity Model, which uses flows as population-based, commercial, tourism, etc., associating the flow size, the distance between pairs of sites (origin-destination) . The association coefficient (interactions) is constructed as follows:

$$Association\ Coefficient = \frac{\frac{X_{ij}}{X_{oi}} + \frac{X_{ij}}{X_{dj}} + \frac{X_{ji}}{X_{oj}} + \frac{X_{ji}}{X_{di}}}{4}$$

Donde:

$X_{ij} = Flow\ from\ region\ i\ to\ region\ j$

$X_{ji} = Flow\ from\ region\ j\ to\ region\ i$

$X_{oi} = Total\ Flow\ from\ region\ i$

$X_{oj} = Total\ Flow\ from\ region\ j$

$X_{dj} = Total\ Flow\ to\ region\ j$

$X_{di} = Total\ Flow\ to\ region\ i$

Once obtained all the coefficients of association according to the flow and to the number of principal nodes in the region, its obtained a hierarchy where the pair of sites with the highest ratio indicates the highest interaction, whose origin is obtained is in the node most important of the region dominant.

Projecting input-output matrix

Because implementation of NIAMC has a horizon that goes from 2015 to 2062, we have to know the possible transactions for this period by projecting the Input-Output Matrix. In the case of Mexico, the National Input-Output Matrix used corresponds to 2008, because it is consistent with the information set out in the 2009 Economic Census [5] . With this information the input-output matrix projection of is made in the traditional way:

I. Estimation of technical coefficients
II. Projection of new expected final demand[6]
III. Estimation of Leontief's[7] inverse matrix
IV. Estimation of new production
V. New input-output matrix estimation

It should be noted that National Input-Output Matrix 2008 contains 79 sub-sectors, nevertheless for the projections, this matrix was adjusted to 70 subsectors because of the irrelevance of some subsector for this analysis. The matrix projections obey national stages of construction and operation of NIAMC. First, they were projected per year from 2008 up to 2013. With the National Input-Output 2013 the following is performed:

i. Input-output matrices were projected for the construction stage or n of 2014-2018.
ii. Once projected these matrices, was carried out an investment simulator, whereby increased by the construction corresponding subsectors , with the corresponding investment amount this way you can appreciate the impact on the sector [8]
iii. Assuming that all investment for the period 2014-2018 was absorbed by the construction, the intput-output matrices were projected for 2019-2062, which correspond to the operational stage of NIAMC and whose sectors affected are 481 "name of the subsectors" and 488 "sub name".

Considering the total projected matrices, were analyzed the impacts on the macroeconomic aggregates and estimating jobs.

Construction of regionalized input product matrix

Once the region of study is identified, based on economic-functional analysis and their interactions, the best type is analyzed to regionalize the Input-Output matrix. First, it is necessary to obtain the relevant macroeconomic

[5] Economic Census 2009 actually associated information for the year 2008. INEGI shows an updated input-output matrix for 2012, that will not be used because it does not yet have official information for 2014 Economic Census .

[6] The estimation was based on the growth rates raised in 2008-2013 and with official expected estimations growth rates.

[7] The Leontief inverse matrices were calculated using the *Python Module for Input-Output Analysis* Program *(PyIO version 2.1)* from The University of Illinois at Urbana-Champaign.

[8] It should be noted that because in National Imput-Output Matrix 2008 there is no specific section for airports construction, is considered the sector 23 "construction" as a representative of that activity.

information both nationally and at the regional level. Note that in the case of Mexico's functional economic regionalization, (CEDRUS, 2013) the smallest spatial unit used is the municipality, which helps to obtain information, without obeying the political and administrative boundaries of the states and without excluding the interactions between the regions (or between nodes in different regions).

The regional matrix estimating method, at least for this research, was to use a top-down approach, i.e. from the National Input –Output Matrix towards building a regional input-output matrix. This was done by the technique of estimating coefficients location, by the method of Flegg (1995). This technique was chosen as the best for regionalization of the matrix, because it's about identifying transactions in the area NIAMC location. The National Input-Output Matrix has 79 sub-sectors; nevertheless the structure had to be modified because some sub-sectors are not significant at this level of analysis, leaving 67 sub-sectors. The assumptions for the construction of the Input Product Regionalized are:

i. The regional economy has a similar behavior to the national, that is, envolving at the same rate of growth of the national economy.
ii. Macroeconomic –aggregates of the región conserve he same proportion than the national.[9]
iii. The breakdown of total jobs for the region bears the same proportion to the breakdown of jobs to the national economy[10]

Under this concept, the questions we try to answer through research are:

i. Does the New International Airport of Mexico City constitute a cluster of airport services with national, regional and local impact?
ii. The stages of construction and operation of the Airport will be a source of economic growth and development for Mexico?

The hypothesis is next:

i. The New Mexico City International Airport constitute a cluster of airport services, because it is a project of national need to efficiently compare the commercial and passenger flows; whose impacts are borne at the national, regional and local level to generate economic concentration and allow connectivity both likely with international airport with other nodes.

ii. The stages of construction and operation airport will constitute a source of growth and economic development for Mexico. The first step to be a source of regional growth, as populations attract flows mainly from national Macro Region Center whose investment amounts seems to increase the number of jobs. Whereas, in the operational phase to be a source of national growth, since the generation of

[9] Except for the case of variable Gross Fixed Capital Formation, which has variations to perform a dynamic investment for the construction phase of the airport in their respective sectors.

[10] What is unique amending total jobs created from increased investment in the construction phase of the airport and the number of passengers at the stage of its operation.

services to provide will be given by the interactions between different nodes airport and whose number of jobs created is found n in function or to increase the flow of passengers.

3. Background and characterization on of NIAMC

Background

The background to the International Aeropuerto Internacional de la Ciudad de Mexico (AICM) date from 1912, then its location would be in "Llanos de Balbuena" (Venustiano Carranza). Due to its proximity to the historic center, it was decided to relocate it in the east of the Delegation Venustiano Carranza on the boundary with the State of Mexico. It was so, as it was built in 1928 and went into operation a year later, under the name “Puerto Central Aereo” (central air port)

Noting that Mexico City was developed explosively, as its population tripled from 1910 to 1930 (the equivalent of one fifth of the urban population of the country) and whose urban area grew 8 times. It is the Cuauhtemoc Juarez, Miguel Hidalgo and Venustiano Carranza delegations with the highest population density.

The establishment of the AICM is following the development of the City of Mexico, referring to the creation of the Central Region of the country, with the Distrito Federal absorbent node of economic activities (by providing more than 25% of manufacturing, trade and services) and the State of Mexico, Puebla, Hidalgo, Morelos, Tlaxcala and Queretaro its area of influence.

The 1940-1970 period is very important nationally, but especially for the Central Region as an impressive development of industry, trade and services was taken. At that time the region contributed around half of manufacturing and more than 40% in commercial activities and services. This growth owes its importance to the City of Mexico, it thronged as 90% of economic activity in the region.

Thus, in 1970, the central region accounted for 33% of the total population and 44% of the urban population. Stressing the north, east and west of Mexico City and the neighboring municipalities in the State of Mexico: Tlalnepantla, Chimalhuacán, Ecatepec, Nezahualcoyotl, La Paz and Tultitlan. Despite efforts to improve the airport infrastructure was reached in 1970 to saturation, with no opportunity to increase airspace capacity and ground infrastructure.

In this situation, the Secretaria de Comunicaciones y Transporte (Ministry of Communications and Transport) (SCT) proposes the use of land in the former Lake Texcoco.

From that year until now, the Mexican economy was reoriented to foreign markets (exports) and Mexico City suffered a deindustrialization, which moved to the periphery. Currently the City of Mexico in conjunction with the Central Region, continue to rank first in terms of production, value added, employment and population density. His activities correspond to 21% of gross domestic product, specializing in trade and services.

Characterization of the population in the area

Surrounding the location of NIAMC areas, immediately (within 7 km) and mediate (within 14 km, containing ring 7 km), shaped by geo-statistical areas basic (AGEB's, and the sum of them make up the urban areas and rural). The area is characterized by having a population which has important employment needs [to be of "bedroom" areas no economic activities developed comprehensively achieve], social security, education, etc. In education, the population has no access to post-basic education, the average number of years the population is aged 9 and 13, and the lowest levels of education are between 6 and 7 years. In terms of housing, overcrowding is in means (the ratio between the number of people living in one place and the number of rooms per household) in the area mediate levels, while the Chimalhuacán, Ecatepec, Tepexpan, municipalities Chiconcuac Juarez and San Salvador Atenco overcrowding is at very high levels. Most concentrated area home features floor, but the piped water service is covered. Chimalhuacán, Chiconcuac, Coatlinchan and the boundary between Ecatepec and the Sierra de Guadalupe most homes have either drainaje and services.

Moreover, the territory of Texcoco has a rural area (belonging to the immediate area) where poor quality of life and high levels of unemployment there.

4. Identification and functional economic delimitation of NIAMC

The functional economic delimitation of NIAMC obey to interaction criteria of economic activities (concentration, population importance, connectivity system between them –transporting system) between regions and them study do not obey to political-administrative limits. Being an infrastructure project of national needed, the functional economic delimitation give up in a national, regional and local levels.

National Delimitation

NICM should be regarded as a principal node, because it will be an economic activity generator; to corroborate its importance eleven major airport nodes were identified in Mexico (SCT,2013), includes NIAMC. First, the flows between nodes were obtained, that is, national and international passenger's flows for each node, the following table show those nodes for 2005 to 2014:

Table 1. Passenger Flow between mean National Airports, 2005-2014

Origin\Destination	MEXICO CITY	CANCUN	GUADALAJARA	MONTERREY	TIJUANA	SAN JOSE DEL CABO	PUERTO VALLARTA	TOLUCA	HERMOSILLO	MÉRIDA	PUEBLA	NACIONAL	INTERNACIONAL	TOTAL
MEXICO CITY		11,167,423	8,958,551	10,699,097	4,957,984	1,786,881	2,242,273	61	2,608,113	4,243,421	7,019	86,398,711	45,358,643	178,428,177
CANCUN	11,712,317		1,163,849	2,208,693	27,448	-	-	1,637,652	5,532	24,162	322,688	17,938,019	36,044,414	71,084,774
GUADALAJARA	9,001,894	1,182,189		2,320,446	4,490,686	693,204	498,878	885,096	780,332	149,010	203,031	24,299,855	10,872,679	55,377,300
MONTERREY	10,552,234	2,177,847	2,269,674		619,693	165,110	333,419	1,320,102	732,998	374,525	210,523	24,314,761	3,882,831	46,953,717
TIJUANA	4,580,172	36,290	4,070,318	597,379		217,877	189,394	608,886	675,107	6,130	387,217	17,993,643	118,722	29,481,135
SAN JOSE DEL CABO	1,799,461	-	705,790	165,791	249,199		-	487,325	162	-	-	3,582,905	9,962,175	16,952,808
PUERTO VALLARTA	2,068,249	88	515,568	328,445	205,331	2		360,108	121	-	-	3,726,672	8,745,575	15,950,159
TOLUCA	3	1,640,964	1,084,701	1,580,662	761,389	508,357	361,636		216,967	313,017	79	8,603,463	336,454	15,407,692
HERMOSILLO	2,130,050	5,090	739,600	716,994	732,463	178	78	155,543		-	24,091	5,590,602	386,416	10,481,105
MERIDA	4,185,684	25,562	145,977	389,547	9,066	-	-	315,290	-		-	5,344,061	409,846	10,825,033
PUEBLA	4,540	316,652	179,969	214,434	381,343	-	-	90	128,680	-		1,234,214	180,901	2,640,823
NATIONAL	85,540,028	17,371,783	23,497,297	24,538,789	19,660,080	3,526,110	3,657,736	8,390,255	6,287,876	5,397,167	1,163,118		125,999,339	325,029,578
INTERNATIONAL	46,323,982	33,855,477	11,026,891	3,909,736	77,792	9,818,239	8,751,411	330,935	398,947	419,995	192,122	129,878,694		244,984,221
TOTAL	177,898,614	67,779,365	54,358,185	47,670,013	32,172,474	16,715,958	16,034,825	14,491,343	11,834,835	10,927,427	2,509,888	328,905,600	242,297,995	1,023,596,522

Source: Author´s calculation based on data from Communication and Transportation Ministry in Mexico.

Considering the total flows in the above table, it must be the airport of Mexico City is the node with the highest number of passengers compared to the remaining ten nodes. It is important to know the participation of airport nodes regarding national and international flows. In terms of national flows, the NIAMC participates with 65% of the total national flow, followed in importance Monterrey and Guadalajara with 19% and 18% respectively.[11]

Table 2. National Passenger Flow between mean Airports, 2005-2014

Airport	*National Origin*	*National Destination*	*Total National Flow*	*% (about National Flow)*
MEXICO CITY	85,540,028	86,398,711	171,938,739	65
CANCUN	17,371,783	17,938,019	35,309,802	13
GUADALAJARA	23,497,297	24,299,855	47,797,152	18
MONTERREY	24,538,789	24,314,761	48,853,550	19
TIJUANA	19,660,080	17,993,643	37,653,723	14
SAN JOSE DEL CABO	3,526,110	3,582,905	7,109,015	3
PUERTO VALLARTA	3,657,736	3,726,672	7,384,408	3
TOLUCA	8,390,255	8,603,463	16,993,718	6
HERMOSILLO	6,287,876	5,590,602	11,878,478	5
MERIDA	5,397,167	5,344,061	10,741,228	4
PUEBLA	1,163,118	1,234,214	2,397,332	1
OTHERS AIRPORTS			3,851,582	1

*As it is considered the total passsenger flow, the sum exceeds the 100% because there are flows between the nodes

Source: Author´s calculation based on data from Communication and Transportation Ministry in Mexico.

[11] Later it is shown that the location of AICM in the center of Mexico Region, note that nodes Toluca and Puebla are also in the region and the importance of the national flow is just 7% overall, indicating the AICM is the largest agglomerates flows within the Central Region.

Internationally, the node Mexico City is also the most important because it absorbs 36% of total international flows, followed in importance Cancun Guadalajara 27% and 9%. Apart from Tijuana, Toluca, Hermosillo, Merida and Puebla are nodes which together represent just 1.1% of the international flow.

Table 3. International Passenger Flow between mean Airports, 2005-2014

Airport	*International Origin*	*International Destination*	*Total National Flow*	*% (about International Flow)*
MEXICO CITY	46,323,982	45,358,643	91,682,625	36
CANCUN	33,855,477	36,044,414	69,899,891	27
GUADALAJARA	11,026,891	10,872,679	21,899,570	9
MONTERREY	3,909,736	3,882,831	7,792,567	3
TIJUANA	77,792	118,722	196,514	0.1
SAN JOSE DEL CABO	9,818,239	9,962,175	19,780,414	8
PUERTO VALLARTA	8,751,411	8,745,575	17,496,986	7
TOLUCA	330,935	336,454	667,389	0.3
HERMOSILLO	398,947	386,416	785,363	0.3
MERIDA	419,995	409,846	829,841	0.3
PUEBLA	192,122	180,901	373,023	0.1
OTHERS AIRPORTS			25,542,484	10

Source: Author´s calculation based on data from Communication and Transportation Ministry in Mexico.

Furthermore if you consider the total flow of passengers (domestic and international), it is expected that the AICM is dominant, which represents 51% of this flow. Cancun, Guadalajara and Monterrey are next in importance, however agglomerate together only 44% below Mexico City.

Table 4. Total Passenger Flow between mean Airports, 2005-2014

Airport	*Total Passenger Flow*	*% (about the sum national plus international)**
MEXICO CITY	263,621,364	51
CANCUN	105,209,693	20
GUADALAJARA	69,696,722	13
MONTERREY	56,646,117	11
TIJUANA	37,850,237	7
SAN JOSE DEL CABO	26,889,429	5
PUERTO VALLARTA	24,881,394	5
TOLUCA	17,661,107	3
HERMOSILLO	12,663,841	2
MERIDA	11,571,069	2
PUEBLA	2,770,355	1
OTHERS AIRPORTS	29,394,066	6

*Flow International regarding Mexico

Source: Author´s calculation based on data from Communication and Transportation Ministry in Mexico.

Despite knowing the shares of airport nodes, you must know the interaction that occurs between these and other national and international airports. To do that it's used a gravity model for analyzing passenger flows used by association coefficients:

$$Association\ Coefficient = \frac{\frac{X_{ij}}{X_{oi}} + \frac{X_{ij}}{X_{dj}} + \frac{X_{ji}}{X_{oj}} + \frac{X_{ji}}{X_{di}}}{4}$$

Where:

$X_{ij} = Passengers\ from\ \ region\ i\ to\ region\ j$

$X_{ji} = Passenger\ from\ region\ j\ to\ region\ i$

$X_{oi} = Total\ passengers\ from\ region\ i$

$X_{oj} = Total\ passengers\ from\ region\ j$

$X_{dj} = Total\ passengers\ to\ region\ \ j$

$X_{di} = Total\ passengers\ to\ region\ i$

The results show that the flow of passengers from the Mexico City airport compared to other nodes report that the highest interactions occur with Mérida, Monterrey and Hermosillo, and with zero interactions with Puebla and Toluca due to its proximity. Moreover considering the interactions between national and international flows and between nodes, it shows that Mexico City ranks sixth as a national destination and fourth destination of international flows.

Table 5. Hierarchy between mean Airport Destination, 2005-2014

Origin from Mexico City		National Origin		International Origin	
Destination	**Association Coefficient**	**Destination**	**Association Coefficient**	**Destination**	**Association Coefficient**
NATIONAL	0.46	TIJUANA	0.53	NACIONAL	0.46
MERIDA	0.38	TOLUCA	0.49	CANCUN	0.40
INTERNATIONAL	0.27	HERMOSILLO	0.48	SAN JOSE DEL CABO	0.39
MONTERREY	0.23	MERIDA	0.47	PUERTO VALLARTA	0.37
HERMOSILLO	0.20	MONTERREY	0.47	MEXICO CITY	0.27
GUADALAJARA	0.16	INTERNATIONAL	0.46	GUADALAJARA	0.18
CANCUN	0.15	MEXICO CITY	0.46	MONTERREY	0.08
TIJUANA	0.14	PUEBLA	0.43	PUEBLA	0.07
PUERTO VALLARTA	0.09	GUADALAJARA	0.38	MERIDA	0.04
SAN JOSE DEL CABO	0.07	CANCUN	0.19	HERMOSILLO	0.03
PUEBLA	0.00	PUERTO VALLARTA	0.15	TOLUCA	0.02
TOLUCA	0.00	SAN JOSE DEL CABO	0.14	TIJUANA	0.00

Source: Author´s calculation based on data from Communication and Transportation Ministry in Mexico.

The following map shows the results of interactions with origin in Mexico City to the other nodes, whit this has been shown to NIAMC is a principal node for national needed; impacts that may occur they are primarily found mainly in the operational stage of NIAMC.

Map 1. Passengers Flow between México City and National Nodes, 2005-2014

Regional Delimitation

Following the theoretical framework of the economic-functional regionalization (CEDRUS, 2013), the regional division is bounded to the Mexican Central Region, because it's where is currently the AICM and the next location NIAMC will be in places very close to it . The Central Region is made up of 548 municipalities corresponding to the states of Guerrero (5), Hidalgo (80), State of Mexico (122), Morelos (33), Oaxaca (1), Puebla (210), Querétaro (17) , Tlaxcala (60), Veracruz (4) and the Federal District (16 delegations).

The following map shows the proposed economic-functional regionalization produced by CEDRUS (CEDRUS, 2013), emphasizing the location of the Central Region and the location inside NIAMC:

Map 2. Location the New International Airport Mexico City within Center Region.

The importance of considering the regional division lies in that, the construction phase of NIAMC is more concentrated than in the operational phase, so the impact that will have on the stage of construction will be mostly regional production process, assuming that attract greater flows to increase employment in the region. Analyzing the economic-functional regions in the following table we can see that the Central Region is the largest in the country to generate 35% of value added and 36% of the total gross output and agglomerated 33% of the total population and 36% of employment.

Table 6. Mean variables in Mexican Regions, 2008 (thousand of Mexican pesos).

Macro Region	Value Added*	Total production*	Total Population**	Employment**
Center	**1,281,392,630**	**2,883,867,754**	**35,851,976**	**7,263,486**
North Center	221,968,750	615,059,258	10,342,142	1,759,424
West Center	256,817,063	589,407,353	12,663,363	2,342,673
Eastern Center	123,856,585	237,800,616	5,819,704	723,446
North	160,570,699	355,050,193	5,731,557	1,225,799
Northeast	461,969,503	1,226,166,847	10,330,315	2,400,513
Northwest	86,675,871	208,917,353	2,315,797	525,894
Peninsula of North Baja Califronia	98,131,004	214,749,199	3,262,584	751,071
Peninsula of South Baja California-Pacific Coast	63,107,566	136,837,049	3,364,337	606,915
Peninsula of Yucatan	68,342,968	164,012,376	3,662,875	792,300
Southeast	799,197,859	1,196,455,599	4,804,094	633,377
Southwest	74,237,892	221,035,480	10,325,154	1,091,936

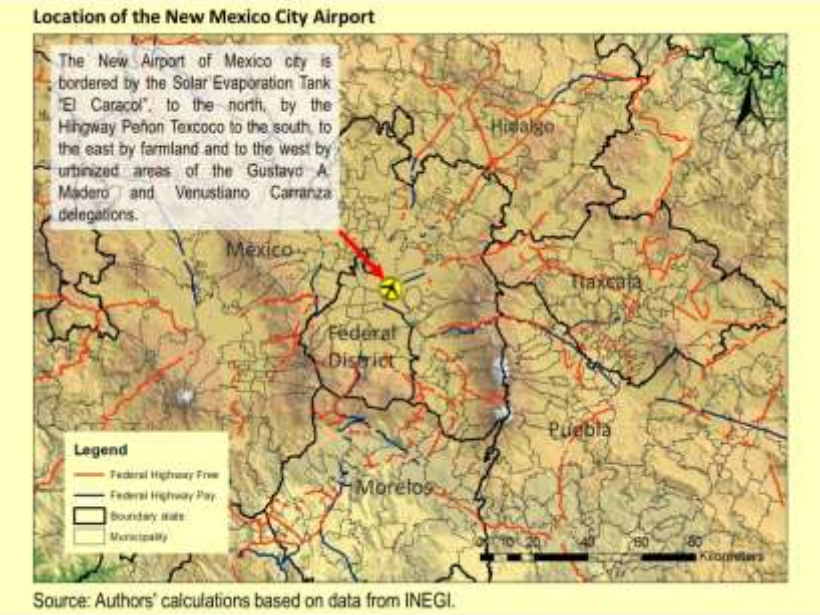
Total	3,696,268,389	8,049,359,076	108,473,898	20,116,834

*/ Thousand of pesos
**/Number of people
Source: Author´s calculation based on data from INEGI

Local Delimitation

The New International Airport of Mexico City will have the new location in the boundaries between the municipalities of San Salvador Atenco and Ecatepec de Morelos, which correspond to the State of Mexico; together with delegations Venustiano Carranza and Gustavo A. Madero Federal District. Therefore the local scope is important because it will have impacts on the surrounding construction sites.

Map 3. Location of the New International Mexico City Airport.



5. Identification of the value chains associated with the stages of construction and operation of the new airport in Mexico City.

The stages of construction and airport operations involve various production processes, thus identifying production for each chain is necessary. To do this we started from the National Input Output Matrix 2008; key sectors were identified by both, the supply side and demand-side under a Pareto optimum (80-20).

Value Chain "Construction" Sector

At the stage of airport construction subsectors are considered representative 236 "Construction" 237 "Civil engineering construction works" and 238 "Specialized construction works". The sectors which bind 80% of the value of both demand-side and supply-side is presented.

Table 6. Chain Value of Building Sector for Building Airport, 2008

Dominant sectors by supply within Building Sector			Dominant sectors by demand within Building Sector		
236	**237**	**238**	**236**	**237**	**238**
236 (100%)	237 (98.3%)	236 (52.9%)	212 (2.1%)	212 (1.8%)	221 (1.9%)
		237 (23.3%)	221 (1%)	237 (5.6%)	323 (1.4%)
		213 (2.9%)	238 (10.1%)	238 (10.8%)	324 (10.7%)
		431 (1.8%)	321 (2%)	321 (0.7%)	325 (1.7%)
		622 (1.5%)	324 (2.4%)	324 (4.7%)	327 (2.1%)
		611(%)	325 (2.7%)	325 (2.5%)	331 (12%)
			326 (2.7%)	326 (1.6%)	332 (7.5%)
			327 (13.3%)	327 (6.4%)	333 (3.2%)
			331 (14.1%)	331 (11.7%)	334 (2.2%)
			332 (5.3%)	332 (3.7%)	335 (5.8%)
			335 (2.7%)	333 (1.5%)	339 (1%)
			431 (12.6%)	335 (5.5%)	431 (12.4%)
			484 (1.6%)	431 (11%)	484 (1.8%)
			517 (1.7%)	484 (1.6%)	517 (3.2%)
			522 (1.8%)	522 (3.3%)	522 (6.6%)
			532 (0.7%)	524 (3.3%)	531 (2.4%)
			541 (2%)	532 (1.2%)	532 (1.3%)
			561 (2.2%)	541 (1.7%)	541 (1.4%)
				561 (2.9%)	561 (1.9%)
				721 (1.5%)	

Source: Author´s calculation based on data from Mexican Input-Output Table 2008 by INEGI.

Value chain "Airport Services" subsector

At the stage of operation of the airport is considered representative sub-481 "Air transportation" and 488 "Services related to transportation". The sectors which bind 80% of the value of both demand-side and supply-side is presented.

Table 7. Chain Value of Airport Services Sector for Operating Airport, 2008

Dominant sectors by supply within Airport Services Sector	Dominant sectors by demand within Airport Services Sector
488	**488**
315 (4.4%)	221 (9.6%)
333 (1%)	222 (2.5%)
481 (67.7%)	324 (2.6%)
484 (4%)	333 (7.1%)
532 (1.1%)	431 (2.2%)
931 (5.2%)	517 (1%)
	524 (5.2%)
	533 (11.8%)

Source: Author´s calculation based on data from Mexican Input-Output Table 2008 by INEGI.

6. Development of input-output matrices to assess the stages of construction and operation of the airport.

The development of input-output matrices to assess the stages of construction and operation of NIAMC entails the projection matrix for each period. It is considered the National Input-Output National Matrix 2008, from which estimates were made in 2013 by the traditional technique and assuming that the macroeconomic aggregates maintain the same proportions, in addition to using growth rates of the Mexican economy and forecast raised by official sources.

Table 8. Growth Rate for Mexican Economics 2008-2061.

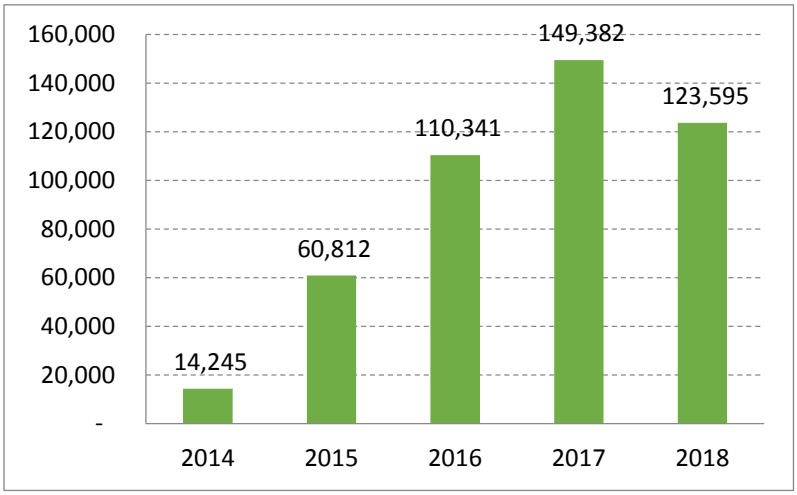
Period	Growth Rate
2008	1.4
2009	-4.7
2010	5.11
2011	4.04
2012	3.98
2013	1.07
2014	2.3
2015	3.5
2016	4
2017	4
2018	4

2019-2022	2.3
2023-2027	2.3
2028-2061	2.3
2062	2.3

Source: INEGI, SHCP and World Bank, since June 2014.

The investment envisaged for the implementation of NIAMC is 458.375 million pesos, an amount that will be absorbed in the construction phase of the airport:

Graph 1. Investment in Airport Building (Million of Mexican pesos at present value of 2014).



Source: Author´s calculation base on data of Airport Master Plan.

Regionalization of the Input-Output for the construction stage NIAMC

Since the construction phase is a more concentrated process, it was decided to regionalize the National Input – Output to the Mexico Center Region, through top-down approach. To do that the National Input-Output Matrix projected to 2013 were considered and using the economic variables of the Central Region projected by 2013 was considered.

The regionalized matrix 2013 input arrays regional product for the period 2014-2018 were projected. Note that once these matrices projected were done, a simulator investment was made, using the investment amounts for each year, adjusted to representative construction sectors. The results show the following:

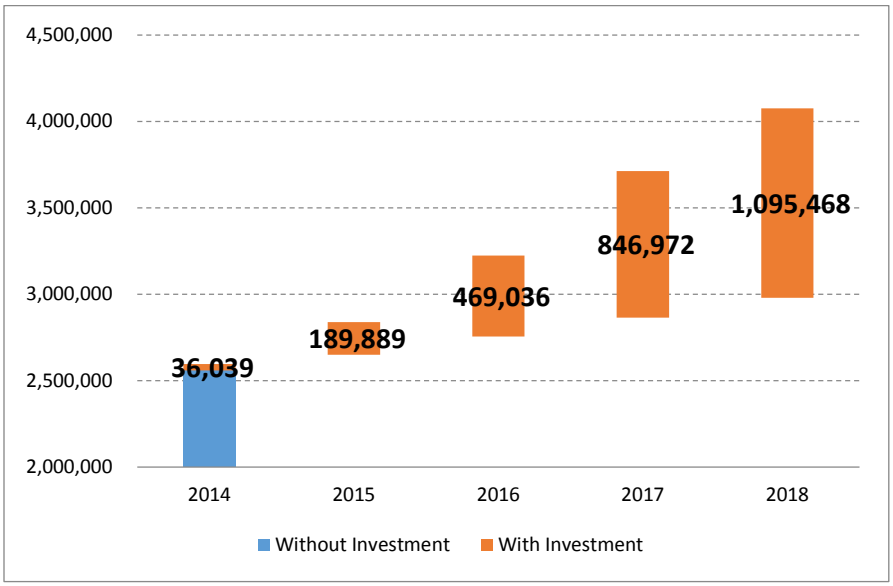
Table 9. Macroeconómic Aggregates, 2014-2018 (Million of mexican pesos)

Concept	2013	2014	2015	2016	2017	2018
Total Product	3,879,297	5,251,885	4,795,281	5,059,965	5,315,998	5,479,543
Gross Intermediate Consumption	990,435	1,367,256	1,188,320	1,261,669	1,331,126	1,366,437
Production Taxes	53,775	55,012	56,937	59,215	61,583	64,046
Production Subsidies	2,835	2,900	3,002	3,122	3,247	3,377
Net taxes less subsidies	44,552	62,910	59,604	62,614	65,580	67,781
Added Value	2,888,862	3,884,629	3,606,961	3,798,296	3,984,872	4,112,567
Gross wages and salaries	750,514	1,039,963	936,234	989,633	1,040,953	1,071,843
Social Benefits	13,613	18,496	15,740	16,757	17,712	18,160
Pay fewer benefits	608,524	841,705	761,513	804,453	845,814	871,237
Income taxes	43,851	62,183	58,853	61,833	64,768	66,937
Income Subsidies	- 702	- 727	- 751	- 781	- 812	- 845
Operating Surplus	2,093,795	2,781,756	2,611,123	2,746,049	2,878,338	2,972,942
Gross Domestic Product	7,317,466	8,415,091	8,295,989	8,674,885	9,056,524	3,907,543
Final Demand	3,349,645	3,885,061	3,607,433	3,798,826	3,985,407	4,113,061
Private Consumption	17,820,111	31,262,995	20,597,096	22,760,074	24,655,049	24,738,149
Goverment Consumption	8,474,005	8,668,907	8,972,319	9,331,212	9,704,460	10,092,639
Gross Fixed Investment	12,689,049	12,988,387	13,436,222	13,974,441	14,533,984	15,114,824
Changes in inventories	9,769	369,947	58,098	97,406	128,494	108,692
Exports	14,650,668	15,720,325	15,609,406	16,309,064	17,016,777	17,646,677
Imports	- 16,533,231	- 18,859,872	- 17,763,690	-18,674,221	-19,568,228	- 20,216,086
Statistical variation	10,920	11,171	11,562	12,024	12,505	13,005

Source: Author´s calculation using own porjections of Input-Output Table 2014-2018, based on data Input-Output Table 2008 from INEGI.

With the amount of investment, the jobs created in the construction phase in the Central Region show the following:

Graph 1. Employment generated within Building Stage for Central Region of Mexico, 2014-2018



Source: Author´s calculation using own porjections of Input-Output Table 2014-2018, based on data Input-Output Table 2008 from INEGI

According to the requirements of employment in construction it was estimated that the jobs created are 41% direct and 59% induced, so that each year the total number of jobs is as follows:

Table 10. Type of employment, 2014-2018

Year	Direct Employment	Induced Employment	Total Employment
2014	1,064,020	1,531,151	2,595,171
2015	1,163,822	1,674,769	2,838,591
2016	1,321,711	1,901,974	3,223,685
2017	1,521,841	2,189,966	3,711,808
2018	1,670,708	2,404,189	4,074,897

Source: Author´s calculation using own porjections of Input-Output Table 2014-2018, based on data Input-Output Table 2008 from INEGI

Input-Output Matrix for the operative stage of the NIAMC

Since the operational phase has a greater impact at the national level for the period 2019-2062 it was decided to project the input-output matrices considering the National Input-Output Matrix 2008, considering different periods of time and under the same assumptions as in step operational. The result in the macroeconomic aggregates is as follows:

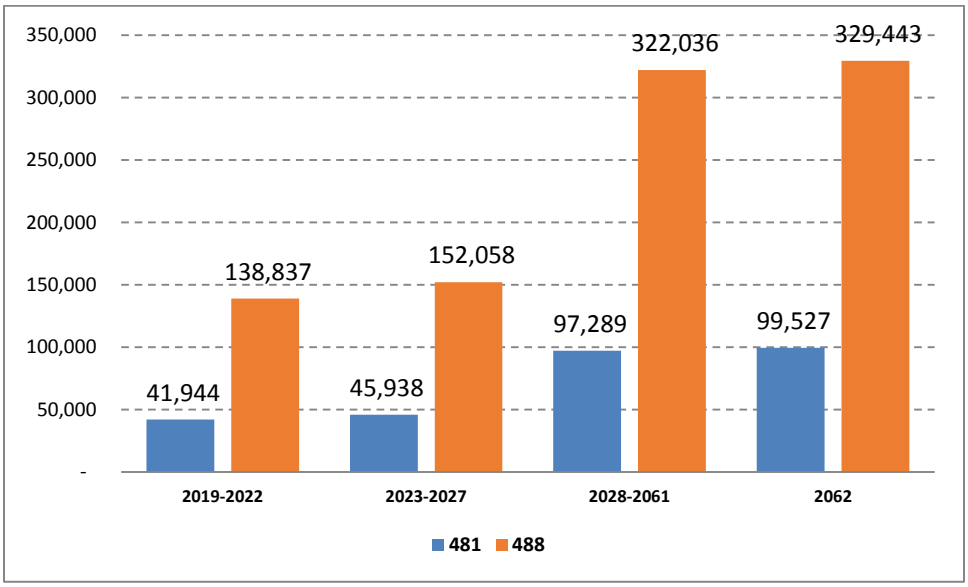
Table 11. Macroeconómic Aggregates, 2019-2062

Concept	2019-2022	2023-2027	2028-2061	2062
Total Product	29,617,652	32,463,998	69,152,899	69,202,892
Gross Intermediate Consumption	13,056,768	14,317,490	30,588,673	30,344,737
Production Subsidies	362,246	396,740	840,236	840,236
Added Value	16,560,884	18,146,508	38,564,226	38,858,155
Gross wages and salaries	4,618,495	5,060,479	10,751,004	10,850,264
Social Benefits	203,482	222,874	472,263	470,525
Pay fewer benefits	3,806,921	4,171,223	8,861,561	8,946,437
Income taxes	108,970	119,465	254,822	263,246
Income Subsidies	5,468	5,988	12,685	12,686
Operating Surplus	11,838,886	12,972,552	27,571,085	27,757,332
Gross Domestic Product	17,001,602	18,629,193	39,586,482	39,903,923
Final Demand	16,355,207	17,922,300	38,077,250	37,955,322
Private Consumption	10,183,645	11,163,064	23,762,178	23,640,410
Goverment Consumption	1,518,244	1,662,816	3,521,600	3,521,600
Gross Fixed Investment	3,985,740	4,365,274	9,245,010	9,245,069
Changes in inventories	123,333	135,077	286,073	286,073
Exports	3,813,513	4,176,646	8,845,525	8,846,701
Imports	- 3,264,768	- 3,575,649	- 7,572,700	- 7,574,093
Statistical variation	- 4,499	- 4,928	- 10,436	- 10,436

Source: Author´s calculation using own porjections of Input-Output Table 2014-2018, based on data Input-Output Table 2008 from INEGI

According to the results of the projection of the input-output matrices to assess the operational side, the number of jobs created at this stage is as follows:

Graph 2. Employment generated within Airport Operation Stage, 2019-2062



Source: Author´s calculation using own porjections of Input-Output Table 2019-2062, based on data Input-Output Table 2008 from INEGI

According to employment requirements for this stage it was estimated that 15% are direct jobs, 50% indirect jobs and induced jobs 35%, so that the number of jobs by type is as follows:

Table 12. Type of employment, 2019-2062

Year	Direct Employment	Indirect Employment	Induced Employment
2019-2022	27,117	90,390	63,273
2023-2027	29,699	98,998	69,298
2028-2061	62,899	209,663	146,764
2062	64,345	214,485	150,139

Source: Author´s calculation using own porjections of Input-Output Table 2019-2062, based on data Input-Output Table 2008 from INEGI

However, it is assumed that the number of jobs in the operational phase is in function of the number of passengers who are every year; the goal of keeping the number of passengers jobs created is as follows.

Table 13. Number of workers and Passengers as a goal for each period.

Period	Workers	Passengers*
2019-2022	74,254	36,700,000
2023-2027	98,533	48,700,000
2028-2061	116,338	57,500,000
2062	240,768	119,000,000

*Passenger for each year

Source: Author´s calculation base on data of Airport Master Plan.

7. Analysis of productive linkages s airport

For the analysis of chains Leontief inverse matrices are used for each year, the results show the following:

- At the stage of construction, the chains are backward linkages, and the chain is confirmed to have a ratio greater than unity. In terms of multipliers it can say that considering the amount of investment in each sector, for every dollar allocated to the sector 236, will impact 0.26% in the same sector; 1.33% for the sector 237 and 8.64% for the sector 238.

Table 14. Backward Linkages in Airport Building Stage, 2014-2018.

Period	Airport Building Stage					
	Without Investment			With Investment		
	236	237	238	236	237	238
2014	1.0026	1.0134	1.0864	1.0026	1.01337	1.08643
2015	1.0026	1.0134	1.0864	1.0026	1.01336	1.08644
2016	1.0026	1.0134	1.0864	1.0026	1.01337	1.08645
2017	1.0026	1.0134	1.0865	1.0026	1.01337	1.08645
2018	1.0026	1.0134	1.0864	1.0026	1.01337	1.08643

Source: Author´s calculation using own projeccions about Leontief Table.

- At the stage of the operation, they are forward chains, and chain was confirmed to have a ratio greater than unity. In terms of multipliers you can say that considering the amount of investment in each sector absorbed in the previous step, for every dollar that is allocated to the sector 481 will have an impact of 99.4% in that sector and 29.7% for the sector 488.

Table 15. Forward Linkages in Airport Building Stage, 2019-2062.

Airport Operating Stage		
Period	481	488
2019-2022	1.994	1.297
2023-2027	1.995	1.296
2028-2061	1.995	1.296
2062	1.995	1.296

Source: Author´s calculation using own projeccions about Leontief Table.

8. Conclusiones

NIAMC the project is necessary due to the saturation in the current AICM and problems that this entails in passenger flows. Its new location will be an opportunity to generate local, regional and national employment. Responding to questions from initial investigation, we conclude the following:

- The New International Airport of the City of Mexico in fact conform to a cluster of airport services as necessary to address the problems of efficiency in commercial and passenger flows; whose impacts can be observed in macroeconomics aggregates simulated previously and found at national, regional and local levels, to generate economic concentration or n or mica and allow connectivity both within the pa í s international airport with other nodes.
- The stages of construction or operation of the airport is a source of growth and development economic of Mexico. The stage of construction it will be a source of regional growth, as populations attract flows mainly from the central region of the contry and whose investment amounts will increase the number of jobs. The operational stage will also be a source of national growth, since the generation or of services to provide will be given the results of the airport interactions between different nodes and whose number of jobs generated in function to be found or increase in the flow of passengers.

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