Impact of the new Ryanair´s Maintenance Centre at Seville

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Abstract:

Maintenance Repair and Overhaul (MRO) is one of the most important segments in aerospace industry and its size is comparable to aircraft manufacturing, as a matter of fact. Seville has a long tradition in aerospace industry, although mainly focussed on aircraft assembly. In 2017, Ryanair chose Seville as one of its maintenance bases in Europe, owing in part to the already existing capabilities around aircraft manufacturing in this area. This centre includes the building of one hangar that can accommodate two B737 aircraft. It is an opportunity to diversify aerospace industry to segments other than aircraft assembly.

This work assesses the impact of this new activity in Andalucía (Spain), although it will affect to Sevilla mainly. It makes use of a Computer General Equilibrium (CGE) model, a tool to measure economic impact that overcomes some of the limitations of linear models, which are an alternative to CGEs. It requires a Social Accounting Matrix (SAM) to be calibrated, in consequence a SAM including the MRO sector has been drawn up as a part of this work.

This paper assesses the impact of building construction work of new hangars, as well as the impact of this new activity in the economy.

We conclude that this new activity will have an important impact in terms of employment although it is a quite isolated activity from the rest of the economy. It has a positive employment multiplier, although less than 1. The annual impact of this activity on GDP will be around 5 million euro, though it could reach more than 12 million euro in revenues.

This work estimates the workload based on data from similar MROs centres, so it can be valued more accurately once the centre starts to operate.

Keywords: *Ryanair, MRO, Seville, Economic, Impact, CGE*

JEL codes: O14, O21, O22, O25, L62, C67

1. Introduction

This work assesses the potential impact of the new Maintenance Overhaul and Repair (MRO) center to be stablished in Seville by Ryanair.

MRO may be defined as "all actions that have the objective of retaining or restoring an item in or to a state in which it can perform its required function. The actions include the combination of all technical and corresponding administrative, managerial, and supervision actions" [1].

There is an important aeronautical activity in Seville, where Airbus holds two important productive centers. One is located at San Pablo airport, where different military transport types are assembled, and another one at Tablada neighborhood, whose main activity is focused on aerostructures manufacturing. Around these activities there is also an important productive fabric, focused on engineering activities as well as manufacturing of aerostructures. Seville has been sometimes described as the third aeronautical pole in Europe due to its activities of aircraft assembly, although Madrid plays also an important role.

Airbus also holds an MRO center in Seville, which is focused on maintenance activities of those aircraft produced in Seville. However, Ryanair's MRO center will boost this activity in Seville, that has not been very important so far, and opens the way to civil maintenance activities, that has better perspectives than military ones.

The new Ryanair's MRO center will host a 5000 m^2 hangar. The estimated cost is about 8 million euro and will employ 150 people. Around 20% of the total fleet of Rayan air will be served by this installation, around 100 aircraft per year. Ryanair is the largest operator of 737, and will hold more than 520 aircraft by 2024[2].

This new activity will ease the diversification of aeronautical activities in Seville, improving one of the less representative so far. Due to the importance of aeronautical

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[1] Rodrigues, D. and Lavorato, P. (2016): "Maintenance, Repair and Overhaul (MRO) Fundamentals and Strategies: An Aeronautical Industry Overview" *International Journal of Computer Applications, Volume 135 No.12, p. 22-29*

[2] Ryanair, https://www.ryanair.com/gb/en/useful-info/about-ryanair/fleet

sector in Seville (Cardenete and López, 2015), the assessment of the impact of this new activity is of the major interest for policy makers and the aeronautical lobby.

MRO is one of the most prominent business in aerospace sector, whose revenues are close to those from aircraft manufacturing.

In 2005, the value of MRO market exceeded 100 billion dollars, even more than the value of aircraft manufacturing (75 billion dollars)[3].

Today, MRO market is slightly lower than aircraft manufacturing, manly due the increase of production rates over the last decade. In 2015 the value of MRO market accounted for around 135 billion dollars, of which about 65 billion dollars came from the civil air transport. However, that year aircraft manufacturing accounted for around 180 billion dollars[4].

Nevertheless, we can conclude that the size of both MRO and aircraft manufacturing market are about the same order of magnitude. This shed some light about the importance of MRO market.

Civil MRO market is segmented into four different segments: engine overhaul, component repairs, line maintenance and airframe heavy maintenance.

Airframe heavy maintenance consist in the inspection and repair of the aircraft structure every certain defined intervals of time. Typically, need to be carried out at specific locations with certain resources and tools. There are four levels of maintenance inspections, labelled as “A”, “B”, “C” and “D”. “C” and “D” are the ones covered by Heavy Structure Maintenance. “C” Checks typically includes a detailed inspection of the structure, components and accessories. It can last for three days and requires up to 4.000 manhours[5][6]

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[3] CFI International (2005): MRO Industry Outlook

[4] CFI International (2015): MRO Industry Outlook

[5] Global MRO Market Assessment. AeroStrategy for The Aeronautical Repair Station Association (ARSA), 2009.

[6] Aircraft Commerce Review (2006). Analysing the 737NG’s first base checks. Aircraft Commerce, No. 46, p. 48-52

In this market three different kinds of companies are present. There are Overall Equipment Manufacturers (OEM) which are the aircraft manufacturers. Other companies working in this market are those linked to airlines, that take care of their own fleet and aircraft from others. Finally, there are independent MRO centers. The main stake belongs to MROs related to airlines.

There are three main cost sources in MRO market. The most important one is labor, which account for around the 70% of total cost. It includes direct labor force, licensed and not licensed, as well as indirect employees, and general and administrative overhead charges. Second source of cost is material, that accounts for a 20% of total cost. It includes consumables as well as spare and airframe parts. Finally, specialized services represent the 10% of total cost. It includes specialized services contracted to independent shops, such us nondestructive inspections, composites repair or fuel tank inspections[7].

The supply chain is thus typically composed of part providers, which supplies parts and consumables. These parts are delivered directly to MROs or through distributors. Finally, there are specialized repairs shops.

The paper is organized as follows. Section 2 presents a brief literature review about the subject presented in this work, and section 3 explains the basic Computer General Equilibrium (CGE) model as well as the calibration with a Social Accounting Matrix (SAM) as database. In Section 4 the paper shows how the shock is simulated in the model and section 5 main results are shown and discussed. Finally, section 6 concludes and summarizes.

This work analyses the impact of the new MRO activity regardless of the impact of the infrastructure construction.

Economic Impact Analysis is used to either predict the impact in the economic indicators as a result of the implementation of future investment or policies, or to evaluate the impact of past or present policies.

[7] AeroStrategy for The Aeronautical Repair Station Association (2009): Global MRO Market Assessment. http://arsa.org/wp-content/uploads/2012/09/ARSACivilAircraftMROMarketOverview-20090821.pdf

EIA methodology is mainly based on the use of mathematical models. Analysis of impact can be done through different methodologies.

First alternative is based on linear models. These models make use of Input Output (IO) tables or the more complex SAM, that are the natural evolution of the first ones. Linear models suffer from some constrains. They focused on the lack of dynamism or their inability to adequately reflect the replacement of local production by imports, as a consequence of changes in prices (R. C. Waters, 1977). Today the limitations of IO models are well known (Kockelman *et al*, 2013), as the existence of fixed prices, fixed coefficient technology or constant returns of scale. More recently Cardenete and Sancho (2012) showed the limitations to the use of multipliers based on IO models when there are supply constraints.

CGE provides a modelling approach that overcomes these limitations, since it considers price effects, elasticities of demand and substitution of products and factors. CGE can furthermore make use of different production functions for each sector and different utility function for utility-maximizing consumers.

But CGE models also have some limitations and critics, such as the need of a big amount of statistical data, whose updating or quality is variable. Additionally, the accuracy of their results relay on how the equations reproduce the real behavior of the economy in a certain point of the time. For this reason, methodologies based on IO and SAM tables are the most widely used due to their simplicity, that they are easily implementable and that they are empirically operational.

The concept of general equilibrium in the economy was developed at the end of the 19th century by Walras (1874), and later completed by Arrow and Debrew (1954), although CGE models finally gathered momentum with the development of computers at the end of the 20th century. The evaluation of the parameters that reflect the behavior of the economic agents is done with data from a SAM. It includes data of transactions between the different agents in the economy, and it represents the equilibrium of reference that the CGE model aims to reproduce.

2. Brief literature Review

The impact of the aerospace sector has been already widely addressed in different studies, mainly at the USA (2016), as those for Washington (2016) or Florida (2012). Most of them have been produced by universities or consultancy for the public administration. It is also a common approach to use IO analysis as methodology. In some cases, they consider MRO activities (Canada, 2018).

The impact of aerospace industry in Andalusia or in Seville has been also considered in previous papers, as those from Castillo *et al* (2005) and more recently by Cardenete and López (2015), highlighting the relevance of the sector in terms of employment and source of salaries, due to its indirect and induced effects, although poorly connected with the rest of the economy. However, these studies focused on the impact of the existing aerospace industry, and they made use of IO tables, instead of CGE models.

3. One Applied General Equilibrium Model

3.1. The Model

A static general equilibrium model is the basis for the within period equilibrium. It follows the classical CGE formulation, with a set of equations that represents the interactions among the different actors in the economy: producers, households and the government. All agents, consumers and firms, behave rationally as utility and profit maximizers, and as far as constant returns of scale are assumed for firms, to maximize profits for them is the same than to minimize cost. The model includes 33 sectors, two factors (labor and capital) one household type and one account representing the rest of the world (ROW).

The production technology is given by a nested production function. In the first level, the quantity of value-added for sector j is determined by the aggregation of primary factors labor and capital by a CES technology, In the second level the domestic output of a sector is obtained by combining, through a Leontief technology, inputs from the rest of sectors and value-added, and finally the overall input is obtained combining domestic q_i and imported outputs according to the Armington (1969) hypothesis, with a Constant Elasticity of Substitution (CES) aggregator:

$$VA_j = \left[\left(\gamma_{Lj} \cdot L_j \right)^{\beta_j} + \left(\gamma_{Kj} \cdot K_j \right)^{\beta_j} \right]^{\frac{1}{\beta_j}} \quad (1)$$

$$q_j = \min \left(\frac{y_{1j}}{a_{1j}}, \frac{y_{2j}}{a_{2j}}, ..., \frac{y_{33j}}{a_{33j}}, \frac{VA_j}{v_j} \right) \qquad j = 1,2...,33 \quad (2)$$

$$y_j = \left[\left(\mu_{qj} \cdot q_j \right)^{\alpha_j} + \left(\mu_{mj} \cdot m_j \right)^{\alpha_j} \right]^{\frac{1}{\alpha_j}} \quad (3)$$

Where:

VA_j is value-added of sector j and Lj and K_j are primary factors labor and capital.

β_j represents the elasticities in the CES production function for VA_j

γ_{Lj} and γ_{Kj} are share parameters for CES production function for VA_j

q_j is the domestic output of sector j as combination of VA_j and inputs from other sectors

a_{ij} and ν_j are the technical coefficients of the Leontief aggregator for q_j

y_{ij} are the quantities of y_i available for the manufacturing of y_j.

y_j is the total output of sector j as aggregation of domestic q_j and imported m_j outputs

μ_{Lj} and μ_{Kj} are share parameters for CES production function for y_j

α_j represents the elasticities in the CES production function for y_j

Elasticities have been set to 0,5. They represent a low elasticity but within the range of values usually found in the literature

The consumer h demands final consumption and saving. He is assumed to maximize a Cobb-Douglas utility aggregator subject to a disposable income constraint, and a price vector $\mathbf{p}(p_1, \ldots p_j, \ldots)$ for goods and $\mathbf{w}(w, r)$ for primary factors:

$$\begin{aligned} & MaxU_h \left(C_{jh}, S_h \right) = \left(\prod_{j=1}^{n} C_{jh}^{\chi_{jh}} \right) S_h^{\kappa_h} \qquad j = 1,2,...,33 \\ & s.t. YDISP_h = \sum_{j=1}^{n} p_j C_{jh} + pinvS_h \end{aligned} \quad (4)$$

Where:

U_h is the utility of consumer h

C_{jh} represents the consumption of each good j by the representative consumer h

S_h is the savings of consumer h

YD_h is the disposable income of consumer h

p_j is the price of good j

pinv is the price of the good of investment

Household income is financed by the sale of the primary inputs, labor and capital. The customer also pays taxes; *ID* is the tax rate on consumer´s income and *CO* is the employee´s contribution to the social security. He receives lump transfers and public goods from the government *TSM*, and also receives transferences from the ROW, *TRM*. Disposable income for consumption is gross income minus taxes,

$$YDISP = wL + rK + ipcTSP + TRM - ID(rK + ipcTSP + TRM + wL) - CO \cdot wL \qquad (5)$$

Whereas *w* and *r* are the prices of the primary factors, labor and capital, and *ipc* is the consumer price index.

The government is a special agent in the economy that taxes exchanges between the rest of agents to get resources. With them, the government finances its activity. On the other hand, it also transfers resources to the private sector through consumption of goods and services. The difference between expenses and income will determine the deficit. The different components of the taxes collection can be denoted as:

$$RIP = \sum_{j=1}^{n} \frac{\tau_j}{1+\tau_j} \cdot y_j p_j \qquad (6)$$

$$RP = \sum_{j=1}^{n} CP_j w\, l_j \qquad (7)$$

$$RO = CO \cdot w \cdot L \qquad (8)$$

$$RD = ID(w \cdot L + r \cdot K + ipc \cdot TSP + TRM) \qquad (9)$$

Where

RIP is the collection of indirect taxation to the productive activity, including VAT,

τ_j denotes the tax rate on production of sector j

RP is the employer´s contribution to the social security

CP_j is the rate of employer´s contribution to the social security in sector *j*.

RO is the employee´s contribution to the social security in sector *j*.

RD is the direct taxation on consumer´s income.

Tariff for imports has not been considered because most of them come from the rest of Spain and the EU. In our model, the demand of the public sector is kept as steady. The government deficit *D* is consequently endogenously determined as follows:

$$D = -R + TSP\ ipc + \sum_{j=1}^{n} DC_j p_j \qquad (10)$$

Where

D is the government deficit

R is the total collection of taxes

DC_j. is the government demand of goods from sector *j*

The Andalusian economy is very small compared with the rest of the world, the demand level of the foreign sector is thus assumed to be exogenously given, not being influenced by domestic variables. Additionally, imports are considered as imperfect substitutes for domestic production, following the Armington hypothesis (1969). As a result, imports are endogenously determined, and external deficit is consequently endogenously determined also as

$$F = prm\sum_{j=1}^{n} m_j - TRM - prm\sum_{j=1}^{n} EXP_j \quad j = 1,2,...,33 \qquad (13)$$

Where

prm is the weighed averaged price of the international market,

EXP_j is the external demand of goods from sector *j*

This is a savings driven model, so the level of investment is endogenously determined by savings, which is also endogenously defined by the preferences of consumers and the deficits of public and external sectors, according to the following equation.

$$pinv\sum_{j=1}^{n} INV_j = S \; pinv - D + F \tag{14}$$

Where,

INVj is the level of investment

Prices are endogenous in the model and they are made up considering production and prices of goods and primary factors. There is an internal price pi_i of the locally produced good i as defined in expression (15), where pva_i denotes the price index for added value used in sector i, under zero-profit condition. There is also a final price p_i that takes into account the participation of imported goods in the production of final products, as well as indirect taxation τ_i to production, as we can see in Equation (16). In this expression ξ_i and ζ_i represent, respectively, the participation of locally produced and imported good in the final product.

$$pi_i = pva_i \cdot v_i + \sum_{j=1}^{n} p_j \cdot a_{ij} \tag{15}$$

$$p_i = (1+\tau_i)(\xi_i \cdot pi_i + \zeta_i \cdot prm) \tag{16}$$

Where

pi_i is the internal price of the locally produced good i

pva_i denotes the price index for added value used in sector i, under zero-profit condition.

p_i is the final price

τ_i represents the indirect taxation to production,

ξ_i and ζ_i are, respectively, the participation of locally produced and imported good in the final product.

Labor market behavior is imposed by assuming that the real wage is sensitive to the unemployment rate. It is related to the power of unions, or any other socioeconomic factors inducing frictions and rigidities in the labor market. The idea behind the proposed formulation is that of a wage curve (Blanchflower and Oswald, 1990, 1994) that captures the relationship between the real wage and through a parameter β. Salaries

are rigid when β is large, and salaries are more flexible when β is decreasing. In the model this elasticity has been set according to the data from Bande *et al* (2012).

This model follows the implementation of Kehoe et al. (1995), based on the use of the elasticity of the real wage relative to the unemployment rate:

$$\overline{w} = \left(\frac{1-u}{1-\overline{u}}\right)^{\frac{1}{\beta}} \qquad (17)$$

Where

$\overline{w}$ is the real wage rate

u is the unemployment rate

$\overline{u}$ is the benchmark unemployment rate.

3.2. Model Resolution

Due to the Walras´ law, one equation is redundant. For this reason, one of the prices has to be chosen as *numéraire* and results are referred to it. In this case, the net price of labor has been chosen as numéraire.

The equilibrium in the economy is reached when the consumers maximize their utility and firms their benefits. In addition, the government redistributes among the different actors in the economy. All markets also reach their equilibrium; at each market of factors and goods demand equals supply.

GAMS software module computes the benchmark equilibrium and uses it as an internal basis for subsequent simulation. This guarantees very fast compilation and execution time and, in practice, yields convergence in all cases.

3.3. Calibration of the model. SAM as database

SAM is an extension of IO tables (Leontief, 1941, 1951), first developed by Stone (1964), and it gives a detailed account of interindustry transactions in an equilibrium setup in which total supply matches the sum of intermediate and final demand. Once the model is stablished, all parameters in the model need to be calibrated to reproduce such equilibrium. For calibration purposes, this model uses the SAM of the Andalusian economy for 2010 assembled using data from Input-Output framework (Andalusian

Institute of Geography and Statistics (IECA), 2010). The aerospace sector has been disaggregated with data from Cardenete and López (2015) and MRO sector. Finally, it includes 25 productive sectors: the 23 as a consequence of aggregating sectors from the original table, plus aerospace and MRO sectors.

MRO sector has been added in this paper to gather the impact of the new MRO services to be provided at Seville airport. MRO sector has been modeled attending to the structure of this sector:

- 70% of total costs are labor cost, including general and administrative headcount.
- 10% are outsourced activities, such as repairs. These services as well as general services have been splinted among the different sectors in the economy, in line with the aerospace sector.
- 20% are materials. About a 20% of this quantity is provided by distributors, however in Seville there is not a wide base of distributors, only about supplies, such as bolts or sealants. Therefore, this amount has been reduced to a 15%. The rest is modelled as imports, as there is no Boeing´s parts manufacturers in Andalusia, or PMAs and Surplus parts.

Total output has been valued attending to this cost structure, and based on the average salary paid by aerospace sector in Andalusia. The information salaries and employees in aerospace sector are from IECA.

As a result, we have the SAM of Andalusia with aerospace and MRO sectors disaggregated.

Figure 1. Brief structure of the SAM.

	Productive Sectors (1…25)	Productive Factors: - (26) Labour - (27) Capital	Institutions: - (28) Household and institutions - (30) Direct tax - (31) Indirect tax - (32) PPAA (Public Administrations)	(29) Savings/Investment	(33) Foreign Sector
Productive Sectors (1…25)	INTERMEDIATE CONSUMPTION MATRIX (1)	FINAL USE MATRIX (3)			
Productive Factors: - (26) Labour - (27) Capital Institutions: - (28) Household and institutions - (30) Direct tax - (31) Indirect tax - (32) PPAA (Public Administrations) (29) Savings/Investment (33) Foreign Sector	PRIMARY FACTORS MATRIX (2)	CLOSING MATRIX (4)			

Source: Cardenete, Fuentes, Mainar and Delgado (2011)

4. Shaping the Shock

This paper assesses the footprint of the new MRO center attending to the impact of the infrastructure (construction), which is a one-off impact, and the one of the MRO center activity, which is recurrent over the time.

The impact of the infrastructure construction, is modeled as an impact in the demand of construction, as an increase of demand from the investment account. The equilibrium prior to the shock has been reached by calibrating the model with the SAM of Andalusia of 2010 assembled from Input-Output framework (IECA).

Afterwards, the shock has been modeled keeping the same calibration, and increasing the demand from investment account by 8 million euro, and a new equilibrium is reached.

First of all, we have to assume that the impact is small, because the shock is negligible when it is compared with the size of the Andalusian economy.

The impact of the Ryanair´s MRO center has been modeled in a different way. Prior to the commissioning of the center, the economy comes from an equilibrium that is defined by the SAM of Andalusia in year 2010. The SAM calibrates the parameters at the equations that stablish the behavior of the economy. Once that the MRO center starts its activity, it is modelled by the inclusion of new equations defining the behavior of MRO sector. The parameters of these new equations are calibrated by the SAM with the MRO sector. With these new equations a new equilibrium is reached, gathering the effects of the impact. The difference between two equilibriums quantifies the impact. Labor vector helps to quantify the effect in terms of employment, as the quantity of work from the model has not direct relationship to jobs or working hours.

The vector is necessary as the ratio to pass from amount of work in the model to jobs is not the same for each sector. It is consequence of having only one type of work in the model, and with same labor price. For qualitative result, amount of work is enough, but the use of labor vector shed more light about number of jobs created or destroyed.

5. Results

The result about the impact of the construction of Ryanair´s MRO service center shows that impact is no positive, but it is in line with the results from other studies making use of CGE models and assuming the limitation to the delivery of resources. Table 1 summarizes impact´s main results.

Table 1. Economic Impact of Ryanair´s MRO center Construction at Seville Airport

GPD	-0,10 million €
Construction total output	2,72 million €
Total Output	-0,32 million €
Investment	-0,91 million €
External Defcit	-0,87 million €
Labor	-9 *

* It does not represent jobs or working hours

GDP decreases by roughly 0,1 million euro, despite the investment increase of 8 million euro. Therefore, the multiplier od construction is negative, as it has been already highlighted by Cardenete & Sancho (2016), although in this case for the Spanish economy, when a CGE model is used instead of SAM or IO linear models.

The total production of construction increases by about 2,7 million euro, much less that the investment increase of 8 million euro.

Both effects are due to the fact that, having non-unlimited resources, the ones required to meet the demand are taken from other with better indirect and induced effects, minimizing the total effect. The demand of construction from its own as well as from building materials and the manufacturing of metallic parts, are the ones that increase the most. However more of the sectors reduce their demand of construction, mainly from manufacturing of transport material and non-market services. As a consequence, the net demand from intermediate consumption decreases, minimizing the increase of demand as investment.

There is an increase of employment at construction sector, as a consequence of the total increase of demand of construction. However, the total effect in the economy is a net decrease in total employment. Once again as a consequence of the existence of scarce resources.

The impact of MRO service center is positive, as opposed to the service center construction, and recurrent over the time. The main figures showing the annual impact of MRO center are shown at table 2.

Table 2. Economic Impact of Ryanair´s MRO center at Seville Airport

GPD	5,05 million €
MRO total output	12,57 million €
Total Output	3,13 million €
Investment	-7,70 million €
External Defcit	-9,49 million €
Household Consumption	3,47 million €
Labor	418 *
MRO Labor	567 *
Jobs	85 jobs
MRO Jobs	150 jobs

There is a positive impact in GDP of some 5 million euro, despite the MRO external demand of nearly 12 million euro. It means that the impact is positive, although with a multiplier effect lower than 1, and close to 0,5. It is not a bad result, when compared with typical multiplier in the Spanish economy. Once that we assume finite resources through a CGE model (Cardenete and Ferran, 2016), only a few sectors offer multipliers higher than 0,5. The increase of GDP is mainly due to of household consumption, which gathers the induced effects of MRO´s salaries, of nearly 3,5 million euro, and an external deficit reduction of some 9,5 million euro. There are, meanwhile, an investment reduction of almost 9,5 million euro, which lowers the other contributions. The fall on investment is due to a minor contribution of external savings linked to the reduction of external deficit.

In terms of employment, the results shed a positive impact also. There is an increase on total employment, although impacted by a reduction in the rest of the sectors, shrinking the total effect in the economy, although still positive. As a result, labor multiplier is almost 0,6. The sector that contributes the most to reduce the total effect is construction. The reduction of investment has a marginal effect in construction, but it has an important weight in the economy, and it is very labor intensive also. On the other hand, sectors of market services and commerce are the ones that contributes the most to an increase on labor demand.

6. Conclusions

MRO sector is an important segment of aerospace sector. Its value in terms of sales is of the same order of magnitude as the aircraft production.

The establishment of a MRO service center at Seville is very important in that regard. It offers the possibility of diversify current aerospace industry focused on aircraft production, to other segments. Although there are MRO activities at Seville, this new MRO center opens the way to civil activities, which are more relevant and with better future prospects.

The impact of the construction of the MRO service center has a poor impact in economy of Andalucía, and hence at Seville. This result is in lines with those for the Spanish economy using the same assumptions than in this work.

But the activity of the service center is, however, positive and recurrent over the time. GDP multiplier is positive although less than one, but it is not a bad performance when compared with other sectors (Cardenete and Sancho, 2016). The results measure the impact on GDP in some 5 million euro, lower than the increase of external demand and consumption, a consequence of a reduction of investment. The result is also positive in terms of employment, although the net result could be lower than the increase at MRO sector, as there are labor intensive sectors which reduce its participation in the economy. Due to the cost structure, one of the sources to improve economy is through induced effects of MRO salaries, which are the main source of costs. However, the integration with the rest of the economy is poor, with low intermediate demand, for the reason that a minor part of the output requires intermediate products, but salaries. In addition, the main part of intermediate demand of parts are imports, and only repair workshop already working as Airbus´s subcontractor can provide repair services to MRO also.

This work has some room for improvement. The use of different substitution elasticities can be added to the results, through a a sensitivity analysis. The use of a SAM of Seville instead of Andalusia to calibrate the model will also add more accuracy to the effect in Seville. The use of different …an also improve the result.

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