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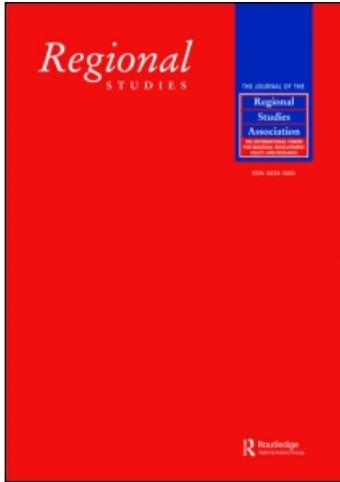
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The Regional Economic Impact of an Airport: The Case of Amsterdam Schiphol Airport

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HAKFOORT J., POOT T. and RIETVELD P. (2001) The regional economic impact of an airport: the case of Amsterdam Schiphol Airport, *Reg. Studies* **35**, 595–604. The completion of the so-called ‘third package’ in the liberalization of European aviation has changed the environment in which airports operate considerably. The continued growth of air traffic has led to a public debate in many Western countries about the expansion of airport capacity in the light of the externalities emanating from these traffic nodes. In this paper we try to measure the economic impact of Amsterdam Schiphol Airport on the Greater Amsterdam region, by means of a social accounting matrix of this region. The paper tries to avoid some of the pitfalls of earlier studies by using a counterfactual approach in measuring the economic impact. We are able to distinguish employment created in sub-regions of the Greater Amsterdam region, and the education and qualification levels associated with this employment. Our results indicate that the total multiplier of direct employment on Amsterdam Schiphol Airport is approximately 2: one job on the airport leads to approximately one job in indirect and induced employment.

Airport Forward effects Amsterdam Schiphol Airport The Netherlands Regional impact

HAKFOORT J., POOT T. et RIETVELD P. (2001) L'impact régional d'un aéroport: étude de cas de l'aéroport de Schiphol, *Reg. Studies* **35**, 595–604. L'achèvement du troisième ensemble de mesures en faveur de la libéralisation de l'aviation européenne a modifié sensiblement le milieu des aéroports. La croissance continue du trafic aérien a incité à un débat public dans plusieurs pays occidentaux quant au développement de la capacité d'accueil à la lumière des effets externes engendrés par ces noeuds de trafic. A partir d'une matrice des comptes publics, cet article cherche à estimer l'impact économique de l'aéroport de Schiphol à Amsterdam sur l'agglomération d'Amsterdam. Pour cette estimation de l'impact économique, on se sert d'une approche spontanée afin d'éviter quelques-uns des écueils des études antérieures. Cela permet de distinguer la création d'emploi dans les sous-régions de l'agglomération d'Amsterdam, et les niveaux d'éducation et de qualification y associés. Les résultats laissent supposer que le multiplicateur global de l'emploi direct sur l'aéroport de Schiphol à Amsterdam se chiffre 2 environ: à savoir, la création d'un emploi à l'aéroport entraîne la création d'un emploi environ dans l'emploi indirect et induit.

Aéroport Effets d'entraînement
Aéroport de Schiphol à Amsterdam
Pays-Bas Impact regional

HAKFOORT J., POOT T. und RIETVELD P. (2001) Die regionalwirtschaftliche Auswirkung eines Flughafens: der Fall Schiphol, des Flughafens von Amsterdam, *Reg. Studies* **35**, 595–604. Die Fertigstellung des sog ‘dritten Pakets’ der Liberalisierung der Europäischen Luftfahrt hat das Milieu, in dem Flughäfen betrieben werden, beträchtlich verändert. Die anhaltende Zunahme des Flugverkehrs hat in vielen westlichen Ländern zu einer öffentlichen Diskussion des Ausbaus der Flughafenkapazitäten im Lichte der externalen Effekte geführt, die von diesen Verkehrsknotenpunkten ausgehen. In diesem Aufsatz wird versucht, die wirtschaftliche Auswirkung von Schiphol, dem Flughafen von Amsterdam, auf die Region Groß-Amsterdam mit Hilfe einer Sozialberichterstattung dieser Region zu messen. Der Aufsatz versucht, Fallen zu vermeiden, in die frühere Studien gegangen waren, indem er einen den Tatsachen nicht entsprechenden Ansatz bei der Messung der wirtschaftlichen Auswirkung benutzt. Es gelang, sowohl Erwerbsstellen auszumachen, die in Teilregionen Großamsterdams geschaffen worden waren, als auch das Niveau der Bildung und Qualifikationen, das mit diesen Erwerbsstellen einhergeht. Die Ergebnisse deuten darauf hin, daß der Gesamtmultiplikator der direkten Erwerbstätigkeit in Schiphol, dem Flughafen von Amsterdam, sich auf annähernd 2 beläuft: eine Erwerbsstelle im Flughafen führt zu nahezu einer andern in indirekter und durch erstere herbeigeführte Erwerbstätigkeit.

Flughafen Vorauswirkungen
Schiphol, Flughafen von Amsterdam
Die Niederlande Regionale Auswirkung

INTRODUCTION

Air traffic has experienced rapid growth in the last two decades and the signs are that this growth will continue in the foreseeable future (OECD, 1997). In Europe as well as in other parts of the world, this has caused air congestion as well as increasing pressure on airports to expand.

The completion of the liberalization of the scheduled air transport industry within the 17 states of the European Economic Area on 17 April 1997 has changed the prospects for the European air transport market considerably (GRAHAM, 1997). According to ALLEN *et al.*, 1997, the key factors determining the shares of the various airports and the shape of the airline networks are:

- the network strategy of the dominant airline (in many cases the national flag carrier)
- (global) alliances and code sharing amongst airlines
- the development of the high speed rail network in Europe
- the competition between (potential) hubs, especially amongst those with small or stagnating local markets
- the competition between transfer and local passengers for peak period capacity, since many European hubs are becoming increasingly congested
- consumer expectations with respect to the routing of flights (direct or connecting)
- the development of an 'open skies policies' between European and US governments
- the pressure for cost reduction on airports
- the route strategy of second tier airlines.

Airports can be seen to serve two main functions (KRAMER, 1988). A first main function of an airport concerns its role as a transport node. In this respect essentially three markets of passengers can be distinguished (for freight a similar distinction can be made – see RIETVELD, 1997):

1. Persons living in the region served by the airport who visit other regions by plane
2. Passengers living elsewhere who travel to the region by plane
3. Transfer passengers whose origin and destination do not coincide with the region where the airport is located.

The demand for the airport in the first two markets depends on factors such as: the size and the features of employment and population located in the region near the airport; the presence of special tourist attractions in the region; prices of tickets; airport taxes; frequency and destination of flights offered; and the accessibility of the airport. When several airports are located in a city, competition between airports would also have to be considered. The third market does not so much depend on the regional features, but on specific quality features of the airport itself, the presence of a main carrier on

the airport, the quality of connections and on the position of the airport in the broader airport system.

A second function of the airport concerns the role they play in, and the interactions with, the regional economy (see KRAMER, 1988). Clearly the activity in the airport (in terms of, for example, the number of flights and the number of people working in the airport area) may have an important impact on the region as a whole. Therefore, the focus of our paper will be on the link between the first and the second functions of airports.

The economic and environmental impact of the airport on the region combined with the continued growth of air traffic has led to a considerable public debate around the planned expansion of airports in many Western countries. This debate has mostly centred around the trade-off between the negative external effects on the region such as noise, pollution and safety risks and the economic benefits of the expansion for the region.

However, in a number of cases the economic benefits of investing in the expansion of the airport on a national scale have been questioned. While a further expansion of the airport may be beneficial for the region, it may not be for the country as a whole because of 'crowding out' effects. The net present value of a (government) investment in airports can well be negative.

In this paper we investigate the impact of Amsterdam Schiphol Airport on the Greater Amsterdam region (ROA) through means of an expanded input-output model. This model makes it possible to investigate possible forward and backward linkages on the regional economy, the rest of the Netherlands and imports/exports. Backward linkages indicate how many suppliers to the airport benefit when the activity on the airport grows. Forward linkages indicate how much the region benefits from the proximity of the airport in terms of location.

The rest of the paper is organized as follows. The next section presents an overview of studies with respect to the employment impact of airports. In the third section, the economic performance of different types of economic activity in the ROA region is compared with the Greater Rotterdam region (Rijnmond) and with the Netherlands as a whole. The fourth section continues by providing a description of the evolution of different types of economic activity in the airport area itself; the fifth section describes the methodology used in measuring the economic impact of the airport on the region and the input-output model, MADAM; and the sixth section proceeds by presenting the main results. A final section provides concluding remarks.

A REVIEW OF THE EMPIRICAL LITERATURE

Policy makers often see airports as strategic assets to the regional and national economy (TWOMEY and

TOMKINS, 1995). They provide a gateway to international markets and therefore promote high-value import and export activity. The economic significance of airports is, however, not limited to the value added and employment created in the transport sector of the economy ('on the platform'). Expansion of an airport might well have temporary and non-temporary effects on the demand side and the supply side of the economy respectively (RIETVELD and BRUINSMAN, 1998).

The *temporary* effects on the demand side of the economy relate to the increase in income and employment during the period in which the investment takes place because of activities of construction firms and their suppliers. These types of effects are commonly studied by means of input-output analysis. In the case of airports, these types of effects consist of the design of the facility, the building of (additional) runways, the construction of terminals and hangars, the installation of traffic navigation systems and so on (BUTTON and TAYLOR, 2000). For a full assessment of these types of effects, one should also take account of any crowding-out that occurs in the wider economy as a result of the way the project is financed. Increased taxes in the case of tax financing or higher interest rates as a result of public borrowing on the capital market have negative effects on consumption and investment in the general economy.

Non-temporary effects of the expansion of the airport on the demand side consist of the costs of operation and maintenance of the airport facilities such as the employment involved in maintaining the facility, in handling the aircraft and passengers, in transporting cargo to and from the terminal, and so on (BUTTON and TAYLOR, 2000). Non-temporary effects on the supply side include the permanent effects the expansion has on productivity and the location of activities (see STOUGH *et al.*, 1999, for a study that examines the impact of infrastructure availability in a region on the location of high-tech firms). These latter effects may consist of a reduction in generalized transport costs for travellers, the effect the investment has on productivity of different sectors and on the attractiveness of regions, environmental effects and so on.

The theoretical foundation to analyse the full impact of infrastructure investments is, of course, cost-benefit analysis (CBA). CBA is firmly based in welfare economics and is often used in practice. Every effect of an investment project can be systematically estimated and, wherever possible, given a monetary value. In addition, cost-benefit analysis gives an overview of the distribution effects, alternatives and uncertainties (see CPB/NEI, 2000).

In practice, a CBA consists of different studies to collect information on the effects the investment has on the demand and supply side of the economy using a variety of empirical methods. In this paper, we focus on one particular method: the use of a social accounting matrix (SAM) or extended input-output model. The

SAM allows us to study the impact of an increase in direct employment on the airport by means of so-called backward and forward linkages which lead to additional value-added and production off-site.

Backward linkages consist of the 'feeding' or supplying role of firms outside the airport area; input-output tables provide information on the structure of supply to the airport. Forward linkages indicate the extent to which the airport creates an attractive business environment and leads to the relocation of activity towards the region in which the airport is located. Another example of a forward linkage is tourism to a certain region.

Using the SAM to calculate the impact of the expansion of an airport on value-added and employment makes it possible to estimate the temporary effects of construction and the non-temporary effects of operation and maintenance of the infrastructure on the demand side by means of the backward linkages. The method does, however, not take account of any crowding-out that might occur as a result of the investment. On the supply side, using the SAM to estimate the effect of the impact of the expansion of the airport on the attractiveness of the region might be approximated by means of the forward linkages. The method does not take account, however, of some of the other effects that might occur on the supply side such as the reduction of generalized transport costs, environmental impacts of the investment and so on. (For a discussion about the environmental impacts of airports we refer to MORRELL and LU, 2000, and NERO and BLACK, 2000).

In this paper we shall refer to the employment on the airport itself as direct employment, to the employment created to backward linkages as indirect employment and to the employment created by forward linkages as induced employment.

Table 1 gives an overview of a number of studies that have tried to estimate the direct employment and the associated indirect, induced and combined indirect and induced multipliers of this direct employment at a number of Western European airports using input-output models (see IAURIF, 1995, for evidence regarding US airports). The indirect multiplier is defined as the total of direct and indirect employment to direct employment. The induced multiplier is defined as the total of direct and induced employment to direct employment and the combined indirect/induced multiplier is defined as the total of direct, indirect and induced employment to direct employment. It is already clear from these numbers that there is no consensus in the studies regarding the shares of direct, indirect and induced employment in the total employment associated with the airport.

The number of passengers per direct employment varies widely amongst the studies listed in Table 1: from 274 to 1,250 passengers per directly employed worker. Most combined indirect and induced multipliers are

Table 1. Estimated direct employment and indirect and induced multipliers at Western European airports in various studies

Airport(s) and year of study/ passenger throughput	Passenger throughput	Study area	Estimated direct employment	Indirect multiplier	Induced multiplier	Combined indirect/induced multiplier
Paris (Orly and CdG): 1988	40 million ppa	Ile-de-France	65,000	1.1	2.1	2.3
Paris (Orly and CdG): 1991	44.8 million ppa	Ile-de-France	72,000	1.1	2.1	2.3
London: 1993	72.6 million ppa	South East England	82,000	1.2	1.3-1.8	1.5-2.0
Manchester: 1988	10 million ppa	North West England	8,000	2.5	1.9-4.1	4.4-5.6
Manchester: 1991	10.8 million ppa	North West England	10,600	2.4	2.2	3.6
Manchester: 1993	13.4 million ppa	North West England	10,600	1.9	1.6	2.5
			(full-time)			
Copenhagen: 1983	NA	Copenhagen region	12,100	1.1	2.5	2.6
Copenhagen: 1991	11.9 million ppa	Copenhagen region	14,500	1.8	2.1	2.9
Amsterdam: 1993	21.3 million ppa	Netherlands	37,000	NA	NA	2.0
Düsseldorf	11.3 million ppa	Nord Rhein Westfalen	9,800	2.7	5.5	7.2
Oslo: 1996	NA	Oslo region	10,000	NA	NA	3.5

Source: IAURIE, 1995; INSTITUTE OF TRANSPORT ECONOMICS NORWAY, 1997; own calculations.

between 2.0 and 3.5 although the studies differ with respect to the relative weight of the indirect and induced multipliers.

Possible reasons for the differences in multipliers include different assumptions regarding the existence of forward and backward linkages, a different size of the geographical area over which the multiplier is measured and a different pattern of economic activity in the airport area. A typical problem in studies that try to measure the regional impact of economic activity over time is the definition of a base scenario. How high would the growth of production and employment in the region be without the airport? This point will be addressed later in this paper.

THE ECONOMIC PERFORMANCE OF THE GREATER AMSTERDAM REGION

The Dutch economy is characterized by two major transport nodes that serve as hubs in the international transport system: Amsterdam Airport Schiphol, and Rotterdam seaport. These two hubs have traditionally played an important role in the spatial policy of consec-

utive Dutch governments. Both transport nodes have experienced a rather steady growth in terms of volume during the past decades, but the growth rate in the aviation sector has been considerably higher in the airport than in the seaport: 8% versus 2.5% per annum.

This can be explained amongst others by the difference in the life cycle of the modalities concerned; Rotterdam has been an important seaport for more than a century, whereas Schiphol only started to play a significant role some 35 years ago. In the meantime, Schiphol has become an important hub in the intercontinental airline network. Its role is clearly bigger than might be expected when only the size of the national economy is taken into account (it ranks in fourth position of European airports in terms of passengers and third in terms of freight). We start with a concise comparison of long run economic growth in the two regions concerned.

Table 2 provides some descriptive statistics of the average annual growth of the number of jobs in the Greater Amsterdam Region (ROA),¹ the Greater Rotterdam Region (Rijnmond) and the Netherlands as a whole. Separate growth percentages are given for five sectors: agriculture and manufacturing; wholesaling

Table 2. Average annual growth of the number of jobs in ROA, Rijnmond and the Netherlands in the period 1970-95

	Agriculture/ manufacturing	Wholesale/ transport	Producer services	Consumer services	Non-profit	Total
Amsterdam centre	-6.0	-4.7	-1.3	-1.1	-0.1	-2.3
Rest of Amsterdam	-2.0	1.8	3.2	0.2	2.6	0.7
ROA North	-1.3	2.2	2.6	2.2	2.0	0.6
Meerlanden	-0.4	4.2	4.7	3.1	2.6	2.5
Amstelland	0.6	2.6	5.9	2.1	2.8	2.4
ROA total	-1.8	1.3	2.0	0.6	2.1	0.6
Rijnmond	-1.5	-0.1	2.4	1.1	1.5	0.3
The Netherlands	-0.8	1.5	3.1	1.3	2.1	0.9

Source: Foundation for Economic Research. 1994 and 1995 are estimates from the MADAM model. In the data set for Rijnmond the self-employed and working family members are excluded.

and transport; producer services; consumer services; and the non-profit sector.

How well does the Greater Amsterdam Region perform economically compared to the Greater Rotterdam Region with its international seaport, and the Netherlands as a whole? Table 2 gives the annual average growth rates of employment in different sectors in ROA in the time period 1970–95 compared to Rijnmond and the Netherlands as a whole.

On average, the Greater Amsterdam and Rotterdam Regions have experienced lower growth than the Netherlands as a whole over the period 1970–95. However, ROA grew faster than Rijnmond in this period. An important if not the only explanation for the divergence in growth between the two regions is the difference in development of the second sector, which includes distribution and transport activities. This sector experienced a stronger growth in ROA than in the port of Rotterdam.

The experience of Rotterdam is in line with many other port regions in Europe, whose growth record has been rather disappointing during the past decades (see CHESHIRE, 1990). There are two major reasons for this; one is that due to technological change (containerization) port activities have become much less labour intensive. So even when they grew in volumes of goods transported, they declined in terms of employment. The other reason is that part of the port related activities have shifted to inland regions thus leading to the formation of 'port networks'. Similar developments did not take place in the aviation sector.

The lower growth performance of the Amsterdam

and Rotterdam metropolitan regions compared to the national average also reflects that, during the last decades, the agglomeration advantages of these regions have weakened (ATZEMA, 1999). Other regions in the country, well connected to these metropolitan regions, have been able to achieve higher growth figures.

Geographically, the Greater Amsterdam Region can be subdivided into a number of sub-regions, which are depicted in Fig. 1. These are the city centre of Amsterdam, ROA North, Meerlanden (where the airport is located), Amstelland (located south of Amsterdam, near the airport area) and Almere (located east of Amsterdam).

If we compare the employment growth of the sub-regions in ROA, the south of ROA does relatively well. Amstelland and Meerlanden, which are close to the airport, have experienced an average growth that is higher than in other parts of ROA and also far above the average of the country as a whole.

The relatively positive development of ROA compared to Rijnmond can, for the most part, be explained by the growth in these two sub-regions and in particular to the sectors wholesale and transport, and producer services. Almost 45% of the total employment in the Meerlanden region consists of employment in the wholesaling and transport sector which is closely related to the activity on the airport.

Based on this rudimentary 'shift and share' argument, the development of activity on and around the airport is therefore an important factor in explaining the diverging growth rate between ROA and the Rijnmond area.

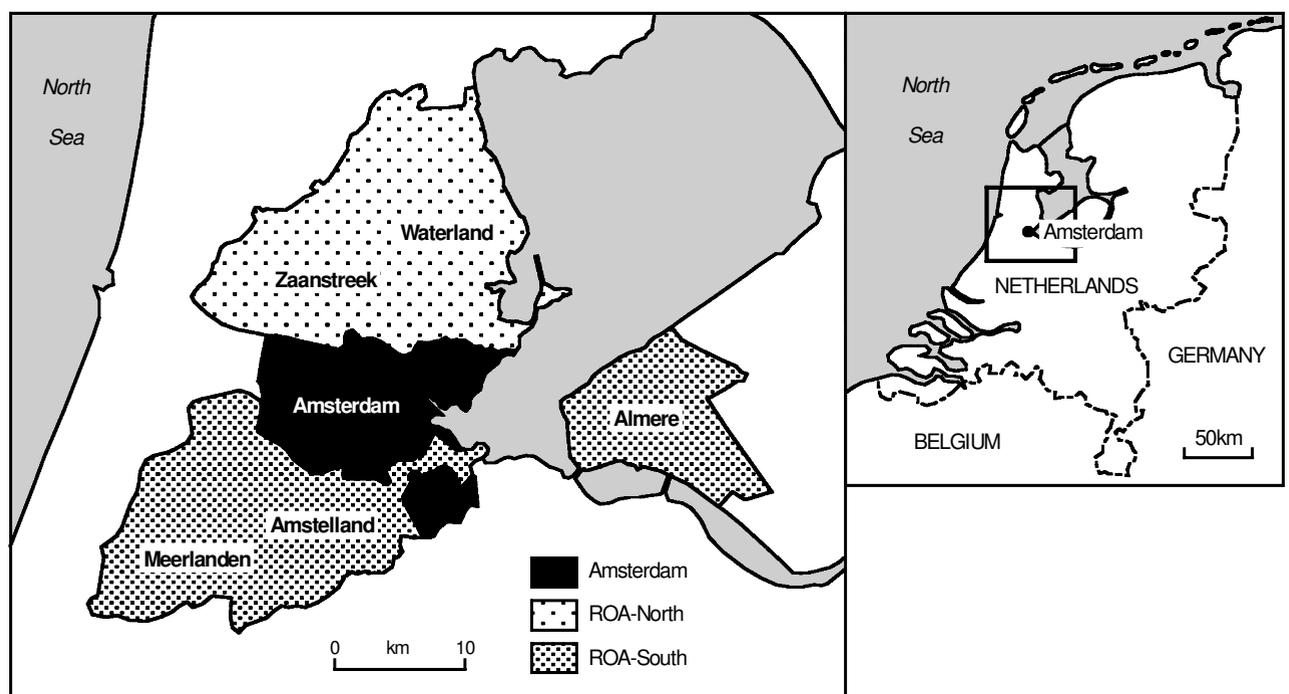


Fig. 1. ROA and its subregions

Moreover, there are indications that the importance of Schiphol related activities for the region might even increase in the future. In the light of the process of concentration and rationalization in the banking and insurance sector (part of the producer services sector), which is concentrated in the Amsterdam area, the employment growth in this sector is likely to be lower than it was in the period 1970–95.

DIRECT EMPLOYMENT IN THE SCHIPHOL REGION

Before we discuss the method and results of the estimates of the employment effects of Schiphol on the region, we first discuss the growth of employment on the airport itself. *The Statistiek Werkzame Personen* published by Amsterdam Schiphol Airport gives an overview of the number of employed persons (> 12 hours per week) on the airport itself and the distribution of employment over the various sectors. A summary of the results for a number of years is given in Table 3.

By far the largest share of employment at Schiphol is generated by the aircraft carriers, until recently by aircraft manufacturer Fokker, and the security and exploitation services of the airport (including military police). The growth of employment at Schiphol itself is therefore mostly due to the aircraft carriers; in 20 years the employment in this sector more than doubled.

The employment of aircraft manufacturers decreased considerably between 1990 and 1996 due to the financial problems and resulting bankruptcy of Fokker. The decrease in employment in this sector has however not led to a decrease in overall employment at the airport;

this has further increased by almost 2,000 jobs particularly by an increase in suppliers, cleaners and cargo handlers.

METHODOLOGY

The number of jobs listed in the previous section can be regarded as the direct economic impact of the airport (KRAMER, 1988). Using a SAM, the indirect economic impact of the airport in terms of jobs can then be found by analysing the forward and backward linkages between the activities on the airport and those in the region (PERROUX, 1950).

Perhaps a more interesting question than the forward and backward linkages of the airport in one year (basically the non-temporary effects on the demand and supply side), such as in the studies listed in Table 1, is the question of how much employment is gained by the future growth of the airport. This requires assumptions regarding the growth of the airport and the region with and without further passenger growth.

In this paper we investigate the impact of Amsterdam Schiphol Airport using the extended input–output model or social accounting matrix MADAM. MADAM (Model AmsterDAM) has been developed by the Foundation for Economic Research in Amsterdam² and describes the production and employment in a large number of sectors (55) in the ROA economy. Being an input–output model, it also describes the ‘buy and make’ relationships between firms in different sectors in the Amsterdam region (ROA), the rest of the Netherlands and abroad.

The model is ‘extended’ because it not only includes the relationship between the production and employ-

Table 3. Direct employment in the Schiphol area, various years

	1976	1980	1985	1990	1996
Aircraft carriers	11,739	14,505	16,343	22,550	24,323
Aircraft manufacturers	4,677	5,166	5,525	6,531	1,184
Government/security/exploitation	2,646	3,198	3,486	4,232	4,348
Suppliers	585	666	968	2,056	3,764
Cleaners	744	846	1,246	1,295	1,698
Handling and expedition	952	1,230	1,397	1,541	1,927
Construction and installation firms	355	615	631	1,289	1,003
Restaurants/hotels and bars	403	488	557	640	1,230
Retail	358	371	445	714	913
Public transport and taxis	100	188	256	393	602
Banks	121	137	156	174	236
Couriers	—	—	133	203	119
Car rental	77	72	50	110	130
Oil and gas companies	93	106	107	127	154
Consultancy firms	138	141	128	144	196
Maintenance	—	102	75	143	194
Industrial firms	482	222	150	96	25
Personnel organizations	18	11	21	32	126
Agricultural firms	21	25	19	10	3
Other	92	211	221	295	2281
Total	23,988	28,508	32,041	42,641	44,550

Source: Amsterdam Schiphol Airport.

ment of firms in the three areas, but also how these decisions relate to the consumption decisions by households in the region. An increase in production can lead to an increase in income for households, part of which is spent in ROA and part of which is spent outside of the region (rest of the Netherlands or abroad). On the other hand, some consumers in ROA earn money by working outside of the ROA area.

An extended input–output model such as MADAM can be used to calculate how many jobs are created in a region when a sector such as airport activity grows and how this affects production, income and (un)employment in three areas. An interesting aspect of the model is that MADAM contains information about the share of different qualification levels in each sector of the economy. For each sector of the economy the share of five different qualification levels are known. This information can be compared with the information on the education level of the labour force in the region, which is also made up of five different levels. These education levels vary from ‘no education’ to ‘university education’. It is therefore possible to analyse the ‘match’ between the qualification levels required given the economic structure of the region and the education of the labour force.

The studies using input–output analysis that were mentioned above can be criticized on the ground that they lack a counterfactual. That is, the studies do not take account of the economic activity that would be present in the absence of the (growth in) airport activity. In this study we therefore make assumptions about what would happen in the case of the expansion of airport activity that is expected (the base line scenario) and the case of zero growth of airport activity (not surprisingly called the zero growth scenario). A scenario analysis like this requires assumptions about the growth of the general economy and the investment needed to make the expansion of airport activity possible. The difference between the base line scenario and the zero growth scenario then gives an estimate of the impact of the development of the airport on the ROA region.

In so doing, we also avoid the pitfall of assuming that the economic structure of the region is time-invariant. In operational terms, this is equal to assuming that the technical coefficients of the input–output structure remain the same, even when simulating the future development of a region over a period of 10 years or more. This is highly unlikely in any region, but seems particularly inappropriate for airport regions such as Amsterdam where airport activity has shown double-digit growth.

Our scenario analysis makes use of data for the period 1987–98. In our *base line scenario*, we use data on the actual economic development in the region between 1987 and 1998. More precisely, the development of activity on the airport between 1987 and 1994 is equal to the realized activity, while for the period

1995–98 we assume that this development is equal to the forecast by the CPB Netherlands Bureau of Economic Policy Analysis (with some adjustments for regional differences). We also collected information from government reports on the additional investments in the region by central government and the airport authorities to make the growth of aviation activities possible. These investments are included in the base line scenario but are not included in our counterfactual, the zero growth scenario.

This *zero growth scenario* assumes that there is no growth of aviation activities between 1987 and 1998 (or alternatively, that there is a ‘freeze’ on growth of aviation activities from 1987 onwards). Compared to the base line scenario, the share of aviation activities in the region therefore declines because other sectors show growth while aviation activities do not by assumption. Also, the region does not profit from the investment needed to make the growth of the aviation structure possible both in airport facilities and additional infrastructure.

If we compare the base line scenario with the zero growth scenario, we can calculate the backward and forward linkages. The backward linkages consist of the difference between the generated production and employment with suppliers in the two scenarios, taking account of the additional consumption expenditure that is generated in the process.

The calculation of forward linkages in applied research is more troublesome. An important reason why different studies arrive at different conclusions (see above) is that they make different assumptions about the impact of expansion of airport infrastructure on the attractiveness of regions. There is no doubt that expansion of airport activity has an impact on the numbers of firms locating in the area, the number of visitors to conferences, the number of tourists and so on, but in many cases it is hard to find a causal relationship.

In this study we make a relatively modest assumption about the forward linkages, relating only to conference visits and tourism. Our assumption is that 8% of all *foreign* passengers arriving at Schiphol visit the Amsterdam region and spend money on accommodation, restaurants, theatres and the like. (As a result, the employment related to forward linkages is not linearly related to the amount of passengers visiting Schiphol). This assumption holds for both the base line and the zero growth scenario. The average amount spent by foreign visitors is established from a number of studies that describe tourism in Amsterdam, including DUTCH STATISTICS, 1992a, 1992b; DE NATIONALE INVESTERINGSBANK *et al.*, 1994; and O + S, 1993.

Summarizing, the difference between the economic impact found in the base line and the zero growth scenarios therefore consists of three components: (1) the difference in the growth of direct employment on the airport and the related employment found through the

backward linkages; (2) the difference in investment in the airport and the related infrastructure and its effects on employment in the region; and (3) the difference in tourist expenditure of foreign origin and destination passengers in Amsterdam.³

MEASURING THE ECONOMIC IMPACT OF THE AIRPORT EXPANSION: RESULTS

The most important results of the differences between the base line and the zero growth scenarios are given in Table 4. A freeze in airport activity on Schiphol at the level of 1987, the zero growth scenario, results in 42,000 jobs less in 1998 than in the base line scenario. This reduction in job growth affects the periphery of Amsterdam in particular: here the number of jobs created is 34,000 below the level of the base line scenario. Of these 34,000 jobs, 32,000 relate to jobs of 12 hours or more. More than half the difference in jobs in the periphery – 18,000 jobs – consists of jobs with low qualification levels such as low-skilled manufacturing activities, drivers, security staff and the like.

When we look at education level, which of course can differ from the qualification level, there are also important differences between the two scenarios. In the base line scenario, 12,000 more jobs are created for workers with no education or a low level of education. This scenario also creates more jobs for workers with a higher education level (universities and polytechnics) – 7,000 jobs that are directly or indirectly related to the expansion of the airport.

Table 4. Deviations between the base line and zero growth scenario in 1998 within ROA (jobs per region)

	Amsterdam	ROA (excluding Amsterdam)	ROA total
Total difference between the two scenarios	7,000	35,000	42,000
Qualification level of the additional jobs created in the base line scenario:			
qualification level 1	1,000	12,000	13,000
qualification level 2	2,000	7,000	9,000
qualification level 3	2,000	8,000	10,000
qualification level 4	1,000	5,000	6,000
qualification level 5	0	2,000	2,000
Education level of the workers taking on additional jobs created in the base line scenario:			
no education	1,000	3,000	4,000
lower level education	2,000	9,000	11,000
medium level education	3,000	15,000	18,000
higher education	1,000	5,000	6,000
university education	0	2,000	2,000

Source: Own calculations.

Economic development in ROA
all sectors 1987-1998

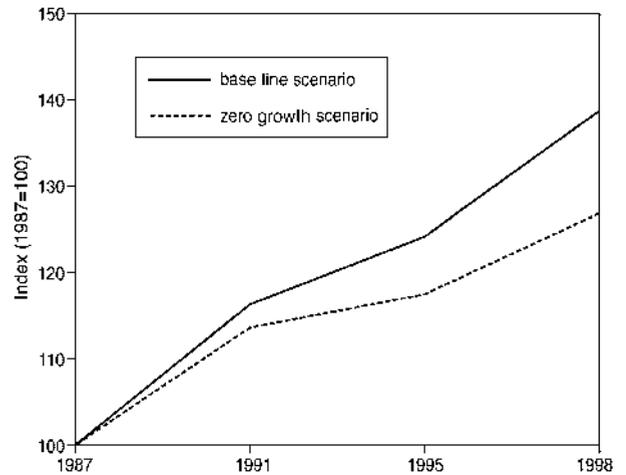


Fig. 2. Employment growth in the base line and zero growth scenarios

In comparison with the periphery, the differences between the two scenarios are smaller for Amsterdam itself. Here the base line scenario creates 9,000 jobs more than the zero growth scenario. These 9,000 jobs consist of approximately 3,000 jobs for workers with a lower or no education, approximately 4,000 jobs for workers with a medium level of education and approximately 1,000 jobs for workers with higher education in Amsterdam firms. The main difference between these results for Amsterdam and the periphery can be explained from the relationships between the various sectors within ROA (not given in Table 2).

The two scenarios also provide different results for production in 1998, particularly for the aviation industry and the construction industry (as you would expect). The production in the former in the base line scenario is Dfl 7 billion above that in the zero growth scenario. For the construction industry, the difference is Dfl 1 billion. These differences are caused by differences in the level of investment in civil engineering works and buildings. Other sectors that show different growth of production under the two scenarios are the aircraft industry (through less intermediary activity), business services and the distribution sector.

Total employment growth in the two scenarios is graphically depicted in Fig. 2. Table 5 gives an overview of the difference between the base line scenario and the zero growth scenario per sector. The reported results are conservative estimates. As mentioned before, we have not taken forward linkages into account other than the visits of foreigners to Amsterdam. The contribution of these forward linkages to the total difference between the base line and the zero growth scenario is therefore limited (around 2,000 jobs in 1998 between the two scenarios). The most important contribution of the airport to the region therefore consists of the direct employment on the airport and its suppliers.

Table 5. Deviations between the base line and zero growth scenarios in 1998

	Production 1991 (Dfl millions, 1987)	Base line scenario (% annual average change)			Zero growth scenario (% annual average change)		
		1987-91	1991-95	1996-98	1987-91	1991-95	1996-98
<i>Amsterdam</i>							
Manufacturing:	14.4	2.5	0.3	3.3	2.4	-0.1	2.7
of which construction	2.7	5.5	-0.3	6.3	5.4	-1.8	4.0
Trade and transport	10.0	3.4	0.9	2.9	3.2	0.7	2.7
Financial and commercial services:	13.7	2.2	1.7	2.7	2.1	1.6	2.6
of which commercial services	5.9	3.4	1.0	3.0	3.3	0.8	2.7
Other services	7.5	2.5	1.0	1.8	2.4	0.8	1.5
Non-profit	10.3	1.3	0.5	1.3	1.2	0.4	1.1
Total	55.9	2.3	0.9	2.5	2.2	0.7	2.2
<i>Periphery</i>							
Manufacturing:	15.9	6.3	1.4	5.2	6.1	0.7	4.1
of which construction	2.9	6.0	3.4	10.0	5.7	0.0	5.5
Trade and transport	15.9	7.9	4.7	7.5	4.2	1.0	3.0
Financial and commercial services:	4.1	11.4	3.0	3.8	11.2	2.6	3.4
of which commercial services	2.9	14.0	3.0	4.0	13.9	2.6	3.6
Other services	5.0	3.5	1.1	2.8	3.1	0.7	2.2
Non-profit	3.7	2.1	1.0	1.8	1.9	0.7	1.4
Total	44.7	6.5	2.6	5.4	5.1	1.0	3.2

Source: MADAM.

CONCLUDING REMARKS

Airports have a dual function: they act both as transport nodes and as 'growth poles' in the regional economy. In this paper an attempt has been made to measure the impact of Amsterdam Schiphol Airport on the region using an extended input-output model. The results over the period 1987-98 indicate that this impact is considerable; growth of the airport between 1987 and 1998 led to additional employment in the Greater Amsterdam region of 42,000 jobs in 1998.

This result is in line with earlier studies of the impact of Schiphol Airport on Dutch employment: the combined indirect and induced multiplier is around 2.0. If we compare our results to the studies mentioned in Table 1 and those listed in a recent report by YORK CONSULTING, 1998, they are on the low side of the spectrum. The main reasons for this are that we have made a rather modest assumption about the forward linkages resulting from the growth of the airport, and the use of the counterfactual method. Studies that do not use a counterfactual are likely to overestimate the economic impact of the airport because they do not take account of the growth that would occur in the absence of an expansion of the airport. Other possible differences relate the geographical size of the area under study and the organization of activities on or around the airport platform. A full comparison of the differences in estimates would require a meta-analysis of the different studies, which is beyond the scope of this paper.

As argued above, the use of an extended input-output model or SAM can provide important information about the economic impact of an airport but does

not lend itself alone to a full assessment of the economic costs and benefits of the expansion of an airport. This requires a full cost-benefit analysis. In a CBA a trade-off is made between the costs of a certain investment and the social effects of this investment. Our study does, for example, not take account of any crowding-out that might occur as a result of the way the investment in aviation infrastructure is financed nor does it provide information about the negative (environmental) externalities that need to be considered for a full assessment of the social costs and benefits of such an investment (see MORRELL and LU, 2000, for a discussion about the charging for negative externalities at Amsterdam Schiphol Airport).

Another point to be made is that in our study we have highlighted the impact of Amsterdam Schiphol Airport on the Greater Amsterdam Region. One should be aware, however, that the economic impacts of the airport might be much wider than in the study area concerned. Schiphol is the only major airport in the country. It also serves other cities like Rotterdam, The Hague and Utrecht, which are conveniently located with respect to Schiphol at distances of some 50 km and which are rather well connected in terms of both road and rail. This has two implications. The impacts of airport growth on the economy may have been larger than those only observed in the Greater Amsterdam region. On the other hand, one must also take into account the possibility that a certain part of the developments in Amsterdam and the Schiphol area are the consequence of a spatial relocation of economic activities that otherwise would have remained located

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in other parts of the country. One must not underestimate the attraction exerted by successful symbols like fast growing airports on firms that are considering a new location (see RIETVELD and BRUINSMA, 1998). This latter possibility would imply that part of the observed growth in the region took place at the expense of other regions. This issue of the spatial distribution of economic impacts of airports is a promising subject for further research.

1. ROA stands for Regionaal Overlegorgaan Amsterdam and is a body that provides a discussion platform for municipalities in the Greater Amsterdam Area.
2. An extensive description of the model is found in FOUNDATION FOR ECONOMIC RESEARCH, 1992.
3. The aircraft manufacturer Fokker, located in the airport area, went bankrupt in 1996 and is excluded from the analysis.

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