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The Impact of the EU-US Open Skies Agreement on International Travel and Carbon Dioxide Emissions

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Abstract: We use a model of domestic and international tourist numbers and flows to estimate the impact of the EU-US Open Skies agreement that is to take effect in March 2008. The Open Aviation Area will result in increased competition between transatlantic carriers and consequently falls in the cost of flights, therefore we look at the change in visitor numbers from the US into the EU and corresponding CO_2 emissions. We find that passenger numbers arriving from the US to the EU will increase by approximately 1% and 14% depending on the magnitude of the price reductions. This increase in passenger numbers does not however result in a corresponding rise in emissions as arrivals into other countries from the US fall by a comparable amount. The number of tourist arrivals from the US to countries outside of the EU will fall and overall emissions would then increase by a maximum of 0.7%. If we assume that domestic holidays and foreign holidays are close substitutes these effects are strengthened and US passengers switch from domestic trips to foreign destinations as airfares converge.

Keywords: International tourism, open skies agreement, carbon dioxide emissions

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1. Introduction

Traditionally the airline industry has been characterised by the dominance of national carriers who have retained monopolies on routes from their country. Recent years have seen increasing numbers of bilateral agreements — so called 'Open Skies' or Open Aviation Area (OOA) agreements — allowing foreign carriers to operate on national routes. Achieving the liberalisation of these industries is no easy feat, as national carriers' rights to airport slots gives them a monopolistic advantage they have been unwilling to give up. On the 22nd March 2007 the European Commission announced that an OOA agreement had finally been reached between the US and the EU. Once it comes into effect, on the 30th March 2008, EU carriers will be allowed to fly to any airports in the US from any European cities and vice versa.[1] The signatory countries expect this will result in increased competition between airlines at major European and US hubs, which will result in falls in fares for passengers. This paper investigates the implication of the liberalisation of these routes for the travel patterns of EU and US passengers and carbon dioxide emissions.

The Open Skies agreement was greeted with much enthusiasm by politicians in Europe. Up to 26 million additional travellers between Europe and North America over the next five years were predicted as a result,[2] which is a remarkable number that requires further scrutiny. This is one aim of this paper. Another aim of the paper is to investigate how much of the increased travel between the USA and the EU is due to increased travel, and how much is due to displacement from other destinations. Thirdly, although climate change is high on the political agenda in the EU, the official assessment of the Open Skies agreement omitted its implications for carbon dioxide emissions. This paper fills that gap.

This paper builds on the model used in Tol (2007), FitzGerald and Tol (2007) and Mayor and Tol (2007) but instead of looking at the effect of carbon pricing on aviation, looks at the effect of price falls due to increased competition. This paper only considers *international* aviation *demand* by *tourists*. Domestic air travel is excluded, as is travel for business purposes. There is a global database of reasonable quality on international tourist travel – but there is nothing of the sort for domestic tourist travel or for business travel. As such, a choice has to be made between geographic comprehensiveness, and comprehensiveness in a travel sense. The current paper opts for the former, which of course does not make the latter less relevant. Note that business travellers are less likely to respond to price changes than tourists and that only shifts in demand induced by a fall in the price of air travel between the US and the EU are considered. It should also be noted that the present analysis does not look at the impact of an EU-US OOA on intra-EU flights but only on transatlantic journeys.

The following section reviews the previous literature on the effect of Open Skies agreements on the market. Section 3 presents the model. Section 4 discusses the results. Section 5 shows a sensitivity analysis and section 6 concludes.

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[1] The Irish Times 22/03/07 "Key parts of EU-US aviation pact".

[2] "Over the five years that the effect is discernable, the total increase in passenger numbers generated by an OOA is estimated at 26 million", Booz Allen Hamilton (2007:vii).

2. The Open Skies Agreement: background and previous studies

To date, access to the transatlantic market was restricted by bilateral Open Skies agreements between individual European countries and the US. The proposal accepted in March of this year aims to completely liberalise this market and replace individual agreements with a uniform procedure for the EU. As of March 2008, EU carriers will no longer be restricted to fly to the States exclusively from their own countries, they will be allowed to merge and create alliances with US carriers and own more than 50% of a US airline's total equity.[3]

The deal is set to take effect in March 2008, but some airlines have already announced the introduction of additional transatlantic routes. The EU Commission expects the agreement to have a number of beneficial consequences for transatlantic passengers. Increased consumer benefits and new jobs can be expected, but the main result will be increased competition between airlines, which will lead to lower fares for passengers. The possibility of mergers and deeper alliances will also present the prospect of cost savings within airlines, which can also translate into lower fares. See Pitfield (forthcoming) for a recent discussion of airline alliances and a lead into the literature on this matter.

Two previous studies commissioned by the European Commission have looked at the impact of a possible OOA between the EU and the US. Booz Allen Hamilton (2007) build on the analysis of the Brattle Group (2002) and look at the consequences of an OOA on passenger volumes, fares, consumer benefits, internal airline costs and productivity. The Brattle Group (2007) finds that the cost reductions resulting from an OOA would 'imply fare reductions of between two percent and six percent' (2007:3-7) and that this would result in an increase of between 1 million and 3.2 million passengers on transatlantic routes. The first figure is based on the estimated cost savings made by airlines through the elimination of inefficiencies and the restructuring of existing airlines towards what is described as the industry benchmark. The bulk of savings comes from increased efficiency on intra-EU flights. These cost savings are then fed through to passengers through fare reductions, and with assumed price elasticities of demand of 1 and 2.5, the corresponding impact of demand for flights is inferred. Four countries are considered in this analysis, Ireland, Greece, Spain, and the United Kingdom, i.e. EU countries without existing OOAs with the US at the time.

The Booz Allen Hamilton (2002) report follows the same methodology. The same four countries are examined with the addition of Hungary. It finds that the removal of restrictions between the EU and the US would generate an additional 26 million passengers in the five years after the agreement. The increase in passengers would be progressive over the five years as it is assumed it would take time to implement cost saving measures. These analyses use the same elasticities of demand and the same assumptions regarding cost savings, however neither look at the effect of fare reductions on the *destination choices* of travellers.

The most striking difference in the methodology of these reports and the one used in the present paper is in relation to the responsiveness of travellers to cost changes. Indeed, as detailed in the following section, the elasticity used in this analysis is linked to income per capita. The elasticities used in the Brattle and Booz Allen Hamilton reports are estimates of price elasticities of demand taken from Brueckner and Spiller (1994) and Brander and Zhang (1990), which range from 1.6 to 2.5.

[3] The Irish Times, various articles February-March 2007.

3. The model

Simulations are done with the Hamburg Tourism Model (HTM), version 1.3. Previous model versions focussed on climate change (Hamilton *et al.*, 2005a,b; Bigano *et al.*, 2005) while the current version is designed to analyse climate policy (Tol, 2007).

HTM predicts the number of domestic and international tourists from 207 countries and traces the international tourists to their destinations. Tourism demand is primarily driven by per capita income. Destination choice is driven by income, climate, length of coastline, and travel time and cost. A reduction in the cost of travel is expected to lead to increased travel to the destinations affected by the cost fall.[4] The model runs in time steps of 5 years, from 1980 to 2100. See Tol (2007) for details. Here, only results for 2010 are shown.

Data were primarily taken from WTO (2003) and EuroMonitor (2002). Behavioural relationships were estimated for 1995 (the most recent year with reasonably complete data coverage), and used to interpolate the missing observations. Observations on travel time and travel cost are very limited. Here, travel time and cost are assumed to be linear in the distance between airports, using data for Heathrow, Europe's busiest airport. The airfare elasticity of destination choice is $-1.50 + 0.14 \ln y$, where y is the average per capita income in the country of origin. For UK (US) travellers, this translates into an elasticity of –0.45 (-0.41), which compares well to the estimates of Crouch (1995), Witt and Witt (1995) and Wohlgemuth (1997) but is low compared to the elasticities found by Oum *et al.* (1990), Brons *et al.* (2001) and Gillen *et al.* (2004) and those used by the Brattle Group (2002, 2007) and Booz Allen Hamilton (2002).

We use these lower elasticities for four reasons. Firstly, our price elasticity falls with rising per capita income, and is therefore lower than in previous studies. Secondly, we include the duration of the flight as well as its cost; as the two are correlated, the price elasticity is obviously lower if duration is included. Thirdly, we consider trade-offs between *countries*. The higher estimates for the price elasticity of travel demand are found for alternative city destinations, which are closer substitutes than alternative country destinations, and for price competition on the same route. Fourthly, what matters to the tourist is the total cost of the holiday. As airfares have fallen, the share of travel in total holiday costs has decreased, and travellers have become less sensitive to the price of tickets (Njegovan, 2006).

The model was used to "predict" tourist numbers for 1980, 1985, and 1990, and shown to have a predictive power of over 70%. Carbon dioxide emissions equal 6.5 kg C per passenger for take-off and landing, and 0.02 kg per passenger-kilometre (Pearce and Pearce, 2000). It is assumed that no holidays of less than 500 km distance (one way) are taken by air, and that tourists travelling more than 5000 km, travel by air; in between the fraction increases linearly with distance. For tourists travelling from island nations like the UK, the respective distances are 0 and 500 km. Total modelled emissions in 2000 are 140 million metric tonnes of carbon, which is 2.1% of total emissions from fossil fuels. This is from tourism only. Total international aviation is responsible for some 3% of global emissions.[5] There are no published numbers on the share of tourism in total international travel.

[4] The Agreement will predominantly affect the cost of transatlantic flights. We recognise however that other aspects of travel, such as the quality of air travel, may also be affected.
[5] See http://themes.eea.europa.eu/Environmental_issues/climate/indicators.

4. Scenarios and Results

Scenarios

The model is calibrated for 1995. Observed data for population and economic growth from 1995 to 2004 is used. Between 2005 and 2020, growth rates gradually converge to the SRES A1 scenario (Nakicenovic and Swart, 2001). The price of oil is kept constant at the price in September 2006. Results are presented for 2010 only, and in deviations from the baseline, so that the baseline details are largely irrelevant.

We analyse the effect of hypothetical price falls as changes from the current situation. The scenarios used were price falls of 5%, 20% and 50%. The results for other price changes can be deduced from the results presented here. The effect of these airfare price reductions on arrivals from the US is examined for three different destination scenarios. The first (henceforth referred to as EU5) comprises the five countries that did not have pre-existing Open Skies agreements with the US, i.e. the UK, Ireland, Greece, Spain and Hungary. Hence, it would be expected that routes to these countries would face a higher level of liberalisation and consequently a bigger change than those to countries with pre-existing treaties. We also look at the consequences for travel to the EU27 and the EU27 plus the EEA (Switzerland, Norway and Iceland). The change in emissions of carbon dioxide from the increase in travel is also examined.

Results

The Open Skies agreement, through increased competition and fare reductions, will have the expected result of increasing air travel between the US and the EU. All three scenarios show that the number of passengers arriving in European countries from the US will increase as flights to these destinations become cheaper. The impacts of 20% price reductions on arrivals are seen in Figure 1. A 20% fall in the price of flights to EU5 countries will result in a 7.3% increase in arrivals into these countries but a 1.3% fall in arrivals into the remainder of the EU and the three EEA countries. EU5 countries become more attractive to US travellers and they substitute away from other destinations, including European ones. If the price fall is applied to flights to EU27 countries, we observe a 4.8% increase in arrivals into EU5 and 4.5% into the rest of the EU. The three EEA countries experience a 3.7% reduction in arrivals. This implies that there is a certain level of substitution between countries in the rest of the EU (i.e. EU27 – EU5) and EEA countries. Given cheaper flights to the EU27, US travellers will travel less to Switzerland, Norway and Iceland. If the price of flights to the EU and EEA region fall by 20%, arrivals increase by 4.5% in the EU5, the rest of the EU, and the EEA.

Figure 2 shows the effect of a 5% fall, a 20% fall and a 50% fall in the cost of flights to EU27 countries on arrivals. The increase in arrivals into EU5 countries is slightly higher than for arrivals into the rest of the EU – as is also seen in Figure 1, where the same effect is observed for the EEA. The reason is that the number of US travellers is fixed (see below for a sensitivity analysis). The number of inbound tourists is determined by the attractiveness index of a country divided by the sum of the indices for all countries. If the attractiveness of one small country increases (say due to cheaper flights), the increase in tourist numbers is almost equal to the change in attractiveness. However, if all countries' attractiveness indices change by the same amount, travel patterns do not change. Therefore, the relative effect of price changes is smaller if it affects a group of countries with a greater initial market share. Figures 1 and 2 confirm this, and show that this effect is small.

The corresponding changes in emissions are presented in Figure 3. The effect is not large: global emissions only increase by 0.7% under a 50% decrease in the cost of air travel to EU27 countries. The reason for this small increase in emissions relative to the increase in arrivals is seen in Figure 4, and also Figures 1 and 2. Figure 4 shows the change in the number of arrivals from the US into the EU27 and the rest of the world under the hypothetical price reductions for flights to EU27 countries. It is clear from the graph that the increase in the number of arrivals from the US into the EU27 is offset by a corresponding fall in arrivals from the US into the rest of the world and consequently the impact on emissions is small. The same holds for outbound travellers from the EU. There would be more travel to the USA, but less to other destinations.

Hence, the fall in airfares on trans-Atlantic flights will cause US (EU) passengers to substitute some of their foreign trips to EU (US) destinations. Faced with lower costs of flights, US (EU) travellers will fly more to EU (US) destinations but less to the rest of the world. However, even with a 50% fall in the price of transatlantic tickets to EU27 countries, US travellers will only increase their trips to these countries by 14%. Europe (USA) as a holiday destination for US (EU) tourists is still considered a long distance location and requires significant time and on-site cost investments. A fall in the cost of tickets will make Europe (the USA) more attractive to US (EU) tourists but it will not deeply affect their long distance travel *patterns*. If US (EU) tourists were going to take one long distance trip a year, they will probably continue doing so. The effect of price reduction on arrivals would probably be more important if we were examining an Open Skies agreement between neighbouring countries.

5. Sensitivity Analysis

The assumed price elasticity is evidently important. It is also very uncertain. The surveys of Oum *et al.* (1980) and Gillen *et al.* (2004) reveal a wide range of estimates. The price elasticity used here is a result of calibration rather than estimation. The model was recalibrated so that the price elasticity equals twice and four times the time elasticity. The price elasticity then falls from -0.41 (base case) to -0.54 (twice) and -0.64 (four times) for the USA.[6] The impact on US arrivals into the EU5 and EU27 is shown in Figure 5. A greater sensitivity to price strengthens the effect of a price reduction, and arrivals increase accordingly. With a 20% price reduction on flights to EU5 countries, the number of arrivals from the USA into the EU5 will increase by 10% with a high elasticity and just over 12% with a very high elasticity. A similar effect is observed when considering a 20% price fall on flights to EU27 countries and arrivals in these countries.

In the analysis above, it was assumed that a change in transatlantic fares resulted in a substitution between foreign holiday destinations, but not between domestic and international holidays. To test the sensitivity of this, we assume that the (base case) price elasticity of substitution between foreign destinations also governs the substitution between domestic and international holidays. Figure 5 shows the results. There is a significant switch from domestic flights to international flights. This effect is stronger for EU27 countries than for EU5 countries (compared to their respective base cases). US travellers will have a tendency to take more trips abroad. When this effect involves the price of flights to EU27 countries, and consequently includes a number of less obvious or less popular holiday destinations than the UK, Spain or France, then there is a greater increase in the number of US arrivals. This can be explained by the way holiday destination choice is modelled. First, travellers decide how

[6] Note that the studies surveyed in Oum *et al.* (1980) typically do not include travel time. This implies an upward bias in the price elasticity. Note also that tourists are likely to judge a holiday based on its total cost, another reason why the price elasticity of a single holiday component is limited.

many holidays they will take. Second, they decide how many of these trips are domestic, and how many are foreign. Third, they decide on the destination. In the second step, the price of the average domestic holiday is compared to the price of the average foreign holiday. If the price falls for more countries, the average price of foreign holidays falls further, and more people would substitute away from domestic holidays.

This effect is also shown in Figure 4. The number of arrivals into the EU27 countries is higher under the domestic/international substitution case than in the base case without such a substitution. In parallel, the number of arrivals into the rest of the world falls in the base case, but is relatively unchanged in the domestic/international substitution case. Indeed, when the cost of flights to the EU27 falls by a small amount, tourists, substitute away from domestic holidays and increase their trips to all destinations abroad. Once the price reductions get very high, tourists will then substitute away from all types of trips and move towards EU27 trips. Hence, in the base case, the price fall on flights to EU27 countries leads to an increase in arrivals into these countries corresponding to the fall in holidays to the rest of the world. When substitution between domestic and international holidays is taken into account, the price fall will lead to an increase in arrivals into EU27 countries that will correspond mostly to a fall in domestic holidays coupled with a small increase in arrivals into the rest of the world (if the price fall is small), or a small reductions in arrivals into the rest of the world (if the price fall is large).

This substitution influences travel patterns but also carbon dioxide emissions. Figure 3 shows that when the substitution between domestic and international destinations is taken into account, emissions will increase by a lot more than in the base case. For instance, when prices on flights to EU27 countries fall by 50%, global emissions increase by 2.8% compared to 0.7% in the base case. As tourists substitute away from (short-haul) domestic flights towards (long-haul) international flights, emissions increase.

6. Discussion and Conclusion

We use a model of international flows of tourists to determine the effects of the US-EU Open Skies agreement on travel patterns. We find that the introduction of competition into the market and the resulting lower fares for passengers have the expected result — there will be an increase in the number of passengers flying on routes affected by price reductions. However, we find that these effects are smaller than previous studies suggest. When the agreement was signed, it was largely publicized that the OOA would increase the number of passengers on transatlantic routes by significant proportions. We find that the average increase in the number of transatlantic passengers ranges between 1% and 14% depending on the price reductions. There are a number of reasons for this lower increase.

First, because the affected destinations are long-distance destinations rather than neighbouring countries, a reduction in the price of tickets will not lead to an upsurge in transatlantic travel. US and EU tourists may be more likely to travel to the opposite continent but they will not necessarily travel there several times a year. Previous estimates assume price elasticities that are more appropriate for close substitutes (e.g., different airlines on the same route) than for long-haul flights. Furthermore, the price of tickets is not the only consideration when making a transatlantic trip as tourists also take into account onsite costs such as accommodation, food and sightseeing. As an OOA has no effect on these variables, it is unlikely that halving the cost of air travel will double the number of travellers. So the OOA will increase the number of trips made between the US and the EU, but increases will be of a smaller magnitude.

Emissions will also increase under the OOA although not as much as travel increases. This is because the increase in travel between the EU and the USA will be counterbalanced by a reduction in travel to other destinations.
Furthermore, if the prices of flights to only a subset of countries are affected, then other EU members will see a drop in arrivals. If US travellers are making a transatlantic trip, they will be more likely to choose a country in Europe with cheaper flights than one with expensive travel costs. Consequently, the countries affected by price reductions become more attractive. This has implications for the three EEA countries who were not part of the agreement but have existing bilateral agreements with the States. It may be in their interest to reconsider their bilateral agreements in order to remain attractive destinations.

There are several caveats to the results. Examining the effect of the OOA on intra-EU flights and on mergers would complete this analysis. The current model is focussed on leisure travel, but business travel is affected by the Open Skies agreement too. The USA is treated as a single destination. All this is deferred to future research. We also eagerly await the data that will show whether the predictions of our simulation model are roughly correct.

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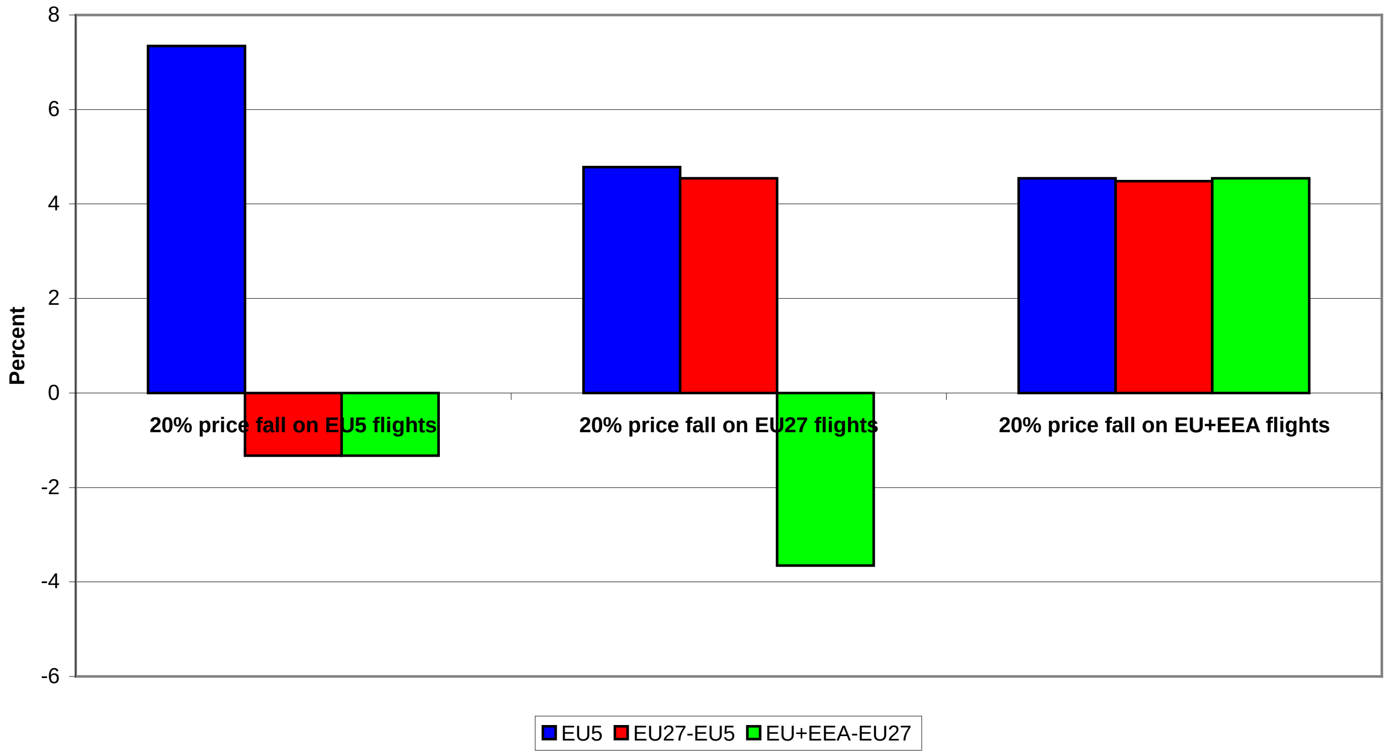

Figure 1 Effect of a 20% fall in the cost of flights to EU5 countries, EU27 countries and EU+EEA countries on arrivals into the EU5, EU27-EU5 and EU+EEA-EU27 zones from the US.

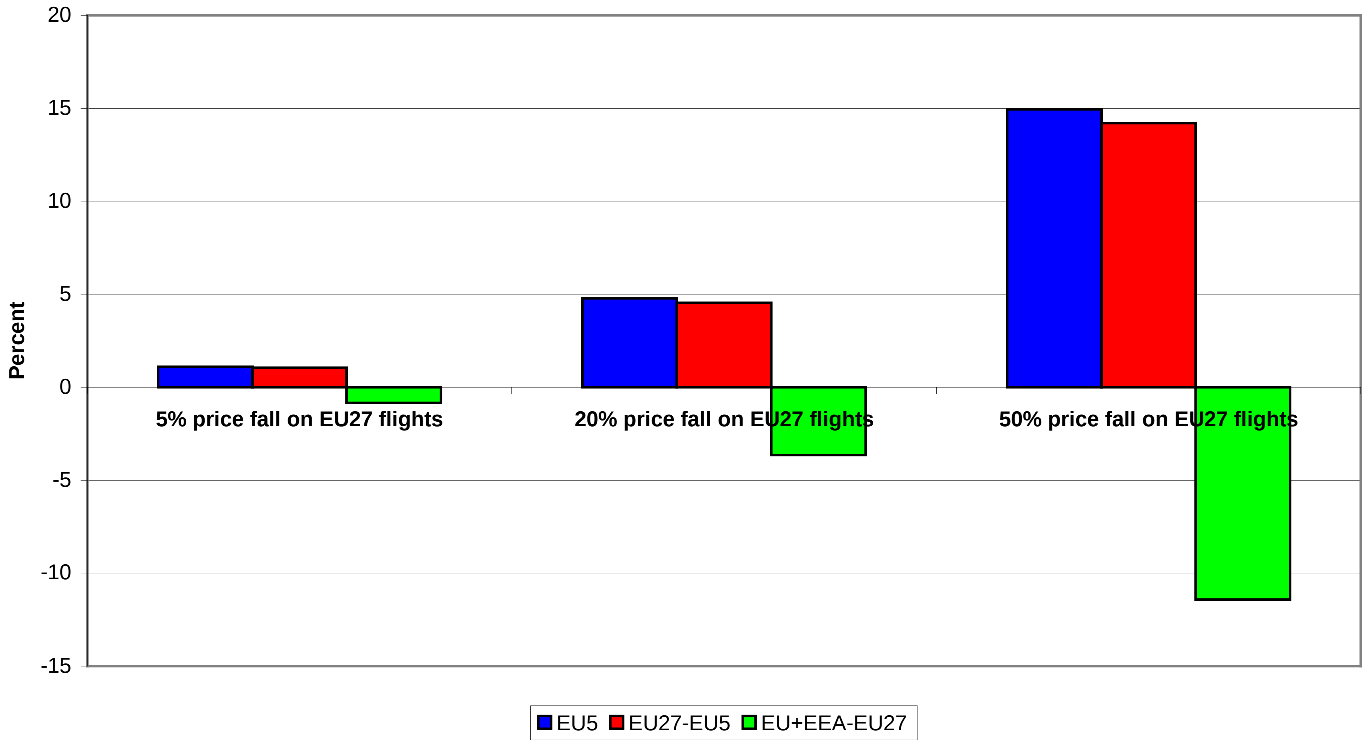

Figure 2 Effect of 5%, 20% and 50% falls in the cost of flights to the EU27 countries on arrivals in the EU5, EU27-EU5 and EU+EEA-EU27 zones from the US.

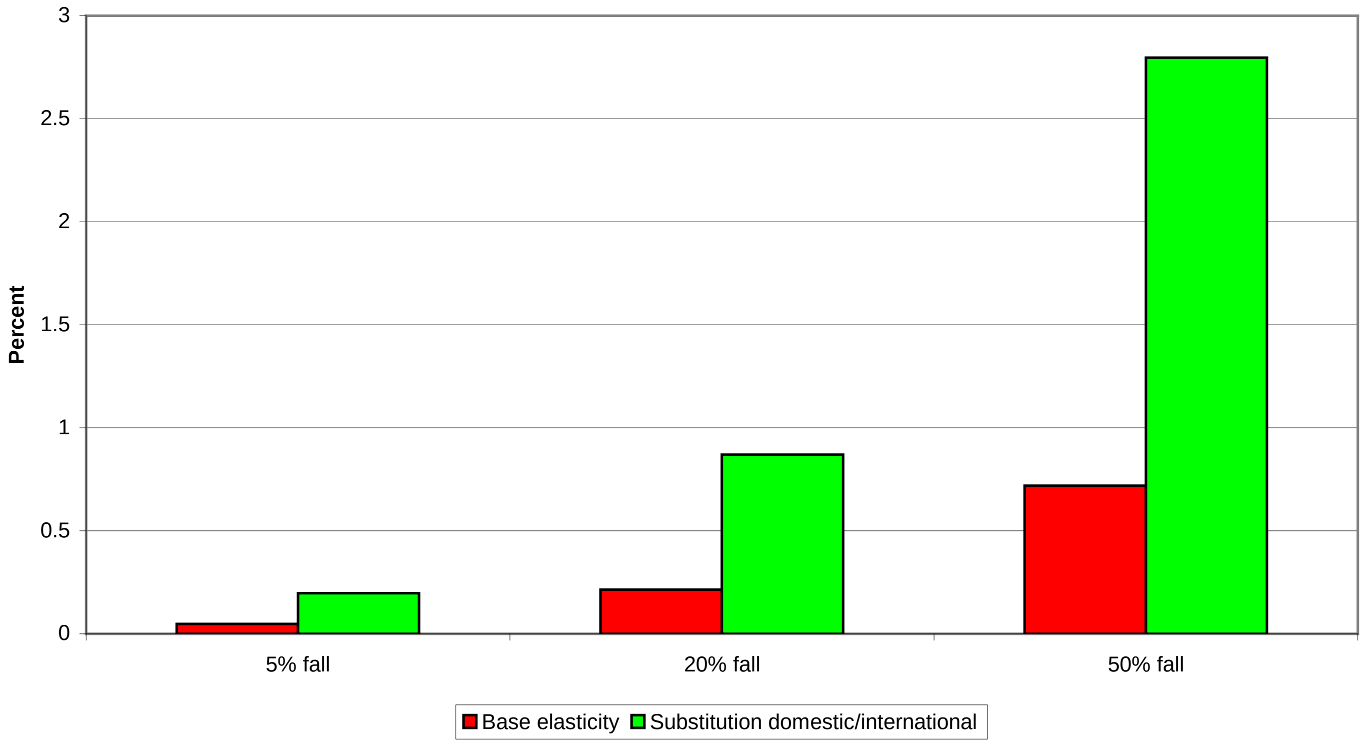

Figure 3 Percentage increase in world CO_2 emissions under different price reduction scenarios for EU27 flights, for the base elasticity scenario and the scenario with substitution between domestic and international travel.

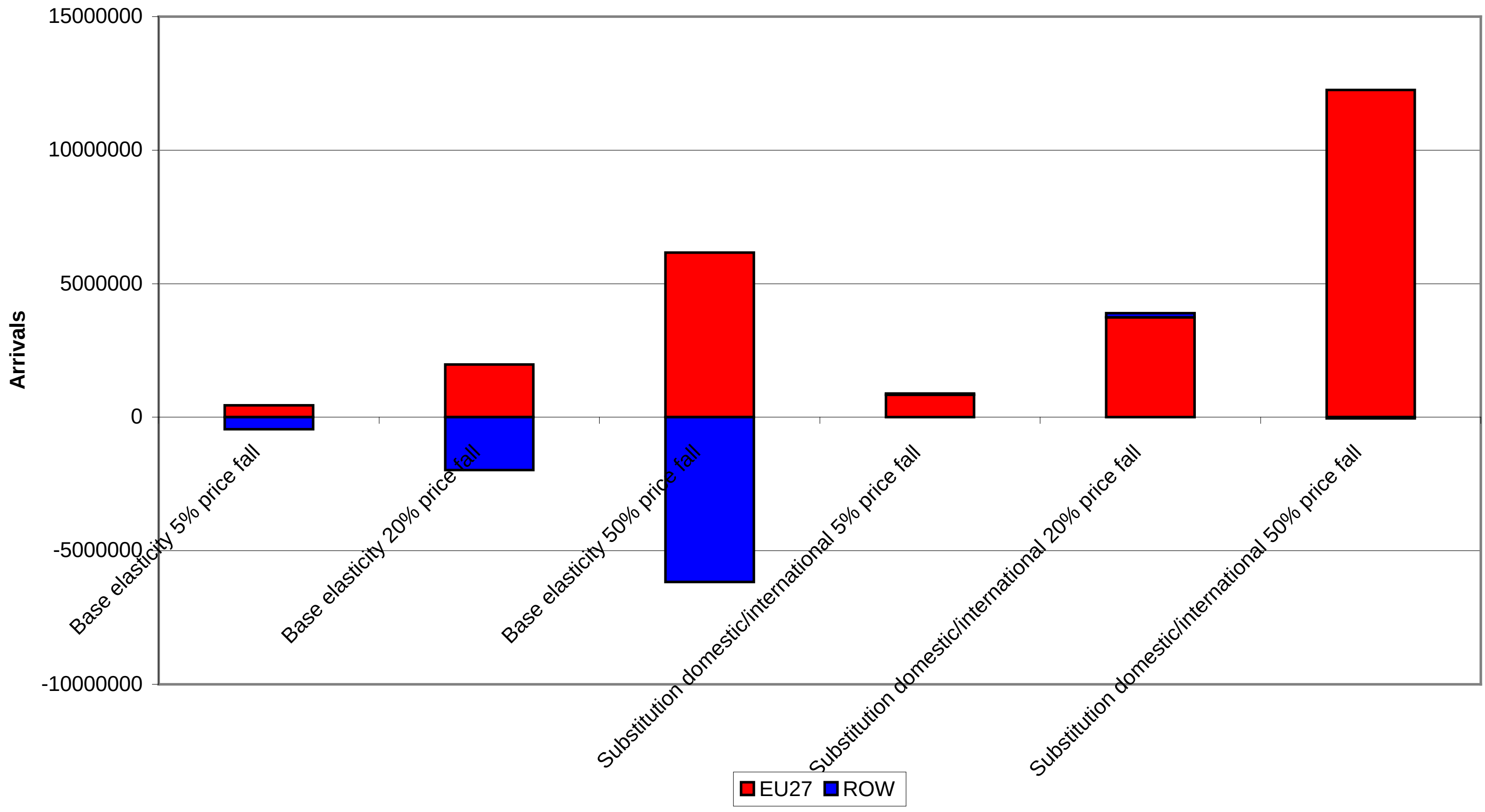

Figure 4 Change in arrivals from the US into the EU27 and the rest of the world under different price reductions for EU27 flights, for the base elasticity scenario and the scenario with substitution between domestic and international travel.

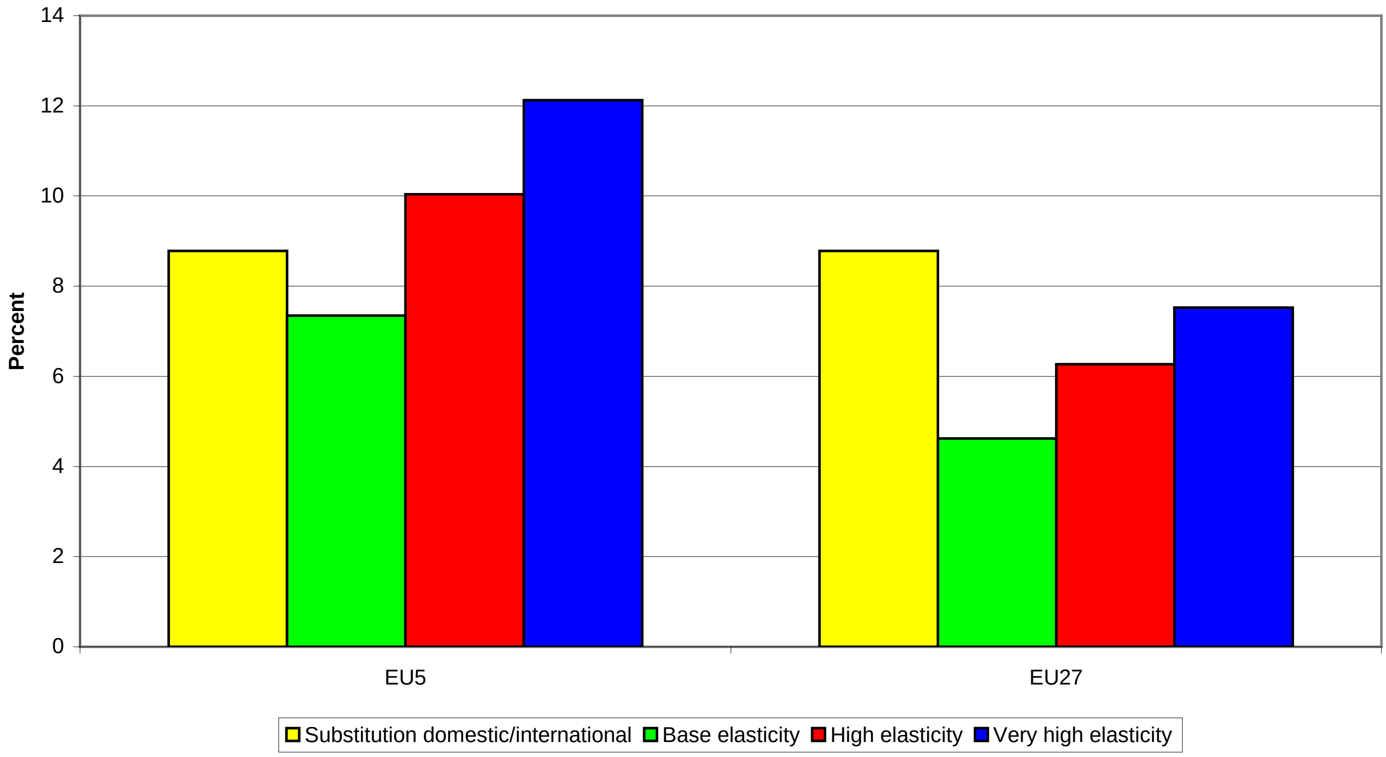

Figure 5 Effect of a 20% fall in the price of flights to the EU5 on arrivals into EU5 countries and of a 20% fall in the price of flights to the EU27 on arrivals into EU27 countries, using different elasticity and domestic/international substitution conditions.

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