

**The impact of peak oil on tourism in Spain:**  
**An input-output analysis of price, demand and economy-wide effects**

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## **Abstract**

This article examines the potential effects of peak oil on Spanish tourism and indirectly on the rest of the economy. We construct several scenarios of price increases in oil, related fossil fuels and their inflationary effects. These scenarios provide the context for an input-output (I/O) analysis which uses I/O tables extended with Tourism Satellite Accounts. The analysis comprises three steps: (1) applying an I/O price model to estimate the price change of tourism services in Spain due to an increase in the prices of oil and other fossil fuels; (2) assessing the effects of price changes on demand for tourism services; and (3) estimating the impacts of demand change on the country's economy using an I/O demand model. The results show that a decreased demand for tourism services results in the greatest fall in outputs in the tourism-related shares of air transport, water transport, restaurants, hotels, and railway transport sectors.

**Keywords:** energy, input-output model, oil price, scenarios, Spain, tourism demand

## **1. Introduction**

Peak oil represents a point at which the production of conventional oil reaches a maximum yearly level, after which it terminally declines (Grant, 2007). There is an increasing concern about the imminence of peak oil at a global scale and its effects on the world economy (Campbell and Laherrère, 1998; Deffeyes, 2001; Bentley, 2002; Aleklett and Campbell, 2003; Hirsch et al., 2005; Greene et al., 2006; Leder and Shapiro, 2008; Hall and Day, 2009; Friedrichs, 2010). Peaking of world oil production does not mean that we are running out of oil. In fact, there is theoretical and empirical evidence that a region's or country's maximum oil production is usually reached when around half of the recoverable resource has been produced (Bentley, 2002; Hirsch et al., 2005; Höök et al., 2009). Peak oil does imply, however, that supply will start declining and will not be able to meet a rising or even constant demand. This may have serious economic consequences as most modern industrial transport, agricultural, and industrial systems are highly dependent on relatively low-cost oil. Hirsch et al. (2005) predict that as peaking is approached, liquid fuel prices and price volatility will increase dramatically. They conclude that without timely mitigation, the economic, social, and political costs will be unprecedented.

Forecasts which are optimistic about the timing of the global peak oil production indicate that it will occur after 2020 (Adelman and Lynch, 1997; Odell, 1999; Davis, 2003; Greene et al., 2006; EIA, 2010; IEA, 2010), while more "pessimistic" ones claim that it has already occurred or will occur before 2020 (Campbell and Laherrère, 1998; Deffeyes, 2001; Bentley, 2002; Aleklett and Campbell, 2003; Campbell, 2003; Bakhtiari, 2004; Hall and Day, 2009; Jakobsson et al., 2009; Maggio and Cacciola, 2009; Aleklett et al., 2010; Nashawi et al., 2010). If the latter is true, there is insufficient time to develop large-scale, commercially competitive alternative energy sources that could replace oil. High oil prices may lead to a substitution effect, i.e. stimulate demand for other energy sources, such as coal

or liquefied natural gas. This substitution can, however, be only temporary since coal and natural gas are finite resources as well.

Only few studies have tried to assess the impact of oil scarcity on tourism (Becken, 2008; Yeoman et al., 2007). They suggest that tourism is due to its inherent transport component highly dependent on the availability of oil. Oil depletion and the lack of alternatives, in particular for aviation and road transport, are likely to increase the prices of travel, resulting in a lower demand for tourism. However, there is little evidence that the tourism sector is concerned about peak oil and its implications. For example, tourism growth predictions and tourism planning usually do not take into account oil depletion and a possible long-term oil price increase.

In 2010 Spain was the fourth tourism destination in the world according to the number of international tourist arrivals, which amounted to 52.7 million, and the second one according to international tourism receipts (UNWTO, 2011). In 2007 tourism contributed €113.21 billion to the country's economy, which represented 10.8% of the GDP and created 7.3% of total employment (INE, 2009a).<sup>1</sup> Therefore, the Spanish economy relies heavily on tourism, which makes it vulnerable to various external factors that can cause a decline in international tourism demand (e.g., political instability at a destination, economic recession in countries of origin, or oil depletion).

This article develops various scenarios of a rise in the oil price and associated price changes in other fossil fuels (gas and coal) and primary inputs. Scenarios are motivated by empirical studies found in the literature. Our analysis estimates the effect of price increases of energy carriers and primary inputs on the prices of Spanish tourism supply. To achieve this, an input-output (I/O) price model combined with Tourism Satellite Accounts (TSA) is applied. Based on the price elasticity of demand for Spanish tourism, a change in tourism demand due to the assessed price increase is estimated. Next, implications for the overall Spanish economy are evaluated using an I/O demand-driven model.

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<sup>1</sup> The most recent data on tourism accounts for Spain are available for the year 2007.

The remainder of this article is organized as follows. Section 2 analyses the potential effects of a rise in the price of oil on the prices of tourism products and services in Spain and develops a set of scenarios. It consists of four subsections. Subsection 2.1 explains the I/O price model and I/O data for Spain. Subsection 2.2 describes six scenarios of price increase for different fossil fuels. Subsection 2.3 introduces two scenarios of price increase of primary inputs. Subsection 2.4 presents results of the I/O price model analysis, which show price increases of tourism and other economic sectors in Spain. Section 3 studies the effects of the resulting price changes on tourism demand. Section 4 examines the effects of a change in tourism demand on the Spanish economy. Section 5 concludes.

## **2. Effects of the oil price increase on the prices of tourism services in Spain**

### *2.1. The input-output price model for Spain*

Research on tourism issues by using the input-output analysis is rather scarce. An example is a special issue of Economic Systems Research (Los and Steenge, 2010). However, none of this work examines the interactions between tourism activities and energy issues. The method used here for analyzing the effect of higher oil prices on the prices of tourism products and services in Spain is the I/O price model. In this model quantities are fixed and prices change, which enables assessing the effects of a change in the value added costs (i.e. a price change of any primary input) or a change in import prices in one or more sectors on sectoral unit costs and output prices via the fixed production coefficients (Bulmer-Thomas, 1982; Miller and Blair, 2009). Like in the traditional Leontief model, the fixed nature of the technical or I/O coefficients is the main limitation of this model. These coefficients describe the quantity of intermediate input required to produce one unit of output. The fixed coefficient assumption implies constant returns to scale and constant proportions of inputs. The latter reflects complementarity between inputs; that is, output cannot be increased by substituting one input for another (Hoekstra,

2005). In addition, in the price model the final demand has no role in the price formation. So far no published study of peak oil impacts on the economy has used an I/O price model.<sup>2</sup>

The I/O price model used in this study can be expressed as:

$$\Delta P = [(I - A_D)]^{-1} [A_m' \Delta P_m + A_v' \Delta P_v] \quad (1)$$

where  $A_D$  is the matrix of domestic coefficients,  $A_m$  the matrix of import requirements per unit of output,  $A_v$  the matrix of primary input requirements (consisting of labour costs, net taxes, and gross operating surplus) per unit of output,  $\Delta P_m$  and  $\Delta P_v$  are vectors of assumed changes in imports and primary input prices, and  $\Delta P$  is the resulting vector of changes in domestic output prices. In this model,  $\Delta P_m$  and  $\Delta P_v$  are considered exogenous variables, which means that one can determine their changes and then quantify their effects on domestic output prices. We simultaneously assume (a) an increase in the prices of imports from energy sectors and (b) an increase in the prices of primary inputs due to inflationary effects of a rise in oil prices. Section 2.2 deals with the part (a) by constructing six distinct scenarios, while Section 2.3 addresses part (b) by formulating two additional scenarios.

Data used for the analysis include the Spanish I/O industry-by-industry tables in basic prices for 2005, which embrace 73 industries. All parts of this study used separate I/O tables for domestic production and for imports, which are provided by INE (2009b). The energy sectors are classified as follows: (1) mining of coal and lignite, extraction of peat; (2) extraction of crude petroleum and natural gas, mining of uranium and thorium ores; (3) manufacture of coke, refined petroleum products, and nuclear fuel; (4) production and distribution of electricity; (5) manufacture of gas, distribution of gaseous fuels through pipes, steam and hot water supply. In order to observe the effect of an oil price

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<sup>2</sup> It was suggested though by Kerschner and Hubacek (2007) in a presentation at the International I/O association conference. They showed a slide with some preliminary results of an I/O price model study. Furthermore, Kerschner and Hubacek (2009) used I/O analysis to assess the economic effects of peak oil, applying a supply-constrained model. This allows for “exogenising” sectors that suffer a supply shortage and estimating the impact of reduced outputs of the supply-constrained sector(s) on unconstrained sectors. Their findings show that the most affected sectors in the countries analyzed (UK, Japan and Chile) are transportation, electricity production, financial services, and foreign trade.

change, we disaggregated the extraction of petroleum from that of natural gas. For this purpose, we employed use and supply tables for Spain for 2005 and assumed an industry-based technology. This implies that an industry has a uniform input structure, regardless of its output product mix (i.e. that any secondary or by-product of an industry is technically related to its main production), as opposed to a commodity-based technology assumption according to which a commodity has a uniform input structure in any industry in which it is produced (Miller and Blair, 1985).

In the I/O tables for Spain tourism is not classified as a separate industry, but rather embraces several industries which include both tourism and non-tourism activities. We used Spanish TSA for 2005 to determine the ratios of products and services corresponding to tourism activities within each economic sector. Tourism in this case comprises activities related to both domestic and foreign tourists. In 2007 foreign tourists contributed 43.5% to tourism revenues in Spain. Table 1 presents total outputs of each tourism-related sector and ratios of tourism activities in these sectors.

[INSERT TABLE 1 AROUND HERE]

## *2.2. Scenarios of price increases in energy carriers*

From 1869 until 2009, the average world crude oil price adjusted for inflation was US\$23.42 per barrel (WTRG Economics Inc., 2011). Several oil shocks throughout history showed dramatic effects of oil and gas shortages on their prices. Between 1987 and 2001 the oil price oscillated around US\$15-20 per barrel, except for a spike in 1990 due to the Gulf War (see Figure 1). A combination of a weak dollar, rapidly growing demand, and possibly also speculation<sup>3</sup> stimulated a rise in crude oil prices causing a record level of US\$144 on 3<sup>rd</sup> July 2008 (daily European Brent spot price). The subsequent global

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<sup>3</sup> Buyuksahin and Harris (2011) show that the high oil prices of 2008 were not due to speculation, but that speculation followed high prices. Even though it is difficult to provide a definite proof for this, their finding supports the idea that oil prices are ultimately determined by real scarcity.

recession tumbled the oil price to US\$34 by December 2010. After economic recovery in certain parts of the world and continued boosting demand from developing countries such as China and India, the price of crude oil rose again sharply to US\$120 in April 2011. It is expected that demand in developing countries will keep increasing in this decade as populations grow and incomes rise (Kerr, 2011).

[INSERT FIGURE 1 AROUND HERE]

This study considers three different scenarios of a rise in oil prices in the long run. Scenario 1 uses projections of the IEA (2010) and EIA (2010), which are rather similar. They assume that the oil price would increase by approximately 25% by the year 2035 compared to the 2008 levels (i.e. from US\$95 to around US\$119 per barrel). Since the Spanish I/O data used here are for 2005, they implicitly assume 2005 oil prices. In line with this, we choose as the baseline oil price level its average price in Europe in 2005, which was equal to US\$54.57. Hence, scenario 1 assumes that the price of oil imports increases by 110% compared to the 2005 levels (i.e. to US\$115). As IEA (2010) and EIA (2010) price projections are based on the future oil production trends which are strongly criticized for being overly optimistic by some authors (Bentley, 2002; Hirsch et al., 2005; Jakobsson et al., 2009), they can be considered as rather conservative estimations. This argument is also supported by the current oil prices. A number of studies predict the peak in oil production sooner and expect a substantial rise in oil prices as a consequence. To reflect this, in scenarios 2 and 3 we assume considerably higher oil price, namely US\$150 and US\$200 per barrel (i.e. an increase of 175% and 267%), respectively. In this way, scenario 2 observes the effects of a permanent oil price increase in the range of the one which took place in the summer 2008, while scenario 3 is aimed at investigating the consequences of a more extreme though not unrealistic rise in oil prices, which corresponds to the Energy Information Agency high oil price scenario.

Further, several assumptions about the effects of higher oil price on the prices of other energy sources have to be made. According to economic theory, the prices of natural gas and crude oil should be related as they are substitutes in intermediate production and are often complements (co-products) in extraction. Historical market behaviour indeed suggests that the price of natural gas is closely following the price of oil. In addition, empirical evidence has shown that crude oil and natural gas prices have a long-run co-integrating relationship (Yücel and Guo, 1994; Villar and Joutz, 2006; Panagiotidis and Rutledge, 2007). These studies indicate that a permanent 1% increase in the oil price leads to a rise in the price of natural gas between 0.38% and 0.89%, with the majority of studies reporting natural gas price increase of 0.80% or higher. Moreover, Yücel and Guo (1994) and Chaudhuri (2001) found that if a price of oil increases by 1%, the price of coal increments between 0.34% and 0.63%. Only Bachmeier and Griffin (2006) report that crude oil, coal, and natural gas markets are very weakly integrated.

Based on these studies, we consider two different scenarios of correlation between natural gas and crude oil prices. In the first scenario (scenario A), the natural gas price increase equals 50% of the crude oil price increase, while in the second scenario (scenario B) the natural gas price follows the crude oil price increase completely (100%). As for the relationship between oil and coal prices, we assume that a 1% increase in both oil prices would lead to a 0.5% increase in coal prices. Nevertheless, a more extreme increase in oil and gas prices in the long term (scenarios 2B and 3B) is likely to cause a shift towards a higher demand for coal, leading to a more than proportional increase in the price of coal in relation to oil and gas prices. For this reason, in these two scenarios we assume that a 1% increase in oil prices would induce a 0.75% increase in coal prices.

Next, a change in the price of electricity production and distribution sector because of an increase in the oil price is determined based on the proportions of different energy sources used in electricity production in Spain (Table 2). Finally, with the increase in oil, gas, coal, and electricity prices one

could expect that the nuclear and renewable energy prices would also rise as their equipment needs fossil fuels. However, we assume that their prices do not change. In this sense, our estimates can be considered as conservative.

[INSERT TABLE 2 AROUND HERE]

### *2.3. Scenarios of price increases in primary inputs*

Oil price increase normally leads to inflation, so it is necessary to make assumptions about its effects on the price increase of primary inputs, i.e. the value-added expenditures. These include labour costs (such as wages, salaries and social contributions), taxes less subsidies, and gross operating surplus of economic sectors. Álvarez et al. (2011) show that a 10% rise in the price of oil would lead to an inflation of 0.24% or 0.38% in Spain within 2 years, depending on the model used for the analysis. Llop and Pié (2008) analyze the effect of a 10% tax on intermediate energy use on the economy of Catalonia (a Spanish Autonomous Community), which is expected to have similar effects as a 10% increase in the price of energy imports. They conclude that such a tax would increase consumption prices by 0.51% (0.75%) under a competitive (mark-up) price formulation option. Furthermore, LeBlanc and Chinn (2004) assessed the effect of an oil price increase on inflation in G-5 countries (UK, France, Germany, Japan, and USA). In their most general model specifications, the inflationary effect of a 10% oil price increase varies between 0.1% for France, which mainly relies on nuclear energy, and 2.5% for the UK. Berument and Taşçi (2002) conducted a similar study for Turkey and found that a 20% increase in crude oil price leads to a general price level increase of 2.01% when wages are adjusted while other income factors are fixed. Based on the findings of these studies, we implement two scenarios of price increases of primary inputs due to energy price increases, according

to which a 100% increase in oil price causes a 5% and 10% increase in the price of primary inputs, respectively.

#### *2.4. Results of the input-output price model analysis*

A complete overview of the price increases of outputs in each sector of the Spanish economy resulting from price increases in imports of energy carriers and primary inputs is presented in Table 3. Assumptions about the natural gas and coal price increase with respect to the oil price increase do not play an important role, which means that scenarios A and B yield very similar results. For that reason, we report only scenarios A, which represent more conservative estimates.<sup>4</sup> The highest price increase occurs in energy sectors (rows 9 to 11 in Table 3), as expected. These are followed by transport sectors, in particular air, water, and other land transport (including transport via pipelines) as they are very oil-intensive. On the other hand, railway transport and support and auxiliary transport activities are less oil-intensive and thus experience more moderate price increases. The third most affected group of sectors embraces manufacturing (e.g., of chemicals, cement, glass, ceramics). The price increase of primary inputs has expectedly the largest impact in the sectors with a high value added. For example, among tourism activities transport sectors are driven more by the energy price increase, while labour-intensive sectors, such as hotels and restaurants are driven more by increases in primary input prices. The results for tourism sectors show that the highest price increases in outputs occur in air transport (23.2% to 63.9%),<sup>5</sup> water transport (18.5% to 52.8%), other land transport and transport via pipelines (14.5% to 46.2%), support and auxiliary transport activities (8.9% to 32.5%), and railway transport (8.6% to 32.4%). Apart from transport sectors, the most substantial price increases occur in restaurants (8.6% to 27.8%), non-market recreational, cultural and sporting activities (6.7% to 28.2%), travel agency

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<sup>4</sup> The results of the six B scenarios are available from the authors upon request.

<sup>5</sup> The ranges represent results for the least and the most extreme scenarios of price increases in oil (US\$115 and US\$200) and primary inputs (5% and 10%), respectively.

activities (6.6% to 25.1%), hotels (6.1% to 27.1%), and market recreational, cultural and sporting activities (5.4% to 24.6%).

[INSERT TABLE 3 AROUND HERE]

### **3. Response of demand for Spanish tourism to a change in tourism prices**

In this section a change in the international tourism demand for Spain due to a price increase of tourism products and services is estimated through its price elasticity. In the literature which deals with the price elasticity of international tourism demand, tourism prices have most frequently been represented by the Consumer Price Index (CPI). This has been widely accepted since the mix of goods and services consumed by tourists is not too different from the mix constituting the CPI (Crouch, 1992). However, it is less clear whether absolute prices (prices in one country) or relative prices (ratio of prices in different countries) should be used and if relative prices are used whether they should be related to the prices in origin country or to the prices in competitor countries. Different studies apply distinct definitions of tourism price causing the specification of the price variable in the models to vary (Crouch, 1992). It should also be noted that tourism demand can vary considerably over time due to changes in economic conditions or preferences. Its price elasticity is hence not constant. For this reason, a distinction is generally made between short- and long-term elasticities of tourism demand.

Most studies examine tourism demand focusing on a single origin and single destination country (Crouch, 1992). This also holds for the literature dealing with the demand for Spanish tourism. Garín Muñoz (2007) estimated that the short (long)-term price elasticity of German demand for tourism in Spain for the period 1991-2003 equals  $-1.06$  ( $-2.16$ ). Song et al. (2000) investigated UK tourism demand for 12 countries including Spain between 1965 and 1994. The price elasticity for Spain turned out to be relatively inelastic both in the short and long term, taking values  $-0.491$  and  $-0.496$ , respectively. De Mello et al. (2002) observed UK demand for tourism in France, Spain and Portugal. The results showed that the tourism demand elasticity to price changes in Spain was  $-1.82$  in the period 1969-1979 and  $-1.93$  in the period 1980-1997.

Studies that embrace total inbound tourism of a destination country are fewer, but they provide a more complete estimate of the overall demand. One of them is that of Garín-Muñoz and Pérez Amaral (2000), which assessed the price elasticity of Spanish tourism based on 17 countries of origin. These countries represented 92.5% of the Spanish tourist source market measured in the share of nights spent in Spanish hotels in 1994. The authors calculated that the price elasticity of demand for tourism in Spain is  $-0.30$  in the period 1985-1995. Moreover, González and Moral (1995) estimated the effects of a change in tourism prices in Spain relative to prices in seven countries of origin, which together generate 72% of tourist visits to Spain. They found that a 1% price increase would lead to a decrease of 0.55% in the number of tourists and 0.61% in tourism expenditures, *ceteris paribus*, in the period 1979-1991.

In all the above-mentioned studies the price elasticity of demand for Spanish tourism is negative, as expected from economic theory. However, there are considerable differences in the magnitude of the estimates. For this reason we apply three different scenarios based on the results of the mentioned studies, reflecting price elasticities  $-0.5$ ,  $-1.0$ , and  $-2.0$ . It is likely that price elasticities for different tourism activities vary, meaning that the demand for various tourism products and services would

change at different rates. However, this information is to our knowledge unavailable. We therefore assume an equal reduction in demand for all tourism activities, which can be considered as an “average approach”.

#### 4. Implications of a change in tourism demand for the Spanish economy

This section assesses the repercussions of a change in the demand for tourism in Spain on the country’s overall economy by applying a traditional Leontief I/O model. This model is often referred to as demand-driven model because the final demand vector drives the model entirely and determines total outputs as well as intermediate and primary inputs. This approach is usually applied to examine how a change in the final demand of one or more exogenous sectors would affect the total output of all sectors, taking into account intermediate deliveries necessary to satisfy the new level of demand. This makes the model perfectly suitable for our next research question: how does a change in tourism demand translate into economy-wide effects? The traditional Leontief model can be specified as:

$$X = [I - A]^{-1} Y \quad (2)$$

where  $X$  represents the vector of gross outputs of sectors,  $[I - A]^{-1}$  is the Leontief inverse, and  $Y$  is the vector of final demand. The latter consists of the vectors of domestic final demand ( $h$ ) and exports ( $e$ ), from which the vector of imports ( $m$ ) is deducted. The model can therefore be written as:

$$X = [I - A]^{-1} [h + e - m] \quad (3)$$

Imports appear with a negative sign because they represent a part of demand which is not met by domestic production. However, this approach is problematic because  $m$  represents intermediate import demand and one cannot know how large this is until  $X$  has been estimated. We thus adopted an alternative approach to deal with imports, as proposed in Bulmer-Thomas (1982). Accordingly, the equation for domestic supply and demand is solved as:

$$X = [I - A_D]^{-1} [h_D + e] \quad (4)$$

where  $A_D$  is a matrix of domestic I/O coefficients and  $h_D$  is a home final demand for domestically produced goods and services. First we introduce the new, decreased levels of domestic final demand ( $h_D$ ) and exports ( $e$ ), resulting from the output price increases determined in Section 2.4 combined with the three different price elasticities of demand for Spanish tourism discussed in Section 3. Furthermore, we assume that increases in the prices of primary inputs (e.g., a rise in wages) would to some extent compensate for a rise in the prices of outputs, hence moderating a decrease in demand. Therefore, we correct for the inflationary effect by dividing the percentage decrease in demand by factors 1.05 and 1.10, depending whether the assumed increase in the prices of primary inputs is 5% or 10% (as explained in Section 2.3). Equation (4) then allows us to assess new domestic output levels stemming from diminished demand. These results then enter the following equation to calculate the new levels of imports:

$$m = A_m X + h_m \quad (5)$$

where  $A_m$  is a matrix of import requirements per unit of output and  $h_m$  is a vector of domestic final demand for imports.

We consider two sets of scenarios here, each one comprising 12 sub-scenarios (although only six sub-scenarios corresponding to scenario A are presented in the article). In the first set of scenarios only the demand for tourism activities decreases, while in the second one demand for all economic sectors diminishes. Changes in domestic outputs discussed further in this section are based on the assumption that the price elasticity of demand is  $-0.5$  in both sets of scenarios. From all the calculations we performed it follows that domestic outputs change proportionally to the price elasticity. This means that when the price elasticity is assumed to be  $-1.0$  ( $-2.0$ ), changes in outputs are double (four times higher) compared to the ones at the price elasticity of  $-0.5$ .

In the first set of scenarios demand for tourism activities falls, while that for other sectors stays unchanged. In such a case, sectors related to tourism activities experience the greatest reductions in

domestic outputs. The air transport sector suffers the largest reduction in outputs (−8.5% to −22.4%),<sup>6</sup> followed by water transport (−5.6% to −15.3%), restaurants (−3.0% to −12.4%), railway transport (−2.5% to −9.0%), travel agencies' activities (−2.5% to −8.8%), hotels (−2.3% to −9.6%), other land transport and transport via pipelines (−2.3% to −7.0%), and market recreational, cultural and sporting activities (−1.7% to −7.2%). All output changes refer only to that part of the sector which is associated with tourism activities. Other tourism sectors experience slightly more moderate output decreases. Apart from the tourism sectors, notable output decreases are observed for manufacture of beverages (−0.7% to −2.7%), air transport from non-tourism activities (−0.5% to −1.4%), and renting of machinery, personal and household goods (−0.4% to −1.3%). The estimates of this set of scenarios are conservative as in theory one could expect that demand for all economic sectors decreases when their prices go up.

Therefore, the second set of scenarios assumes that demand for all economic sectors decreases. As it is very difficult to know price elasticities of aggregate products and services for all sectors in the economy, we have applied a low price elasticity scenario (−0.5) in order to ensure conservative estimates. The resulting changes in domestic outputs are presented in Table 4. The most prominent output decrease takes place in the manufacture of coke, refined petroleum products and nuclear fuel (−23.8% to −57.3%), extraction of crude petroleum (−19.6% to −48.1%), extraction of natural gas, mining of uranium and thorium ores (−9.5% to −24.9%), air transport (−8.9% to −23.8%), water transport (−6.7% to −18.8%), manufacture of gas, distribution of gaseous fuels through pipes, steam and hot water supply (−5.9% to −16.8%), fishing (−4.5% to −15.3%), production and distribution of electricity (−4.3% to −13.4%), and other land transport and transport via pipelines (−4.0% to −12.9%). These results show that in this set of scenarios energy and transport sectors (both from tourism and

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<sup>6</sup> The ranges relate to the least and the most extreme scenarios. The former (latter) scenario assumes oil price increase of 110% (267%) and primary inputs price increase of 5% (10%).

non-tourism activities) are the most affected ones. Changes in domestic outputs of the tourism sectors are rather similar under the two sets of scenarios with slightly more prominent decreases in the second set due to additional indirect effects throughout the economy.

[INSERT TABLE 4 AROUND HERE]

Furthermore, import levels will change as they need to be adjusted to the new domestic output levels. Therefore, in the second step of our I/O demand model new import levels of all economic sectors are calculated based on their new domestic outputs by applying equation (5). In the first set of scenarios (only demand for tourism sectors decreases) the most substantial reductions in imports occur in the following sectors: renting of machinery, personal and household goods (−3.8% to −10.1%), support and auxiliary transport activities (−2.4% to −6.5%), travel agencies' activities (−1.5% to −5.2%), restaurants (−1.5% to −5.2%), hotels (−1.1% to −4.0%), water transport (−1.0% to −3.5%), manufacture of coke, refined petroleum products and nuclear fuel (−0.7% to −1.9%), and air transport (−0.6% to −1.9%).<sup>7</sup>

Changes in the import levels for the second set of scenarios (where demand for all economic sectors falls) are shown in Table 5. The greatest fall in imports is observed in energy sectors, particularly in the extraction of crude petroleum (−23.5% to −56.7%), manufacture of coke, refined petroleum products and nuclear fuel (−8.3% to −22.1%), and extraction of natural gas and mining of uranium and thorium ores (−5.8% to −16.6%). Next most affected groups of sectors embrace financial and tourism sectors. Service-based tourism sectors (e.g., travel agencies, hotels and restaurants) experience larger decreases in imports than transport sectors in the second set of scenarios. In addition,

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<sup>7</sup> These ranges correspond to the least and the most extreme scenario of price increase of energy carriers and primary inputs and price elasticity of demand equal to −0.5.

decreases in imports of tourism sectors are approximately double in the second than in the first set of scenarios.

[INSERT TABLE 5 AROUND HERE]

## **5. Conclusions**

This study analyzes the potential effects of peak oil on Spanish tourism sectors and consequently on the Spanish economy using the price and demand models of the input-output (I/O) analysis. After reaching the maximum point of the conventional oil production at the global level, it is expected that the oil prices will rise sharply due to the inability of (constant or reduced) supply to meet (increasing) demand. There is a growing amount of evidence that peak oil is either already underway or will occur within this decade. Record-high oil prices in 2008 and 2011 are possibly signs of the peak oil era. The increase in oil prices is likely to induce higher prices of travel, which in turn would reduce demand for tourism. Since Spain is one of the top tourism destinations in the world and tourism represents one of its most important economic activities, its economy may be strongly affected by the peak oil phenomenon.

This article considers various oil price scenarios (US\$115, US\$150, and US\$200), and related scenarios with price increases of other energy sources and their inflationary effects on the economy. It analyzes (1) how much would prices of Spanish tourism supply change due to the oil price increase according to a price I/O model, (2) how would such price increase affect demand for Spanish tourism considering its price elasticity, and (3) what would be the effects of a reduced demand for tourism (and of a reduced demand for all economic sectors) on the whole Spanish economy by using the demand I/O model.

The results show that prices of Spanish tourism supply would rise most considerably in transport sectors. This most of all holds for air, water, and other land (including pipelines) transport sectors

because they are the most energy-intensive tourism activities. Different studies have shown that the price elasticity of demand for Spanish tourism varies between  $-0.30$  and  $-2.16$ . This study presents results for the price elasticity  $-0.5$ , which can be considered as conservative. We also performed calculations for elasticities  $-1.0$  and  $-2.0$ , which indicated that domestic outputs change proportionally with price elasticity.

If one assumes a decrease in demand for tourism sectors only, the greatest reductions in outputs are observed in tourism-related part of air transport ( $-8.5\%$  to  $-22.4\%$ ), water transport ( $-5.6\%$  to  $-15.3\%$ ), restaurants ( $-3.0\%$  to  $-12.4\%$ ), railway transport ( $-2.5\%$  to  $-9.0\%$ ), and hotel ( $-2.3\%$  to  $-9.6\%$ ) sectors. The ranges correspond to the least and the most extreme scenarios of price increases of oil and primary inputs. One can note that output reductions vary substantially depending on the oil price and primary inputs price scenarios. If demand for all economic sectors is assumed to fall, energy and transport sectors (from both tourism and non-tourism activities) will suffer the most prominent reductions in domestic outputs. The range of output reductions between the least and most extreme scenarios of oil and primary inputs price increase is  $-23.8\%$  to  $-57.3\%$  for manufacture of coke, refined petroleum products and nuclear fuel;  $-19.6\%$  to  $-48.1\%$  for the extraction of crude petroleum;  $-9.5\%$  to  $-24.9\%$  for the extraction of natural gas, mining of uranium and thorium ores;  $-8.9\%$  to  $-23.8\%$  for air transport; and  $-6.7\%$  to  $-18.8\%$  for water transport sectors.

Of course, one should be aware that there are other factors apart from prices which may affect demand for tourism. For example, despite high oil prices at the moment and the ongoing global economic crisis, political instability in the Middle East has led to an increased demand for tourism in Spain. Moreover, I/O analysis cannot predict which markets (i.e. countries of origin) would experience stronger or weaker changes in demand, but one would expect that in the case of very high oil prices the demand of tourists coming from more distant countries would be more affected.

In conclusion, the tourism industry in Spain should be concerned about the impact of peak oil because transport sectors related to tourism activities will be among the most affected economic sectors in Spain by high oil prices. Effects on other, less oil-intensive sectors, such as hotels and restaurants depend largely on the price increases of primary inputs. We believe that further research is needed on developing adaptation strategies to high energy prices in tourism. In addition, more research on (likely heterogeneous) price elasticities of demand for different tourism products and services could improve the accuracy of estimations of the impacts of peak oil on tourism.

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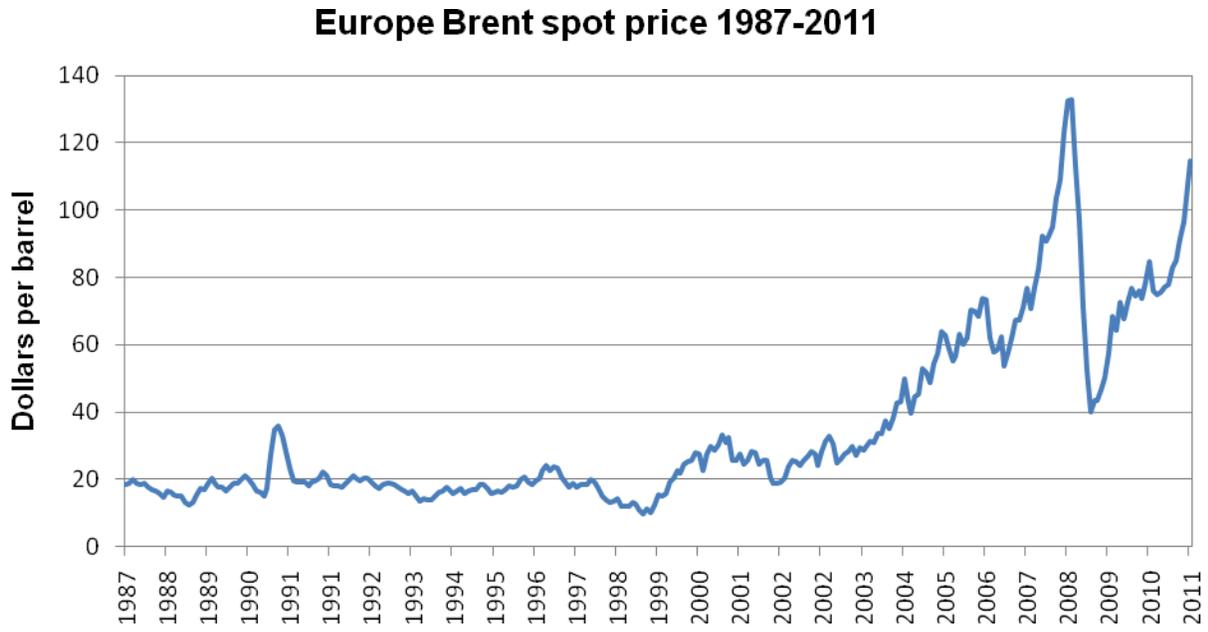
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*Figure 1. Crude oil prices (European Brent spot price FOB) in the period 1987 to 2011*

*Source:* Based on data from the U.S. Energy Information Administration

*Table 1. Proportion of tourism activities within, and energy intensity of, tourism-related sectors*

Tourism-related sectors	Total output of a sector (million €)	Proportion of tourism activities <sup>i</sup>
Hotels	16126.8	0.9872 <sup>ii</sup>
Restaurants	85295.3	0.2851
Railway transport	2456.1	0.6177
Other land transport; transport via pipelines	41298.1	0.0583
Water transport	2802.3	0.1496
Air transport	7800.6	0.9476
Support and auxiliary transport activities	28511.1	0.1352
Travel agencies' activities	9174.3	0.5510
Market recreational, cultural and sporting activities	29434.7	0.0736
Non-market recreational, cultural and sporting activities	8543.4	0.0722

*Source:* Own calculations based on the Spanish I/O tables and Tourism Satellite Accounts for 2005.

*Notes:*

<sup>i</sup> Based on Tourism Satellite Accounts.

<sup>ii</sup> Services in this category are considered tourist-based except for persons who use hotel establishments as their regular accommodation.

*Table 2. Scenarios of an increase in the prices of imports from different energy sectors in the input-output price model in relation to 2005 levels*

	<b>Scenario 1A</b>	<b>Scenario 1B</b>	<b>Scenario 2A</b>	<b>Scenario 2B</b>	<b>Scenario 3A</b>	<b>Scenario 3B</b>
<b>Oil price in absolute terms (% change relative to 2005)</b>	<b>US\$115 (110%)</b>	<b>US\$115 (110%)</b>	<b>US\$150 (175%)</b>	<b>US\$150 (175%)</b>	<b>US\$200 (267%)</b>	<b>US\$200 (267%)</b>
Mining of coal and lignite; extraction of peat	55%	55%	87.50%	131.25%	133.50%	200.25%
Extraction of crude petroleum	110%	110%	175%	175%	267%	267%
Extraction of natural gas; mining of uranium and thorium ores	55%	110%	87.50%	175%	133.50%	267%
Manufacture of coke, refined petroleum products and nuclear fuel	110%	110%	175%	175%	267%	267%
Production and distribution of electricity	36.96%	53.74%	58.80%	96.21%	89.71%	146.78%
Manufacture of gas; distribution of gaseous fuels through pipes; steam and hot water supply	55%	110%	87.50%	175%	133.50%	267%

Table 3. Percentage price increase of domestic outputs under different scenarios of price increases of imports from energy sectors and primary inputs relative to 2005<sup>i</sup>

		SCENARIOS					
		Price increase of primary inputs follows oil price increase by 5%			Price increase of primary inputs follows oil price increase by 10%		
		1A <sup>ii</sup>	2A	3A	1A	2A	3A
Nr	Sector	Percentage changes (%)					
1	Agriculture, livestock and hunting	7,33	11,66	17,78	12,01	19,11	29,16
2	Forestry, logging and related service activities	6,06	9,65	14,72	11,46	18,23	27,81
3	Fishing	11,29	17,96	27,40	15,66	24,92	38,02
4	Mining of coal and lignite; extraction of peat	10,48	16,67	25,43	14,89	23,68	36,13
5	Extraction of crude petroleum	13,16	20,94	31,95	16,80	26,73	40,78
6	Extraction of natural gas; mining of uranium and thorium ores	13,16	20,94	31,95	16,80	26,73	40,78
7	Mining of metal ores	7,79	12,39	18,90	11,89	18,92	28,86
8	Other mining and quarrying	12,10	19,26	29,38	16,36	26,02	39,70
9	Manufacture of coke, refined petroleum products and nuclear fuel	82,75	131,65	200,87	84,07	133,75	204,07
10	Production and distribution of electricity	22,55	35,88	54,74	26,35	41,93	63,97
11	Manufacture of gas; distribution of gaseous fuels through pipes; steam and hot water supply	37,11	59,04	90,08	39,07	62,16	94,84
12	Collection, purification and distribution of water	8,13	12,93	19,73	12,54	19,95	30,44
13	Manufacture of meat products	7,01	11,15	17,01	11,61	18,47	28,19
14	Manufacture of dairy products	7,12	11,34	17,29	11,41	18,15	27,69
15	Manufacture of other food products	6,18	9,84	15,01	9,94	15,81	24,13
16	Manufacture of beverages	6,80	10,81	16,50	10,76	17,12	26,13
17	Manufacture of tobacco products	5,08	8,09	12,34	8,94	14,22	21,69
18	Manufacture of textiles	5,37	8,54	13,04	8,74	13,91	21,22
19	Manufacture of wearing apparel; dressing and dyeing of fur	5,42	8,63	13,17	9,32	14,83	22,63
20	Manufacture of leather and leather products	5,63	8,96	13,66	9,38	14,92	22,76
21	Manufacture of wood and wood products	6,54	10,40	15,87	10,18	16,19	24,71
22	Manufacture of pulp, paper and paper products	6,58	10,47	15,9	10,03	15,96	24,36
23	Publishing and printing	6,03	9,59	14,63	10,34	16,46	25,11
24	Manufacture of chemicals and chemical products	12,42	19,77	30,16	15,28	24,31	37,09
25	Manufacture of rubber and plastic products	6,22	9,90	15,11	9,53	15,17	23,14
26	Manufacture of cement, lime and plaster	10,72	17,05	26,01	15,29	24,33	37,12
27	Manufacture of glass and glass products	9,42	14,98	22,86	13,63	21,69	33,09
28	Manufacture of ceramic products	8,93	14,21	21,68	13,23	21,05	32,12
29	Manufacture of other non-metallic mineral products	9,07	14,44	22,02	13,29	21,14	32,25
30	Manufacture of basics metals	7,71	12,26	18,71	11,31	18,00	27,46
31	Manufacture of fabricated metal products	5,84	9,30	14,19	9,49	15,10	23,04
32	Manufacture of machinery and equipment n.e.c.	5,49	8,73	13,32	9,26	14,74	22,49
33	Manufacture of office machinery and computers	3,92	6,24	9,52	6,84	10,88	16,59
34	Manufacture of electrical machinery and apparatus n.e.c.	5,04	8,02	12,24	8,07	12,84	19,59
35	Manufacture of electronic equipment and apparatus	3,22	5,13	7,82	5,37	8,54	13,03
36	Manufacture of medical, precision and optical instruments	4,44	7,06	10,77	7,82	12,44	18,98
37	Manufacture of motor vehicles, trailers and semi-trailers	3,73	5,94	9,07	6,16	9,80	14,95
38	Manufacture of other transport equipment	4,89	7,79	11,88	8,10	12,89	19,67
39	Manufacture of furniture; manufacturing n.e.c.	5,58	8,87	13,54	9,48	15,08	23,00
40	Recycling	6,00	9,55	14,57	9,62	15,31	23,36
41	Construction	6,36	10,11	15,43	11,05	17,58	26,83
42	Sale and retail of motor vehicles; retail sale of automotive fuel	6,09	9,69	14,79	10,45	16,62	25,36
43	Wholesale trade and commission trade	7,08	11,26	17,18	11,91	18,95	28,92
44	Retail trade; repair of personal and household goods	6,44	10,24	15,62	11,65	18,53	28,27
<b>45</b>	<b>Hotels (tourism activities)</b>	<b>6,12</b>	<b>9,74</b>	<b>14,86</b>	<b>11,18</b>	<b>17,78</b>	<b>27,13</b>
46	Hotels (non-tourism activities)	6,12	9,74	14,86	11,18	17,78	27,13
<b>47</b>	<b>Restaurants (tourism activities)</b>	<b>6,51</b>	<b>10,36</b>	<b>15,81</b>	<b>11,46</b>	<b>18,24</b>	<b>27,82</b>
48	Restaurants (non-tourism activities)	6,51	10,36	15,81	11,46	18,24	27,82

49	<b>Railway transport (tourism activities)</b>	<b>8,60</b>	<b>13,69</b>	<b>20,88</b>	<b>13,35</b>	<b>21,24</b>	<b>32,40</b>
50	Railway transport (non-tourism activities)	8,60	13,69	20,88	13,35	21,24	32,40
51	<b>Other land transport; transport via pipelines (tourism activities)</b>	<b>14,46</b>	<b>23,01</b>	<b>35,11</b>	<b>19,03</b>	<b>30,27</b>	<b>46,19</b>
52	Other land transport; transport via pipelines (non-tourism activities)	14,46	23,01	35,11	19,03	30,27	46,19
53	<b>Water transport (tourism activities)</b>	<b>18,48</b>	<b>29,40</b>	<b>44,85</b>	<b>21,75</b>	<b>34,60</b>	<b>52,79</b>
54	Water transport (non-tourism activities)	18,48	29,40	44,85	21,75	34,60	52,79
55	<b>Air transport (tourism activities)</b>	<b>23,20</b>	<b>36,91</b>	<b>56,32</b>	<b>26,30</b>	<b>41,85</b>	<b>63,85</b>
56	Air transport (non-tourism activities)	23,20	36,91	56,32	26,30	41,85	63,85
57	<b>Support and auxiliary transport activities (tourism activities)</b>	<b>8,89</b>	<b>14,14</b>	<b>21,58</b>	<b>13,39</b>	<b>21,30</b>	<b>32,50</b>
58	Support and auxiliary transport activities (non-tourism activities)	8,89	14,14	21,58	13,39	21,30	32,50
59	<b>Travel agencies' activities (tourism activities)</b>	<b>6,62</b>	<b>10,52</b>	<b>16,06</b>	<b>10,35</b>	<b>16,47</b>	<b>25,12</b>
60	Travel agencies' activities (non-tourism activities)	6,62	10,52	16,06	10,35	16,47	25,12
61	Post and telecommunications	6,09	9,70	14,79	10,74	17,08	26,06
62	Financial intermediation, except insurance and pension funding	5,48	8,71	13,29	10,64	16,92	25,82
63	Insurance and pension funding, except compulsory social security	5,67	9,02	13,77	10,54	16,77	25,58
64	Activities auxiliary to financial intermediation	6,32	10,05	15,34	11,29	17,96	27,40
65	Real estate activities	5,71	9,09	13,87	11,02	17,54	26,75
66	Renting of machinery, personal and household goods	6,73	10,71	16,33	11,58	18,42	28,11
67	Computer and related activities	5,45	8,68	13,24	10,36	16,49	25,16
68	Research and development	6,76	10,76	16,41	11,52	18,33	27,97
69	Other business activities	6,10	9,70	14,80	11,00	17,50	26,71
70	Market education	6,34	10,09	15,40	11,61	18,47	28,18
71	Market health and social work	6,06	9,64	14,71	11,01	17,52	26,74
72	Market sewage and refuse disposal, sanitation and similar activities	7,19	11,43	17,44	12,18	19,38	29,57
73	Market activities of membership organization n.e.c.	6,51	10,35	15,80	11,51	18,31	27,94
74	<b>Market recreational, cultural and sporting activities (tourism activities)</b>	<b>5,39</b>	<b>8,57</b>	<b>13,08</b>	<b>10,14</b>	<b>16,14</b>	<b>24,62</b>
75	Market recreational, cultural and sporting activities (non-tourism activities)	5,39	8,57	13,08	10,14	16,14	24,62
76	Other service activities	6,57	10,45	15,94	11,57	18,41	28,09
77	Public Administration	6,36	10,12	15,44	11,46	18,24	27,83
78	Non-market education	6,15	9,79	14,93	11,52	18,33	27,97
79	Non-market health and social work	6,20	9,87	15,06	11,03	17,55	26,77
80	Non-market sewage and refuse disposal, sanitation and similar activities	7,92	12,60	19,22	12,83	20,42	31,15
81	Non-market activities of membership organization n.e.c.	6,60	10,50	16,02	11,43	18,18	27,74
82	<b>Non-market recreational, cultural and sporting activities (tourism activities)</b>	<b>6,66</b>	<b>10,60</b>	<b>16,17</b>	<b>11,64</b>	<b>18,51</b>	<b>28,24</b>
83	Non-market recreational, cultural and sporting activities (non-tourism activities)	6,66	10,60	16,17	11,64	18,51	28,24
84	Private households with employed persons	5,50	8,75	13,35	11,00	17,50	26,70

<sup>i</sup> Shaded rows denote the most affected sectors, while rows in bold denote tourism sectors.

<sup>ii</sup> See Table 2 for an explanation of the energy price scenarios 1A, 2A and 3A.

Table 4. Percentage changes in domestic outputs under different scenarios of price increases of imports from energy sectors and primary inputs relative to 2005, assuming a price elasticity of demand for all economic sectors equal to  $-0.5^i$

		SCENARIOS					
		Price increase of primary inputs follows oil price increase by 5%			Price increase of primary inputs follows oil price increase by 10%		
		1A <sup>ii</sup>	2A	3A	1A	2A	3A
Nr	Sector	Percentage changes (%)					
1	Agriculture, livestock and hunting	-3,16	-5,03	-7,67	-4,98	-7,92	-12,09
2	Forestry, logging and related service activities	-1,86	-2,96	-4,52	-2,95	-4,69	-7,16
3	Fishing	-4,52	-7,19	-10,96	-6,29	-10,01	-15,27
4	Mining of coal and lignite; extraction of peat	-3,68	-5,86	-8,94	-4,83	-7,68	-11,71
5	Extraction of crude petroleum	-19,64	-31,25	-47,68	-19,81	-31,51	-48,08
6	Extraction of natural gas; mining of uranium and thorium ores	-9,50	-15,11	-23,05	-10,24	-16,29	-24,85
7	Mining of metal ores	-3,02	-4,81	-7,34	-4,40	-7,00	-10,67
8	Other mining and quarrying	-1,91	-3,03	-4,63	-2,62	-4,16	-6,35
9	Manufacture of coke, refined petroleum products and nuclear fuel	-23,75	-37,79	-57,66	-23,59	-37,53	-57,25
10	Production and distribution of electricity	-4,32	-6,88	-10,49	-5,52	-8,79	-13,40
11	Manufacture of gas; distribution of gaseous fuels through pipes; steam and hot water supply	-5,95	-9,46	-14,44	-6,93	-11,02	-16,81
12	Collection, purification and distribution of water	-3,26	-5,18	-7,91	-4,81	-7,65	-11,67
13	Manufacture of meat products	-3,23	-5,13	-7,83	-5,14	-8,17	-12,47
14	Manufacture of dairy products	-3,29	-5,23	-7,98	-5,07	-8,07	-12,31
15	Manufacture of other food products	-2,95	-4,69	-7,15	-4,61	-7,33	-11,18
16	Manufacture of beverages	-3,09	-4,91	-7,49	-5,02	-7,98	-12,18
17	Manufacture of tobacco products	-2,37	-3,77	-5,75	-3,98	-6,33	-9,65
18	Manufacture of textiles	-2,43	-3,87	-5,90	-3,83	-6,09	-9,29
19	Manufacture of wearing apparel; dressing and dyeing of fur	-2,39	-3,81	-5,81	-3,84	-6,11	-9,32
20	Manufacture of leather and leather products	-2,65	-4,22	-6,44	-4,22	-6,71	-10,23
21	Manufacture of wood and wood products	-1,76	-2,79	-4,26	-2,72	-4,33	-6,61
22	Manufacture of pulp, paper and paper products	-2,57	-4,10	-6,25	-3,88	-6,18	-9,42
23	Publishing and printing	-2,29	-3,64	-5,56	-3,62	-5,76	-8,79
24	Manufacture of chemicals and chemical products	-4,08	-6,49	-9,91	-5,06	-8,05	-12,28
25	Manufacture of rubber and plastic products	-2,36	-3,75	-5,73	-3,53	-5,62	-8,57
26	Manufacture of cement, lime and plaster	-0,81	-1,29	-1,97	-1,23	-1,96	-2,99
27	Manufacture of glass and glass products	-2,53	-4,03	-6,14	-3,76	-5,98	-9,13
28	Manufacture of ceramic products	-1,94	-3,09	-4,71	-2,82	-4,49	-6,84
29	Manufacture of other non-metallic mineral products	-0,71	-1,13	-1,73	-1,09	-1,74	-2,66
30	Manufacture of basics metals	-2,27	-3,62	-5,52	-3,33	-5,30	-8,09
31	Manufacture of fabricated metal products	-1,51	-2,40	-3,66	-2,30	-3,65	-5,57
32	Manufacture of machinery and equipment n.e.c.	-1,90	-3,02	-4,61	-2,91	-4,64	-7,07
33	Manufacture of office machinery and computers	-1,92	-3,05	-4,66	-3,16	-5,02	-7,66
34	Manufacture of electrical machinery and apparatus n.e.c.	-1,53	-2,43	-3,71	-2,34	-3,72	-5,67
35	Manufacture of electronic equipment and apparatus	-1,50	-2,39	-3,65	-2,39	-3,80	-5,80
36	Manufacture of medical, precision and optical instruments	-1,30	-2,06	-3,15	-2,14	-3,41	-5,20
37	Manufacture of motor vehicles, trailers and semi-trailers	-1,66	-2,64	-4,03	-2,59	-4,12	-6,29
38	Manufacture of other transport equipment	-1,98	-3,15	-4,80	-3,05	-4,85	-7,40
39	Manufacture of furniture; manufacturing n.e.c.	-1,71	-2,72	-4,15	-2,75	-4,37	-6,67
40	Recycling	-2,24	-3,56	-5,43	-3,28	-5,22	-7,97
41	Construction	-0,42	-0,66	-1,01	-0,68	-1,09	-1,66
42	Sale and retail of motor vehicles; retail sale of automotive fuel	-2,71	-4,30	-6,57	-4,15	-6,61	-10,08
43	Wholesale trade and commission trade	-2,47	-3,94	-6,01	-3,92	-6,24	-9,52
44	Retail trade; repair of personal and household goods	-2,66	-4,24	-6,46	-4,57	-7,27	-11,09
45	<b>Hotels (tourism activities)</b>	<b>-2,80</b>	<b>-4,46</b>	<b>-6,80</b>	<b>-4,72</b>	<b>-7,50</b>	<b>-11,44</b>
46	Hotels (non-tourism activities)	-2,80	-4,46	-6,80	-4,72	-7,50	-11,44
47	<b>Restaurants (tourism activities)</b>	<b>-3,07</b>	<b>-4,89</b>	<b>-7,46</b>	<b>-5,15</b>	<b>-8,20</b>	<b>-12,51</b>

48	Restaurants (non-tourism activities)	-3,07	-4,89	-7,46	-5,15	-8,20	-12,51
<b>49</b>	<b>Railway transport (tourism activities)</b>	<b>-3,16</b>	<b>-5,03</b>	<b>-7,67</b>	<b>-4,61</b>	<b>-7,33</b>	<b>-11,19</b>
50	Railway transport (non-tourism activities)	-3,16	-5,03	-7,67	-4,61	-7,33	-11,19
<b>51</b>	<b>Other land transport; transport via pipelines (tourism activities)</b>	<b>-3,98</b>	<b>-6,32</b>	<b>-9,65</b>	<b>-5,30</b>	<b>-8,44</b>	<b>-12,87</b>
52	Other land transport; transport via pipelines (non-tourism activities)	-3,98	-6,32	-9,65	-5,30	-8,44	-12,87
<b>53</b>	<b>Water transport (tourism activities)</b>	<b>-6,66</b>	<b>-10,59</b>	<b>-16,16</b>	<b>-7,74</b>	<b>-12,32</b>	<b>-18,79</b>
54	Water transport (non-tourism activities)	-6,66	-10,59	-16,16	-7,74	-12,32	-18,79
<b>55</b>	<b>Air transport (tourism activities)</b>	<b>-8,89</b>	<b>-14,15</b>	<b>-21,58</b>	<b>-9,81</b>	<b>-15,61</b>	<b>-23,82</b>
56	Air transport (non-tourism activities)	-8,89	-14,15	-21,58	-9,81	-15,61	-23,82
<b>57</b>	<b>Support and auxiliary transport activities (tourism activities)</b>	<b>-3,49</b>	<b>-5,55</b>	<b>-8,46</b>	<b>-4,84</b>	<b>-7,71</b>	<b>-11,76</b>
58	Support and auxiliary transport activities (non-tourism activities)	-3,49	-5,55	-8,46	-4,84	-7,71	-11,76
<b>59</b>	<b>Travel agencies' activities (tourism activities)</b>	<b>-2,93</b>	<b>-4,67</b>	<b>-7,12</b>	<b>-4,31</b>	<b>-6,86</b>	<b>-10,47</b>
60	Travel agencies' activities (non-tourism activities)	-2,93	-4,67	-7,12	-4,31	-6,86	-10,47
61	Post and telecommunications	-2,52	-4,01	-6,11	-4,00	-6,36	-9,71
62	Financial intermediation, except insurance and pension funding	-2,52	-4,01	-6,12	-4,21	-6,70	-10,23
63	Insurance and pension funding, except compulsory social security	-2,64	-4,19	-6,40	-4,49	-7,14	-10,89
64	Activities auxiliary to financial intermediation	-2,77	-4,40	-6,71	-4,67	-7,43	-11,33
65	Real estate activities	-2,26	-3,60	-5,50	-4,00	-6,36	-9,71
66	Renting of machinery, personal and household goods	-2,57	-4,09	-6,23	-3,80	-6,04	-9,21
67	Computer and related activities	-1,36	-2,17	-3,31	-2,19	-3,48	-5,30
68	Research and development	-2,04	-3,25	-4,96	-2,96	-4,71	-7,18
69	Other business activities	-2,22	-3,53	-5,39	-3,44	-5,48	-8,36
70	Market education	-2,09	-3,33	-5,08	-3,52	-5,60	-8,55
71	Market health and social work	-2,07	-3,30	-5,03	-3,55	-5,65	-8,62
72	Market sewage and refuse disposal, sanitation and similar activities	-2,13	-3,39	-5,17	-3,35	-5,33	-8,13
73	Market activities of membership organization n.e.c.	-2,78	-4,42	-6,75	-4,14	-6,59	-10,05
<b>74</b>	<b>Market recreational, cultural and sporting activities (tourism activities)</b>	<b>-2,37</b>	<b>-3,76</b>	<b>-5,74</b>	<b>-4,08</b>	<b>-6,50</b>	<b>-9,91</b>
75	Market recreational, cultural and sporting activities (non-tourism activities)	-2,37	-3,76	-5,74	-4,08	-6,50	-9,91
76	Other service activities	-3,01	-4,79	-7,32	-5,06	-8,05	-12,28
77	Public Administration						
78	Non-market education	-0,14	-0,22	-0,34	-0,25	-0,40	-0,61
79	Non-market health and social work	-0,27	-0,43	-0,66	-0,46	-0,74	-1,12
80	Non-market sewage and refuse disposal, sanitation and similar activities	-0,09	-0,15	-0,22	-0,14	-0,22	-0,34
81	Non-market activities of membership organization n.e.c	-3,14	-5,00	-7,63	-5,19	-8,26	-12,61
<b>82</b>	<b>Non-market recreational, cultural and sporting activities (tourism activities)</b>	<b>-0,78</b>	<b>-1,24</b>	<b>-1,89</b>	<b>-1,30</b>	<b>-2,07</b>	<b>-3,16</b>
83	Non-market recreational, cultural and sporting activities (non-tourism activities)	-0,78	-1,24	-1,89	-1,30	-2,07	-3,16
84	Private households with employed persons	-2,62	-4,17	-6,36	-5,00	-7,95	-12,14

<sup>1</sup> Shaded rows denote the most affected sectors, while rows in bold denote tourism sectors.

ii See Table 2 for an explanation of the energy price scenarios 1A, 2A and 3A.

Table 5. Percentage changes in imports under different scenarios of price increases of imports from energy sectors and primary inputs relative to 2005, assuming a price elasticity of demand for all economic sectors equal to  $-0.5^i$

		SCENARIOS					
		Price increase of primary inputs follows oil price increase by 5%			Price increase of primary inputs follows oil price increase by 10%		
		1A <sup>ii</sup>	2A	3A	1A	2A	3A
Nr	Sector	Percentage changes (%)					
1	Agriculture, livestock and hunting	-2,02	-3,21	-4,91	-3,17	-5,05	-7,70
2	Forestry, logging and related service activities	-1,97	-3,13	-4,77	-3,00	-4,77	-7,28
3	Fishing	-0,04	-0,06	-0,10	-0,07	-0,10	-0,16
4	Mining of coal and lignite; extraction of peat	-4,07	-6,48	-9,89	-5,25	-8,35	-12,75
5	Extraction of crude petroleum	-23,51	-37,41	-57,07	-23,36	-37,17	-56,71
6	Extraction of natural gas; mining of uranium and thorium ores	-5,85	-9,31	-14,20	-6,84	-10,88	-16,60
7	Mining of metal ores	-2,30	-3,67	-5,59	-3,36	-5,35	-8,16
8	Other mining and quarrying	-1,96	-3,12	-4,75	-2,63	-4,19	-6,39
9	Manufacture of coke, refined petroleum products and nuclear fuel	-8,27	-13,15	-20,06	-9,09	-14,46	-22,05
10	Production and distribution of electricity	-4,27	-6,79	-10,35	-5,47	-8,69	-13,27
11	Manufacture of gas; distribution of gaseous fuels through pipes; steam and hot water supply	-4,32	-6,88	-10,49	-5,52	-8,79	-13,40
12	Collection, purification and distribution of water	0	0	0	0	0	0
13	Manufacture of meat products	-0,48	-0,76	-1,16	-0,76	-1,22	-1,85
14	Manufacture of dairy products	-0,51	-0,81	-1,24	-0,80	-1,27	-1,94
15	Manufacture of other food products	-1,00	-1,58	-2,42	-1,56	-2,48	-3,79
16	Manufacture of beverages	-0,37	-0,59	-0,90	-0,59	-0,93	-1,42
17	Manufacture of tobacco products	-0,01	-0,02	-0,04	-0,02	-0,04	-0,06
18	Manufacture of textiles	-1,42	-2,25	-3,44	-2,21	-3,52	-5,37
19	Manufacture of wearing apparel; dressing and dyeing of fur	-0,02	-0,03	-0,05	-0,03	-0,05	-0,07
20	Manufacture of leather and leather products	-0,52	-0,83	-1,27	-0,83	-1,32	-2,01
21	Manufacture of wood and wood products	-1,65	-2,63	-4,01	-2,57	-4,09	-6,23
22	Manufacture of pulp, paper and paper products	-2,26	-3,60	-5,49	-3,44	-5,47	-8,34
23	Publishing and printing	-0,63	-1,01	-1,54	-0,96	-1,53	-2,33
24	Manufacture of chemicals and chemical products	-2,25	-3,59	-5,47	-3,01	-4,79	-7,31
25	Manufacture of rubber and plastic products	-2,03	-3,23	-4,92	-3,05	-4,85	-7,40
26	Manufacture of cement, lime and plaster	-0,64	-1,02	-1,56	-1,00	-1,60	-2,43
27	Manufacture of glass and glass products	-1,92	-3,06	-4,67	-2,94	-4,68	-7,13
28	Manufacture of ceramic products	-0,57	-0,91	-1,38	-0,87	-1,39	-2,12
29	Manufacture of other non-metallic mineral products	-0,78	-1,25	-1,90	-1,22	-1,94	-2,96
30	Manufacture of basics metals	-1,64	-2,61	-3,99	-2,50	-3,98	-6,08
31	Manufacture of fabricated metal products	-1,51	-2,40	-3,66	-2,29	-3,65	-5,56
32	Manufacture of machinery and equipment n.e.c.	-0,93	-1,48	-2,26	-1,35	-2,15	-3,29
33	Manufacture of office machinery and computers	-0,87	-1,38	-2,10	-1,37	-2,17	-3,32
34	Manufacture of electrical machinery and apparatus n.e.c.	-1,24	-1,98	-3,02	-1,91	-3,03	-4,63
35	Manufacture of electronic equipment and apparatus	-0,71	-1,13	-1,72	-1,13	-1,80	-2,74
36	Manufacture of medical, precision and optical instruments	-0,50	-0,79	-1,21	-0,82	-1,30	-1,99
37	Manufacture of motor vehicles, trailers and semi-trailers	-0,70	-1,11	-1,69	-1,08	-1,73	-2,63
38	Manufacture of other transport equipment	-0,90	-1,43	-2,19	-1,21	-1,92	-2,93
39	Manufacture of furniture; manufacturing n.e.c.	-0,38	-0,60	-0,92	-0,60	-0,96	-1,47
40	Recycling	0	0	0	0	0	0
41	Construction	-0,61	-0,98	-1,49	-0,98	-1,56	-2,38
42	Sale and retail of motor vehicles; retail sale of automotive fuel	-2,16	-3,44	-5,25	-3,33	-5,30	-8,09
43	Wholesale trade and commission trade	-2,35	-3,74	-5,71	-3,69	-5,86	-8,95
44	Retail trade; repair of personal and household goods	0	0	0	0	0	0
45	<b>Hotels (tourism activities)</b>	<b>-2,74</b>	<b>-4,36</b>	<b>-6,66</b>	<b>-4,08</b>	<b>-6,49</b>	<b>-9,90</b>
46	Hotels (non-tourism activities)	-2,74	-4,36	-6,66	-4,08	-6,49	-9,90
47	<b>Restaurants (tourism activities)</b>	<b>-2,93</b>	<b>-4,66</b>	<b>-7,11</b>	<b>-4,31</b>	<b>-6,86</b>	<b>-10,46</b>

48	Restaurants (non-tourism activities)	-2,93	-4,66	-7,11	-4,31	-6,86	-10,46
<b>49</b>	<b>Railway transport (tourism activities)</b>	<b>-1,52</b>	<b>-2,42</b>	<b>-3,69</b>	<b>-2,28</b>	<b>-3,62</b>	<b>-5,53</b>
50	Railway transport (non-tourism activities)	-1,52	-2,42	-3,69	-2,28	-3,62	-5,53
<b>51</b>	<b>Other land transport; transport via pipelines (tourism activities)</b>	<b>-2,72</b>	<b>-4,34</b>	<b>-6,61</b>	<b>-3,93</b>	<b>-6,26</b>	<b>-9,55</b>
52	Other land transport; transport via pipelines (non-tourism activities)	-2,72	-4,34	-6,61	-3,93	-6,26	-9,55
<b>53</b>	<b>Water transport (tourism activities)</b>	<b>-1,95</b>	<b>-3,11</b>	<b>-4,74</b>	<b>-2,87</b>	<b>-4,57</b>	<b>-6,98</b>
54	Water transport (non-tourism activities)	-1,95	-3,11	-4,74	-2,87	-4,57	-6,98
<b>55</b>	<b>Air transport (tourism activities)</b>	<b>-1,48</b>	<b>-2,35</b>	<b>-3,59</b>	<b>-2,07</b>	<b>-3,29</b>	<b>-5,02</b>
56	Air transport (non-tourism activities)	-1,48	-2,35	-3,59	-2,07	-3,29	-5,02
<b>57</b>	<b>Support and auxiliary transport activities (tourism activities)</b>	<b>-5,49</b>	<b>-8,74</b>	<b>-13,34</b>	<b>-6,69</b>	<b>-10,64</b>	<b>-16,23</b>
58	Support and auxiliary transport activities (non-tourism activities)	-5,49	-8,74	-13,34	-6,69	-10,64	-16,23
<b>59</b>	<b>Travel agencies' activities (tourism activities)</b>	<b>-2,93</b>	<b>-4,66</b>	<b>-7,11</b>	<b>-4,31</b>	<b>-6,86</b>	<b>-10,46</b>
60	Travel agencies' activities (non-tourism activities)	-2,93	-4,66	-7,11	-4,31	-6,86	-10,46
61	Post and telecommunications	-1,85	-2,94	-4,49	-2,94	-4,68	-7,13
62	Financial intermediation, except insurance and pension funding	-2,31	-3,68	-5,61	-3,46	-5,50	-8,40
<b>63</b>	<b>Insurance and pension funding, except compulsory social security</b>	<b>-2,80</b>	<b>-4,45</b>	<b>-6,79</b>	<b>-4,41</b>	<b>-7,02</b>	<b>-10,72</b>
64	Activities auxiliary to financial intermediation	-2,53	-4,02	-6,14	-4,11	-6,54	-9,98
65	Real estate activities	0	0	0	0	0	0
<b>66</b>	<b>Renting of machinery, personal and household goods</b>	<b>-5,05</b>	<b>-8,04</b>	<b>-12,26</b>	<b>-5,88</b>	<b>-9,35</b>	<b>-14,26</b>
67	Computer and related activities	-0,04	-0,06	-0,10	-0,07	-0,10	-0,16
68	Research and development	-2,40	-3,82	-5,83	-3,39	-5,39	-8,22
69	Other business activities	-2,39	-3,81	-5,81	-3,62	-5,76	-8,79
70	Market education	0	0	0	0	0	0
71	Market health and social work	0	0	0	0	0	0
72	Market sewage and refuse disposal, sanitation and similar activities	0	0	0	0	0	0
73	Market activities of membership organization n.e.c.	0	0	0	0	0	0
<b>74</b>	<b>Market recreational, cultural and sporting activities (tourism activities)</b>	<b>-1,85</b>	<b>-2,94</b>	<b>-4,49</b>	<b>-3,13</b>	<b>-4,98</b>	<b>-7,60</b>
75	Market recreational, cultural and sporting activities (non-tourism activities)	-1,85	-2,94	-4,49	-3,13	-4,98	-7,60
76	Other service activities	0	0	0	0	0	0
77	Public Administration	0	0	0	0	0	0
78	Non-market education	0	0	0	0	0	0
79	Non-market health and social work	0	0	0	0	0	0
80	Non-market sewage and refuse disposal, sanitation and similar activities	0	0	0	0	0	0
81	Non-market activities of membership organization n.e.c.	0	0	0	0	0	0
<b>82</b>	<b>Non-market recreational, cultural and sporting activities (tourism activities)</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
83	Non-market recreational, cultural and sporting activities (non-tourism activities)	0	0	0	0	0	0
84	Private households with employed persons	0	0	0	0	0	0

<sup>1</sup> Shaded rows denote the most affected sectors, while rows in bold denote tourism sectors.

ii See Table 2 for an explanation of the energy price scenarios 1A, 2A and 3A.