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Assessing the Impact of High Energy Prices on Tourism in the EU

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Assessing the impact of high energy prices on tourism in the EU

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Abstract

In this paper, we use the computable general equilibrium model JRC-GEM-E3 to assess how energy price shocks affect the tourism industry in the EU. The tourism sector itself is not very energy intensive and thus the direct effect of higher energy prices likely is small. However, there are indirect effects that make the tourism sector sensitive to changes in energy prices. When energy price increases, it forces households to spend a larger share of their budget on energy to fulfil their basic needs. Households then have less disposable income available to spend on luxury goods, and therefore cut purchases on goods and services with a high income elasticity, including tourism. Furthermore, purchases of tourism services often require transport services as a complement and the increased price of transport services also affects the price of the bundle of the two services. The model results suggest that relative output losses of the tourism sector can be larger than other more energy intensive sectors because of these indirect effects.

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Keywords: Tourism, energy price shock, CGE modelling

1. Introduction

Tourism can stimulate economic growth by creating jobs, particularly in areas where opportunities may be limited (e.g., rural areas or in southern EU member states with per capita income below the European average) (e.g. Hartrich and Martinez, 2020), and promote investment in infrastructure (e.g., construction of airports, roads, and hotels) (e.g. Soshkin, 2019). Tourism activity can support local businesses, leading to educational opportunities (e.g., language learning, environmental education) and facilitate cultural exchange and appreciation of different lifestyles (e.g. UNWTO, 2018).

However, in recent years, the tourism industry was facing headwinds. The COVID-19 crisis brought many activities and travel to a standstill in 2019 and it took several years for the sector to recover. The number of nights spent in EU tourist accommodation returned to pre-pandemic levels only around May 2022 (Eurostat, 2024).[1] However, also in 2022, high energy prices in the wake of Russia's war in Ukraine sent shockwaves through the European economy, with estimated GDP impacts for the EU ranging between -0.2% and -2.8% according to different studies (Di Bella et al., 2022). Energy prices at record levels and a general increase in inflation implied a reduction in real income, putting households in a difficult situation when making choices on where to spend (Guan et al., 2023; Fulvimari et al., 2023; Steckel et al., 2022).

While the tourism sector itself is not a very energy intensive sector when compared to e.g. industrial sectors, and thus the direct effect due to production cost increases resulting from higher energy prices is likely comparatively small, other elements cause stronger impacts on the tourism sector. Tourism services are often luxury goods and are characterized with a high income elasticity (see e.g. Peng et al., 2014). This means that while households increase their expenditure for necessary energy consumption in response to energy price shocks, they have less disposable income to spend on luxury goods, including tourism. Furthermore, purchases of tourism services often require transport services as a complement and the increased price of transport services also affected the price of the 'combined bundle'. Because it can capture these interactions, computable general equilibrium (CGE) analysis is a useful tool for studying the tourism industry and has been used in numerous studies in the past (Blake et al., 2006). For this paper, we therefore develop a model version of JRC-GEM-E3 which explicitly represents tourism activities, to assess the direct and indirect impacts of high energy prices on the tourism sector in Europe.

Many previous CGE studies on tourism assess the impact of changes in tourism flows on the broader economy (e.g. Dixon et al., 2019; Wittwer, 2017). Other CGE tourism studies may focus on the impact of external shocks on the tourism sector or the effects of policy interventions. For example, studies may look at the effects of disease outbreaks (e.g. Dwyer et al., 2006), international events such as the Olympics (e.g. Blake, 2005) or taxation policy (see Dwyer (2015) for a comprehensive overview of types of CGE tourism analysis). Moreover, the interplay between climate impacts and tourism is another well-documented area of CGE research (e.g. Berrittella et al., 2006; Bigano et al., 2008; Roson and Sartori, 2014). Berrittella et al. (2006) document how changes in tourism demand caused by climate change propagate through the rest of the economy. They find that changes in tourism demand and household income lead to substitution effects for other goods and services and lead to changes in the demand and prices of capital and labour, which ultimately also affects investment flows and regional welfare (Berrittella et al., 2006).

[1] See the EU Tourism Dashboard (European Commission, 2023) for more information and data.

Another strand of tourism CGE studies that is relevant to the current paper is the analysis of negative exogenous shocks to tourism, and in particular the impact of COVID-19 (Arriola et al., 2022; Aydin and Ari, 2020; Leroy de Morel et al., 2020; Roson and Van der Vorst, 2023; UNCTAD, 2020; 2021). These studies provide insights on how to model exogenous shocks to tourism, such as a disease outbreak or a surge in energy prices. The UNCTAD report found that the global collapse of tourism would have severe negative consequences for global GDP, the wages of skilled employment and the demand for low-skilled employment (UNCTAD, 2020/2021). The analysis of Arriola et al. (2022) demonstrates that the rate of recovery of the tourism sector would also be strongly dependent on the extent of global coordination on the loosening of restrictions. These studies underline that the tourism sector was already no longer operating under business-as-usual circumstances when the sector was faced with rising energy prices in late 2021.

While, at the time of writing, there has not been much research on the effects of the 2022 energy price shock on tourism, there are some previous studies that look more generally at the connections between tourism and energy consumption. Notably, Poutakidou and Menegaki (2023) gauge the impact of the 2022 energy price shock in Greece by conducting questionnaires with both domestic tourists and hoteliers/managers. They find that Greek hoteliers were expecting a decrease in tourist expenditure due to higher energy prices. At the same time, tourists also seemed – to some extent – willing to rearrange their spending structure so that they did not have to sacrifice their holidays (Poutakidou and Menegaki, 2023).

Additionally, Becken and Lennox (2012) employ a CGE model to analyse the effects of an increase in oil prices on tourism in New Zealand and find that higher oil prices have a strong negative effect on tourism due to a combination of income and price effects. This study soft-links a global CGE model (GTAP) with a tourism-specific CGE model for the New Zealand economy, by first simulating a change in the productivity of oil production and using the results of this simulation to shock the tourism-specific model. Becken and Lennox (2012) also distinguish different origin destinations for tourism to New Zealand and find that exchange rates play an important role in determining tourism flows. Moreover, due to the high fuel costs of long-haul travel, more far-removed locations such as the UK saw a larger decrease in tourism to New Zealand.

An important consideration is that many of the studies above start with demand-side shocks to tourism, e.g. based on separate forecasts for future tourism demand, and subsequently analyse the effects of these shocks on the wider economy (e.g. Berrittella et al., 2006; Bigano et al., 2008; UNCTAD, 2020/2021). In other words, tourism demand in many of these studies is exogenous. This paper rather starts from an external shock (high energy prices) and evaluates how this affects tourism demand and the wider economy, keeping the demand for tourism-related sectors endogenous (i.e., as a modelling result).

In this paper, we describe the development of a new version of the JRC-GEM-E3 model, which has been used for many applications related to energy and climate change (e.g. Weitzel et al., 2023, Garaffa et al., 2023). This version allows zooming in on the tourism sector for the analysis of scenarios developed in the context of high energy prices. These effects are captured in the scenarios and the results indicate that these channels are more important than the direct effect from higher energy prices on the tourism sector itself. The findings suggest that despite a low energy intensity of the tourism sector, relative output losses are larger than other sectors, including some industrial sectors. This paper's results therefore support the need for a CGE model when assessing economic impacts, as the high energy prices affect the tourism sector via different channels.

The remainder of the paper is structured follows: Section 2 describes the model setup and the scenarios for the analysis. Section 3 presents and discusses the results. Section 4 concludes.

2. Methods

In this section, we give a brief overview of the JRC-GEM-E3 model used for the analysis in this study, in particular defining the 'tourism' sector as well as the baseline and energy price shock scenarios.

2.1. Model and tourism sector definition

We use the computable general equilibrium (CGE) model JRC-GEM-E3 (Capros et al., 2013; Weitzel et al., 2023), running several shocks over a projected baseline to assess the effects of higher fossil fuel and electricity prices. JRC-GEM-E3 is a global, multi-regional, multi-sectoral, dynamic-recursive CGE model developed to assess energy, climate and environmental policies. For this application, the model represents 33 sectors and 49 regions (27 EU member states and 22 other regions worldwide); see the Supplemental Information for a list of regions and sectors. Within each sector, a representative firm minimizes costs to produce output; production possibilities are defined with nested constant elasticity of substitution (CES) production functions. The different regions are linked via Armington trade (Armington, 1969), assuming that goods produced in different regions are imperfect substitutes. Capital and labour are assumed to be mobile between sectors, but not between regions. The labour market is modelled via a wage curve approach, allowing for an endogenous adjustment of unemployment. The model is run in recursive dynamic fashion and solved in 5 year time steps. However, in this paper we are less interested in the dynamics over time, but rather in the changes resulting from an exogenous fuel price shock for a given snapshot (time step) of the economy. For this purpose, we chose the model year 2025 as a reasonable approximation of the current description of the economy (in the absence of an energy price shock).

Final consumption by the representative household in a region is modelled using a linear expenditure system (LES) and 14 consumption purpose categories, which are linked to production sectors through a consumption matrix (Cai and Vandyck, 2020). Purchases of durable consumption goods (appliances and vehicles) are governed also by the price of a connected non-durable good (household energy and operation of vehicles, respectively). The purchase of these connected non-durables is not only governed by their price, but also the stock of the corresponding durables (Capros et al., 2013). The consumption matrix connects the demand per production sector (CPA, classification of products by activity) to consumer categories (COICOP, classification of individual consumption according to purpose). This is a central feature to the analysis of price shocks on consumers in JRC-GEM-E3 that is typically not captured in standard CGE models.[2] In our analysis, this is important to cover as the loss in real income leads to reduced purchasing power, which in turn leads to reduced spending across various consumption categories. Changes in the demand of these consumption categories therefore will have a direct effect on the demand of the tourism sector in JRC-GEM-E3.

[2] Using the initial consumption matrices from Cai and Vandyck (2020), we find some inconsistencies related to the tourism sector. For instance, in the original matrix, we find that the consumption of tourism ending-up as a relatively high share of expenditure in 'Clothing and Footwear'. This is caused by the construction of the underlying consumption dataset, which created a link between activity 'CPA_S96 Other personal services (S9609 - Other personal service activities n.e.c.)' and 'Clothing and Footwear' (COICOP-CP031 and -CP032 categories). We adjusted the consumption matrix to reduce the weight of this link. Table SI.3 in the Supplemental Information provides an overview of the calibrated consumption matrix aggregated to the EU to indicate the main connections between the new tourism sectors and consumption categories ('Recreational Services' and 'Miscellaneous Goods and Services').

The JRC-GEM-E3 model is calibrated to the input-output tables from the GTAP10 databases (Aguiar et al., 2019; Chepeliev, 2020), which includes 65 sectors. Among these sectors there is no explicit 'tourism' sector and the understanding of what is included within the tourism activities is not unique. Most global CGE analyses of the impact of COVID-19 on tourism made use of the GTAP database. For example, UNCTAD (2020; 2021) conducted an analysis of the impact of the shutdown of global tourism on GDP and employment. For this analysis, the UNCTAD report focuses on two GTAP sectors: 'Accommodation, food and service amenities' (AFS) and 'Recreation and other services' (ROS). The AFS sector in GTAP includes the ISIC Rev.4 Section 'I - Accommodation and food service activities', and the ROS sector includes the ISIC Sections: 'R - Arts, entertainment and recreation'; 'S - Other service activities'; and 'T - Activities of households as employers; undifferentiated goods and services-producing activities of households for own use'.[3] In this paper, we follow this choice and explicitly represent the AFS and ROS sectors, while in previous exercises with the JRC-GEM-E3 model (e.g. Weitzel et al. 2023, Garaffa et al., 2023), the AFS and ROS sectors were mapped into the broader 'Market Services' sector. For ease of representation, we aggregate the two new sectors into a single 'tourism' sector to show some of the results.

Other studies may make use of different definitions of the 'tourism' sector. For example, the 'Tourism ecosystem' in the Annual Single Market Report (European Commission, 2021a; European Commission, 2022) includes transport (categories H49 to H51), and travel agency and business-related activities (categories N79 and N82), but exclude the ISIC Sections S and T. This is relevant to keep in mind when interpreting the results of this paper, as a great share of tourism's impact in the EU happens through transport, in particular air transport, which is represented as a separate sector in JRC-GEM-E3. Moreover, some single country CGE models have implemented specific data extensions to reflect specificities of the tourism sector. For example, Wittwer (2017) expanded the USAGE CGE database for the US economy to include sectors such as domestic and foreign holidays of US residents, as well as exports of tourism services to foreign residents. Similarly, Dixon et al. (2019) developed VURM-VE, a CGE model for Australia with a specific focus on the visitor economy. The underlying data of the model includes tourism consumption (domestic and international) by Australians, tourism in Australia by foreign visitors and expenditure by foreign students in Australia. Leroy de Morel et al. (2020) use a similarly extended model of the New Zealand economy to analyse the impact of COVID-19 on tourism and the wider economy. While such extensions can provide additional insights, they would be much more difficult to implement in a global model and therefore are beyond the scope of this paper.

2.2. Baseline

In this paper, we draw on a baseline that includes recent economic developments (arising from the COVID-19 shock) and represents an up to date description of EU energy and climate policies. In particular, by calibrating the JRC-GEM-E3 model to be consistent with the energy balances from the PRIMES energy system model, changes in energy use and energy intensity follow historic trends and policies enacted under the Fit-for-55 package (European Commission, 2021b) in order to meet the EU's climate target of reducing greenhouse gas emissions by 55% below 1990 values. For the full set of policies considered, see Annex 6, Section 3.1.1 of European Commission (2024).

[3] The Supplemental Information describes the complete list of divisions for the AFS and ROS categories, which closely follow the *Nomenclature statistique des activités économiques dans la Communauté européenne* (NACE) Rev. 2 structure. The concordance between the GTAP sectors and the United Nations general classifications International Standard Industrial Classification of All Economic Activities (ISIC) rev. 4 and Central Product Classification (CPC) v.2.1 is available at GTAP (2024).

To describe the economy in the 2014 base year, we use the GTAP-Power database (Chepeliev, 2020) which provides additional detail to the GTAP10 database (Aguiar et al., 2019) by explicitly representing various power generation technologies. We use the PIRAMID tool, which applies a multi-regional, generalized RAS (MR-GRAS) algorithm, to project input-output tables with constraints that ensure that these calibration objectives are reached (Temursho et al., 2020; Wojtowicz et al., 2019). The time dependent parameters of the JRC-GEM-E3 model are then calibrated to reproduce the forward-projected input-output tables. The PIRAMID tool therefore allows for a consistent projection of energy use of the various sectors in JRC-GEM-E3.

For the baseline construction, we assume that the tourism sector will grow at the same rate as the other service sectors, i.e. faster than the rate of GDP for the EU. This assumption reflects that economies are shifting more towards services, while the share of industry in GDP becomes smaller. This implies that the share of tourism in the EU economy increases over time and reaches 6.4% of EU value added in 2025 (Figure 1). To calibrate energy use in the tourism sector, we downscale available energy projections for the aggregate service sector (including tourism) from European Commission (2024) by using information on the consumption of energy in the tourism sector as well as in other service sectors in the GTAP base year.

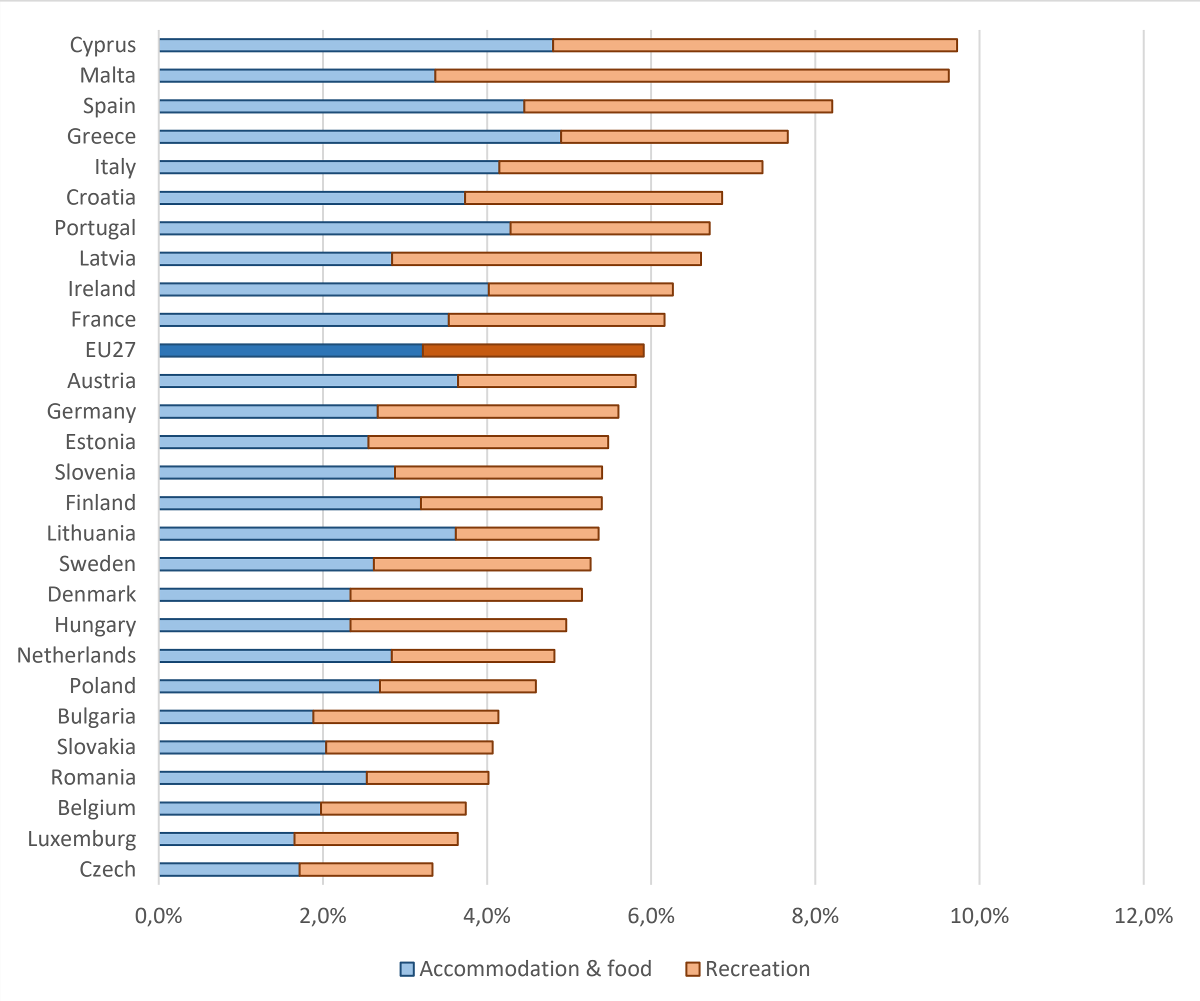

Figure 1. Total output for 'accommodation & food' and 'recreation' as a percentage of total output by Member State and for the EU. Reference scenario in 2025.

Source: JRC-GEM-E3.

Figure 1 indicates that in the baseline, the total output for tourism as a percentage of total output varies across EU member states. The total output share in main EU destinations like Spain (8.2%), Italy (7.4%) and Portugal (6.7%) is above the EU average (5.9%) reflecting the relevance of the tourism sector in these economies, whereas less visited destinations include Belgium (3.7%) and Denmark (5.2%). These values reflect a similar ranking of the importance of tourism in Member States as those of the EU Tourism Dashboard (European Commission, 2022). Figure 1 also indicates the relative importance of AFS and ROS in the different member states. Accommodation and food represent about half (54.5%) of the tourism sector in the EU, reaching higher shares in relevant EU tourism destinations like Greece (64%) and Portugal (63.9%). Combining this with data from European Commission (2022), which shows that enterprises operating in tourism are mainly concentrated in accommodation (14%) or food and beverage serving (61%) activities, this implies that AFS enterprises are generally smaller than ROS enterprises.

The direct impact of an energy price shock depends on the energy intensity, as a higher energy intensity will lead to larger cost increases. Figure 2 shows the fuel inputs as a monetary share (%) of the total value of output (production) of the two tourism subsectors for EU member states, and the corresponding energy intensity (in toe/M$). As expected, we observe that electricity is the main energy input to both tourism subsectors, with smaller shares in some countries for oil or gas. As transport is not included in the tourism sector as modelled here, the overall share of energy and in particular the share of oil is relatively low. Energy expenses account for only 0.7% of value of the accommodation & food and the recreation sectors, whereas they represent e.g., 7.8% in the ferrous metals sector. Therefore, energy price shocks are not expected to have substantial direct impacts over the tourism sector compared to, for example, more energy intensive sectors.

Figure 2. Fuel inputs as a share (%) of output and energy intensity (toe/M$) of the 'accommodation & food' (a) and 'recreation' (b) sectors by EU member state. Reference scenario in 2025.

Source: JRC-GEM-E3.

2.3. High energy price shock scenarios

The High Energy Prices (HEP) scenarios are based on the same policies as the ones included in the Fit-for-55 package in the baseline scenario, but with higher energy prices. Following the stylized scenario analysis performed for the impact assessment of the 2040 climate target in order to estimate the exposure of the EU economy to exogenous fuel price shocks under different levels of decarbonization (European Commission, 2024), we assume a doubling of fossil fuel prices in the HEP scenarios. In JRC-GEM-E3, the fuel price shock is modelled as a mark-up of the production of the corresponding fossil fuels (coal, oil, gas) in all regions, leading to increases on fossil fuel prices globally. However, we exempt from the price increase industries and consumers in countries where energy prices have not risen substantially in the recent energy crisis due to sufficient domestic supply; this is done by subsidizing domestic use in these regions, i.e. offsetting the mark-up for domestic consumption. For instance, domestic natural gas prices in exporting countries such as Russia or the USA are thus excluded from the full price increase[4]. For crude oil, the price increase is assumed to be more globally uniform as there is a liquid world market, i.e. all regions are subject to the same shock, except for Russia and the Middle-East, which are subject to half of the price increase. For coal, a globally uniform price increase of production is also assumed, with the exception of Australia, China, India, Russia and the USA, where it is limited to 50%, as much of it is a domestic market. While we follow some realism in terms of the regional distribution of a global price shock reflecting observations from the recent energy price crisis in Europe, the equal increase for all fossil prices deviate from the observed price changes, which were much more concentrated in gas markets.

As can be seen in Figure 2, electricity is the main energy cost for the tourism sector. While the JRC-GEM-E3 model captures higher input costs to the electricity generation sector under the scenarios with increased fossil prices, the change in electricity costs is relatively limited because of the average pricing mechanism in the model. Specifically, as in all sectors, electricity prices in JRC-GEM-E3 are set based on the cost of inputs. As fossil fuels account for a relatively low share of the overall cost of the electricity sector (including capital, labour and other intermediate inputs), the electricity price increase due to a doubling of fossil fuels is relatively limited. This is due to CGE models (including JRC-GEM-E3) typically operating with average prices being equal to average costs due to the assumption of constant returns to scale. In the 2022 energy price crisis, wholesale electricity prices also increased in line with change in gas prices, because gas fired power plants as marginal producers were setting the price for the whole market. We model these spill-overs with a mark-up on electricity prices to trigger a price increase of 50% in Europe. In this scenario, we further control for capital mobility out of the electricity generation and transmission & distribution sectors. Without this, higher electricity prices in the EU lead to lower electricity demand and thus lower capital use in the electricity sectors, which lowers the economy-wide rental value of capital under the assumption of capital mobility across sectors. Restricting the outflow of capital from the electricity sector to other sectors avoids that cheaper capital originally employed in the electricity sector reduces the production costs of other sectors, in particular those with relatively high value added shares like services (including tourism). Controlling for capital mobility is implemented in the model by reducing the capital stock after the energy price shock by the amount of capital outflows observed from the electricity sector. Since we are only interested in effects in a single year, this adjustment does not affect capital dynamics in following years.

[4] In addition to Russia and USA, exporting countries/regions excluded from the gas price increase are Canada, Middle-East, Africa and Australia. Mexico, Central America and South America are subject to half of the gas price increase.

The main scenario of the analysis includes price increases for all fossil fuels as well as the spill-over to electricity prices (HEP_fossil+elec). In addition, we run four scenarios with individual price shocks on coal (HEP_coal), gas (HEP_gas) and oil (HEP_oil) as well as all fossil fuels combined (HEP_fossil) to gauge the relative importance of price shocks for different fossil fuels. For all scenarios, we assume an imperfect labour market closure, allowing for (un)employment adjustments linked to a wage curve representation in JRC-GEM-E3. In response to the higher energy prices, real wages decline (as consumer prices increase), reducing labour supply in the short-term. Under an alternative closure with a perfect labour market, it can be expected that the results are qualitatively similar, but lower in magnitude.

3. Results and Discussion

3.1. Production and consumption changes at the EU level

As already mentioned above, energy price shocks are not expected to have substantial direct impacts on the tourism sector compared to, for example, more energy intensive sectors. This becomes more evident when looking at the results in Figure 3, which shows the change in sectoral production cost in the HEP_fossil+elec scenario for the EU, where we see a cost increase of 1.1% for recreation and 1.4% for accommodation and food in 2025. Note that these cost increases not only include the additional cost of energy purchases, but also increased cost from other intermediate inputs that are affected stronger by higher energy prices. This is also the reason why the tourism sub-sector with the lower energy intensity (AFS) has the higher price increase. Among all sectors, only the market service sector has lower price increases (0.6%) than the tourism sector. Other sectors are subject to higher impacts in their production cost; for example, energy intensive industry sectors like chemicals or ferrous metals experience price increases by 7.1% and 8.9%, respectively. Other sectors with significant additional costs include the transport sectors, due to their high cost share related to the purchase of fuels. Land, air, and water transport are faced with a cost increase of 5.2%, 12.6% and 14.4%, respectively.

Figure 3 indicates that despite the relatively minor increases in production costs from the energy price shock, the output of the tourism sectors declines by 2.2% in recreation and 3.2% in accommodation & food. This is relatively high and only water transport sector has a similar decrease (-3.1%). It is striking that the tourism sector as modelled has output losses that are larger than those of industrial sectors, which face significantly higher price impacts. This disconnection between price increases and output losses can be explained by general equilibrium effects. As energy prices increase not only in the EU, but also for competitors outside the EU, EU producers – which are producing with a relatively low energy intensity in the global comparison – are able to increase their market share in some of the sectors (see also Weitzel et al., 2024, for a further discussion with respect to the role of global vs. regionally heterogeneous energy price increases on industrial sectors in the EU). Note that the nature of the stylized energy price shock in this paper does not necessarily resemble the effects of the 2022 energy price crisis as it also assumes a doubling of oil prices globally. This leads to a significant loss in purchasing power and thus to a strong demand response for tourism (see also section 3.3). The large reduction of the tourism sectors in the EU is therefore due to indirect effects which do not relate to the price increase of the sector itself.

A significant share of demand for tourism activities comes from household consumption.[5] As explained in Section 2.1, the 33 productive sectors in JRC-GEM-E3 are linked to 14 household consumption categories. As such, there is no direct household consumption of accommodation & food and recreation, which are a productive sector in the model. Instead, the tourism sectors are linked to those consumption categories that reflect household demand for tourism. When looking at the changes of household demand in the tourism sector, the consumption categories that most reflect changes in the demand for tourism in JRC-GEM-E3 are 'Recreational services' and 'Miscellaneous goods and services' (Table SI.3). It is important to note that the consumption category 'Recreational services' is different from the productive sector 'Recreation'. Tourism corresponds to 66.2% of total households' consumption expenditures in 'Recreational services', while it corresponds to 11% of total households' consumption expenditures in 'Miscellaneous goods and services'. Tourism activities entering other consumption categories are minor.

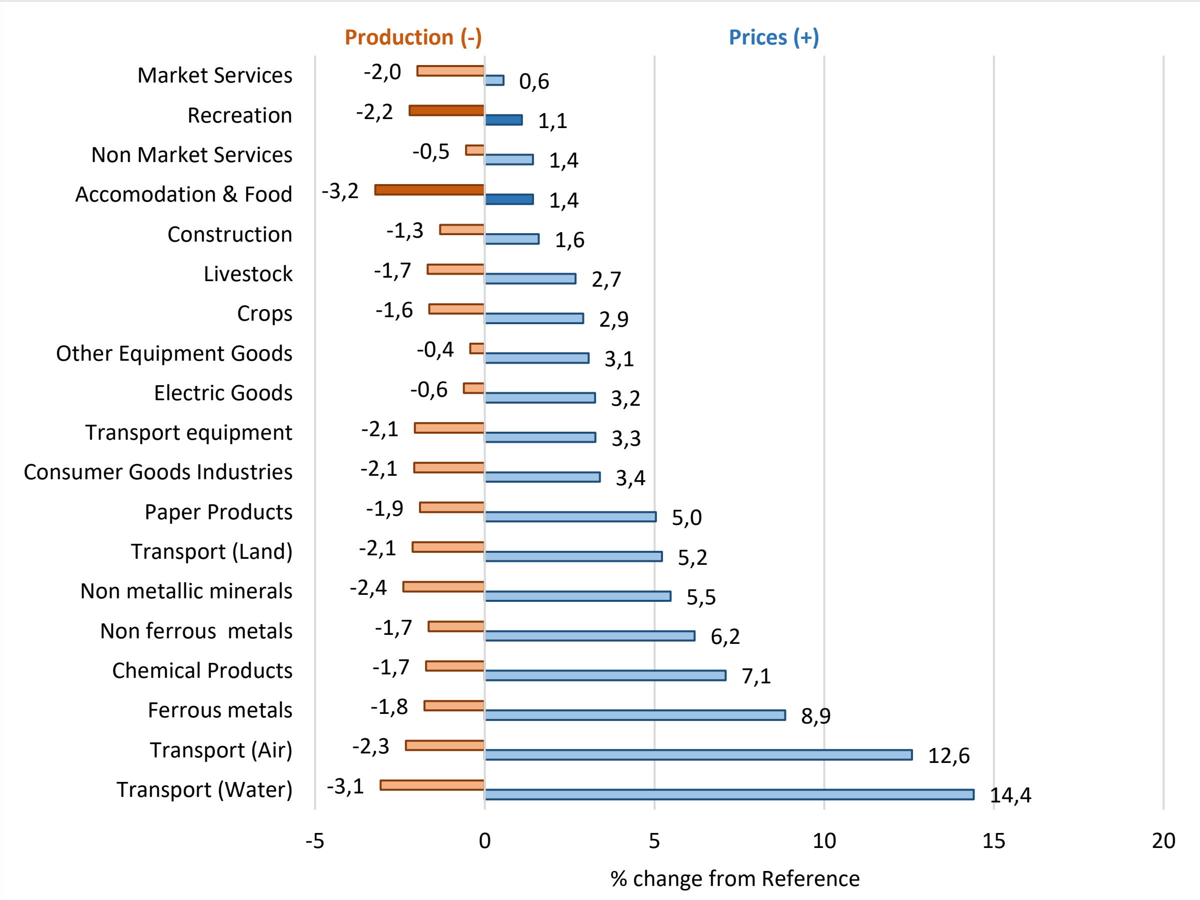

Figure 3. Production cost by sector (excluding energy sectors) in the High Energy Prices scenario with spill-overs to electricity prices (HEP_fossil+elec) the EU in 2025. Sorted by level of price increase, highlighting changes in the 'accommodation & food' and 'recreation' sectors (darker bars). Relative change (%) to the Reference.

Source: JRC-GEM-E3.

[5] There is also intermediate demand from other sectors and public purchases (e.g. arising from business travel). Final demand for tourism arising from fixed capital formation (i.e. investment activities) is negligible. In the scenarios, household demand declines by more than other demands for tourism in JRC-GEM-E3. We therefore also capture the empirical finding of Peng et al. (2014) that business travel (income elasticity of 1.6) is less sensitive to changes in income than travel related to visiting friends or relatives (income elasticity of 2.2) and holidays (income elasticity of 2.4).

Figure 4 visualises similar results as Figure 3, but this time looking at demand and prices from the household consumption perspective. In other words, the figure displays changes for the 14 household consumption categories rather than the productive sectors. Tourism (i.e. accommodation & food, and recreation) is not a consumption category, so instead, Figure 4 highlights the consumption categories that are most closely related to tourism. After the energy price shock, consumer prices for these two categories are not substantially affected and increase by 1.9% for 'recreational services' and 1.1% for 'miscellaneous goods and services', respectively, compared to the Reference scenario in 2025. More substantial price changes are observed in energy intensive categories, particularly in the 'operation of transport equipment' (12.1%) which reflects the price increase in oil products used in private transport (e.g., gasoline, diesel) and 'fuels and power' (38.5%) which contains the effect of increasing energy prices for heating as well as the household use of electricity to power appliances. It is important to point out that within the consumption category recreational services, the price change of the category (1.9%) is larger than that of the both tourism sub-sectors (1.1% and 1.4%, recall Figure 3). This is due to the 11.9% share of transport services with a significantly higher price change in this consumption category (based on Table SI.3). The model allows for some substitution within a consumption category, but overall transport and tourism are complements and thus the tourism sector is affected indirectly through price changes in transport services as spending on the recreational consumption category (*vis-à-vis* other consumption categories) is determined by the relative aggregate price, as well as changes in disposable income.

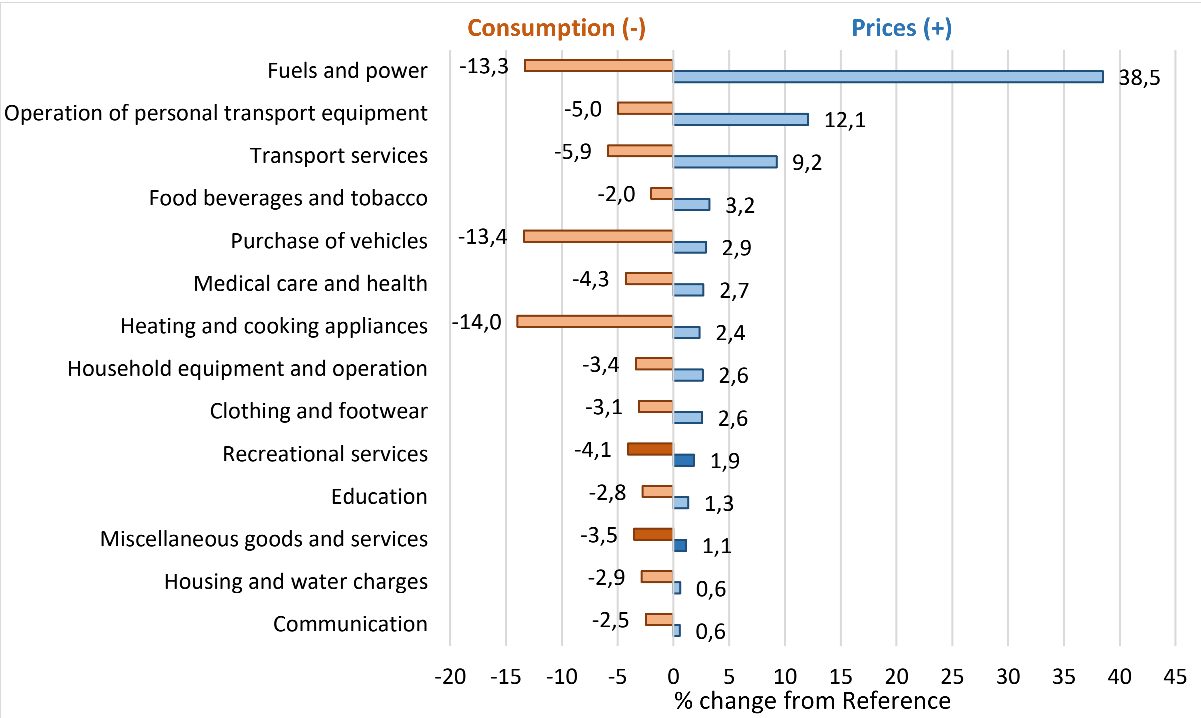

Figure 4. Households' consumption price for the EU in the High Energy Prices scenario with spill-overs to the electricity sector in 2025. Sorted by level of price increase, highlighting changes in the 'Recreational services' and 'Miscellaneous goods and services' consumption categories (darker bars) where most of final demand for the tourism sector is allocated. Relative change (%) to the Reference.

Source: JRC-GEM-E3.

In terms of quantities consumed, we observe consumption of 'Recreational services' and 'Miscellaneous goods and services' is decreased by 4.1% and 3.5%, respectively (Figure 4). While consumer prices do not substantially affect these two categories, when compared to other sectors, households reduce relatively more their consumption in these consumption categories than in other categories, such as 'Food and beverage'. While food and beverages have a relatively high price increase, the low income elasticity in this consumption category leads to a relatively low adjustment in the quantity purchased. Likewise, the reduction in the fuels and power as well as in transport services categories are relatively small compared to the large price increase. The price increase in basic consumption categories like energy, transport, and food thus imply that households will spend a larger share of their income on these goods. In contrast, 'recreational services' is typically a luxury good with an income elasticity larger than unity, which is in line with the income elasticities we use in JRC-GEM-E3. This means that the reduced available income (after fulfilling basic needs) will lead to overproportional cuts in consumption categories with high income elasticities, such as recreational services and miscellaneous goods. This explains the larger drop for lower expenditure levels in these consumption categories and are the main driver for reduced output in the European tourism sector.

3.2. Impacts in different EU member states

As shown in Figure 1, tourism plays a more important role in some EU member states compared to others. This is reflected in Table 1, which indicates that in the Reference scenario around 15.6 million jobs in the tourism sector are projected for the EU in 2025. Spain (13.3%) and Italy (12.0%) are the countries with higher share of tourism jobs in total jobs, above the EU average (8.0%). Unsurprisingly, the largest losses in output and employment occur in countries where high energy prices have the largest adverse impacts. These tend to be EU member states with a higher energy intensity which also tend to have lower per capita income levels. Further, in countries with lower per capita income levels, the income elasticity for recreational services is higher than in countries with higher per capita income levels. This means that the (domestic) demand by households for tourism is expected to decline stronger.

Overall in the EU, JRC-GEM-E3 projects the drop in tourism employment (3.7%) to be larger than the drop in sectoral output (2.9%); this also holds for individual member states. This is due to the assumption on the labour market closure which relates unemployment to changes in the real wage (see also Table 2). With the price increase of energy, consumer prices in general increase, leading to a decline in the real wage and higher unemployment. This affects in particular the tourism sector as a relatively labour intensive sector (6.3 and 8.7 workers per USD million produced for 'accommodation & food' and 'recreation', respectively) compared to other sectors such as consumer goods industries and market services (4.0 and 4.6 workers per USD million produced, respectively). In terms of absolute employment loss in the tourism sector, the overall effects are largest in bigger member states (e.g. Italy, Spain, Germany), while in relative terms, the largest losses are in Bulgaria, Lithuania and Latvia, where the energy price shock has a larger impact on the economy.

Table 1. Employment in the tourism sector by Member State and for the EU in 2025. Absolute number of jobs in tourism (combining 'accommodation & food' and 'recreation' sectors), as a share of jobs services and total employment (%), and (total) tourism output (USD bn) in the Reference scenario. Jobs losses (in absolute number of jobs and relative change %) and relative change in tourism output in the High Energy Prices scenario with spill-overs to electricity prices. Ranked by the share of tourism ('accommodation & food' and 'recreation') jobs in total jobs.

Member State	Reference scenario in 2025				HEP_fossil+elec scenario in 2025		
	Tourism sector jobs (thousands of workers)	Share of tourism jobs in services	Share of tourism jobs in total jobs	Total tourism output (USD bn)	Job losses from Reference (thousands of workers)	% change in jobs to Reference	% change in total output to Reference
Spain	2,675	20.4%	13.3%	247.6	-104.7	-3.9%	-3.0%
Italy	2,779	19.3%	12.0%	330.3	-88.1	-3.2%	-1.9%
Cyprus	50	19.4%	11.6%	6.7	-2.4	-4.9%	-4.0%
Ireland	263	14.3%	11.0%	67.9	-6.4	-2.4%	-2.5%
Slovenia	94	16.0%	9.8%	8.0	-4.2	-4.5%	-3.4%
Portugal	433	14.3%	9.4%	36.6	-19.3	-4.5%	-3.2%
Lithuania	105	15.8%	8.5%	7.1	-7.0	-6.7%	-4.7%
Greece	321	13.5%	8.5%	33.6	-18.1	-5.6%	-4.0%
Malta	24	11.6%	8.3%	4.1	-1.5	-6.3%	-4.2%
Austria	343	12.5%	8.0%	58.0	-9.6	-2.8%	-2.0%
Croatia	126	13.1%	8.1%	9.2	-7.1	-5.7%	-4.8%
France	2,160	11.5%	8.0%	356.6	-69.6	-3.2%	-2.4%
Germany	2,919	11.8%	7.3%	472.1	-93.9	-3.2%	-2.2%
Estonia	181	10.8%	7.3%	33.2	-6.8	-3.8%	-2.8%
Finland	45	12.5%	7.3%	4.4	-3.0	-6.7%	-5.4%
Latvia	55	13.3%	7.2%	5.8	-4.9	-8.8%	-6.2%
Denmark	178	9.6%	6.4%	40.3	-4.5	-2.6%	-2.1%
Sweden	315	8.5%	6.1%	66.9	-10.1	-3.2%	-2.3%
Hungary	275	10.0%	6.0%	20.6	-16.3	-5.9%	-4.0%
Netherlands	492	8.3%	5.6%	109.1	-9.4	-1.9%	-0.6%
Luxemburg	16	7.3%	5.2%	10.3	-0.4	-2.3%	-1.6%
Slovakia	123	9.2%	5.2%	11.6	-5.7	-4.7%	-3.0%
Belgium	801	8.9%	4.9%	75.7	-37.2	-4.6%	-3.6%
Poland	236	7.5%	4.8%	57.2	-9.3	-4.0%	-2.9%
Bulgaria	131	9.2%	4.6%	7.4	-11.4	-8.7%	-6.2%
Czech	195	7.8%	3.9%	21.1	-7.8	-4.0%	-2.5%
Romania	298	8.6%	3.8%	22.7	-13.9	-4.7%	-3.9%
EU27	15,635	12.9%	8.0%	2,124.1	-572.8	-3.7%	-2.4%

Source: JRC-GEM-E3.

3.3. Sensitivity for shocks in different fuels

In order to determine which type of energy shock that is most detrimental for the tourism sector, Table 2 reports macroeconomic indicators as well as indicators concerning the EU tourism sector scenarios that shock only individual fuels, and the scenario with price spill-overs to the electricity sector. From the macro indicators, the shock on the oil price clearly has the largest impact among the fossil fuels, but with the spill-over to the electricity prices hurting economic activity the most, due to the widespread use of electricity. Electricity directly consumed by households constitutes a relevant expenditure, meaning that price changes directly reach households and affect overall consumption choices. This also explains why aggregate consumption falls most under this scenario and the consumer price index increases most. At the same time, the additional effect of energy price increases to the electricity sector has the largest impact on aggregate employment. This is not only due to the increase in consumer prices caused by the electricity component in the consumption basket and the related reduction in the real wage. It is also caused by the fact that the electricity sector has a larger working force compared to other fossil fuels. Higher electricity prices depress electricity demand, which in the CGE model results in reductions in sectoral employment for the electricity sector of JRC-GEM-E3. This additional supply of labour further reduces the wage rate and increases unemployment. While we do not allow for this type of spill-over for capital (see Section 2.3, scenario description), there is however an impact through the labour market.

Table 2. Macroeconomic and tourism indicators for high energy prices in different High Energy Price scenarios. Relative change (%) to the Reference in 2025.

Macroeconomic indicators	coal	oil	gas	fossil (coal+oil +gas)	fossil +elec
Gross Domestic Product	-0.03	-0.50	-0.17	-0.74	-1.73
Investment	0.02	0.03	-0.05	0.00	-0.77
Private Consumption	-0.18	-1.75	-0.49	-2.50	-3.97
Consumer Price Index	0.38	2.13	0.44	2.96	3.93
Employment	-0.04	-0.71	-0.23	-1.05	-2.39
Skilled Labour	-0.02	-0.78	-0.23	-1.16	-2.54
Unskilled Labour	-0.05	-0.66	-0.24	-0.98	-2.29
Indicators related to tourism					
Related to the tourism sectors (i.e. the production side)					
Price increase in Accommodation & Food	0.30	0.92	0.11	1.35	1.42
Price increase in Recreation	0.28	0.86	0.20	1.35	1.09
Output change in Accommodation & Food	-0.15	-1.45	-0.37	-2.07	-3.23
Output change in Recreation	-0.12	-0.86	-0.29	-1.34	-2.21
Employment change in Accommodation & Food	-0.16	-1.76	-0.45	-2.51	-3.91
Employment change in Recreation	-0.16	-1.41	-0.44	-2.10	-3.45
Related to the consumption category 'Recreational services' (i.e. the consumption side)					
Price increase for consumption of recreational services	0.30	1.35	0.12	1.78	1.78
Quantity decrease for consumption of recreational services	-0.19	-1.85	-0.48	-2.63	-4.07

Source: JRC-GEM-E3.

Comparing the indicators related to the tourism sectors, the oil price shock contributes most to the increases in the price of the recreational services consumption category, which is the price that consumers consider for the bundle that includes most of tourism. The shock both affects the price of the accommodation & food as well as recreation sectors (mainly through intermediate inputs, as the direct consumption of oil is relatively minor, recall Figure 2) and through the cost of transport services. In all cases, the price of the consumption bundle recreational services increases more than the price of the productive tourism sectors. This increase in prices as well as the reduced income available for luxury consumption then leads to a reduction in the purchase of recreational services. Despite having a price increase that is lower than the change in the consumer price index (CPI), the reduction in consumption of recreational services is at least as big as the change in aggregate consumption.

In all scenarios, the decline of the tourism output sectors is smaller than the decline in the consumption of recreational services, which indicates some substitution within that consumption bundle of recreational services. Further, the decline of tourism output is larger than the decline in GDP for the whole economy, indicating that tourism is affected overproportionally; the same applies for employment. Given that the direct price increase is limited, this points to the conclusion that the main effect on the tourism sector is caused from the demand side as consumer spending is diverted to higher priced necessities. Across the different fuels, a price increase for oil and electricity has the largest effect on output and employment in the tourism sector, as this has the largest effect on aggregate consumption, and thus leads to the strongest adjustment in income available for luxury consumption. Note that when adding the spill-overs of fossil energy prices to the electricity prices, the price increase of tourism and recreational services is lower than under only a price increase of fossil fuels. This is due to the low value share of energy (including electricity) inputs in this sector, but a relatively large value share of labour. The lower wages thus outweigh the higher energy costs for the tourism sector under our labour market closure.

4. Conclusions

While previous studies have looked more generally at the connections between tourism and energy consumption, the effects of the 2022 energy price shocks on tourism were not explored explicitly. In this paper, we look more specifically into the impacts of high energy prices on the tourism sector in the EU. To do so, we extend the JRC-GEM-E3 model to include an additional sectors 'Accommodation and food and beverage service activities' (AFS) and 'Recreational and other services' (ROS) to represent tourism.

While the direct increase on the costs of tourism are limited, the overall effects on the sector can still be sizable and the output loss can be larger than changes in GDP and employment for the whole economy, i.e. the sector is affected overproportionally from high energy prices. This is driven primarily by a demand side effect. As households spend more on necessities, they cut back expenditure on luxury goods such as recreational services, including tourism. In addition, tourism is often purchased together with transport services, which are typically energy intensive, so higher energy prices have negative spill-over effects on the demand for tourism. Therefore, price shocks affecting oil and electricity are most pervasive to the tourism sector because they cause the largest reduction in available income by households and oil price increases have the largest effect on the price of transport services.

While these insights are useful to understand how energy price shocks can have repercussion effects on sectors less directly affected, there may be aspects that we do not capture (explicitly) in the current version of JRC-GEM-E3. There may for example be substitution within tourism, e.g. consumers still going on vacation, but using less pricy accommodation. While the quantity reduction for transport is larger than for tourism, we do not explicitly model how higher energy prices may shift tourism towards closer destinations. In particular, we may not fully capture repercussions on international tourism, i.e. tourists from northern European countries substituting tourism in classic destinations like Spain or Italy with domestic tourism – our consumption bundle links transport with tourism, but not specifically for individual 'packages' (e.g. air transport with international tourism and land transport with domestic tourism), which means that destinations with large international inflow of tourism may be affected stronger than shown in our results.

At the same time, model results from the stylized scenarios depicted in this study can differ qualitatively in some aspects during the energy price crisis of 2022. Declines in bookings would be lower than suggested by the model if there was a shift in preferences (Poutakidou and Menegaki, 2023), e.g. a higher valuing of tourism also to still make up for missed vacations during the COVID-19 period. Further, while the price shocks observed in 2022 differed from the stylized price shocks assessed here, policies were rolled out to reduce the negative effect on households (Fulvimari et al., 2023). While measures targeted at poorer households and specific hardships would benefit people with a low expenditure share to tourism activities, not all response policy followed such a targeted approach. Policies were also in place to avoid job losses due to a temporary shock, which may have dampened the labour market response. Despite these differences, the stylized scenarios are still valuable to understand the mechanisms at play that show the forces to which the tourism sector is exposed in a situation of an energy price shock.

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Supplemental Information

Concordance between GTAP sectors and ISIC classification

With respect to the concordance to ISIC Rev. 4, the AFS sector in GTAP includes classification I - Accommodation and food service activities (same as NACE rev.2), which comprises the following divisions:

- I55 - Accommodation
  - 5510 - Short term accommodation activities
  - 5520 - Camping grounds, recreational vehicle parks and trailer parks
  - 5590 - Other accommodation
- I56 - Food and beverage service activities
  - 5610 - Restaurants and mobile food service activities
  - 5621 - Event catering and other food service activities
  - 5629 - Other food service activities
  - 5630 - Beverage serving activities

The ROS sector in GTAP includes three broad classifications: R - Arts, entertainment and recreation; S - Other service activities; and T - Activities of households as employers; undifferentiated goods and services-producing activities of households for own use. The three classifications comprise the following divisions:

- R90 - Creative, arts and entertainment activities
- R91 - Libraries, archives, museums and other cultural activities
  - 9101 - Library and archives activities
  - 9102 - Museums activities and operation of historical sites and buildings
  - 9103 - Botanical and zoological gardens and nature reserves activities
- R92 - Gambling and betting activities
- R93 - Sports activities and amusement and recreation activities
  - 9311 - Operation of sports facilities
  - 9312 - Activities of sports clubs
  - 9319 - Other sports activities
  - 9321 - Activities of amusement parks and theme parks
  - 9329 - Other amusement and recreation activities n.e.c.
- S94 - Activities of membership organizations
  - 9411 - Activities of business and employers membership organizations
  - 9412 - Activities of professional membership organizations
  - 9420 - Activities of trade unions
  - 9491 - Activities of religious organizations
  - 9492 - Activities of political organizations
  - 9499 - Activities of other membership organizations n.e.c.
- S95 - Repair of computers and personal and household goods
  - 9511 - Repair of computers and peripheral equipment
  - 9512 - Repair of communication equipment
  - 9521 - Repair of consumer electronics
  - 9522 - Repair of household appliances and home and garden equipment
  - 9523 - Repair of footwear and leather goods

    - 9524 - Repair of furniture and home furnishings
    - 9529 - Repair of other personal and household goods
- S96 - Other personal service activities
    - 9601 - Washing and (dry-) cleaning of textile and fur products
    - 9602 - Hairdressing and other beauty treatment
    - 9603 - Funeral and related activities
    - 9609 - Other personal service activities n.e.c.
- T97 - Activities of households as employers of domestic personnel
- T98 - Undifferentiated goods- and services-producing activities of private households for own use
    - 9810 - Undifferentiated goods-producing activities of private households for own use
    - 9820 - Undifferentiated service-producing activities of private households for own use

JRC-GEM-E3 sectors and regions

Table SI.1: Sectors in the JRC-GEM-E3 model

Energy sectors	Other sectors
Coal	Crops
Crude Oil	Ferrous metals
Oil	Non-ferrous metals
Gas	Chemical Products
Electricity supply	Paper Products
Coal fired	Non-metallic minerals
Oil fired	Electric Goods
Gas fired	Transport equipment
Nuclear	Other Equipment Goods
Biomass	Consumer Goods Industries
Hydro electric	Construction
Wind	Transport (Air)
Solar PV	Transport (Land)
	Transport (Water)
	Market Services
	Non Market Services
	Livestock
	Forestry
	Accommodation & Food
	Recreation

Source: JRC-GEM-E3.

Table SI.2: Regions in the JRC-GEM-E3 model

EU27	Other regions
Austria	Argentina
Belgium	Australia
Bulgaria	Brazil
Cyprus	Canada
Czech Republic	China
Germany	United Kingdom
Denmark	Indonesia
Spain	India
Estonia	Japan
Finland	Korea
France	Mexico
Greece	Russian federation
Hungary	Saudi Arabia
Ireland	Turkey
Italy	USA
Lithuania	South Africa
Luxembourg	EFTA
Latvia	Middle East
Malta	Africa
Netherlands	Other Americas
Poland	Other Asia
Portugal	Rest of Eurasia
Slovakia	
Slovenia	
Sweden	
Romania	
Croatia	

Source: JRC-GEM-E3.

JRC-GEM-E3 sectors and consumption categories

Table SI.3. Sectors of production and consumption categories in JRC-GEM-E3. Coloured rows and columns indicate the main consumption categories affected by tourism demand. Values in $2014 billion for the EU27 in the Reference scenario in 2025. Households do not directly consume output from power generation technologies.

JRC-GEM-E3 sectors of production / Consumption categories	Food beverages and tobacco	Clothing and footwear	Housing and water charges	Fuels and power	Household equipment and operation	Heating and cooking appliances	Medical care and health	Purchase of vehicles	Operation of personal transport equipment	Transport services	Communi-cation	Recrea-tional services	Miscella-neous goods and services	Educa-tion	Total
Crops	84.3	0.0	0.0	0.0	0.0	0.0	0.0	8.4	7.8	0.0	0.0	1.5	0.0	0.0	102.0
Coal	-	-	-	6.1	-	-	-	-	0.0	-	-	-	-	-	6.1
Crude Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Oil	-	-	-	26.4	-	-	-	-	141.2	-	-	-	-	-	167.6
Gas	-	-	-	44.5	-	-	-	-	2.0	-	-	-	-	-	46.5
Electricity supply	-	-	-	89.7	-	-	-	-	1.1	-	-	-	-	-	90.8
Ferrous metals	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4
Non-ferrous metals	0.0	0.1	0.0	0.0	0.2	0.0	0.0	0.0	0.0	-	-	0.0	0.1	0.0	0.5
Chemical Products	65.4	12.9	3.8	0.7	38.0	0.0	76.0	0.0	15.4	0.0	0.0	13.6	29.6	0.0	255.4
Paper Products	23.8	5.1	0.5	0.0	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.2	8.0	0.0	40.2
Non-metallic minerals	0.0	0.0	2.5	4.2	14.1	3.8	0.0	0.0	2.5	0.0	0.0	1.1	1.6	0.0	29.9
Electric Goods	0.1	0.0	0.0	0.0	80.7	80.0	3.2	0.0	22.4	0.0	4.0	1.5	13.7	0.0	205.6
Transport equipment	0.0	0.0	0.0	0.0	1.4	0.0	0.5	129.9	12.9	0.0	0.0	0.0	0.8	0.0	145.6
Other Equipment Goods	0.0	52.4	0.9	0.0	94.6	8.8	41.8	0.0	3.2	0.0	0.1	15.6	51.2	0.0	268.7
Consumer Goods Industries	1,010.3	119.6	0.2	0.0	10.9	0.0	0.6	5.9	0.0	0.0	0.0	2.1	1.5	0.0	1,151.2
Construction	0.0	0.0	35.1	0.0	21.5	34.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	90.8
Transport (Air)	5.6	0.1	0.8	0.0	0.0	0.0	0.0	0.1	0.0	107.1	0.0	14.5	0.0	0.0	128.2
Transport (Land)	5.2	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	141.8	0.0	148.0	0.0	0.0	295.8
Transport (Water)	2.6	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	17.8	0.0	0.5	0.0	0.0	21.0
Market Services	14.1	133.7	1,820.8	11.5	149.9	0.5	7.5	0.7	404.8	3.4	239.4	240.8	914.8	0.2	3,942.1
Non Market Services	29.2	1.9	4.4	0.1	4.6	0.6	286.9	1.7	8.5	0.0	0.1	24.1	70.9	88.8	521.7
Livestock	34.9	0.0	0.0	0.0	0.2	0.0	0.0	1.7	0.0	0.0	0.0	0.5	0.5	0.0	37.8
Forestry	-	-	-	13.9	-	-	-	-	-	-	-	-	-	-	13.9
Accommodation & Food	3.3	0.0	81.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	786.2	0.0	0.0	871.1
Recreation	15.5	36.1	32.9	0.0	93.0	13.4	9.5	0.3	1.5	0.0	0.5	121.7	134.9	0.3	459.6
Total	1,294.3	362.1	1,984.2	197.2	512.3	141.2	426.1	148.7	623.3	270.1	244.2	1,372.1	1,227.5	89.3	8,892.6

Source: JRC-GEM-E3

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