DSGEs and PVARs: Applications to Macroeconomics

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Abstract

This thesis adopts DSGE and PVAR models to examine three questions in macroeconomics. The first chapter singles out some pitfalls that DSGE models face when a fraction of rule-of-thumb consumers is assumed in order to replicate the positive response of consumption to government spending shocks observed in SVAR models. The second chapter quantifies the importance of the tourism channel for the international transmission of cyclical fluctuations to the Mediterranean basin. We show that, absent tourism flows, the output effects in a typical destination country would be one-fourth smaller. The third chapter examines the impact of austerity shocks on labor markets in the euro area. We find that the cross-country responses of labor market variables differ, notwithstanding similar output multipliers, as institutional reforms and dedicated policy plans foster the link between fiscal impulses and the domestic labor market.

Resumen

Esta tesis adopta modelos DSGE y PVAR para examinar tres preguntas de macroeconomía. El primer capítulo identifica algunas dificultades que enfrentan los modelos DSGE cuando se supone que una fracción de consumidores sea de tipo rule-of-thumb con el fin de replicar la respuesta positiva del consumo a los shocks de gasto público que se observa en los modelos SVAR. El segundo capítulo cuantifica la importancia del canal de turismo para la transmisión internacional de las fluctuaciones cíclicas en la cuenca mediterránea. Se demuestra que, ausentes los flujos de turismo, los efectos sobre el producto en un país mediterráneo sería un cuarto menor. El tercer capítulo examina el impacto de los shocks de austeridad en los mercados laborales de la zona Euro. Encontramos que las respuestas de las variables del mercado laboral difieren entre los países, no obstante multiplicadores de producción similares. Las cuasas parecen estar relacionadas con reformas institucionales y planes de política económica dedicados que fomentan el vínculo entre los impulsos fiscales y del mercado laboral nacional.

Foreword

This dissertation collects three essays in macroeconometrics. While each chapter asks a different question, the methodological approach is shared across all of them. The use of quantitative macroeconomic models to describe how variables of interest respond to economic shocks represents the common denominator of this work.

The first chapter takes the lead from the fact that Dynamic Stochastic General Equilibrium (DSGE) models have a hard time replicating the positive consumption response typically found in Structural Vector Autoregressive (SVAR) models in response to government spending shocks. It then tests whether a DSGE model featuring a fraction of rule-of-thumb consumers generates consumption dynamics consistent with those obtained from SVAR models, thus overcoming the dichotomy between the former and the latter class of models. A limited information estimation method which involves a comparison of the impulse response functions in the DSGE and the SVAR is used. A set of statistical tests is adopted to detect those impulse response functions that are valid and relevant. The results show that no combination of the estimated model parameters can deliver a consumption impulse response in the DSGE that is close to the one obtained from the SVAR. Accordingly, the statistical tests detect the consumption impulse response in the model as misspecified. Since most of the extensions that usually show up in medium scale DSGE models are unsuccessful at reconciling the consumption dynamics in the model with those in the data, the evidence casts doubts on the ability of the rule-of-thumb mechanism to effectively match the data along the very same aspect that it aims at explaining.

The second chapter, co-authored with Fabio Canova, investigates the importance of the tourism channel for the international transmission of cyclical fluctuations to the Mediterranean basin. We use five Mediterranean destination countries and a number of source countries, for the most part located in Europe, to provide broad evidence on the link between tourism and business cycles. We show that source country output shocks produce important fluctuations in international tourism flows, confirming the luxury good characteristics of international tourist flows. Crucially, tourism appears to be an important channel for the international transmission of output shocks: absent the tourism channel, the output effects in a typical destination country would be reduced by about one-fourth. Shocks to tourism unrelated to output fluctuations in the source country - but instead to preferences for certain locations, aggressive marketing strategies or political instability - are also important for destination country output. On the policy front, our empirical analysis supports development strategies and international trade agreements focused on tourism. On the one hand, the effective management of tourism flows can guarantee a stable source of revenues for destination countries in the Mediterranean. Given that in certain regions, like the Middle East, tourism flows are potentially important but currently hampered by political and religious disputes, the potential gains from boosting the tourism sector are sizable. On the other hand, policy actions trying to improve integration in the Mediterranean should not be devoted only to establishing stronger trade links. Fostering the tourism relationships may help Mediterranean economies to integrate faster with the EU.

The third chapter provides empirical evidence on the link between fiscal policy and the labor markets for a group of euro area countries. While output multipliers have received a lot of attention in recent research, this chapter shows that fiscal policy, growth and the labor markets should be jointly considered. First, countries with similar output responses to fiscal innovations can experience very different unemployment multipliers, as institutional reforms and public investment plans foster the link between growth and jobs. Spain and Germany - one launched ambitious public infrastructure and housing plans, the other reformed its system of labor relations - are flagship cases. They both share similar output multipliers with Italy, a country notoriously lagging in its efforts to modernize the labor markets and administer public investment projects affectively, but score considerably larger unemployment multipliers. Cross-country segmentation in unemployment responses exposes the common currency block to risks and high adjustment costs. Flexibility in hours worked and wages could provide an alternative channel of adjustment and smooth the effects of adverse fiscal shocks, but our evidence shows that their contribution is negligible. Second, growth and jobs are intertwined also along the participation margin. We show that during normal times the negative income effect associated to fiscal contractions prevails and forces agents to join the labor force and look for jobs, thus participation goes up. However, government consumption cuts have driven the participation rate down since 2007. The reversal is limited to peripheral euro area countries, i.e. those more severely hit by the crisis and those where black labor markets ballooned in recent years. Policymakers should be wary of the perverse effects that austerity measures have on workers' decision to quit the labor force at times of slack activity and low job-finding rates.

Contents

Chapter 1

Testing Rule-of-Thumb Using IRFs Matching

1.1 Introduction

As the events in the aftermath of the 2008 global financial crisis exemplified, government spending is among the most important tools of macroeconomic stabilization policy. Over the last few years, policymakers all around the world - including the US and Europe - turned to large stimulus packages in order to stimulate private demand, restore confidence or sustain the banking sector.

Given the importance that policymakers place on this policy instrument, a solid understanding of the effects that government spending has on the economy would of course be desirable. Yet, macroeconomists lack a unified framework to study how these effects propagate to other variables of interest.

One such example concerns a very important part of the transmission mechanism, that is the response of consumption to government spending shocks: is it positive or negative?

The tools currently available do not help: on the one hand, highly parameterized models - like dynamic stochastic general equilibrium (DSGE) models - say negative, mainly as a consequence of Ricardian agents populating the economy[1]; on the other hand, more parsimonious models - like structural vector autoregressions (SVAR) and dynamic factor models (DFM) - say positive[2].

Within the DSGE literature, Gali et al (2007) - GLV when convenient - propose a New Keynesian model where a fraction of households consumes

[1]See Fatas and Mihov (2001) for a review.

[2]See Caldara and Kamps (2008) and Forni and Gambetti (2010), respectively.

all income available in every period. Various explanations have been suggested for this behavior, which is often referred to as rule-of-thumb or hand-to-mouth: in a strict sense, these consumers could be truly thought as myopic and short-sighted; in a metaphorical sense, they could be viewed as credit constrained and without access to financial markets.
The most notable result of Gali et al (2007) is to show that this feature is enough to obtain a positive response of consumption to a government spending shock.

The aim of this paper is to go one step further by asking whether this strategy is successful not only at delivering a positive response of consumption on impact, but also model dynamics that are compatible with those encountered when data-generated impulse responses are taken as benchmark[3]. This is important for at least two reasons.
First, over the last few years, a number of alternative solutions have been proposed to obtain a positive response of consumption to government spending shocks. Some of those have been shown to replicate the data well in at least few dimensions of interest[4]. It is, therefore, important to explore whether the rule-of-thumb mechanism makes sense when confronted with the data, that is to check if the model delivers empirically plausible IRFs for some key variables, or else what changes are necessary for this to happen. In this sense, the present paper can be interpreted as an attempt to make some progress in discriminating between competing models of government spending shocks[5].
The question also carries a non-trivial policy relevance as it aims at uncovering whether the rule-of-thumb mechanism can successfully meet the data when VAR-based impulses are adopted as the metrics for evaluation, or it works fine only in a stylized setting. To many macroeconomists this may look particularly appealing in light of the fact that, compared to alternatives which involve re-writing the microfoundations of a model, the solution adopted in Gali et al (2007) is probably more palatable: while resorting to microfoundations is regarded by some as ad hoc, only few would reject *ex ante* the

[3]In a sense, the way the Gali et al (2007) paper is organized, with VAR evidence presented first and the model described right after, makes the reader curious about what happens if one tries to bring the two closer together. This paper investigates precisely this matter.

[4]Zubairy (2009) does so explicitly for a model with deep habits, but also Monacelli and Perotti (2008) and Linnemann (2006) dedicate attention to this aspect.

[5]Kormilitsina and Zubairy (2012) go after this question comparing marginal densities of various models, as is also done in Lopez-Salido and Rabanal (2006).

possibility that a fraction of households in the economy deviates from Ricardian behavior.

In order to implement our research question, we adopt a classical limited information approach and we apply impulse response function (IRF) matching to impulses generated from a model with rule-of-thumb consumers and a SVAR. The fact that the empirical regularity that rule-of-thumb consumption aims at replicating is drawn from VAR-based evidence, makes the latter a natural benchmark to check whether the model can replicate the data along the dimension of interest. By so doing, we minimize the number of confounding factors that may affect the results, like additional shocks in order to complete the probability space of the model that would be necessary if one opted for full information estimation, or frictions to make the model realistic in non-crucial dimensions.

Finally, we adopt the statistical criteria proposed in Hall et al (2012) to identify valid and relevant IRFs. These criteria have been developed to select only the IRFs that allow to consistently estimate the parameters using non-redundant information and they prove to be a useful tool for our goals.

To the best of our knowledge, Bilbiie et al (2008) apply IRFs matching to investigate what mechanisms account for the changes in the transmission of US fiscal policy in a model with rule-of-thumb consumers. Beyond the very different focus, there is a key difference between their paper and mine: these authors use a model where households' preferences are non-separable in consumption and leisure[6]. As pointed out in Linnemann (2006), non-separable preferences make the consumption Euler equation observationally equivalent to the one obtained in a model with rule-of-thumb consumers and are *per se* enough to generate a positive response of consumption[7]: thus, while mutually non-exclusive, the two mechanisms are rival rather than complement[8].

[6]In their empirical application, the value of the inverse of the intertemporal elasticity of substitution is calibrated at two: for the class of utility function they consider, any value different from one implies non-separability.

[7]Bilbiie (2009) further generalizes this result.

[8]The discussion in section 6 of Gali et al (2007) adopts a similar perspective. The idea that the two mechanisms are distinct alternatives is found in Bilbiie (2011) as well. Kiley (2010) investigates which one among habits, non-separable preferences or rule-of-thumb is responsible for the predictability of consumption growth: his approach is also consistent with the view expressed here. Kormilitsina and Zubairy (2012) obtain a positive consumption response when non-separable preferences and rule-of-thumb consumption are considered together, but an insignificantly positive response when non-separable preferences are dropped and the estimated share of rule-of-thumb consumers remains the same. Although for intertemporal non-separability in consumption, Weber (2002) finds that estimated share of rule-of-thumb consumers becomes insignificant in a model with non-separable preferences.

Instead, we adopt in full the model in Gali et al (2007) that features separable preferences in consumption and leisure.

Related to the discussion above is whether the share of rule-thumb consumers is invariant to changes in policies - i.e. structural - and can therefore be meaningfully estimated. In this regard, it should first be noted that this is not the only paper in the literature that uses estimation: others, listed below, have turned to this method before. Secondly, it is important to remark that the scope here is not to perform a policy experiment, nor to assign any specific interpretation to the rule-of-thumb consumers, out of the few that are usually offered: consequently, it is not necessary to model further how this parameter relates to preferences, technology or institutions.
Instead, as explained in earlier paragraphs, this paper takes inspiration from the methods versus substance approach in the sense that, by matching the model to the data along a crucial aspect, it aims at shedding light on how the former compares to other rivals and whether the estimated values for some relevant parameters are consistent with their calibration counterpart.

The share of rule-of-thumb consumers has been the object of many studies both in the macroeconomic, microeconomic and finance literature: in addition to those that we already mentioned, a list of some that are related to this paper follows. Di Bartolomeo et al (2006), Fioroni et al (2007), Lopez-Salido and Rabanal (2006), Yasuharu (2011) embed rule-of-thumb consumers into models *à la* Smets and Wouters (2003, 2007) that go estimated using Bayesian methods on either US, European or Japanese data and find it to be below 0.5. Canova and Paustian (2011) test the robustness of the share of rule-of-thumb consumers to randomization of the parameter space and find that it falls well above 0.5.

Our results demonstrate that estimates of the share of rule-of-thumb consumers vary a lot depending on the assumed labor market structure, making the latter an assumption a researcher needs to be clear about. We also establish that the consumption dynamics implied by the model are hard to believe if data-generated IRFs are taken as benchmark: in fact, the statistical criteria of Hall et al (2012) reject the validity of the consumption IRF in the model, which means that there are no combinations of the estimated parameters such that the consumption IRF in the model resembles the one in the data.
This outcome follows from the fact that the baseline model generates IRFs

that display a maximal effect on impact and monotonically decay thereafter, while in the data a hump-shaped pattern is usually observed. The pattern is not new and the ubiquitous solution has been to add various kinds of frictions among which, given the question under scrutiny, habits in consumption seem to be the first candidate. What we show, then, is that habits in consumption for Ricardian households are not successful in reconciling model-generated IRFs with the data, which marks a stark difference compared to monetary-policy models of the business cycle: Fuhrer (2000) documents that habit formation allows to match the response of real consumption to a monetary policy shock, therefore providing a successful solution to the excess smoothness puzzle identified in Campbell and Deaton (1989). Instead, only a version of the model with habits in consumption for rule-of-thumb consumers generates IRFs that can successfully be matched to the data. However, this strategy is difficult to defend theoretically: sluggishness is at odds with the one-to-one response of consumption to changes in income that is peculiar of hand-to-mouth consumers.
Our conclusions do not change when investment frictions and capital utilization costs are added to the model. Finally, though less orthodox, habits in leisure have also been shown to increase the fit to the data (see Wen (1998)): when extended to this context, indeterminate solutions arise that make it impossible to implement this strategy for reasonably large degree of habit persistence.

Overall, our results cast doubts on the ability of the rule-of-thumb mechanism to effectively match the data with respect to the very same aspect that it aims at explaining. Of course, this conclusion requires to recognize the VAR approach as the right one to derive stylized facts on the effects of shocks that models should be able to reproduce in order to be considered plausible, according to the lines traced by Christiano et al (1996a,b).

The material is organized as follows: section 1.2 quickly reviews the model paying particular attention to the few modifications that are necessary in order to implement estimation; section 1.3 describes the methodology adopted and all the relevant corollary; section 1.4 presents the results; finally, section 1.5 concludes.

1.2 Model, a refresher

Different assumptions regarding the way households behave in response to changes in disposable income imply opposite conclusions about the effects of government spending shocks. A major distinction can be traced between the permanent income theory of consumption on the one hand and the Keynesian theory of consumption on the other hand. While the former puts emphasis on forward looking behavior from the side of agents, their ability to borrow and the care they give to the present discounted value of future income streams, the latter describes consumption decisions as mechanic and short-sighted and believes that agents focus on current disposable income.

The first set of assumptions has been embraced by DSGE models and rests at the heart of the Ricardian equivalence that characterizes this class of models: here, government spending shocks generate a negative wealth effect which induces households to consume less and work more.

The second set of assumptions belongs to ISLM type models and makes it more likely to observe a positive reaction in response to government spending shocks.

Gali et al (2007) bring these two distinct approaches together using an otherwise standard New Keynesian model, except for the aggregate Euler equation of consumption, which combines that of Ricardian with a proportion λ of rule-of-thumb households.

The full set of log-linearized equations describing the model appears in the Appendix to this Chapter. Equation (A.1) describes the Euler equation for Tobin's q, equation (A.2) defines investment, equation (A.3) is the capital law of motion and equation (A.4) wages. Equations (A.5) and (A.6) are especially relevant as they represent the consumption Euler for Ricardian households and consumption of rule-of-thumb consumers: the latter is shown to equal labor income net of taxes. Equation (A.7) determines aggregate consumption by combining the two together in the proportion λ, which defines the share of rule-of-thumb consumers. Equations (A.8) and (A.9) describe the New Keynesian Phillips curve and the marginal cost. Equation (A.10) is the production function, equation (A.11) is the accounting identity. The three equations that follow describe the fiscal policy block of the model: the bond law of motion, the fiscal policy rule and the government spending process. The last two are the rental rate of capital and the monetary policy rule.

Equation (A.4) is taken from Colciago (2011) and it is derived under the assumption that wages are set by workers' unions facing a constant probability $1-\theta_w$ of resetting wages in every period: the newly reset wage is chosen to maximize a weighted average of agents' lifetime utilities. This formulation is adopted here since it has some nice properties.

First, wage stickiness dampens the strong response of wages to a rise in output, thus avoiding the large increase in income and the consequent strong movement in rule-of-thumb consumption that can sustain sunspot equilibria under fully flexible wages. This problem is discussed in details in Gali et al (2007) and Gali et al (2004), where it it shown that models with rule-of-thumb consumers break the standard result that ensures a unique equilibrium (determinacy) when the interest rate in the monetary policy rule responds more than one-to-one to inflation, i.e the Taylor principle[9]. The problem is especially acute under imperfectly competitive labor markets - i.e. wages set by unions - as it appears by looking at the top two panels of Figure A.1: in the top-left panel, we plot the determinacy and indeterminacy regions under competitive labor markets and flexible wages; in the top-right panel, we plot the same areas in the case of imperfectly competitive labor markets and flexible wages. It is clear that the latter significantly restricts the range of admissible parameters. This property becomes troublesome in an estimation set-up, as it prevents full exploration of the entire - i.e. theoretically plausible and empirically relevant - range for some parameters' values of interest: as the plots show, a researcher whose goal was to obtain estimates of λ may be compelled to bound estimation between 0 and 0.5, something that is clearly at odds with her ultimate objective. As the bottom-left panel of Figure A.1 makes clear, sticky wages make the problem less acute[10].

Also, wage stickiness makes the admissible range for some parameters' values less stringent, as is the case for the elasticity of marginal disutility of labor

[9]Put differently, there are combinations of parameters - two in particular, λ and θ_p - that determine a non-unique solution despite $\phi_p > 1$.

[10]It should be stressed that the adoption of sticky wages implies to opt for imperfectly competitive labor markets where wages are set by unions, rather than the case where agents optimally choose their labor supply taking wages as given in a perfectly competitive market. This choice is consistent with the evidence in Gali et al (2007) that imperfectly competitive labor markets makes it more likely to observe consumption crowding-in for moderate values of λ. It is also in line with Di Bartolomeo et al (2006), Fioroni et al (2007), Lopez-Salido and Rabanal (2006), Yasuharu (2011). The effects of changing this assumption are considered in section 1.4.1.

φ: this turns out to be useful in some sensitivity exercises performed in section 1.3.2.
Furthermore, as discussed in Colciago (2011), the large jump in wages generated by fully flexible contracts is counterfactual, so the adoption of sticky wages helps to make the model less misspecified in this respect.
Finally, both Colciago (2011) and Furlanetto (2007) show that crowding-in of aggregate consumption is preserved also under this option.
Note that setting $\theta_w = 0$ reduces equation (A.4) to

$$w_t = \frac{\varphi}{1-\alpha} y_t - \frac{\alpha}{1-\alpha} \varphi k_{t-1} + c_t \tag{1.1}$$

which is the one found in Gali et al (2007).

The log-linearized model economy described in equations (A.1)-(A.16) can then be solved using any among the available software packages and the resulting state-space representation can be used to derive the dynamics in response to a unitary innovation in the only source of exogenous fluctuations, i.e. the government spending shock.

1.3 IRFs Matching

IRFs matching estimation is a limited information approach that minimizes the distance between sample and model generated IRFs. As the name suggests, the method focuses on specific functions of the data, namely the IRFs that can be traced out following an economically interesting innovation.
This is sometimes regarded as an advantage since it allows a researcher who is interested in estimating a subset of the model's parameters, or in testing the model along some dimensions but not others, to avoid endorsing the entire model, up to the distribution of the unobserved shocks. The latter falls under the so called full information methods, which view the model under scrutiny as providing a complete statistical characterization of the data, in the form of a likelihood function.

In order to establish some notation, define $\hat{\gamma}_t$ as the estimated IRFs in the data, γ_t as the simulated theoretical IRFs in the model and Ξ_t as the vector of estimated parameters. Then, the estimator can be written as

$$\Xi_t^* = \underset{\Xi}{\operatorname{argmin}} \left(\hat{\gamma}_t - \gamma_t(\Xi)\right)' W_t^{-1} \left(\hat{\gamma}_t - \gamma_t(\Xi)\right) \tag{1.2}$$

where W_t is a weighting matrix whose diagonal elements are the variances of sample-generated IRFs. This choice is quite standard and it is motivated by the desire to give more weight to more precise IRFs. The notation $\gamma_t(\Xi)$ is meant to emphasize that model-generated impulses are function of the model's structural parameters.

While section 1.2 has already reviewed how to simulate the model's dynamics $\gamma_t(\Xi)$, the next one describes how we compute the data-based IRFs $\hat{\gamma}_t$.

1.3.1 VAR

To obtain the empirical counterpart of model-generated IRFs, we adopt a recursive identification scheme with government spending ordered first in the VAR, reflecting the assumption that the latter is predetermined with respect to other macroeconomic variables and does not respond contemporaneously to them, at least at quarterly frequency. The structural shock of interest can then be backed out from the reduced form innovations by imposing a Cholesky decomposition to the VAR residuals.

This strategy is consistent with the way government spending enters the model's equations (A.1) - (A.16) and it is common to many related applications, such as Gali et al (2007), Fatas and Mihov (2001), Zubairy (2009), Bouakez and Rebei (2007), Ambler et al (2010) and Monacelli and Perotti (2008).

We consider a total of four variables: beyond government spending, we include taxes, output and consumption. This is the formulation originally proposed in Blanchard and Perotti (1999). A number of robustness exercises performed on fiscal policy VARs showed that the dynamics of consumption are robust across alternative orderings and number of the variables included. If one was willing to match the data in many other dimensions, features like prices and wages indexation, interest rate smoothing or other real frictions would be worth consideration: yet, this would add little to the analysis that follows.

The data are taken from either the Fred2 database administered by the St. Louis Fed, or from the Bureau of Economic Analysis[11]. The time interval

[11]Government spending is defined as the sum of federal, state and local consumption expenditures and gross investment (FGCE + SLCE). Taxes net of transfers are obtained from federal, state and local government current receipts minus grants in aid and transfer payments to persons (NIPA tables). Output is gross domestic product (GDP). Consumption is the sum

spans from 1954:3 to 2006:4: this sample is canonical in many applications and stops before the 2007 break.

As pointed out by Ramey (2011), the standard identification scheme may be vulnerable to fiscal foresight, implying that the supposedly structural innovation is actually a convolution of the true shock and its own lagged values. To account for this criticism, we add the war dummy computed by Ramey (2011) as an exogenous variable in the VAR: this should control for events - like foresight associated with big military buildups occurred during war episodes - that are determined outside the system of interest and, as such, not accounted for in the endogenous variables appearing in the VAR.
The resulting set of equations can be compactly written as follows:

$$Y_t = a + bt + B(L)Y_{t-1} + C(L)d_t + v_t \tag{1.3}$$

where Y_t is a matrix with variables along the columns and each observation along the rows, *a* is the constant, *b* is the linear trend coefficient, *L* is the lag operator and *B(L)* and *C(L)* are lag polynomials of degree four, d_t is the exogenous regressor and v_t is the reduced form innovation.

Before moving on to the estimation's results, the researcher needs to choose which parameters to estimate and which IRFs to use for the task. This is the purpose of the following two sections.

1.3.2 Parameters' identification

Canova and Sala (2009) show that DSGE models' parameters are affected by severe identification problems, especially when using limited information approaches. Cases of under identification - i.e. parameters do not enter model IRFs - and weak identification - i.e. the objective function is flat or has ridges - happen most times.
The authors propose methods to reduce the arbitrariness that researchers may face when deciding which parameters to fix and which ones to estimate. Such methods are developed in two related steps: the first aims at revealing those parameters that can be successfully identified, the second at detecting whether

of personal consumption expenditures in services and non-durable goods (PCESV+PCND). All series are expressed in real terms by dividing for the gross domestic product implicit price deflator (GDPDEF). Per capita values result after dividing for civilian non-institutional population (CNP160V). All data enters in log-levels.

or not these can be jointly estimated.

First, we perform routine tasks that help to distinguish between parameters that carry valuable information for the objective function and parameters that do not. In particular, we compute the model's IRFs varying one parameter at a time over an economically meaningful interval: if variations in one parameter imply negligible alterations in the shape of simulated IRFs, then there is little hope to pin down that parameter using IRFs matching[12].

Despite this process is based upon informal tests, a researcher may gather useful information. Indeed, Figures A.2-A.4 show that the degree of IRFs' variability varies across plots depending on which parameter is moving: despite the model has a total of twelve parameters, only few of them can significantly affect the shape or the size of the IRFs.

By eyeballing these plots, we include the share of rule-of-thumb consumers λ, the inverse of the Frish elasticity of labor supply φ, the Calvo parameter for price stickiness θ_p and the autoregressive coefficient of the shock process ρ_g in the group of parameters that are more likely to have relevant information and thus are carried over to step number two. All others - i.e. α, δ, μ_p, η, θ_w, ϕ_p, ϕ_b, ϕ_g - are left out and calibrated.

Second, one needs to make sure of which ones, among the selected parameters, can be jointly estimated. Hints about the presence of potential identification problems can be found by plotting, a few dimensions at a time, the objective function of interest, which in this case is given by the distance between the set of IRFs obtained from the true parameters and those generated by randomized parameters[13]. Figures A.5-A.6 reveal that the parameters λ, φ and θ_p - when taken in pairs - have ridges, i.e. there exist combinations of parameters' values such that the objective function takes values very close to those at the true minimum.

As argued in Canova and Sala (2009), ridges make identification problematic since most optimization algorithms have hard time finding the minimum of a function under this scenario. To get a taste of that, we run the global optimization routine `MultiStart` in `MATLAB` using the surfaces plotted in Figures A.5-A.7 as the objective function. The results are plotted in Figures A.8-A.9:

[12] Recall that model's IRFs enter the objective function defined in equation (1.2): if these are insensitive to variations in parameters, so will the objective function.

[13] Here, "true" refers to parameters fixed at calibrated values. These are moved, i.e. randomized, over the same interval used in step one and the distance function is computed for each random draw.

blue circles denote the starting points for each run of the optimization algorithm, black stars mark the parameters' values at the optimum and the yellow bar is the calibrated parameter value used to generate true IRFs. These plots suggest that - when ridges are present - optimum values may depend on the starting points, they are different from the true ones and, most importantly, they tend to ride along the ridge[14].
The outcome for the pair λ and ρ_g is qualitatively different. Figure A.7 reveals that the surface near the optimum is segmented, rather than smooth: this is important because it allows the algorithm to identify a unique minimum with high probability. Figure A.10 proves that this is indeed the case: various runs converge to the true parameters' values and the observed dispersion - especially in the parameter λ - is the consequence of basins of attractions associated to the crispy surface. However, global optimization routines, more sophisticated than the gradient based local optimizers used to produce these plots, can handle these scenarios successfully.

To summarize, an overview of identification problems confirms that most of the model's parameters are hard to identify. Consistently with the discussion above and the focus of this paper on how consumption responds to government spending shocks, we leave for estimation only λ and ρ_g which identify the parameters characterizing the two processes. All remaining parameters are fixed at the calibrated values adopted in Gali et al (2007)[15].

1.3.3 IRFs Selection Criteria

Whenever a researcher implements IRFs matching estimation, she has to decide which impulses to use and which ones to discard. For sufficiently rich models involving laws of motion for many variables, this opens the door to arbitrariness. Hall et al (2012) propose statistical criteria to select, among the possible IRFs to match, only those that are valid and relevant.
The validity criterion identifies the IRFs that allow to obtain consistent estimators of the parameters of interest and are not misspecified. Suppose, for example, that the IRF identified in the data is positive, but the same IRF in the

[14] Consider, for example, Figure A.8 which shows that the estimated optimum values of both λ and φ are systematically overestimated compared to the true ones. It can be seen from Figure A.5 that this is the trajectory of the ridge.

[15] The choice to be parsimonious in the number of estimated parameters at this point of the paper is also motivated by the fact that in later sections, where we consider a number of extensions to the baseline setup, new estimated parameters will be added.

model is negative: this would be detected as invalid.
The relevance criterion pins down, among the valid IRFs, the ones that are informative in the sense that they provide non-redundant information. The latter can be applied both across IRFs and across horizons: for now, we fix the IRFs' length at $T = 20$, which is quite standard in the literature.
The validity and relevance criteria are specified as

$$\begin{aligned} VIRSC_t(c) &= T\left(\hat{\gamma}_t - \gamma_t(\Xi)\right)' W_t^{-1}\left(\hat{\gamma}_t - \gamma_t(\Xi)\right) - h(|c|)k_t & (1.4)\\ RIRSC_t(c) &= log(|V_t(c)|) + k(|c|)m_t & (1.5)\end{aligned}$$

where

$$V_t(c) \equiv \left(J_t' W_t^{-1} J_t\right)^{-1}\left(J_t' W_t^{-1}\Sigma_{\hat{\gamma}} W_t^{-1} J_t\right)\left(J_t' W_t^{-1} J_t\right)^{-1}$$

defines the asymptotic variance of the estimator, J_t is the Jacobian of the objective function evaluated at the optimum, $\Sigma_{\hat{\gamma}}$ is the covariance matrix of sample generated IRFs, $h(|c|)k_t$ and $k(|c|)m_t$ are deterministic penalties increasing in the number of IRFs *c* whose values are reproduced in Table 1.1.

In order to make these criteria operative, the algorithm that follows is run. Firstly, define a selection matrix *c* that allows to pick all possible combinations of IRFs. In the case at hand, this translates into a matrix that has as many columns as the number of variables in the VAR and as many rows as the number of combinations of such variables when taken alone, in pairs, in group of three or all four of them together. Secondly, compute IRFs in the model and in the VAR up to horizon *T* and collect them in the vectors $\hat{\gamma}_t$ and $\gamma_t(\Xi)$ respectively. Use these inputs to estimate the parameters' values at the optimum and compute the $VIRSC_t(c)$ for all entries of the matrix *c*. Next, choose the *c* that minimizes $VIRSC_t(c)$ and, for those combinations of IRFs that pass the validity criterion, compute the $RIRSC_t(c)$ according to the formulas above. Finally, choose the *c* that minimizes the $RIRSC_t(c)$ and report the estimated parameters using valid and relevant IRFs only.
Intuitively, the validity criterion ranks all combinations of IRFs based on the value of the objective function at the optimum. By definition, the latter gives an indication of how large the distance is between the dynamics of the model and the data for each *c*: this measure is corrected by subtracting a penalty which accounts for the fact that the more IRFs one considers, the larger is the observed distance. Thus, the validity criterion chooses those IRFs that are

sufficiently well shaped with respect to the model to imply the smallest distance between the theoretical model and the data, controlling for the number of IRFs.
Similarly, the relevance criterion orders the combinations of valid IRFs based on a measure of the asymptotic variance of the estimator and a penalty that is added, rather than subtracted, to it.

These tests are used to select the inputs for estimation and, in doing so, they provide a check on whether the consumption dynamics in the model are deemed valid and relevant.

1.4 Results

This section presents the results obtained by matching the IRFs generated from the model outlined in section 1.2 to those obtained from the SVAR of section 1.3.1.
The material is organized in sub-sections corresponding to alternative versions of the baseline model with rule-of-thumb consumers.

1.4.1 Model with rule-of-thumb consumers

A first set of results is presented in Table 1.2. To begin with, we skip the steps in the algorithm that consider the validity and relevance criteria: the numbers in Table 1.2 should therefore be seen as the output that one gets by matching the model IRFs to the SVAR dynamics, disregarding the extensions proposed in Hall et al (2012). Instead, for now, we are mostly interested in drawing attention to the role played by the assumed labor market structure and to present the main results for a benchmark estimation.
As mentioned in section 1.2, the model specification adopted here is such that unions set wages in every period in order to maximize a weighted average of agents' lifetime utility, subject to a labor demand schedule. This decision has been motivated both in light of its computational advantage and as a continuity choice with respect to related literature. The alternative set-up is the one where labor markets are perfectly competitive and households choose optimally their labor supply taking wages as given.

The results in Table 1.2 establish that the assumed labor market structure

significantly distorts inference about λ. On the one hand, under imperfectly competitive labor markets the estimated value falls below 0.5 and are broadly comparable to the findings in Di Bartolomeo et al (2006), Fioroni et al (2007), Lopez-Salido and Rabanal (2006), Yasuharu (2011). On the other hand, under the alternative assumption, the conclusion is reversed: in this case, the point estimate is similar to the one in Canova and Paustian (2011), which lies in the upper tail of the distribution of estimates obtained in the literature cited.
These findings are consistent with the remark in Gali et al (2007) that, when the two alternatives are compared based on their ability to deliver a positive response of consumption to government spending shocks, the latter is less promising: as we show, a much larger value of λ is needed to get the desired result. Canova and Paustian (2011) find that the share of rule-of-thumb households is not robust to parameters' randomization and that an implausibly high value of λ is needed to obtain a positive consumption response. While acknowledging that they are working under perfectly competitive labor markets, the authors do not consider the alternative scenario. The evidence in Table 1.2 suggests that results may have been more favorable if imperfectly competitive labor markets were used instead. Lopez-Salido and Rabanal (2006) obtain higher estimates of λ when the latter choice is considered: this result is counterintuitive and may be due to non-separable preferences adopted in their paper.
Figure 1.1 overlaps the IRFs resulting from the model solved using the estimated parameters values to those generated from the SVAR: starred lines represent SVAR IRFs, dashed lines 95% bootstrapped confidence bands and solid lines model IRFs. It suffices this plot to make clear that, despite the consumption response in the model is positive on impact, the dynamics afterwards are very different: while the response in the data is quite small and builds up over time, thus taking a modest hump shaped pattern, the response of consumption (and output) in the model tends to be maximal on impact and decays fast thereafter.

Statistical tests support the visual impression. Estimation is run once again, this time including the statistical criteria to select valid and relevant IRFs as described in the algorithm of section 1.3. The results are reported in Table 1.3. Each column lists the results for different penalization criteria: the first

and second rows indicate the IRFs selected by the VIRSC and RIRSC respectively; the remaining rows host the values for the estimated parameters with standard errors in parenthesis.
Since the AIC and HQC criteria give identical results, we focus on them. As the top two rows show, the VIRSC identifies government spending and taxes as the only two valid IRFs and the RIRSC selects spending as the relevant IRF to estimate the autoregressive coefficient ρ_g.
Clearly, the striking aspect is that the IRF of consumption - along with that of output - is identified as misspecified, or, equivalently, the model is considered not able to replicate the data sufficiently well along this dimension to obtain consistent estimates of the parameters of interest.Therefore, the validity criterion offers statistical support to the conclusion a researcher would reach by eyeballing the IRFs plot. Some additional remarks are in order.
Firstly, given that the consumption IRF bears crucial information for the estimated share of rule-of-thumb consumers but is dropped from estimation, λ is poorly evaluated: as Table 1.3 shows, the routine stops around 0.5 which lies halfway in between the lower and upper bound and the associated standard error is huge[16].
Secondly, when the model's parameters are estimated using only the subset of valid and relevant IRFs, the IRF of government spending to its own shock is matched very well to the one in the data. Compared to Figure 1.1, Figure 1.2 makes clear that the shock now fits the data a lot better: the point estimate of the autoregressive coefficient, therefore, certainly benefited from dropping nuisance information.
Finally, the model is capable of tracking well the dynamics of taxes derived from the SVAR: since this result is obtained for calibrated values of the coefficients ϕ_b and ϕ_g in the tax rule, the tax IRF is identified as redundant by the RISC: it does not bring any relevant information for the estimated parameters.

All in all, the dynamic behavior of output and consumption do not look surprising since many standard specifications of DSGE models imply that variables jump on impact, pulling forward in time their responses to shocks. In fact, this feature is typical of permanent income hypothesis models with

[16] Alternatively, the appropriate entry in the Hessian matrix at the optimum is very small. See Canova (2007), chapter 5.5.

rational expectations.
Since the ability to match the data along certain dimensions is usually considered a desirable property too, research has been done extensively on this aspect, most of the times using monetary-policy models of the business cycle - see Leeper et al (1996) and Christiano et al (1996a,b). The answer has usually been to add frictions in order to induce sluggishness in the variables' response, as is the case, for example, in Christiano et al (2005). By now, the DSGE literature offers a pretty wide array of artifices to replicate the impulse response functions of real world data, like investment or capital utilization adjustment costs, durability, time to build, learning-by-doing and others. Still, these make *a priori* little sense when consumption dynamics are the primary object of interest: relying on any of those to explain the evolution of consumption does not look like best practice, especially so given that VAR evidence is for the most part based on consumption of non-durables and services, for which such frictions are very hard to imagine.
A less questionable alternative is to update the utility function to include habits in consumption, a strategy consistent with the focus of this paper. Therefore, in the section that follows we implement this insight to try to reconcile the model with the data.

1.4.2 Habits in consumption

Since the model is populated by two kinds of consumers, one should mind the logical distinction between rule-of-thumb behavior and habits in consumption. While the former type of consumers is demanded to respond immediately and one-for-one to shocks in current income, habits delay part of the response to income shocks: therefore, these two consumption patterns can hardly coexist in the same household[17].
For this reason, we update the model by adding habits in consumption to the Ricardian households utility, while leaving unchanged the part referring to rule-of-thumb households. After log-linearizing, the consumption block of

[17] See Fuhrer (2000).

the model can be written as

$$
\begin{aligned}
c_t^o &= \frac{h^o}{1+h^o}c_{t-1}^o + \frac{1}{1+h^o}E_t c_{t+1}^o - \frac{1-h^o}{1+h^o}\left(r_t - E_t \pi_{t+1}\right) && (1.6) \\
c_t^r &= \frac{1-\alpha}{\left(1+\mu_p\right)\boldsymbol{\gamma}_c}\left(w_t+n_t\right) - \frac{1}{\gamma_c}t_t^r && (1.7) \\
c_t &= \lambda c_t^r + (1-\lambda)\, c_t^o && (1.8)
\end{aligned}
$$

where h^o is the parameter denoting the degree of habit persistence in Ricardian households' preferences. The remaining equations stay unchanged and are not reported to economize on space.

Estimation results are listed in Table 1.4: notice that the degree of habit persistence is among the estimated parameters.

One immediately realizes that the results are disappointingly similar to the baseline case considered in section 1.4.1. In particular, VIRSC once again drops consumption from the set of valid IRFs and, consequently, neither λ nor h^o can be correctly pinned down by the optimization algorithm.

To understand what mechanisms are responsible for the observed result, let's consider Figure 1.3. There, we plot the evolution of consumption in response to a government spending shock for increasing degree of habit persistence[18]: dotted lines represent rule-of-thumb consumption, starred lines describe Ricardian consumption and continuous lines aggregate consumption which results by combining the two others in the proportion λ and constitutes the object of interest.

The plot highlights that habits induce the expected hump shaped pattern in Ricardian consumption: households wishing to smooth both the level and the change in consumption react gradually to a shock in government spending, leading to a hump-shaped response. The stronger is habit formation - i.e. the higher is h^o - the more hump-shaped the response of consumption to changes in income will be. However, habits do nothing to flip the impact response on the positive quadrant, making it more likely for aggregate consumption to be compatible with VAR evidence.

Imagine λ was free to move, as is the case in estimation. It could give more

[18]For the sole purpose of this plot, all other parameters are calibrated at the values used in Gali et al (2007). Also, the fact that we switch from estimation, adopted in the previous section, to calibration here and in the following sections, should not be regarded skeptically: calibration represents a milestone in constructing and estimating models and proves valuable to learn about their properties.

weight to either rule-of-thumb or Ricardian consumption IRFs. As it appears from Figure 1.3, the former would be rejected by statistical criteria because it has the wrong shape, the latter because it has the wrong sign. This is behind the VIRSC results of Table 1.4.

The conclusion we derive is definite: habits in consumption are not successful in matching the model-generated consumption IRF to VAR-based evidence. And there is no easy way to see how they could succeed: the fraction of households assumed to behave in a hand-to-mouth fashion reacts contemporaneously to the shock, while habits induce the desired consumption pattern in Ricardian households but leave the stark consequences of Ricardian equivalence intact. Estimation of λ boils down to trading off between two misspecified dynamics and is doomed to failure when faced with a validity criterion.

The results above mark a stark difference with respect to monetary policy models where habits have been shown to represent a valuable mechanism. For example, Fuhrer (2000) documents that habit formation allows to match the response of real consumption to a monetary policy shock, providing a successful solution to the excess smoothness puzzle identified in Campbell and Deaton (1989). Nonetheless, the discussion so far provides guidance on how to proceed. In particular, it suggests that, in order to improve the fit of the model along the dimension of interest, it is either necessary to dampen the response of rule-of-thumb consumers or to overturn the Ricardian consumption IRF. We discuss the former in the following paragraph and the latter in section 1.4.4.

A straightforward solution to induce sluggishness in the response of rule-of-thumb consumers is to introduce lagged consumption in the preference specification for this class of consumers. Bosca et al (2011) proceed by assuming that rule-of-thumb households are also subject to a maximization problem, adapted to account for the fact that these households hold no capital and that the liquidity constraint requires to equate consumption and labor income in every period. Then, lagged consumption enters into the relevant log-linearized consumption equation as is shown below:

$$
\begin{aligned}
c_t^o &= \frac{h^o}{1+h^o} c_{t-1}^o + \frac{1}{1+h^o} E_t c_{t+1}^o - \frac{1-h^o}{1+h^o} \left(r_t - E_t \pi_{t+1}\right) && (1.9)\\
c_t^r &= h^r c_{t-1}^r + \frac{1-\alpha}{\left(1+\mu_p\right) \boldsymbol{\gamma}_c} \left(w_t + n_t\right) - \frac{1}{\gamma_c} t_t && (1.10)\\
c_t &= \lambda c_t^r + \left(1-\lambda\right) c_t^r && (1.11)
\end{aligned}
$$

where h^r is the parameter denoting the degree of sluggishness in rule-of-thumb consumption[19].

Table 1.5 shows that the VIRSC identifies spending, taxes and consumption as the valid IRFs, while the RIRSC selects spending and consumption as the relevant ones to estimate the parameters of interest. Indeed, it is especially welcome to see that the consumption IRF is recognized as both valid and relevant, a sign that the results go in the desired direction. As already observed, taxes are included among the valid IRFs because their dynamics fit the data well despite using calibrated parameters: nevertheless, they are dismissed as irrelevant since they carry redundant information given that the estimated parameters only enter the model's equations characterizing government spending and consumption. Output is, once again, dropped.

Further insights can be gained by looking at Figure 1.4. The bottom right panel shows that the consumption IRF displays a hump-shaped pattern and lies within the confidence bands of the SVAR. Instead, output jumps too much on impact: this explains why the VIRSC discards this IRF. The spending IRF is unchanged with respect to Figure 1.2.

From an econometric point of view, the results also look fine: standard errors for all estimated parameters are not large and the Hessian entries evaluated at the maximum are non-zero, suggesting there are no major identification problems.

From the point of view of the theory, one thing to remark is that the estimated value of λ is high. This could be anticipated from the discussion above: given that the dynamics for Ricardian consumers are misspecified, a large enough weight needs to be put on the rule-of-thumb component of aggregate consumption to make the latter look similar to SVAR evidence.

[19]We leave habits in Ricardian consumption since these are necessary to obtain the desired result and do not worsen estimation precision.

Another important point in Table 1.5 is that, while the estimated degree of habit persistence for Ricardian households is moderate, the one for rule-of-thumb consumers needed to match the data is very large.

1.4.3 Investment frictions and capital utilization costs

A nowadays conventional strategy used to reconcile the dynamics of DSGE models with the data is to allow for investment frictions and capital utilization adjustment costs. As noted in section 1.4.2, such features do not look like a first best solution when consumption dynamics are the primary object of interest. However, they are intuitively appealing in this context because they usually contribute to induce a smooth shape in the variables' response to shocks. In the case at hand, if this was the pattern followed by output, it would then be transmitted to rule-of-thumb consumers as a consequence of the liquidity constraint they are subject to and result in dumped consumption dynamics.

To accommodate for the kind of frictions popularized by Smets and Wouters (2003, 2007), the set-up of the model needs to be adapted in few details. Ricardian households seek to maximize:

$$E_0 \sum_{t=0}^{\infty} \beta^t \left(\log C_t^o - \frac{(N_t^o)^{1+\varphi}}{1+\varphi} \right) \tag{1.12}$$

subject to the intertemporal budget constraint and capital law of motion:

$$\begin{aligned} P_t \left(C_t^o + I_t^o \right) + R_t^{-1} B_t^o + \psi(Z_t) K_{t-1}^o &= P_t W_t N_t^o + P_t R_t^k K_t + B_{t-1}^o + \\ &\quad + D_t^o - P_t T_t^o \qquad (1.13) \\ K_t^o &= (1-\delta) K_{t-1}^o + \\ &\quad + \left(1 - S\left(\frac{I_t^o}{I_{t-1}^o} \right) \right) I_t^o \qquad (1.14) \end{aligned}$$

Compared to the baseline GLV model, equation (1.13), which equalizes total expenditures to total revenues, has been updated to include costs associated with variations in the degree of capital utilization, denoted $\psi(\cdot)$. Due to capital utilization costs, a household can increase her rental income by increasing the utilization rate of capital, but, in doing do, she also needs to pay a cost:

this induces a gradual response of the marginal cost to movements in production. It is assumed that ψ is an increasing and convex function, that the utilization rate Z_t equals one in the steady state and that $\psi(1) = 0$.
Additionally, equation (1.14), describing the evolution of capital over time, includes adjustment costs in investment that are meant to create an incentive for the household to smooth physical investment over time. These are introduced via the function $S(\cdot)$ which is assumed to be such that $S(\cdot)$ and $S'(\cdot)$ equal zero in the steady state: this implies that the adjustment cost only depends on the second order derivative.
The inclusion of capital utilization costs requires to re-write both the aggregate production function and the accounting identity in the following way:

$$\begin{aligned} Y_t &= (Z_t K_{t-1})^{\alpha} L_t^{1-\alpha} && (1.15) \\ Y_t &= C_t + I_t + G_t + \psi(Z_t) K_{t-1} && (1.16) \end{aligned}$$

The Lagrangian of the household's optimization problem is:

$$\begin{aligned} L = \; & E_0 \sum_{t=0}^{\infty} \beta^t \Bigg\{ \left[\log C_t^o + \frac{(N_t^o)^{1+\varphi}}{1+\varphi} \right] \\ & -\lambda_t \Bigg[C_t^o + I_t^o + R_t^{-1} B_t^o + \psi(Z_t) K_{t-1}^o - P_t W_t N_t^o + P_t R_t^k K_t - B_{t-1}^o \\ & -D_t^o + P_t T_t^o \Bigg] \\ & -\mu_t \left[K_t^o - (1-\delta) K_{t-1}^o - \left(1 - S\left(\frac{I_t^o}{I_{t-1}^o} \right) \right) I_t^o \right] \Bigg\} \qquad (1.17) \end{aligned}$$

and it shall be remarked that, now, also the level of investment and capital utilization are among the choice variables.
The firms' problem, together with the fiscal and monetary policy block of the model stay unchanged and are not discussed in details here. Instead, we report the log-linearized equations, stemming from the maximization problem described in the lines above, that replace some of the equations listed in (A.1)-

(A.16). These are:

$$
\begin{aligned}
q_t &= -\left(r_t - E_t\pi_{t+1}\right) + \left(1-\beta\left(1-\delta\right)\right) E_t r_{t+1}^k + \\
&\quad +\beta\left(1-\delta\right) E_t q_{t+1} && (1.18)\\
i_t &= \frac{1}{1+\beta} i_{t-1} + \frac{\beta}{1+\beta} E_t i_{t+1} + \frac{1}{S''(1)}\frac{1}{1+\beta} q_t && (1.19)\\
z_t &= \psi r_t^k && (1.20)\\
y_t &= \left(1-\alpha\right) n_t + \alpha z_t + \alpha k_{t-1} && (1.21)\\
y_t &= \gamma_c c_t + \gamma_i i_t + \gamma_k z_t + g_t && (1.22)\\
r_t^k &= c_t - z_t - k_{t-1} + \left(1+\varphi\right) n_t && (1.23)
\end{aligned}
$$

where equation (1.18) describes Tobin's q, equation (1.19) defines investment, equation (1.20) is the capital utilization rate, equation (1.21) characterizes aggregate production, equation (1.22) is the accounting identity and equation (1.23) is the rental rate of capital.
These extensions come along with three additional parameters: the investment adjustment cost $\frac{1}{S''(1)}$, the inverse of the elasticity of the capital utilization cost function ψ and γ_k. The latter is pinned down from steady state relations; for the remaining two, we consider the range of lowest and highest values used in Onatski and Williams (2010)[20].

Do investment frictions and capital utilization costs succeed in smoothing the response of output and, consequently, consumption for the fraction of rule-of-thumb households? To answer this question we simulate the output and consumption dynamics for varying degree of investment frictions and capital utilization costs. Figure 1.5 plots the results[21]. It is clear that the answer is negative: this variant of the model delivers a smoothed response of investment as is observed from the top panel, but both the output and consumption IRFs are only marginally affected, as it appears from the middle and bottom panels respectively[22].
Is this finding entirely new? Actually not. A closer look at Smets and Wouters (2003, 2007) reveals something similar. If one compares the dynamics of the

[20] That is: $\frac{1}{S''(1)} \in [0.12, 0.28]$ and $\psi \in [2.8, 10]$.

[21] In this example, the value of the wage elasticity parameter φ is calibrated at one, which is closer to the numbers commonly found in related literature.

[22] Increasing capital adjustment costs, i.e. lowering η, in the baseline version of the model drives to analogous conclusions and is not reported.

endogenous variables across the various shocks, it appears that government spending shocks often imply output responses maximal on impact and monotonically decaying thereafter, as is observed here, rather than building up over time. The same conclusions also apply to Fioroni et al (2007), Lopez-Salido and Rabanal (2006), Yasuharu (2011): these papers build upon Smets and Wouters (2003, 2007) , add a fraction of rule-of-thumb consumers and estimate λ by means of Bayesian methods. Despite a richer basket of microfoundations, the implied dynamics of output after a government spending shock are comparable to the ones that we find.

Since these papers cover a pretty wide array of possible specifications for preferences and tax policies, the results we get are unlikely to be confined to the choices made here, but hold generally: this can probably be put in connection with the fact that output is, for the most part, demand driven in the class of New Keynesian models and frictions affecting the production side of the economy have negligible effects on its dynamics when government spending shocks are the focus of the analysis.

1.4.4 Habits in leisure

The majority of DSGE-type models assumes that preferences are either time separable in both consumption and leisure, or time non-separable in consumption only. This choice implies that hours agents currently supply are orthogonal to hours worked in previous periods.

However, there a no compelling reasons to exclude that hours supplied in different periods may be complements, rather than substitutes. In theory, it is not hard to imagine that habits are formed over the number of weekdays that one is willing to work, or the praxis of working during daytime and sleeping at night. In the data, there exists evidence supporting this hypothesis: the results in Hotz et al (1988), Bover (1991), Eichenbaum et al (1988), Wen (1998) go in this direction.

Habits in leisure imply that agents' utility today depends both on present and past levels of leisure. In turn, this means that habit-forming agents dislike large swings in their hours worked and wish to smooth their labor supply path over time. As a result, habits in leisure determine a sluggish adjustment of labor in response to shocks. Since capital is predetermined, the dynamic

properties of hours worked translate into a hump-shaped output response. In other words, although *via* a different path, this mechanism could result in a similar outcome to the one described in section 1.4.3.
This may well represent an alternative endogenous channel of busyness cycle propagation. In this regard, Wen (1998) shows that leisure habits improve both the spectra of simulated data and the IRFs' patterns of an otherwise standard Real Business Cycle model compared to the data[23].

In what follows we solve a version of the model where utility is assumed to be time non-separable in both consumption and leisure. Since habits in leisure only appear in the first order conditions when agents can optimize with respect to their own work effort, the imperfectly competitive labor market structure is excluded *a priori*: there is no straightforward way to accommodate for the fact that unions could deliberately discriminate the working choices of some households but not others.
The Lagrangian for this new optimization problem reads as follows:

$$\begin{aligned} L &= E_0 \sum_{t=0}^{\infty} \beta^t \Bigg\{ \left[\log\left(C_t^o - H_t\right) + \frac{\left(N_t^o - J_t\right)^{1+\varphi}}{1+\varphi} \right] \\ &\quad -\lambda_t \left[C_t^o + I_t^o + R_t^{-1} B_t^o - P_t W_t N_t^o + P_t R_t^k K_t - B_{t-1}^o - D_t^o + P_t T_t^o \right] \\ &\quad -\mu_t \left[K_t^o - (1-\delta) K_{t-1}^o - \left(\frac{I_t^o}{K_{t-1}^o} \right) K_{t-1}^o \right] \Bigg\} \end{aligned} \tag{1.24}$$

which is standard apart for the habits terms in both consumption and leisure that are defined as $H_t \equiv h^o C_{t-1}^o$ and $J_t \equiv h^n N_{t-1}^o$ respectively.
The first order conditions with respect to consumption, bond holdings, hours worked and the capital stock are:

$$\frac{1}{C_t - H_t} = \lambda_t \tag{1.25}$$

$$1 = E_t \left(\beta \frac{\lambda_{t+1}}{\lambda_t} R_t \frac{P_{t+1}}{P_t} \right) \tag{1.26}$$

$$W_t = \left(C_t - H_t\right)\left(N_t - J_t\right)^{\varphi} \tag{1.27}$$

[23] Bouakez and Kano (2006), Johri (2009), Jaimovich and Rebelo (2009), Ljungqvist and Uhlig (2000), Yun (1996) are more examples of leisure habits models, though less relevant for our scopes.

$$Q_t = E_t \Bigg\{ \beta \frac{\lambda_{t+1}}{\lambda_t} \Bigg[R^k_{t+1} + Q_{t+1} \Bigg((1-\delta) + \phi_{t+1} - \\ - \left(\frac{I^o_{t+1}}{K^o_t} \right) \phi'_{t+1} \Bigg) \Bigg] \Bigg\} \tag{1.28}$$

Log-linearization of equations (1.25) and (1.26) leads to a canonical consumption Euler, as in equation (1.6); the Euler equation for Tobin's q is also standard and identical to equation (A.1). The only new log-linear equilibrium condition is, not surprisingly, the one for labor, which looks like:

$$w^o_t = \frac{1}{1-h^o} \left(c^o_t - h^o c^o_{t-1} \right) + \frac{\varphi}{1-h^n} \left(n^o - h^n n^o_{t-1} \right) \tag{1.29}$$

It is clear that by setting both habits parameters to zero, equation (1.29) reverts to the one found in Gali et al (2007).
It should also be emphasized that the condition above holds for Ricardian agents only, while for rule-of-thumb households - whose problem is left untouched - the habitual condition determining labor effort

$$w_t = c^r_t + \varphi n^r_t \tag{1.30}$$

is in place.
Given the salary at which both households' types work is assumed to be the same, one can combine equations (1.29) and (1.30) and solve for the wage rate:

$$\begin{aligned} w_t &= c_t + \varphi n_t \\ &= \left(\frac{\lambda}{1-h^o} + 1 - \lambda \right) c^o_t - \lambda \frac{h^o}{1-h^o} c^o_{t-1} + \left(\frac{\lambda}{1-h^n} + 1 - \lambda \right) \varphi n^o_t - \\ &\quad -\lambda \frac{h^n}{1-h^n} \varphi n^o_{t-1} \end{aligned} \tag{1.31}$$

Again, note that shutting down the habits channel, equation (1.31) yields results alike to the original model.

Let's focus now on λ and consider two extreme cases: one where λ is zero and the other where it is equal to one. Under the former scenario, equation (1.31) trivially reverts to an identity; most importantly, though, it becomes immediately clear that the effects of habits in both consumption and leisure

disappear. Conversely, when the value of λ is unity, the habits' effect is maximal.
This introduces a compositional effect in labor dynamics as a function of λ: while it may be interesting to explore further this phenomenon, its implementability is problematic. On the one hand, as noted above, very low values of the share or rule-of-thumb consumers mute the effects of habits so much to make the results *de facto* indistinguishable from those obtained ignoring habits at all: this brings us back to the baseline case considered in section 1.4.1. On the other hand, higher values of λ drive the model into indeterminate solutions for reasonably large degree of habit persistence: this appears distinctly from the bottom right panel of Figure A.1 that plots the indeterminacy region for increasing values of h^n.
In short, one can never really test what happens when preferences features habits in leisure. There is no easy way out of this problem. The most obvious action is to lower the degree of price stickiness in order to lessen the risk of running into an indeterminate solution. However, as discussed in Gali et al (2007), when prices are fully flexible consumption is always crowded out, a fact that, by definition, removes any chance of reconciling the model with SVAR dynamics.

1.5 Conclusion

The aim of this exercise is to test whether a DSGE model featuring a fraction of rule-of-thumb consumers can generate consumption dynamics that are comparable to those typically found in SVARs and therefore successfully solve the dichotomy between the former and the latter class of models with respect to the response of consumption to a government spending shock. A limited information estimation which involves a comparison of the impulse response functions in the DSGE and in the SVAR is used. While focusing on the dynamics of consumption, this strategy allows the model to be misspecified along dimensions that are of no direct interest. The statistical criteria developed in Hall et al (2012) are adopted to detect those impulse response functions that are valid and relevant.

The most striking result of the paper is that the consumption response in the model is rejected and identified as not valid. There is no combination of the estimated model parameters that delivers a consumption IRF in the DSGE close to the one obtained from the SVAR. Accordingly, the tests in Hall et al (2012) detect the consumption impulse response in the model as misspecified. In practice, the model can, for some parameters' values, deliver a positive response of consumption on impact, but it fails to track the benchmark SVAR dynamics afterwards: while a hump-shaped pattern characterizes the consumption dynamic in the data, the response in the model decays monotonically.

A number of extensions to the baseline model are considered to overcome this difficulty. However, most additions that usually show up in medium scale DSGE models are unsuccessful at reconciling the consumption dynamics in the model with those in the data. Habit formation for Ricardian households induce a hump-shaped pattern in Ricardian consumption, but the fraction of households assumed to behave in a hand-to-mouth fashion keeps reacting contemporaneously to the shock. Habits in leisure generate indeterminate solutions for intermediate parameters' values: consequently, it is impossible to implement this approach for a reasonable degree of habit persistence. Investment frictions and capital adjustment costs do not induce a sufficiently large delay in the output response, which in turn could be transmitted to rule-of-thumb consumers.

The only successful approach is to allow for habit formation in rule-of-thumb consumers. While empirically valid, this strategy is difficult to maintain theoretically: sluggishness is often considered at odds with the one-to-one response of consumption to changes in income that is peculiar of this class of consumers.

Overall, the results cast doubts on the ability of the rule-of-thumb mechanism to effectively match the data with respect to the very same aspect that it aims at explaining. This conclusion is in line with Kormilitsina and Zubairy (2012) who, adopting a different metrics of evaluation, find that the rule-of-thumb mechanism ranks lowest when marginal posteriors of competing models are compared.

Figures and Tables

Table 1.1: Penalty criteria

	AIC	SIC	HQC
$h(\|c\|)$	$2\|c\|$	$\|c\|$	$2\|c\|$
k_t	1	$\log T$	$\log\log T$
$k(\|c\|)$	$2\|c\|$	$\|c\|$	$2\|c\|$
m_t	$\frac{1}{\sqrt{T}}$	$\frac{\log T}{\sqrt{T}}$	$\frac{\log\log T}{\sqrt{T}}$

Notes: Penalty criteria for $VIRSC_t(c)$ and $RIRSC_t(c)$. See Hall et al (2012) for details.

Table 1.2: Optimization output, alternative labor markets

	Non-Competitive	Competitive
λ	0.287	0.717
	(0.005)	(0.004)
ρ_g	0.872	0.872
	(0.005)	(0.005)

Notes: Standard errors in parenthesis. Estimates obtained matching spending, taxes, output and consumption.

Table 1.3: Optimization output, GLV model

	AIC	SIC	HQC
VIRSC	G T	G T Y	G T
RIRSC	G	Y	G
λ	0.495	0.010	0.495
	(∞)	(0.032)	(∞)
ρ_g	0.961	0.268	0.961
	(0.037)	(0.033)	(0.037)

Notes: Abbreviations are as follows: G is government spending, T is taxes, Y is output, C is consumption. Standard errors in parenthesis.

Table 1.4: Optimization output, GLV model with habits in consumption

	AIC	SIC	HQC
VIRSC	G T	G T Y	G T
RIRSC	G	G Y	G
λ	0.495	0.010	0.495
	(∞)	(0.032)	(∞)
ρ_g	0.961	0.268	0.961
	(0.037)	(0.003)	(0.037)
h^{RIC}	0.495	0.00	0.495
	(∞)	(0.059)	(∞)

Notes: Abbreviations are as follows: G is government spending, T is taxes, Y is output, C is consumption. Standard errors in parenthesis.

Table 1.5: Optimization output, GLV model with sluggish ROT consumption

	AIC - SIC - HQC
VIRSC	G T C
RIRSC	G C
λ	0.856
	(0.015)
ρ_g	0.955
	(0.003)
h^{RIC}	0.570
	(0.005)
h^{ROT}	0.990
	(0.024)

Notes: G is government spending, T is taxes, Y is output, C is consumption. Standard errors in parenthesis.

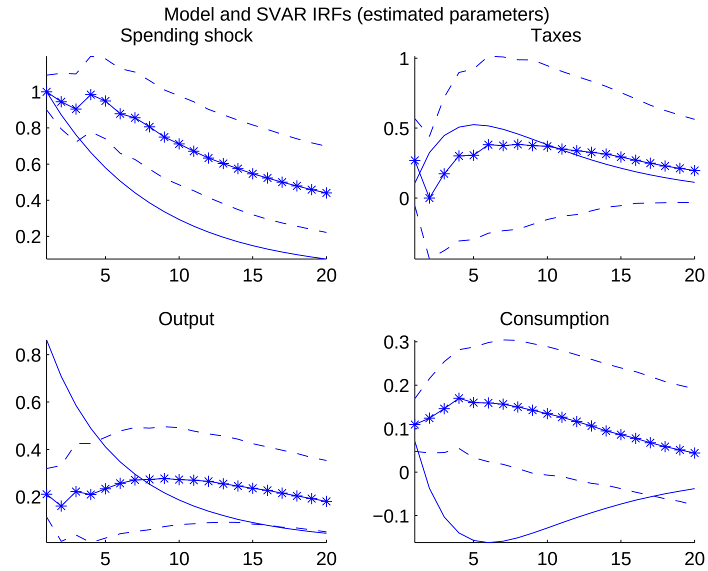


Figure 1.1: Model and SVAR IRFs: no selection criteria. Starred line: VAR-based IRF. Dotted line: 95% bootstrapped confidence bands. Solid line: model-generated IRF using estimated parameters.

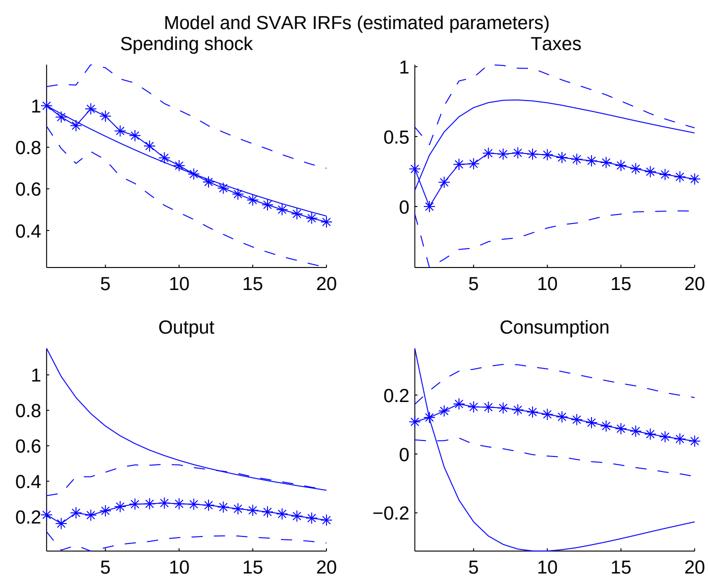


Figure 1.2: Model and SVAR IRFs: government spending valid and relevant; taxes valid and non-relevant; output and consumption non-valid and non-relevant. Starred line: VAR-based IRF. Dotted line: 95% bootstrapped confidence bands. Solid line: model-generated IRF using estimated parameters.

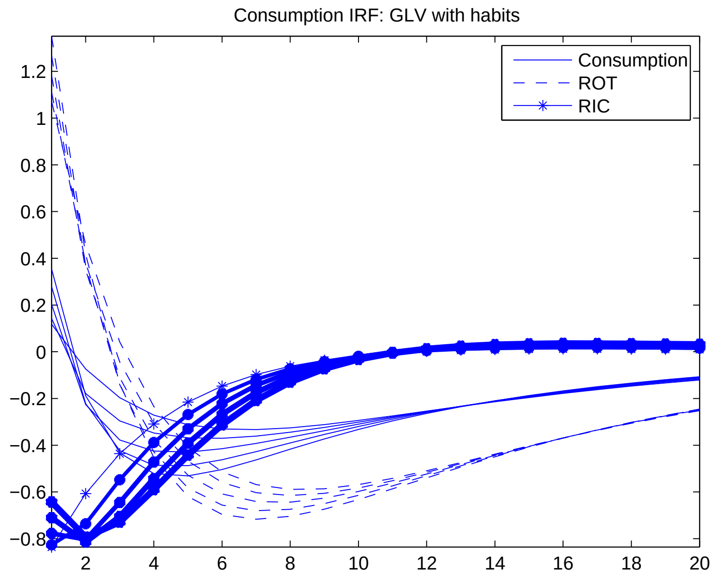


Figure 1.3: Consumption IRF in a model with habits. Dotted lines: rule-of-thumb consumption; starred lines: Ricardian consumption; continuous lines: aggregate consumption. From thin to thicker, $0.00 \leq h^{RIC} \leq 0.9$.

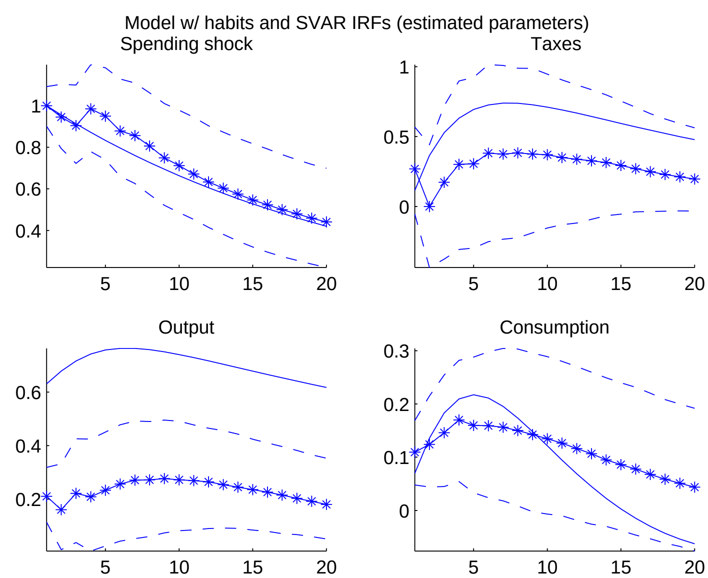


Figure 1.4: Model and SVAR IRFs: government spending and consumption valid and relevant; taxes valid and non-relevant; output non-valid and non-relevant. Starred line: VAR-based IRF. Dotted line: 95% bootstrapped confidence bands. Solid line: model-generated IRF using estimated parameters.

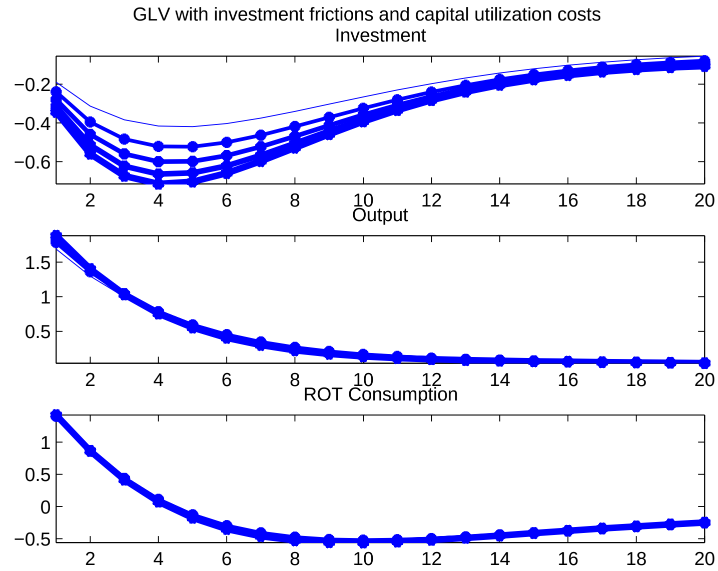


Figure 1.5: Investment, output and ROT consumption IRFs in a model with investment frictions and capital utilization costs. From thin to thicker, $0.12 \leq \frac{1}{S''(1)} \leq 0.28$ and $2.80 \leq \psi \leq 10$.

Chapter 2

How important is tourism for the international transmission of cyclical fluctuations? Evidence from the Mediterranean

2.1 Introduction

A number of studies have recently looked at the characteristics of cyclical fluctuations in the Mediterranean basin (see Canova and Ciccarelli (2012), Canova and Schlaepfer (2012), Canova and Altug (2012)). While the focus of these studies is different, the evidence they provide consistently suggests that business cycles in the region are peculiar. For example, if one only considers canonical economic indicators representative of production and trade, cycles in the Mediterranean region are quite heterogeneous, the idiosyncratic component is non-negligible, and international comovements occur primarily with the Euro area and not with the neighbors. In addition, these tendencies are persistent and there is no trend toward greater global or regional integration. Moreover, factors related to the institutional and cultural background seem to be important to explain the similarities and differences in business cycles features of the region. Finally, time variations in the characteristics of domestic business cycles are unrelated to preferential trade and financial agreements signed with the European Union (EU). Thus, Mediterranean business cycles differ from those of, say, South Asia or Latina America, where idiosyncrasies have been progressively eliminated and countries have become effectively more integrated into the world economy over the last 20 years. Furthermore, the special pattern of cyclical correlations the region displays indicates that alternative channels of international transmission, different from traditional trade and financial linkages, could be relevant to understand the nature of the fluctuations.

This paper looks at the international propagation of cyclical fluctuations to the region through the lenses of tourism flows. We are interested in two questions. First, we want to measure how important shocks originating outside of the region are for the Mediterranean economies and, in particular, how relevant shocks to tourism flows are. Second, we want to assess whether output fluctuations originating abroad propagate to the Mediterranean basin via the tourism channel. While production and trade indicators alone are too fragmented to provide a cohesive picture, there may be room for certain economic activities to play a role in shaping business fluctuations in the Mediterranean. Tourism is a good candidate and a few numbers may indicate why.

The eleven non-EU countries belonging to the southern Mediterranean rim - i.e. Algeria, Egypt, Israel, Jordan, Lebanon, Libya, Morocco, Palestine, Syria, Tunisia and Turkey, aka MED 11, Lanquart (2011) - received 82.3 million of foreign tourists in 2010. In absolute terms the number is modest, just around 10% of global international tourist arrivals; in comparison, France alone in 2010 received 77 million tourists. However, the compounded growth rate since 1990 has been 325%, well above the 214% registered globally over the same period. Turkey, Egypt, Morocco and Tunisia are the preferred destinations and Europe is the main generating market, representing 58% of foreign tourists arrivals in 2007. Russia sends a large fraction of tourist to Turkey and Syria and has a fast growing share of the tourist market in the Mediterranean.

All countries in the region are, for the most part, poor. According to the 2012 World Economic Outlook Database prepared by the International Monetary Fund, and with the exception of Turkey, they rank between the 43rd and the 89th position in a list of 184. Tourism related activities are important for the local economies. For example, the GDP share of tourism related activities in the MED 11 was 9.1% in 2010. Tourism receipts as a share of total service receipts are estimated to be 71.6% in Turkey, 67.9% in Syria, 67.5% in Morocco, 63.3% in Tunisia and 50.1% in Egypt in 2010. Employment in the tourism sector grew 152% from 1990 to 2000 and a further 144% in the following decade, and now represents on average 13.6% of total employment, according to Lanquart (2011). In some countries, such as Tunisia or Egypt, the share of the population employed in tourist related activities is larger and exceeds 25%. Thus, the fair performance in the global tourism market in recent years, the large share of tourism related activities, and a relatively small dimension of the economies, give tourism a chance to play a role in the international transmission of shocks to the region.

The question of whether fluctuations in small open economies are mainly driven by domestic or imported factors has long being discussed in the international business cycle literature (see Canova (2005), Kose and Prasad (2010)) but the conclusions are still controversial. However, very little is known about the imported component of fluctuations in many Mediterranean countries and, in general, about the share of these imported fluctuations due to tourism related activities. Our investigation sheds light on both issues and quantifies the importance of the tourism channel for the international propagation of output shocks.

The analysis employs reduced form tools, documenting unconditional static and dynamic correlations between outputs and tourism flows, and more structural methods, measuring the effect of output and tourism shocks in the source country on the destination country variables[1]. In the baseline exercises, the Euro area is used as the source country for a number of Mediterranean destinations because of the importance of European tourists in the region and the data availability. Given that certain countries receive a large portion of tourists from the United Kingdom, Russia, France, we will also measure the impact of income shocks originating in these countries on the domestic variables of selected destination countries. Given that international output comovements in response to source country output shocks are the sum of a direct effect and an indirect effect via the tourist channel, we conduct a counterfactual eliminating this latter effect, so as to quantify the importance of the tourism channel for the international transmission of cyclical fluctuations.

The reduced form connection between output cycles in the source country and tourism flows directed to the Mediterranean is modest. A stronger connection emerges if one instead focuses on periods when economic activity contracts. The reduced form relationship between tourism flows and cyclical activity in the destination countries is instead significant and tourism flows have predictive power for future developments in the destination country output cycles. Furthermore, the correlation between tourism flows and output in

[1] We use the term "source" country to refer to the country or the region where tourists come from and "destination" country to indicate the countries where tourists go.

the destination countries is higher than the correlation between output cycles in the source and in the destination countries, and stronger in the long run than at business cycle frequencies.

On average, unexpected output disturbances in the source country produce considerable movements in tourist flows and important output effects in the destination country. The latter then induce important second round consequences on local investment and net exports. The behavior of the individual economies is somewhat idiosyncratic. For example, the contemporaneous reaction of tourist flows in Cyprus, Tunisia, Syria and Morocco to source country output shocks is positive and significant but the initial effect on tourist flows in Turkey is small and significant movements appear only with one year delay. In addition, while output, consumption, investment and net export generally increase in response to source country output shocks, countercyclical movements are observed in Morocco. Interestingly, the shape and the magnitude of the responses induced by source country output shocks are roughly similar if different source countries and different measures of tourism flows are employed.

Imported shocks account for a large portion of the fluctuations in the destination economies: in fact, between 30 to 70% of the fluctuations in domestic output, consumption and investment are due to foreign disturbances and tourism shocks account for about half of this percentage. In addition, tourist flows are an important channel of transmission of cyclical fluctuations: on average, the impact effect on domestic output would be one-fourth smaller without this channel. For the individual countries the magnitude of the effect is less precisely estimated but the same outcome ensues for Cyprus, Morocco, Syria and Turkey.

It is difficult to relate our results to the existing literature because, apart from Sturm and Sauter (2010), who examine the performance of the tourism sector during the 2007-2009 recession, the relationship between business and tourism cycles in the region has not been studied. There are a number of case studies examining the relationship between tourism flows and economic conditions in certain countries, see e.g. Guizzardi and Mazzocchi (2010) (Italy), Costas and Bruno (2009) (Switzerland), Eeckels et al (2006) (Greece), Mayers and Jackman (2011) (Barbados), Sergo and Poropat (2010) (Croatia), Latzko (2004) (Hawaii), to mention but a few, but the methodology, the samples and the data considered in these studies are different. Furthermore, because they consider only one country and an aggregate flow of tourists, these studies lack a multilateral international perspective and are unable to provide robust evidence on the relative importance of the tourism channel for the international transmission of cyclical fluctuations or the role of tourism disturbances for domestic activity. By systematically investigating a variety of countries that share geographical proximity and compete for tourists, and disaggregating tourism flows by source country, we hope to provide a more accurate and reliable picture.

The rest of the paper is organized as follows. Section 2.2 describes the data used. Section 3.3 presents the methods. Section 2.4 summarizes the evidence obtained using the number of tourist arrivals. Section 2.5 considers alternative measures of tourist flows. Section 2.6 concludes.

2.2 Data

Systematic and comparable tourism data for the Mediterranean is difficult to obtain. Many countries do not report separate tourism statistics - these are typically conglomerated in the service account balance - and expenditure data rarely reflect actual expenditures incurred by tourists (typically, number of nights times a notional measure of average daily expenditure is used). Moreover, when the data is available, the sample is often too short or does not cover one complete cycle, making it unsuited for the purpose of studying the international transmission of cyclical fluctuations. Finally, it is important to have tourism flows disaggregated by country of origin.

The World Bank publishes tourism data in a large number of countries, but the sample is very short and only aggregate figures are reported. Using aggregated tourism data is problematic since it is only recently that cyclical fluctuations have become more synchronized around the globe. Thus, cyclical changes in an hypothetical aggregated source country need not to have any relationship with cyclical tourism changes. The World Tourism Organization (UNWTO) is now trying to consistently measure and record the state of the tourism sector worldwide. However, the project is still in its infant stage and the information available for the Mediterranean region covers only the

2006-2010 period, which is of limited use for studies like ours[2]. Hence, the only viable sources of information about tourism flows are those reported by central banks, the statistical offices or the tourism ministry of the destination countries. Heterogeneities in the availability, the quality and the length of the data sets should not be overlooked when comparing the results across countries.

Tourism data usually comes into three categories: number of tourist arrivals registered at the border, number of nights spent in hotels, and total per-capita expenditures. Arrivals can be retrieved quickly from police checks at airports, harbors and borders; the other two categories require a lot more statistical effort. Given the costs involved, Mediterranean countries typically report the number of arrivals, and in a few isolated cases, one of the other two quantities. If tourism demand is influenced by households' disposable income, which seems reasonable since international tourism is a luxury good, then only total per-capita expenditures can be confidently related to changes in the propensity to consume induced by evolving economic conditions. The number of nights spent in hotels may indirectly capture such changes, as households may decide to shorten their vacations if income falls. The number of arrivals registered at the border, on the other hand, captures well the binary decision of going versus not going, but it may be insensitive to mild income fluctuations in the source country.

Table 2.1 summarizes the available data. We have tourist arrivals data by source country for Cyprus, Turkey, Tunisia, Morocco and Syria. Thus, out of the four major non-European tourist destinations in the Mediterranean, only Egypt is missing. In Algeria, Libya and Lebanon, the tourism sector is relatively small, so omission of these countries is unlikely to cause important biases. For Israel, tourism flows are important but primarily driven by non-economic considerations. We include Cyprus in our sample, even though it is part of the EU, because it has good data; it is geographically close to several countries we analyze; and it effectively competes for tourists with the other destinations on the eastern and southern coast of the Mediterranean sea. Data on the number of nights spent in hotels is available only for Tunisia, while per-capita expenditures data is available just for Cyprus. Due to the limited

[2]We thank Laura Munoz (UNWTO) for making available to us all the data in the "Compendium of Tourism Statistics" and the "Yearbook of Tourism Statistics".

coverage, these measures are employed only for sensitivity analysis. The frequency of the data is annual. Quarterly data are available for Cyprus and Turkey but the sample covers less than 10 years, making them unusable for our purposes.

Tourism data is used in conjunction with macroeconomic variables monitoring sectors of the local economy. We have data on gross domestic product, household final consumption expenditures, gross fixed capital formation, exports and imports of goods. We were unable to find good measures of labor market conditions that are sufficiently long and complete to match the length of tourism data. Lack of labor market data is not fatal, but given the relevance of the tourism sector for employment in these countries, it may render the interpretation problematic when some unexpected patterns are present.

To insulate our analysis from idiosyncratic noise, we focus attention on tourist arrivals from four major regions: the Euro area, the United Kingdom, Russia and France. We separate the United Kingdom from other countries in Europe because the cyclical fluctuations are not perfectly aligned and because British tourism flows to Cyprus are large. We also focus on Russia because it is a major economic partner and a major source country for tourism flows for Turkey, Syria and Cyprus. We supplement the analysis conducted with Euro area data with France data since aggregation may wash out important links. Euro area output is constructed in two ways: using the synthetic aggregate Euro area 15 output data provided by Eurostat; using a population based weighted average of individual output data for those countries for which tourism flows are available. By and large, it does not matter which of the two series is used: they are highly correlated (above 0.9) and have peaks and troughs which are perfectly aligned. We thus report results with the latter measure.

All macroeconomic data, except trade in goods, comes from the World Bank World dataBank and it is expressed in constant 2000 US dollars. Nominal exports and imports of goods come from the International Monetary Fund International Financial Statistics data set. These series are deflated using the domestic GDP deflator for 2000.

In measuring the cyclical role of tourism, one should be aware that the link between economic conditions in the source country and tourism flows is complex and their comovements are influenced by a number of factors peculiar to the tourism sector. For example, there are lags between the time when the decision to go on holiday is taken and the time when the holiday actually takes place. Although tourism in the region is not necessarily concentrated in one season, a large portion of it is represented by families and elderly people who usually plan their holidays well in advance. Consequently, it is unclear how shocks impacting on households' disposable income affect tourism flows. If negative shocks to tourist arrivals from a source country are resilient despite the improving economic outlook, for instance because holidays were booked several months in advance, the adverse consequences of these shocks would be magnified when observed with the lenses of tourism flows. Alternatively, if shocks that were not foreseen in advance materialize at a later time, they may end up having a minor impact on tourism demand because the costs of disrupting the booking process make it more convenient to keep a finalized reservation, despite the deteriorating economic condition, softening the consequences of negative income shocks. Our use of annual data may make these lags less important, but still they should be kept in mind when interpreting the results. Another factor to take into account is that tourist agencies tend to specialize in particular destinations, making the connection between business cycle fluctuations in the source country and tourist flows less dependent on income and prices of the services offered and more a function of cohort effects, advertisement strategies and other non-market features. Finally, destinations in the region are close substitutes and tourist flows may be easily diverted from one country to another because of political uncertainty, medical scares, or rumors about threats that tourists may face.

2.3 Methodology

The analysis will be conducted using both reduced form and structural techniques. The reduced form methods we employ are bilateral static and dynamic correlations of outputs growth in the source and destination countries and tourism flows growth. To compute dynamic correlations we turn the data in frequency domain and compute bilateral correlations between any two of the three variables at certain frequencies.

We will also relate bilateral output growth correlations in source and destination countries with the average level of tourist flows, once we control for a number of country specific and macroeconomic characteristics. In particular, letting $m_{ij} = corr(y_{it}, y_{jt})$ and letting $\bar{T}_{ij}$, be the average tourist flows between country i and j, we compute conditional rank correlation between m_{ij} and $\bar{T}_{ij}$, given a set of controls X_j. In our case X_j includes a measure of openness, to account for potential comovements due to trade; the industry share of value added, to control for the composition effects described by Imbs (2004); the log-level of GDP per capita, to account for the possibility that development affects the synchronicity of output cycles; and the share of credit to GDP to proxy for the financial development of the country. Rank rather than Pearson correlations are reported to allow the relationship to take a non-linear form.

We use structural Bayesian panel VARs to estimate the average and the individual destination country effects of source country shocks and to assess the relevance of the tourism channel in propagating fluctuations in the region. The VAR model for each country includes source country real gross domestic product, the number of tourist arrivals from the source country and four destination country variables: real gross domestic product, real household final consumption expenditures, real gross fixed capital formation and real net exports of goods. All series enter in logs. We use one lag of the dependent variables, as this is sufficient to whiten the residuals, a constant and a linear trend.

Given that each destination country is small relative to the source countries, the structural model assumes that source country variables are weakly exogenous with respect to destination country variables. Thus, source country output and tourism shocks may generate contemporaneous fluctuations in the destination country, but not vice-versa. The weak exogeneity assumption of source country output is strongly supported by the forecast error variance decomposition: the combined effect of shocks in the destination country is a negligible source of fluctuations for source country output at all horizons. The restriction that tourism flows feed into destination country output but not vice-versa within a year is more controversial as political turmoil may affect domestic output and scare tourists away. Since the available sample excludes the recent Arab spring, we believe our identification assumption is reasonable. Finally, we impose the restriction that tourism shocks do not feed contemporaneously into source country output.

Because the time dimension of our data set is not large, estimates of the VAR coefficients are likely to be imprecise. The presence of considerable cyclical heterogeneities indicates that it is not a good idea to run a pooled VAR for the five countries. To reduce the small sample problem, we use a multi-country random coefficient Bayesian model. The distinctive feature of such model is that it allows us to efficiently combine unit-specific and cross sectional information, thus mitigating small sample biases, without imposing homogeneous dynamics. To achieve this, we assume that country-specific dynamic coefficients are realizations from the same underlying data generating process. This means that the dynamics of transmission of source country shocks are potentially different across countries, but the distribution from which they come from has a common mean.

Multi-country random coefficient Bayesian VAR models have been used in Canova (2005), Ciccarelli and Rebucci (2006), Canova and Pappa (2007), Jarocinski (2010). The specification we adopt is similar to Jarocinski (2010). For each country, the VAR model is:

$$y_{n,t} = B'_n y_{n,t-1} + \Gamma'_n z_{n,t} + u_{n,t} \tag{2.1}$$

where $n = 1, 2, \ldots, N$ denotes countries; $t = 1, 2, \ldots, T_n$ time and T_n varies with the country; $y_{n,t}$ is an $M \times 1$ vector of endogenous variables; $z_{n,t}$ collects deterministic components; $u_{n,t}$ are VAR innovations; B_n and Γ_n are matrices containing the slopes and the intercept coefficients. Rewrite (3.1) as:

$$Y_n = X_n B_n + Z_n \Gamma_n + U_n \tag{2.2}$$

where X_n is the matrix obtained by stacking vertically the T_n observations in $y'_{n,t-1}$. Thus Y_n and U_n are $T_n \times M$; X_n is $T_n \times M$; Z_n is $T_n \times Q$; B_n is $K \times M$; Γ_n is $Q \times M$. Let $y_n \equiv vec(Y_n)$, $\beta_n \equiv vec(B_n)$ and $\gamma_n \equiv vec(\Gamma_n)$. We assume that the slope coefficients satisfy:

$$p(\beta_n | \bar{\beta}, \tau, O_n) = N(\bar{\beta}, \tau \times O_n) \tag{2.3}$$

where $\bar{\beta}$ is the common mean and $\tau \times O_n$ is the dispersion. We restrict $\tau \times O_n$ to be diagonal, where τ is a parameter that controls the general tightness of the restriction and O_n is a scale factor. Letting σ^2 be the variance of the error in the univariate autoregression of each VAR series, the i-th element of O_n is:

$$O_{n,i} = diag\left(\sigma^2_{n,i} \otimes \frac{1}{\sigma^2_{n,n}}\right), \quad i = 1, \ldots m. \tag{2.4}$$

We employ this scaling factor since, with a single variance parameter τ, it may be difficult to capture the cross variable variations in the β_n. Adding O_n makes the variance of $\beta_{n,i}$ specific to the variable i. One may have some subjective idea about how much the country-specific coefficients differ from the common mean and thus pin down the magnitude of τ. Here we prefer to be agnostic and use a diffuse prior:

$$p(\tau) \propto 1 \tag{2.5}$$

The VAR innovations are i.i.d. $N(0, \Sigma_n)$ and the prior on their covariance matrix is also diffuse, i.e.:

$$p(\Sigma_n) \propto |\Sigma_n|^{-\frac{1}{2}(N+1)} \tag{2.6}$$

The priors for the coefficients on the deterministic variables and for the common mean are also diffuse:

$$p(\gamma_n) \propto 1 \tag{2.7}$$

$$p(\bar{\beta}) \propto 1 \tag{2.8}$$

The posterior densities for the coefficient of interest are computed by combining prior information with the likelihood which, for the stacked vector of countries, is:

$$\begin{aligned} p(Y|\beta_n, \gamma_n, \Sigma_n) \;\; \propto \;\; & \Pi_n|\Sigma_n|^{-\frac{T_n}{2}} exp\Bigg[-\frac{1}{2}\sum_n (y_n - X_n\beta_n - Z_n\gamma_n)'(\Sigma_n^{-1} \otimes I_{T_n}) \\ & (y_n - X_n\beta_n - Z_n\gamma_n)\Bigg] \end{aligned} \tag{2.9}$$

Since the priors are conjugate, the conditional posterior densities are analytically available and this enables us to numerically compute the joint posterior distributions with the Gibbs sampler.

The joint posterior for the unknowns is:

$$
\begin{aligned}
p(\beta_n, \gamma_n, \Sigma_n, \bar{\beta}, \tau|Y) \;\; &\propto \;\; p(\beta_n, \gamma_n, \Sigma_n, \bar{\beta}, \tau)\; p(Y|\beta_n, \gamma_n, \Sigma_n, \bar{\beta}, \tau) \\
&\propto \;\; \Pi_n|\Sigma_n|^{-\frac{T_n}{2}} exp\Bigg[-\frac{1}{2}\sum_n (y_n - X_n\beta_n - Z_n\gamma_n)'(\Sigma_n^{-1} \otimes I_{T_n}) \\
&\quad\;\; (y_n - X_n\beta_n - Z_n\gamma_n)\Bigg] \\
&\quad\;\; \times |\tau|^{-\frac{NMK}{2}} exp\left[-\frac{1}{2}\sum_n (\beta_n - \bar{\beta})'(\tau \times O_n)^{-1}(\beta_n - \bar{\beta})\right] \\
&\quad\;\; \times \tau^{-\frac{\nu+2}{2}} exp\left[-\frac{1}{2}\frac{s}{\tau}\right] \\
&\quad\;\; \times \Pi_n|\Sigma_n|^{-\frac{M+1}{2}} \qquad (2.10)
\end{aligned}
$$

Let $\Theta \equiv [\beta_n,\ \gamma_n,\ \Sigma_n,\ \bar{\beta},\ \tau]$ and denote by Θ/α the vector of Θ excluding the coefficient α. The conditional posterior of β_n is:

$$p(\beta_n|Y, \Theta/\beta_n) = N(\tilde{\beta}_n, \tilde{\Delta}_n) \qquad (2.11)$$

where

$$\tilde{\Delta}_n = \left(\Sigma_n^{-1} \otimes X_n'X_n + \tau^{-1}O_n^{-1}\right)^{-1}$$

and

$$\tilde{\beta}_n = \tilde{\Delta}_n \times \left((\Sigma_n^{-1} \otimes X_n')(y_n - Z_n\gamma_n) + \tau^{-1}O_n^{-1}\bar{\beta}\right)$$

The conditional posterior of γ_n is:

$$p(\gamma_n|Y, \Theta/\gamma_n) = N(\tilde{\gamma}_n, \tilde{\Gamma}_n) \qquad (2.12)$$

where

$$\tilde{\Gamma}_n = \left(\Sigma_n^{-1} \otimes Z_n'Z_n\right)^{-1}$$

and

$$\tilde{\gamma}_n = \tilde{\Gamma}_n \times \left(\Sigma_n^{-1} \otimes Z_n'\right)(y_n - X_n\beta_n)$$

The conditional posterior of Σ_n is:

$$p(\Sigma_n|Y, \Theta/\Sigma_n) = iW\left((Y_n - X_nB_n - Z_nC_n)'(Y_n - X_nB_n - Z_nC_n), T_n\right) \qquad (2.13)$$

The conditional posterior of $\bar{\beta}$ is:

$$p(\bar{\beta}|Y,\Theta) = N(\bar{\bar{\beta}}, \bar{\Delta}) \tag{2.14}$$

where

$$\bar{\Delta} = \left(\sum_n \tau^{-1} O_n^{-1}\right)^{-1}$$

and

$$\bar{\bar{\beta}} = \bar{\Delta} \times \sum_n \tau^{-1} O_n^{-1} \beta_n$$

The conditional posterior of τ is:

$$p(\tau|Y,\Theta/\tau) = IG\left(\frac{(N \times M \times P \times M) + \nu}{2}, \frac{\sum_n \left(\beta_n - \bar{\beta}\right)'^{-1} \left(\beta_n - \bar{\beta}\right) + s}{2}\right) \tag{2.15}$$

By iteratively sampling from (2.11)-(2.15), one obtains a sequence for Θ that can be used for inference. We make 1300000 draws, use 300000 for burn-in and keep one every 1000 draws of the remaining for inference. Convergence and autocorrelation diagnostics are satisfied with our selected sample.

A few words of explanations about our choices are needed. The multi-country VAR model is put into action by adopting a hierarchical structure in which the country-specific coefficients are randomly drawn from a Normal distribution with a common mean. This is typically referred as the first stage of the hierarchy. The second stage consists of prior assumptions about the distributions of the common mean and of the country-specific variances. For the former we employ noninformative priors; the latter are estimated in an Empirical Bayes fashion.

The conditional posterior for β_n has a natural weighted average format where sample and prior information receive weights proportional to their relative precision. Thus, the country model whose coefficients are more tightly estimated receives more weight relative to the prior as compared to the model where the coefficients are imprecisely estimated. The variance of country-specific coefficients depends on how different the estimated country-specific coefficients are and their precision. If they are different and the uncertainty around the estimates is small, the variance in the second level of the hierarchy will be large indicating significant heterogeneity.

2.3.1 Counterfactual

The structural responses of the destination countries' variables to source country output shocks are the sum of two distinct effects: a pure output shock effect and an effect due to changes in tourism flows. The first measures spin-offs due to the fact that shocks in source and destination country output may be correlated; the second the indirect effect that source country output fluctuations may have via tourism flows. Thus, while the first is the "common shock" component, the second measures the "international transmission" due to tourism.

To isolate the contribution of the latter, we compute an hypothetical impulse response capturing only the common shock effect, and compare its shape and magnitude to the one originally estimated. Whenever differences in the responses are significant, the tourism channel plays a non-trivial role in the transmission of shocks from the source to the destination country.

We focus on the measurement of the "multiplier" effect that tourism may have for output in the destination economies. While it is possible to compute multipliers for the other three variables, one needs to add assumptions which may be difficult to rationalize in our context [3].

To see what the exercise involves, consider the matrix A_0 used to transform each country reduced form VAR into a structural model, i.e. $A_0 D A_0' = \Sigma^{-1}$, where D is a diagonal matrix. A_0 is a 6×6 matrix with a lower triangular structure in the first three equations - the rest is unrestricted. The instantaneous effect of a source country output shock on the destination country's output is given by the coefficient $a_{3,1}$. If tourism flows respond to source country output shocks - i.e. $a_{2,1} \neq 0$ - and if the destination country output responds to tourism flows on impact - i.e. $a_{3,2} \neq 0$ - the indirect effect of source country output shocks is $a_{2,1} \times a_{3,2}$. When transmission extends beyond the impact period, tourism flows respond to source output shocks at future horizon and lagged tourism coefficients enter significantly the equation for output in the destination country. To eliminate the indirect effect at all horizons, we generate an artificial tourism shock series that offsets the response of tourism flows to a source country output shock. Given our setup, we can construct the

[3]For example, to control for the effect that tourism has on net exports, we need also to eliminate all intermediate channels that from source country output may spread to domestic consumption, investment and to net exports, and this requires a set of shocks which are correlated in a particular and improbable way.

shock series using the country-specific residuals covariance matrix Σ_n or the average covariance $\bar{\Sigma} \equiv \frac{1}{N}\sum_{n=1}^{N}\Sigma_n$. Let the average and the country-specific impulse responses be:

$$\bar{\Phi}_{i,q,h} = e_i \bar{\Lambda}^{h-1}(A_0(\bar{\Sigma}))_q^{'} \tag{2.16}$$

$$\Phi_{i,q,h,n} = e_i \Lambda_n^{h-1}(A_0(\Sigma_n))_q^{'} \tag{2.17}$$

where $\bar{\Lambda}$ is the companion representation of the matrix of average slope coefficients $\bar{\beta}$ and Λ_n is the equivalent companion form for the country-specific slope coefficients β_n; e_i is a selection vector picking the response of a particular variable i, q indicates the shock of interest; $h = 1, \ldots, H$ defines the horizon; and the dependence of A_0 on Σ_n or $\bar{\Sigma}$ is made explicit.

To set to zero the response of tourist flows to an output shock in the source country, $\bar{\Phi}_{2,1,h} = \Phi_{2,1,h,n} = 0$, for all h and for each n, we construct an artificial average shock $\bar{\epsilon}_{i,h}$ and an artificial country-specific shock$\epsilon_{i,h,n}$. For $h = 1$, the artificial shocks are defined as:

$$\bar{\epsilon}_{2,1} = -\frac{(A_0(\bar{\Sigma}))_{2,1}^{'}}{(A_0(\bar{\Sigma}))_{2,2}^{'}} \tag{2.18}$$

$$\epsilon_{2,1,n} = -\frac{(A_0(\Sigma_n))_{2,1}^{'}}{(A_0(\Sigma_n))_{2,2}^{'}} \tag{2.19}$$

For all $h > 1$, the artificial shocks are:

$$\bar{\epsilon}_{2,h} = \frac{\bar{\Phi}_{2,1,h} + \sum_{j=1}^{h-1} e_{i=2}\bar{\Lambda}^{h-j}A_0(\bar{\Sigma})_{q=2}^{'}\bar{\epsilon}_{2,j}}{e_{i=2}A_0(\bar{\Sigma})_{q=2}^{'}} \tag{2.20}$$

$$\epsilon_{2,h,n} = \frac{\Phi_{2,1,h,n} + \sum_{j=1}^{h-1} e_{i=2}\Lambda_n^{h-j}A_0(\Sigma_n)_{q=2}^{'}\epsilon_{2,j,n}}{e_{i=2}A_0(\Sigma_n)_{q=2}^{'}} \tag{2.21}$$

Thus, the hypothetical responses measuring only the direct effect of the output shock are:

$$\tilde{\bar{\Phi}}_{i,1,h} = \bar{\Phi}_{i,1,h} + \sum_{j=1}^{h} e_i\bar{\Lambda}^{h-j}A_0(\bar{\Sigma})_{q=2}^{'}\bar{\epsilon}_{2,j} \tag{2.22}$$

$$\tilde{\Phi}_{i,1,h,n} = \Phi_{i,1,h,n} + \sum_{j=1}^{h} e_i\Lambda_n^{h-j}A_0(\Sigma_n)_{q=2}^{'}\epsilon_{2,j,n} \tag{2.23}$$

2.4 The results

We organize the presentation of the results in several subsections. First, we look at the dynamics of tourist flows and present reduced form evidence. Then, we look at average and individual country responses estimated from a baseline BVAR and analyze the dynamics of tourism flows and domestic variables in few special cases of interest. Finally, we report the results of the counterfactual experiment.

2.4.1 The tourist data

To begin with, we briefly discuss tourism flows data we have available. The on-line appendix plots tourist arrival data for Cyprus, Morocco, Syria, Tunisia and Turkey by source country [4].

Tourism flows are heterogeneous at least in two dimensions: aggregate trends are different; the evolution by source country is different. For example, aggregate tourist arrivals to Cyprus and Tunisia fluctuate around a positive trend since the 1980s, while in Morocco and Syria total tourist arrivals stay flat until the late 1990s and pick up only afterwards. In Turkey total tourist arrivals grew for the entire sample, but at a stronger pace since the year 2000. Differences in the evolution of tourist arrivals by source country can, at times, be explained by source country factors - for example, the number of Irish tourists visiting Cyprus fell back to mid '80s values, following the financial disruptions of 2008. In others cases, see e.g. the evolution of the number of Finnish tourists arriving in Cyprus, which steadily grew since mid '80s, peaked in 1990, and quickly fell afterwards and never recovered, they can be explained by evolving consumers' tastes, marketing strategies or the segmentation of tourism demand. Note that certain source countries dominate tourist arrivals in certain destinations: for example, British tourists to Cyprus represent around half of annual arrivals to the island, and French tourists to Tunisia account for more than 40% of the total annual inflow.

[4]For Morocco we plot - and use in the analysis that follows - a simple moving average of two consecutive observations of the original data since the latter displays marked swings in the first six years of the sample.

2.4.2 Reduced-form evidence

Figure 2.1 plots output growth and tourism growth in the source countries and output growth in the five destination countries: dashdotted lines represent annual changes of (log) tourist arrivals; continuous and dashed lines indicate annual changes of the source country and destination country (log) output respectively; shaded regions denote source country recessions. Recession dates for the Euro area are from the CEPR, for the UK from the Bank of England, for Russia and France from the Economic Cycle Research Institute.

Tourist arrivals growth data looks quite cyclical and downward movements correspond to recessionary episodes in the source countries. This is very clear for Cyprus were the sample is sufficiently long to cover three recessions in the UK and the Euro area. In Morocco and Tunisia, the sample is considerably shorter but also in this case the growth rate of tourist arrivals is negative around Euro area (France) recessions. Consistent with this pattern, the number of Russian tourist arrivals to Syria and Turkey displays two large and consecutive drops in 1998 and 1999, in coincidence with the Russian financial crisis, and in 2009 when Russia experienced the worst contraction since the Ruble crisis.

While tourism flows are negatively affected by recessionary episodes, it is of interest to know whether comovements between source country output and tourism cycles extend beyond contraction episodes. Table 2.2 reports bilateral unconditional static cross-correlations up to two leads and lags of the three variables. In general, comovements between source country output and tourism flows are low: the largest value is observed for Russian output and Russian arrivals to Syria.

Why are the correlations generally low? As we have already mentioned a number of elements specific to the tourism market may shift the relationship between output and arrivals forward or backward in time. To dig deeper into these numbers, we separate correlations at business cycle frequencies from those at long run frequencies. Intuitively, long term tourism flows should reflect the evolution of economic prosperity in the source countries while cyclical factors may be more important in describing the link between tourism flows and destination country output. In Table 2.3 frequencies centered around $\pi/2$ correspond to cycles of about four years; frequencies around zero capture long run comovements.

In many cases, the correlation between source country output and tourist arrivals is stronger in the long run than at business cycles frequencies. Consistent with the static correlations, the three largest dynamic correlations correspond to Russian arrivals to Syria, French arrivals to Morocco and Russian arrivals to Turkey, all of which are close to or above 0.5.

While the first part of the relationship is somewhat weak, the connection between the flow of tourists and output in the destination country is stronger - see the middle panel of Table 2.2. The highest correlation 0.7 is between tourist arrivals from the United Kingdom and Cyprus' output; the correlations between Euro area tourist arrivals and Cyprus' output; Euro area and French arrivals and Tunisia's output, and Euro area and Russian arrivals and Turkey's output are also strong. Moreover, the maximum correlation is generally contemporaneous. The exceptions are Morocco and Syria where output cycles lag tourist arrivals from the Euro area. Note that the correlation between tourist arrivals and destination country's output is stronger in the long run, indicating that the beneficial effects of tourism flows are long lasting.

Interestingly, in eight out of ten total combinations, the contemporaneous correlation between tourist arrivals and output in the destination country is larger than the correlation between outputs in the source and destination country. The two exceptions are represented by the Euro area and Cyprus and by France and Morocco, probably because source country and destination country output cycles are well synchronized in these two pairs. In the long run, the comovements between tourism and output cycles are generally larger than those among outputs [5].

The statistics we report in Tables 2.2 and 2.3 give a glimpse of the unconditional role of tourist flows for each country pair. To sharpen the conclusions, we have also computed rank correlations between a measure of bilateral output synchronicity and bilateral tourist flows, netting out the effects due to trade links, the level of industrial and financial development and the indus-

[5] We have also computed Granger causality tests in order to check whether (i) output Granger causes tourist flows in the source country and (ii) tourist arrivals Granger cause destination country's output. The results are in the on-line appendix. In only one out of ten cases output Granger causes tourism in the source country - it is with Russian output and Russian tourist arrivals to Syria - confirming that tourism cycles in the source countries are not strongly related to local economic conditions in the source country. On the other hand, tourism flows Granger cause destination country's output in three cases: Euro area and French tourist arrivals to Tunisia, and Russian tourist arrivals to Syria.

trial structure of the destination country. The results partially support the idea that tourism flows matter: rank correlations are modest (0.24) but they are significantly different from zero at the 10 % level.

2.4.3 Structural evidence: average responses

Average responses are useful as they give an idea of the dynamics of the variables of interest that would be observed in a hypothetical representative country belonging to the Mediterranean region. Since small open economy models often use such an assumption, the results we present are of direct interest to theorists modeling imported cyclical fluctuations. Figure 2.2 plots the responses to a Euro area output shock. The size of the shock is normalized to one; the continuous line represents the median posterior response, computed horizon by horizon, and the dotted lines denote 68% posteriors credible sets.

The tourism variable reacts positively and significantly on impact. The magnitude is large, as a 1% increase in Euro area output triggers an increase in tourism flows of approximately 2%. The response is maximal on impact and then it slowly returns to zero. Given that the reduced form evidence suggested that output in the source country and tourism flows are weakly correlated, an explanation for this stronger pattern is needed. To understand the differences, note that here the results concern unexpected output shocks. Thus, the lack of correlation found in the previous subsection may indicate that the relationship between the predictable components of source country output and of tourism flows is very weak.

Domestic output in the representative Mediterranean country grows on impact, the median effect is non-negligible and persistent. The median response of domestic consumption is also positive but more muted, while investments react strongly and display a humped shaped dynamic. The median response of net-exports is zero on impact, but turns negative afterwards. Thus, tourist inflows trigger an increase in investments much more than consumption, making the output effects in the average destination country long lasting.

As we have mentioned, an average measure of the heterogeneity in the dynamic responses is the hypervariance parameter τ. Its posterior density, which we present in the on-line appendix, is centered around 0.01, indicating a considerable degree of heterogeneity in the five countries we examine. For comparison, the posterior density obtained by Jarocinski (2010) using a group of eastern European countries has zero mass above 0.001.

2.4.4 Structural evidence: individual country responses

In the individual countries, the response of tourist arrivals is usually positive, but there are differences in the magnitude of the impact response and in the shape of the dynamic effects. For example, a 1% increase in Euro area output contemporaneously increases Euro area tourist arrivals in the median by about 1.5% in Cyprus, by 2.5% in Morocco, by 1% in Tunisia but about by 6% in Syria; the impact response in Turkey is only 0.5% but the median response becomes larger after one year. The similarities in the responses of tourist arrivals to Cyprus, Morocco and Tunisia suggest they compete to attract the same Euro area tourists, while the large response of tourist arrivals to Syria is probably due to the fact that the market is exotic, segmented from the rest, and thus much more sensitive to unexpected income changes in the source country.

The responses of the local variables are also quite heterogeneous. Domestic output responds positively in Cyprus, Tunisia, Syria and Turkey and negatively in Morocco. The latter reaction is puzzling, and may be due to the short sample available. Consumption responses are positive in Cyprus, Syria and Tunisia, negative in Morocco and essentially zero in Turkey. The response of investment is, on the other hand, positive in all countries although its shape varies. Net exports are either positive or insignificant on impact, but negative thereafter in all countries except Cyprus, where they are negative on impact and essentially zero afterwards.

2.4.5 How important are foreign shocks?

To study how important foreign shocks are for fluctuations in these destination countries and to measure the contribution of tourism shocks to the local fluctuations, we decompose the forecast error variance of each of the endogenous variables into components attributable to the various structural shocks. Table 2.4, which reports the contribution of the external shocks at horizons 0, 1, 4, and 8, has a few interesting features.

Fluctuations in tourism flows are generally dominated by shocks to tourism itself, with shocks to Euro area output playing a small role. Interestingly, tourism flows are hardly influenced by cycles in the destination country. Clearly, acts of terrorism or periods of political instability do affect the tourism sector. For example, arrivals in Tunisia fell by about 50% in 2011 as a consequence of the turmoils that occurred during the Arab spring[6]. However, these episodes are either too recent, or their occurrence has been rare in the sample, so that the effects are not measurable in the aggregate.

The pattern of fluctuations in destination country's variables is heterogeneous. At one extreme there is Cyprus, where source country output and tourism shocks each explain in the median around 40% of domestic output fluctuations at the eight years horizon. These shocks have an equally relevant role in determining fluctuations in consumption and net exports. At the other extreme, are Turkey and Syria: here the Euro area output and tourism shocks together account for about one-third of fluctuations in the domestic variables. As we will see next, the conclusion changes when we relate Turkish variables with the Russian output cycles. Morocco and Tunisia are intermediate cases: the role of imported shocks for domestic variables is sizeable and about 50 % of the fluctuations in domestic variables are of foreign origin.

2.4.6 Some special bilateral relationships

We have already highlighted the special role that output and tourism cycles in the United Kingdom, Russia and France may play for Cyprus, Turkey and Tunisia. In this subsection, we look at the transmission of output and tourism shocks for these three special pairs to see whether the conclusions we have previously reached are confirmed or not.

We estimate Bayesian VARs with the same structure and the same variables we have previously employed, except that the source country output and tourism flows are now from the United Kingdom in the case of Cyprus, France in the case of Tunisia and Russia in the case of Turkey. To be consistent with the approach adopted so far, estimation is Bayesian. We employ an independent Normal-Wishart prior for the parameters as in Koop and Ko-

[6]Reuters, US on-line edition: interview with Tunisia Trade and Tourism Minister Mehdi Houas, released on June 15th 2011.

robilis (2010) and inference is based on a sample of 1000 observations sampled from 130000 draws, after discarding 30000 for burn-in. In order to bring information from the region-wide models into the single-country VARs, the priors for the slope coefficients and the covariance matrix of the residuals are centered at the average posterior values previously obtained. Figure 2.4 plots the responses and Table 2.5 displays the forecast error variance decomposition.

For Turkey, the tourism variable reacts strongly on impact and jumps by about 2.5% - recall that with tourist arrivals from the Euro area the jump is insignificant on impact and small compared to other Mediterranean countries. Domestic output, consumption and investment are all positive and significant, and this represents an important change relative to the baseline case of the previous subsection, where all the responses where insignificantly different from zero. Consistently with this evidence, the forecast error variance decomposition assigns a large role to the Russian output shocks: while the median contribution of the Euro area output shock to Turkish output does not exceed 10%, the median contribution of the Russian output shock is 60% contemporaneously and stays around 55% eight years into the future. Two other facts are worth noticing: since the role of the tourism shocks is also large, between 52% and 87 % of domestic fluctuations at the eight years horizon are of imported nature. Moreover, since half or more of Russian tourist arrivals variability to Turkey is explained by the Russian output shocks, tourism in Russia is much more dependent on income than in the Euro area.

When the UK is the source country for Cyprus, the evidence is broadly comparable to that obtained using Euro area data. The tourism variable jumps on impact by almost 2%, which is very close to the value observed in Figure 2.3, but the maximal effect is reached three years after the shock. The responses of the domestic variables is muted as compared those following a Euro area output shock: the peak responses of domestic output and investment are about three times smaller and the response of consumption fluctuates around zero. One reason for why these effects are smaller is that Cyprus cycles are well synchronized with the Euro area cycles, but much less so now with the UK cycles. This conjecture is supported by the forecast error variance decomposition which assigns a considerably smaller share of the domestic fluctuations to UK output shocks (about 5%) as compared to Euro area output shocks (about 35%). However, the role of UK tourism shocks is larger: comparing Tables 2.4 and 2.5, one can see that independent shocks to the UK tourism variable account for twice as large share of Cyprus output fluctuations as compared to a Euro area tourism shock. Thus, the combined effect of imported shocks on Cyprus output is large, regardless of the source country.

Switching the source country from the Euro area to France for Tunisia has minor consequences on the conclusions we have reached. Tourist flows react more strongly to France output shocks but, relatively speaking, the instantaneous response of domestic output and consumption is muted and larger effects are observed with a lag. The combined effect of France output and tourism shocks on Tunisia output, consumption and investments is roughly the same as the one of the Euro area at longer horizons, but the importance for Tunisia output and investments is smaller at horizon 0 and 1 (30% and 55% as compared to 6% and 37%).

2.4.7 How important is tourism to transmit output shocks internationally?

Next, we evaluate the role of tourism as a channel of international transmission of output shocks, disentangling the direct and the indirect effects of source country output shocks as described in section 2.3.1. Figure 2.5 plots the dynamic response of output with the indirect effect associated to tourism flows (the continuous line is the median and the dotted lines the 68% posterior intervals) and without (starred line). The first plot reports the effect in the representative country. The remaining plots show the effects for individual countries. Table 2.6 has impact and cumulative multipliers computed at the eight year horizon.

Tourism plays a non-trivial role in the representative country: the median impact response of domestic output in the typical destination country would fall from 0.4 to 0.3 when the tourism channel is shut down. Although the effect is not a-posteriori significant - the counterfactual response remains within the original posterior interval - it is quantitatively important and, at least for the first two years, the counterfactual response is close to the lower bound of the original posterior interval. Furthermore, the persistence of the output response is lower as compared to the baseline case.

The pattern for individual countries is also consistent with the idea that the tourism sector matters in transmitting international cyclical fluctuation in the Mediterranean. Cyprus is the country where this role is more prominent, see Figure 2.5 and the on-line appendix. Both in the case of Euro area output shocks and UK output shocks, the response of Cyprus output would be considerably smaller at all horizons, if the tourism channel was eliminated. As shown in Table 2.6, the median cumulative Cyprus output multiplier produced by a Euro area output shock would fall from 1.68 to 1.29 without the tourism channel and the posterior intervals would not overlap. In Morocco, Syria and Turkey the tourist channel looks less crucial. Nevertheless, absent the tourism channel, domestic output fluctuations in the destination country would have been different. For example, in Morocco, the counterfactual output response is more negative in years one and two; in Syria, domestic output is considerably less positive in all periods, resulting in a median cumulative multiplier of 2.72 compared to 3.09 in the baseline case; in Turkey, there is no difference with the baseline on impact, but responses are more negative afterward. Note that for Turkey, the same exercise performed using Russian output data and Russian tourist arrivals, delivers a counterfactual output response that remains below the lower bound of the posterior credible set from horizon zero up to six.

It is important to stress that since source country output and tourism fluctuations are stronger during downturns and since the VAR assigns equal weights to positive and negative shocks, the results presented here should be considered a lower bound for the role that tourism flows may have during economic contractions. Given that the samples contain only one or two recessions, it is very hard to distinguish recessionary and non-recessionary effects with a sufficient degree of precision. Thus, the estimation of a nonlinear model capturing these effects is left for future research.

2.5 Sensitivity analysis

The analysis so far employed tourist arrivals as our main tourism variable. As mentioned earlier, this is not the ideal measure, but it has the advantage of being available for all five countries. In this section, we examine whether our conclusions change when we use different tourism variables. Data on the number of nights spent by international tourists is available only in Tunisia, for the sample 1988 to 2010, and has information on the source countries which is similar to the data on the number of tourist arrivals[7]. Data on per-capita tourist expenditures is available only in Cyprus and covers the 1995 to 2010 period. Since the sample is considerably shorter than in the baseline experiments, conclusions should be drawn with care. To economize on space, the plots and tables with these two alternative variables are in the on-line appendix.

2.5.1 Number of nights spent in Tunisia

Data on the number of nights spent is quite volatile but troughs around 1992, 2001 and 2008 are clearly visible. To make the comparison with the evidence in section 2.4 straightforward, we focus on the number of nights spent by tourists from the Euro area and from France. As in section 2.4.2, we extract the cyclical component by taking first differences of the original data.

Fluctuations in the number of nights spent both by European and French tourists are similar to those obtained using the number of tourist arrivals, both qualitatively and quantitatively. For example, the growth rate of the number of nights spent by European tourists has been negative in all years from 2006 to 2010, with the exception of a slightly positive value observed in 2008. The largest drop is in 2009; negative values are observed from 2000 to 2003 and before the 1992 recession. When one looks at the number of nights spent by French tourists, the conclusions are similar, but negative fluctuations in co-incidence with recessionary episodes are milder, probably because the strong social and economic ties make large slumps in tourism flows from France unlikely, even during downturns.

Given the similarities in the time series pattern of tourist arrivals data and number of nights spent, static and dynamic correlations with source country and destination country output are practically unchanged.

There are a few differences in the shape of the responses the structural analysis delivers, but previous conclusions are, by and large, confirmed[8]. The

[7] With respect to the number of observations, the sample of number of nights spent is one year longer. With respect to the number of source countries, there is no information on the number of nights spent for tourists from Spain and Luxembourg.

[8] Here we do not have the luxury of using a random coefficient Bayesian VAR as we have data only for one country. To make the analysis comparable, we specify the prior distribution on the coefficients of the VAR to be centered at the average posterior coefficients estimated from the random coefficient Bayesian VAR model - thus reflecting the assumption that the underlying economic effects should be similar, even though different tourism data is used - and letting the variance of the

conclusions obtained from the forecast error variance decomposition are also similar: median posterior estimates are obviously different, but the 68% posterior credible sets often overlap.

2.5.2 Per-capita expenditures in Cyprus

Per-capita expenditures by tourists in Cyprus is comparable across countries and around 700 euro on average. Russian tourists are the biggest spenders, as their per-capita expenditures exceed 1000 euro for several years in the sample. Since the Russian tourist phenomena is relatively new in Cyprus, we focus on expenditures made by tourists from the United Kingdom and the Euro area.

The comovements between output in the source country and expenditures are strong and the same tendency to jointly fall during economic slowdowns that characterizes the number of tourist arrivals is also present. For example, we observe negative growth rates in 2000 and 2001 for British tourists and positive, although sensibly smaller compared to previous years, rates in 2001 and 2002 for European tourists. The magnitude of the contraction of per-capita expenditure during the recent recession is around 10%.

The contemporaneous correlation between Euro area output and per-capita expenditures is larger than the one observed in the case of tourist arrivals, confirming the superior ability of per-capita expenditures to capture fluctuations in households' disposable income over the cycle. Contrary to the case of tourist arrival data, dynamic correlations are relatively similar across frequencies, but this may be spuriously due to the fact that sample is shorter.

The responses estimated with expenditure data are very close to those obtained using tourist arrivals data. In particular, the impact response of per-capita expenditure to a source country output shock is similar to the one obtained with tourist arrival data, indirectly confirming that expenditures data is artificially constructed combining the duration of the stay abroad with a notional measure of average daily expenditures. The forecast error variance decomposition shows that per-capita expenditures are in large part driven by idiosyncratic shocks, as is the case with tourist arrival flows, but assigns a smaller role to tourism shocks in driving fluctuations of domestic output and

prior to be relatively large to allow the data to deviate from the prior is needed.

consumption in the destination country.

2.6 Conclusions

The literature has been concerned for a while with the international transmission of shocks and with the channels through which spillovers occur. In many regions of the world, the trade and the financial channels are strong and fluctuations over time in their size appear to be responsible for the pattern of convergence or decoupling observed in the cyclical fluctuations around the world (see Imbs (2004), Kose and Prasad (2010)). The few studies which have looked at cyclical fluctuations in the Mediterranean have found instead that trade and financial channels are not important and that similarities and differences in the cyclical fluctuations in the region are more related to institutional and cultural factors.

The Mediterranean however is a cradle of tourism: in many countries tourism revenues are a large portion of the service account balance; tourism related activities account for a significant fraction of total employment; and, as the Arab spring demonstrates, reductions of tourism flows can cause important welfare losses in the destination economies.

This paper examines the magnitude of imported fluctuations and attempts to quantify the importance of the tourism channel for the international transmission of cyclical fluctuations to the Mediterranean. We use five destination countries and a number of source countries to provide broad evidence on the link and employ alternative measures of tourism flows to make sure that the results we obtain are robust. The analysis reaches four main conclusions.

First, output shocks in the source country generate important fluctuations in international tourism flows. Thus, the luxury good characteristics of international tourist flows is confirmed. Our analysis shows that the link is obscured if unconditional correlations are considered and the predictable part of the fluctuations is not filtered out of the data. In addition, we show that the reaction of tourism flows to income shocks is much stronger in recessions than in expansions. Second, tourism is an important channel of international transmission of output shocks. For example, if the tourist channel were wiped out, the output effects in a typical destination country would be reduced by one-fourth. Third, shocks to tourist arrivals unrelated to income fluctuations in the source country are also important for destination countries output. While disturbances of this type may have to do with preferences for certain location, aggressive marketing strategies, and political instabilities, it is clear that making tourism flows more predictable will improve the ability of destination countries to effectively deal with tourists flows and reduce the downside risks for the local communities. Fourth, in the five destination countries we consider, imported shocks explain a considerable fraction of the variability of domestic variables.

Our work is the first that systematically investigates the role of the tourism channel for the international transmission of cyclical fluctuations. As all pioneer contributions, it suffers from a number of data limitations. For example, we were able to collect data of comparable quality only for five countries in the Mediterranean region and the available series (number of tourist arrivals) is not the most informative. In addition, the samples are generally short and some of the economies we consider are not necessarily ideal for studying the international transmission of cyclical fluctuations, as idiosyncratic elements are very strong. Moreover, there seems to be a stronger relationship between income in the source country and tourist flows in recessions, but we are unable to exploit this observation in our analysis because the data is short. Hopefully, longer time series, more reliable data for a larger number of source and destination countries, and better recording practices will make studying the contribution of tourism flows to international cyclical fluctuations much easier in the future.

There are many avenues for future research that this paper opens. First, our evidence indicates the need to build international business cycle models where tourism flows, tourism competition and marketing strategies play an important role. Disregarding this channel of transmission may hamper our understanding of how shocks in a large country are transmitted to a small open economy and bias the measurement of other channels of propagation. Second, the counterintuitive pattern of transmission observed in Morocco calls for more international evidence on the role of the tourism channel in other regions of the world. Third, the conclusions we reach call into question European policies trying to improve the integration of the Mediterranean into the EU. Policy actions should not be devoted only to establish stronger trade links; fostering the tourist relationships may help to integrate faster Mediterranean economies with the EU and may have long lasting beneficial output effects because of the virtuous investment cycle they ignite. Investigations studying the best way to achieve the integration goal with a given amount of resources, and the welfare consequences of different policies are likely to improve our understanding of the problem and rationalize policy choices better. Finally, the evidence we have provided is also useful to design development strategies in countries like those of the Middle East, where tourism flows are potentially important but currently hampered by political and religious disputes.

Figures and Tables

Table 2.1: Tourism data

Destination country	Source country	Arrivals	Nights	Expenditures
Cyprus	Euro area	1980 - 2010	- - - -	1995 - 2010
	United Kingdom	1980 - 2010	- - - -	1995 - 2010
	Russia	1994 - 2010	- - - -	1995 - 2010
Morocco	Euro area	1992 - 2009	- - - -	- - - -
	United Kingdom	1992 - 2009	- - - -	- - - -
	France	1992 - 2009	- - - -	- - - -
Syria	Euro area	1985 - 2008	- - - -	- - - -
	United Kingdom	1985 - 2008	- - - -	- - - -
	Russia	1995 - 2008	- - - -	- - - -
Tunisia	Euro area	1988 - 2010	1987 - 2010	- - - -
	United Kingdom	1988 - 2010	1987 - 2010	- - - -
	France	1988 - 2010	1987 - 2010	- - - -
Turkey	Euro area	1984 - 2011	- - - -	- - - -
	United Kingdom	1984 - 2011	- - - -	- - - -
	Russia	1998 - 2011	- - - -	- - - -

Notes: ”Arrivals ” refers to number of tourist arrivals registered at the border; ”Nights ” refers to number of nights spent by tourists; ”Expenditures ” refers to per-capita tourist expenditures. Frequency is always annual.

Table 2.2: Unconditional cross-correlations

Output in SC & Arrivals in MED	Lags or leads (in years)				
	-2	-1	0	1	2
EA - CY	$0.352*$	0.109	$0.202*$	0.003	$-0.286*$
UK - CY	0.042	-0.011	$0.215*$	0.189	0.116
EA - MA	0.039	$0.198*$	0.146	0.120	0.199
FR - MA	0.027	$0.268*$	$0.297*$	$0.401*$	$0.291*$
EA - SY	$0.410*$	-0.052	-0.096	$-0.274*$	-0.209
RU - SY	-0.097	-0.115	$0.505*$	$0.628*$	$0.570*$
EA - TN	$0.308*$	-0.047	0.029	-0.041	-0.132
FR - TN	$0.347*$	-0.015	$0.149*$	-0.065	-0.308
EA - TR	$0.237*$	$-0.164*$	0.060	0.147	-0.045
RU - TR	-0.172	-0.233	$0.387*$	$0.298*$	-0.202
Arrivals in MED & Output in MED	**Lags or leads (in years)**				
	-2	-1	0	1	2
EA - CY	0.033	-0.167	$0.585*$	0.027	$0.366*$
UK - CY	$0.335*$	0.025	$0.704*$	$0.229*$	$0.274*$
EA - MA	$0.719*$	0.252	0.116	0.234	0.198
FR - MA	$0.607*$	0.130	-0.001	0.186	$0.230*$
EA - SY	$0.414*$	0.157	$0.233*$	$-0.322*$	0.170
RU - SY	$0.181*$	0.055	0.295	$0.694*$	$0.180*$
EA - TN	$0.347*$	-0.115	$0.425*$	-0.478	0.069
FR - TN	$0.398*$	-0.108	$0.353*$	$-0.490*$	0.081
EA - TR	0.052	$-0.235*$	$0.349*$	-0.195	0.108
RU - TR	-0.209	-0.010	$0.559*$	-0.279	0.450
Output in SC & Output in MED	**Lags or leads (in years)**				
	-2	-1	0	1	2
EA - CY	$0.274*$	$0.161*$	$0.632*$	$0.361*$	-0.162
UK - CY	-0.115	0.031	$0.420*$	$0.378*$	0.091
EA - MA	$-0.270*$	0.011	0.057	-0.041	0.247
FR - MA	$-0.273*$	0.050	0.074	-0.077	0.193
EA - SY	-0.182	$-0.398*$	-0.056	-0.065	$0.143*$
RU - SY	$0.267*$	0.183	-0.054	$0.672*$	$0.309*$
EA - TN	$-0.252*$	$-0.189*$	$0.303*$	$0.417*$	-0.041
FR - TN	-0.095	$-0.250*$	$0.286*$	$0.395*$	0.028
EA - TR	$0.179*$	0.117	0.220	-0.120	-0.276
RU - TR	-0.013	0.169	$0.528*$	-0.207	$-0.356*$

Notes: The numbers in the table represent $corr(x_t, y_{t+i})$, where $i = [-2,\ -1,\ 0,\ 1,\ 2]$, x_t is the varaible listed first and y_t is the variable listed second. The sample length varies across pairs: see Table 2.1 for details. The top panel computes correlations between output in the source country (SC) and tourist arrivals in the destination country (MED); the middle panel computes correlations between tourist arrivals and output in the destination country (MED); the bottom panel computes correlations between output in the source country (SC) and in the destination country (MED). Starred values mean that the 68% confidence intervals do not include zero. Confidence intervals are computed from 500 bootstrapped replications of the sample cross-correlation. Country codes: EA is Euro area; UK is United Kingdom; RU is Russia; CY is Cyprus; MA is Morocco; SY is Syria; TN is Tunisia; TR is Turkey.

Table 2.3: Dynamic correlations

Output in SC & Arrivals in MED	Frequencies	
	0	$\frac{\pi}{2}$
EA - CY	0.452	0.116
UK - CY	0.295	0.257
EA - MA	0.303	0.084
FR - MA	0.633	0.197
EA - SY	-0.346	-0.200
RU - SY	0.694	0.266
EA - TN	0.185	-0.165
FR - TN	0.232	0.011
EA - TR	0.429	-0.064
RU - TR	0.490	0.470
Arrivals in MED & Output in MED	**Frequencies**	
	0	$\frac{\pi}{2}$
EA - CY	0.756	0.327
UK - CY	0.929	0.547
EA - MA	0.731	-0.375
FR - MA	0.566	-0.433
EA - SY	0.619	-0.053
RU - SY	0.859	0.150
EA - TN	0.517	0.096
FR - TN	0.624	-0.003
EA - TR	0.217	0.145
RU - TR	0.641	0.389
Output in SC & Output in MED	**Frequencies**	
	0	$\frac{\pi}{2}$
EA - CY	0.866	0.588
UK - CY	0.335	0.498
EA - MA	0.027	0.110
FR - MA	0.039	0.138
EA - SY	-0.367	0.034
RU - SY	0.767	-0.373
EA - TN	0.236	0.374
FR - TN	0.373	0.261
EA - TR	0.095	0.307
RU - TR	0.337	0.652

Notes: Frequencies centered at zero capture comovement in the long run; frequencies around $\pi/2$ coincide with business cycles of about four years. The sample length varies across pairs: see Table 2.1 for details. The top panel computes dynamic correlations between output in the source country (SC) and tourist arrivals in the destination country (MED); the middle panel computes dynamic correlations between tourist arrivals and output in the destination country (MED); the bottom panel computes dynamic correlations between output in the source country (SC) and in the destination country (MED). Country codes: EA is Euro area; UK is United Kingdom; RU is Russia; FR is France; CY is Cyprus; MA is Morocco; SY is Syria; TN is Tunisia; TR is Turkey.

Table 2.4: Forecast error variance decomposition

Cyprus	Time horizon (in years)			
	0	1	4	8
EA tourism Shock1	10 (2,32)	11 (2,32)	15 (4,36)	17 (4,37)
Shock2	90 (68,98)	85 (66,95)	75 (56,91)	73 (52,90)
CY output Shock1	49 (28,66)	48 (26,66)	48 (23,67)	48 (23,67)
Shock2	22 (12,36)	24 (12,40)	25 (11,45)	25 (11,45)
CY consumption Shock1	21 (2,60)	21 (4,54)	23 (6,53)	25 (7,51)
Shock2	12 (1,49)	21 (6,59)	29 (9,62)	28 (9,60)
CY investment Shock1	48 (19,77)	48 (20,76)	47 (21,74)	46 (21,74)
Shock2	8 (1,30)	8 (2,25)	9 (4,26)	10 (4,26)
CY net Exports Shock1	18 (2,63)	19 (4,54)	24 (8,52)	25 (8,53)
Shock2	23 (1,64)	31 (7,68)	34 (12,63)	34 (13,62)

Morocco	Time horizon (in years)			
	0	1	4	8
EA tourism Shock1	9 (0,29)	12 (3,26)	13 (4,29)	14 (4,30)
Shock2	91 (71,100)	83 (67,93)	79 (61,90)	76 (60,89)
MA output Shock1	6 (1,24)	8 (2,24)	10 (3,26)	11 (3,27)
Shock2	34 (8,56)	37 (10,57)	38 (13,57)	37 (14,57)
MA consumption Shock1	7 (1,25)	10 (3,30)	15 (5,36)	16 (5,36)
Shock2	15 (1,39)	15 (2,38)	17 (4,40)	19 (4,40)
MA investment Shock1	34 (3,77)	32 (14,60)	32 (14,61)	32 (14,60)
Shock2	27 (2,69)	19 (5,52)	22 (6,52)	23 (7,53)
MA net Exports Shock1	9 (1,34)	12 (2,35)	14 (4,36)	16 (5,37)
Shock2	80 (52,94)	73 (49,89)	70 (47,86)	69 (44,84)

Syria	Time horizon (in years)			
	0	1	4	8
EA tourism Shock1	17 (4,41)	17 (5,37)	20 (7,39)	22 (8,41)
Shock2	83 (59,96)	70 (51,87)	61 (43,78)	59 (41,77)
SY output Shock1	28 (6,49)	31 (9,52)	34 (13,57)	34 (14,57)
Shock2	8 (1,24)	8 (2,23)	9 (2,23)	9 (2,23)
SY consumption Shock1	23 (3,54)	23 (5,53)	25 (7,53)	27 (8,53)
Shock2	7 (1,25)	8 (2,25)	9 (2,26)	9 (2,26)
SY investment Shock1	76 (30,95)	76 (42,93)	76 (46,91)	74 (46,90)
Shock2	4 (0,21)	4 (1,17)	5 (1,17)	5 (1,18)
SY net Exports Shock1	19 (2,47)	19 (5,44)	23 (8,49)	24 (9,52)
Shock2	6 (1,30)	9 (3,32)	10 (3,32)	10 (3,31)

Tunisia	Time horizon (in years)			
	0	1	4	8
EA tourism Shock1	4 (0,15)	6 (1,16)	9 (3,18)	9 (3,19)
Shock2	96 (85,100)	93 (83,98)	89 (79,96)	88 (78,95)
TN output Shock1	10 (1,29)	11 (2,26)	13 (4,26)	13 (4,27)
Shock2	17 (3,38)	23 (9,41)	29 (12,46)	29 (13,47)
TN consumption Shock1	11 (1,37)	11 (2,37)	14 (3,38)	13 (4,39)
Shock2	33 (11,66)	35 (11,63)	36 (13,63)	37 (14,64)
TN investment Shock1	6 (1,30)	8 (1,28)	10 (3,29)	11 (3,30)
Shock2	66 (34,88)	48 (24,74)	46 (22,70)	45 (21,70)
TN net Exports Shock1	50 (11,85)	36 (11,66)	28 (11,60)	28 (12,59)
Shock2	22 (3,61)	41 (18,66)	47 (21,72)	47 (21,72)

Turkey	Time horizon (in years)			
	0	1	4	8
EA tourism Shock1	3 (0,14)	6 (2,16)	11 (4,22)	11 (4,22)
Shock2	97 (86,100)	92 (82,97)	86 (73,93)	85 (71,92)
TR output Shock1	11 (2,26)	10 (3,22)	12 (5,23)	13 (6,24)
Shock2	13 (3,32)	12 (4,30)	12 (4,27)	12 (5,27)
TR consumption Shock1	13 (1,37)	13 (3,35)	16 (5,37)	17 (5,37)
Shock2	10 (1,31)	12 (3,35)	14 (3,36)	14 (3,36)
TR investment Shock1	17 (3,35)	16 (3,34)	15 (4,32)	15 (5,32)
Shock2	6 (1,19)	7 (1,19)	8 (2,20)	8 (2,20)
TR net Exports Shock1	4 (0,16)	5 (2,17)	7 (2,18)	7 (3,18)
Shock2	4 (0,16)	12 (4,28)	15 (6,34)	15 (6,34)

Notes: The first column indicates the countries considered and the relevant variables in the VAR. "Shock1 " is output shock in the source country; "Shock2 " is tourism shock. The numbers in parenthesis are the lower and upper 68% posterior credible intervals. Country codes: EA is Euro area; CY is Cyprus; MA is Morocco; SY is Syria; TN is Tunisia; TR is Turkey. The tourism variable is Tourist Arrivals.

Table 2.5: Forecast error variance decomposition, case studies

Cyprus	Time horizon (in years)			
	0	1	4	8
UK tourism				
Shock1	23 (9,35)	22 (9,36)	17 (4,32)	15 (3,31)
Shock2	77 (65,91)	71 (57,84)	50 (38,65)	38 (25,56)
CY output				
Shock1	25 (9,39)	22 (7,37)	17 (4,33)	15 (3,31)
Shock2	29 (18,42)	34 (22,49)	35 (21,54)	34 (20,53)
CY consumption				
Shock1	4 (0,14)	7 (2,21)	15 (5,31)	16 (4,32)
Shock2	3 (0,11)	6 (2,15)	20 (9,37)	29 (15,47)
CY investment				
Shock1	19 (4,41)	17 (4,38)	15 (3,33)	15 (3,31)
Shock2	31 (16,50)	28 (13,47)	29 (14,47)	32 (16,50)
CY net exports				
Shock1	25 (3,62)	24 (8,49)	23 (10,39)	18 (6,34)
Shock2	40 (9,77)	38 (17,63)	34 (21,48)	34 (20,50)

Tunisia	Time horizon (in years)			
	0	1	4	8
FR tourism				
Shock1	17 (5,34)	15 (4,31)	19 (8,35)	20 (8,36)
Shock2	83 (66,95)	83 (67,94)	79 (63,89)	77 (61,88)
TN output				
Shock1	25 (9,44)	21 (8,39)	25 (12,41)	25 (12,41)
Shock2	6 (1,15)	7 (2,16)	15 (7,25)	17 (9,27)
TN consumption				
Shock1	31 (12,54)	26 (9,48)	20 (8,41)	23 (11,42)
Shock2	18 (6,36)	29 (14,47)	33 (17,50)	32 (18,48)
TN investment				
Shock1	31 (8,59)	30 (8,52)	22 (7,43)	23 (9,43)
Shock2	45 (20,70)	33 (14,53)	25 (11,44)	26 (13,44)
TN net exports				
Shock1	21 (2,63)	20 (6,43)	17 (6,35)	20 (9,38)
Shock2	52 (16,85)	68 (48,86)	74 (56,87)	71 (54,84)

Turkey	Time horizon (in years)			
	0	1	4	8
RU tourism				
Shock1	52 (30,71)	50 (29,70)	53 (34,71)	53 (34,71)
Shock2	48 (29,70)	48 (28,69)	44 (26,64)	43 (26,63)
TR output				
Shock1	55 (29,74)	49 (24,70)	45 (22,66)	45 (22,66)
Shock2	2 (0,9)	3 (1,12)	5 (1,15)	5 (1,16)
TR consumption				
Shock1	58 (33,78)	55 (32,75)	52 (32,71)	51 (32,71)
Shock2	4 (0,13)	8 (2,20)	10 (3,23)	10 (3,23)
TR investment				
Shock1	60 (32,79)	59 (28,78)	56 (25,74)	55 (25,74)
Shock2	3 (0,10)	3 (0,10)	3 (1,11)	4 (1,12)
TR net exports				
Shock1	18 (3,48)	24 (11,45)	25 (12,45)	26 (13,45)
Shock2	9 (1,27)	24 (10,43)	28 (13,47)	27 (13,46)

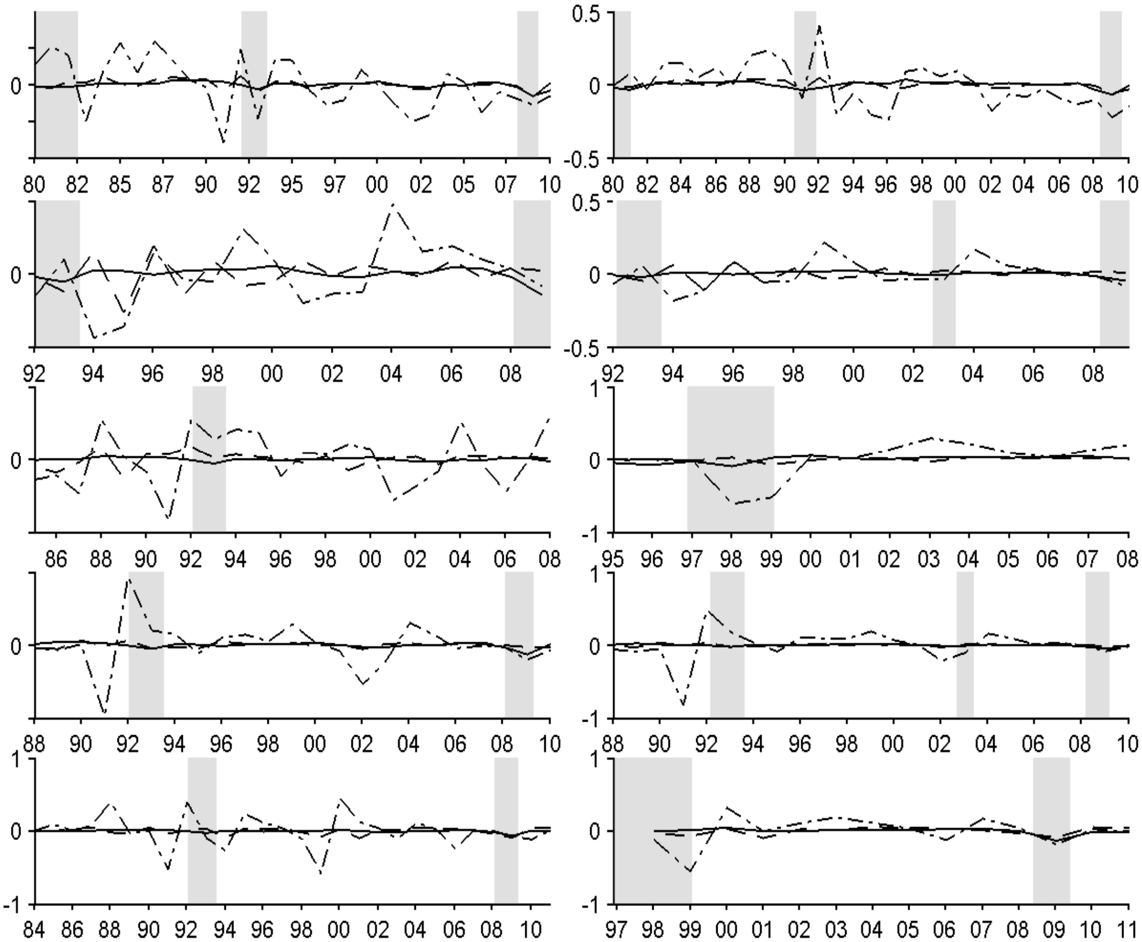
Notes: Left: Cyprus. Middle: Tunisia. Right: Turkey. The first column indicates the countries considered and the relevant variables in the VAR. "Shock1 " is output shock in the source country; "Shock2 " is tourism shock. The numbers in parenthesis are the lower and upper 68% posterior credible intervals. Country codes: UK is United Kingdom; RU is Russia; FR is France; CY is Cyprus; TN is Tunisia; TR is Turkey. The tourism variable is Tourist Arrivals.

Table 2.6: Output multipliers

	Impact Multiplier		Cumulative Multiplier	
	Baseline	Counterfactual	Baseline	Counterfactual
Average	0.62 (0.25,1.05)	0.44 (0.12,0.81)	0.32 (-0.26,0.77)	0.32 (-0.14,0.67)
Cyprus	1.19 (0.88,1.56)	0.91 (0.65,1.17)	1.56 (1.17,1.92)	1.22 (0.96,1.44)
Morocco	-0.33 (-1.41,0.74)	-0.58 (-1.32,0.18)	-0.26 (-2.39,0.70)	-0.25 (-1.70,0.48)
Syria	1.74 (0.53,3.01)	1.27 (0.19,2.41)	3.45 (2.73,4.24)	2.82 (1.96,3.58)
Tunisia	0.13 (-0.17,0.42)	0.15 (-0.09,0.39)	-0.09 (-0.85,0.27)	-0.04 (-0.59,0.19)
Turkey	0.89 (0.13,1.58)	0.89 (0.13,1.47)	0.42 (-0.91,1.30)	0.66 (-0.45,1.40)

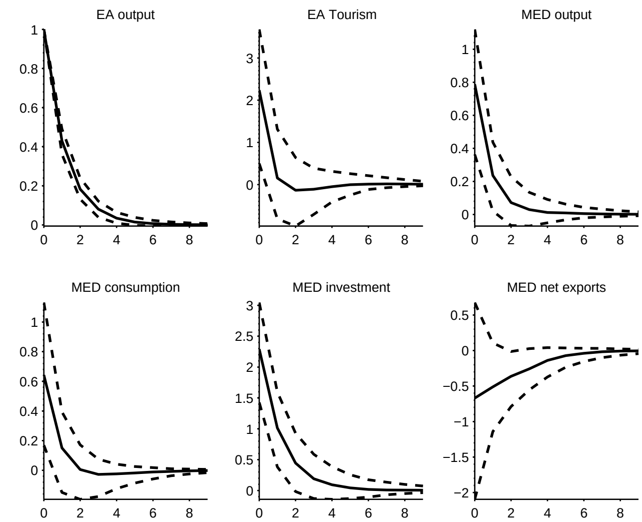
Notes: Impact multipliers in the baseline case are constructed as the value at time zero of the domestic output impulse response in the destination country divided by the value at time zero of the Euro area output shock. Cumulative multipliers in the baseline case are constructed as the sum over time of the value of the domestic output impulse response in the destination country divided by the sum over time of the value of the Euro area output shock. Under the counterfactual scenario, the tourism channel is closed. The tourism variable is Tourist Arrivals. In parenthesis are 68% posterior credible intervals.

Figure 2.1: Cyclical fluctuations



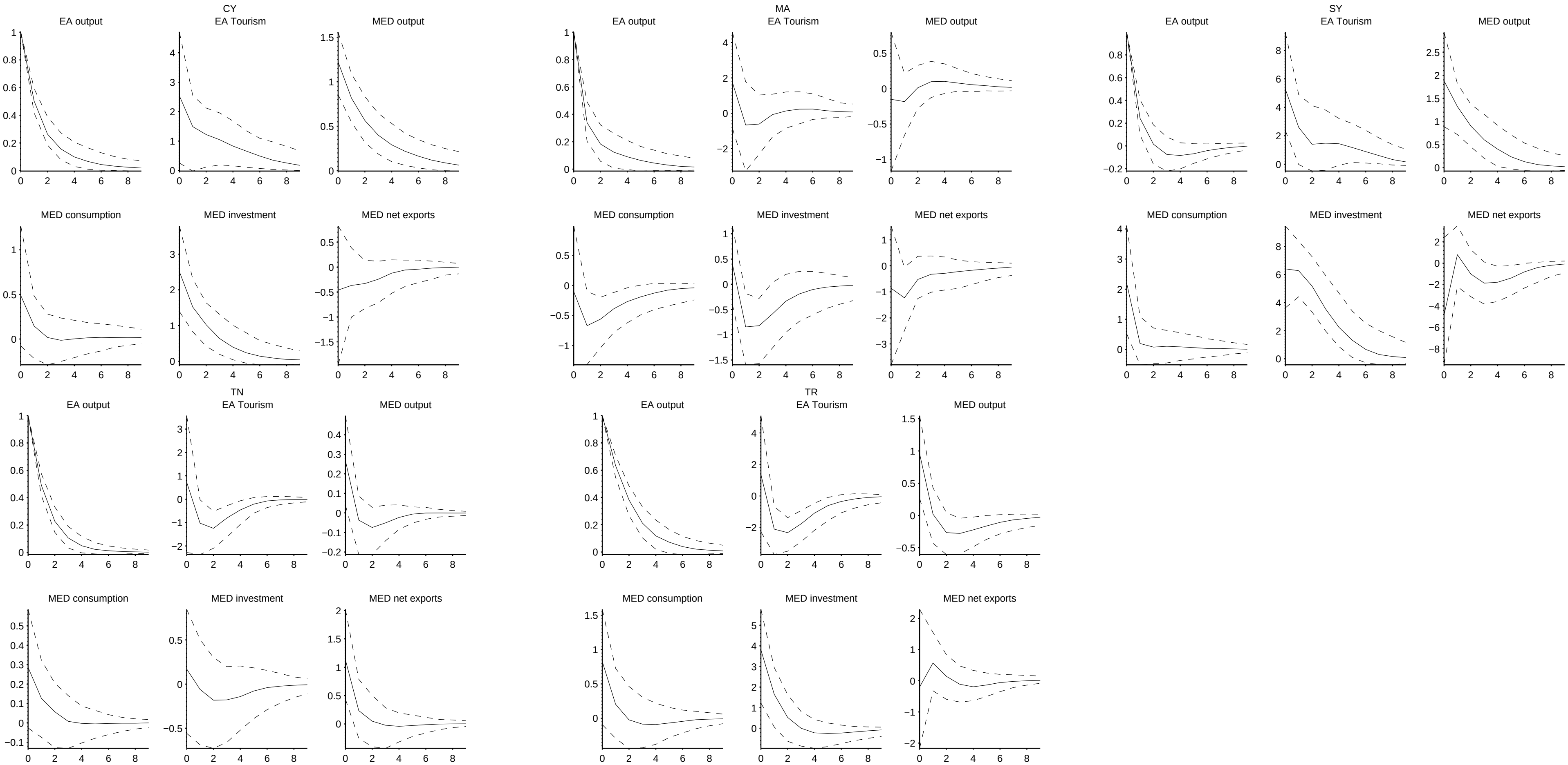
Notes: From left to right: CY-EA, CY-UK; MA-EA, MA-FR; SY-EA, SY-RU; TN-EA, TN-FR; TR-EA, TR-RU. Dashdotted line: annual changes of (log) tourist arrivals. Continuous and dashed lines: annual changes of the source country and destination country (log) output respectively. Shaded regions: recessions. Country codes: EA is Euro area; UK is United Kingdom; FR is France; RU is Russia; CY is Cyprus; MA is Morocco; SY is Syria; TN is Tunisia; TR is Turkey.

Figure 2.2: Responses to a Euro area output shock, average effect



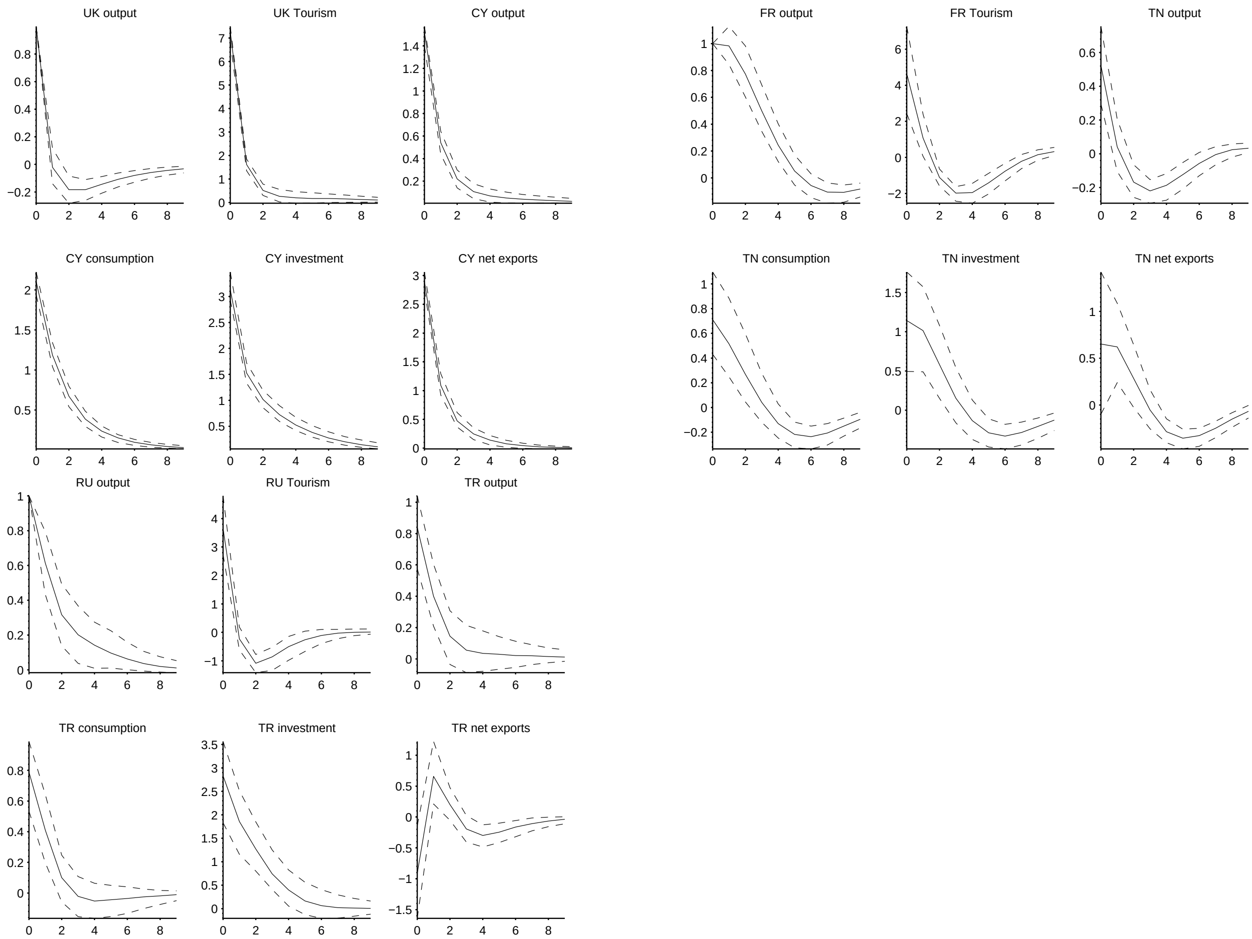
Notes: Continuous line: median posterior IRF. Dotted lines: 68% posterior credible interval. The order of the plots is the following: Euro area output, Euro area tourist arrivals, MED output, MED consumption, MED investment, MED net exports. Here, MED identifies the typical destination country.

Figure 2.3: Responses to a Euro area output shock, individual country effects



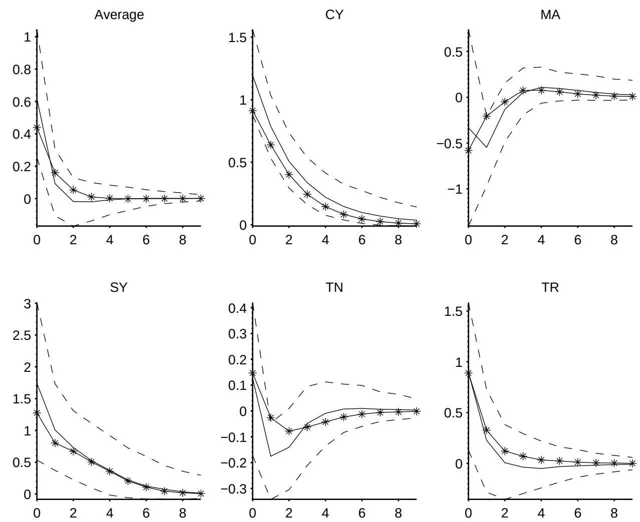
Notes: Top panel, from left to right: Cyprus, Morocco, Syria. Bottom panel, from left to right: Tunisia, Turkey. Continuous line: median posterior IRF. Dotted lines: 68% posterior credible interval. The order of the plots is the following: Euro area output, Euro area tourist arrivals, MED output, MED consumption, MED investment, MED net exports. Here, MED identifies the relevant destination country. Country codes: EA is Euro area; CY is Cyprus; MA is Morocco; SY is Syria; TN is Tunisia; TR is Turkey.

Figure 2.4: Responses to source country output shocks, case studies



Notes: Top panel, left: Cyprus. Top panel, right: Tunisia. Bottom panel: Turkey. Continuous line: median posterior IRF. Dotted lines: 68% posterior credible interval. The order of the plots is the following: source country output, source country tourist arrivals, MED output, MED consumption, MED investment, MED net exports. Here, MED identifies either Cyprus or Turkey. Country codes: UK is United Kingdom; RU is Russia; FR is France; CY is Cyprus; TN is Tunisia; TR is Turkey.

Figure 2.5: Counterfactual destination country output



Notes: Top panel, from left to right: average effect; Cyprus, Morocco. Bottom panel, from left to right: Syria, Tunisia, Turkey. Continuous line: median posterior IRF. Dotted lines: 68% posterior credible interval. Starred line: counterfactual dynamic response of the destination country output without the tourism channel. Country codes: CY is Cyprus; MA is Morocco; SY is Syria; TN is Tunisia; TR is Turkey.The tourism variable is Tourist Arrivals.

Chapter 3

The labor market outcomes of austerity. Evidence for Europe

3.1 Introduction

The last few years have witnessed an unprecedented use of fiscal policy tools in advanced economies. Fiscal measures were taken in an attempt to cushion the severity of the downturn and boost private demand soon after the onset of the 2008 financial crisis, as central banks quickly hit the zero lower bound, responding to the collapse of houses and assets prices, and the credit channel was impaired by a dysfunctional banking sector. According to estimates from the OECD (OECD 2009), the United States deployed the largest fiscal package, with an implied cumulated budget impact over the period 2008-2010 of about 5 ½ percent of domestic output expressed at 2008 prices. In Europe, the size of fiscal interventions was smaller and, for the most part, these went through automatic stabilization mechanism rather than discretionary measures. Nonetheless, the implied adjustment in the volume of revenues and in spending plans represented a sizable portion of domestic output for historical standards in most Member States. Since 2010, stimulus policies were considerably reduced and eventually replaced by fiscal consolidation programs. These were aimed at breaking the negative spiral of skyrocketing government deficits and ballooning public debts that resulted from the fall in tax revenues and the increase in expenditures. Austerity measures were therefore put into action in several countries, under the close supervision of European partners with sounder public finances and larger trade surpluses, with the twin goal of restoring confidence in the euro area and setting its economies back on a long term growth path. These events revived attention, both in policy circles and academia, about the consequences of fiscal policy, its interplay with the state of the economy, the monetary policy stance, the level of debt and credit conditions (see Blanchard and Leigh 2013; Corsetti et al. 2013; Guajardo et al. 2013; Auerbach and Gorodnichenko 2012; Christiano et al 2011; Nickel and Tudyka 2013; Ferraresi et al. 2013).

While most of the research undertaken so far investigates the link between fiscal policy and output growth, this paper focuses on the labor market outcomes of fiscal interventions in Europe.

Labor market variables are among the most important real indicators available to economists and policymakers, and complement the information provided by aggregate output. If output multipliers describe the possible benefits, or costs, for the economy in the aggregate, the response of labor market variables provides an accurate picture of the repercussions that fiscal interventions entail for a country's employment outcomes. In turn, these can have relevant economic consequences, hardly accounted for by conventional measures of output multipliers. For example, high unemployment and low participation destroy human capital, are more likely to determine tensions and turmoils (Voth and Ponticelli 2012), and the associated income shortfalls are strong predictors of households mortgage defaults (Gerardi et al. 2013).

The present context in Europe is particularly prone to stimulating attention towards the link between fiscal policy and the labor markets: the unemployment rate is at historic heights in a number of countries - like Greece with 27.5% unemployment rate, Spain 25.9% and Portugal 15.3% in December 2013; measures of discouraged workers, or workers only marginally attached to the labor force, have been growing rapidly; and a debate about the feasibility of region-wide recovery plans based on fiscal responsibility and internal devaluation is ongoing.

The scope of this paper is primarily descriptive and its goal is to provide an empirical characterization of the relationship between government spending and various labor market variables for Europe as a whole and for several European countries individually. To this end, we examine a set of euro area Member States - Austria, France, Germany, Greece, Italy, Netherlands, Portugal and Spain - and we estimate a panel Bayesian random coefficient VAR model featuring fiscal, real and monetary variables. The panel structure is advantageous as it allows to compute an average response, which can be broadly seen as euro area-wide evidence, while retaining information on individual country results.

The results can be organized around three main points.
First, despite output multipliers do not exceed unity and show little cross-country variation, unemployment multipliers are heterogeneous across countries and government spending tools. This variation does not occur randomly. For example, Spain has about the same output multiplier that Italy has in response to government investment shocks, but its unemployment multiplier is four times larger. If we compare Germany and Italy, we find similar output multipliers to government consumption shocks, but a remarkably larger response of unemployment in Germany. These are notable examples since Spain undertook massive housing and public infrastructure investment projects since the early 2000s, while in Germany the Hartz plan reformed the labor market legislation, and the country's system of industrial relation was reorganized as well[1]. This evidence suggests that institutional reforms and dedicated policy actions can strengthen the link between fiscal policy and jobs given a similar macroeconomic outlook, a point also raised in IMF (2014).
Second, the interplay of fiscal contraction and economic slack had adverse consequences on the participation rate in peripheral euro area countries. Using the sample prior to the 2007 shock, the participation rate typically increases in response to cuts in government consumption - a dynamic consistent with the negative income effect associated with fiscal tightening. However, if the crisis period is included, the average response becomes negative. In our view, this can be attributed to the discouraged worker's effect prevailing over the income effect observed during normal times, whereby the gloomy economic outlook and scarce outside options in place since the onset of the crisis caused laid-off workers to give up looking for jobs. Interestingly, the reversal is lead by the results in Greece, Italy, Portugal and Spain, while no change is observed in core euro area countries before and after 2007. The geographical divide is likely attributable to (i) peripheral Member States being more severely hit by the crisis and (ii) the comparatively more attractive alternative of black markets in southern Europe. The data seem to uphold our reading. By the end of 2013, the number of discouraged workers in Italy represented 13% of the workforce, three times above the European average, while in Ger-

[1]For Spain, consider the Plan Estatal de Vivienda y Suelo 1999-2001, 2002-2005, 2006-2008, and the Plan de Infraestructuras, Transporte y Vivienda 2012-2024. For Germany see Krebs and Scheffel (2013) and Dustman et al (2013).

many it stood to just above 1%. The black labor market also ballooned in the euro area periphery, reaching an estimated 20% of national income in Italy, Greece and Spain according to estimates from Eurostat.

Third, a host of policy prescriptions stems from our analysis. Labor markets in Europe are still segmented, as shown by the cross-country heterogeneity of unemployment multipliers, and the resilience of unemployment to fiscal shocks is low, since impulse responses display only moderate signs of mean reversion many quarters after the shock. Reducing geographic segmentation would likely cap the adjustment costs to exogenous shocks hitting the common currency block. To avoid that increases in unemployment have significant hysteresis effects, and to minimize the risk that prolonged unemployment spells turn into long-term unemployment, efforts should be placed in fostering active labor market policies (ALMP). That is, even in the context of shrinking government bills, it is advisable that policymakers set aside the resources necessary to cushion the adverse impact of austerity measures on laid-off workers, in order to avoid that temporary budget cuts turn into permanent losses of human capital and productive potential.
The responses of wages and hours worked are small compared to those observed in unemployment and the participation rate. These findings place emphasis on the inadequate degree of flexibility characterizing European labor markets, especially in peripheral countries. Movements in hours worked, if quantitatively relevant, could offer an alternative channel of adjustment to adverse shocks, in addition to the extensive margin captured by the binary choice of working versus not working. Similarly, wage negotiation could provide a way out to workers' layoffs during periods of weak demand. Therefore, our results reinforce the argument that European countries should undertake efforts to enhance labor hoarding practices, and adopt labor market reforms to reduce downward wage rigidities and increase the flexibility of hours to labor market conditions.

The rest of the paper is organized as follows. Section 3.2 revises several contributions similar to this work for either their interests or methods. Section 3.3 describes the model and the estimation techniques. Section 3.4 outlines the data used and motivates the choice of the endogenous series included in the model. Section 3.5 presents and discusses the results. Sections 3.6 concludes.

3.2 Literature

The closest works to ours are Pappa (2009), Bruckner and Pappa (2010) and Bermperoglou et al. (2013). These papers adopt a multi-country approach and present stylized facts on the responses of labor market variables to fiscal shocks using VAR methods. Pappa (2009) studies the dynamics of the real wage and employment in the US, both at the federal and at the state level, after either a government consumption, government investment or a government employment shock. Bermperoglou et al. (2013) consider also shocks to government wages in a group of countries including the US, UK, Japan and Canada and find that cuts in the government wage bill can be expansionary and reduce unemployment, while other types of shocks are typically associated with output losses and increases in unemployment. Bruckner and Pappa (2010) examine the effects of government expenditure shocks on labor market variables in a sample of OECD countries and show that fiscal expansions can lead to significant increases in the unemployment rate. In comparison to this literature, we also find that shocks to different government spending tools have qualitatively and quantitatively different effects on unemployment. Cuts to government investment always imply an increase in unemployment. However, in the case of government consumption shocks, the confidence bands are large and we cannot rule out that negative shocks reduce unemployment. In fact, there are two cases, Austria and Portugal, where the median response falls below zero.

Other authors adopt VAR methods to identify the determinants of fluctuations in the unemployment rate in individual countries, such as Dolado and Jimeno (1997) for Spain, Gambetti and Pistoresi (2004) for Italy and Alexius and Holmlund (2007) for Sweden. Their focus is broader compared to ours, that is instead specific to fiscal policy. However, an interesting commonality emerges: several of these papers emphasize the hysteretic behavior of the unemployment rate in response to shocks, a finding that is consistent with the persistent dynamics that we observe in our data.

3.3 The methodology

The core evidence of the paper is obtained using a hierarchical panel VAR model. The choice is motivated by several considerations. Firstly, since the time dimension of European data is not long, VAR coefficients are imprecisely estimated. Secondly, the countries in our sample are likely to be characterized by considerable cyclical heterogeneity as they include Member States from both the north and the south of Europe, some of them notoriously lead the European economic cycle while others lag, and their national account figures differ remarkably. While the first argument raises doubts about the opportunity of running single-country VAR models using OLS, the latter indicates that it is not a good idea to estimate a pooled VAR for the eight countries either.

The distinctive feature of the multi-country random coefficient Bayesian VAR model that we adopt is to efficiently combine unit-specific and cross sectional information by assuming that country-specific dynamic coefficients are realizations from the same underlying data generating process. In other words, the dynamics of transmission of the shocks are potentially different across countries, but the distribution from which they come from has a common mean. The first point allows to estimate the model without imposing homogeneous dynamics. The second point minimizes the small sample problem by setting an average prior for the individual country results that summarizes cross-country information.

Multi-country random coefficient Bayesian VAR models have been used in Canova (2005), Ciccarelli and Rebucci (2006), Canova and Pappa (2007), Jarocinski (2010).

For each country, the VAR model is:

$$y_{n,t} = B'_n y_{n,t-1} + \Gamma'_n z_t + u_{n,t} \tag{3.1}$$

where $n = 1, 2, \ldots, N$ denotes countries; $t = 1, 2, \ldots, T_n$ time and T_n varies with the country; $y_{n,t}$ is an $M \times 1$ vector of endogenous variables; $z_{n,t}$ collects deterministic components; $u_{n,t}$ are VAR innovations; B_n and Γ_n are matrices containing the slopes and the intercept coefficients. Rewrite (3.1) as:

$$Y_n = X_n B_n + Z_n \Gamma_n + U_n \tag{3.2}$$

where X_n is the matrix obtained by stacking vertically the T_n observations in $y'_{n,t-1}$. Thus Y_n and U_n are $T_n \times M$; X_n is $T_n \times M$; Z_n is $T_n \times Q$; B_n is $K \times M$; Γ_n is $Q \times M$. Let $y_n \equiv vec(Y_n)$, $\beta_n \equiv vec(B_n)$ and $\gamma_n \equiv vec(\Gamma_n)$. We assume that the slope coefficients satisfy:

$$p(\beta_n|\bar{\beta}, O_n) = N(\bar{\beta}, c \times O_n) \tag{3.3}$$

where $\bar{\beta}$ is the common mean and $c \times O_n$ is the dispersion, c being the parameter that controls the general tightness of the restriction. We initially tried to be agnostic about how much the country-specific coefficients differ from the common mean and imposed a diffuse prior on the parameter. However, such a choice resulted in fairly large estimates of c and, in turn, in systematic violations of the stability test for the VAR coefficients $\bar{\beta}$. This may be caused by a lack of sufficient information in our sample to precisely estimate this parameter. Therefore, its value is treated as fixed. Letting σ^2 be the variance of the error in the univariate autoregression of each VAR series, the i-th element of O_n is:

$$O_{n,i} = diag\left(\sigma^2_{n,i} \otimes \frac{1}{\sigma^2_{n,n}}\right), \quad i = 1, ...m. \tag{3.4}$$

We employ this scaling factor since, with a single variance parameter c, it may be difficult to capture the cross variable variations in the β_n. Adding O_n makes the variance of $\beta_{n,i}$ specific to the variable i.
The VAR innovations are i.i.d. $N(0, \Sigma_n)$ and the prior on their covariance matrix is diffuse, i.e.:

$$p(\Sigma_n) \propto |\Sigma_n|^{-\frac{1}{2}(N+1)} \tag{3.5}$$

The priors for the coefficients on the deterministic variables and for the common mean are also diffuse:

$$p(\gamma_n) \propto 1 \tag{3.6}$$

$$p(\bar{\beta}) \propto 1 \tag{3.7}$$

The posterior densities for the coefficient of interest are computed by combining prior information with the likelihood which, for the stacked vector of countries, is:

$$p(Y|\beta_n, \gamma_n, \Sigma_n) \propto \Pi_n|\Sigma_n|^{-\frac{T_n}{2}} exp\Bigg[-\frac{1}{2}\sum_n (y_n - X_n\beta_n - Z_n\gamma_n)'(\Sigma_n^{-1} \otimes I_{T_n}) (y_n - X_n\beta_n - Z_n\gamma_n)\Bigg] \tag{3.8}$$

Since the priors are conjugate, the conditional posterior densities are analytically available and this enables us to numerical compute the joint posterior distributions with the Gibbs sampler. The joint posterior for the unknowns is:

$$\begin{aligned} p(\beta_n, \gamma_n, \Sigma_n, \bar{\beta}|Y) &\propto p(\beta_n, \gamma_n, \Sigma_n, \bar{\beta})\, p(Y|\beta_n, \gamma_n, \Sigma_n, \bar{\beta}) \\ &\propto \Pi_n|\Sigma_n|^{-\frac{T_n}{2}} exp\Bigg[-\frac{1}{2}\sum_n (y_n - X_n\beta_n - Z_n\gamma_n)'(\Sigma_n^{-1} \otimes I_{T_n}) \\ &\quad (y_n - X_n\beta_n - Z_n\gamma_n)\Bigg] \\ &\quad \times |c|^{-\frac{NMK}{2}} exp\left[-\frac{1}{2}\sum_n (\beta_n - \bar{\beta})'(c \times O_n)^{-1}(\beta_n - \bar{\beta})\right] \\ &\quad \times \Pi_n|\Sigma_n|^{-\frac{M+1}{2}} \end{aligned} \tag{3.9}$$

Let $\Theta \equiv [\beta_n,\ \gamma_n,\ \Sigma_n,\ \bar{\beta}]$ and denote by Θ/α the vector of Θ excluding the coefficient α. The conditional posterior of β_n is:

$$p(\beta_n|Y, \Theta/\beta_n) = N(\tilde{\beta}_n, \tilde{\Delta}_n) \tag{3.10}$$

where

$$\tilde{\Delta}_n = \left(\Sigma_n^{-1} \otimes X_n'X_n + c^{-1}O_n^{-1}\right)^{-1}$$

and

$$\tilde{\beta}_n = \tilde{\Delta}_n \times \left((\Sigma_n^{-1} \otimes X_n')(y_n - Z_n\gamma_n) + c^{-1}O_n^{-1}\bar{\beta}\right)$$

The conditional posterior of γ_n is:

$$p(\gamma_n|Y, \Theta/\gamma_n) = N(\tilde{\gamma}_n, \tilde{\Gamma}_n) \tag{3.11}$$

where

$$\tilde{\Gamma}_n = \left(\Sigma_n^{-1} \otimes Z_n'Z_n\right)^{-1}$$

and

$$\tilde{\gamma}_n = \tilde{\Gamma}_n \times \left(\Sigma_n^{-1} \otimes Z_n'\right)(y_n - X_n\beta_n)$$

The conditional posterior of Σ_n is:

$$p(\Sigma_n|Y, \Theta/\Sigma_n) = iW\left((Y_n - X_nB_n - Z_nC_n)'(Y_n - X_nB_n - Z_nC_n), T_n\right) \tag{3.12}$$

The conditional posterior of $\bar{\beta}$ is:

$$p(\bar{\beta}|Y, \Theta) = N(\bar{\bar{\beta}}, \bar{\Delta}) \tag{3.13}$$

where

$$\bar{\Delta} = \left(\sum_n c^{-1}O_n^{-1}\right)^{-1}$$

and

$$\bar{\bar{\beta}} = \bar{\Delta} \times \sum_n c^{-1}O_n^{-1}\beta_n.$$

By iteratively sampling from (3.10)-(3.13), one obtains a sequence for Θ that can be used for inference. The first 300000 draws are used for burn-in. Subsequently, 500 draws are used for posterior inference. These represent the last draw of chains counting 500 draws each. This solution, instead of thinning from the same chain, is well suited for parallel computing, a strategy that is adopted here, since every chain can be sent to a different worker. Convergence and autocorrelation diagnostics are satisfied.

As detailed above, the multi-country VAR model is put into action by adopting a hierarchical structure in which the country-specific coefficients are randomly drawn from a Normal distribution with a common mean. This is typically referred as the first stage of the hierarchy. The second stage consists of prior assumptions about the distributions of the common mean and of the country-specific variances. For the former we employ noninformative priors; the latter are estimated in an Empirical Bayes fashion.

The conditional posterior for β_n has a natural weighted average format where sample and prior information receive weights proportional to their relative precision. Thus, the country model whose coefficients are more tightly estimated receives more weight relative to the prior as compared to the model where the coefficients are imprecisely estimated. The variance of country-specific coefficients depends on how different the estimated country-specific coefficients are and on their precision. If they are different and the uncertainty around the estimates is small, the variance in the second level of the hierarchy will be large indicating significant heterogeneity. Conversely, if country-specific coefficients are similar, the variance in the second level of the hierarchy will be smaller.

3.4 Data and model specification

The data is available at the quarterly frequency. The full sample spans from 1991:Q1 up to 2012:Q4 for all countries except Spain, Portugal and Greece for which we have to start in 1995:Q1 (Spain and Portugal) and 2000:Q1 (Greece). Since our estimation approach does not allow for time varying coefficients, but breaks and parameter instability are possible with two decades or more of data, we also use fifteen-years-long windows starting in 1991:Q1 and roll from one year to the next keeping the window size constant. This results in a total of seven subsamples estimates[2].

All real variables are expressed in per capita terms at constant 2005 prices and enter the VAR in logs. All variables are in levels, except for the (CPI) inflation rate which is in first differences. A constant and a linear trend are added to the VAR.

Regarding the VAR model specification, there is little guidance on which data to include. As a general principle, all series relevant for the phenomenon one wishes to describe should be considered. This reduces the risk of leaving important information outside of the model. For example, as fiscal and monetary policies operate in tango (Davig and Leeper 2011), VAR aiming at characterizing fiscal policy outcomes but neglecting monetary variables are likely to provide distorted conclusions (Rossi and Zubairy 2011). More generally, research based on factor models (Forni et al. 2012) and large VAR models (Banbura et al. 2010) has shown that there is a value in endowing the econometrician with a large information set.

In practice, these recommendations often collide with the challenge of producing reliable parameters estimates, or finding sensible identification restric-

[2] In the case of Greece, the estimation sample remains forcefully fixed at 2000:Q1-2012:Q4 always. For Spain and Portugal, the starting date of the window is kept fixed at 1995:Q1 for the first four runs.

tions when the system is beyond minimal. As a result, the literature has witnessed a fairly large range of VAR specifications to investigate the same phenomenon.

To avoid the arbitrariness of picking one, among other possible, set of variables and to gauge the repercussions on the results from using models of different sizes, we run for each country in our sample a battery of VAR models, from smaller to bigger, estimated by OLS[3].

The small version features data on government expenditures, revenues and debt, unemployment, domestic output and the short term interest rate. Government expenditures are split into investment, consumption and social benefits (or social transfers in kind), which encompass several social safety nets programs including unemployment benefits. This system contains the minimal ingredients to study the effects of fiscal shocks on the economy: the fiscal series and output allow to meaningfully identify fiscal shocks controlling for the business cycle[4]; the level of debt accounts for the significant country heterogeneity that characterizes our sample in this respect[5]; the short term interest rate proxies the monetary policy instrument[6]; finally, unemployment is the variable of interest.

The intermediate VAR model further includes total wages, hours worked per employee, the participation rate and the inflation rate. Compared to the previous one, this version features a richer set of labor market indicators, which can be useful to control for changes along the intensive (hours) or the extensive

[3]As argued in Section 3.3, these VARs are likely to be affected by many shortcomings given our set-up. For this reason, the emphasis here is not on inference, but instead on the insights that can be gained in terms of model specification. The implicit assumption is that, while inference changes depending on the methodology, the dynamic relationships between variables captured by the system of VAR equations remain stable. The additional advantage is to work with a computationally lighter version of the model.

[4]For instance by adopting a Cholesky orthogonalization of the covariance matrix when government investment and consumption are ordered first in the VAR, or by imposing theory-based sign restrictions (see Blanchard and Perotti 2002; Canova and de Nicoló 2002)

[5]We do not allow for feedback from selected endogenous variables to the debt level. Research based on US data did not find remarkable differences for the dynamics of macroeconomic variables other than the debt itself (Favero and Giavazzi 2007). Using annual data from 1970, Nickel and Tudyka (2013) show that the level of debt matters for the effects of fiscal stimulus policies in a group of European countries. Our sample is, however, much shorter and throughout this period no country experienced large swings in its stock of debt. Also, interest rates have been converging along a downward trend and the monetization of debt through inflation has not been an option during at least half of our sample period as the creation of money was centralized and separated from national government authorities. In this scenario, it is unlikely that debt stabilization entered strongly in domestic policymakers' preferences. Some of these conditions changed from 2008 onward. So, as a robustness exercise, we identify shocks also imposing a mean reverting process on the dynamics of debt: differences are negligible.

[6]Domestic rates behaved consistently with the centralized conduct of monetary policy on the run-up of the euro and after its adoption.

(participation) margin, and in the elasticity between earnings and vacancies. It also allows for a trade-off between inflation and unemployment.
The large VAR has a richer description of the real and financial sides of the economy. It includes private consumption and investment in housing from the national account identity, as well as domestic banks credit to non-financial firms and the yield on 10-years government bonds[7]. The last two series have been on top of the watch list of policymakers and analysts, especially for peripheral countries, since the onset of the financial crisis, when domestic credit conditions deteriorated markedly and doubts on the solvency of national governments demanded higher returns for holding their debt. As fiscal policy instruments were heavily called into question, through either automatic stabilizers or discretionary programs of stimulus first and austerity later, their interaction with the former becomes of particular interest in the last portion of the sample.
The VAR also features four exogenous variables that are intended to control for developments in the US- and EU-wide business cycle and monetary policy stance: the US and euro area output, and the t-bill and Eonia interest rates. The lag length is set to one[8].

Figure C.1 displays the sequence of orthogonalized residuals for government consumption and investment respectively, for each of the countries in our dataset: the green line corresponds to the small model, the blue line to the medium and the red line to the large VAR model. The innovations for both government consumption and investment appear to be broadly consistent across the three different models[9]. Therefore, it is unlikely that an econometrician running any of these would arrive at antithetical conclusions. Few exceptions depart from this general remark.
In Italy, the shocks to the government consumption equation in the small VAR look implausibly large compared to those in the medium and large model. A rationale for the observed differences can be that the small VAR misses some relevant information for the correct identification of the innovations: lacking this information, the fiscal residuals absorb spurious fluctuations that are,

[7]Due to the short sample available for Greece, the large VAR runs into stability issues when estimated using OLS. To circumvent this problem, instead of adding a third round of series, we substitute the latter to the set of labor market variables used in the medium sized VAR model.

[8]This choice is sufficient to whiten the residuals from autocorrelation.

[9]This is true also for the reduced form residuals.

instead, filtered out in the two bigger models. In Austria and Portugal, fluctuations in both government consumption and investment innovations from the small VAR are only mildly correlated to those in the other models; instead, they are characterized by a large serial correlation with their own lags. Inference based on different shocks' sequences can be difficult to reconcile: for example, the unemployment IRFs to a government consumption shock in Austria lie on the positive or negative quadrant, depending on whether they are constructed from the small VAR model or the two bigger ones.
Since these preliminary tests indicate that the small VAR may sometimes produce results distant from those obtained from the two alternatives, we choose to leave the small VAR model aside, and we will adopt the medium model as our benchmark. In turn, we keep the large VAR for robustness as in some countries its fiscal innovations are systematically larger than the ones in the benchmark model. The most remarkable case is Greece. Here, a VAR with data on domestic credit conditions and credit spreads delivers government consumption and investment innovations with a different time profile and more ample fluctuations. It can also be seen that the fiscal shocks become bigger from 2010 onward, when the task-force composed by representatives from the European Union, the European Central Bank and the International Monetary Fund took office to guide the country through a steadfast fiscal adjustment program.

Throughout the analysis, the system of equations characterizing our VAR, be it the benchmark or the large one, is going to remain the same. This choice is consistent with the definition of the VAR model as a self-contained system of endogenous equations, whereby dropping one or more series for the purpose of a given exercise actually alters the definition of the stylized economy and impinges the theoretical foundations for results' comparability. One may argue that, as far as inference is not affected, these details can be overlooked. However, Figure C.2 shows that it is possible to run into cases confirming our concerns. The green line plots the innovations in the government investment equation obtained from the benchmark VAR model. The blue line shows the same concept, but constructed from a VAR where the government investment series is tossed, depending on the identified shock. The examples of Portugal and Spain are of particular interest as they show not only that distortions can be large, but also of opposite sign: in one case the shocks are overestimated, in the other underestimated.

3.4.1 Identification of the shocks

The shocks are identified using the sign restrictions approach proposed by Canova and de Nicoló (2002). For each posterior draw k, the method is based upon drawing a random normal matrix with zero mean and unit variance, performing a QR decomposition to obtain the matrix H such that $HH' = I$ and computing $Q(s, j, k)H = R(s, j, k)$, where Q is the impulse response matrix to shock s at horizon j produced by a Cholesky decomposition of the residuals covariance matrix. If the rotated impulse response matrix R satisfies the theoretical restrictions, the rotation is stored and the routine moves to the posterior draw that follows, otherwise a new rotation is generated according to the steps outlined above. Therefore, the results reflect both parameter and identification uncertainty.

The restrictions imposed to identify government spending shocks are standard and they involve a total of four instantaneous sign restrictions: (i) government consumption, or investment, declines; (ii) government revenues are non-positive; (iii) deficit declines; (iv) output declines. We consider only contemporaneous restrictions since theory typically provides robust restrictions for only a limited number of periods (Canova and Paustian 2011).

When fiscal policy shocks are the object of interest, this approach avoids most of the shortcomings affecting identification schemes based on a triangular decomposition of the covariance matrix. In fact, since all variables are endogenous, there is no need to impose exogeneity of some with respect to others (Blanchard and Perotti 2002). Also, the identification does not rely on time lags between approval and implementation of a policy decision, therefore concerns related to the predictability of fiscal innovations are ruled out (Ramey 2011).

The output and unemployment multipliers on impact are computed as the change in either one or the other series for a 1% change in government spending. The cumulative multipliers are constructed in a similar way, except that the changes are summed over the impulse response function horizon, which is sixteen quarters.

3.5 The results

3.5.1 Output multipliers

As our VAR includes output among the observables, it is straightforward to compute fiscal multipliers for government consumption and investment shocks. These are reproduced in Table 3.1 for a sample ending in 2006:Q4. The output multipliers for government consumption shocks fall within a range from 0.21 to 0.91. The smallest value is realized in Greece; this is very close to the result obtained in Spain, in which case the median output multiplier is 0.23. Output multipliers are above the 0.5 threshold only in the three largest economies in our sample, that is Germany (0.62), France (0.91) and Italy (0.69). No country has a fiscal multiplier greater than unity. As the size of the multiplier is country-, time- and state-dependent, and since different authors may use different data, the literature does not agree on an exact value. However, most estimates coming from different models fall in the range from 0.3 to 1. For example, Perotti (2005) using a constant parameter VAR finds an annualized government spending multiplier of 0.6 on impact for Germany. Cléaud et al. (2013) obtain an impact multiplier of 1.1 for France with a time-varying structural VAR. Estimates produced for a number of individual European countries using the European Commission Quest Model (ECQM) vary from a minimum of 0.4 for Netherlands to a maximum of 0.7 for Portugal (see HM Treasury 2003). Therefore, our results fall within, or close to, the range that is usually considered reasonable for advanced economies.
Concerning the output multipliers associated to government investment shocks, these are smaller than the corresponding ones for government consumption shocks[10]. As spending on investment is generally associated to the productive component of the government bill, while government consumption expenditures go for the most part to servicing wages of public employees, our results may come as a surprise. The conditional responses of other government spending categories are key to rationalize our findings. On average, after a negative 1% government consumption shock, both government investment and government social benefits fall by 0.2% on impact, and government social benefits further decline for three more quarters until reaching a bottom

[10]This conclusion is robust to the horizon over which multipliers are computed since the impulse response of output reaches the peak on impact and decreases monotonically thereafter.

of -0.4%. Instead, a government investment shock induces a decrease in both government consumption and social benefits of only 0.06%, approximately four times smaller. Therefore, the strong conditional comovement of government investment and social benefits after a government consumption shock can help to explain the more contractionary effects on output observed in Table 3.1. This mechanism can be especially important since social benefits represent a relevant portion of public spending. The share of government social benefits to domestic output over the sample is 19% in Austria, 18% in France, 17% in Germany and Italy, 13% in Netherlands, Portugal and Spain, 16% in Greece. For comparison, these numbers are only slightly below the share of government consumption over output. Symmetrically, the small output multipliers associated to government investment shocks may also come as a consequence of the relatively small share of government investment over domestic output, which is around 3% in all countries. In short, the negligible consequences that government investment shocks seem to have on aggregate output can be explained in part by the synchronization between public spending categories conditional on a government consumption shock; in part by the comparatively small share of government investment in public spending in euro area countries.

3.5.2 The labor market outcomes

A discussion of the labor market outcomes can be organized around few key results.

First, the unemployment responses are heterogeneous across countries. While output multipliers are always negative and fall within a relative compact range - see the discussion in the section above -, the response of unemployment can take on different signs and varies substantially in magnitude across countries. As Table 3.1 shows, unemployment falls in Austria in response to a contractionary government consumption shock, and the same is true in Portugal for both government consumption and investment shocks. While these numbers are not statistically significant, Figure 3.1 shows that the impulse responses become significant over time. Unemployment increases after negative fiscal shocks in all other cases. The size of the jump, however, varies substantially from one country to the other. As cross-country hetero-

geneity is observed also using a sample that includes the last six years, the different country-specific elasticities of the unemployment rate to fiscal shocks are likely attributable to structural factors of the euro area economies, rather than the adverse economic cycle that prevailed recently and affected some countries more than others.
Interestingly, this variation does not seem to occur at random. Few cases captured our attention. Spain, where ambitious public infrastructure and housing plans have been implemented since the late 1990s[11], scores the highest unemployment multiplier to government investment shock. The same holds true for Germany in response to government consumption innovations. This evidence squares well with the reform efforts that German policymakers undertook for more than a decade now and that led to a reformed system of industrial relations, wage negotiations and legislative framework[12].
Reading these results in conjunction to the country output multipliers reveals that the similarity in the macroeconomic outlook to fiscal impulses may hide important differences in their effects on unemployment. For example, output responds similarly to government investment shocks in Italy and Spain (-0.13* and -0.16* respectively), but the unemployment response is zero in Italy and 4.13* in Spain. Similarly, output multipliers to government consumption shocks are close in Italy and Germany (-0.62* and -0.69* respectively), but the unemployment responses differ remarkably (see Table 3.1 and Figure 3.1). In this group, Italy implemented neither large public investment projects in transportation and housing - as is the case of Spain - nor institutional reforms to boost labor market flexibility - as Germany did. According to our results, the link between jobs and growth varies across countries, a point also raised in IMF (2014), and dedicated policy plans or institutional reforms can help to foster the spillover from growth to the labor markets.

Second comes the evidence on the participation rate. The participation rate is an important indicator of the labor market. It proxies for the available human capital stock, therefore higher participation rates are usually seen as a positive signal for the long-term growth potential of a country. Contractionary government spending cuts can affect the participation rate by reducing

[11] The major ones have been Plan Estatal de Vivienda y Suelo 1999-2001, 2002-2005, 2006-2008, and the Plan de Infraestructuras, Transporte y Vivienda 2012-2024.

[12] See Krebs and Scheffel (2013) and Dustman et al (2013) for a discussion

available income, thus forcing more households to look for jobs. Participation would rise as a consequence of the negative income effect[13]. However, if the probability of finding a job exceeds the effort needed for searching, households may also decide to drop off the labor force, pushing participation down. Both forces seem to have been at work in the euro area. Figure 3.4 superposes the average response of the participation rate over the short sample (black line) to the response from a sample ending in 2012:Q4 (blue line). Leaving the crisis period out, it is easy to see that the median response of the participation rate is positive. During normal times, the negative income effect dominates, pushing more people to join the labor force in response to government spending cuts. This fact is beneficial since the increase in the participation rate helps to mitigate the negative consequences of higher unemployment on the employment to population ratio[14]. When the sample is extended to include the last six years, the response of the participation rate to government consumption shocks becomes significantly negative. The average result is driven by a reversal in the sign of the responses in peripheral countries - Greece, Italy and Spain - while the evidence for euro area core is consistent across subsamples (see Figure 3.2). The geographical dichotomy is stark and in our view it can be explained by (i) peripheral Member States being more severely hit by the crisis and (ii) the comparatively more attractive alternative of black markets in southern Europe. The first factor would have determined tougher labor market conditions in southern Europe compared to core countries, which in turn resulted in lower job finding rates that pushed people out of the legal labor force. The data seem to uphold our reading. By the end of 2013, the number of discouraged workers in Italy represented 13% of the workforce, three times above the European average, while in Germany it stood to just above 1%. The black labor market also ballooned in the euro area periphery, reaching an estimated 20% of national income in Italy, Greece and Spain according to estimates from Eurostat. Various reasons can explain why this phenomenon is not observed in the case of government investment

[13]On this, see Campolmi et al. (2011). An alternative explanation has to do with expectations of future expansion in activity following adjustments in public spending, see Giavazzi and Pagano (1990).

[14]The employment to population ratio (EP) can be written as one minus the unemployment rate (UR) multiplied by the labor force participation rate (LFPR), that is $EP = (1 - UR) * LFPR$. When we construct a decomposition of the labor market changes by taking differences of logs, we obtain $\Delta log(EP) = -\Delta UR + \Delta log(LFPR)$, making use of the approximation that the log of $(1 - UR)$ is equal to the negative of UR.

shocks. For example, public investments are directed to sectors with a lower proportion of women, whose incentives to leave the labor market and dedicate to family-care activities can be stronger compared to men; sectors that require the acquisition of technical know-how, thereby making it more costly for workers to leave the labor force; sectors sheltered from business cycle fluctuations, thus less prone to be affected by the discouraged worker phenomenon.
As Figure 3.4 shows, negative fiscal shocks occurring at times of slack activity are especially adverse not only for the participation rate, but also for unemployment. Leaving the crisis period out, the median jump of unemployment after a government investment shock is about one third less on impact and 70% smaller four years later compared to baseline.

So far we have discussed aspects pertaining to the extensive margin of adjustment to fiscal shocks, i.e. the repercussions on the number of people willing to work but without a job, and on the share of the population in the labor force. Reducing the amount of hours worked per employee or lowering wages, while minimizing the number of layoffs, is, in principle, an alternative strategy to respond to shortages in aggregate demand. Responsiveness of hours and wages to economic conditions is usually regarded as highly desirable: it helps to mitigate the rise in unemployment and, when the recovery establishes, it allows firms to be ready to expand production quickly. According to our evidence, however, these mechanisms do not seem to be yet at work in euro area countries, particularly in the periphery. The median average response of hours worked displayed in Figure 3.4 is not statistically significant at all horizons and it is quantitatively small compared to the change in unemployment. The country responses plot in Figure 3.2 show that hours worked react to government consumption shocks somewhat more noticeably in Austria, France and Germany. Instead, they are never significant in the periphery. Real wages fall in response to both government consumption and investment shocks, a finding that is consistent with most studies that employ VAR techniques and consumption - instead of product - wages. The median decline following a government consumption innovation is approximately three times as large as the one observed after an investment shock. This is in part explained by salaries of public servants entering into government consumption data, so that wage cuts and freezes imposed by the government are effective immediately. In part, there may also be signaling effects, so that when the government reduces public salaries, the private sector follows as well.

3.5.3 Allocative effects across sectors

The allocation of government spending is usually directed to few sectors of activity where the government is the largest buyer or the main provider of services. This raises a concern about whether the results described in the previous paragraph are representative of the dynamics across sectors, or else aggregate figures hide remarkable differences. To shed light in this direction we construct the IRFs of the employment rate by sector of activity in each of the countries in our dataset and compare the latter with the country-specific IRFs obtained from aggregate data. By so doing we can check how close the sectoral IRFs are compared to the aggregate. The focus on employment is motivated by the fact that employment numbers are the only labor market indicators available at the sectoral level for European countries. The sectors are: (i) agriculture, forestry and fishing; (ii) industry (except construction); (iii) manufacturing; (iv) construction; (v) financial and insurance; (vi) real estate; (vii) public administration.

Employment is not among the observables used to estimate our benchmark VAR models. However, a version is equipped with the unemployment rate (UR) and the participation rate ($LFPR$), so we can use the equivalence $ER = (1 - \frac{UR}{100})LFPR$ to back out the employment rate (ER).

The sectoral IRFs are obtained, first, by estimating a distributed lag model

$$y_t = \alpha_1^s x_t^s + \alpha_2^s x_{t-1}^s + \cdots + \alpha_n^s x_{t-n}^s \tag{3.14}$$

where the dependent variable y_t is the total employment rate and the explanatory variables x^s are the contemporaneous and lagged values of employment rates by sector of activity s. We use a relatively large number of lags, $n = 20$, because employment series are extremely persistent. We take the resulting coefficients as a reduced form representation of the relationship between employment in the aggregate and at the sectoral level. Next, we use the estimated sectoral coefficients to back out the sectoral impulse response function according to the formula

$$irf_t^s = \beta_1 irf_t + \beta_2 irf_{t-1} \tag{3.15}$$

where irf_t^s denotes the sectoral impulse response function of the employment rate at time t, irf_t without the sectoral subscript s identifies the aggregate one and $t = 2, \ldots, 16$ is the chosen length of the impulse response interval. The coefficient β_1 is the average of the α^s for the first ten periods, β^2 for the last ten. We experimented with alternatives, such as the sum or the median and splitting the time unevenly, but the overall conclusions did not change. Finally, in (3.15) we use only one lag to be in line with the formulation of the panel VAR used in estimation.

Tables 3.2 and 3.3 report the results for the government consumption and investment shocks respectively. The top half of the table presents the distance between aggregate and sectoral IRFs on impact; the bottom half shows the cumulative distance which is constructed as the sum of the distance at every t[15].

Sectoral differences are more common in response to government investment shocks and in core euro area countries. Italy is the only one in the pool of peripheral economies to display significant variations in the dynamics across sectors. Shocks in industry, manufacturing and construction have a similar magnitude on impact, with the only exceptions of the industry sector in Netherlands and the manufacturing and construction sectors in France. The dynamics are more heterogeneous. For example, shocks in manufacturing die out more quickly in France, Germany and Italy; this is the case also for the industry sector in France, Germany, Netherlands and Italy. The dynamics are instead more persistent in the construction sector in Germany and Netherlands. Similar patterns are observed in the public administration sector: while the difference on impact is never significant, sectoral IRFs in Austria, Germany, Netherlands and Italy die out sooner.

The agricultural, real estate and financial sectors are very idiosyncratic. Here, differences with respect to aggregate are quantitatively large; occur both for government consumption and investment shocks; last over all horizons; and are positive, indicating that the shocks take longer to vanish compared to the aggregate case. However, the tiny employment numbers of these sectors (below 4% of the labor force) make the economic impact of such big differences

[15]From the numbers in the tables, one cannot distinguish whether the employment rate IRFs are positive or negative, but only see if the sectoral IRFs are comparatively bigger or smaller than the aggregate IRFs. Positive numbers mean that the sectoral IRFs react more, either more positively or more negatively. Negative numbers mean that the response of the sectoral IRFs is more muted.

negligible, and susceptible of misspecification when fed into our model.

3.5.4 Spending reversals

Fiscal stimulus packages are, by their very nature, temporary. Once the welfare policy objectives have been obtained or the economic fundamentals restored, governments withdraw the spending increases and tax rebates that were initially voted. Sometimes, expansionary fiscal measures are not only in place for a limited amount of time, but they are also undone at a later stage to meet binding fiscal constraints, like deficit rules and debt ceiling, or to fulfill the political agenda of the ruling party. For example, as discussed in the introduction to this paper, a number of euro area countries initially reacted to the crisis by passing stimulus packages, deploying automatic stabilizers and approving further selective discretionary easing. However, most of these initiatives were abandoned when national budgets seemed to go off-the-cliff and governments quickly turned to a conservative fiscal stance[16].

Fiscal expansions with spending reversals are more cost effective, as the debt overhang is necessarily reduced (OECD 2009). Moreover, a credible commitment to compensate the increase in spending - or the drop in revenues - can help to limit interest rates hikes and thus the cost of borrowing for countries starting from high levels of debt.

If the budgetary implications of spending reversals are fairly straightforward, their real effects are more uncertain. A major concern is whether the beneficial effects of the fiscal stimulus are long-lasting, or else if they vanish as soon as the stimulus is withdrawn and the reversal kicks-in.

To measure the success of spending reversals, we choose to track the performance of the unemployment rate conditional upon two alternative spending plans. The baseline scenario involves a permanent increase in government spending for four quarters. The magnitude of the jump is set to one standard deviation and occurs on the last available observation of our sample, which coincides with 2012:Q4 for all countries. The reversal scenario implies that the increase in government spending lasts only for two quarters and

[16]Spending reversals can apply not only to selected policy initiatives, but more generally to positive government spending innovations. Fitting a VAR model to US data, Corsetti et al. (2012) show that the trajectory of government spending after a shock falls below zero from the twelfth quarter onward and interpret this pattern as evidence of debt-stabilizing spending reversals. We do not observe any undershooting in our VAR, which may suggest that European countries did not systematically react to their debt levels, or that they did not do so sufficiently strongly over the estimation period.

is followed by a decrease of identical magnitude. Conditional upon these two alternative cases, we forecast the value of the unemployment rate using the estimated coefficients from the VAR model (Blake and Mumtaz 2012).

The results are reported in Table 3.4. The first column to the left reports the observed value of the unemployment rate on 2012:Q4 in each of the countries in our dataset. The remaining columns show the forecast four quarters ahead under the baseline or the reversal scenario, for both an expansion in government consumption and government investment.

The main point that comes out of the table is that fiscal expansions followed by spending reversals eliminate most of the benefits coming from the initial spending increase. This is especially clear when conditioning on the path of government investment. Take the case of Germany. The forecasted value of the unemployment rate drops by 53% after four quarters of higher government spending. If instead we allow for a reversal after the second quarter, the median forecast at the end of the period is 7.2%, which means 33% higher than the latest available observation. This outcome is also observed in Austria and Netherlands. In France, Italy and Portugal the projected unemployment rate declines under both scenarios, but the difference is nonetheless large.

When conditioning upon a path for government consumption the picture is less clear and blurred by larger confidence intervals. Although the exact figures differ, the main insight applies to Greece, Italy and Spain. The results for Austria and Netherlands show a deterioration under the baseline and an improvement under the reversal: this is counterintuitive but consistent with evidence of expansionary fiscal austerity already encountered in section 3.5.2 and discussed in Bruckner and Pappa (2010) for a different set of countries.

3.6 Conclusions

We presented empirical evidence on the link between fiscal policy and the labor markets for a group of euro area countries using data since the early nineties. While output multipliers have received a lot of attention in recent research, this paper shows there's a lot to learn from studying other indicators of real activity.

To start with, we show that the link between growth and jobs varies considerably across countries. That is, countries with similar output responses to fiscal innovations can experience very different unemployment multipliers. The relationship between growth and jobs can be driven by specific public spending plans and institutional reforms. Spain and Germany - one launched ambitious public investment plans in transportation and housing, the other reformed its system of labor relations - are flagship cases. Both share similar output multipliers with Italy, a country notoriously lagging in its efforts to modernize the labor markets and administer public investment projects effectively. But Spain has a four times larger unemployment multiplier to government investment shocks; and Germany has an even higher unemployment multiplier to government consumption.

This segmentation exposes the common currency block to risks and high adjustment costs, as individual countries respond differently to shocks. For example, excessive reliance on budget deficits and foreign capital inflows into a specific sector of the economy may prove harmful if economic conditions change. Back in 2007, millions of low-skilled workers employed in the Spanish construction sector were suddenly laid off and it was impossible to re-employ them quickly. To the other extreme, Germany, by taking comprehensive structural reforms, managed to go from sick-man to power-horse of Europe.

Flexibility in hours worked and wages might represent a strategy to smooth the effects of adverse fiscal shocks. Changes in hours offer an alternative channel of adjustment, in addition to the binary choice of working versus not working. Similarly, wage negotiation could provide a way out to workers' layoffs during periods of weak demand. Our evidence shows that movements in hours worked are small and often not statistically significant, especially in peripheral countries. Instead, wages only respond to cuts in government consumption, as public salaries count for a large part of government disbursements for consumption.

All in all, our evidence makes a strong case for (i) the adoption of a coordinated agenda for labor markets reforms in order to reduce heteroschedasticity within the euro area; (ii) efforts to enhance labor hoarding practices, reduce downward wage rigidities and increase the flexibility of hours worked to labor market conditions.

Our results also show that the interaction of fiscal policy shocks with the state of the economy can deliver perverse effects on unemployment and the participation rate. The mechanism at work in the case of the participation rate is complex and deserves model validation. We argue that during normal times the negative income effect associated to fiscal contractions prevails and forces agents to join the labor force and look for jobs, thus participation goes up. However, since the onset of the 2007 crisis, a discouraged worker effect dominates in peripheral countries, and people quit the labor force in response to austerity in public spending.

Finally, we show that the dynamics described using aggregate data provide a good representation of the likely outcomes of government spending shocks in the public administration, manufacturing, industry and construction sectors.

Figures and Tables

Table 3.1: Impact multipliers

	Output Multiplier		Unemployment Multiplier	
	G consumption	G investment	G consumption	G investment
Austria	-0.42*	-0.05*	-0.91	0.53
France	-0.91*	-0.22*	6.34*	2.44*
Germany	-0.62*	-0.06*	8.71*	1.12*
Netherlands	-0.35*	-0.06*	0.43	0.73
Greece	-0.21*	-0.18*	1.53	2.10*
Italy	-0.69*	-0.13*	0.23	0.03
Portugal	-0.41*	-0.07*	-4.52	-1.72
Spain	-0.23*	-0.16*	1.02	4.13*

Notes: Impact multipliers are constructed as the value at time zero of the output impulse response divided by the value at time zero of the government spending shock. Asterisks mean that the result is significant at 68% level.

Table 3.2: Government consumption shock, employment rate by sector of activity: distance from aggregate.

	Impact Distance						
	Agriculture	Industry	Manufacturing	Construction	Financial	Real estate	Public administration
Austria	17.21*	-4.86	-4.51	5.41	25.17*	79.43*	-6.41*
France	1.58	2.55	4.77*	7.54*	10.89*	20.35*	-0.90
Germany	13.15*	-1.22	-1.13	1.68	5.74*	21.01*	-1.37
Netherlands	1.60	-0.99	-0.68	1.08	3.75*	19.30*	-1.16
Greece	0.01	-0.05	-0.04	-0.00	0.75	15.76*	-0.06
Italy	3.87*	0.62	0.67	-0.12	1.82	20.80*	-0.08
Portugal	0.67	0.69	0.68	0.07	3.55	11.72*	-0.67
Spain	2.07	-1.39	-1.16	-0.71	13.92*	33.08*	-1.53
	Cumulative Distance						
Austria	144.17*	-44.12	-40.20	46.52	229.31*	723.13*	-57.22
France	0.78	36.84*	63.05*	48.45*	51.15	197.38*	-16.10
Germany	81.72*	-6.98	-6.52	10.37	38.36*	133.68*	-8.32
Netherlands	30.88*	-4.52	-3.13	12.58	36.48*	185.47*	-11.10
Greece	-1.37	-2.16	-0.92	2.82	43.28*	1190.42*	-6.03
Italy	76.01*	-18.68	-18.02	9.84	81.87*	756.42*	-14.32
Portugal	-2.19	-5.29	-5.00	-0.78	33.32	113.00*	-4.26
Spain	23.94	-14.62	-12.27	-7.50	151.88*	357.72*	-18.63

Notes: The impact distance is constructed as the difference between the sectoral and the median aggregate employment rate IRFs to a government consumption shock in the first quarter. The cumulative distance is constructed as the sum over sixteen quarters of the difference between the sectoral and the median aggregate employment rate IRFs. Asterisks mean that the difference is significant at 68% level. Agriculture includes also forestry and fishing; industry excludes construction; financial includes insurance.

Table 3.3: Government investment shock, employment rate by sector of activity: distance from aggregate.

	Impact Distance						
	Agriculture	Industry	Manufacturing	Construction	Financial	Real estate	Public administration
Austria	2.31*	-0.04	-0.18	0.52	0.13	0.47	-0.23
France	0.77	1.36	2.46*	3.62*	4.89*	8.07*	-0.30
Germany	3.97*	-0.64	-0.58	0.54	0.48	4.89*	-0.50
Netherlands	-1.01*	-1.10*	-0.75	0.30	1.87*	9.92*	-0.60
Greece	-0.15	-0.01	0.07	0.29	0.85*	45.28*	-0.33
Italy	3.44*	-0.85	-0.83	0.36	2.78*	31.92*	-0.56
Portugal	0.53	0.69	0.67	0.08	0.69	2.13	0.23
Spain	0.71	-1.02	-0.84	-0.52	8.11*	20.47*	-0.17
	Cumulative Distance						
Austria	36.97*	-7.11	-7.37	10.49	36.28*	114.85*	-10.33*
France	-2.39	-10.42*	-14.47*	-6.63*	10.85	84.73*	-7.04
Germany	114.52*	-12.87*	-11.87*	14.94*	39.54*	170.74*	-12.68*
Netherlands	18.23*	-11.00*	-7.54	12.14*	41.93*	215.82*	-12.98*
Greece	-1.02	-1.28	-0.44	2.07	26.62*	762.91*	-4.01
Italy	48.21*	-13.46*	-12.94*	7.54	61.79*	516.89*	-10.43*
Portugal	-5.25	-11.04	-10.50	-1.59	55.90*	190.13*	-6.30
Spain	15.60	-7.57	-6.40	-3.90	86.90*	200.09*	-13.42

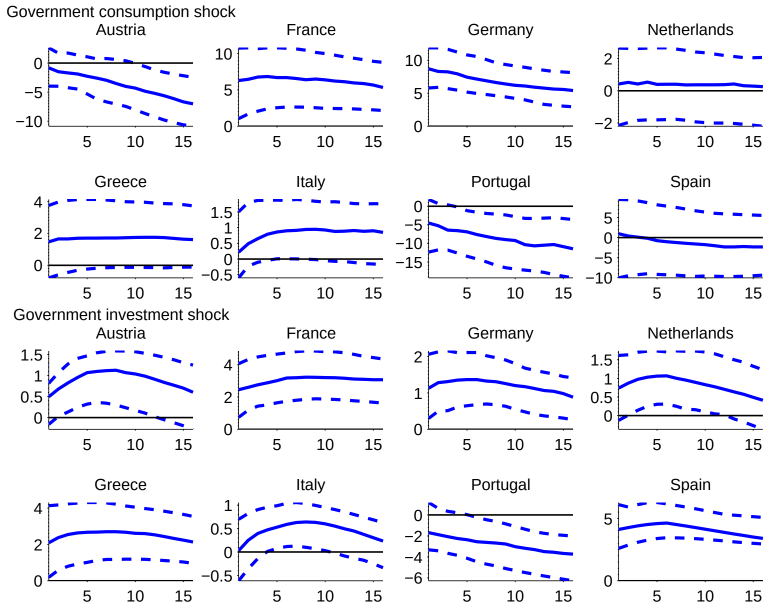
Notes: The impact distance is constructed as the difference between the sectoral and the median aggregate employment rate IRFs to a government spending shock in the first quarter. The cumulative distance is constructed as the sum over sixteen quarters of the difference between the sectoral and the median aggregate employment rate IRFs. Asterisks mean that the difference is significant at 68% level. Agriculture includes also forestry and fishing; industry excludes construction; financial includes insurance.

Table 3.4: Conditional forecasts: unemployment rate.

		Government Consumption		Government Investment	
	2012:Q4	Baseline	Reversal	Baseline	Reversal
Austria	4.57	9.31 (3.02,16.30)	-9.77 (-23.96,3.05)	2.76 (2.01,3.54)	5.34 (3.50,7.35)
France	10.50	5.91 (-1.56,13.37)	-2.71 (-21.15,17.01)	3.51 (1.60,6.53)	5.59 (-1.77,10.11)
Germany	5.40	-3.20 (-8.81,2.15)	19.24 (7.41,31.93)	2.52 (1.59,3.32)	7.20 (5.07,9.42)
Netherlands	5.63	10.54 (7.09,13.83)	-11.81 (-20.24,-2.39)	1.66 (0.60,2.54)	9.13 (6.57,11.74)
Greece	26.10	2.01 (-1.68,7.08)	12.17 (-0.41,20.45)	2.30 (-0.03,4.49)	10.78 (5.39,17.82)
Italy	11.40	1.91 (-0.86,4.42)	11.58 (4.26,19.38)	2.92 (1.73,4.23)	7.18 (4.59,10.28)
Portugal	17.03	-6.07 (-10.95,-2.38)	34.78 (23.93,46.87)	2.12 (1.05,3.09)	10.03 (7.09,13.25)
Spain	26.13	7.20 (-14.31,23.15)	-1.91 (-37.79,50.21)	4.74 (-0.91,10.70)	3.89 (-13.54,21.02)

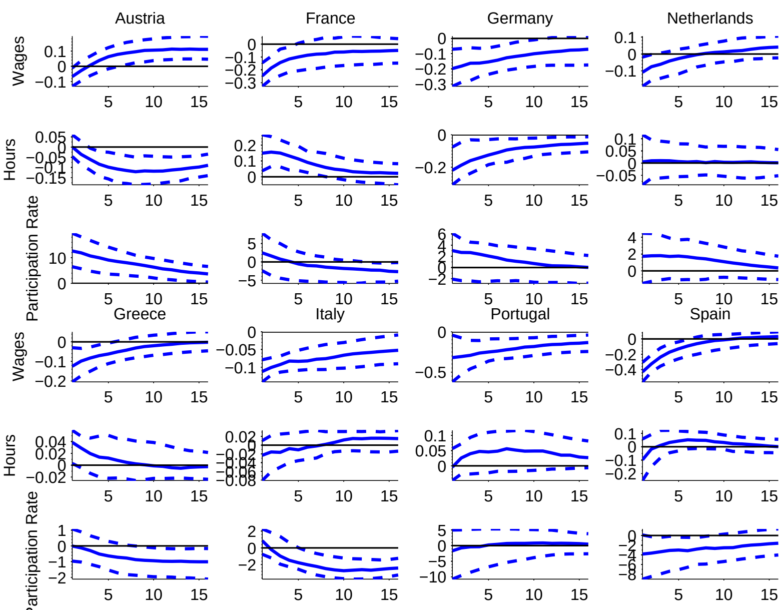
Notes: Forecasts are conditional on an assumed path for government consumption or government investment. Under the baseline scenario government consumption (or investment) grows by one standard deviation and remains fixed at that value for four quarters. Under the reversal scenario, the positive jump during the first two quarters is followed by a reversal during the last two quarters. The table shows the initial value of the unemployment rate observed in 2012:Q4 and the forecast at the end of the fourth quarter for each case.

Figure 3.1: Contractionary government spending shocks: country-specific unemployment.



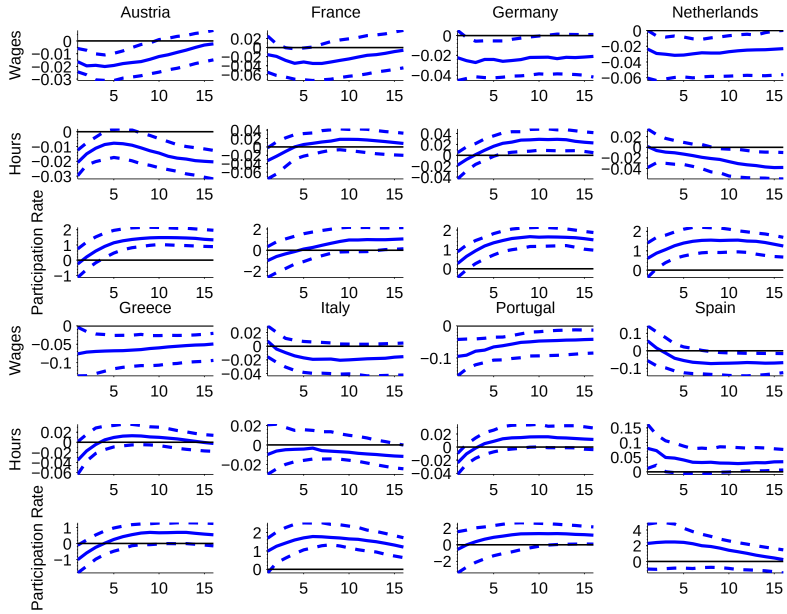
Notes: Continuous line: median IRF; Dotted line: 68% confidence bands.

Figure 3.2: Contractionary government consumption shocks: country-specific labor market variables.



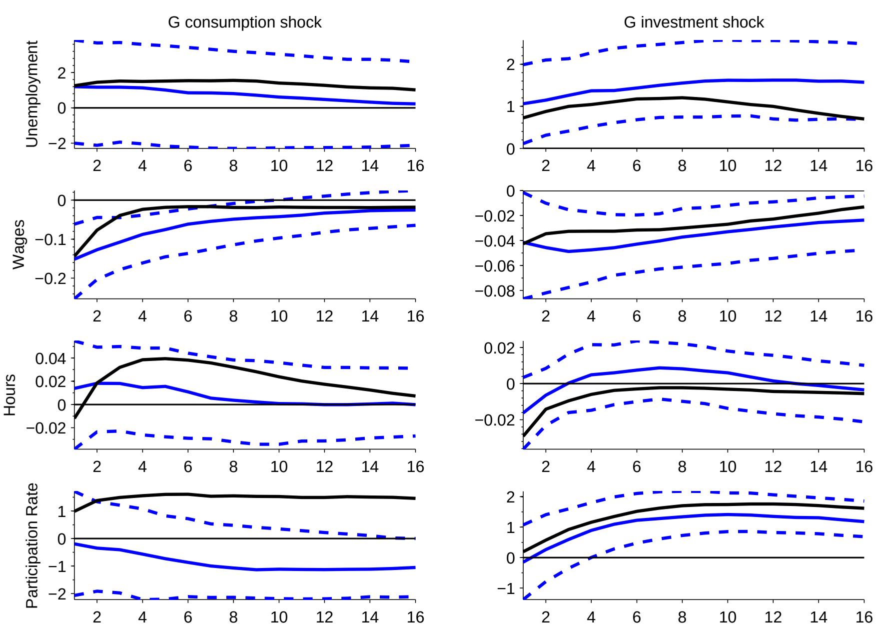
Notes: Continuous line: median IRF; Dotted line: 68% confidence bands.

Figure 3.3: Contractionary government investment shocks: country-specific labor market variables.



Notes: Continuous line: median IRF; Dotted line: 68% confidence bands.

Figure 3.4: Contractionary government spending shocks: average IRFs across samples.



Notes: Continuous line, blue: median IRF 1991-2012; Dotted line: 68% confidence bands 1991-2012; Continuous line, black: median IRF 1991-2006.

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Appendix A

Appendix to Chapter 1

The model:

$$
\begin{aligned}
q_t &= \beta E_t q_{t+1} + \left[1-\beta\left(1-\delta\right)\right] E_t r^k_{t+1} - \left(r_t - E_t \pi_{t+1}\right) && \text{(A.1)}\\
\eta q_t &= i_t - k_{t-1} && \text{(A.2)}\\
k_t &= \delta i_t + \left(1-\delta\right) k_{t-1} && \text{(A.3)}\\
w_t &= \Gamma w_{t-1} + \Gamma \beta E_t \left(w_{t+1} + \pi_{t+1}\right) - \Gamma \pi_t + \\
&\quad + \Gamma \frac{\left(1-\beta\theta_w\right)\left(1-\theta_w\right)}{\theta_w}\left(c_t + \varphi n_t\right) && \text{(A.4)}\\
c^o_t &= E_t c^o_{t+1} - \left(r_t - E_t \pi_{t+1}\right) && \text{(A.5)}\\
c^r_t &= \frac{1-\alpha}{\left(1+\mu_p\right)\gamma_c}\left(w_t + n_t\right) - \frac{1}{\gamma_c} t^r_t && \text{(A.6)}\\
c_t &= \lambda c^r_t + \left(1-\lambda\right) c^o_t && \text{(A.7)}\\
\pi_t &= \beta E_t \pi_{t+1} + \frac{\left(1-\beta\theta_p\right)\left(1-\theta_p\right)}{\theta_p} mc_t && \text{(A.8)}\\
mc_t &= w_t + \alpha\left(n_t - k_{t-1}\right) && \text{(A.9)}\\
y_t &= \left(1-\alpha\right) n_t + \alpha k_{t-1} && \text{(A.10)}\\
y_t &= \gamma_c c_t + \gamma_i i_t + g_t && \text{(A.11)}\\
b_t &= \left(1+\rho\right)\left(1-\phi_b\right) b_{t-1} + \left(1+\rho\right)\left(1-\phi_g\right) g_t && \text{(A.12)}\\
t_t &= \phi_b b_{t-1} + \phi_g g_t && \text{(A.13)}\\
g_t &= \rho_g g_{t-1} + \epsilon_t && \text{(A.14)}\\
r^k_t &= c_t - k_{t-1} + \left(1+\varphi\right) n_t && \text{(A.15)}\\
r_t &= \phi_\pi \pi_t && \text{(A.16)}
\end{aligned}
$$

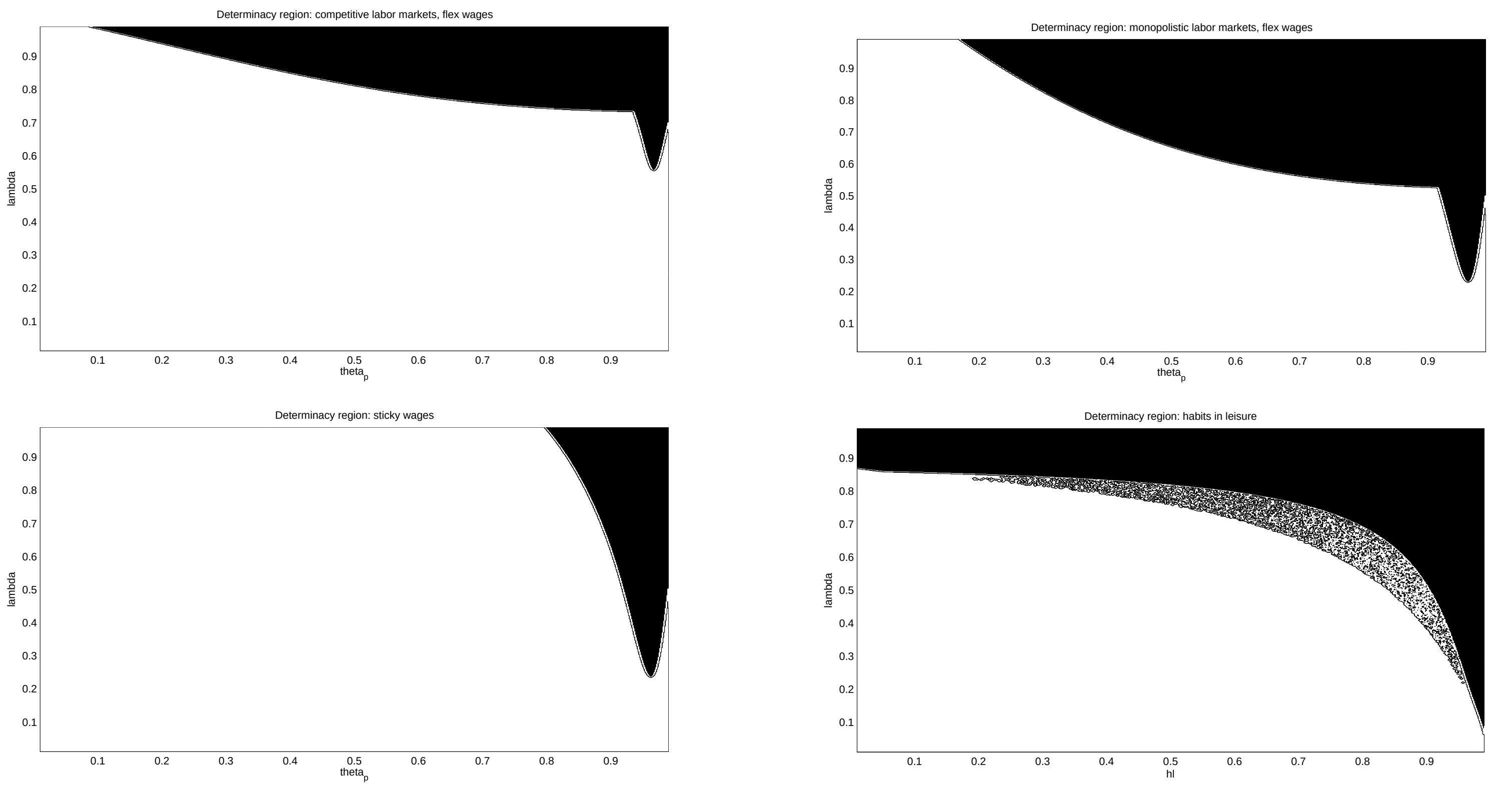


Figure A.1: Determinacy region (white area) under alternative labor market structures and wage contracts. Top left: competitive labor markets and flexible wages. Top right: imperfectly competitive labor markets and flexible wages. Bottom left: imperfectly competitive labor markets and sticky wages. Bottom right: competitive labor markets and leisure habits.

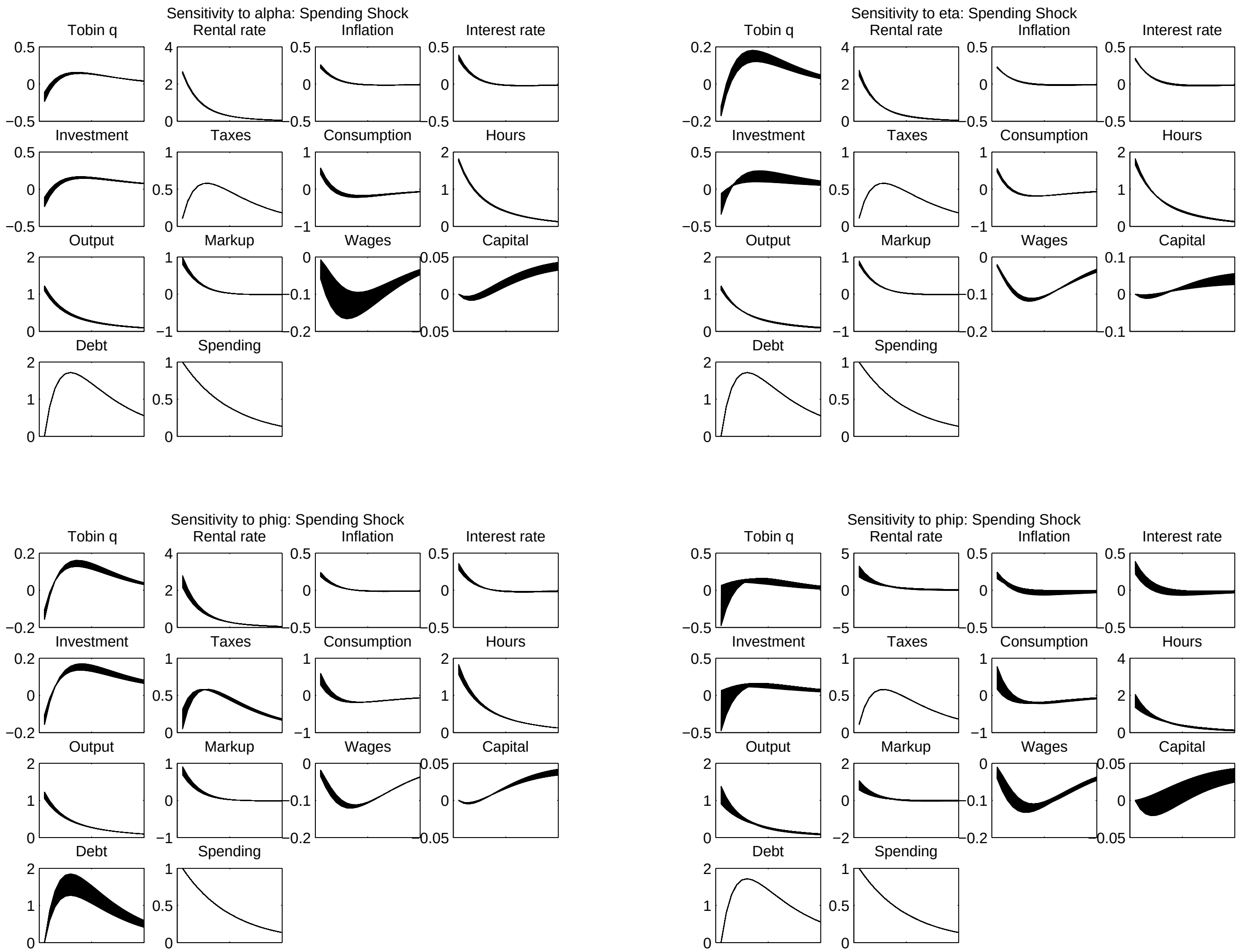


Figure A.2: Parameter randomization and IRFs.

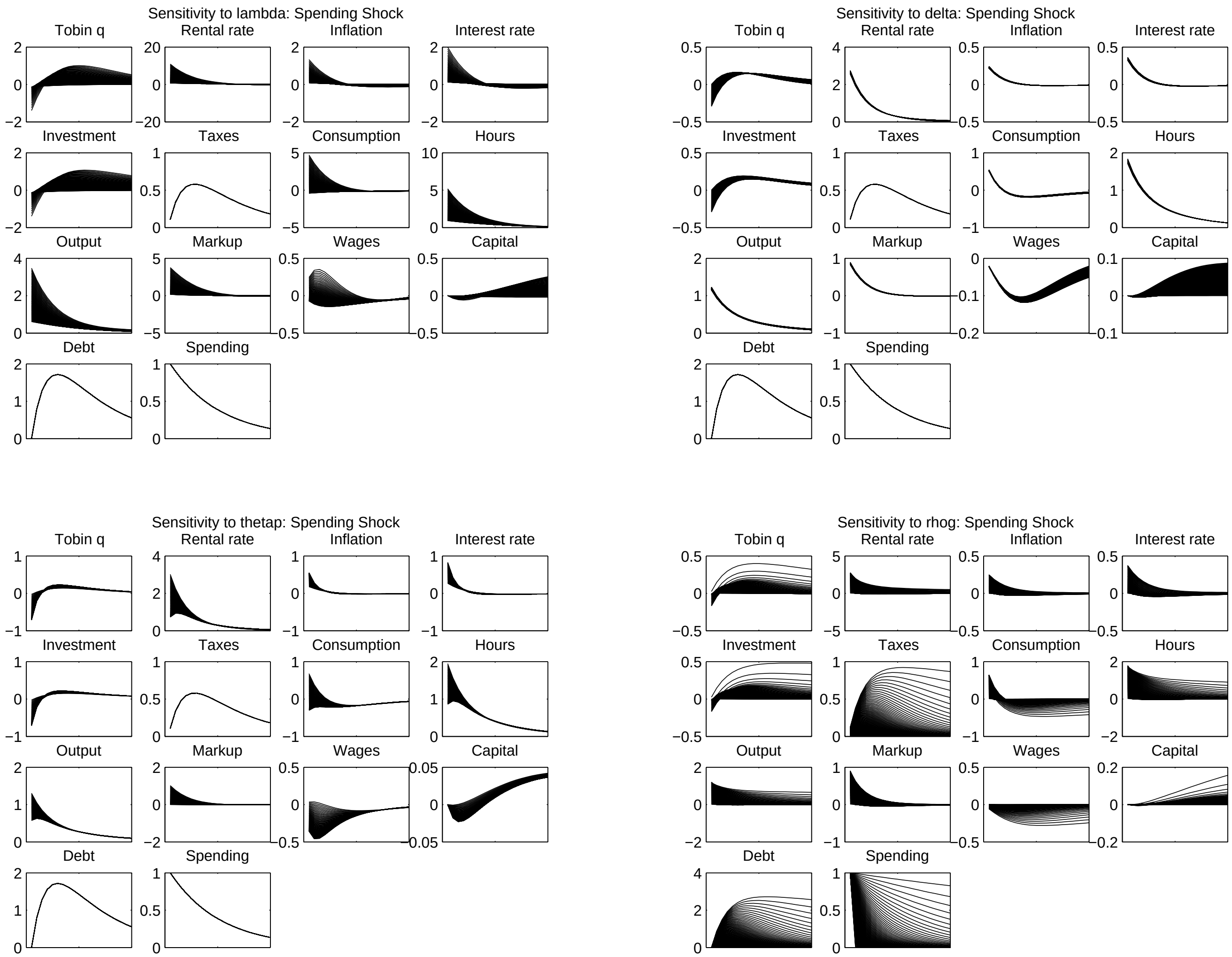


Figure A.3: Parameter randomization and IRFs.

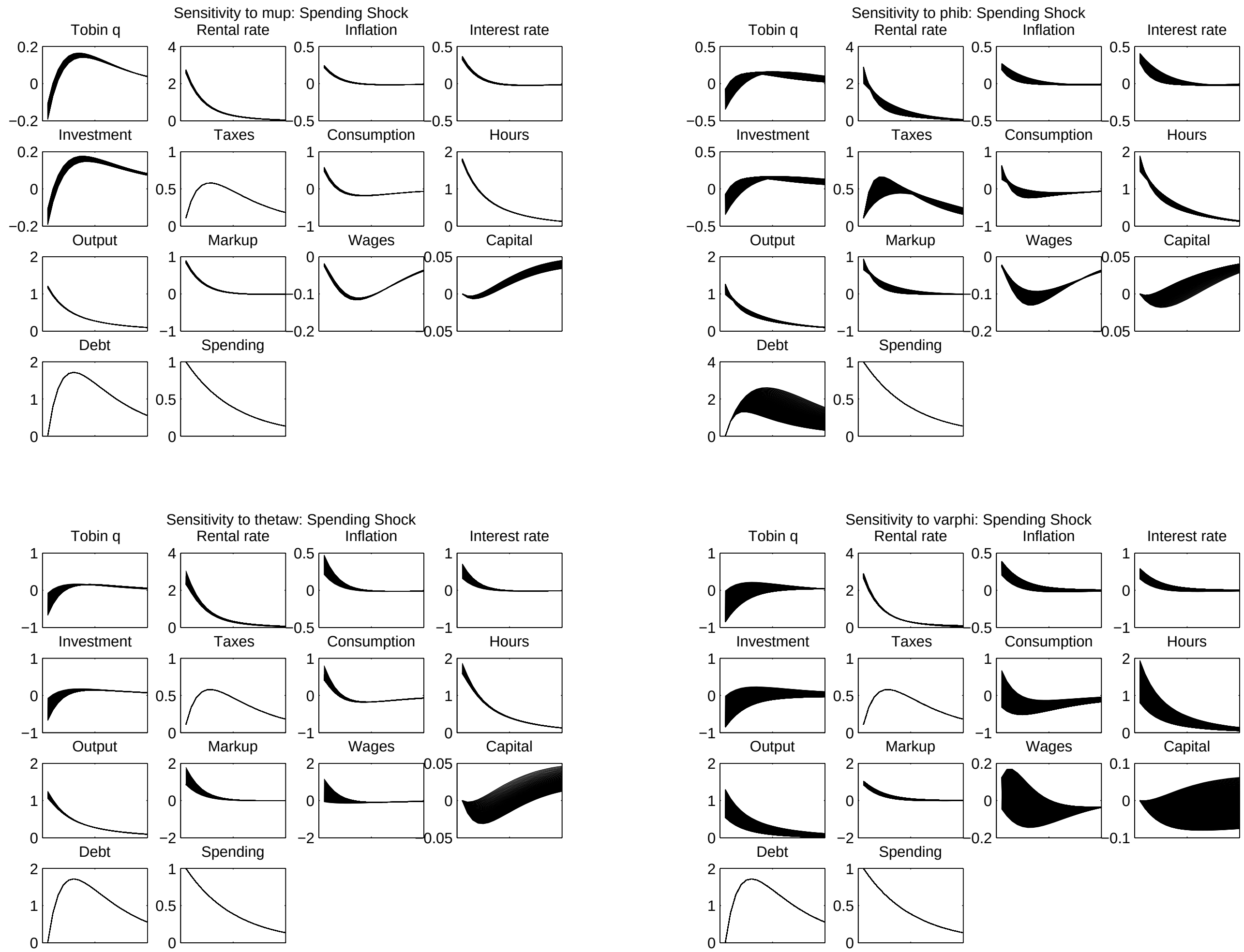


Figure A.4: Parameter randomization and IRFs.

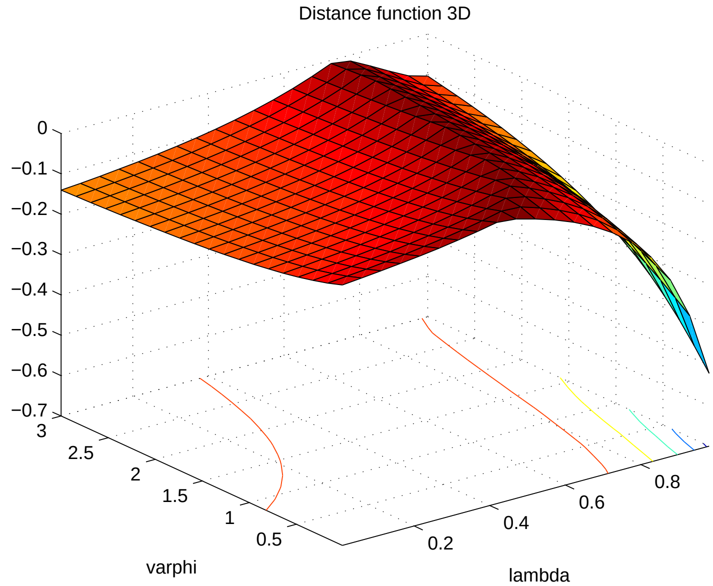


Figure A.5: Distance function in λ and φ.

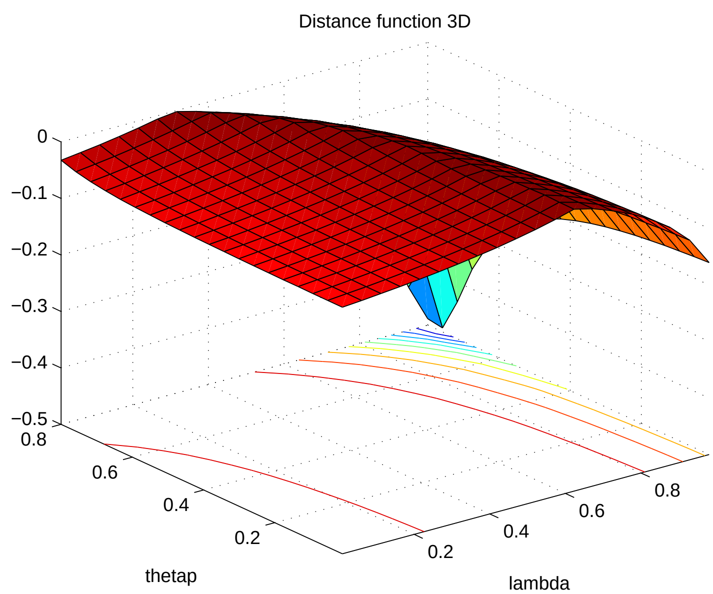


Figure A.6: Distance function in λ and θ_p.

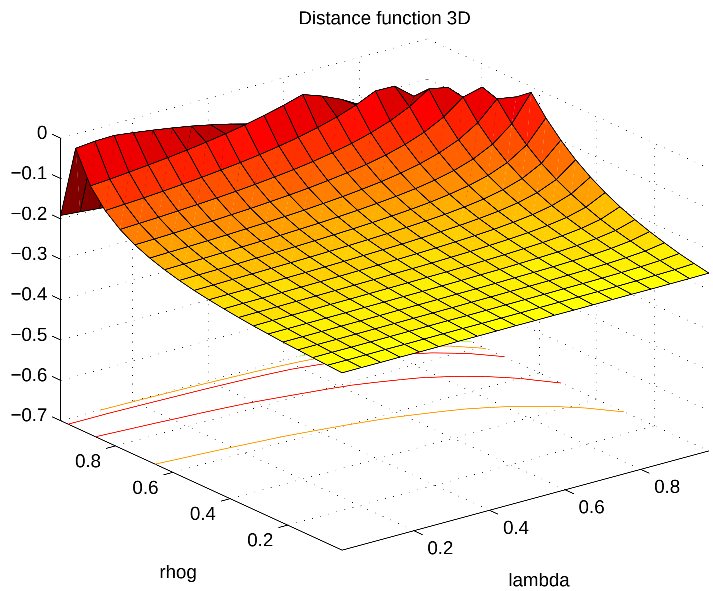


Figure A.7: Distance function in λ and ρ_g.

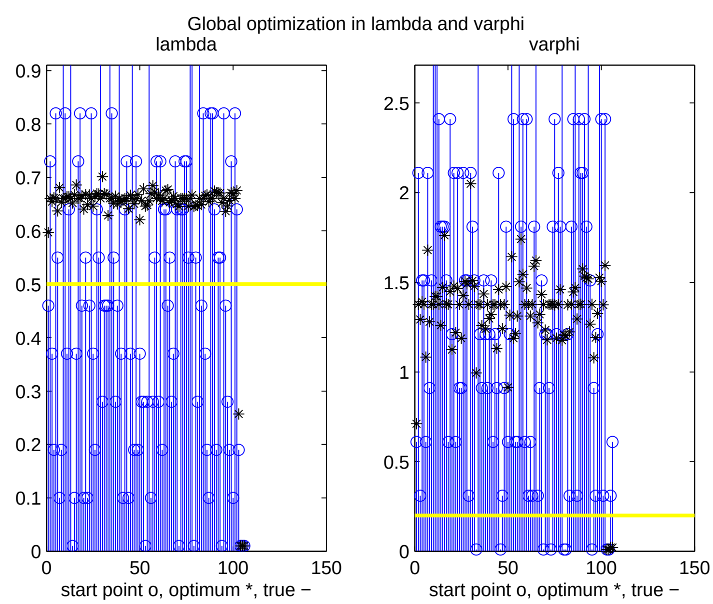


Figure A.8: `MultiStart` optimization results in λ and φ. Blue circles: starting points; black stars: parameters' values at optimum; yellow bar: true parameter value.

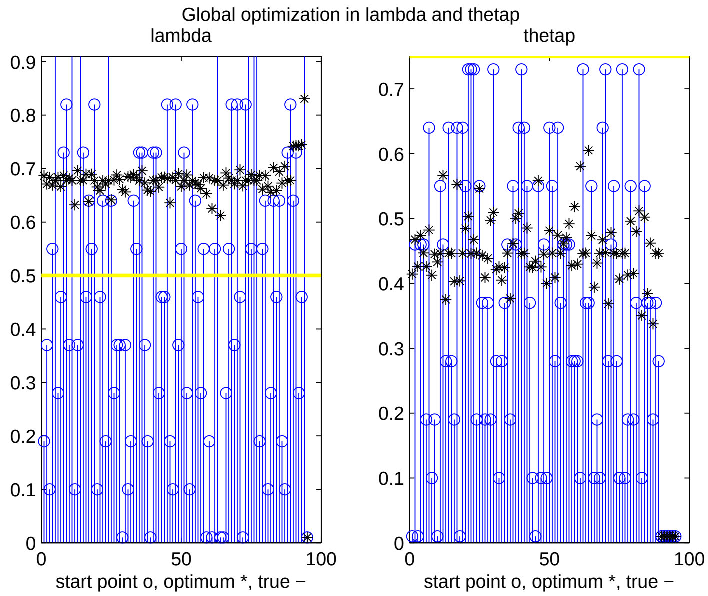


Figure A.9: `MultiStart` optimization results in λ and θ_p. Blue circles: starting points; black stars: parameters' values at optimum; yellow bar: true parameter value.

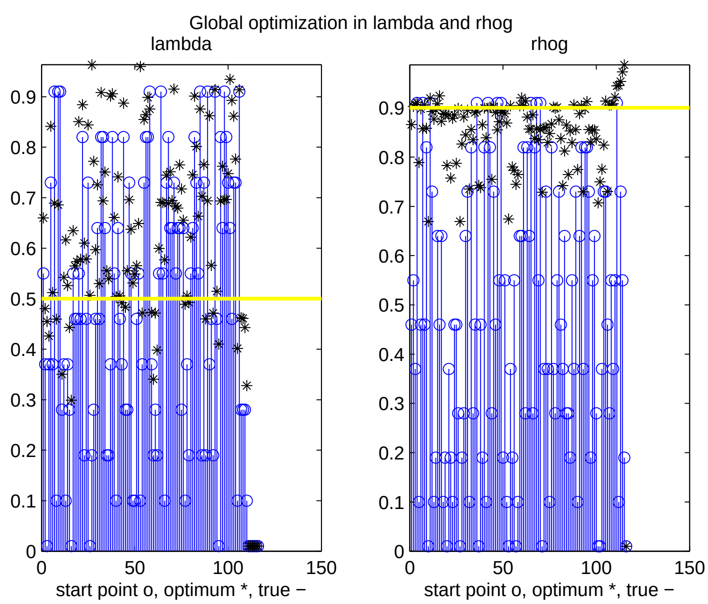


Figure A.10: `MultiStart` optimization results in λ and ρ_g. Blue circles: starting points; black stars: parameters' values at optimum; yellow bar: true parameter value.

Appendix B

Appendix to Chapter 2

Figure B.1: Log number of tourist arrivals: Cyprus

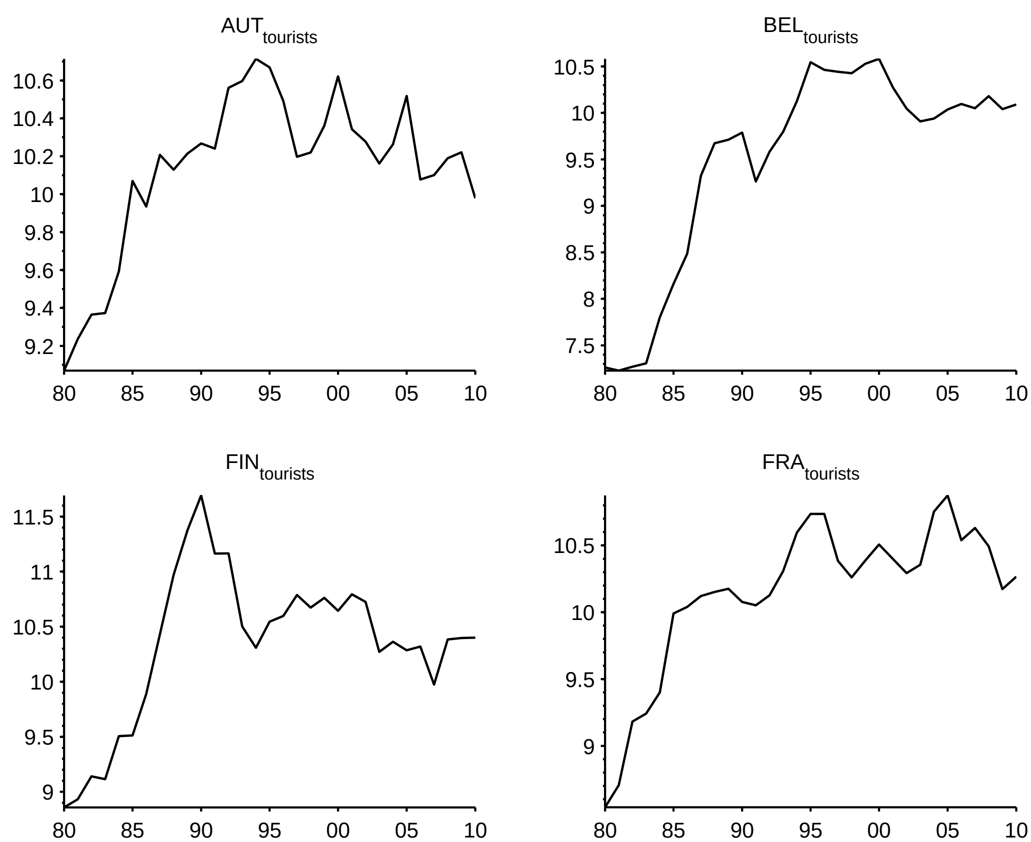


Figure B.2: Log number of tourist arrivals: Cyprus

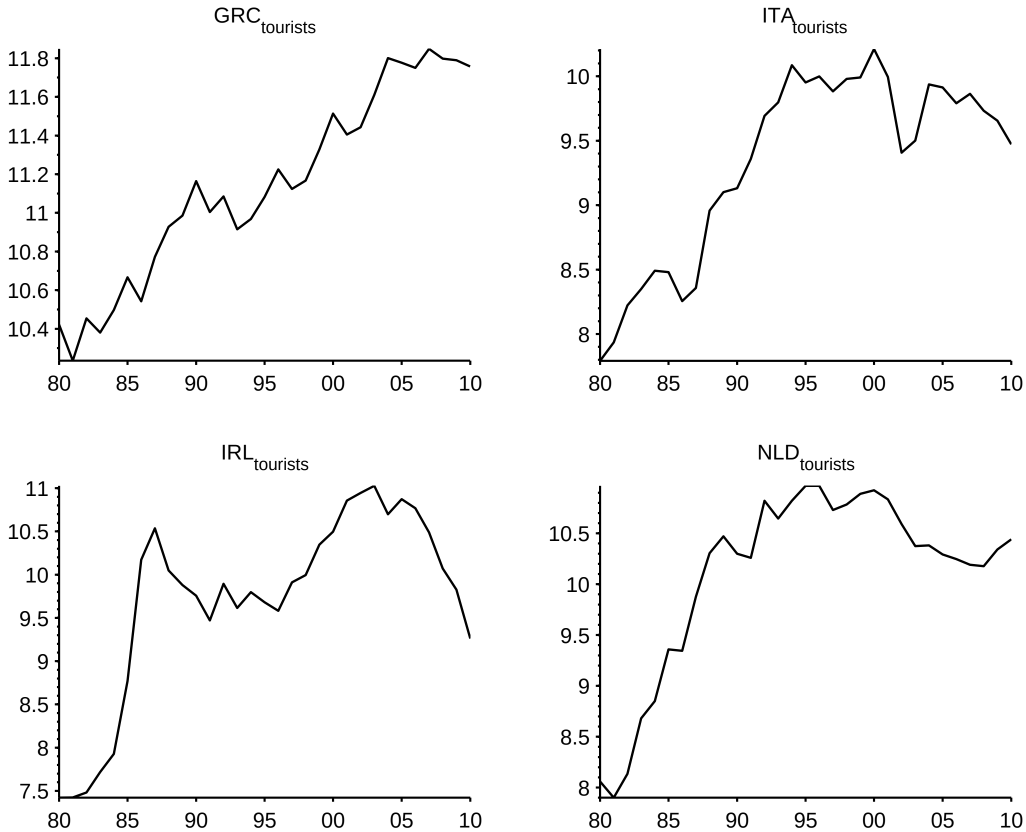


Figure B.3: Log number of tourist arrivals: Cyprus

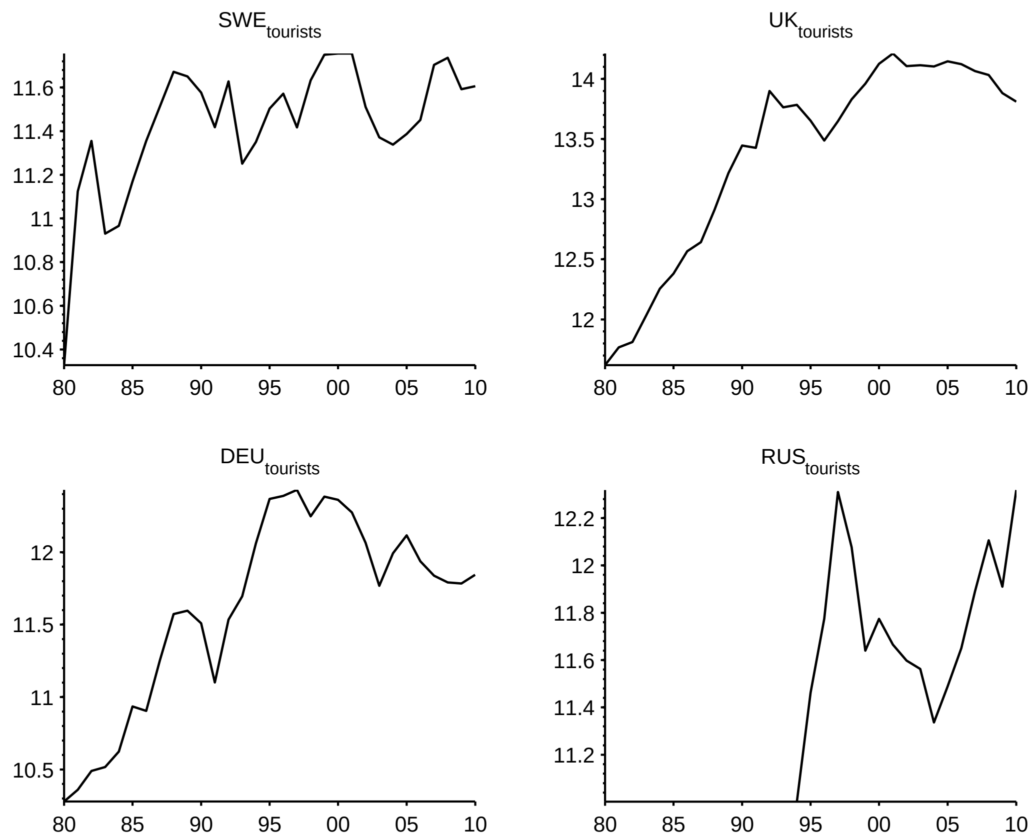


Figure B.4: Log number of tourist arrivals: Cyprus

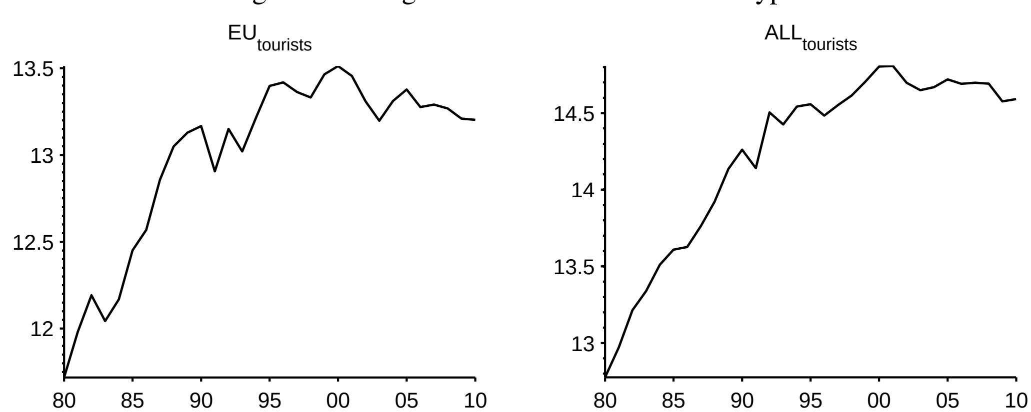


Figure B.5: Log number of tourist arrivals: Morocco

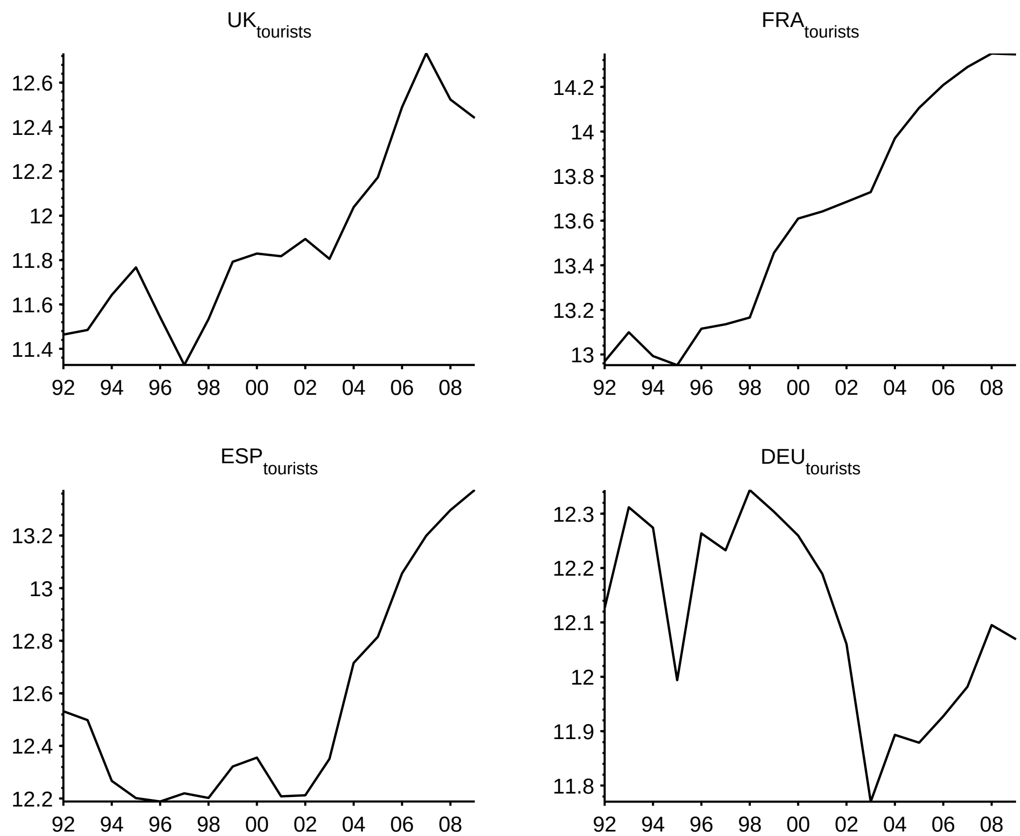


Figure B.6: Log number of tourist arrivals: Morocco

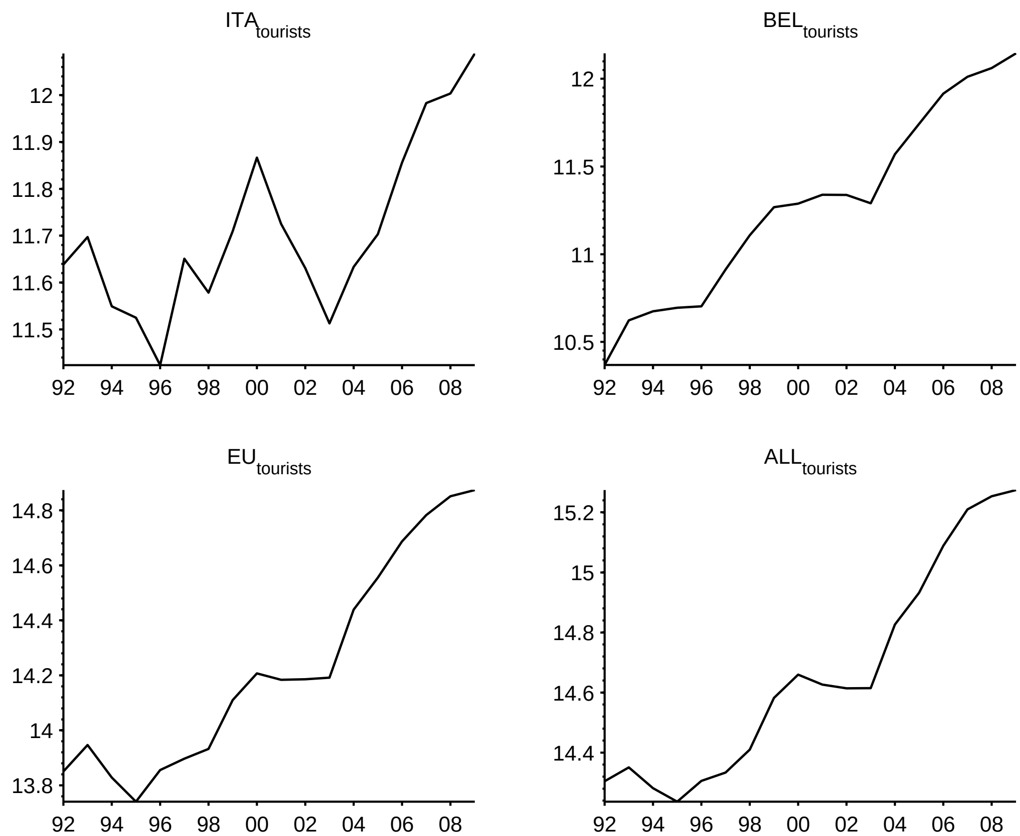


Figure B.7: Log number of tourist arrivals: Syria

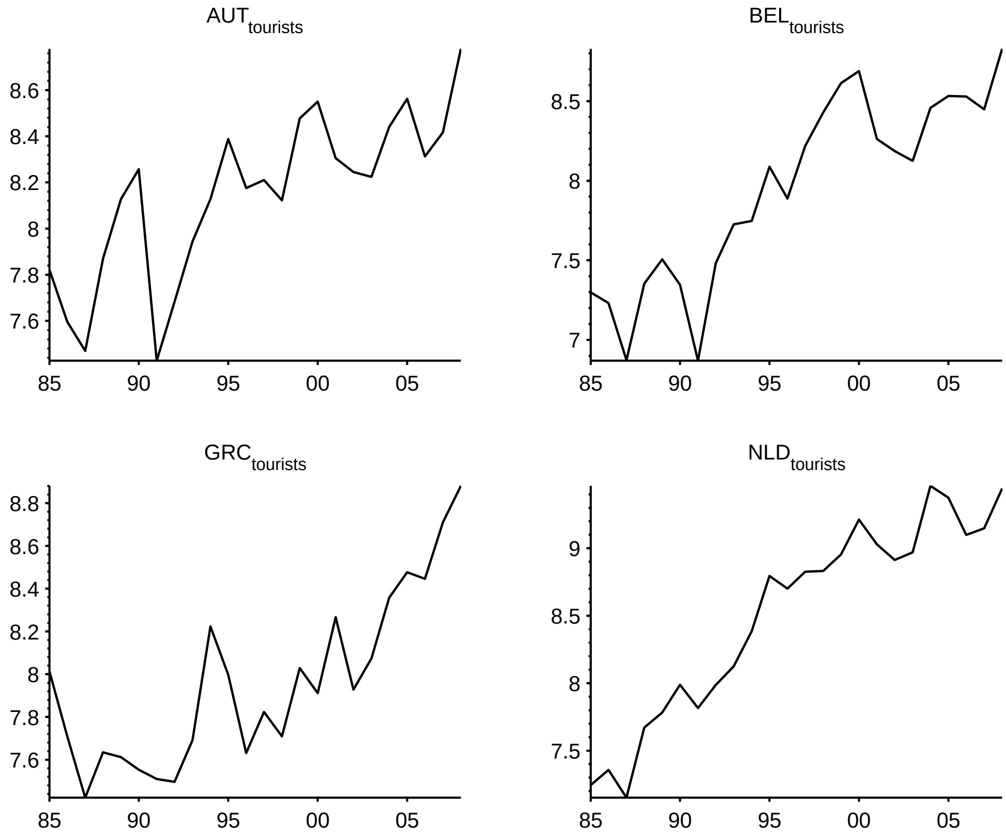


Figure B.8: Log number of tourist arrivals: Syria

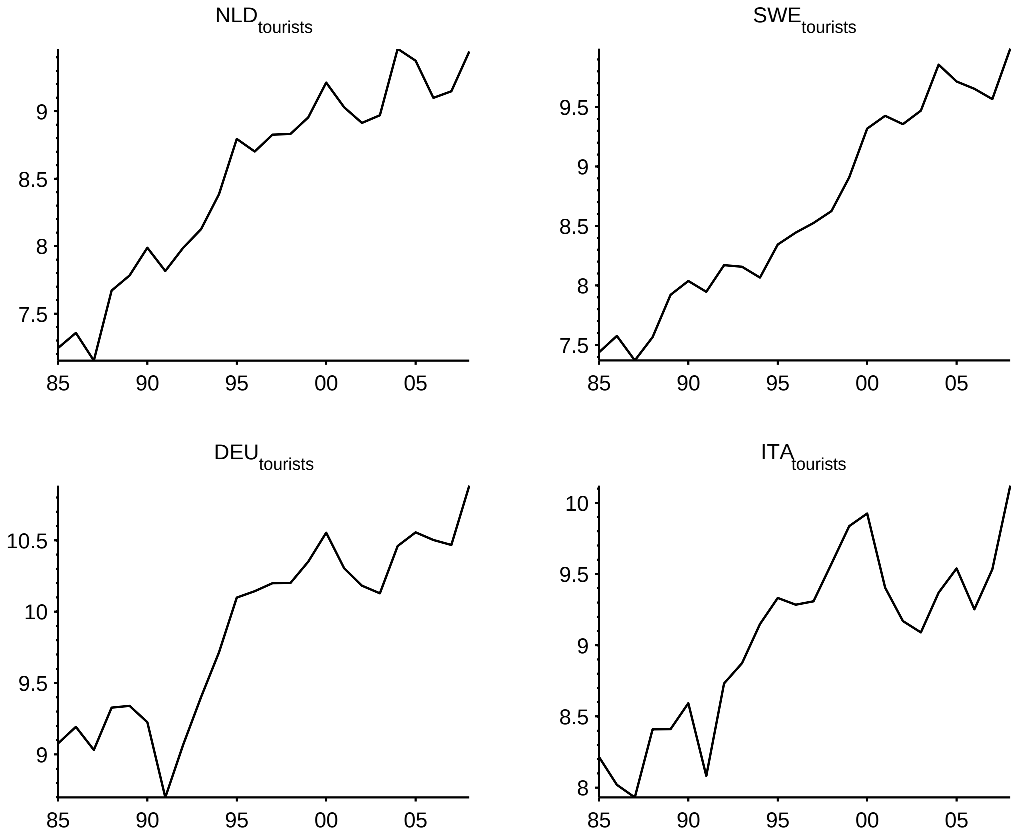


Figure B.9: Log number of tourist arrivals: Syria

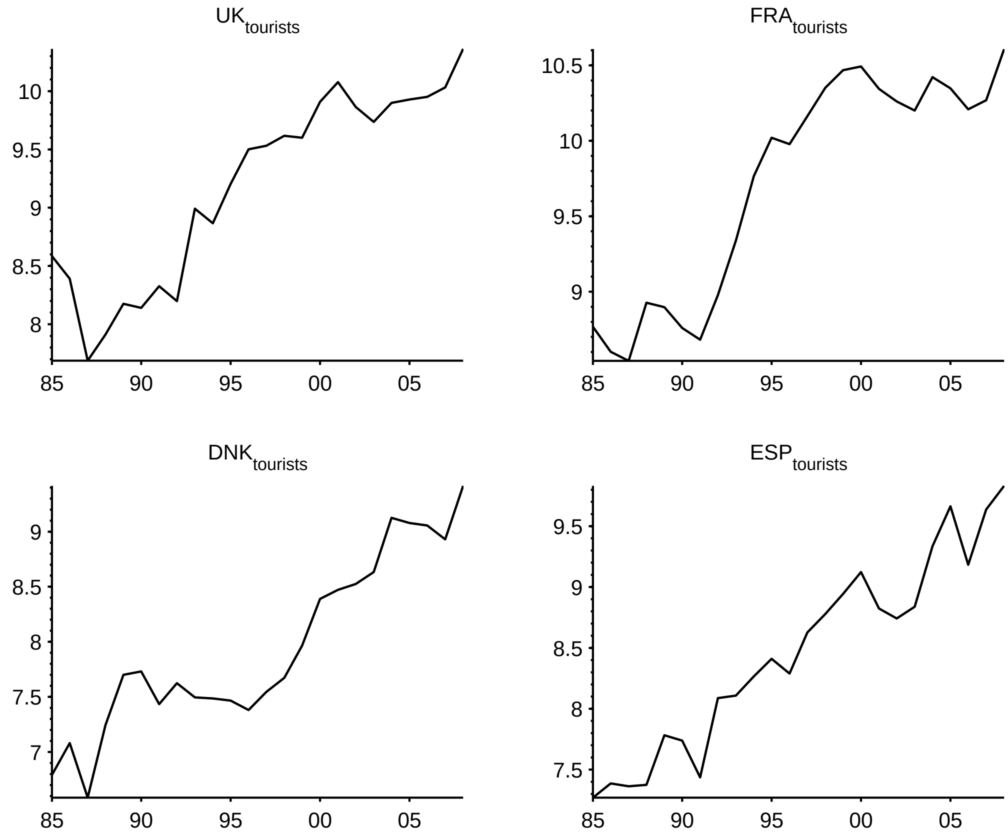


Figure B.10: Log number of tourist arrivals: Syria

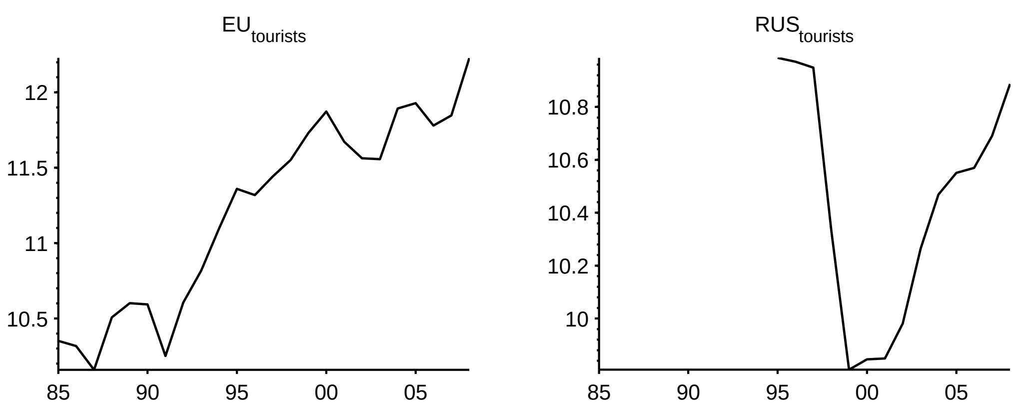


Figure B.11: Log number of tourist arrivals: Tunisia

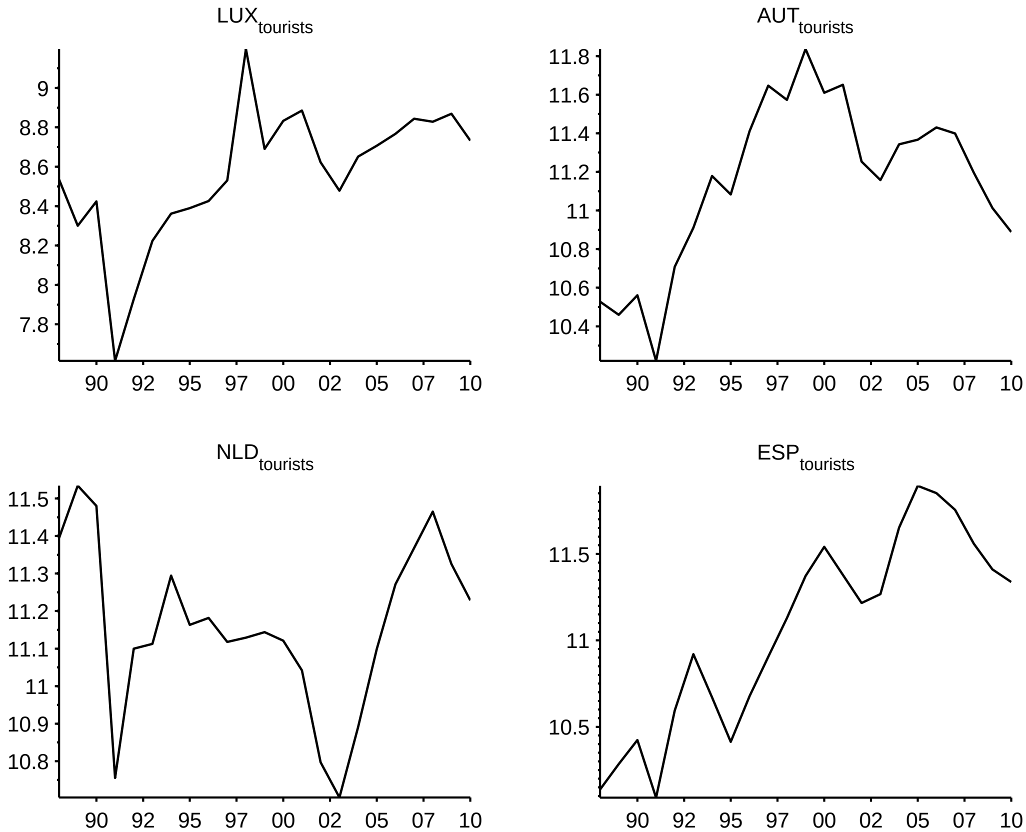


Figure B.12: Log number of tourist arrivals: Tunisia

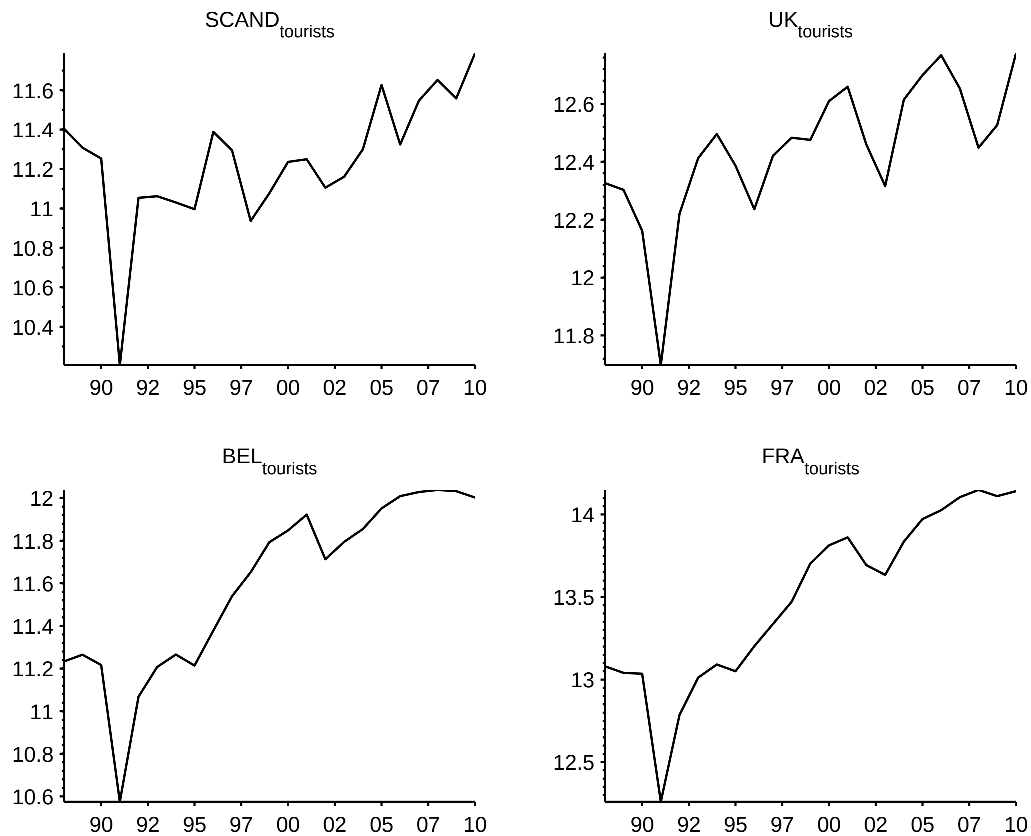


Figure B.13: Log number of tourist arrivals: Tunisia

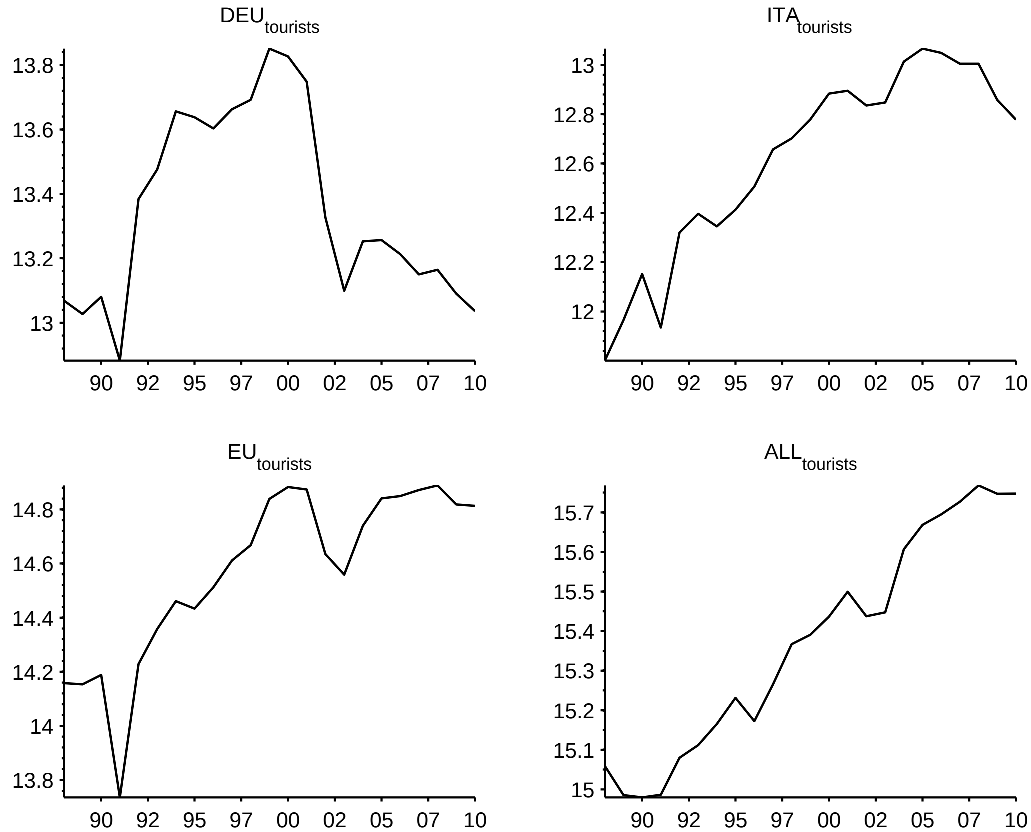


Figure B.14: Log number of tourist arrivals: Turkey

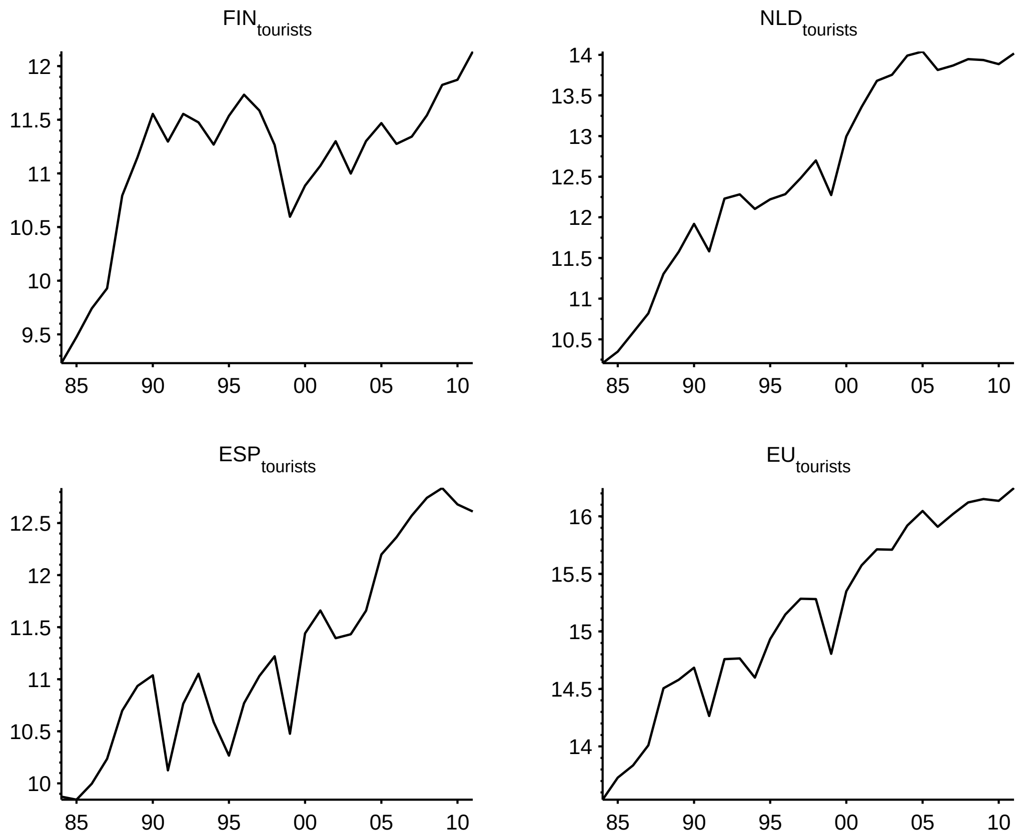


Figure B.15: Log number of tourist arrivals: Turkey

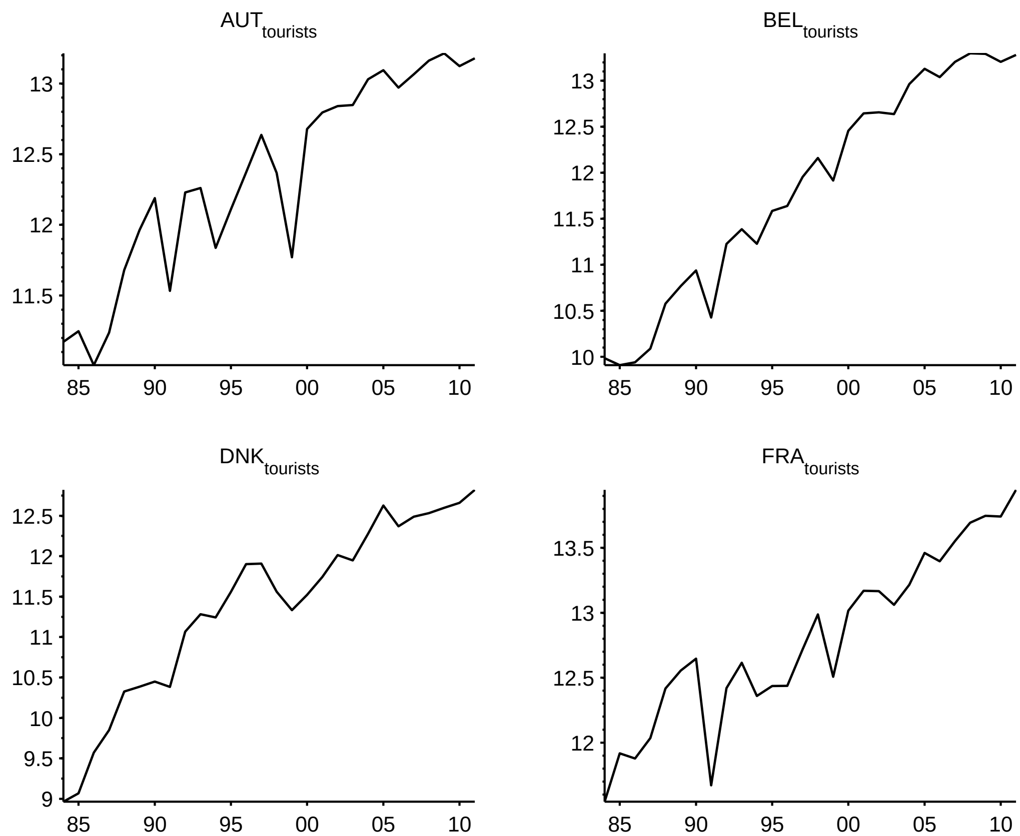


Figure B.16: Log number of tourist arrivals: Turkey

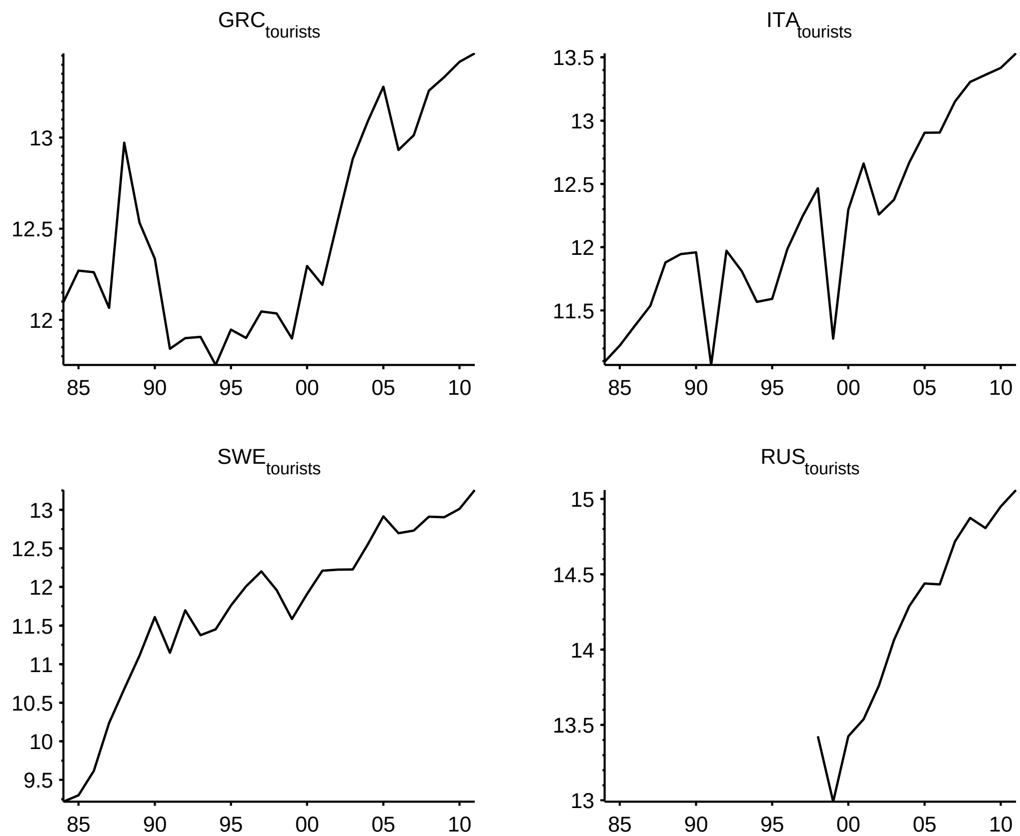


Figure B.17: Log number of tourist arrivals: Turkey

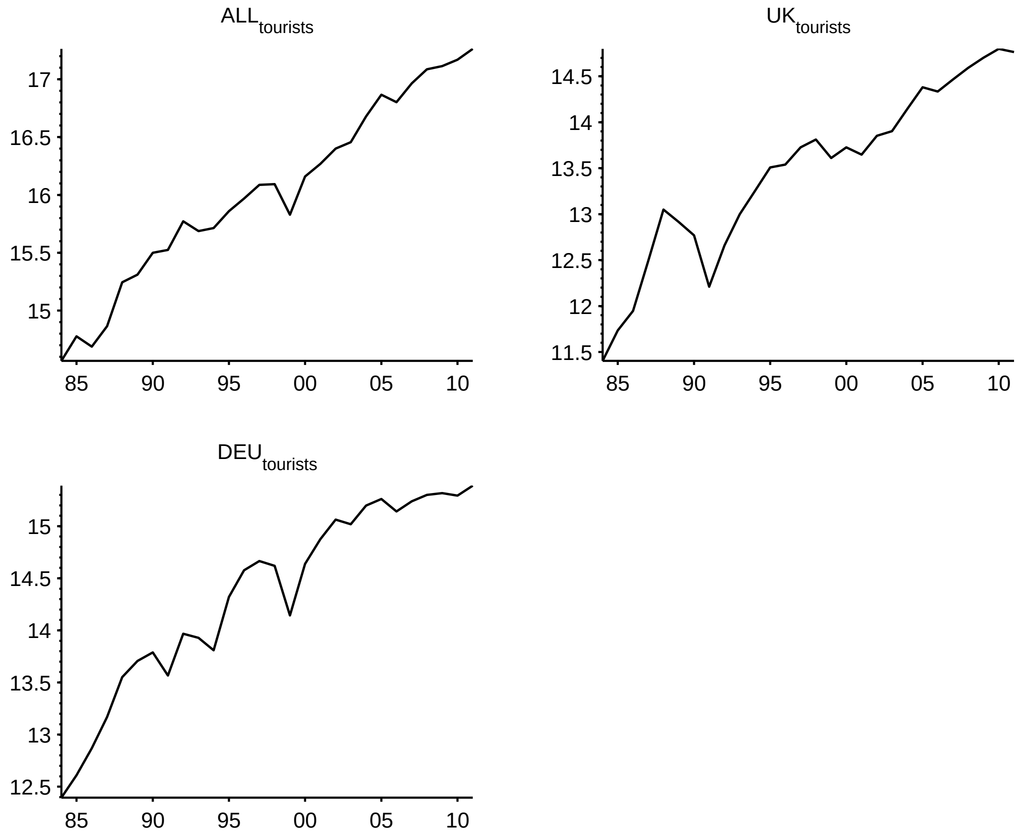


Figure B.18: Posterior density of the hypervariance parameter

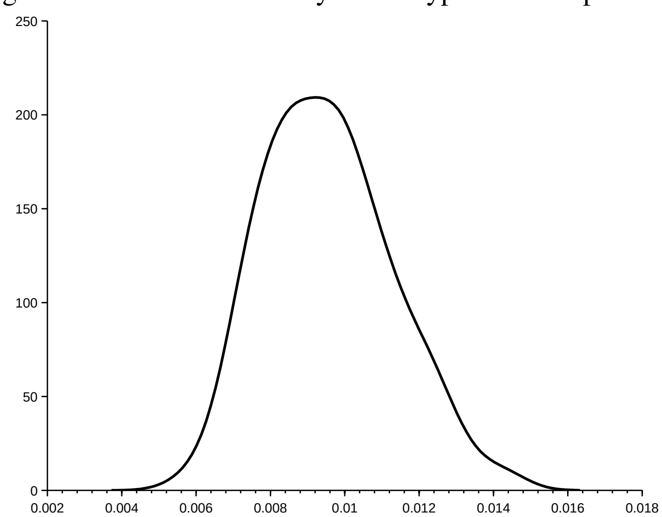
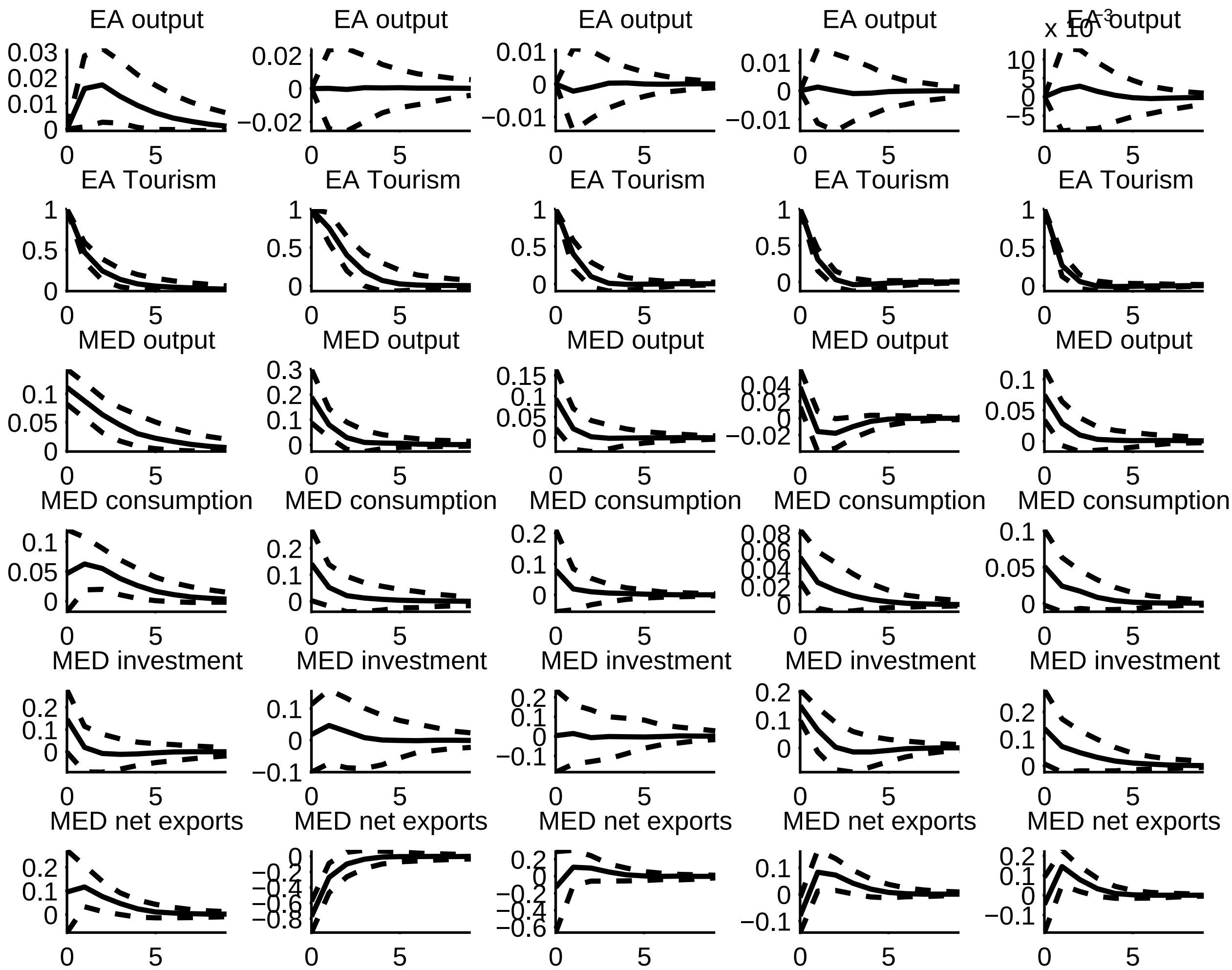


Figure B.19: Responses to a Euro area tourism shock, individual country effects



Notes: From left to right columns: Cyprus, Morocco, Syria, Tunisia, Turkey. Continuous line: median posterior IRF. Dotted lines: 68% posterior credible interval. The order of the plots is the following: Euro area output, Euro area tourist arrivals, MED output, MED consumption, MED investment, MED net exports. Here, MED identifies the typical destination country.

Figure B.20: Log number of nights spent: Tunisia.

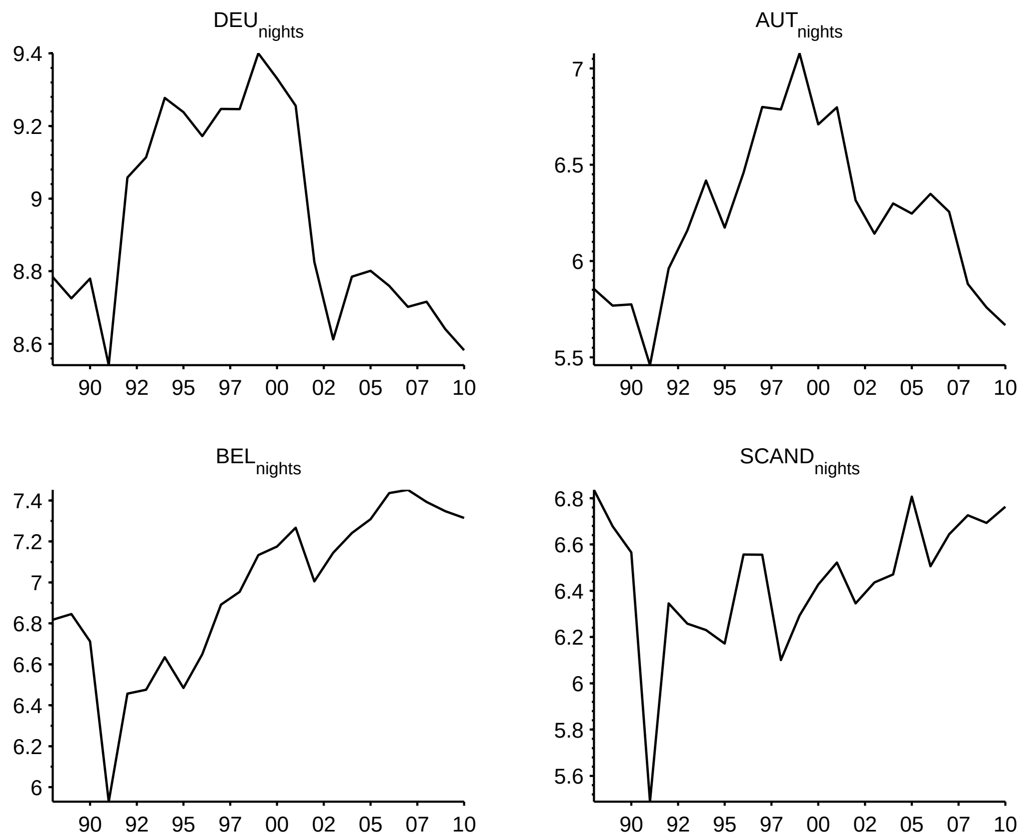


Figure B.21: Log number of nights spent: Tunisia.

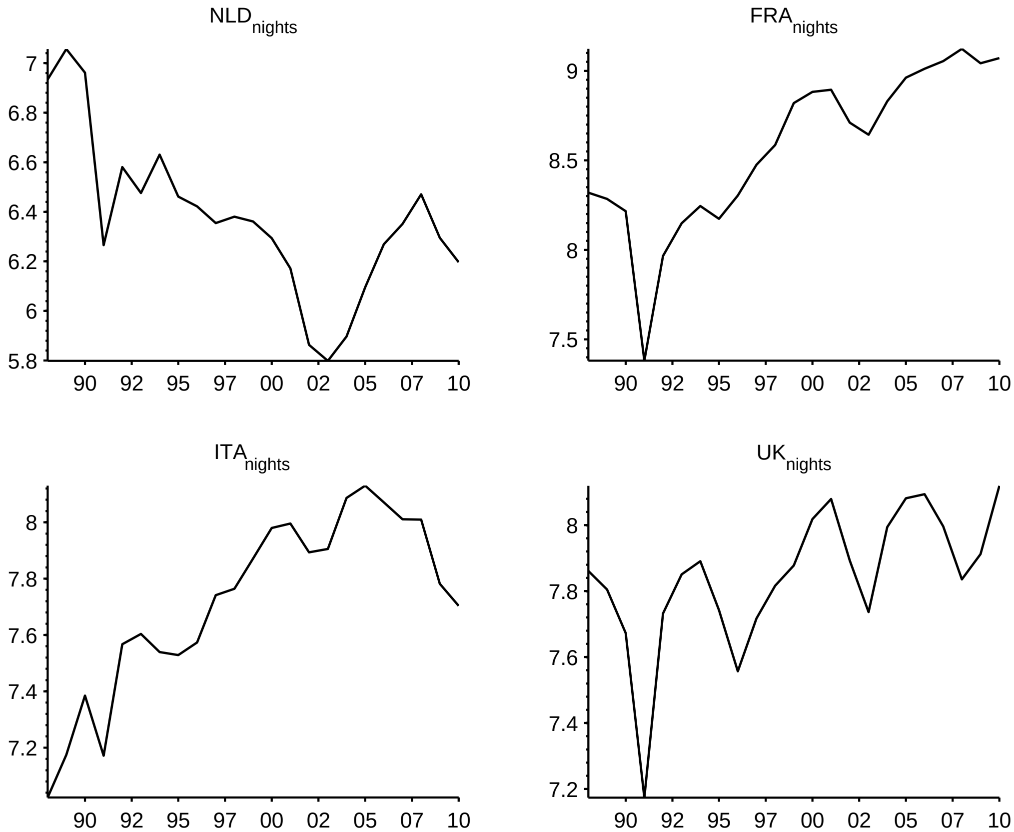


Figure B.22: Log number of nights spent: Tunisia.

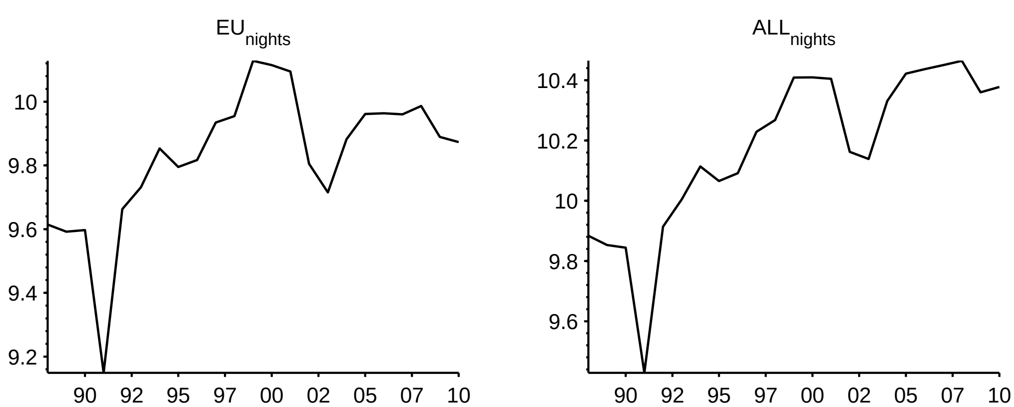


Figure B.23: Log per-capita expenditures: Cyprus.

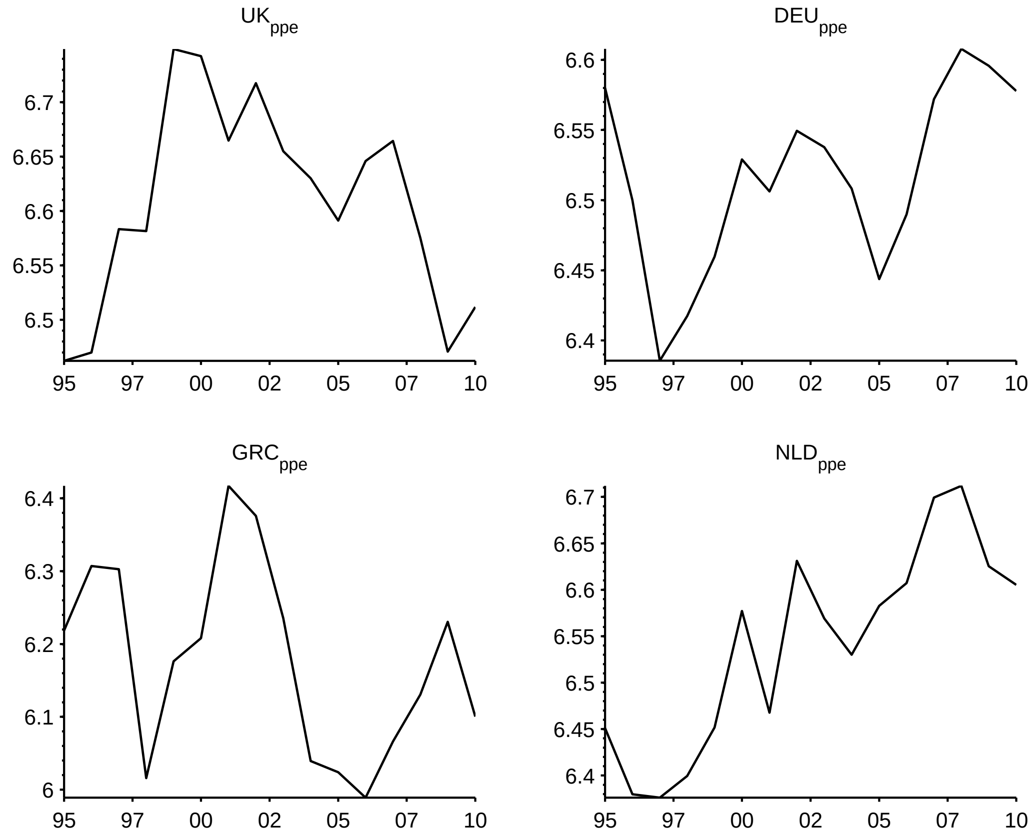


Figure B.24: Log per-capita expenditures: Cyprus.

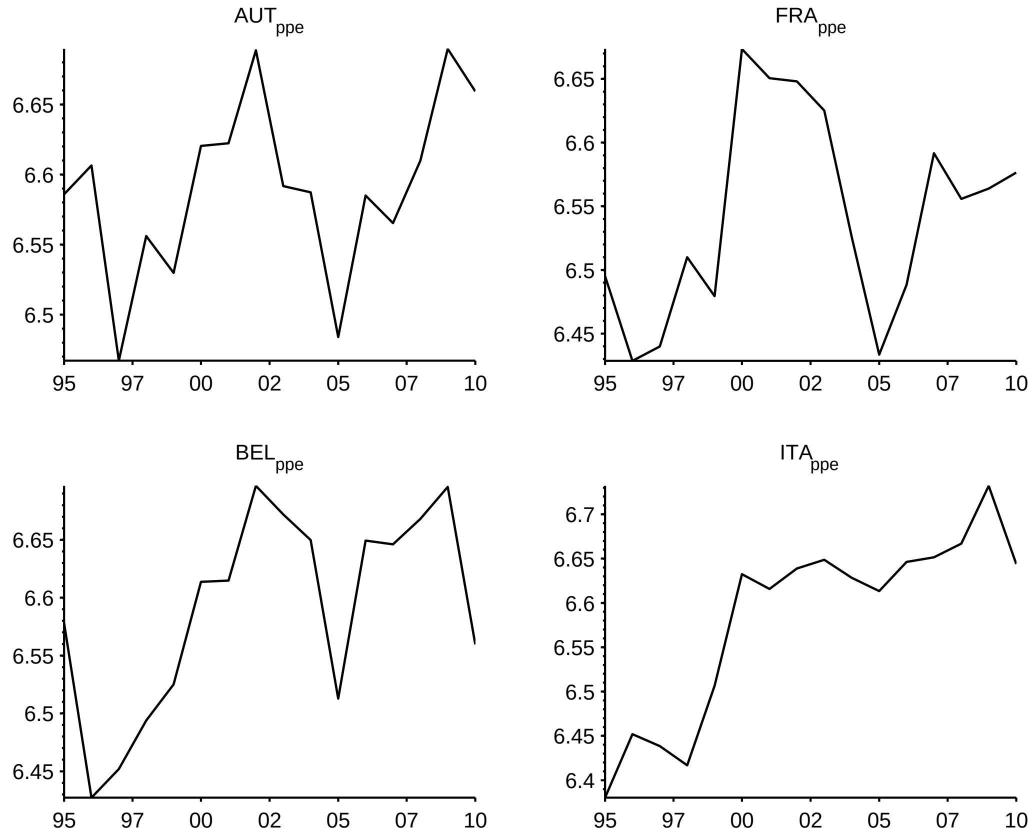


Figure B.25: Log per-capita expenditures: Cyprus.

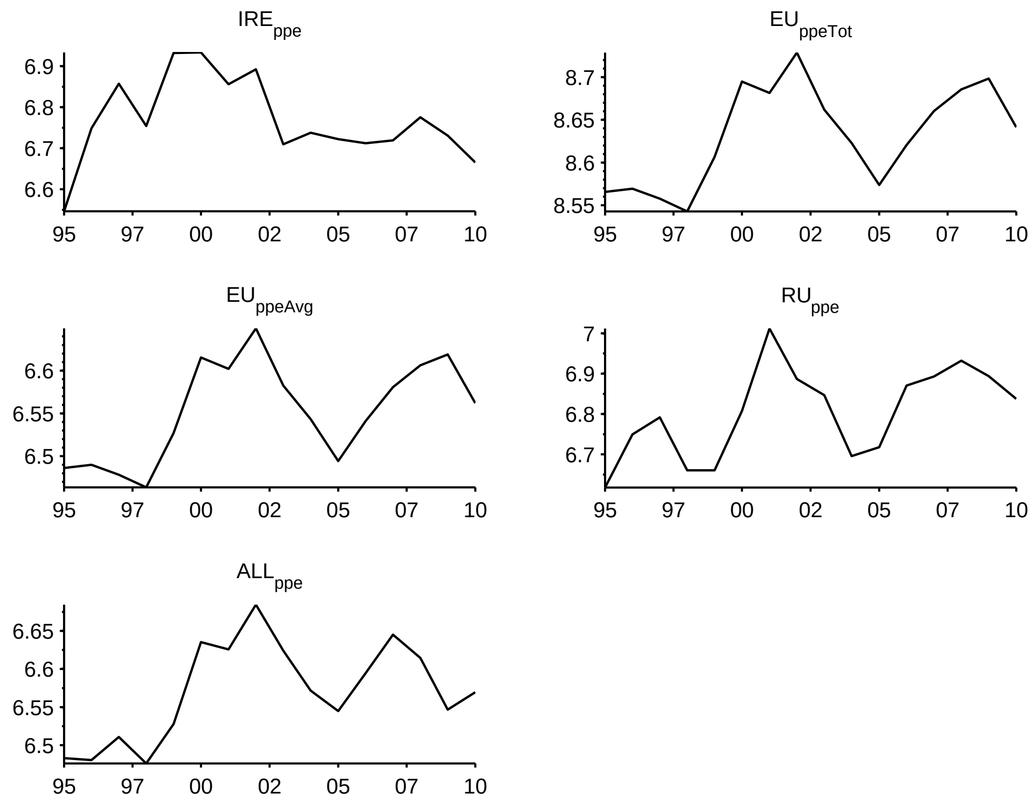
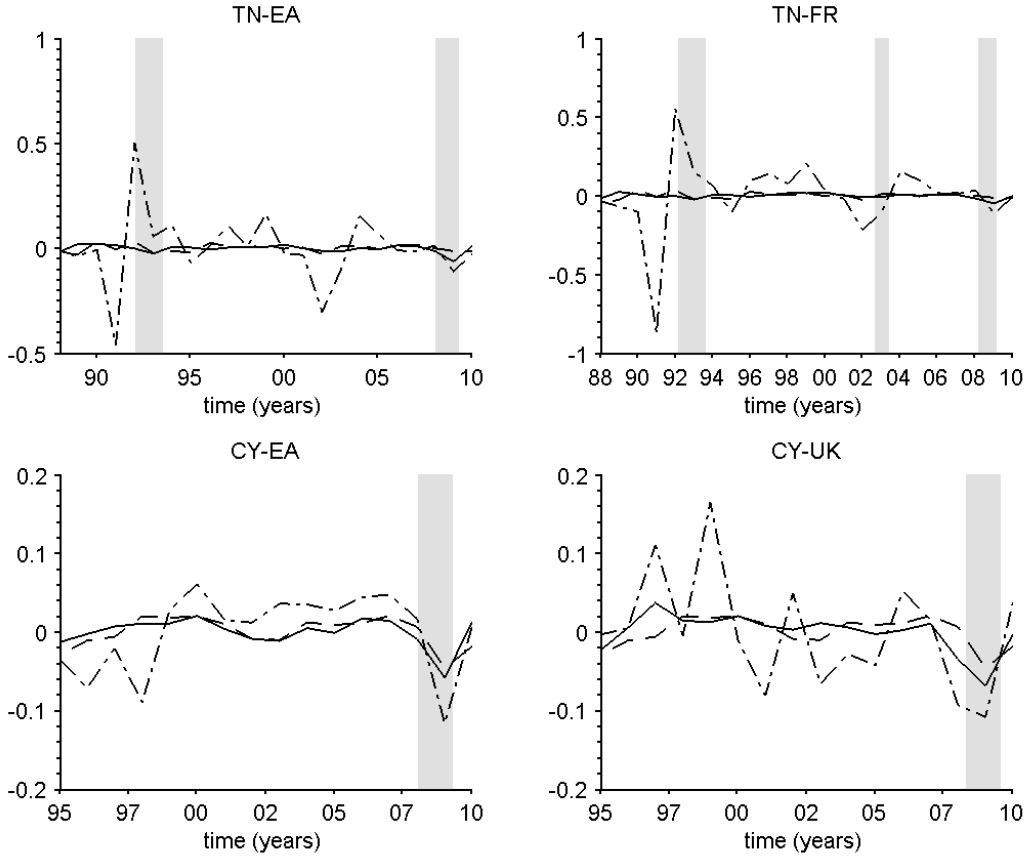


Figure B.26: Cyclical fluctuations



Notes: Top panel: number of nights spent in Tunisia. Bottom panel: per-capita expenditures in Cyprus. Dashdotted line: annual changes of (log) tourist arrivals. Continuous and dashed lines: annual changes of the source country and destination country (log) output respectively. Shaded regions: recessions. Country codes: CY is Cyprus; TN is Tunisia; EA is Euro area; FR is France; UK is United Kingdom.

Table B.1: Unconditional cross-correlations, nights spent and per capita expenditures

	Lags or leads (in years)				
Output in SC & Nights in MED	-2	-1	0	1	2
EA - TN	$0.299*$	-0.074	0.050	-0.050	-0.102
FR - TN	$0.364*$	-0.025	$0.152*$	-0.111	-0.284
Nights in MED & Output in MED					
EA - TN	$0.369*$	-0.112	$0.428*$	$-0.496*$	0.094
FR - TN	$0.428*$	-0.116	$0.337*$	$-0.483*$	$0.092*$
Output in SC & Output in MED					
EA - TN	$-0.256*$	$-0.191*$	$0.292*$	$0.404*$	-0.048
FR - TN	-0.095	$-0.250*$	$0.286*$	$0.395*$	0.028
	Lags or leads (in years)				
Output in SC & Expenditures in MED	-2	-1	0	1	2
EA - CY	$-0.492*$	$-0.189*$	$0.610*$	$0.192*$	-0.043
UK - CY	-0.050	$0.452*$	$0.578*$	0.020	-0.009
Expenditures in MED & Output in MED					
EA - CY	0.125	$0.327*$	$0.592*$	$0.238*$	$-0.438*$
UK - CY	$-0.462*$	-0.130	0.251	$0.590*$	$0.257*$
Output in SC & Output in MED					
EA - CY	$-0.304*$	-0.058	$0.794*$	$0.568*$	-0.157
UK - CY	$-0.481*$	-0.141	$0.636*$	$0.716*$	$0.275*$

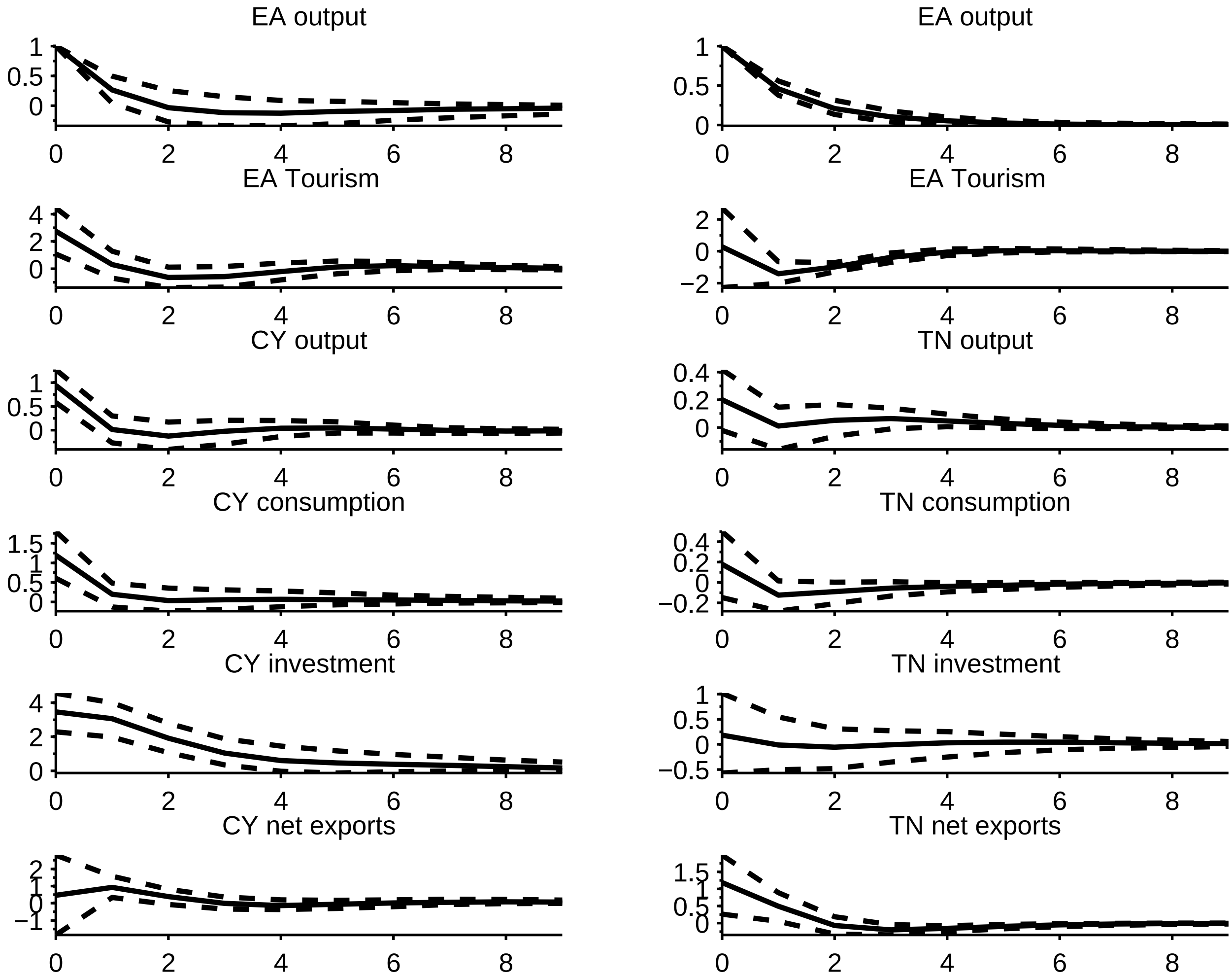
Notes: The numbers in the table represent $corr(x_t, y_{t+i})$, where $i = [-2, \ -1, \ 0, \ 1, \ 2]$, x_t is the country listed first and y_t is the country listed second. The sample length varies across cases: see the paper for details.The top panel computes correlations between output in the source country (SC) and the number of nights (per-capita expenditures) in the destination country (MED); the middle panel computes correlations between the number of nights (per-capita expenditures) and output in the destination country (MED); the bottom panel computes correlations between output in the source country (SC) and in the destination country (MED). Starred values mean that the 68% confidence interval does not include zero. Confidence intervals are computed from 500 bootstrapped replications of the sample cross-correlation. Country codes: EA is Euro area; UK is United Kingdom; CY is Cyprus; FR is France; TN is Tunisia.

Table B.2: Dynamic correlations

	Frequencies	
Output in SC & Nights in MED	0	$\frac{\pi}{2}$
EA - TN	0.199	-0.167
FR - TN	0.206	-0.015
Nights in MED & Output in MED		
EA - TN	0.478	0.081
FR - TN	0.604	-0.037
Output in SC & Output in MED		
EA - TN	0.184	0.367
FR - TN	0.373	0.261
	Frequencies	
Output in SC & Expenditures in MED	0	$\frac{\pi}{2}$
EA - CY	0.305	0.761
UK - CY	0.724	0.602
Expenditures in MED & Output in MED		
EA - CY	0.620	0.681
UK - CY	0.344	0.330
Output in SC & Output in MED		
EA - CY	0.876	0.802
UK - CY	0.653	0.646

Notes: Frequencies centered at zero capture comovement in the long run; frequencies around $\pi/2$ coincide with business cycles of about four years. The sample length varies across cases: see the paper for details. The tourism variable identifies number of nights spent for Tunisia and per-capita expenditures for Cyprus. The top panel computes dynamic correlations between output in the source country (SC) and the tourism variable in the destination country (MED); the middle panel computes dynamic correlations between the tourism variable and output in the destination country (MED); the bottom panel computes dynamic correlations between output in the source country (SC) and in the destination country (MED). Country codes: EA is Euro area; UK is United Kingdom; FR is France; CY is Cyprus; TN is Tunisia.

Figure B.27: IRFs to source country output shocks, sensitivity analysis



Notes: Left column: per-capita expenditures in Cyprus. Right column: number of nights spent in Tunisia. Continuous line: median posterior IRF. Dotted lines: 68% confidence bands computed from the posterior distribution of IRFs. The order of the plots is the following: source country output, source country tourist variable, MED output, MED consumption, MED investment, MED net exports. Here, MED identifies either Tunisia or Cyprus. Country codes: EA is Euro area; CY is Cyprus; TN is Tunisia.

Table B.3: Forecast error variance decomposition, sensitivity analysis

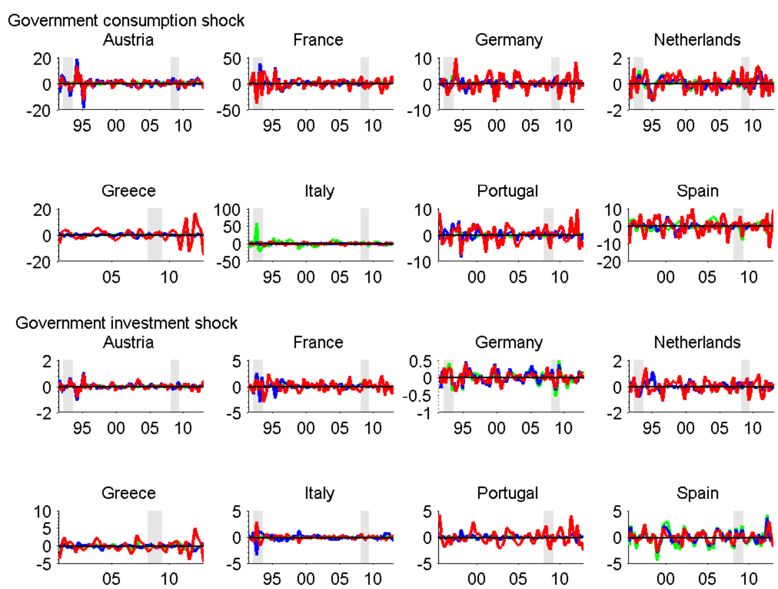
	Tunisia		Cyprus	
Time (in years)	0	8	0	8
Tourism				
Shock1	2	5	19	19
	(0,10)	(3,13)	(3,40)	(6,35)
Shock2	98	93	81	68
	(90,100)	(86,96)	(60,97)	(51,83)
MED output				
Shock1	4	6	37	27
	(1,17)	(2,16)	(17,56)	(14,43)
Shock2	20	31	4	22
	(7,36)	(20,47)	(0,13)	(9,40)
MED consumption				
Shock1	7	12	38	34
	(1,25)	(4,25)	(12,63)	(12,57)
Shock2	27	32	4	10
	(8,49)	(16,53)	(0,19)	(3,28)
MED investment				
Shock1	6	7	64	48
	(0,25)	(2,19)	(35,83)	(22,67)
Shock2	64	38	4	8
	(34,85)	(19,56)	(0,17)	(2,21)
MED net Exports				
Shock1	38	26	15	22
	(6,75)	(9,47)	(2,61)	(6,52)
Shock2	26	55	18	35
	(3,60)	(31,75)	(2,65)	(13,63)

Notes: The first column indicates the relevant variables in the VAR. ”Shock1 ” is output shock in the source country; ”Shock2 ” is tourism shock, which identifies a shock to the number of nights spent in Tunisia and a shock to per-capita expenditures in Cyprus. The numbers in parenthesis are the lower and upper 68% confidence intervals.

Appendix C

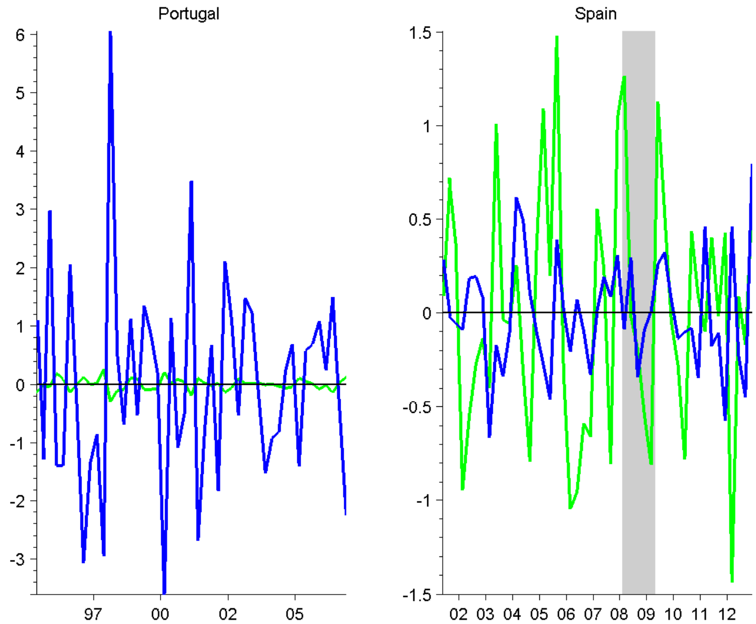
Appendix to Chapter 3

Figure C.1: Government consumption innovations across VARs of different size.



Notes: Green: small model; blue: medium model; red: large model.

Figure C.2: Government innovations in the "full" or "toss" benchmark VAR model.



Notes: Green: "full" VAR estimated with both government consumption and investment data; blue: "toss" VAR estimated leaving out one series among government consumption and investment.