Time varying effects of oil price shocks on euro area exports

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Motivation

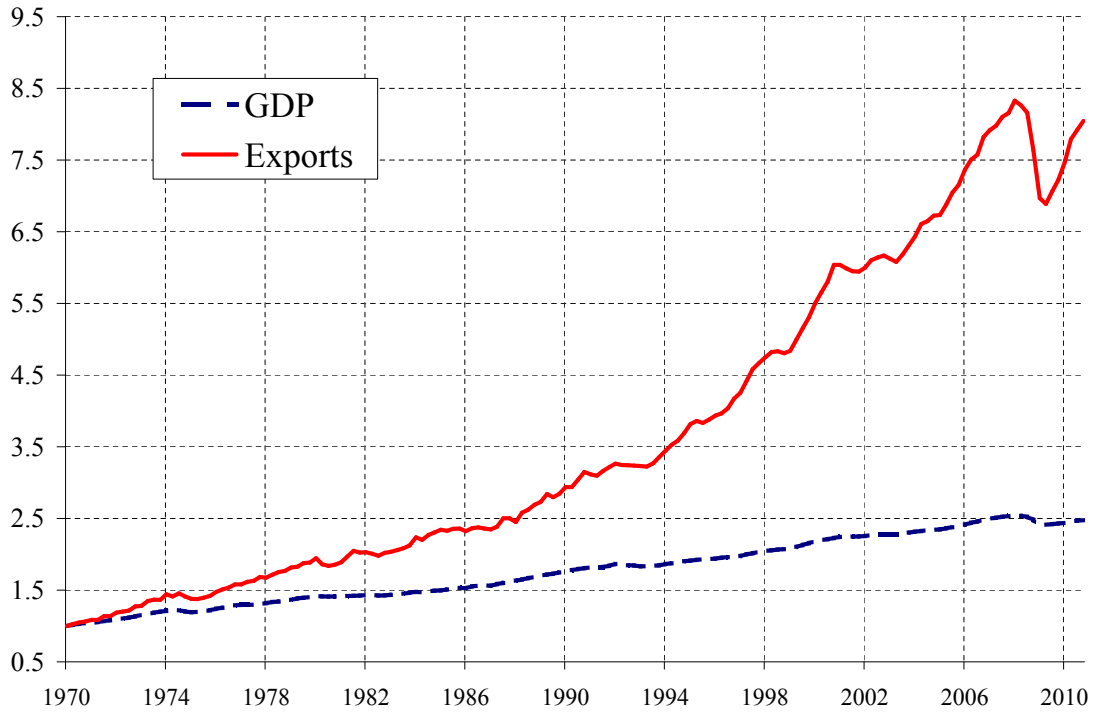
- The changing effect of oil price shocks on the Macroeconomy has been widely studied in rcent years. Two strands can be identified:
- Blanchard and Gali (2009) and Blanchard Riggi (2013) document an attenuation of the recessionary effect of oil price *innovations* and attribute it to:
  1. more effective monetary policy
  2. vanishing wage indexation

- Not all shocks are alike literature: Kilian (2009), Hicks and Kilian (2009), Lippi and Nobili (2012) and Aastveit et al (2013)
  1. Oil price *innovations* are not structural
  2. Apart from some isolated episodes in the 70s they have been mainly driven by expansionary demand shocks rather than by recessionary supply disruptions
  3. This explains the lower recent correlation between oil price spikes and recessions

Motivation

- Implication of Kilian's story for the euro area: we should observe a change in the correlation between oil price shocks and exports
- The issue is particularly relevant as exports have accounted more and more for euro area aggregate demand

Euro area: GDP and exports (1970q1=1)



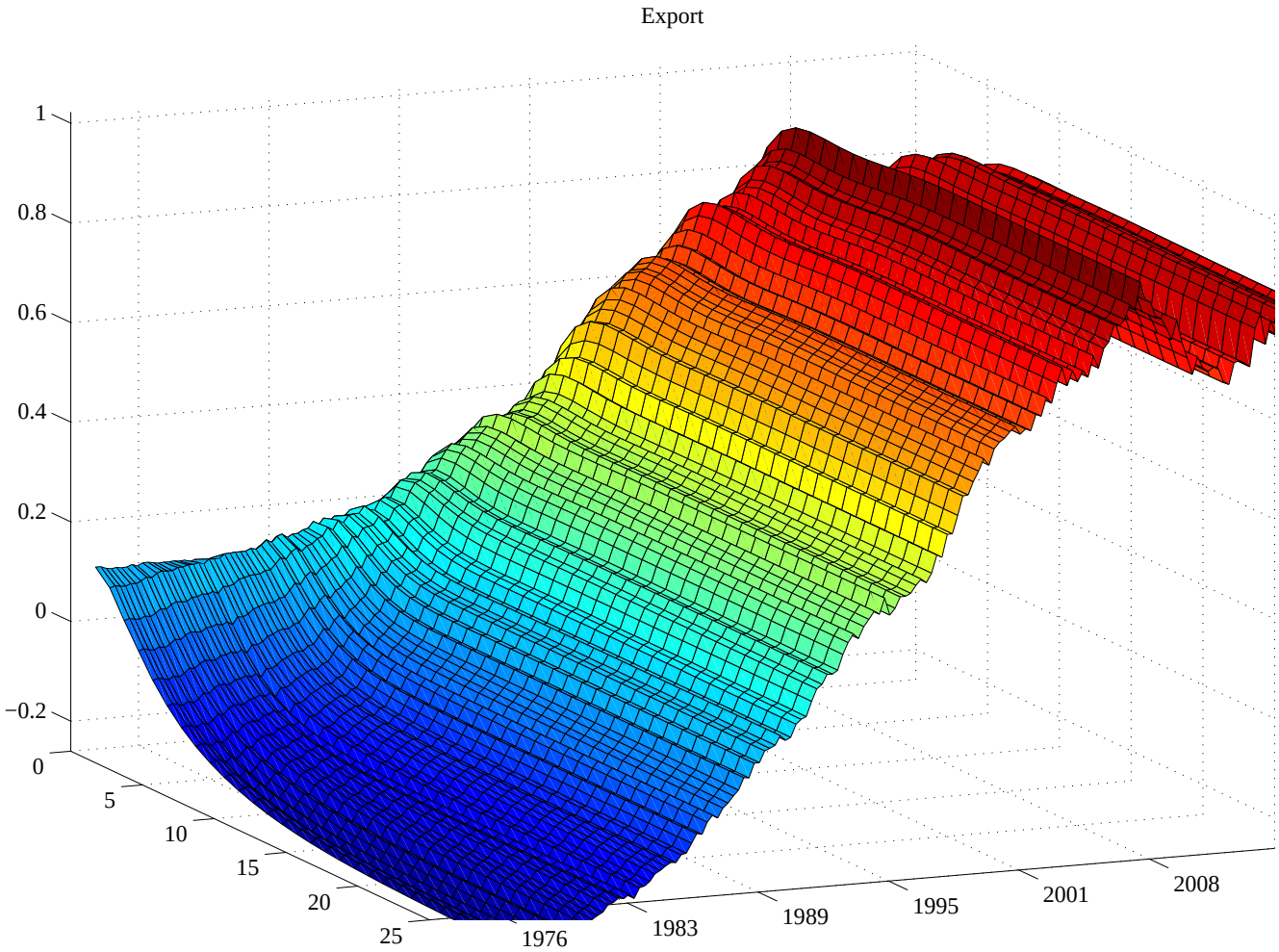
Motivating evidence

- Fit the following model

$$y_t = B_{0,t} + B_{1,t}y_{t-1} + B_{2,t}y_{t-2} + ... + B_{p,t}y_{t-p} + u_t \quad (1)$$
$$Var(u_t) \equiv \Sigma_t \quad (2)$$

- where y_t is a vector of four series: the real price of oil (Brent quality) in U.S. dollars, real exports, foreign GPD (Hahn and Mestre), and the supply of crude oil.
- Data from 1970 to 2011
- Model estimated with Bayesian methods (see large literature, we follow in particular Benati and Mumtaz, 2007) and look at the IRF of exports to an oil price *innovation*

Response of exports to an oil price innovation



Problem: not all shocks are alike! What lies behind this result? Supply/demand shocks? Turn to the theoretical model.

Our strategy

- Start with a theoretical DSGE model with three countries: an oil producing country, a domestic economy (the euro area) and a third block (which we think of as the emerging markets)
- in the model there are two shocks:
  1. An oil supply shock (think about this as the result of geopolitical tensions)
  2. An oil demand shock resulting from a productivity shock in emerging markets (why this? see Lipinska and Millard)
- Then use the model to pin down the signs of the responses of some macro variables to these two shocks
- We impose these sign restrictions to identify the two shocks in a T.V.P. VAR
- Identify the changing features in the correlations between the two shocks and euro area exports
- Go back to the DSGE and check under which calibrations we can replicate the empirical findings.

A preview of the results

- The correlation between the real price of oil and euro area exports conditional on oil supply shocks is negative, whereas it is positive conditional on oil demand shocks.
- Conditional on each shock the correlation between the oil price and euro area exports has changed over time:
  1. less negative conditional on oil supply shocks
  2. more positive conditional on oil demand shocks
- What structural changes can account for these findings? Focus on four channels:
  1. greater trade integration with emerging markets
  2. lower oil share in production
  3. higher reflow of dollars from OPEC countries to the euro area
  4. lower desired markups
- An increase in trade integration alone cannot replicate these findings since it amplifies both the negative and the positive correlations
- The other three channels must have played a role

The model

Our model is a variant of Clarida, Galì and Gertler (2002) sticky price open economy, extended to consider the role of oil price dynamics in the spirit of Campolmi (2008) and Lipinska and Millard (2012).

- Two oil importers: Home "H" and Foreign "F"
- An oil producer

▸ oil importers ▸ oil producer

Shocks

Given our objectives, we focus on two sources of cyclical fluctuations driving up oil prices:

- An oil supply shrinkage $M_t^s = \left(M_{t-1}^s\right)^{\rho_m} e^{u_t}$

Shocks

Given our objectives, we focus on two sources of cyclical fluctuations driving up oil prices:

- An oil supply shrinkage $M_t^s = \left(M_{t-1}^s\right)^{\rho_m} e^{u_t}$
- An increase in foreign productivity, meant to capture the dynamic effects of an oil demand increase fostered by faster foreign growth. (Consistently with overall consensus that in the past decade a large part of oil price increases stemmed from fast growth in emerging economies).
  $Y_t^* = A_t^* N_t^{*\alpha_n} M_{F,t}^{\alpha_m}$, A_t^* is a productivity factor common across firms
  $A_t^* = \left(A_{t-1}^*\right)^{\rho_A} e^{u_t^a}$, where u_t is an i.i.d. shock to foreign technology level.

Model consistent sign restrictions

Following Canova and Paustian (2011), Dedola and Neri (2007) and Lippi and Nobili (2012) we carry out a Monte Carlo simulation on the relevant parameters of our theoretical model, assuming that the latter are uniformly and independently distributed over wide ranges:

	SIMULATED PARAMETERS	range of values
θ	Price stickiness	$[0.1, 0.95]$
χ	Degree of trade openness in H	$[0.0, 1.0]$
χ^*	Degree of trade openness in F	$[0.0, 1.0]$
ϖ_O	Share of F-goods in the oil exporter country' consumers basket	$[0.0, 1.0]$
ϕ_π	Taylor coefficient on inflation	$[1.1, 5.0]$
ϕ_x	Taylor coefficient on the output gap	$[0.0, 1.0]$
ϵ	Elasticity of substitution among differentiated goods	$[3, 11]$
α_m	Oil's share in production	$[0.01, 0.04]$
ρ_m	Persistence of oil supply shock	$[0.5, 0.999]$
ρ_a	Persistence of foreign supply shock	$[0.5, 0.999]$

Model consistent sign restrictions

	CALIBRATED PARAMETERS	
β	Intertemporal discount factor	0.99
σ	Risk aversion	0.1
h	Habit	0.8
ϕ	Inverse of the Frisch elasticity	1.0
α_n	Labor's share in production	2/3
n	Mass of households in H	0.5

Model consistent sign restrictions

▸ oil supply ▸ oil demand

We draw 1000 vectors of the structural parameters from the uniform densities, for each draw we save the responses to an oil supply shock and a foreign productivity shock and compute the median, the 5th and 95th percentiles of the resulting distribution of impulse responses, point by point.

Sign restrictions on VAR variables

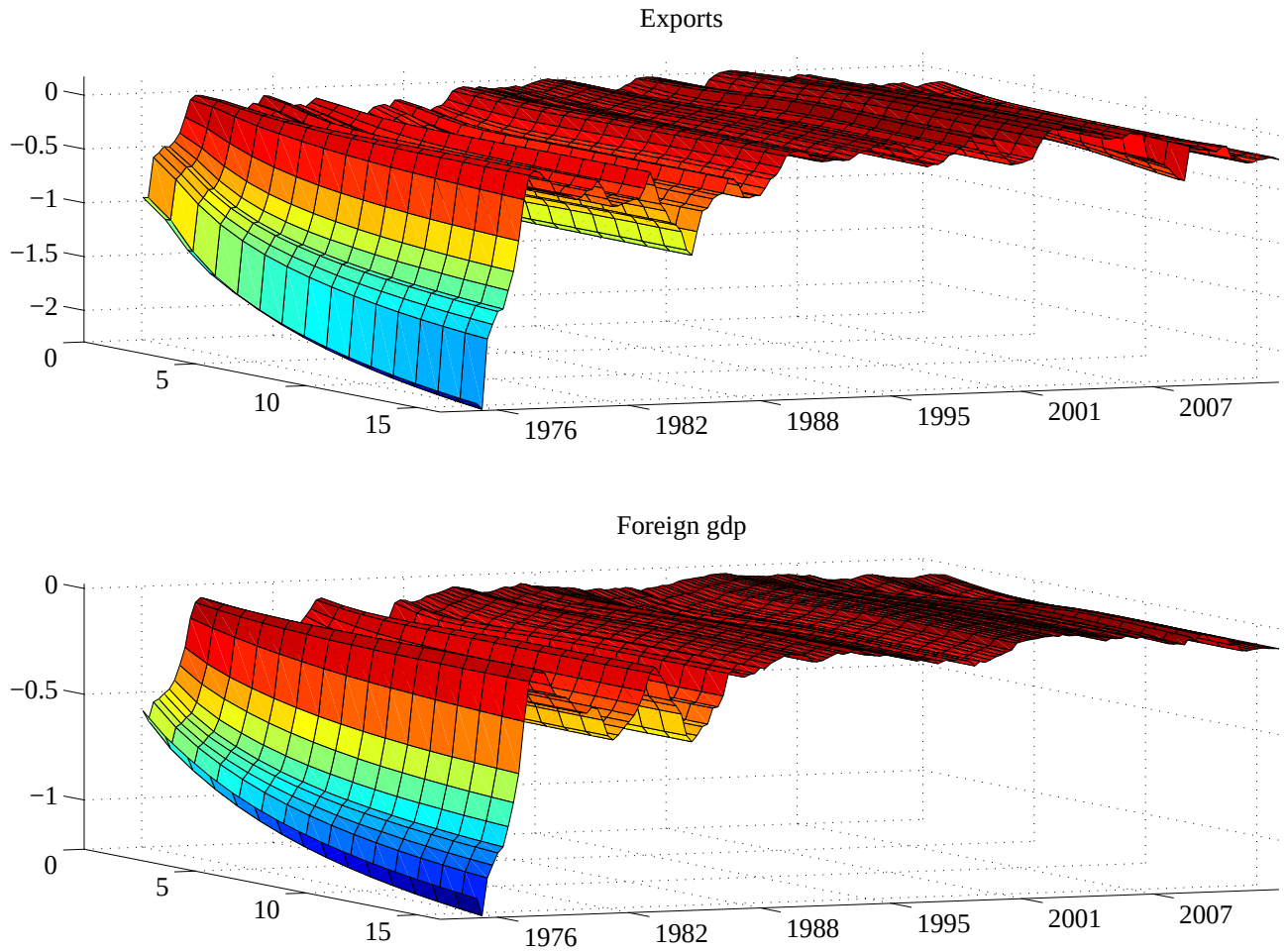
	Structural shocks	
VAR variables	oil supply	foreign productivity
oil supply	-	
oil price*	+	+
RoW GDP	-	+

*The price of oil is the euro price of oil deflated by the euro area CPI, as done in the empirical analysis.

We do not impose any restriction on the response of exports

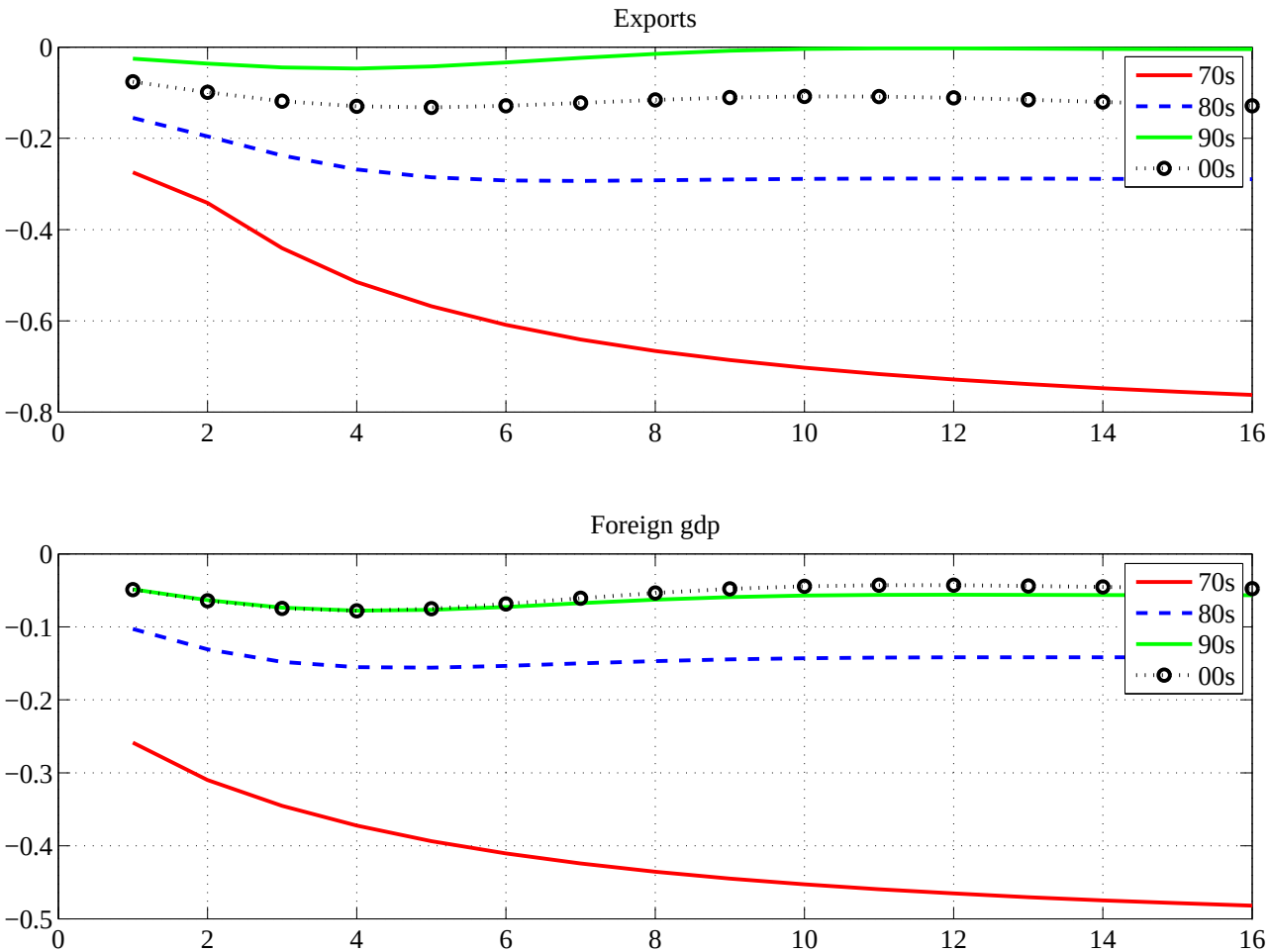
Time varying effect of an oil supply shock

Top panel: exports - Bottom panel: Foreign GDP



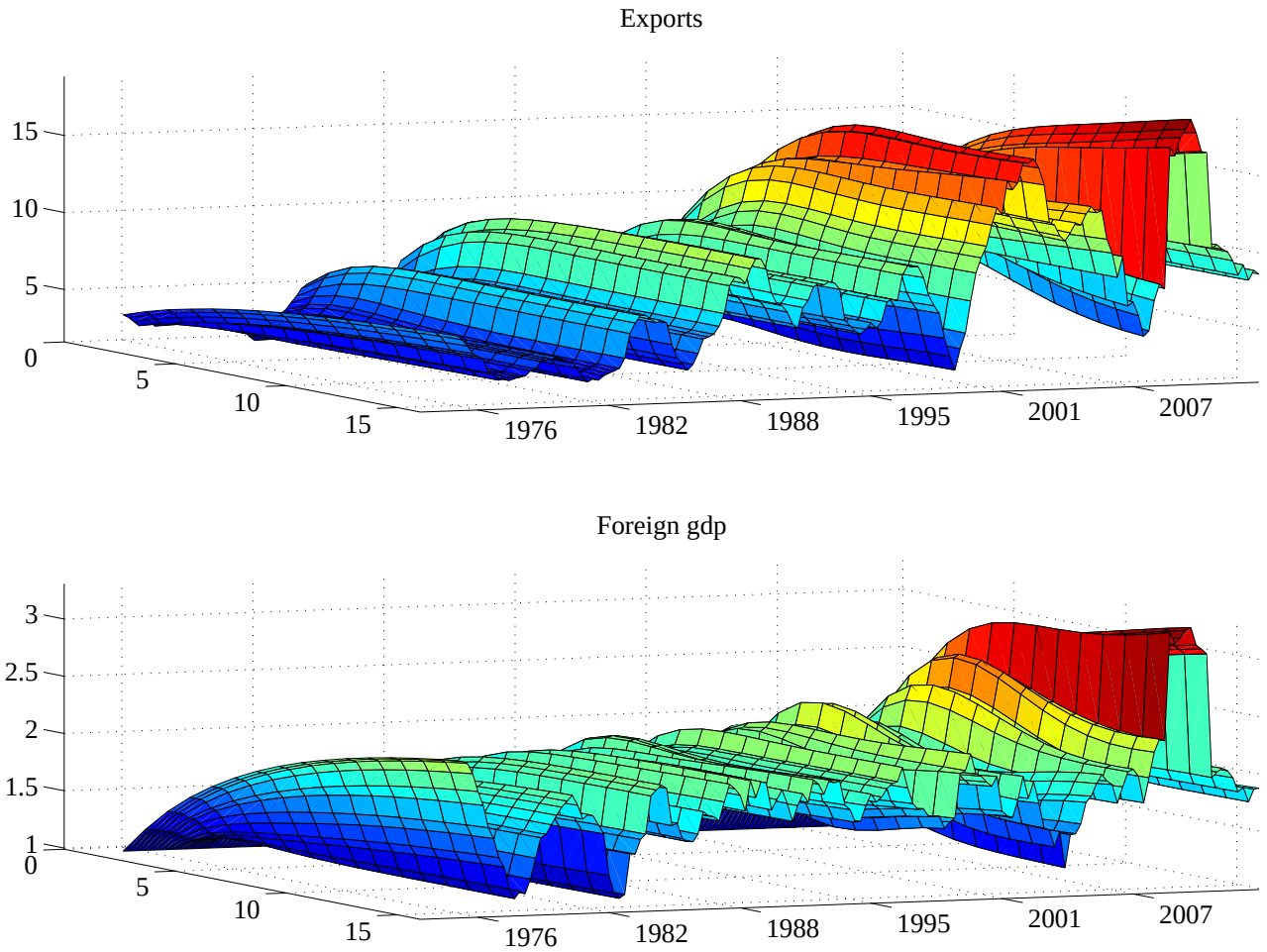
Time varying effect of an oil supply shock: average across decades

Top panel: exports - Bottom panel: Foreign GDP



Time varying effect of a foreign productivity shock

Top panel: exports - Bottom panel: Foreign GDP



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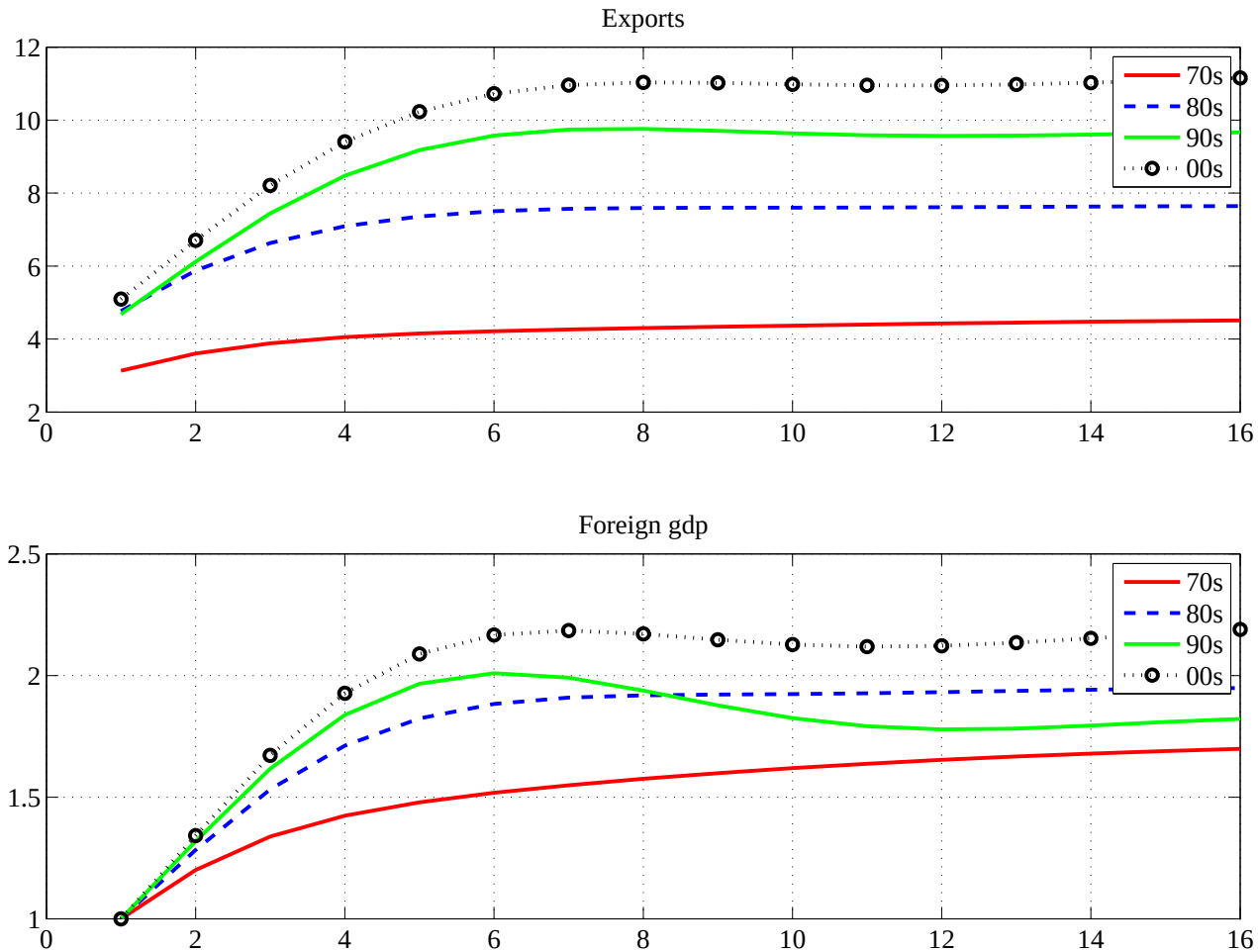
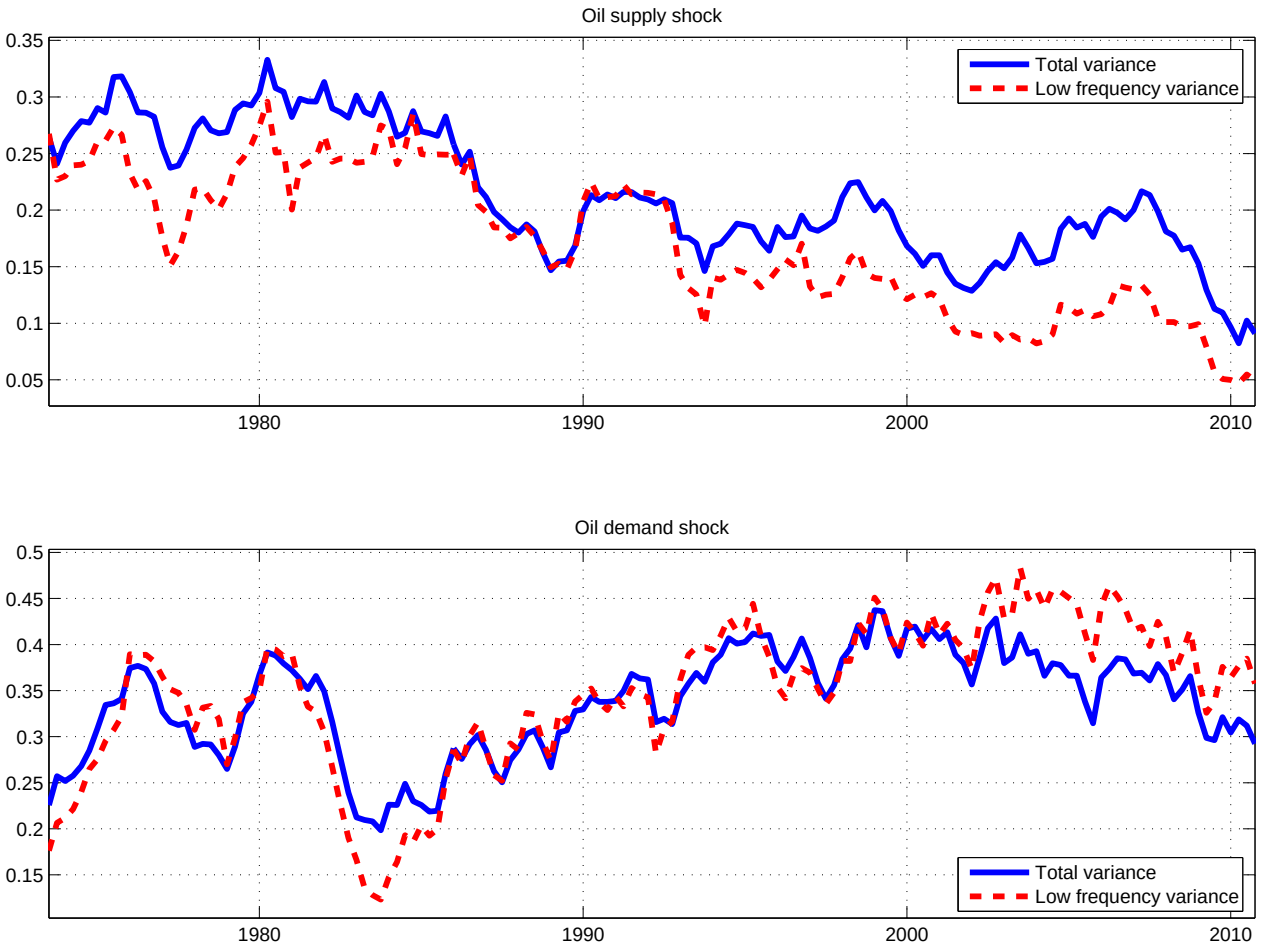


Variance decomposition



Explaining changes in conditional second moments

From our empirical analysis:

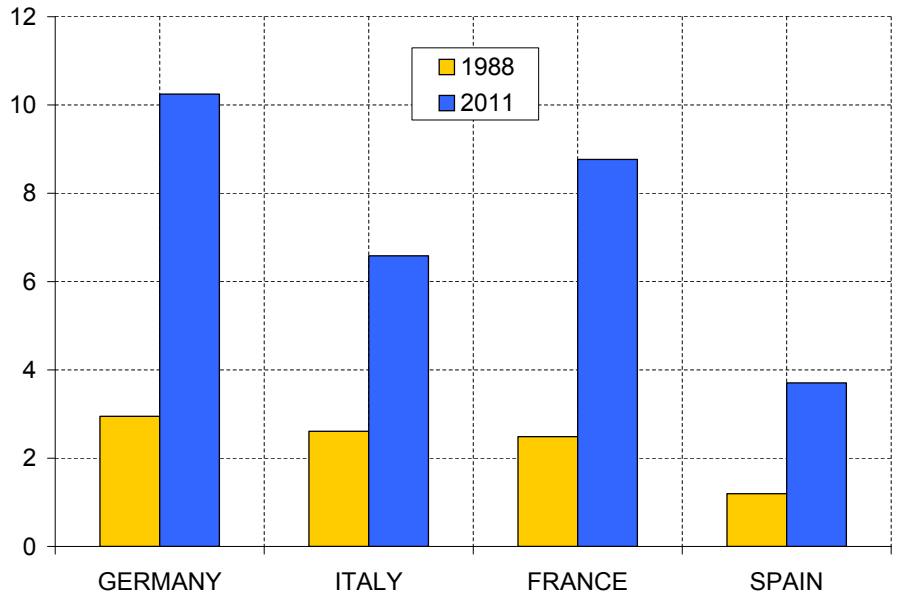
1. the negative correlation between euro area exports and the real price of oil conditional on supply shocks has gone down over time (in absolute value)
2. the positive correlation conditional on oil demand shocks has become stronger

These variations in conditional second moments point to the existence of at least some structural changes that have affected the joint dynamics of euro area exports and the real price of oil over last decades. We qualitatively assess the potential for four plausible explanations, not mutually exclusive:

1. the consolidation of the trade relationship with emerging economies
2. the decrease in the share of oil in production
3. a new advantageous flood of petrodollars towards the euro area
4. lower markups

The consolidation of the trade relationship with emerging economies

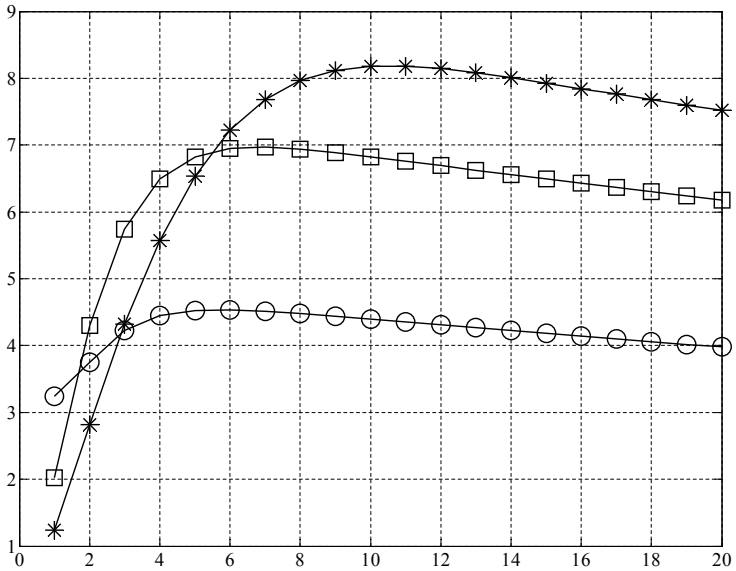
Export shares towards Asian Emerging Countries



- We simulate the theoretical effects on the IRF of exports from H to oil demand and supply shocks of an increase in χ^*, i.e. the preference of the foreign F economy for goods produced by H.

The consolidation of the trade relationship with emerging economies

IRFs of exports from H to an oil demand shock



$-\bigcirc- \ \chi^*= 0.05$
$-\boxdot- \ \chi^*= 0.30$
$-*- \ \chi^*= 1.00$

χ^* is the preference of the foreign F economy for goods produced by H.

The consolidation of the trade relationship with emerging economies

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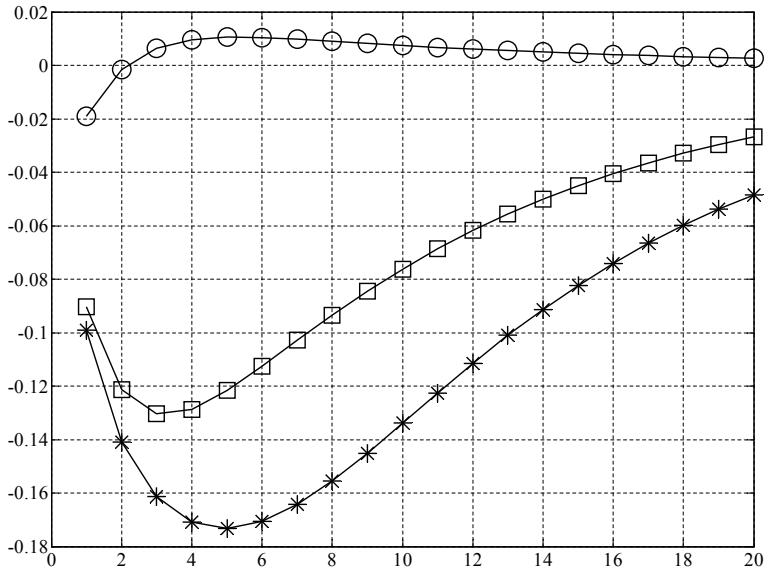

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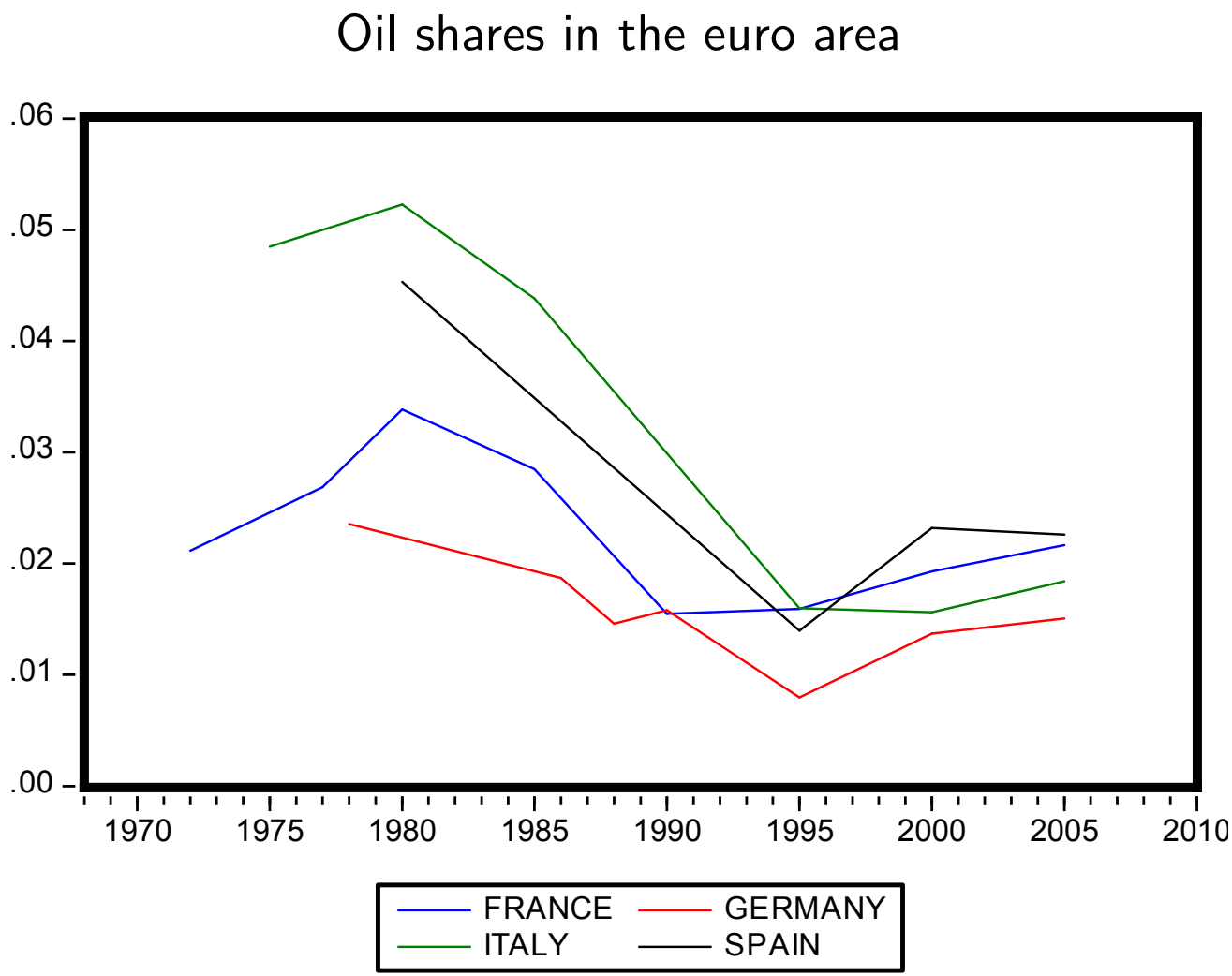
The consolidation of the trade relationship with emerging economies

To sum up:

- When higher oil prices are driven by faster growth in F, the positive conditional correlation between the real price of oil and exports in H can be amplified by a tighter trade relationship with F.
- However, this structural change is conducive to larger negative responses of exports to oil supply shocks. The rationale is as follows:
  When the share of H-produced goods in the consumption basket of F goes up (i.e. when χ^* rises), all other things held constant, the ratio of exports in H towards F (for which oil supply shocks are recessionary) over total exports increases and, specularly, the ratio of exports in H towards the oil producing country (for which oil supply shocks are expansionary) over total exports falls. This explains why when χ^* rises the contractionary effects of the oil supply shock on exports in H become larger.

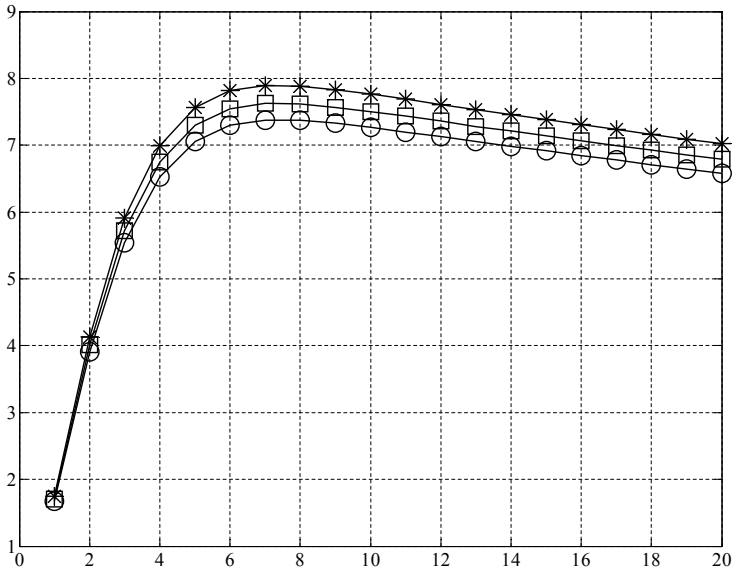
Lower oil shares



- We simulate the theoretical effects on exports' response to oil demand and supply shocks of a decrease in α_m, i.e. oil shares' in production.

Lower oil shares

IRFs of exports from H to an oil demand shock



$-\bigcirc-\ \alpha_m = 0.040$
$-\boxdot-\ \alpha_m = 0.025$
$-*-\ \alpha_m = 0.010$

α_m, is oil share in production.

Lower oil shares

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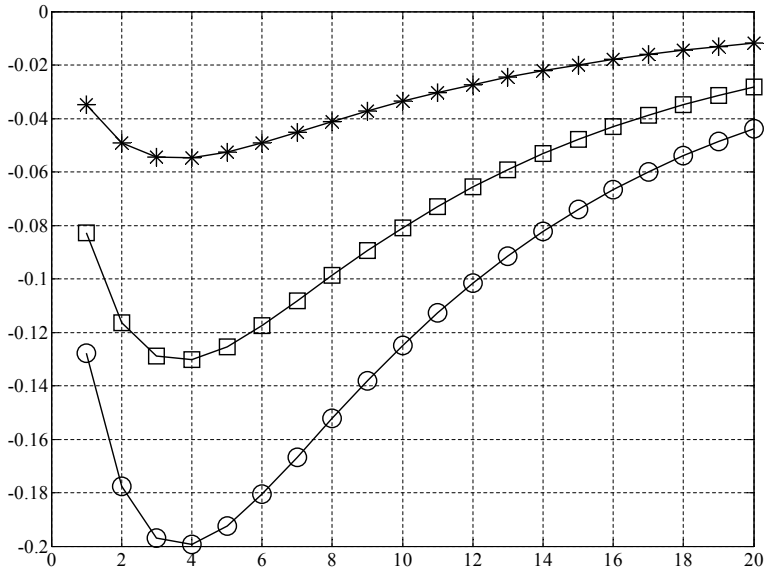

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Lower oil shares

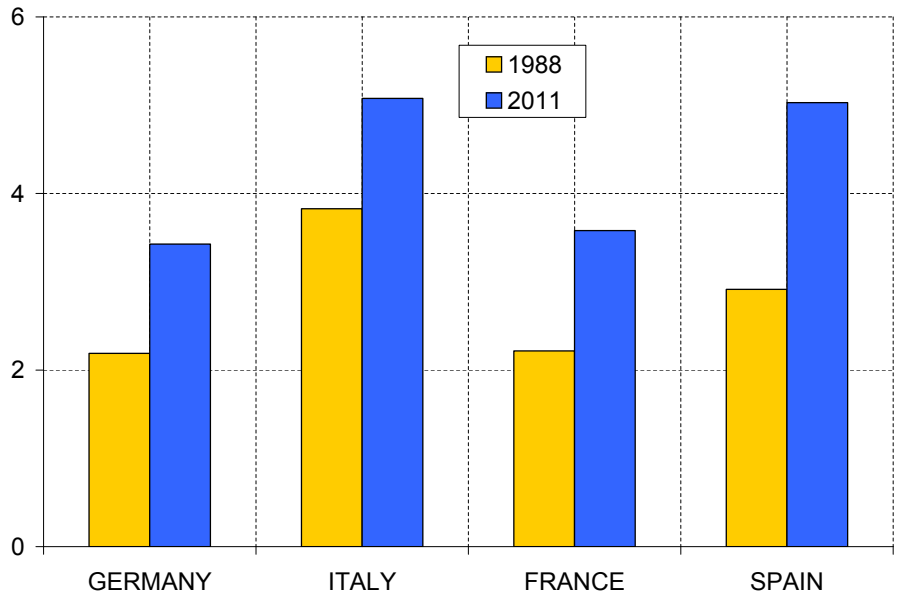
To sum up:

- Lower oil shares reduce the negative impact of an oil supply disruption on exports by reducing the recessionary effects of oil supply shocks on oil importing economies trading with each other
- Lower oil shares have a negligible impact on the response of exports to foreign productivity shocks, because in this case the bulk of exports movements in H depends on the cyclical expansion in F which is almost unaffected by the change in the shares of oil.

A new advantageous flood of petrodollars towards the euro area

- Higgings et al (2006) report evidence on changes in the geography of petrodollar recycling: oil exporters are importing more goods from the euro-area today than they were 25 years ago and fewer from the US.

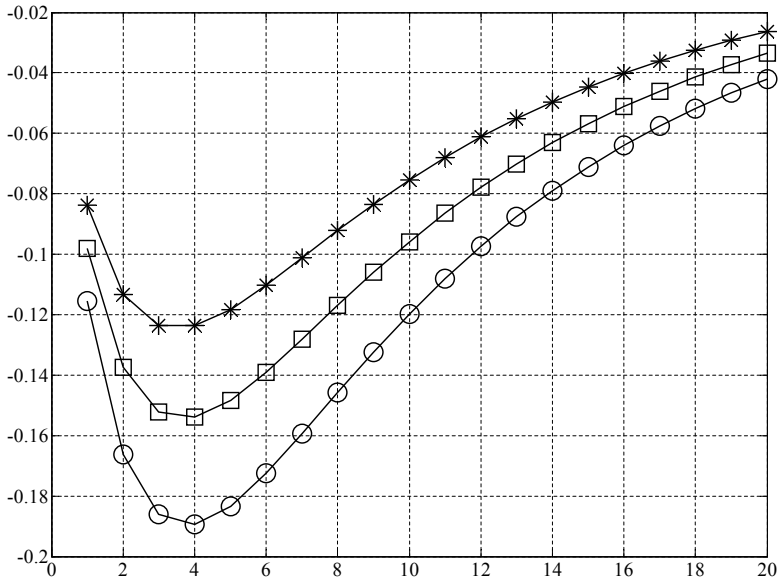
Export shares towards OPEC Countries



- We simulate the theoretical effects on exports responses to oil demand and supply shocks of an increase in $(1-\varpi_O)$, i.e. the preference of the oil producing economy for goods produced by H.

A new advantageous flood of petrodollars towards the euro area

IRFs of exports from H to an oil supply shock



$- \bigcirc - \quad (1 - \varpi_O) = 0.00$

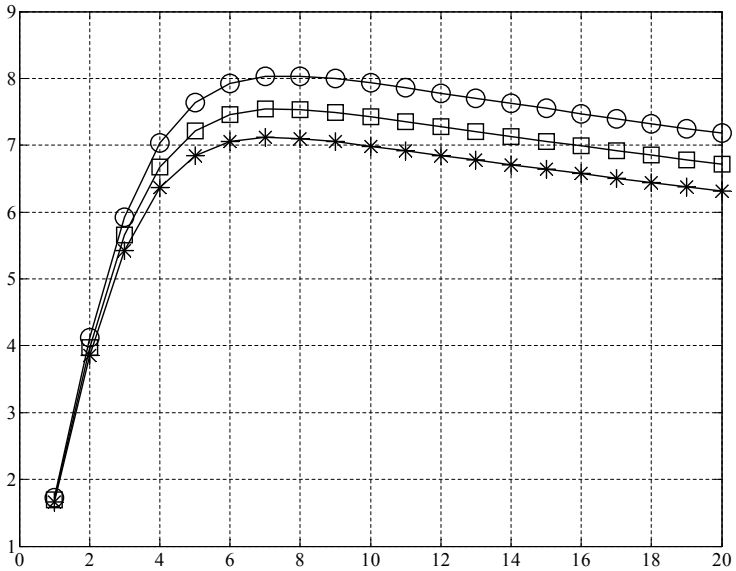
$- \boxdot - \quad (1 - \varpi_O) = 0.50$

$- * - \quad (1 - \varpi_O) = 1.00$

$(1 - \varpi_O)$ is the preference of the oil producing economy for goods produced by H.

A new advantageous flood of petrodollars towards the euro area

IRFs of exports from H to an oil demand shock



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A new advantageous flood of petrodollars towards the euro area

To sum up:

- When the fraction of petrodollars recycled back home to purchase H- produced goods increases, the negative effects of oil supply shocks on exports in H go down in absolute value. Indeed, oil supply shocks are expansionary for the oil producing economy and recessionary for oil importing countries. Hence, exports in H towards the oil producing economy rise, whereas they fall towards F. The increase in $(1 - \varpi_O)$ amplifies the positive response of exports towards the oil producing country, thus lessening their overall contraction.

- The implications conditional on foreign productivity shocks are more negligible, as in this case the bulk of the exports' movements in H depends on the trade relationship with F rather than on that with the oil producing country.

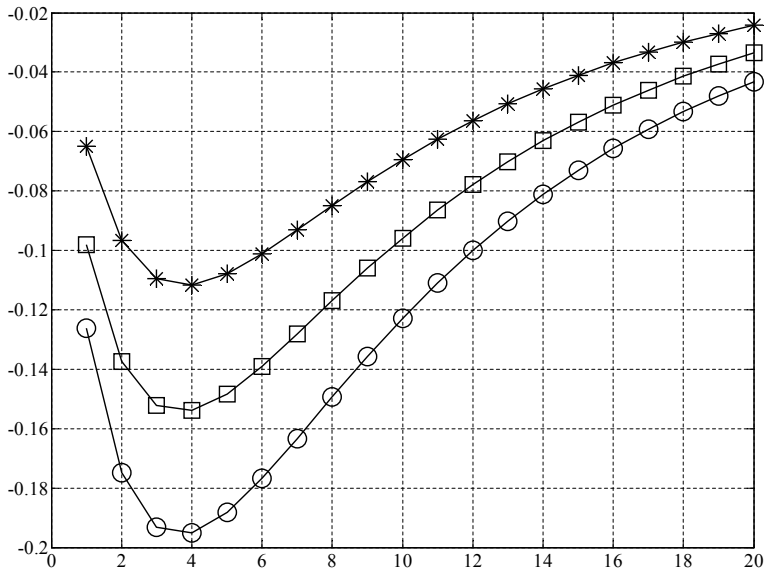
Lower markups

- Global integration, new ICT technologies and the process of European integration increased competitive pressures.

- We simulate the theoretical effects on exports' response to oil demand and supply shocks of an increase in ϵ, i.e. the elasticity of substitution among differentiated goods, implying lower desired markups $\frac{\epsilon}{\epsilon-1}$.

Lower markups

IRFs of exports from H to an oil supply shock



$-\bigcirc-$ ϵ= 3.0 (desired markup 50%)
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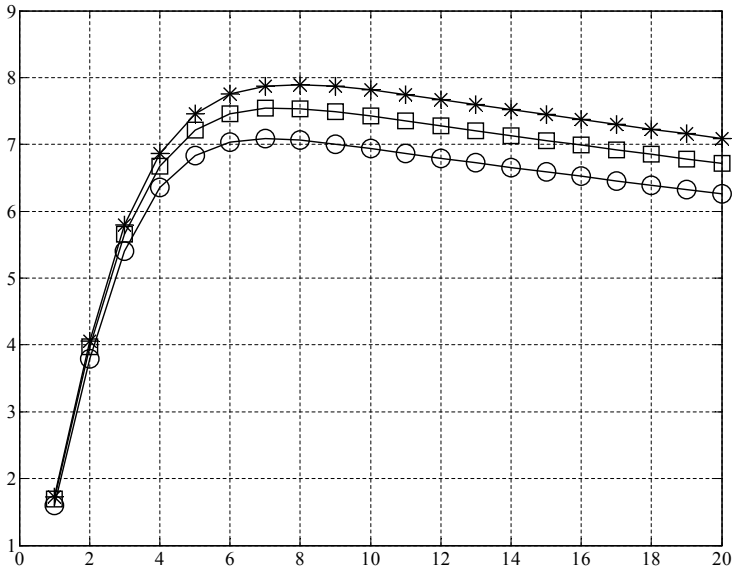
Lower markups

IRFs of exports from H to an oil demand shock



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Lower markups

- Lower desired markups reduce the negative impact of an oil supply disruption on exports by flattening the Phillips curve of oil importing economies. This dampens the inflationary spiral of oil price increases and consequently their recessionary effects. Milder recessions imply that the contraction of exports in these countries, that trade with each other, turns out to be smaller.
- The positive response of exports to faster foreign growth is amplified with lower desired markups. However the quantitative impact is negligible.

Conclusions

- We have documented some changes in the correlation between oil prices and euro area exports over the past four decades
- Overall we find a diminished effect of oil supply shocks on euro area exports
- An increased responsiveness of euro area exports to foreign productivity shocks that yield oil price increases
- Of the four structural explanations we investigate:
  1. stronger integration can account for the changes in the effect of oil demand shocks but generates changes in the response to oil supply shocks that are at odds with the empirical findings
  2. higher reflow from OPEC-higher competition-lower oil shares can rationalise the changing effects of oil supply shocks but seem to have a negligible effect on the evolution of the response to oil demand shocks
- A combination of all the above factors must have been at play

Oil importers

H and F share identical preferences, technology and market structure though shocks may be imperfectly correlated

- Firms:

▶ the model

Oil importers

H and F share identical preferences, technology and market structure though shocks may be imperfectly correlated

- Firms:
  - Intermediate firms are monopolistic competitors ($\frac{\epsilon}{\epsilon-1}$ measures the desired markup, where ϵ is the elasticity of substitution among differentiated goods). They produce a differentiated intermediate good, using oil and employment $Y_t = A_t N_t^{\alpha_n} M_{H,t}^{\alpha_m}$ and set prices in staggered fashion (θ is the Calvo parameter)

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  - Final goods producers are perfectly competitive. They combine intermediate inputs into final output which they sell to households
- Consumption:
  - Households consume a domestically produced good and a good imported from the other country.

    Aggregate consumption in H: $C_t \equiv \Theta C_{F,t}^{\gamma} C_{H,t}^{1-\gamma}$, where $\gamma \equiv (1-n)\chi$ and χ is the degree of trade openness of H

    Aggregate consumption in F: $C_t^* \equiv \Theta^* \left(C_{F,t}^*\right)^{1-\gamma^*} \left(C_{H,t}^*\right)^{\gamma^*}$, where $\gamma^* \equiv n\chi^*$ and χ^* is the degree of trade openness in F.

the model

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H and F share identical preferences, technology and market structure though shocks may be imperfectly correlated

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    Aggregate consumption in H: $C_t \equiv \Theta C_{F,t}^{\gamma} C_{H,t}^{1-\gamma}$, where $\gamma \equiv (1-n)\chi$ and χ is the degree of trade openness of H
    Aggregate consumption in F: $C_t^* \equiv \Theta^* \left(C_{F,t}^*\right)^{1-\gamma^*} \left(C_{H,t}^*\right)^{\gamma^*}$, where $\gamma^* \equiv n\chi^*$ and χ^* is the degree of trade openness in F.
  - They have access to a complete set of Arrow Debreu securities which can be traded both domestically and internationally

▶ the model

Oil producer

- Oil is costless to transport and is non storable. Oil producer does not have access to world capital markets and simply recirculates the revenues from its production of oil on final goods produced in H and F.

▸ the model

Oil producer

- Oil is costless to transport and is non storable. Oil producer does not have access to world capital markets and simply recirculates the revenues from its production of oil on final goods produced in H and F.
- Consumption C^O is a composite index of goods produced in H and in F: $C_t^O \equiv \Gamma \left(C_{F,t}^O\right)^{\omega_O} \left(C_{H,t}^O\right)^{1-\omega_O}$, where $(1-\omega_O)$ is the share of H-produced goods in the consumer's basket, $C_{H,t}^O$ is consumption of the H-produced goods, and $C_{F,t}^O$ is consumption of the foreign F country's goods

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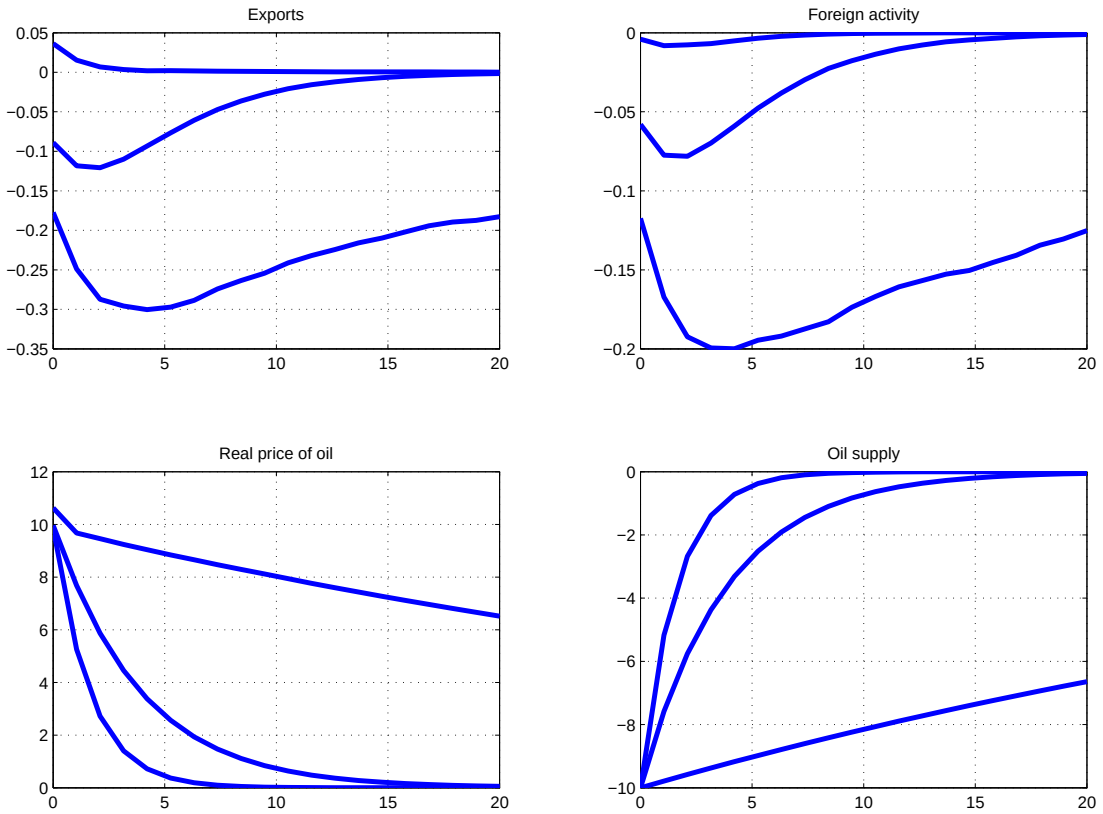
- Oil price is determined in equilibrium
  Oil demand of the world economy is: $M_t^d = n \int_0^1 M_{H,t}(i)\, di + (1-n) \int_0^1 M_{F,t}(i)\, di$
  The oil endowment M_t^s is assumed to follow a first order autoregressive process $M_t^s = \left(M_{t-1}^s\right)^{\rho_m} e^{u_t}$, where u_t is an i.i.d. shock to oil supply.

▸ the model

Oil supply shock

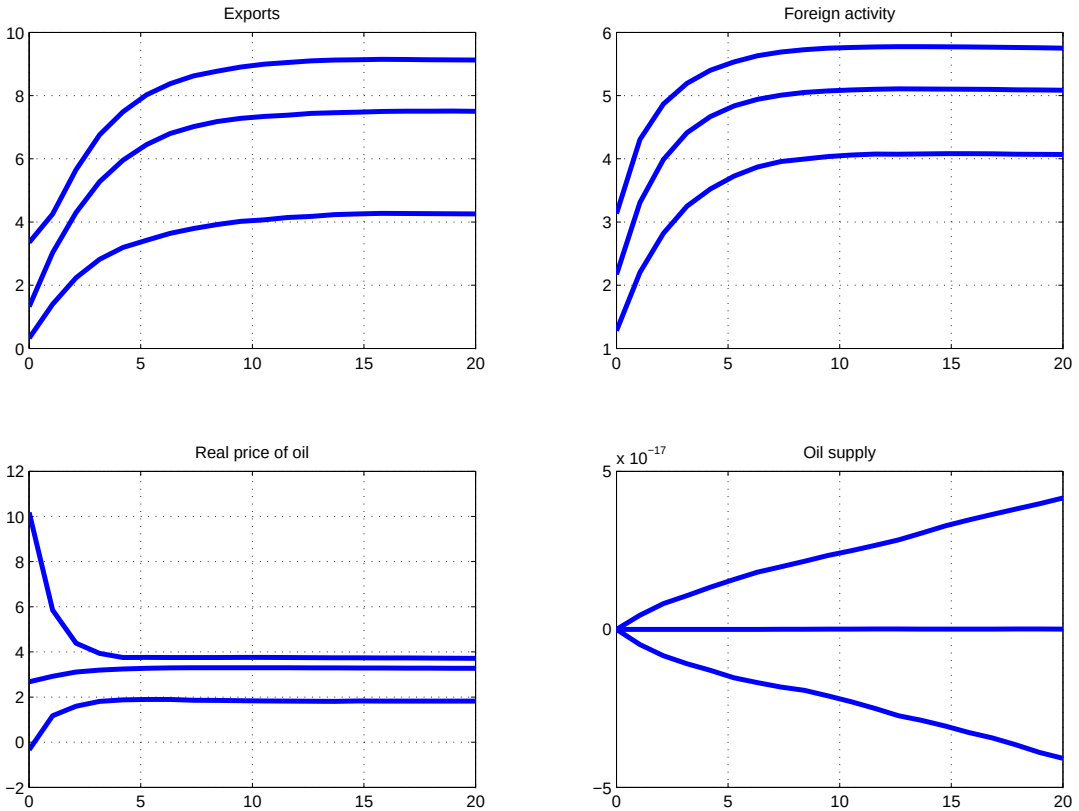
Theoretical IRFs to an oil supply shock



▶ sign restrictions

Oil demand shock

Theoretical IRFs to an oil demand shock



▸ sign restrictions