

Time-Varying Effects of Oil Supply Shocks on the US Economy

C. Baumeister

G. Peersman

Ghent University



Motivation

- The dynamic effects of oil supply shocks on the economy appear to have changed over time
 - Negative oil supply shocks are frequently considered as the underlying source of the 1970s stagflation
 - Second part of the eighties is recognized by significant declines of oil prices without corresponding effects on economic growth
 - Recent oil prices were never as high whilst inflation remained stable and output growth reasonable
- Edelstein and Kilian (2007), Herrera and Pesavento (2007), Blanchard and Gali (2007): find a reduced impact for oil price shocks in more recent times
- This paper further investigates the importance of oil supply shocks when time variation is accounted for

Motivation

- The oil market has undergone substantial changes over time
 - Global capacity utilization rates in crude oil production have not been constant over time
 - Constantly above sustainable capacity since late 1980s as well as in 1973/74 and 1979/80 (Kilian 2006)
 - Dramatic rise in oil price volatility since 1986
 - Transition from a regime of administered oil prices to a market-based system of direct trading in the spot market and collapse of the OPEC cartel (Lee, Ni and Ratti 1995, Ferderer 1996)
 - Relative importance of driving forces behind oil price movements has changed
 - Shifts in composition of oil supply and demand shocks (Kilian 2007, Hamilton 2003, Rotemberg 2007)

Motivation

- Macroeconomic structure has changed over time which could affect the impact of oil supply shocks
 - Improved monetary policy
 - Bernanke, Gertler and Watson (1997), Blanchard and Gali (2007)
 - More flexible labor markets (Blanchard and Gali 2007)
 - Share and role of oil in the economy has varied over time
 - Declining share in consumption and production (Bernanke 2006)
 - Changes in the composition of automobile production and declining overall importance of the automobile sector (Edelstein and Kilian 2007)
 - Other reasons for time variation of impact
 - Time-varying mark-ups of firms (Rotemberg and Woodford 1996)
 - Changes in firm capacity utilization (Finn 2000)

Empirical method

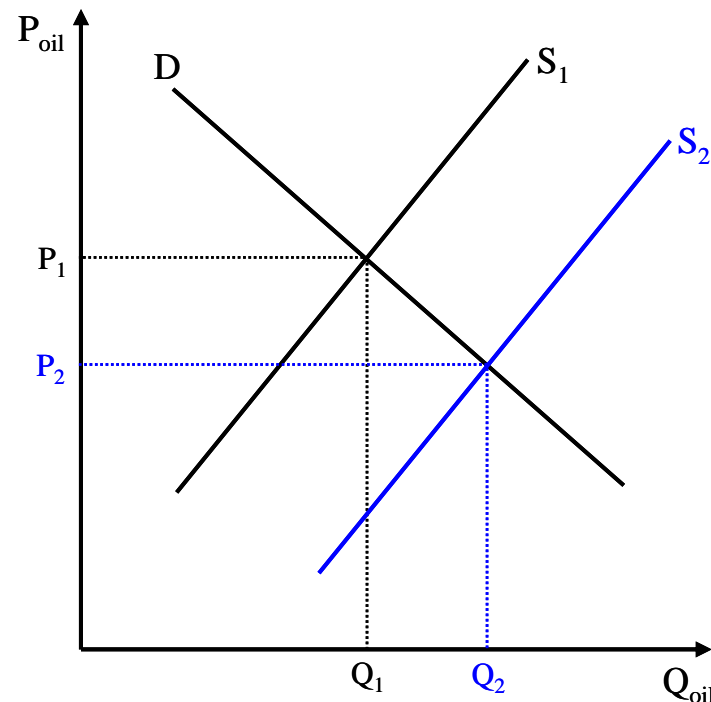
- Multivariate time-varying parameters bayesian VAR with stochastic volatility to explicitly model time variation
 - In spirit of Cogley and Sargent (2002, 2005), Canova and Gambetti (2004), Benati and Mumtaz (2007)
 - Existing evidence
 - Splitting the sample in two subperiods assuming a break in mid 1980s (Edelstein and Kilian 2007, Herrera and Pesavento 2007)
 - Bivariate VARs over moving time windows (Blanchard and Gali 2007)
 - TVP-BVAR should capture time variation (smooth transition) in the propagation of oil shocks without imposing a specific breakpoint
 - Stochastic volatility (time-varying covariance matrix) models changes in the magnitude of structural shocks and its immediate impact
 - Multivariate approach to learn more about sources of variation
 - TVP-BVAR estimated for 1947Q1-2006Q4 (20 years training sample) for global oil production, real crude oil price, US real GDP and US CPI

Empirical method

- New method to identify exogenous oil supply shocks
 - Most studies: all variations in oil prices are exogenous oil supply shocks (no immediate impact of demand shocks on oil price)
 - Barsky and Kilian (2002), Kilian (2006): only a small fraction can be attributed to exogenous oil production disruptions
 - Kilian (2009): exact underlying source is crucial for economic consequences
 - Hamilton (2003), Kilian (2006): measure oil production shortfalls in the wake of political crises and military conflicts
 - Selection of episodes is crucial and no generic supply shocks are identified
 - Kilian (2009): oil supply shocks only source of innovations in oil production (demand shocks only affect oil prices immediately)
 - Is oil supply elasticity really "zero"?
 - Less appropriate for a quarterly VAR
 - Cumbersome two-step procedure

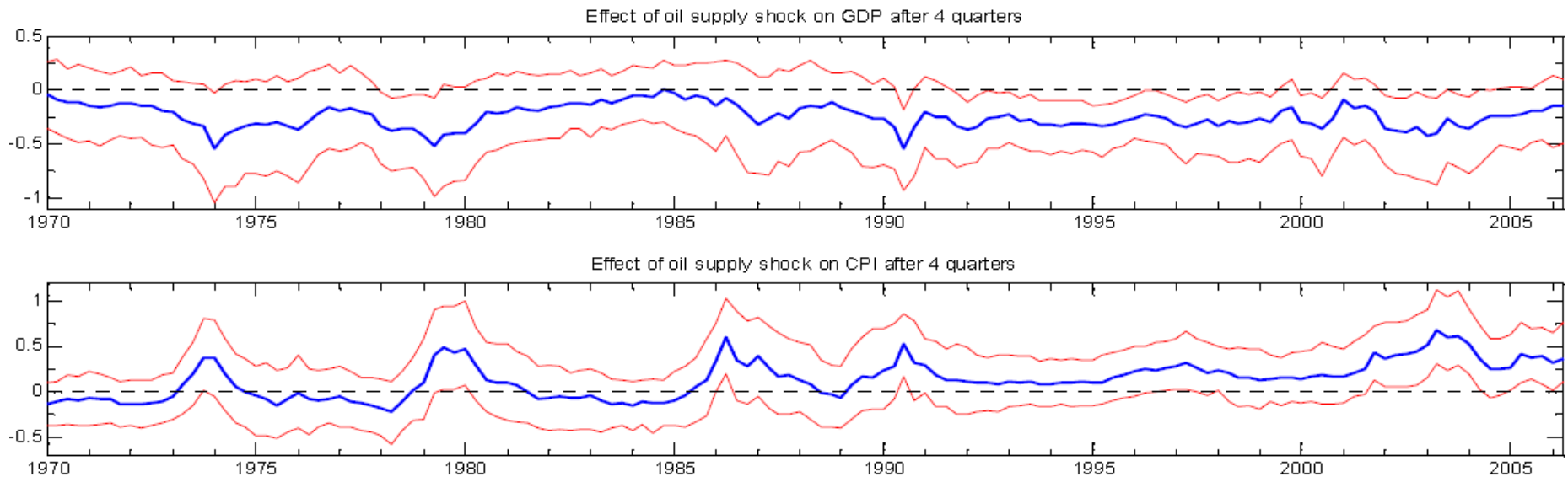
Empirical method

- New method to identify exogenous oil supply shocks
 - We use sign restrictions derived from a simple supply and demand model of the global oil market
 - Faust (1998), Uhlig (2005), Peersman (2005)
 - Oil supply shocks the only disturbances that displace the oil supply curve
 - Supply and demand shocks can affect oil production and prices immediately



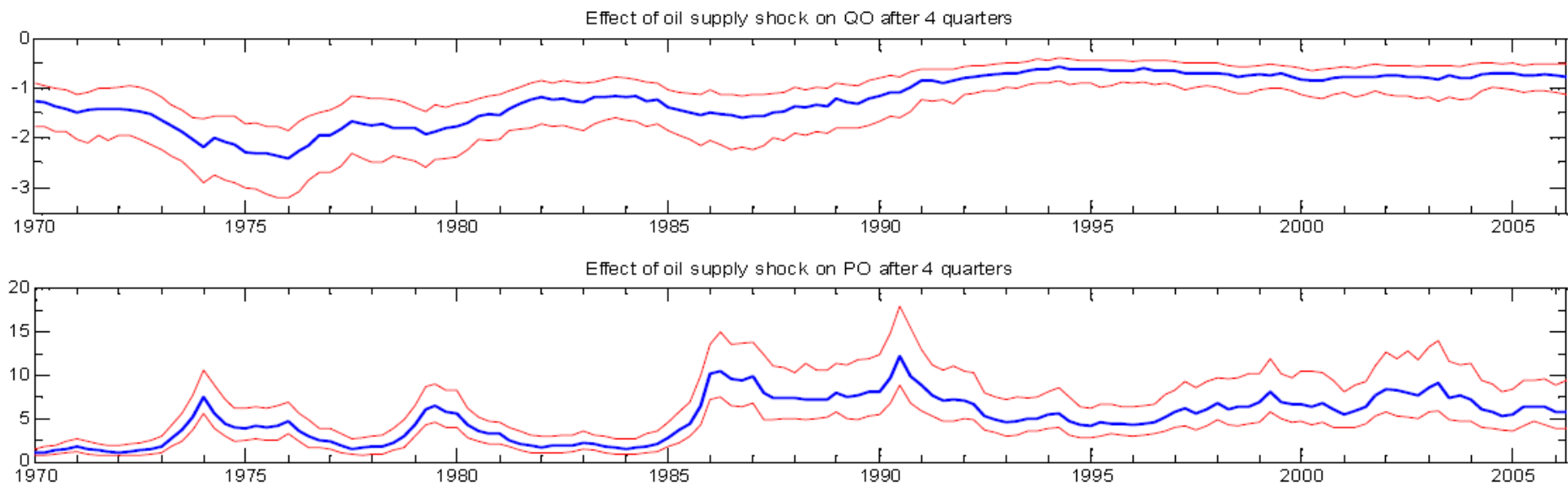
Results

- Typical (one standard deviation) oil supply shock
 - Significant impact on economic activity and inflation
 - Impact has not dramatically changed over time
 - Even a slight stronger impact for some horizons (based on bilateral test)
 - In contrast with most existing evidence
 - How can we explain this?



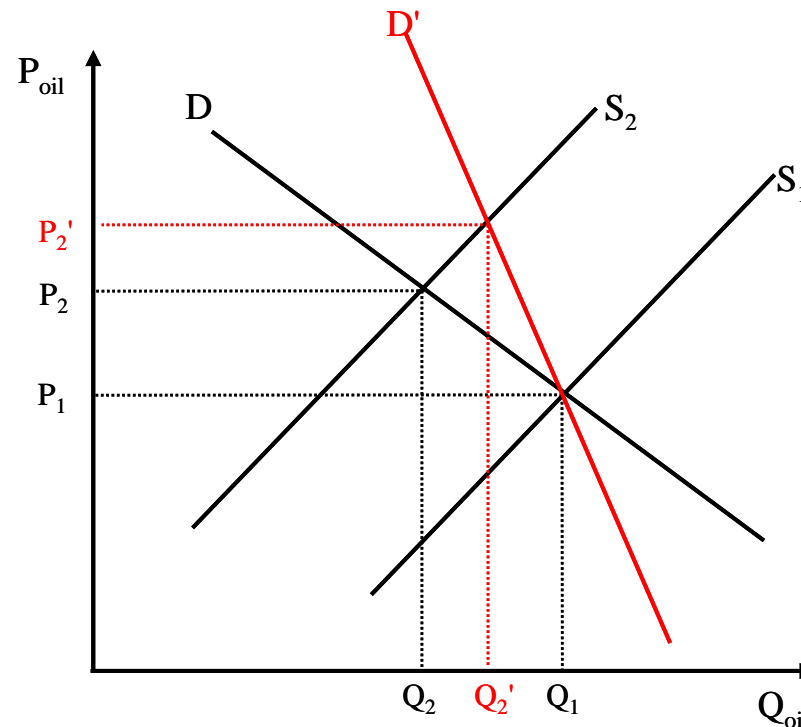
Results

- Typical (one standard deviation) oil supply shock
 - Considerable time variation in oil market dynamics
 - Typical oil supply shock is characterized by a much smaller impact on oil production and a greater effect on the real price of crude oil over time
 - Changes are highly significant (bilateral tests)
 - How should we interpret this?



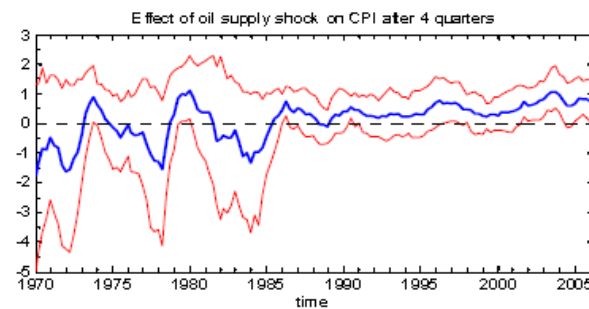
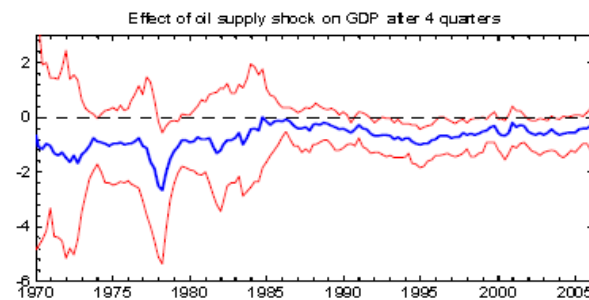
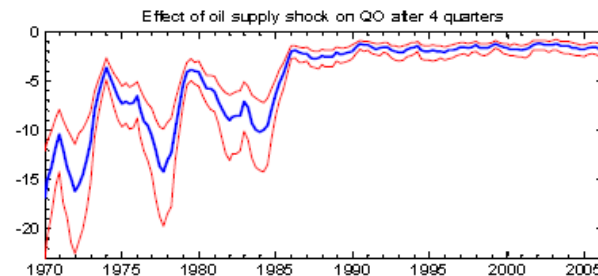
Results

- Typical (one standard deviation) oil supply shock
 - Considerable time variation in oil market dynamics
 - Typical oil supply shock is characterized by a much smaller impact on oil production and a greater effect on the real price of crude oil over time
 - Oil demand curve must have become steeper (less elastic) over time
 - A stylized facts which has not been documented before



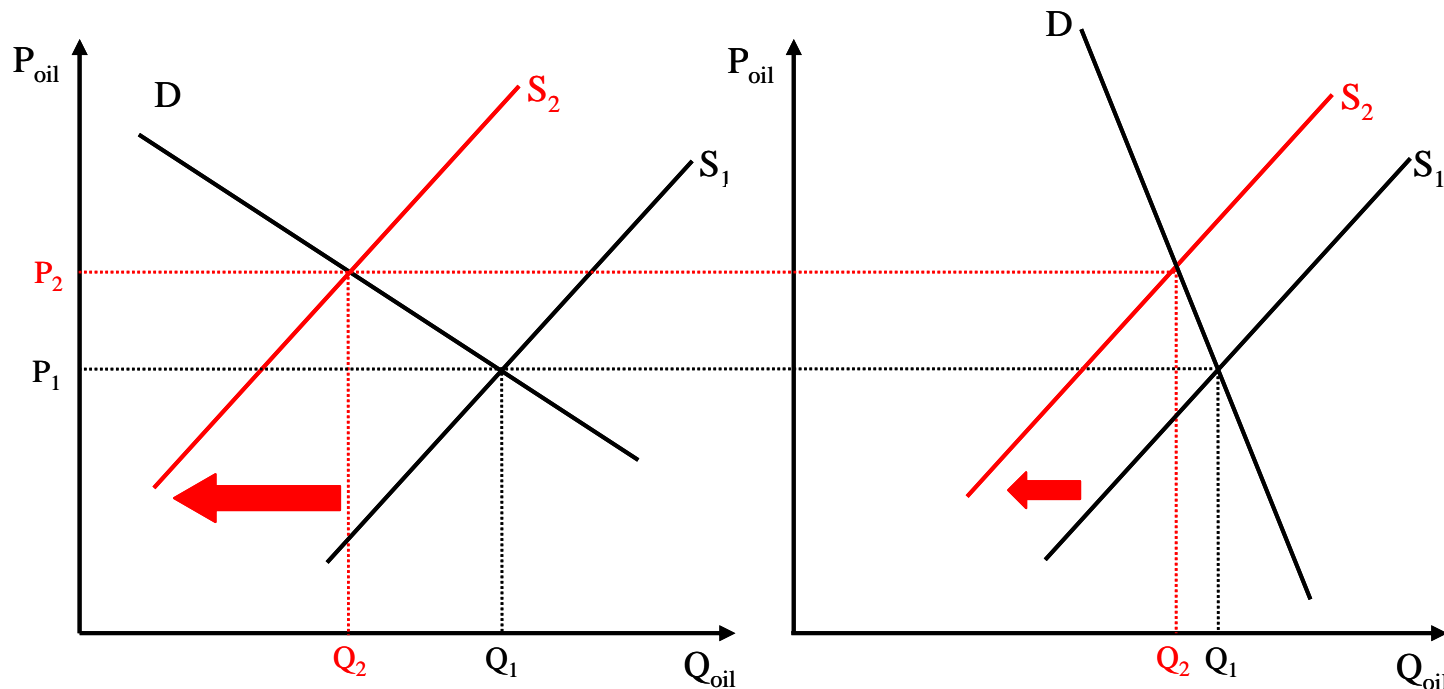
Results

- Consequences for comparisons over time
 - A similar shift of crude oil prices (e.g. 10 percent)
 - We find a more muted impact over time: consistent with existing evidence



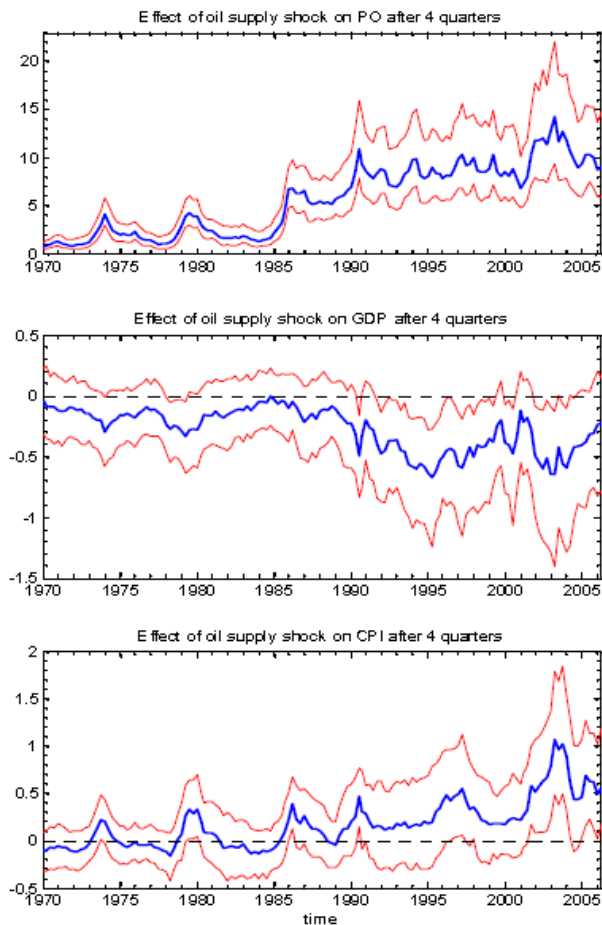
Results

- Consequences for comparisons over time
 - A similar shift of crude oil prices (e.g. 10 percent)
 - We find a more muted impact over time: consistent with existing evidence
 - Comparison cannot really be made because a different underlying supply shock is considered
 - A constant slope of oil demand curve is implicitly assumed



Results

- Consequences for comparisons over time
 - A similar shift of oil production (e.g. 1 percent)
 - We find a much stronger impact over time

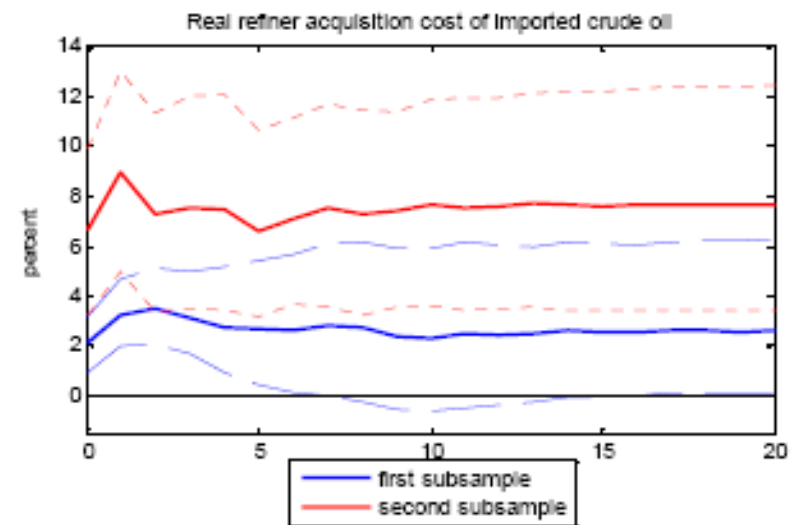
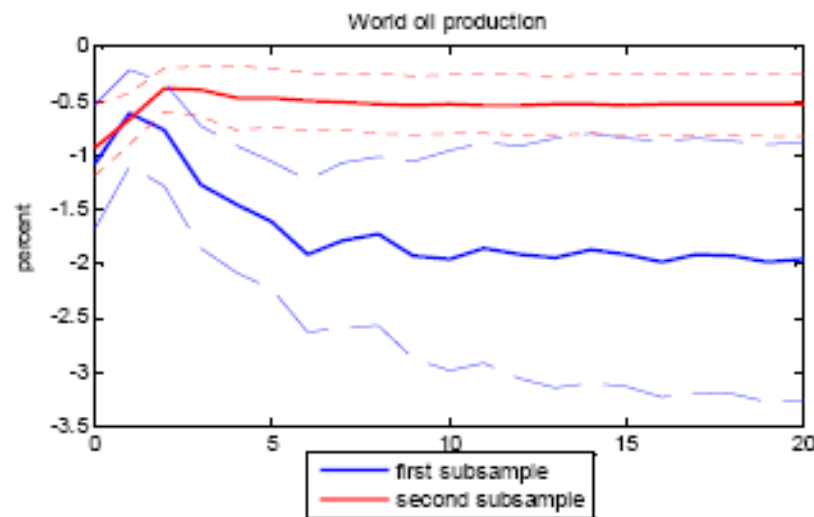


Results

- Consequences for comparisons over time
 - A similar shift of oil production (e.g. 1 percent)
 - We find a much stronger impact over time
 - Also this comparison cannot really be made: a typical oil supply shock is characterized by a disturbance in oil production of more than 2% in 1970s while hardly 0.5% since 1990s
 - Whether this is only because of steepening oil demand curve or also change in volatility of supply shocks cannot be determined
 - Baumeister and Peersman (2009): also volatility of shocks has declined
- Results are very robust
 - Alternative specifications: e.g. adding interest rate (monetary policy), using GDP deflator or unemployment
 - Modeling time-variation: same results for simple sample split
 - Identification strategy: TVP-BVAR with Choleski identification (Kilian 2009 approach)

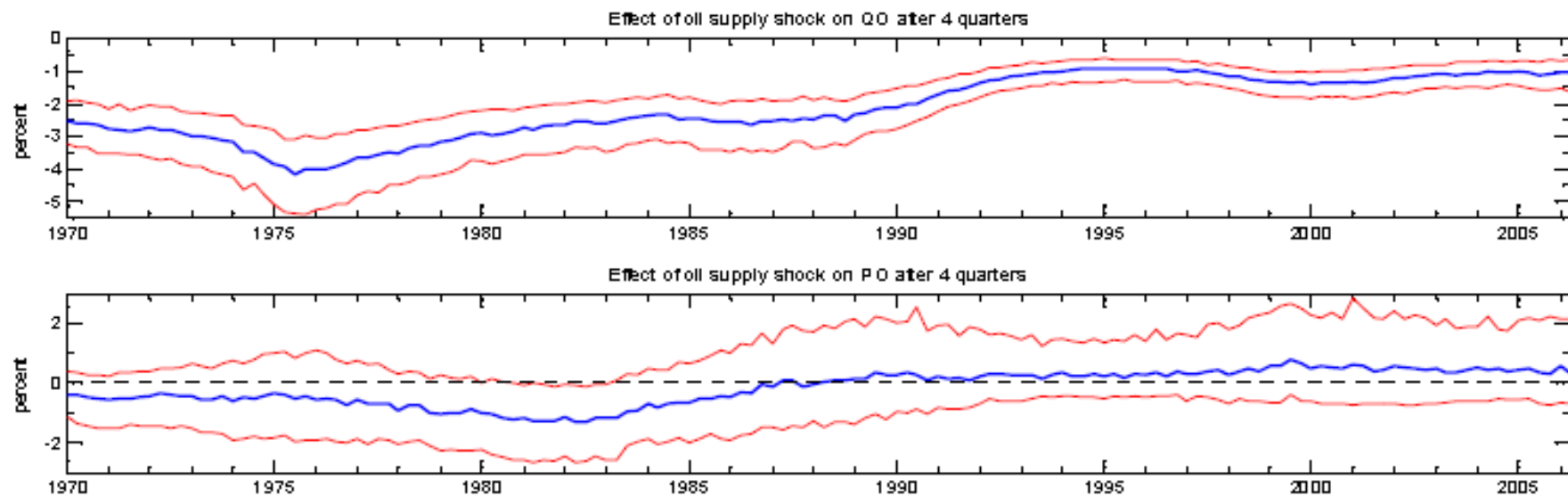
Results

- Results are very robust
 - Modeling time-variation: same results for simple sample split



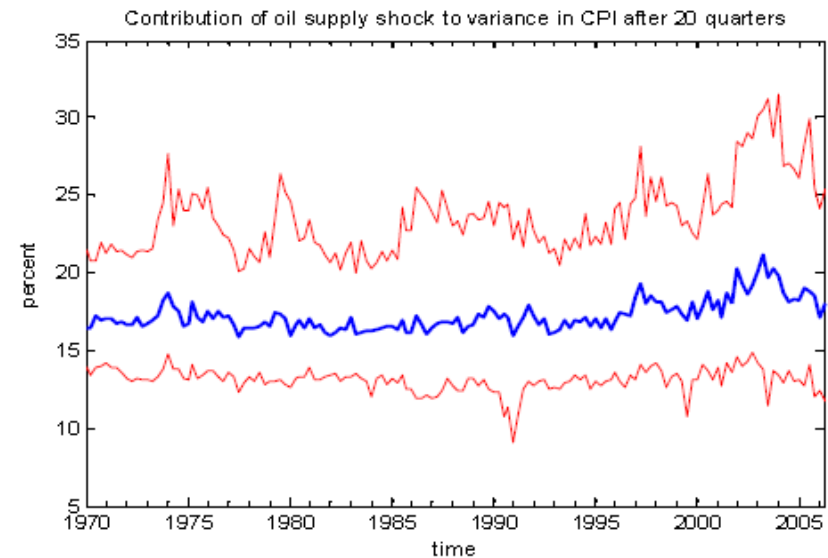
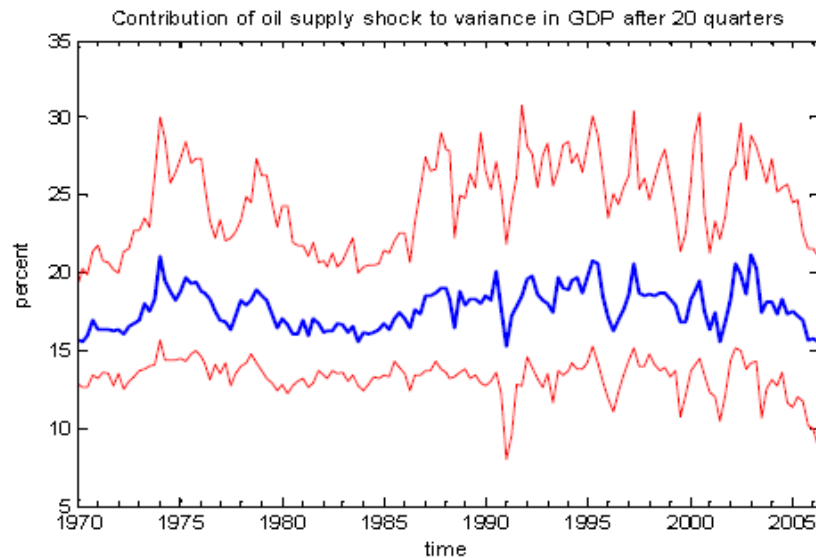
Results

- Results are very robust
 - Identification strategy: TVP-BVAR with Choleski identification (Kilian 2009 approach)



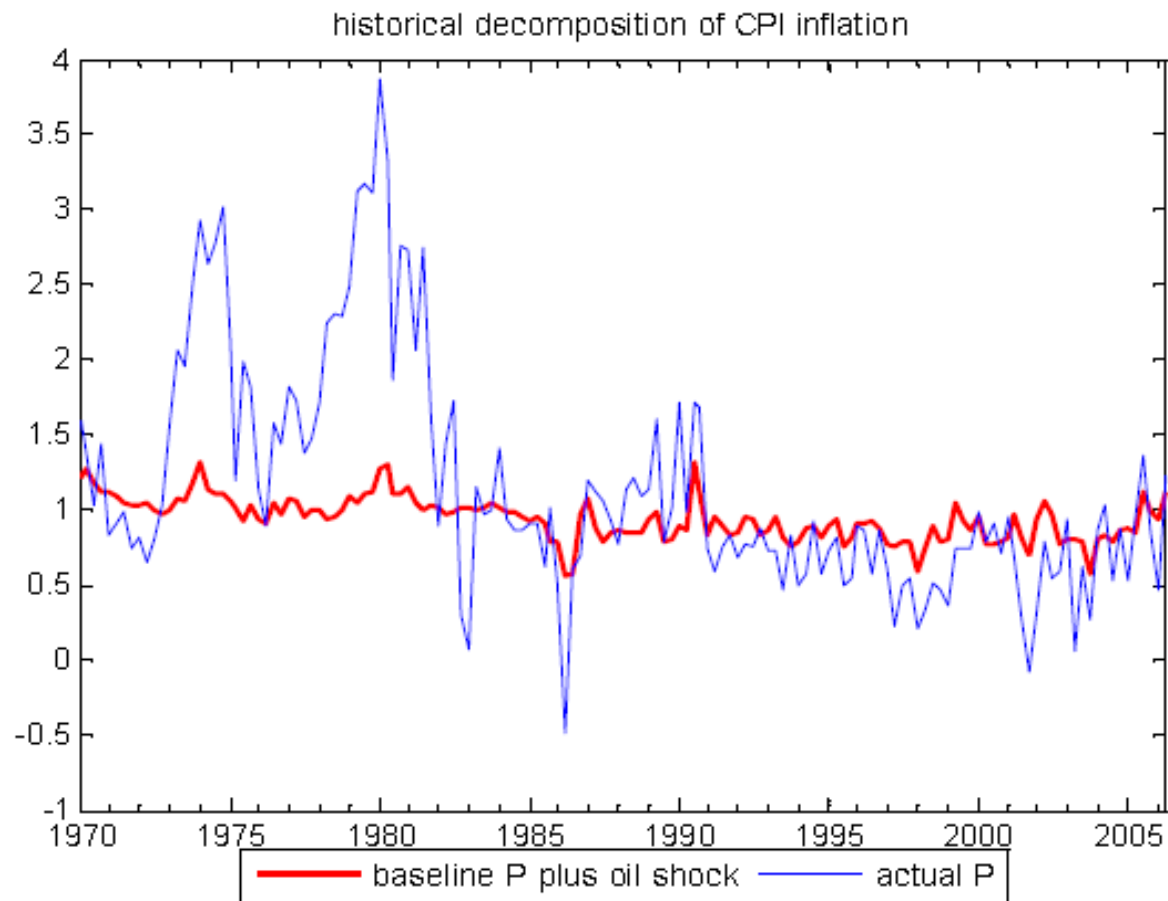
Results

- Contribution of oil supply shocks to the variability of real activity and inflation is economically very relevant
 - Consistently between 15 and 20 percent



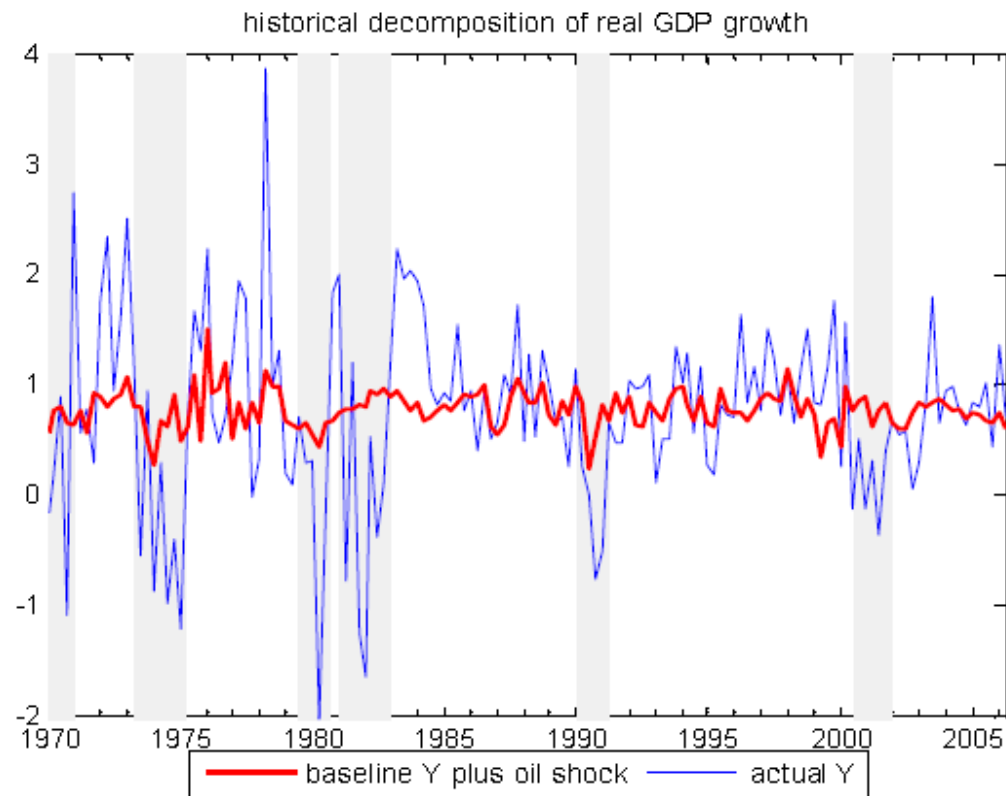
Results

- Why are macroeconomic conditions so different from 1970s?
 - Unfavorable oil supply shocks explain little of the Great Inflation
 - In line with Barsky and Kilian (2003)



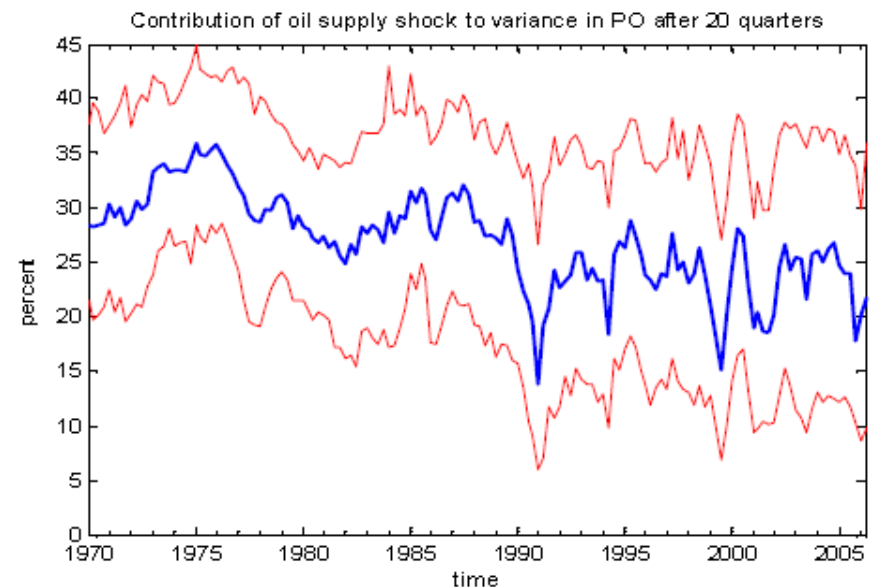
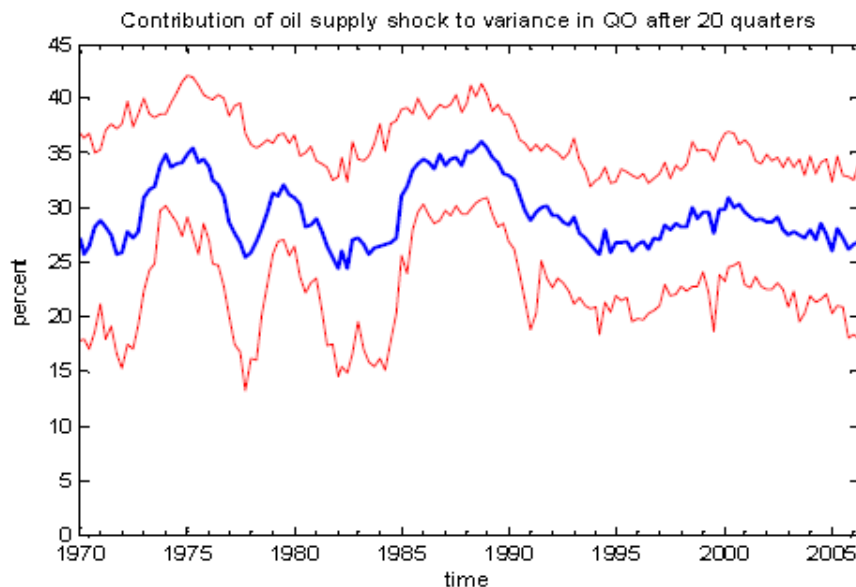
Results

- Why are macroeconomic conditions so different from 1970s?
 - Significant but non-exclusive contribution to 1974/75, early 1980s and 1990s recessions
 - But also significant reduction in economic activity around 1999, which made the ongoing boom more subdued



Results

- Why are macroeconomic conditions so different from 1970s?
 - Current oil prices are more demand driven
 - Contribution of oil supply shocks to real crude oil price volatility decreased from 30 percent to 15-20 percent
 - Contribution to oil production volatility remained however constant which implies that also oil supply became less elastic over time
 - Steeper oil demand AND supply curve can be considered as the main source of increased oil price volatility over time (Baumeister and Peersman 2009)

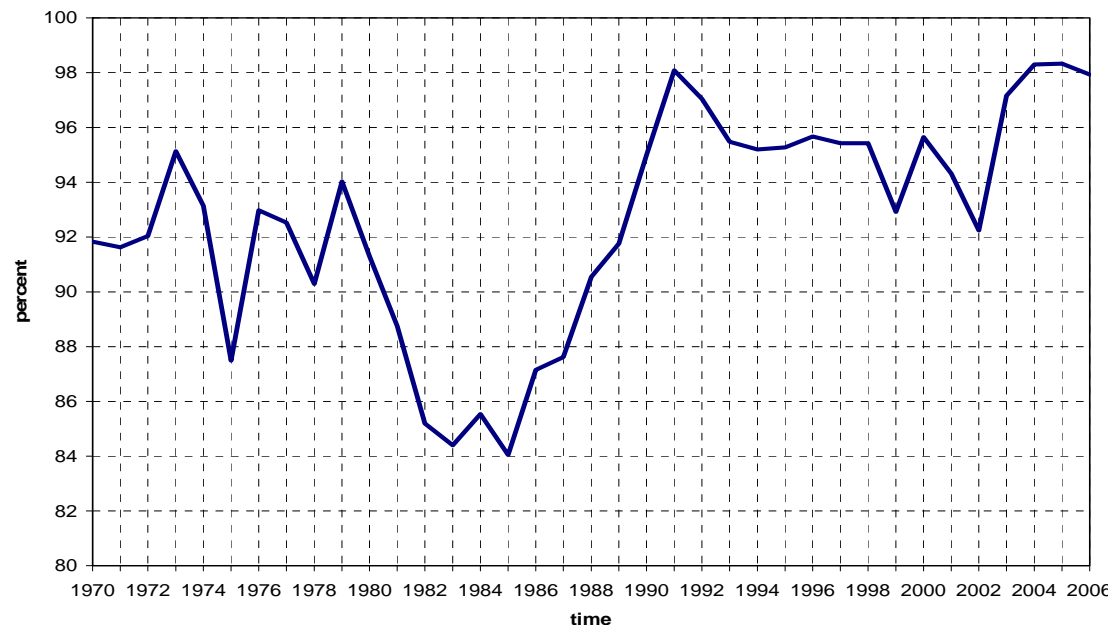


Why a less elastic oil demand curve?

- High oil prices of 1970s caused industries to switch away from oil to other sources of energy
 - Remaining amount of oil is absolute necessity, so less elastic
 - E.g. transportation: increasing share and lack of substitutes
- Cost share of crude oil in total expenditures has decreased
 - One of Marshall's four rules: a smaller share of factor costs leads to a less elastic demand for that production factor if the demand elasticity for the final product is greater than the substitution elasticity between input factors
 - Recent increasing/decreasing oil prices lead again to changes of the share
- Higher share of developing countries in global oil demand
 - State-controlled oil product prices and fuel subsidies: makes demand not very reactive to international price signals

Why a less elastic oil demand curve?

- Capacity utilization rates of crude oil production: close to full capacity can result in a relative higher share of (less elastic) precautionary oil demand
 - A production shortfall cannot be replaced somewhere else
 - Signals tightness in the market which affects demand behavior (risk premium in demand will be very reactive to supply changes)
 - Can also explain the increased price elasticity in 1973/74 and 1979/80



Conclusions

- Remarkable structural change in the oil market over time
 - Steepening of the oil demand curve (less elastic oil demand)
 - Complicates comparisons over time
 - A similar shift of crude oil prices has a more muted impact over time, but this comparison assumes a constant slope of oil demand curve
 - A typical one standard deviation oil supply shock has no reduced impact on output and inflation over time
- The role of oil supply shocks for the economy
 - Contribution to output and inflation economically very relevant
 - Explains little of the “Great Inflation”
 - Significant but non-exclusive contribution to 1974/75, early 1980s and 1990s recessions; but also significant reduction in output around 1999
 - Current oil prices are more demand driven
 - Also oil supply less elastic over time