Commodity price uncertainty co-movement: Does it matter for global economic growth?

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Motivations

- Uncertainty is an old concept (Knight, 1921), but many new measures are available.

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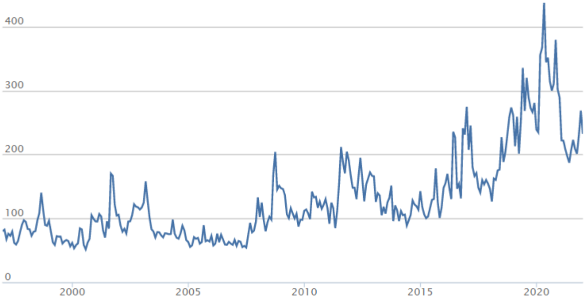
- Uncertainty is an old concept (Knight, 1921), but many new measures are available.
- Well known measure of uncertainty: Global Economic Policy Uncertainty (Baker, Bloom, Davis, 2016)



Motivations

- Another measure of uncertainty: VIX, a proxy for financial market volatility

Motivations

- Evidence of negative correlation between uncertainty fluctuations and macroeconomic activity
- Literature tries to show evidence of causality from uncertainty shocks to macro (Bernanke, 1983; Bloom, 2009 + many others ...)
- Uncertainty comes from various sources: Financial markets (VIX), Economic policy (EPU), real activity (Jurado et al. 2015) ...
- Part of literature also focuses on *oil uncertainty* shocks (Elder and Serletis, 2010, Jo, 2014) and points out significant recessionary effects on U.S. activity.
- Here: we focus on **commodity uncertainty** shocks as a whole and we assess their impact on economic activity (Investment, Exports, Consumption, GDP)

Motivations

- Why looking at commodities? Because the strong co-movement is helpful to understand oil prices ... (Poncela et al., 2020; Alquist et al. 2020)
- Delle Chiaie, Ferrara, Giannone (JAE, 2022) show that by estimating a DFM for all commodities:
  - Common movements on commodities likely reflect a global demand shock (using a narrative approach)
  - Sector-specific movements likely reflect supply shock
- Here: we focus on disentangling **common commodity price uncertainty** vs **commodity-specific price uncertainty**

What do we do in this paper?

- We consider various 12 commodity prices split into 3 groups: metal, agricultural and energy
- We measure uncertainty on each commodity price by taking the quarterly realized variance starting from daily returns (uncertainty=volatility)
- We extract the common uncertainty factor underlying all the commodities through a DFM with block structure (Kose et al., 2003), as well as the 3 group-specific factors.
- Then we sequentially integrate those factors into small-scale SVARs for a bunch of ADV and EME countries and compute IRFs to various commodity uncertainty shocks

What are the main take-aways?

1. A global commodity uncertainty shock depresses investment and exports, for both ADVs and EMEs, much more than VIX and EPU: 1 sd shock generates a drop of about 2% after 2 quarters (also true for GDP and consumption)
2. No evidence of a bounce-back after a global commodity uncertainty shock for both ADVs/EMEs: this shock leads to a long-run adverse impact on the level of investment and thus on potential growth
3. Our approach is a way to disentangle between *bad* and *good* outcomes of oil price uncertainty shocks:
    1. *bad* draws are coming from the global uncertainty component embedded in oil price uncertainty and common with other commodity price uncertainty
    2. *good* draws are coming from the oil sector uncertainty

Related literature

This paper relates to 3 main research fields:

1. Macroeconomic impact of oil price uncertainty shocks
2. Literature on comovement in commodity prices and how it is useful to understand oil prices
3. Good vs Bad outcomes of uncertainty shocks

Related literature 1/3

- Macroeconomic impact of uncertainty shocks is known to be negative, both from theory (*real option* theory and financial frictions, Bernanke, 1983; Bloom, 2009, 2014; ...) and empirics (Bloom, 2009, Baker et al., 2016, Leduc and Liu, 2016, ...)
- True for investment, consumption and output, but also international trade (Feng et al., 2017, Gervais, 2018; Tam, 2018 ...)
- Impact on EMEs much larger than on ADVs (Carriere-Swallow and Cespedes, 2013)
- Existing alternative measure of uncertainty (VIX, EPU, macro, oil ...) leading to relatively similar results. On oil price uncertainty: Guo and Kliesen, 2005; Elder and Serletis, 2010; Jo, 2014 ...

Related literature 2/3

- Emerging literature on the strong comovement among commodity prices in level (agricultural, metal, energy), see Alquist, Bhattarai and Coibion (2020), Poncela, Senra, Sierra (2020) or Delle Chiaie, Ferrara, Giannone (2022)
- Delle Chiaie et al. (2022) estimate in real-time a decomposition of any commodity price into demand (=common component) and supply drivers
- Fernandez et al. (2017, 2018) also point out the significant role of commodities for global business cycles

Related literature 3/3

- In theory, uncertainty shocks do not necessarily lead to negative macro outcomes. 2 theoretical channels outlined in Bloom (2014):
  1. **Growth-option**: uncertainty can encourage investment if it increases the size of the potential prize
  2. **Oi-Hartman-Abel effect**: companies can expand to exploit good outcomes and contract to insure against bad outcomes
- Empirical evidence of positive effects in macro by Forni, Gambetti and Sala (2021) (upside vs downside uncertainty) and in finance by Segal et al. (2015)
- As regards oil price uncertainty, empirical evidence by Mohn and Misund (2009) (also for copper mining by Marmer and Slade (2018))
- Theoretical rationale by Punzi (2019): DSGE in which households and companies consume more today when higher uncertainty

Measuring uncertainty

- We get log-returns from $n = 12$ daily commodity future prices for: agricultural (corn, cotton, soybeans, wheat), metals (copper, gold, silver, platinum) and energy (crude oil, heating oil, petroleum, gasoline).

- We estimate quarterly commodity price uncertainty for any commodity i using realized variances:

$$RV_{i,t} = \frac{252}{T} \sum_{d=1}^{T} (r^i_{t,d} - r^i)^2 \tag{1}$$

- We cover the period ranging from 1988q1 to 2016q4

Estimating the Global Uncertainty (GLUN) Factor

- We get $n = 12$ quarterly realized variances from 3 groups
- We estimate the following DFM: quarterly commodity price uncertainty for any commodity i using realized variances:

$$RV_{i,t} = \beta_i^C F_t^C + \beta_i^g F_t^g + \varepsilon_{i,t} \quad (2)$$

where F_t^C is the common factor and F_t^g are the 3 group factors (g=1,2,3)

- Residuals are supposed to follow an AR(p) process:

$$\varepsilon_{i,t} = \sum_{l=1}^{p} \psi_{i,l} \varepsilon_{i,t-l} + \epsilon_{i,t} \quad (3)$$

Estimating the Global Uncertainty (GLUN) Factor

- Unobserved factors are also supposed to follow AR(p) processes:

$$F_t^C = \sum_{l=1}^{p} \psi_l^C F_{t-l}^C + \nu_t^C \tag{4}$$

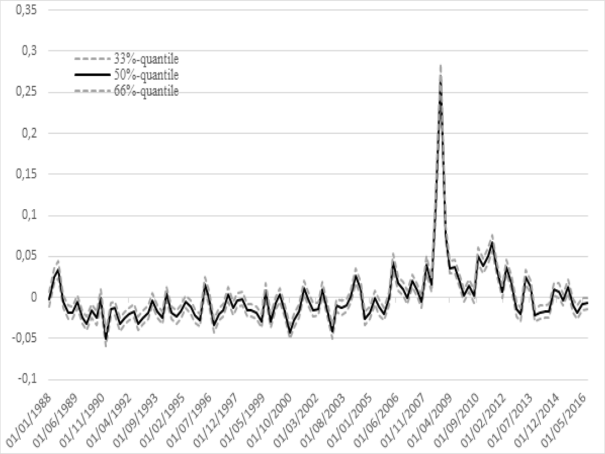
and for $g = 1, 2, 3$:

$$F_t^g = \sum_{l=1}^{p} \psi_l^g F_{t-l}^g + \nu_t^g \tag{5}$$

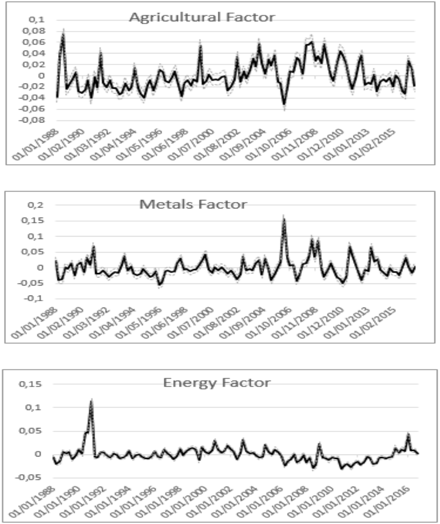
where $\nu_t^C \sim \mathbf{N}(0, \sigma_C^2)$ and $\nu_t^g \sim \mathbf{N}(0, \sigma_g^2)$

- All the innovations are supposed to be White Noise and mutually orthogonal.
- Parameter estimation is carried out using Bayesian methods

Global Uncertainty (GLUN) Factor



Group-Specific Uncertainty Factors



Assessing IRFs using SVARs

- Let's consider a standard SVAR(p) model of the following form for a set of k variables contained in the vector Y_t:

$$A_0 Y_t = c + A_1 Y_{t-1} + \ldots + A_p Y_{t-p} + \varepsilon_t \tag{6}$$

where A_0 is the matrix of contemporaneous variables, A_1 to A_p are matrices of coefficients controlling the dynamics and ε_t is a a vector of structural shocks

Assessing IRFs using SVARs

- Following Caggiano et al. (2014), we estimate small-scale SVAR models with 4 variables in the following order:

$$Y_t = (un_t, \pi_t, x_t, i_t)'$$

  where un_t is the previously estimated commodity uncertainty factor, π_t is the quarterly inflation rate, x_t is a given macroeconomic variable of interest expressed in growth rate and i_t is the nominal policy interest rate

- A robustness check is carried out by putting commodity prices first, leading to similar results.

- We estimate this model for a bunch of 24 ADV and EME countries

Assessing IRFs using SVARs

- As usual with SVARs, A_0 has to be identified
- Here we follow the Bloom's (2009) strategy by putting directly the exogeneous shock into the model as defined by

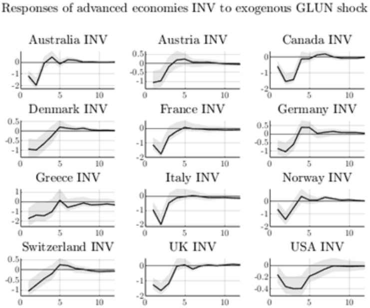
$$un_t = F_t^C \times \mathbf{1}_t(event) \tag{7}$$

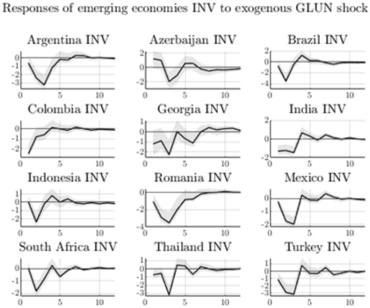
where $\mathbf{1}_t(event)$ is the indicator function that takes 1 if an uncertainty event occurs and 0 otherwise

- The definition of uncertainty events that we take is the one proposed by Piffer and Podstawski (2018) stemming from a narrative approach.

IRFs from a Global Uncertainty shock: Investment

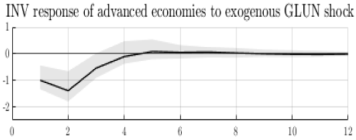
- We compute IRFs from the 24 SVARs applied to each country: Evidence of negative impact on **Investment** growth after a global uncertainty shock

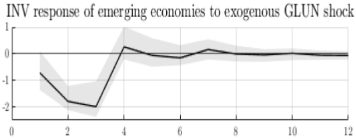




IRFs from a Global Uncertainty shock: Investment

- We summarize the information for ADVs and EMEs

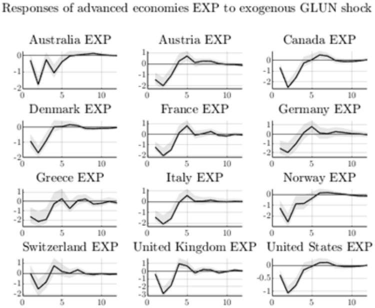


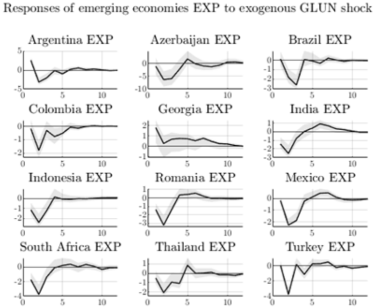


- Large negative impact, especially EMEs
- Lack of bounce-back after uncertainty stops, leading to both short-term and long-term adverse effects (permanent loss in the level of investment, meaning lower potential growth)

IRFs from a Global Uncertainty shock: Exports

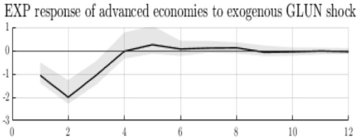
- We compute IRFs from the 24 SVARs applied to each country: Evidence of negative impact on **Exports** growth after a global uncertainty shock

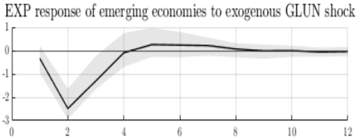




IRFs from a Global Uncertainty shock: Exports

- Median IRF for ADVs and EMEs:





- As for Investment, Large negative impact, especially EMEs
- Lack of bounce-back after uncertainty stops, leading to both short-term and long-term adverse effects

IRFs from Global Uncertainty: GDP and Consumption

- Evidence of negative impact of global commodity uncertainty on GDP and household consumption

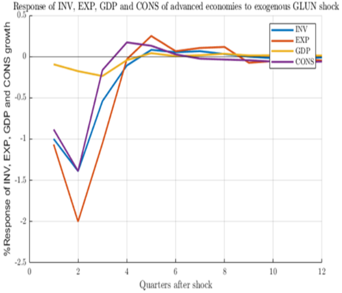


Figure: *ADVs*

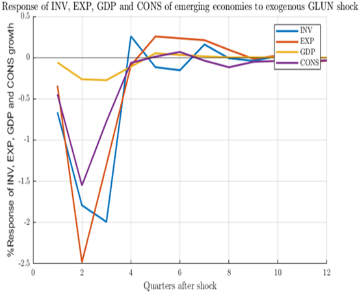
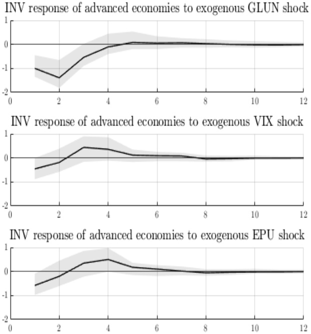


Figure: *EMEs*

Comparing with other shocks: Investment

- Comparison VIX /EPU shocks: Stronger negative IRF from GLUN
- Lack of bounce-back after a GLUN shock, in opposition to other shocks for ADVs (Carriere-Swallow and Cespedes, JIE, 2013)



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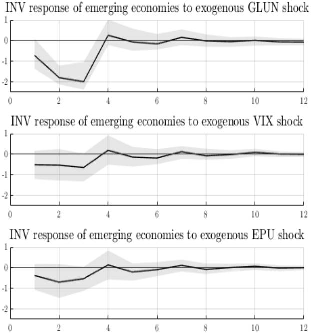

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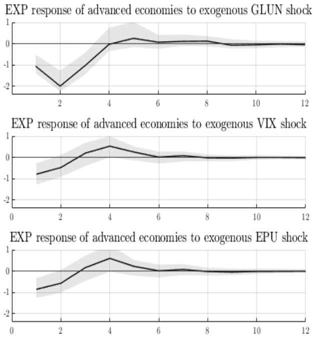

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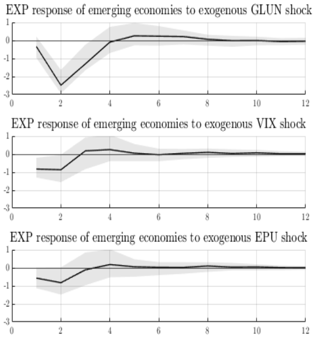
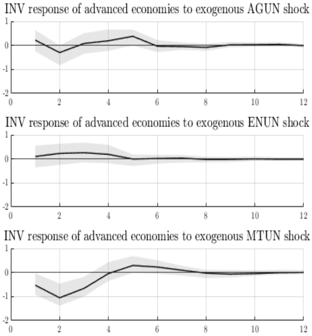


Figure: *EMEs*

IRFs from Group-Uncertainty shocks: Investment

- Comparison between group-specific uncertainty shocks on Investment, once we account for global component
- Metals: strongly negative / Energy: Slightly positive



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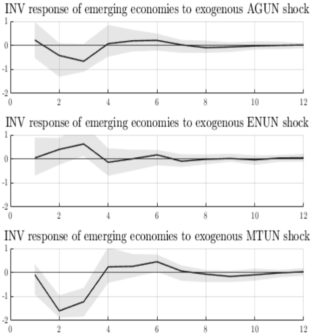

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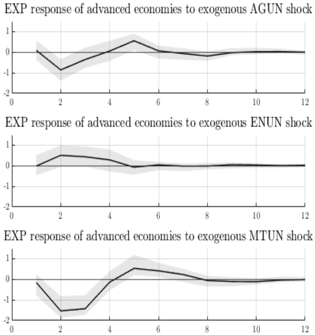

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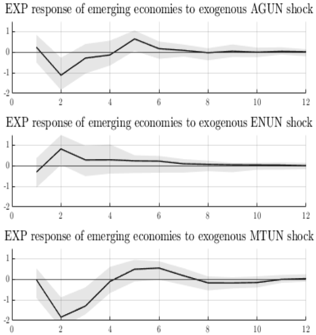


Figure: *EMEs*

Oil price uncertainty shocks: Good vs Bad outcomes

- Let's focus specifically on energy/oil price uncertainty shock
- Large literature showing negative macro impact of oil price uncertainty shock (Elder and Serletis, 2010; Jo, 2014)
- Yet in principle, uncertainty shock are likely to generate positive outcomes : *growth option theory* (Bloom, 2014)
- Only few empirical evidence: Forni, Gambetti and Sala (2021) in macro or Segal et al. (2015) in finance
- Punzi (2019) puts forward a SOE DSGE model in which oil price uncertainty shocks generate positive macro outcomes

IRFs from Energy shocks: Investment

- Evidence of overall positive response at country level: Country-specific IRFs from an energy price uncertainy shock after controlling from global uncertainty component

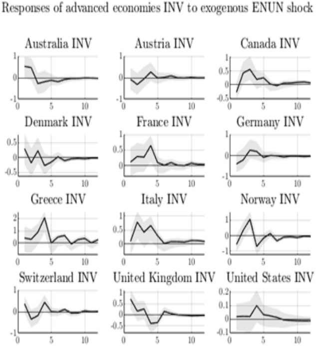


Figure: *ADVs*

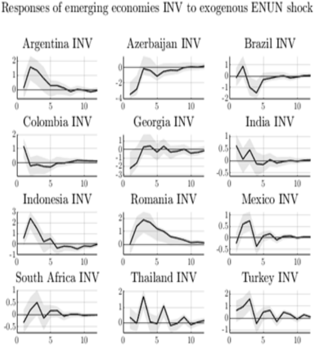


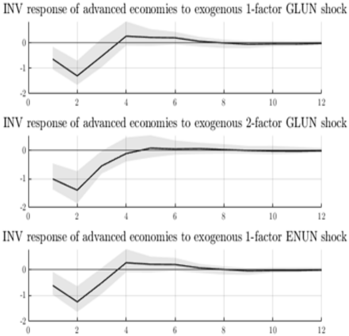
Figure: *EMEs*

Oil price uncertainty shock: Good vs Bad outcomes

- We carry out various exercises:
- 1/ Estimate IRF from *pure* oil price uncertainty shock (ie common factor on the 4 energy price volatilities)
- 2/ Estimate IRF from good/bad commodity uncertainty shocks
- 3/ Supply or Demand shocks?

IRFs from Energy shocks: Investment

- Comparison between various energy uncertainty shocks on Investment



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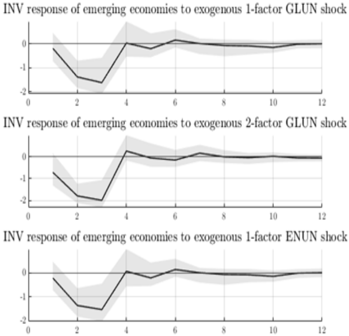


Figure: *EMEs*

Pure oil price uncertainty shock

1. A *pure* energy price uncertainty shock leads to a negative effect on economic activity, as usually highlighted in the literature
2. The effect is the same as a global commodity price uncertainty shock $\rightarrow$ An energy uncertainty shock is likely to reflect only global uncertainty
3. When decomposing energy (=oil) price uncertainty into two main components, (i) part of uncertainty that comoves with other non-energy commodities and (ii) part of uncertainty that is specific to the energy market, the results suggest that those two components will have on average opposite effects on economic activity
4. So our approach: a way to disentangle **"bad"** vs **"good"** oil price uncertainty shocks

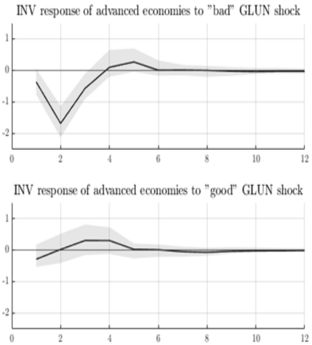
Another strategy to identify Good vs Bad shocks

Robustness check: Does another strategy to identify good/bad shocks lead to different results?

1. We identify a *bad* uncertainty commodity shock when associated with an *increase* in commodity prices, and conversely
2. We use the Bry-Boschan algorithm to identify increase and decrease in the GSCI index
3. This identification strategy leads to similar results as regards IRFs (see Figure next slide)

Another strategy to identify Good vs Bad shocks

- Investment responses to good/bad commodity price uncertainty shock



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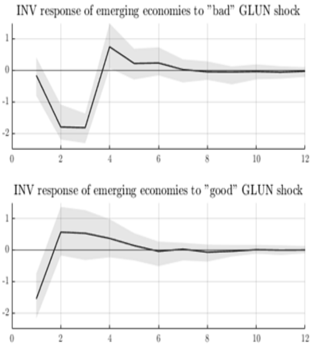


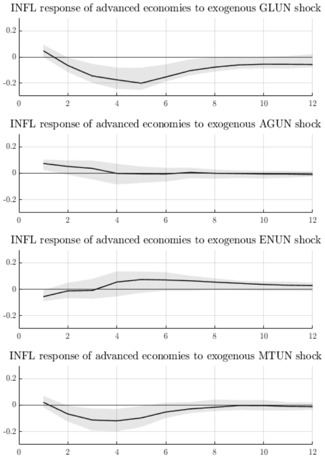
Figure: *EMEs*

Supply or Demand shocks?

1. Are commodity price uncertainty shocks acting as demand or supply shocks?
2. Not a structural model here, but looking simultaneously at inflation is helpful: a demand shock send output and prices in the same direction, while a supply shock send them in opposite directions
3. By looking at IRFs (see Figure next slide), we get that global commodity price uncertainty acts as a **demand** shock, while a specific oil price uncertainty shock tends to act more as a *supply* shock.

Supply or Demand shocks?

- IRFs of inflation to global uncertainty shock and the 3 commodity-specific uncertainty shocks



Conclusions

- A global commodity price uncertainty shock depresses investment and exports, for both ADVs and EMEs, much more than VIX and EPU shocks, acting as a demand shock
- No evidence of a bounce-back after a global commodity price uncertainty shock for both ADVs/EMEs, leading to permanent losses
- Our approach is a way to disentangle between *bad* and *good* outcomes of oil price uncertainty shocks:
  1. *bad* draws are coming from the global uncertainty component embedded in oil price uncertainty and common with other commo price uncertainty
  2. *good* draws are coming from the oil sector uncertainty