# Oil Extraction, Economic Growth, and Oil Price Dynamics

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Ian Schindler (with Aude Illig) Oil price dynamics

## Motivation (Rune Likvern)

#### WORLD CRUDE OIL AND CONDENSATE PRODUCTION 1990 - 2014YTD AND A CONCEPTUAL DESCRIPTION FOR DEVELOPMENT OF BANDS OF



## Principles

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Remark: similar equations with price. The Cost Share Theorem?

## Carey King



#### Finance





#### Turchin and Nefedov (2009)

$$Y = Kq^{\alpha} \implies p = CKq^{\alpha - 1}. \tag{0.4}$$

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Results: 1937–1970:  $\alpha_g \approx 2/3 < 1$ ,  $R^2 = .999$ . 1970–2014 :  $\alpha_s \approx 2.27 > 1$ ,  $R^2 = .913$ . Energy intensity  $\searrow$ .

## Scaling

#### growth:

$$\alpha_g: q_1/q_0 = 1.1 \implies Y_1/Y_0 = 1.07, p_1/p_0 = 0.97C_1/C_0.$$
  
 $\alpha_s: q_1/q_0 = 1.1 \implies Y_1/Y_0 = 1.23, p_1/p_0 = 1.13C_1/C_0.$   
Jevons (1866)

## Scaling

#### growth:

$$\begin{array}{l} \alpha_g \colon q_1/q_0 = 1.1 \implies Y_1/Y_0 = 1.07, \ p_1/p_0 = 0.97 C_1/C_0. \\ \alpha_s \colon q_1/q_0 = 1.1 \implies Y_1/Y_0 = 1.23, \ p_1/p_0 = 1.13 C_1/C_0. \\ \text{Jevons (1866)} \\ \text{contraction:} \\ \alpha_g \colon q_1/q_0 = 0.9 \implies Y_1/Y_0 = 0.93, \ p_1/p_0 = 1.03 C_1/C_0. \\ \alpha_s \colon q_1/q_0 = 0.9 \implies Y_1/Y_0 = 0.77, \ p_1/p_0 = 0.85 C_1/C_0. \end{array}$$

 $\alpha_{s}: q_{1}/q_{0} = 0.9 \implies r_{1}/r_{0} = 0.77, p_{1}/p_{0} = 0.8$ Tainter (1988)

## Scaling

#### growth:

$$\begin{array}{l} \alpha_{g} \colon q_{1}/q_{0} = 1.1 \implies Y_{1}/Y_{0} = 1.07, \ p_{1}/p_{0} = 0.97 C_{1}/C_{0}. \\ \alpha_{s} \colon q_{1}/q_{0} = 1.1 \implies Y_{1}/Y_{0} = 1.23, \ p_{1}/p_{0} = 1.13 C_{1}/C_{0}. \\ \text{Jevons (1866)} \\ \text{contraction:} \\ \alpha_{g} \colon q_{1}/q_{0} = 0.9 \implies Y_{1}/Y_{0} = 0.93, \ p_{1}/p_{0} = 1.03 C_{1}/C_{0}. \end{array}$$

$$\begin{aligned} \alpha_s : q_1/q_0 &= 0.9 \implies Y_1/Y_0 = 0.000, \ p_1/p_0 &= 0.0001/00. \\ \text{Tainter (1988)} \\ Y &= E + E^c, \ C_i = E/(E + E^c). \\ \text{Hamilton (2009, 2013).} \end{aligned}$$

#### Recessions

#### **Past Recessions and Oil Spikes**



## Model I: 3 years of production



Fitted model : Simple regression (1967 - 2015)

 $\mathrm{R}^2\approx.67.$ 

## Model II: 3 years of production + fed rate



Fitted model : Simple regression (1967 - 2015)

## (Our) Conclusions

- Peak oil is about extraction prices rising faster than market prices. It is not an investment opportunity.
- The best current investment is to invest in energy transition.
- As the price of extraction rises, increased oil production will contribute less to economic growth.
- We are reaching the end of economic growth as it was known in the 19th and 20th century.

## via Rune Likvern



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