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# New Kid on the Block? China vs the US in World Oil Markets

Jamie Cross, Bao H. Nguyen and Bo Zhang



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# New Kid on the Block? China vs the US in World Oil Markets

Jamie Cross\* Bao H. Nguyen<sup>†</sup> Bo Zhang<sup>‡</sup>

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## Abstract

China has recently overtaken the US to become the world largest importer of crude oil. In light of this fact, we formally compare contributions of demand shocks from China, the US and the rest of the world. We find that China's influence on the real price of oil has increased over the past two decades and surpassed that of the US. Despite this result, oil prices are more sensitive to demand shocks from the US than China. Finally, we document that demand shocks from China alone were too small to have caused the mid 2003-2008 price surge. Instead, oil specific demand shocks are found to be the major determinant of the real oil price during this period.

**JEL-codes:** C32, E32, Q4

**Keywords:** China, US, Oil markets.

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\*BI Norwegian Business School, Center of Applied Macroeconomics and Commodity Prices (CAMP), Centre for Applied Macroeconomic Analysis (CAMA). Email: jamie.cross@bi.no

<sup>†</sup>Centre for Applied Macroeconomic Analysis (CAMA), Crawford School of Public Policy, Australian National University, Australia and School of Economics, University of Economics Ho Chi Minh City (UEH), Vietnam. Email: bao.nguyen@anu.edu.au

<sup>‡</sup>School of Accounting, Economics and Finance, University of Wollongong, Australia. Email: bzhang@uow.edu.au

# 1 Introduction

Over the past three decades, China has risen from being the 11th largest economy by world share of GDP, to the second largest economy in 2019. This rapid expansion of macroeconomic growth lead the country to be the world's largest net importer of petroleum and other liquid fuels since 2013. This fundamental change in market conditions raises a number of important questions: Have demand shocks from China or the US had a greater impact on the real oil price over the past two decades? Are oil prices more responsive to demand shocks from the US, China or the ROW? Was the recent surge in demand from China large enough to cause the oil price rise of mid 2003-2008?

## 1.1 Contribution

Multiple scholars have suggested that the oil price boom of the mid-2000s was predominately driven by growth in emerging markets, including China (Hamilton, 2009; Kilian, 2009; Baumeister and Peersman, 2013; Kilian and Hicks, 2013; Aastveit et al., 2015). For instance, Aastveit et al. (2015) find that approximately 40% of the 1-2 year variation in the oil price is explained by demand shocks from emerging markets (including China), while demand shocks from developed countries (including the US) explain approximately 15%. Despite this result, direct evidence on the role of China specifically has not been clear. On the one hand, Liu et al. (2016) provides evidence that China-specific demand accounted for 51 percent of the variation between 2000 and 2014. On the other, Mu and Ye (2011); Wu and Zhang (2014); Lin and Li (2015) and Cross and Nguyen (2017) suggest that China's impact on the global oil price has been negligible.

A key reason for this discrepancy is the lack of consistent real economic activity measures in China and the rest of the world (ROW). Such a metric is important because *aggregate demand shocks* are a key driver of the real price of oil (Kilian, 2009). We overcome this problem by constructing consistent indicators of real economic activity the US, China and the ROW based on monthly industrial production. We then use these measures in an extended structural oil market model to address the effect of demand shocks from China and the US on the real price of crude oil over the past two decades.

## 2 Material and methods

### 2.1 Data

We follow [Kilian \(2009\)](#) and use monthly data on three fundamental oil market variables: world oil production, real economic activity (REA) and the real price of crude oil. Oil production is measured in thousands of barrels of oil per day and is available from the US Energy Information Administration (EIA) Monthly Energy Review. The real price of crude oil is taken to be the arithmetic mean of three spot prices provided by the IMF: Dated Brant, West Texas Intermediate and the Dubai Fateh. To get real prices, the nominal series are deflated by the US CPI, which is available from the FRED database. We use average prices to capture the possible influence of China's demand as one of the main traders in Asia. Since existing literature uses either the US refiners' acquisition cost (RAC) for imported crude oil or the West Texas Intermediate (WTI) price of crude oil, we also consider these prices in a robustness exercise.

To address our research question we require *economy-specific* REA measures for the US, China, and the ROW. To that end, we derive the (seasonally adjusted) value of ROW IP by simply subtracting the IP values from the US and China from world IP as provided by industrial production from the World Bank's *Global Economic Monitor* (GEM) database. Since each country's IP is measured in constant US dollar prices (based in 2010) the corresponding REA measures are then modeled using the annualized growth rate these IP indexes. Each series is plotted in [Figure 1](#).

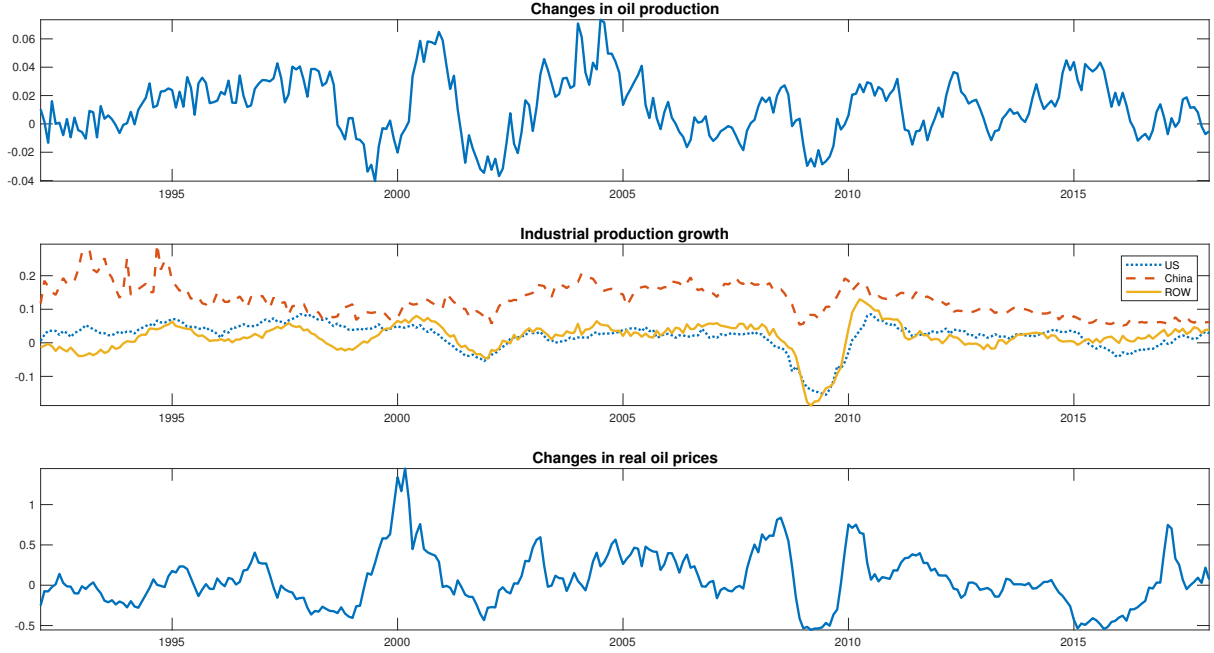


Figure 1: Historical evolution of the series (1992M1-2017M12).

## 2.2 Model

Let  $y_t = [q_t, y_{t,US}, y_{t,China}, y_{t,ROW}, p_t]$ , where the variables are the percentage change in global crude oil production,  $q_t$ , REA,  $y_{t,i}$ ,  $i \in \{US, China, ROW\}$ , and the real price of oil,  $p_t$ . The reduced form VAR is given by

$$y_t = c + \sum_{i=1}^{p=12} B_i y_{t-i} + e_t, \quad e_t \sim N(0, \Sigma) \quad (1)$$

where  $c$  is a  $5 \times 1$  intercept vector,  $B_i$  are  $5 \times 5$  autoregressive coefficient matrices,  $e_t$  is a vector of serially and mutually uncorrelated residuals and  $\Sigma$  is a  $5 \times 5$  covariance matrix.

This model modification is adapted from the one used in [Kilian \(2009\)](#). The difference is that REA has been decomposed into three economies. The model is estimated using standard Bayesian methods discussed in [Bańbura et al. \(2010\)](#). All priors and hyperparameters are as in that paper. The structural VAR model is identified with a standard recursive identification strategy. [Kilian \(2009\)](#) justifies this on the grounds that: (1) oil production is approximately perfectly inelastic at a monthly frequency, and (2) real oil price shocks do not affect global economic activity within a month due to market frictions. Since such a recursive ordering is not easily justified for each economies REA. We investigate the possibility of order effects in a robustness exercise.

### 3 Results and Discussion

#### 3.1 Oil price response to aggregate demand shocks

Are oil prices more responsive to demand shocks from the US, China or the ROW? We address this question by investigating the price response to demand shocks using the posterior cumulative impulse response functions (IRFs) in Figure 2. Each shock is normalized to a one percent increase. Consistent with existing literature, positive demand shocks are found to significantly increase the real oil price. The strongest effect on the oil price comes from the ROW, which increases the price by about 20 percent after a year. Interestingly, the price of crude oil is more sensitive to US demand shocks than those from China.

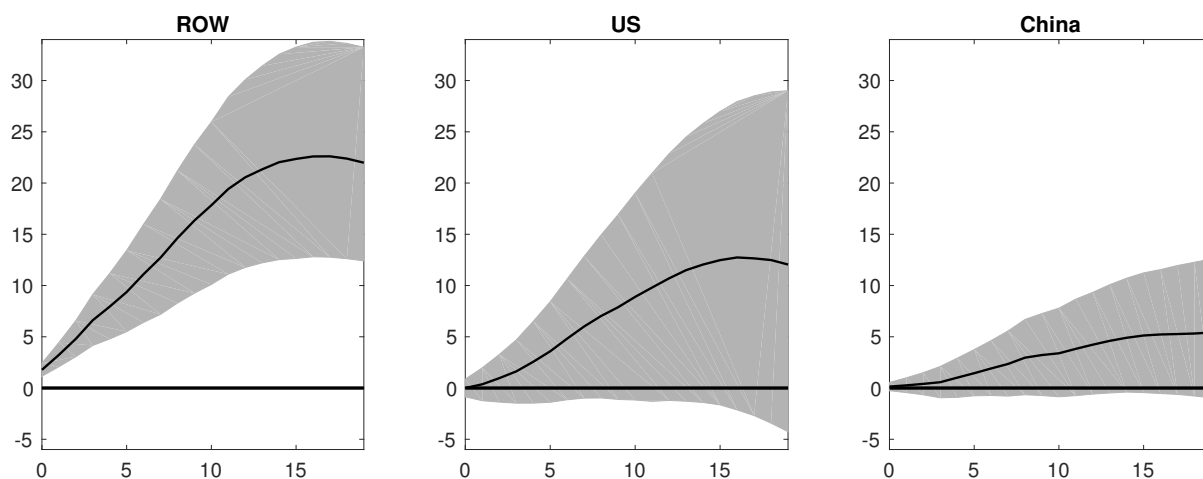


Figure 2: Cumulative impulse responses of the real price of crude oil to 1 percent demand shocks from the US, China and the ROW. Shaded areas are 95% credible sets.

#### 3.2 China vs the US in real oil price fluctuations

Have demand shocks from China or the US had a greater impact on the real oil price over the sample period? We address this question using a historical decomposition of the real oil price in Figure 3. The bars (shaded areas) represent the difference between US and China demand shocks over the sample period. We find that China’s demand for oil has gradually played a more important role than the US’ demand in explaining oil price fluctuations. This is a new finding in the literature and the main result of our paper.

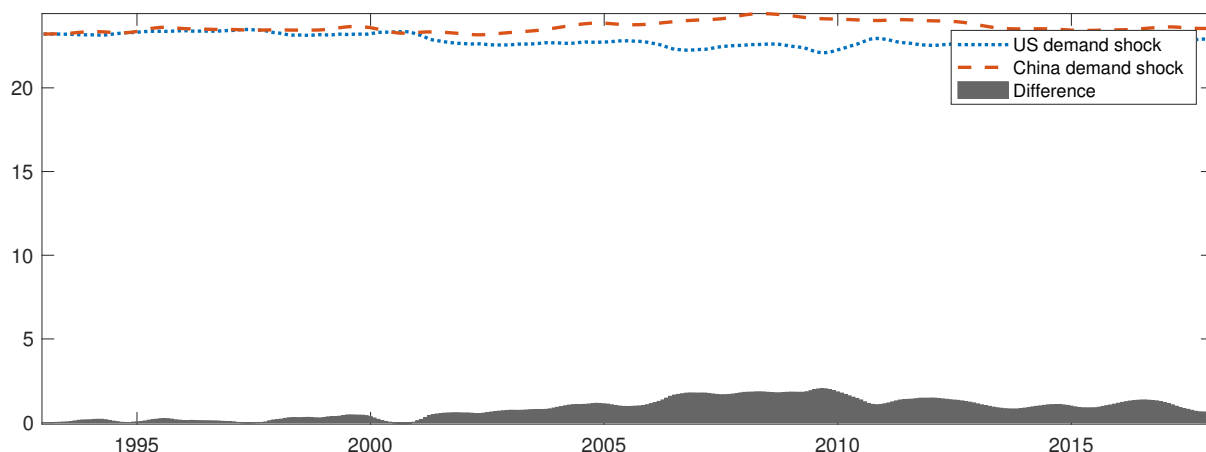


Figure 3: China vs the US in driving the oil price.

### 3.3 Historical counterfactual analysis of the oil price

Was the recent surge in demand from China large enough to cause the oil price rise of mid 2003-2008? We investigate this question using counterfactual historical decompositions of the oil price with a specific focus on demand shocks in Figure 4. While China’s impact was positive during the oil price surge of 2003-2008, the oil specific demand shock, which involves speculative or precautionary motives, is found to be the major determinant of the surge in the oil price during this episode. Our results here is consistent with [Hamilton \(2009\)](#) and [Juvenal and Petrella \(2015\)](#) who also report this shock as the primary driver of the oil price in this period.

More generally, aggregate demand shocks from China and the US have played a much smaller role than those from the ROW. Consistent with [Aastveit et al. \(2015\)](#), we find that demand from the developed country (i.e. the US) has had a largely negative impact, while demand from the developing country (i.e. China) has had a largely positive impact over the sample. While aggregate demand shocks had a positive influence on the oil price during the 1997/98 Asian Financial Crisis, a major seems to have occurred following the turn of the century. Since then, aggregate demand shocks from the US and the ROW have had a negative impact on the real oil price, while the oil-specific demand shock has been positive. This may suggest that the ROW shocks have been dominated by the effects of developed, rather than developing economies. Finally, we observe that reductions in aggregate demand from each economy induced downward pressure on oil prices during 2014-2015 oil price slump.

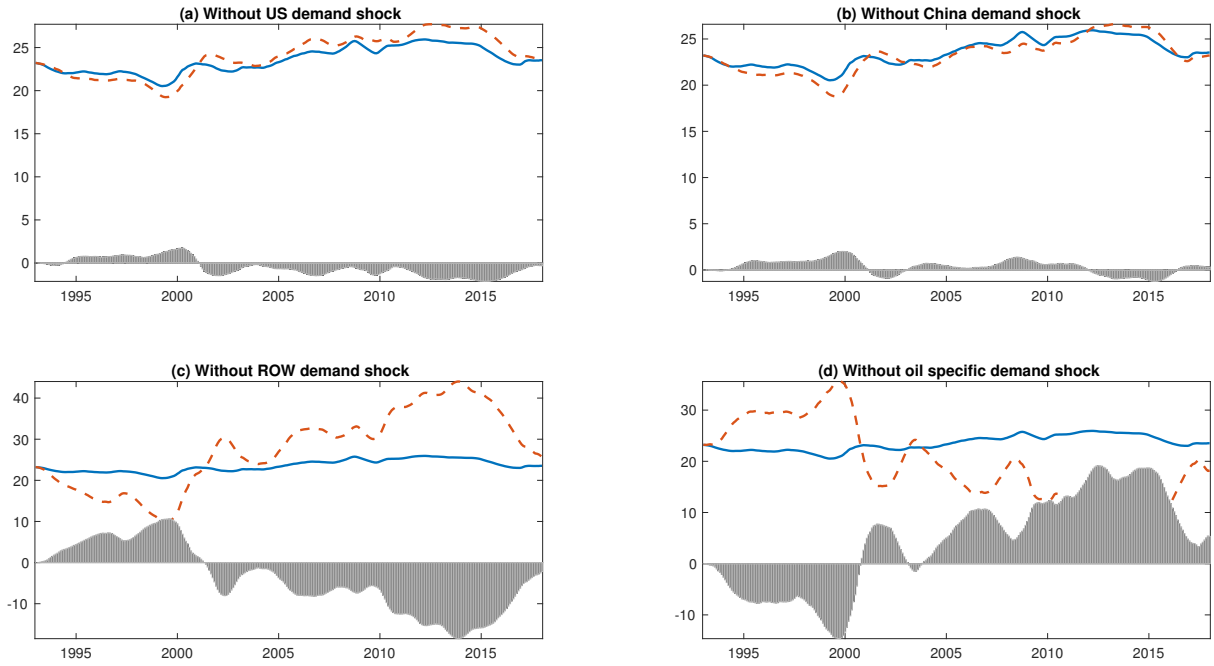


Figure 4: Historical counterfactuals of oil prices.

### 3.4 Robustness

We conduct three robustness checks. First, we examine the possibility of order effects in the identification strategy. This is done by re-estimating the model with each of the six possible orderings of the three REA variables. The resulting posterior medians of the IRFs are in Figure 5. For five of six orderings, a one unit shock from the US produces consistently a larger impact on the oil price than that from China. This exception occurs when we order first the ROW, then China, and then the US. Since the main conclusions hold for an overwhelming majority of the orderings, we interpret this as an overestimate the role of China. We also note that the results for orders with China and the US first and second are identical, while the remaining three orders produce responses that are smaller for US shocks but the same for shocks stemming from both China and the ROW. Importantly, the relative size of the responses is preserved (i.e., the ROW, the US then China) leaving the main conclusions of our analysis unchanged.



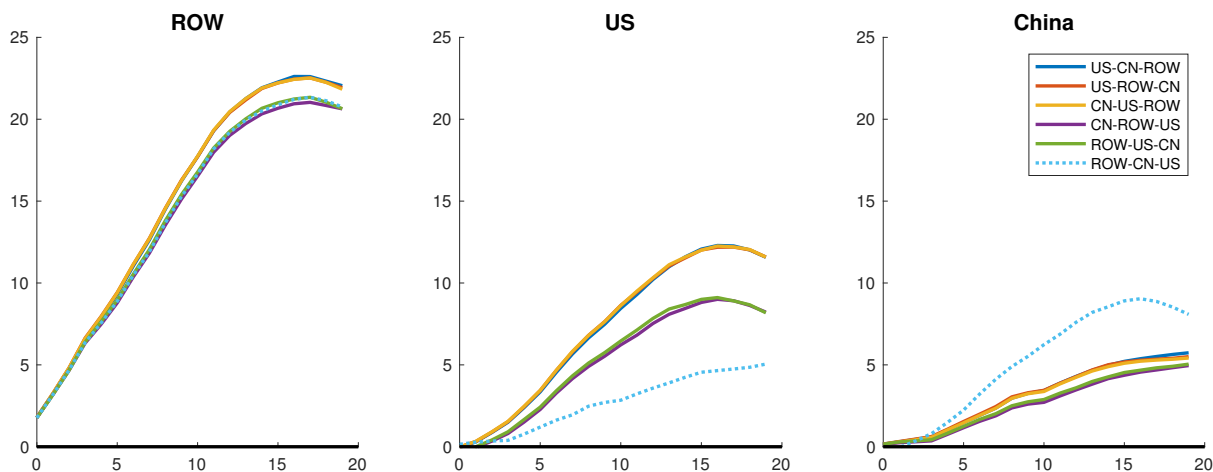


Figure 5: Median responses of the price of crude oil to one percent demand shocks under the six possible recursive orders.

Our second robustness check examines our choice of the real oil price measure. To that end, we replace the average oil prices with the two alternative oil price indexes that are commonly used in the literature: WT and RAC. Since they are extremely similar to the main results we conserve space by excluding them from the paper.

Our final check examines whether the results are robust to the use of steel production, as advocated in [Ravazzolo and Vespignani \(2019\)](#). This is done by replacing IP growth with annualized growth of steel production in the US, China and the ROW, using data from the *World Steel Association* website. Figure 6 presents the equivalent counterfactual displayed in Figure 3. While China’s surpassing of the US is slightly delayed, the main conclusion is in line with our main results.

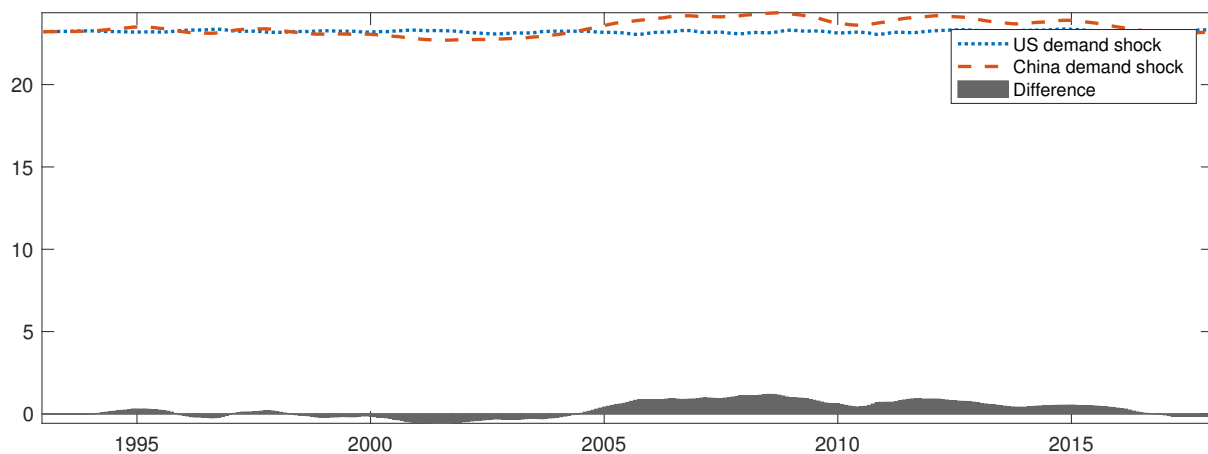


Figure 6: China vs the US in driving the oil price (using the country’s steel production as a proxy for oil demand).

## 4 Conclusion

Have demand shocks from China or the US had a greater impact on the real oil price over the past two decades? Are oil prices more responsive to demand shocks from the US, China or the ROW? Was the recent surge in demand from China large enough to cause the oil price rise of mid 2003-2008? We have provided formal evidence on each of these claims using an extended version of a commonly used structural oil market model. The exception is that the usual global real economic activity measure is decomposed into three economy-specific measures: one each for the US, China and the rest of the world. We found that China's influence on the real price of oil has increased over the past two decades and surpassed that of the US. Despite this result, oil prices are more sensitive to demand shocks from the US than China. Finally, we documented that demand shocks from China alone were too small to have caused the mid 2003-2008 price surge. Instead, oil specific demand shocks, which involve speculative or precautionary motives, were found to be the major determinant of the real oil price during this episode.

## References

- Aastveit, Knut Are, Hilde C Bjørnland, and Leif Anders Thorsrud**, "What drives oil prices? Emerging versus developed economies," *Journal of Applied Econometrics*, 2015, *30* (7), 1013–1028.
- Bañbura, Marta, Domenico Giannone, and Lucrezia Reichlin**, "Large Bayesian vector auto regressions," *Journal of Applied Econometrics*, 2010, *25* (1), 71–92.
- Baumeister, Christiane and Gert Peersman**, "Time-varying effects of oil supply shocks on the US economy," *American Economic Journal: Macroeconomics*, 2013, *5* (4), 1–28.
- Cross, Jamie and Bao H Nguyen**, "The relationship between global oil price shocks and China's output: A time-varying analysis," *Energy Economics*, 2017, *62*, 79–91.
- Hamilton, James D**, "Causes and consequences of the oil shock of 2007-08," Technical Report, National Bureau of Economic Research 2009.

- Juvenal, Luciana and Ivan Petrella**, “Speculation in the oil market,” *Journal of Applied Econometrics*, 2015, 30 (4), 621–649.
- Kilian, Lutz**, “Not all oil price shocks are alike: Disentangling demand and supply shocks in the crude oil market,” *American Economic Review*, June 2009, 99 (3), 1053–1069.
- **and Bruce Hicks**, “Did unexpectedly strong economic growth cause the oil price shock of 2003–2008?,” *Journal of Forecasting*, 2013, 32 (5), 385–394.
- Lin, Boqiang and Jianglong Li**, “The Determinants of Endogenous Oil Price: Considering the Influence from China,” *Emerging Markets Finance and Trade*, 2015, 51 (5), 1034–1050.
- Liu, Li, Yudong Wang, Chongfeng Wu, and Wenfeng Wu**, “Disentangling the determinants of real oil prices,” *Energy Economics*, 2016, 56, 363–373.
- Mu, Xiaoyi and Haichun Ye**, “Understanding the crude oil price: How important is the China factor?,” *Energy Journal*, 2011, 32 (4), 69–91.
- Ravazzolo, Francesco and Joaquin L Vespignani**, “A new monthly indicator of global real economic activity,” *Canadian Journal of Economics*, 2019, *forthcoming*.
- Wu, Gang and Yue-Jun Zhang**, “Does China factor matter? An econometric analysis of international crude oil prices,” *Energy Policy*, 2014, 72, 78–86.

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