

# Understanding Oil Price Dynamics and their Effects over Recent Decades: An Interview with James Hamilton

Fredj Jawadi<sup>a</sup>

---

## ABSTRACT

The following interview with Prof. James Hamilton was conducted in April 2018 by Dr. Fredj Jawadi with the assistance of Professors Jim Smith and Adonis Yatchew during the 5<sup>th</sup> International Symposium in Computational Economics and Finance (ISCEF) held in Paris, France. The interview includes 21 questions related to oil price dynamics. The aim of the discussion was, first, to help the reader gain a better understanding of the factors driving changes in oil prices, second, to examine the impact of oil price shocks on the economy and, third, to understand the dynamics of oil prices in the future. The recent related literature on oil price uncertainty is also discussed. We hope that this interview will give the reader clearer insights into the causes and consequences of oil price change and its evolution over time.

**Keywords:** Oil price shock, Causes of oil price changes, Consequences of oil price shock, Uncertainty, Global financial crisis

<https://doi.org/10.5547/01956574.40.SI2.fjaw>

## BACKGROUND AND INTRODUCTION

James D. (Jim) Hamilton has since 1992 been a professor in the Economics Department at the University of California at San Diego, where he currently holds the Robert F. Engle endowed chair in economics. He served as department chair from 1999–2002, and has also taught at Harvard University and the University of Virginia. He received a Ph.D. in economics from the University of California at Berkeley in 1983. Professor Hamilton has published on a wide range of topics. His research in areas that include econometrics, business cycles, monetary policy and energy markets has received more than 50,000 citations. His graduate textbook on time series analysis has sold over 50,000 copies and has been translated into Chinese, Japanese and Italian. He also contributes to Econbrowser, a popular economics blog. Academic honors include Research Associate with the National Bureau of Economic Research, Best Paper Award for 2010–2011 from the International Institute of Forecasters, and the 2014 award for Outstanding Contributions to the Profession from the International Association for Energy Economics. He is a Fellow of the Econometric Society and the Journal of Econometrics and a Founding Fellow of the International Association for Applied Econometrics. He has been a visiting scholar at the Federal Reserve Board in Washington, DC, as well as the Federal Reserve Banks of Atlanta, Boston, New York, Philadelphia, Richmond and San Francisco. He has also been a consultant to the National Academy of Sciences, the Commodity

*This interview with Prof. James Hamilton was conducted by Fredj Jawadi (University of Lille, France) with the assistance of Professors Jim Smith and Adonis Yatchew, in Paris in April 2018 during the 5th International Symposium in Computational Economics and Finance ([www.iscef.com](http://www.iscef.com)), where Professor Hamilton was among the Keynote Speakers.*

a University of Lille, 104 Avenue du Peuple Belge, 59000 Lille, France. Email: [fredj.jawadi@univ-lille.fr](mailto:fredj.jawadi@univ-lille.fr).

Futures Trading Commission and the European Central Bank, and has testified before the United States Congress. Professor Hamilton has received six teaching awards from the UCSD Economics Department.

The main focus of our interview is on James Hamilton's work in the field of Energy Economics. The aim is to improve our understanding of the drivers of oil price dynamics and their effects on the macroeconomy, both in the past, in the aftermath of the 2008 global financial crisis, and more recently in 2014. This is particularly relevant because Jim has been a leading voice in the field of energy economics since the 1980s. Jim was the plenary speaker at the 5<sup>th</sup> International Symposium in Computational Economics and Finance (Paris, April 12–14, 2018), and he was kind enough to agree to an interview on the evening of the symposium. We sent Jim the questions prior to our meeting.

We hope that this interview will provide you with further insights into the drivers and consequences of oil price shocks, while illustrating Jim's contribution to energy economics and energy markets.

The interview is organized into four sections. The first section presents the context and some general questions on the motivating factors in oil markets. The second section discusses the factors driving changes in oil prices. An analysis of the effects of oil price shocks on the economy is the focus of section three, while section four gives some insights into the future of oil price dynamics.

## 1. CONTEXT AND MOTIVATION

**Fredj: Q1.** When and why did you decide to work on issues in the oil market?

**Jim:** When I was a graduate student in the late 1970s, we were in a very turbulent period for energy markets. We'd seen the OPEC oil embargo of 1973/74 lead to a big increase in the price of oil and then a few years later, with the Iranian revolution in 1978/79, there was another big increase in oil prices, and it seemed that those events were contributing factors to some of the weak US economic performance of that decade. And as I looked into this, I was surprised to discover this wasn't the only time something like this had happened. In fact, of the seven recessions we'd had in the United States up to that point, six of them had been preceded by a very sharp increase in the price of oil and so I decided to work on that relation for my dissertation, and in fact by the time I was done, the count was up to seven out of eight. We had the Iran/Iraq war shortly after the Iranian revolution, and we had one of the shortest expansions in US economic history, we had the eighth US recession follow the seventh within twelve months.

**Fredj: Q2.** How would you classify this area of your research?

**Jim:** It's at the intersection between energy economics and macroeconomics and econometrics, and those are sometimes a little unusual combination for a lot of energy economists from a micro point of view.

I was always interested in the macro question because that's part of what I saw going on in the 1970s.

**Fredj: Q3.** Why should we be interested in this line of research on energy markets?

**Jim:** One of the questions I got when I was pointing out this relation to people, was they said, "Well, how could this be? Oil is such a small share of total GDP, how could something that small in terms of the dollar value lead to these really big disruptions", and I think that's a very interesting question.

I'm convinced that they did, and I'm convinced that that's related to a lot of our puzzles in macro, we seem to see small disturbances have big effects, there's something very inefficient it seems, there's something very disruptive going on in the economic recession.

A lot of people attribute that to nominal rigidities. I think in fact technological rigidities are an important part of it.

**Fredj: Q4.** Is the term “oil shock” a suitable one for describing large changes in oil prices? Why is the oil market so volatile?

**Jim:** Commodity prices generally are volatile, and the reason for that is that the demand is relatively inelastic in the short run. I think that's particularly true in the case of oil. People can't do that much in the short run to change the amount of gasoline they consume this month, and you combine that with the fact that oil has often been subject to substantial disruptions in the supply. Geopolitical events would lead to perhaps a 5% reduction in the total quantity produced. Well 5% might not seem like that big an amount, but when you have that low elasticity in demand, it can lead to a doubling of the price of oil in a relatively short period. So yes, I think shocks is a good term for what these events often were. We've come to use 'shocks' for a general description of something in macro models. In this case, I think we have very clearly identified some historical events and know for sure that OPEC cut production by this amount and here's how much oil prices went up.

## **2. CAUSES AND DRIVERS OF OIL PRICE CHANGES**

**Fredj: Q5.** What are the main historical causes of postwar oil shocks? Are they purely specific to the oil market or are they linked to business cycle dynamics or other exogenous shocks?

**Jim:** You can talk about different contributing factors in different episodes and in fact some people have rightfully pointed out, there were a number of things producing inflationary pressure, for example, in 1974 or '75. But on top of those, there were very specific events. In the fall of 1973, there was a very abrupt cut in the production of oil and a very abrupt increase in the price of oil and there are a number of events like that. I've mentioned the OPEC embargo, the Iranian revolution, the Iran/Iraq war are three of them, the Suez crisis in 1956/57 is another example like that, and the first Persian Gulf War in 1990/91. So those are five classic examples of oil shocks, where I think it's pretty clear that the major driver was exogenous geopolitical events which in fact were unique to the oil sector. So yes, there are a variety of things that could lead to a change in oil prices and that's something we sometimes see, but for some of these episodes I think there's a pretty clear understanding that it really was a shock, an exogenous shock to the economy that manifested in an abrupt increase in the price of oil.

**Fredj: Q6.** Were the causes of the 2008–2009 oil shock different from previous ones? If so, why? What role did China play in the patterns of oil price changes since 2000?

**Jim:** It's very different and that was something that interested me into looking more at what was going on in that episode because there really wasn't anything geopolitical in that case. It was part of a broad pattern in terms that commodity prices generally were strong, and I think that the common factor in that was the strong demand from emerging economies, particularly China. But what I think was a little special about oil was that you see kind of a break in the historical pattern of oil production in 2005 to 2008. Usually it had been going up year after year as we found new sources of oil. Well, it kind of stagnated for 3 years there from 2005 to 2008, world field production of crude oil, and that was the time when the demand for consumption from China was increasing quite a bit. Well

how can you have China consuming more oil when no more oil is being produced? Well the only way is for the other countries, the United States, Europe and Japan, to decrease our consumption of oil. As I was saying, it takes a lot to persuade people in a short period of time to decrease their consumption of oil, and the result was a pretty dramatic increase in the price from the end of 2007 to the middle of 2008, which in terms of magnitude was nearly as big a movement in oil prices as these other episodes I was talking about, although it came from rather different causes, and I was interested to see that the general response of the US economy was not that different to the oil price increase in 2007/2008 compared to the earlier episodes.

**Fredj: Q7.** In your paper “**Understanding Crude Oil prices**”, published in 2009 in *The Energy Journal* (Vol. 30, N°2, 179–206), you mentioned the *role of commodity speculation* among other factors explaining oil price changes. How important is this phenomenon in explaining the run-up in oil prices between 2010 and 2013?

**Jim:** Well, that was a popular hypothesis, particularly from politically active individuals, that this was all speculation somehow that was driving up the price of oil in 2007/2008. The thing you have to wrestle with if you try to put that to the data is well, usually economists would say there’s supply and demand, there’s supply that’s physically being produced and physically being consumed. If the price is higher than that value at which quantity produced equals quantity consumed, what happens is inventories should be accumulating. Well, we didn’t see that much of a change in inventories and if you try to say, well how could that be, how could we have almost equilibrium in the oil market with a price of 100 dollars a barrel and almost still be at equilibrium with a price of 140 dollars a barrel? Well the mathematics to get to that come down to, you’ve got to have very low elasticity of demand, at least in the short run, and I think we had unusually low elasticity of demand in 2007. The price kept going up, Americans kept on consuming almost as much oil as they had been, and it took really quite a big increase. Well, if you say the only way that the speculation stories can work is with a very low short-run elasticity of demand, and that’s true, well that same very low short-run elasticity of demand also means that you can explain the whole thing pretty much with fundamentals. And so I actually was not so persuaded that speculation could be the major factor in the price increase of 2007/2008 or other episodes. Now a lot of other people have looked into this question from different data sources and different ways of posing it. I think that’s the broad conclusion though from the literature, that sure, speculation can and does change the price of oil every day as the market reacts to this hurricane or that bit of news from the Middle East, or whatever it might be—the Department of Energy numbers for inventories this week--but I think it’s doing so in terms of fundamentals. In particular in 2008, what you would see is that when the weekly oil inventory numbers got released and they show “gee inventories are down, not up”, people concluded “wow, the price still isn’t high enough to choke off demand.” I think there’s not a strong case for saying oil prices are driven primarily by speculation.

**Fredj: Q7.** Was this an oil market bubble? Are there analyses, statistical or otherwise that would permit identification of such bubbles with a fair degree of certainty?

**Jim:** Well it looks like a bubble in retrospect in that it went up and then went way down. You might equally well argue that the very low price at the end of 2008 was some kind of bubble, because that turned out not to be sustained; the price went back up. I think it’s really better to interpret the markets in terms of there is a very low short-run elasticity in demand and that means that if there’s a little excess demand for whatever reason you’re going to see a big run up in price, and that’s what happened in 2007/2008. When there’s a little excess supply you see a big drop in the price, that’s

what happened at the end 2008, and that's the way it's always been. A low elasticity of demand in the short run helps you make a lot of sense I think out of the oil markets.

**Fredj: Q8.** The price of oil fell from \$140/barrel in the summer of 2008 to \$60/barrel in November 2008. What were the causes of this abrupt change in oil price? Is the correction an indication of efficiency or inefficiency? Rationality or irrationality? Are there market fundamentals which would suggest a stable price range for the coming years?

**Jim:** It's not rational I suppose if you knew that was going to happen. I think the bottom line is people didn't know. I mean, hey, it's the same thing why did stock prices go down so much. If any of us knew the stock price was going to go down that much, or the oil price was going to go down that much, sure, we would have been selling much earlier. No, I think the bottom line for both the stock market and the oil price is that the magnitude of the economic collapse turned out to be much bigger than anyone had expected. As I was saying, it's hard to get the demand for gasoline to go down just from the price movement. But once you hit people's income, then you see demand drop, and that's what brought oil demand down by a bit. And I think there may have been some delayed response, as the longer run elasticity of demand is higher than the short-run elasticity.

So, the two factors, lower income and gradual adjustment of the kind of cars people drove and so on were, by the end of 2008, giving us a much lower price of oil. Though as I say, I think it went lower than really makes sense in terms of long-run fundamentals, just as the stock market went lower than made sense from long-run fundamentals. It turns out it was not the end of the world in 2008. We got out of that recession, slowly, painfully, so you can maybe say the markets over-reacted a little bit on both sides. That's an easy call with twenty/twenty hindsight. It's a lot harder to say at the time you see these things unfolding.

**Fredj: Q9.** Do you think that the shale revolution will have an enduring, even permanent effect on oil markets? It has been argued that the scalability of shale has further eroded the market power of OPEC. What are your thoughts on this position?

**Jim:** Well, it's certainly had a big effect so far, a bigger effect than I was anticipating. It turns out to be a very different technology than traditional oil production. Traditional production relied on basically discovering these huge reservoirs of oil and pumping that and then eventually you run out of that and you hope you find something else new. The shale is much more of a production process, they go in this place they get oil and then they go somewhere else. And it's almost like an assembly line, a manufacturing operation. There was a tremendous amount of learning that went with that, tremendous productivity gains, that caught me by surprise certainly. But that gave not just the phenomenal increase but the firms could produce the oil at much lower prices than they originally could with the first technology. So, yes that's been a lasting change. I do think that it's not consistent with the price of oil below 50 dollars say for long. I think most of these guys cannot make a profit at that, but above 50 many of them can. And so that's putting at least in the intermediate run a kind of a ceiling on oil prices. If the price were to go back up to 100 dollars a barrel, we'd see a much larger increase from those shale producers in the US and that should temper the tendency to go up from there. And on the way down, if the price goes much below 50, I think a lot of the people have to drop out and that's going to take supply off the market. So yes, it's definitely a different market today because of the shale producers.

Now part of that's also because demand from China has been weaker and commodities overall are down, not just oil, from 2014. And it's also a feature of the fact that production from places like Iraq and Iran has gone up relative to what it had been. So there's a little less demand,

there's an extra buffer for supply and that makes it easier for the US shale producers to be the deciding factor, the marginal producer that's really going to determine the price. Now if we had another major disruption in the Middle East, or if China went back to the growth and commodity consumption that they had been, well you might really tax the ability of these Texas producers to feed the whole world. But at the moment it's definitely calling the shots in the sense that the marginal producer today is the US shale producer. They have an upward sloping marginal cost curve and it functions just like your standard model of supply and demand says it should.

### 3. EFFECTS OF OIL PRICE SHOCKS ON THE MACROECONOMY

**Fredj: Q10.** Your paper "*Oil and the macroeconomy since World War II*", published in the *Journal of political economy* 91 (2), 228–248 in 1983, is the most influential reference in the literature on the macroeconomic effects of oil prices (it has 3119 citations). Can you summarize the main contributions of this paper? Why do you think it has been so influential?

**Jim:** The paper tried to do two things. First, to show that this correlation between oil price movements and what happened later in the US economy was for real, and second to argue that it should be given, at least in part, a causal interpretation. I tried to establish, both in terms of the historical events and in terms of statistical analysis, that the primary causes of these oil price increases came from factors outside the US economy. The way you make that case historically was to claim well, here this shock came from this particular event and here's the war that led to that. The way I tried to do that statistically was to show that in fact you couldn't really predict these oil price increases from the US economic growth that had preceded them or any of a variety of other factors. Now as for its influence, it really wasn't that profound the set of the things that I did. But I think I was in the right place at the right time. I was making a claim that at the time was pretty surprising to people, that oil shocks were a significant factor in some US downturns. Today, that's, I think, the conventional wisdom. I think most people would agree, yes, these events sometimes can be disruptive. There came to be a lot of papers talking about that and fortunately, I was the first in line. So I got a lot of citations that came from that literature. But I don't think it was because I did something so special.

**Fredj: Q11.** In 1996, you published a paper in the *Journal of Monetary Economics* (38, 215–220) "*This is what happened to the oil price—macroeconomy relationship*". You wrote "*Clearly oil prices have behaved radically differently after 1986 than before*", (page 2015) and you seem to answer Hooker (1996) who argued that oil prices no longer had a causal impact on many macroeconomic variables. Why did oil prices behave differently after 1986? Did the relationship with macro variables change? You also predicted that an oil crisis would lead to a recession in the USA? What was the basis for this prediction and were you right?

**Jim:** The historical relation had been estimated by me and many who followed me by linear regression, that is the growth rate of GDP is some linear function of what happens to oil prices prior to that. And that worked OK up until 1986 because really the only big changes we saw in oil prices prior to 1986 were up. Each of those episodes I talked about was an increase in the price of oil, there really wasn't anything leading to a big decrease in the price of oil. Where we got our first observation on what's the consequence of a negative oil shock in 1985/86, we saw a huge drop in the price of oil. That ended up not leading to a boom in the US economy. So clearly it's not a linear relation. My argument was that there's economic disruption that comes from an oil price increase that is not mirrored by benefits from an oil price decrease. If you thought it was purely an income effect or

purely something affecting what you could physically do in terms of production, you might expect symmetry, you might expect linearity. But my view was always it was demand-driven. That for example what happens in a recession when there's a big increase in the price of gasoline is people stop buying new cars, or in particular they stop buying the less fuel-efficient new cars, and you have specialised capital and labour in Detroit and other places that were manufacturing the kind of car people don't want anymore. When that labour and capital becomes idle, you have a big effect on the overall economy when the oil price goes up. Now, when the oil price goes down, people don't go out and buy two cars instead of one, and furthermore, the people who had been producing oil in Texas and elsewhere, when the oil price goes down, that's a loss in their income and there's some specialised labour and capital in oil production as well. So I argue that this is not a linear relation and that that was the answer to why it seemed unstable to someone who expected to see a linear relation. Basically people were surprised that the oil price decrease in '85/'86 and what we saw subsequent to that were not leading to an economic boom. And I said that's perfectly consistent with the observation that a big oil price increase can lead to an economic downturn.

**Fredj: Q12.** Research has suggested a significant link between oil price volatility and the U.S. dollar, but there is less unanimity about the nature and the sign of this relationship. Could you talk about potential links between oil prices and the dollar? Is there a causal relationship? Can the Fed's action affect this relationship?

**Jim:** Certainly the Fed action could affect the relationship. The first thing I'd emphasise is the magnitude. In these episodes I've characterized as oil shocks, you see the price of oil move at least 20% in the space of a month or two, and you don't see a 20% change in the exchange rate within the space of a month or two. If you do, you call it an exchange rate crisis basically and certainly that's not happening with the dollar in any of these episodes. So frankly whether you measured it in terms of dollars or euros or whatever, you're talking about a very similar-sized shock. It's a change in the real price of oil anyway you look at it. Now there are longer-run factors and it's certainly true that other things equal, if there is appreciation of the dollar, you'd think that the price of oil in dollars might be lower as a consequence of that. But the thing you have to remember about exchange rates is they're an endogenous variable, as to some degree in normal times are oil prices. The exchange rate can change because of interest rate differentials or income growth differentials or all kinds of factors. To think there's going to be some constant correlation between the exchange rate and something else is just to overlook that. What you see in the data is the correlation between the exchange rate and really any other variable of interest—whether it's oil prices or interest rates or whatever—those correlations are changing over time. And I think the natural interpretation of that is that the factors driving the exchange rate are changing over time. Sometimes it's the interest differential, sometimes it's the differential in the growth rate, sometimes it's the differential in inflation rates across countries. Depending on the source of why the dollar moves, you'd expect perhaps a very different direction that oil prices would take. But I don't think it's correct to think in simple terms, well when the value of the dollar changes, here's what happens to the price of oil. Instead, when variable X changes, here's how the dollar changes, here's how oil prices should change. And that can result in very different correlations at different times.

**Fredj: Q13a.** According to your *Journal of Econometrics* paper published in 2003 (Vol.113, pp 363–398), “**What is an Oil Shock?**”, and your paper “**Nonlinearities and the Macroeconomic Effects of Oil Prices**”, published in *Macroeconomic Dynamics* (15,3, S3, 364–378) in 2011, the relationship between oil price changes and GDP growth is not linear. What is the basis for the non-linearity?

**Jim:** Again you can make the case either statistically, which I did primarily in that *Journal of Econometrics* article, or in terms of what's going on with economics. Now what I think we observed in 2006, 2007, 2008 is that, for example, the first time gasoline went to 3 dollars a gallon in the United States, there was this big response of consumers. You saw consumer sentiment go down, you saw car sales respond a little bit. Gasoline prices went down, then went back up. The second time we saw 3 dollars a gallon, people didn't pay so much attention in the US. But then when they went to 4 dollars, that got people's attention. The mechanism that I see in play is that when something dramatic happens, like the first time you see gas at 3 dollars a gallon or the first time you see it at 4 dollars a gallon, you say "oh, my gosh, maybe I shouldn't buy this SUV I was thinking of." Insofar as that's the mechanism, that it affects, for example, the demand for newly manufactured cars of a particular type, you'd expect the response to depend on the recent history of oil prices. That's the interpretation I give in terms of the economics. As I say you can make the case purely statistically in terms of the data. Whatever your interpretation, it does seem to be a non-linear relation.

**Fredj: Q13b.** Would you comment on whether your findings can be reconciled with those of Kilian and Vigfusson (2011)? How long has your interest in Nonlinear Time Series been impacting your research on oil price dynamics? Is there a class of nonlinear models which you believe are best suited for studying these relationships?

**Jim:** That's a good question. First, as far as Kilian and Vigfusson go, they have a particular test for non-linearity which involves simulating a potentially non-linear vector system and calculating test statistics based on that, which they liked as sort of a general test. And what they found with that was that they failed to reject the null hypothesis of linearity. But when you do other, more straightforward tests, like just look at the conditional expectation of GDP four quarters ahead, conditional on oil prices and other variables, you get a very simple way to test the linearity hypothesis that doesn't require a simulation. It doesn't require any abstract econometric theory, and actually gives a very simple and powerful test that tends to reject the null hypothesis of linearity. In addition, they were looking at slightly different data. They used a little different sample period from what other people do, they used a little different measure of the price of oil, they made a number of decisions and when I looked at it, every one of those decisions ended up reducing a little bit the case for nonlinearity. But even if you take their specification of oil prices and the sample period and everything else, if you do just the straightforward conditional expectation test, you end up clearly rejecting the null of linearity. So that's one area where I disagree with Lutz and Rob. I think they're just misreading the evidence. They want to just use that one test of theirs, and I don't think it's as powerful a test. Just because you failed to reject the non-linearity hypothesis, that doesn't mean it's true. If there's another more powerful test that does reject it, I think that evidence is clear.

**Fredj: Q13c.** Is there a class of nonlinear models which you believe are best suited for studying these relationships?

**Jim:** Well of course the trouble, as my dear colleague Clive Granger used to say, is that the set of linear models is a pretty big set. But when you think of the set of all possible non-linear models it's like going from the bathtub to the Pacific Ocean. There are all sorts of ways you can write something nonlinear. And it's in fact pretty hard to distinguish one nonlinear model from another. There are lots of ways you could pose the non-linearity and you'll find something similar. My particular approach to that question came from this reasoning I describe that I think people's reaction when they see the price of gasoline go up for the first time is different from their reaction if it's just back up where it was a year ago or two years ago. Using a flexible non-parametric approach to the nonlinear relation,



I found that that specification is quite consistent with what we see in the data. But I would be the first to acknowledge there are lots of other nonlinear ways to write that relation that would also be consistent with the data. What I disagree with Kilian and Vigfusson is, I do not think a linear relation does the job.

**Fredj: Q14.** Economists have used a broad range of models to study the dynamics of oil price and the effects of oil shocks. In your view, which models are best suited to study oil markets as well as the relationships to macroeconomic variables?

**Jim:** I think one of the challenges is that many of the events we've been talking about were not economic events so much. When Iraq invaded Kuwait in 1990, it was not because of something going on with GDP somewhere. It was the politics in Iraq and the move that he thought he could make at that time. I think sometimes in economics, we overlook those kind of common sense developments in the world. So, as far as building a model of that, how do you build a model of Saddam Hussein and what he's going to do? Show me a model of whether there's going to be a war in the Middle East in the next five years. I know that I don't have one that works. So I think we need some humility as far as that goes. And given that these things happen, it's actually great from an econometric point of view because we have all of these natural experiments. What would happen if the world suddenly had to make do with 5% less oil being produced? Well, that's an experiment that's been run for us a number of times and I think we know the answer. It's kind of hard to get by in the short run when that happens.

And as far as modelling the details, the key things we can model successfully I think are the short-run and the long-run responses of both demand and supply to these disruptions. I think as we were discussing, the shale production is introducing a new dynamic into that. Clearly we ought to be using a different model today to describe oil markets than we used 10 or 15 years ago. So that's my answer. I think we never want to let institutional analysis or knowledge of historical events get left out of the process of building a model and understanding what's going on.

**Fredj: Q15.** Some authors have used various structural VARs to study the effects of oil price shocks. What are your views on the suitability of this type of modeling?

**Jim:** Structural vector auto-regression is an approach to get at this problem of identification. We see a correlation between one variable and another. Does that mean that X is causing Y, or is Y causing X, or is some other variable causing them both? Structural vector auto-regressions are one approach to try to answer that issue. There's been a variety of ways that people have gone at that. I have a new paper which I'll be presenting here at this conference tomorrow which revisits that whole approach. What people have assumed primarily in the structural vector auto-regression literature is that they know something about the structure for sure. For example Kilian's earlier work was assuming that there was zero short-run elasticity in supply to the price of oil. When you make assumptions like that, then you can interpret when there's a correlation, it must be supply that caused the quantity to change, and not demand or whatever. But the problem is that we don't really know for sure if the short-run elasticity of supply is zero. We know it's small. I think we know it's not too big, but we don't know for certain that it's zero. One of the things I've been developing recently is an econometric approach where you acknowledge I don't really know for sure this assumption that was playing the role of an identifying assumption in a structural VAR. I have some ideas that I could represent with a Bayesian probability distribution that says "some possible configurations are more likely than others" and use that as a way to revisit these correlations. I just use the oil supply and demand as one example of that. Another is the effect of monetary policy which has also been investigated in a big

literature. But again I come back to the same answer, and I think that the monetary policy literature has come to this conclusion as well, is that your best bet is to try to look for actual experiments if you can find them. If you have some event and you're sure at this particular time the markets were responding to a release from the Federal Reserve that came at such and such a time on this day, I think you have a much stronger case for interpreting the correlation as X is causing Y and not the reverse.

**Fredj: Q16a.** In 2009, you published an interesting paper in *Brookings Papers on Economic Activity*, (Spring, pp. 215–259) entitled: “**Causes and Consequences of the Oil Shock of 2007–2008**”, which has already been cited 1393 times. Accordingly, does the 2007–2008 oil shock appear to be different from previous oil shocks? Is it a demand-driven or a supply-driven shock? Does this recent oil shock still matter for the economy?

**Jim:** Yes, that was a different event. There were no significant disruptions in supply but there was a very sharp move in the price that, given the magnitude of the move and the short time frame of it, was comparable to what we saw happen to the price of oil in some of these other supply-driven changes. Now I think it's interesting to look at what happened to the US economy during that period. What you see is a very similar response from the end of 2007 to the middle of 2008, as you saw to the other historical oil price movements. Namely, you see US consumer sentiment start to tank. You see sales of autos manufactured in the United States start to go down significantly. You see employment in the auto sector falling. And you can estimate relations for those things using data up to 2007 and fit reasonably well what actually happened in the end of 2007, beginning of 2008. Calculations like that lead you to conclude that at least for the early downturn of the great recession, before the financial crisis in the fall of 2008, perhaps as much as half or more of the downturn can be attributed just in terms of the arithmetic to what was happening to the auto sector and related sectors in response to something pretty similar to earlier episodes. Now, it's true that the auto sector was not quite as a big a part of the US economy in 2007 as it had been in 1980, for example, and that's partly a moderating influence. It's also true that the fraction of the budget that people were spending on gasoline in 2005 was substantially lower than it had been in 1980. And so for those reasons you might say, well I should see a smaller response of things like GDP to this oil price increase, and to some degree that's confirmed. But I think we wrote off the US automobile sector too soon. I think one of the things we saw in that episode in 2008 was that our autos still matter a lot to the US economy. And another thing people forget is that because the short-run demand for gasoline is so low, when the price starts to go up significantly, the share of your income that's devoted to energy goes up along with it. So everybody was saying well the expenditure share of energy has been going down and so the economy is less vulnerable than it had been and that's true. By 2008 that expenditure share had gone back up to the kind of numbers we'd seen historically, and at that point it was a much bigger hit to the budgets of lots of consumers and they did start to respond in that way. So I think people overplayed a little bit this idea that well we're not sensitive to oil shocks anymore, manufacturing doesn't matter anymore. There's some truth in that it's probably a smaller effect but it's by no means a negligible effect as I think the events of 2007/2008 showed this.

**Fredj: Q16b.** Is the further effect of this oil shock less important on the US economy given that it is less oil-intensive?

**Jim:** Right at the moment, yes. Right at the moment, the expenditure share is back to a low level and so I think we may be a little bit less vulnerable. As we were saying, I think that the shale production gives us some cushion both in that it will mitigate some of the price increase when the next development comes, and actually because that's US domestic production, that's one sector of the US

economy that would do well if we had an increase. So yes, I think we are a little bit less sensitive than we have been. Though as I was saying, I don't think we're completely insensitive. As a matter of fact, just this year, the US auto companies are making decisions to go back into SUVs, to go back into the fuel-inefficient vehicles, and again this is history replaying itself. That's what we went through with the seventies and that's what we went through with this latest episode. You know, over time everybody gets lulled into thinking gas is going to be cheap and they start to make plans based on that and that all works fine for a while. But I think the auto sector is going to be vulnerable again, especially in a few years, especially if gasoline prices continue to climb a little bit and we have those expenditure shares going back up. I think if had another major event in the Middle East, it would again be disruptive for the US economy.

#### 4. OIL PRICE DYNAMICS IN THE FUTURE

**Fredj: Q17.** Could you comment on how recent geopolitical instability in various parts of the world is likely to impact oil prices? Are there particular geopolitical factors that you believe are especially prominent in your assessment of oil markets?

**Jim:** As I say, I cannot predict the Middle East. One of the reasons I was wrong in thinking where oil markets were going to go is that I was surprised that Iraq was able to increase their production so successfully. It wasn't that long ago when ISIS was claiming a significant chunk of the territory within Iraq, and it looked to me like there was potential instability. We had ongoing discussions about what's going to happen with Iran and that's going on today. Despite all that, Iran and Iraq are producing lots of oil at the moment. But where things will go, I don't know. There's been a history in the Middle East of a lot of turbulent events which have significantly affected world oil production. I think they're, by their nature, impossible to forecast, at least I know I'm not capable of predicting what's going to happen next in the Middle East and North Africa as well. Historically there's been a lot of instability in those areas. Right at the moment we have relative stability, right at the moment there's very abundant production. I think it would be a mistake to assume it's going to be like that for the next ten years for sure.

**Fredj: Q18.** Some oil exporting countries (such as Saudi Arabia through its National Program *Saudi 2030*) plan to reduce their dependency on the oil sector. How could this affect oil prices in the future?

**Jim:** Saudi Arabia is a really important producer in world oil markets and so what happens there is very significant. I'm a little encouraged and optimistic that I think we are seeing the first signs of some real reform in Saudi Arabia, not just in terms of what will be done economically and with their dependence on energy, but the whole political process there seems to be opening up a bit. I think that's good for them and that's good for the world. Now the extent to which they're going to succeed in diversifying their economy, I don't know. I think it's a big challenge, but they've taken the first steps that I think are encouraging for everyone.

**Fredj: Q19.** Do you see a declining impact of oil prices on macroeconomies going forward, for example as a result of decarbonization? If so, over what timeframe?

**Jim:** Well, yes there are some people who talk about peak demand, that think we're going to radically change the way we use automobiles for example for urban transportation, that maybe the use of electric cars or natural gas-powered cars will become a much more dominant factor. That's

another variable that for me is very hard to see how that's going to unfold, but it certainly has the potential. If we do go away from reliance on personal automobiles, that will be a major change in oil markets, no question, because the whole point is as far as transportation goes, gasoline is a very efficient way to deliver energy. It's a much more efficient way to get your car from A to B than natural gas or than electricity. And so it's a significant challenge. In the seventies when oil prices went up, we were able to substitute away, and say "OK, let's not use oil to produce electricity." Well, we use very little oil to produce electricity today. Producing electricity, a BTU from oil, from natural gas, we don't really care. But transportation is really where oil historically had a unique role. If we were to develop alternative solutions technologically to transportation, yes, that would make a major difference in the role of oil markets. That process certainly hasn't happened to a degree today that's made us insulated from changes in oil price. Still, the vast majority of vehicles are gasoline powered and as long as that's the case, I think there's still the vulnerability of economies like the United States to subsequent events should they occur. But if there is a move away from oil as a source of energy, which really, as I say, is going to come down to transportation, that would be a game-changer.

**Fredj: Q20.** Several recent papers suggest increased uncertainty regarding oil prices and reserves. Do you agree with this view? How might uncertainty affect the oil-economy relationship in the future?

**Jim:** Well, there's uncertainty, but I think there's always been uncertainty. We have the shale production now, and that's producing a lot currently. How long can that shale production be maintained from the US? I certainly don't know, whether it's five years, ten years, longer, and particularly if you try to up the volume, how long can you sustain it? Is the geology and is the infrastructure there to really develop the same shale resource in other parts of the world? Maybe, but we don't have it yet. So I think there's lots of uncertainty about supply. We just talked about the uncertainty in terms of demand. I think it's still true that in the short run the demand for oil is very price inelastic and as long as that's the case and as long as it's the case that economies like the US are very dependent on the auto sector, I think we're still going to see some vulnerability.

**Fredj: Q21.** In your opinion, what are some of the most important and pressing questions in the field of energy economics? What advice would you give a PhD student interested in energy economics? Where would you advise them to focus their research?

**Jim:** One of the things that excites me about the younger generation's approach to economics is that they're willing to get into huge datasets, responses of different consumers, different firms, high frequency, and to really get into the details of what happens. I've sketched the broad stories I've seen in terms of the auto sector and what goes on, but you could spell that out in a whole lot more detail, getting into the kinds of data that more and more people are working with today. I think that's the way to go, I think that's the way the profession is going, whether it's studies of oil supply, people are getting into individual well level data, or demand of looking at individual consumers as recorded from these apps that people are using on their smartphones or credit card histories. They're looking at millions of individuals, how this person responded, how that person responded. I think that's a really rich data source. I think that's a way to a lot more mileage into insights into all these questions and that's where I see the profession going and I think it's a great move.

**Fredj:** Thank you.

**Jim:** Thank you.

## REFERENCES

- Baumeister, C., and J. Hamilton (2017). “Structural Interpretation of Vector Autoregressions with Incomplete Identification: Revisiting the Role of Oil Supply and Demand Shocks,” NBER Working Paper 24167. <https://doi.org/10.3386/w24167>.
- Hamilton, J. (1983). “Oil and the Macroeconomy Since World War II.” *Journal of Political Economy* April: 228–248. <https://doi.org/10.1086/261140>.
- Hamilton, J. (2009). “Causes and Consequences of the Oil Shock of 2007–08.” *Brookings Papers on Economic Activity* Spring: 215–259. <https://doi.org/10.3386/w15002>.
- Hamilton, J. (2003). “What Is an Oil Shock?” *Journal of Econometrics* 113: 363–398. [https://doi.org/10.1016/S0304-4076\(02\)00207-5](https://doi.org/10.1016/S0304-4076(02)00207-5).
- Hamilton, J. (1996). “This is what happened to the oil price-macro-economy relationship?” *Journal of Monetary Economics* 38: 215–220. [https://doi.org/10.1016/S0304-3932\(96\)01282-2](https://doi.org/10.1016/S0304-3932(96)01282-2).
- Hooker, M.A. (1996). “What Happened to the oil price-macro-economy relationship?” *Journal of Monetary Economics* 38: 195–213. [https://doi.org/10.1016/S0304-3932\(96\)01281-0](https://doi.org/10.1016/S0304-3932(96)01281-0).
- Kilian, L. (2009). “Not All Oil Price Shocks Are Alike: Disentangling Demand and Supply Shocks in the Crude Oil Market.” *American Economic Review* 99: 1053–1069. <https://doi.org/10.1257/aer.99.3.1053>.
- Kilian, L., and R.J. Vigfusson (2011). “Nonlinearities In The Oil Price-Output Relationship.” *Macroeconomic Dynamics* Cambridge University Press, vol. 15(S3), pages 337–363, November. <https://doi.org/10.1017/S1365100511000186>.



The IAEE is pleased to announce that our leading publications exhibited strong performances in the latest 2018 Impact Factors as reported by Clarivate. The *Energy Journal* achieved an Impact Factor of 2.456 while *Economics of Energy & Environmental Policy* saw an increase to 2.034.

Both publications have earned SCIMago Journal Ratings in the top quartile for Economics and Econometrics publications.

IAEE wishes to congratulate and thank all those involved including authors, editors, peer-reviewers, the editorial boards of both publications, and to you, our readers and researchers, for your invaluable contributions in making 2018 a strong year. We count on your continued support and future submission of papers to these leading publications.