

## Jesús Fernández-Villaverde

*Editor's Note: This is an abbreviated version of EF's conversation with Jesús Fernández-Villaverde. For additional content, go to our website: [www.richmondfed.org/publications](http://www.richmondfed.org/publications)*

Jesús Fernández-Villaverde of the University of Pennsylvania has broader interests than most economists. The work for which he is perhaps most well-known resides at the forefront of formal macroeconomics: theoretical modeling, methods for taking models to the data, and techniques for solving models with computers.

But Fernández-Villaverde also has a passion for the gamut of historical, cultural, and economic forces that shape policy. In recent years, he has studied how politics determine macroeconomic outcomes, the rise of Nazi Germany, the enduring significance of the Magna Carta, and even how contraceptive technologies influence the way societies socialize children about sex. On top of all this is what he calls “a second life” of writing prolifically about economics and policy in Spanish. “It’s like golfers who play both the U.S. tour and the European tour,” he says with characteristic humor.

With a keen interest in the future of macroeconomics, and as the director of graduate studies at the University of Pennsylvania’s economics department, he helps shape the next generation of economists by advising them on how to best invest in their training. He is a research associate at the National Bureau of Economic Research, is a research affiliate at the Centre for Economic Policy Research, and has books in progress on macroeconomics and economic history.

Renee Haltom interviewed Fernández-Villaverde in his office at Penn in February 2018.



**EF:** You’ve been active in the debate over the state of macroeconomics as a discipline. There are prominent economists who say much of what is studied is nonsense, while others argue that macro is thriving if you understand what it is designed to do. What is your view?

**Fernández-Villaverde:** I’m much more sanguine about the state of macro.

Just to give a little bit of background: After World War II, there had been a generation of large macro Keynesian models, as people called them at the time. Larry Klein, who was a professor here at Penn, was a leading proponent and

got the Nobel Prize because of that work. In those models, you’d have an equation for consumption and an equation for investment and an equation for exports and an equation for imports, and then you’d go and estimate them.

Then in the 1970s, the generation of Bob Lucas and Tom Sargent and Neil Wallace said we want to build models where the economy is a system, where rational agents interact in a purposeful way. In the late 1990s and early 2000s, we learned how to econometrically estimate those models. That was, in my opinion, the first and most important advance in macroeconomics in the last 30 or 40 years.

In the mid-1990s, we learned as a profession how to build models that are dynamic, that take the randomness of the economy seriously, and that incorporate price and wage stickiness. That class of models started being called DSGE, which is the terribly unsexy Dynamic Stochastic General Equilibrium acronym. I think these models really clarify a lot of aspects of, for instance, how monetary policy interacts with aggregate activity, and we learn a lot from them.

The second big leap, which we have had over the last 10 years, is a big revival in models with heterogeneity. In the standard basic model that we teach first-year graduate students, there is one household. But, of course, we know this is not a description of reality; we have people who are older versus younger, college-educated versus not college-educated, unemployed versus employed, high-income versus low-income. Both solving these

models and taking them to the data was such a large task that, until around 10 years ago, not that many people wanted to use them. This led to criticisms of representative agent models with only one type of agent, but we didn't have that many alternatives.

But over the last 10 years there has been a tremendous jump in our computational capabilities. This iPhone on my desk is computationally more powerful than the best supercomputer on the planet in 1982. That means we can do a lot of things that even 10 years ago we couldn't.

**EF: What explains the divergence of views on those developments?**

**Fernández-Villaverde:** The problem is that a lot of this exciting, backbreaking research has not transpired outside of the relatively small group of people working on the frontier. This is due, I would say, to three reasons.

First, the people who are doing this are quite busy. When you are in your mid-30s or early 40s, you are trying to establish yourself as a senior member of the profession. You don't really have a lot of time to do interviews or write blogs or go to purely policy-oriented conferences.

Second, many times it takes a generation of students to distill the lessons of frontier research and express them in ways that other researchers, let alone policymakers and the public, can understand. This happens all the time in the history of mathematics and other fields. Until that happens, it's difficult for people to really appreciate how important the tools are.

If you take the best 20 macroeconomists of my generation, of course they don't agree on everything, but the things they talk about are very different from the type of things you will see on Twitter or the blogosphere. The conversation sometimes looks like two very different worlds. Sometimes I see criticisms about the state of macro saying, "Macroeconomists should do X," and I'm thinking, "Well, we have been doing X for 15 years."

Third, sometimes you get a biased view of where the state of a field is just because of who has incentives to talk to the general public. Many of the people who are currently very critical of macro are in another generation, and some of them may not be fully aware of where the frontier of research is right now. They also have plenty of free time, so it's much easier for them to write 20 pages of some type of exposé, if they want to use that word, on the state of macro.

This raises a more general issue of whether academia in general and the economics profession in particular have the right incentives to transmit some of these learnings from the frontier to the general public. Unfortunately, sometimes those incentives do not exist. If you write a successful introductory textbook and it gets adopted in

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the large state schools, you make a lot of money. Similarly, there are incentives to write papers that will go to the *American Economic Review*; then I can go to my dean and say, "Dear dean, increase my wage 10 percent."

But there are not a lot of incentives for your average economist to write a textbook that is a little more advanced and that may impact in the long run the way the profession thinks about the world. For instance, I am writing a textbook with Dirk Krueger, one of my colleagues here. Even if we are successful doing it, which remains to be seen, it is not very clear to me what we are going to get out of it beyond self-satisfaction and perhaps the recognition of our colleagues. I think that that is a little bit of a problem that we suffer in this profession, but also many other fields.

At the end of the day, I think a positive case for macro can be made, and it is a pity that sometimes there are not very good incentives for those who can make it. At the same time, there are strong incentives for those with more negative views to be very vocal about them and try to make a splash.

**EF: Where do you think macro has performed best versus not so well?**

**Fernández-Villaverde:** Where I think we have done well is the well-understood result among macroeconomics that quantitative easing was going to be nearly irrelevant. By "quantitative easing," I mean what sometimes is called QE3, not QE1 and QE2. The latter two were, "Oh my god, the world is about to end," and then the Fed came and said, "Don't worry, if you have some paper, we will buy it to show that the world is not ending." Whereas QE3 was buying a lot of long-run bonds and issuing reserves against it.

There is a classic paper by Neil Wallace, who is of the generation of Bob Lucas, Tom Sargent, Ed Prescott, and Chris Sims — Wallace is the only one that unfortunately has not got the Nobel Prize yet but is someone I admire very deeply. He proved in 1981 that these types of operations were going to be irrelevant. And later Mike Woodford proved that the result holds even more so when you are at the zero lower bound.

So when the Fed announced QE3, most people in monetary economics said the most likely effects were going to be very small. I actually wrote something in Spanish saying that, and you should have seen the amount of hate mail that I got — most people thought either that QE3 would cure all illnesses of the day or that we'd get hyperinflation. I think that the evidence is in and nearly everyone has concluded that QE3 had very small effects (the only discussion seems to be whether the effects were very small or *really* very small). So that was a clear prediction that has been supported nicely by the data.

A place where macro may not have done so well is the consequences of the zero lower bound. The zero lower bound is when nominal interest rates get to zero, and then it's difficult for monetary authorities to lower it below zero. In the standard New Keynesian model, at the zero lower bound the economy is going to suffer deflation and a very severe contraction. We didn't have that. I'm not saying that 2012 to 2016 were great years, but inflation was around 1 percent and there was a moderate expansion.

We also don't understand inflation dynamics very well. We understand that if you are Zimbabwe or Venezuela and you start printing money like crazy, you are going to have a great inflation, but do we really understand why inflation is 1 percent and not 3 percent? In fact, one of the puzzles we have had during the recovery over the last two or three years, even more so in Europe than in the United States, is why inflation has been so subdued. I had many people in central banks asking me why, and I said that I wish I knew because I would be writing a paper about it.

**EF: What are you most excited about in macro?**

**Fernández-Villaverde:** Where I really believe the next generation of students can make big contributions is the integration of micro data with macro data. The amount of information that we have about economic activity at a very, very granular level is absolutely incredible. I'm working on a project for the Philadelphia Fed involving electricity consumption to better understand the dynamics of the business cycle in their district. We actually have information about how much electricity is consumed in the district second by second. As we get better at putting all those numbers together, we are going to have a much better view of what's happening in the economy.

With respect to inflation, it may be the case that, say, butter is a good indicator of how inflation is going to move over the next three months. If I were the president of one of the regional Feds, and I had very detailed information about how the price of butter is evolving in all the supermarkets in my district, I may have an early warning system for inflation. A more concrete example is labor construction accidents. The first time I understood that the real

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### ► Present Positions

Professor of Economics, University of Pennsylvania; Research Associate, National Bureau of Economic Research; Research Affiliate, Centre for Economic Policy Research

### ► Selected Past Positions

National Fellow, Hoover Institution at Stanford University (2014-2015); Kenen Fellow in International Economics, Princeton University (2013-2014); Director, Penn Institute for Economic Research (2011-2012)

### ► Education

Ph.D. (2001), University of Minnesota; B.Sc. in Economics and Management (1996), ICADE, Spain; LL.B. (1995), ICADE, Spain

### ► Selected Publications

"Estimating Macroeconomic Models: A Likelihood Approach," *Review of Economic Studies*, 2007 (with Juan F. Rubio-Ramírez); "Political Credit Cycles: the Case of the Eurozone," *Journal of Economic Perspectives*, 2013 (Luis Garicano and Tano Santos); "Fiscal Volatility Shocks and Economic Activity," *American Economic Review*, 2015 (with Pablo Guerrón-Quintana, Keith Kuester, and Juan F. Rubio-Ramírez); "Solution and Estimation Methods for DSGE Models," *Handbook of Macroeconomics*, Volume 2A (with Rubio-Ramírez and Frank Schorfheide); and numerous other articles and papers

estate bubble was getting out of control was when a friend of mine who is involved in labor administration in Spain told me that construction-related injuries were going up — when the market is hot, you push your workers hard and they start doing awful things to their hands with nails. Another example would be models where we really understand in detail how people make decisions about coming in and out of the labor force.

The reason I think this area of research is going to be enormously important is because we are going to be able to combine those immensely rich data at individual levels with powerful computers that are able to handle them. I really envision a whole new generation of models that will take very seriously everything we know about the microeconomy to build a much more coherent view of the macroeconomy. That's what I tell my students they should spend a lot of time trying to think about — the investment in methods, but also the learning about the economics of these types of problems. That's what I am the most excited about.

**EF: Let's focus on the zero lower bound for a second. What do we understand reasonably well about the zero lower bound and what do we not?**

**Fernández-Villaverde:** Well, we understand well why it's a problem. People who want to save for the future take resources from today and move them into the future, and people who want to invest borrow today — say, to build a factory — and pay it back tomorrow. The saving-investment market clears by a price, and that price is the interest rate. The zero lower bound implicitly introduces a price control in that market. Since that market determines how much we save and invest, things don't get right intertemporally and the economy ends up operating at a lower level of activity than you could get in normal times.

But in the standard model, the negative consequences of the zero lower bound are much more acute than what we actually have seen in the real world, which suggests that there are issues we don't fully understand. For example, I described before a very simple model with one type of investment and one type of saving. In the real world, there is a whole set of investment opportunities and a whole set of saving opportunities. What some people have argued

—and I’m trying to write papers on it now — is that the real constraint right now is not so much a general savings and a general investment market, but markets for safe assets. This research was started by Ricardo Caballero at MIT and by Emmanuel Farhi at Harvard.

The idea is you have a lot of aging Chinese, Japanese, and Germans who want to invest in very safe assets, and there are just not enough of those assets. And that pushes the price of the asset high, which is the same thing as pushing the interest rate down. So maybe it’s not as much that all the investments and savings clear at this zero interest rate, just the market for safe assets, and that’s why things have not been quite as bad as the basic New Keynesian model forecasted.

A lot of very great economists have been doing fantastic work on this. I mentioned Caballero and Farhi, but also Pierre-Olivier Gourinchas and Ben Bernanke himself. What I’m trying to think a little bit about right now, in new research with Robert Barro at Harvard University and Oren Levintal here at Penn, is how economies generate these safe assets and what determines the total amount of safe assets.

**EF: Another common criticism of the profession is that economists routinely use models that are so complex they can’t even understand them. How would you respond to that?**

**Fernández-Villaverde:** Did you come here by plane?

**EF: Yes.**

**Fernández-Villaverde:** Are you aware that aerospace engineers do not fully understand the turbulences that keep that plane in the air?

**EF: I don’t want to think about that until after I’ve flown home.**

**Fernández-Villaverde:** OK, well, my father is an aerospace engineer, so I know that firsthand. (Laughs.) We have a very limited understanding of what makes planes fly. But we have very good computational methods that allow us to simulate how the plane is going to work, and so we are more than happy to get inside a carbon fiber and aluminum tube and go 35,000 feet above the ground at almost 600 miles per hour.

I’m not going to deny that having clean, intuitive models that help us understand the mechanisms at work is important. For instance, they play a tremendously important role in undergraduate education; the book I’m trying to write with Dirk Krueger tries to not use a computer at all so the student can understand really what is going on. But once you want to go to the next step, you need a computer.

Consider the following scenario. There is now a lot of talk about whether the Dodd-Frank law is the best

way to handle financial regulation. The president of the Minneapolis Fed has come out with a simpler system where you just require financial institutions to hold large equity. That’s fine; I can write a simple model on my white board to understand that argument. But when you get to the concrete question of whether we need 15 percent, 16 percent, or 25 percent equity, you cannot get the answer without a quantitative model. It’s the same way that an aerospace engineer will tell you, “We kind of understand Bernoulli’s principle, but there are a couple of things here and there that we are not very sure about.”

To say a model is difficult to understand is, to me, a little bit of a nihilistic view. A much more sensible approach is to understand the things for which we want simple models and the things for which we want complex models.

Now, can you offer me examples of where people use very complex models to do silly things? Yeah, but people buy bananas to do silly things, and we are not going to prohibit selling bananas.

**EF: Presumably not many bananas get published in top journals.**

**Fernández-Villaverde:** You know, I take a little bit of a different view on that.

First of all, I’m an editor of a journal and an associate editor of other journals. As an editor, you need to understand you are never going to get all your calls right. If you only accept papers you are 100 percent sure are right, you will end up not publishing any papers. I don’t even say that my own papers are 100 percent right, and I agree with everything in them.

Whether a paper makes a big advance or not isn’t that consequential. Pick any *American Economic Review* from 1990 and randomly select a paper, and you will see that many of them have been sleeping for eternity and no one cares. Then there are papers that are very important, that people are going to look at again and again to learn from their strengths and weaknesses. Recently I was writing a report about a very famous paper, and I thought at the end of the day, the main result hadn’t held water after 10 years of empirical investigation. But the paper opened such an important door for people to think about the problem, and for that the paper has become a classic.

So are there mistakes in publishing? Of course there are. But the process of science is much more dialectic than sometimes is expressed. This notion of the perfect paper getting published and then we learn something is an idealized view of the way science works.

**EF: One research agenda of yours that did, in fact, have enduring success was on the particle filter. How did that idea come about?**

**Fernández-Villaverde:** I once made a joke at a conference that the particle filter pays for my mortgage. Now a

lot of people ask, “How is your mortgage going?” and I say, “Nearly done.”

Let me give you an example of what the particle filter does. In early 2018 we entered a time of high volatility in the stock market. The problem with volatility is that it is not directly observed: I can go to the back pages of the *Financial Times* and find a value in the table for a stock’s price, but there is no number to express its volatility. What you need is a statistical model that will let you learn about volatility from things you can actually observe, in this case, the variations of the stock market from one day to the next. This is called filtering — learning about things that you haven’t seen from things you can see.

The original filters were developed for the space program. The idea is you are the guy in Houston with a joystick, and you see the satellite but can’t get its exact position because you are measuring with radar and there is noise. What you are trying to figure out is how much to push the joystick to the left or right given what the radar is telling you.

For the longest time the most important filter was the Kalman filter. It requires two assumptions: that the world is linear, and that noise comes from a normal distribution, or is “well behaved.” Those assumptions prevent it from handling many, many questions in macroeconomics. The best example is volatility because it can only be positive: You can have a lot of volatility or very little, but you cannot have negative volatility.

So when I was a graduate student, I was very interested in coming up with methods that could extend filtering to these types of environments. I spent a lot of hours browsing through math journals, and I heard about this new generation of methods called sequential Monte Carlo, which is a complex name for something quite simple: A classic question in a basic probability class is if you throw two dice, what is the probability that the sum of the two is five. You have to calculate the probability that the first is a one and the second is a four, and so on, and when you do that homework you always make a mistake because you forget one combination. Alternatively, you could throw the dice one million times. Of course, in real life you can’t do that, but computers can do it for you.

In the 1990s, some people came up with the idea of applying Monte Carlo recursively to filtering problems. I learned about these new methods, and I thought gee, this can be done in economics as well. So I came back to my office and got my dear friend and co-author Juan Rubio and I explained to him, “This can work,” and he said, “Yeah.” I said, “Well, let’s write a paper.” So we wrote the paper, my most-cited paper probably, and it still pays for my mortgage.

**EF: The eurozone crisis is still in the news. There is little agreement among economists on the fundamental causes of the eurozone’s economic troubles. Depending who you ask, the crisis is about forcing fundamentally different countries to share a common**

**currency, lack of competitiveness in the periphery, or weak and improperly designed institutions. What is your view?**

**Fernández-Villaverde:** My view is a mix of poor institutions and not being an optimal currency area. On the latter, the case for creating the Euro was mainly political and not economic. In Europe by the mid-1990s, a lot of the gains from integration had already been accomplished. It would have been more important to continue eliminating administrative barriers to a unified market, for instance, than to adopt a single currency. But the political process decided for a combination of reasons that a common currency needed to be introduced, so it happened. The problem is this currency has very asymmetric effects in different countries depending on their institutional framework.

Interestingly enough, a lot of economists were aware at the time that the euro’s design had fundamental flaws and that those flaws would eventually have nefarious consequences. For instance, Franco Modigliani, who was a Nobel Prize winner, argued that the introduction of the euro would force countries such as Italy and Spain to undertake the right institutional changes. He argued that once you have the discipline of a monetary union with Germany — he called it an iron straitjacket — you will not have an alternative to reforms.

The euro lowered the interest rates at which peripheral countries could borrow. The reaction of the political system in 2000-2001 was not, “In 10 years we may have a crisis, we need to reform now.” How politics works is, “Hey, now I can borrow at 3 percent where before I was able to borrow at 10 percent, let’s have a party!” What I argue with my co-authors in a paper is the political system tends to expel those who want to impose tough decisions in moments where there is a lot of money. That’s exactly what happens in most European countries. This was not conservative versus socialist or left versus right; it’s even within the same party.

So there were two countries, Greece and Portugal, that had a public debt party. The governments basically engaged in fiscal expenditures that were not sustainable in the long run. Ireland and Spain went for private debt; they say, “Fantastic, this is a great moment to build houses, to borrow from the rest of Europe, and to have a gigantic boom that lasts for six or seven years.” Houses in Spain, for instance, pay the value-added tax, which means the government was getting extraordinary income. In 2005-2007, Spain had a government surplus, not because our fiscal position was healthy in the long run (as often mistakenly argued by U.S. economists who do not understand our budgetary structure but only look at headline numbers), but because we were building so many houses.

The second problem that we highlight is that the big boom lets bad managers get away with it. For instance, we had what were called *cajas* which is roughly equivalent

to a savings and loan. The board of directors was elected by the regional politicians. If I'm the leader of a political party in 2002 and I want to get rid of you, I make you CEO of the local *caja*. Now you are making \$3 million a year, so you happily ride off into the sunset. You may have never run a banking business in your life, but when the economy is growing at 6 percent a year it's nearly impossible to lose money. It's even worse than that: We document that the worst managers are the ones making the most money, because they are taking the really crazy bets that pay a lot in the short run but then collapse the bank when the euro crisis comes.

So the Achilles heel of Europe, at least in the peripheral countries, was these changing incentives within the context of a bad institutional setup.

**EF: What does this imply about the way forward for Europe?**

**Fernández-Villaverde:** Using an old-fashioned terminology, the eurozone has an original sin, which is that it is not an optimal currency area.

At the same time, if you ask me, "Should I marry my friend X?" I may tell you, "No, I don't think you are compatible, you are going to end up divorced." But that's a very different question from, "Should I get a divorce now that we are married and have a mortgage, three kids in school, two cars, and a dog?"

Like it or not, we got married to the Germans, and the Germans got married to the Spaniards. We need to make this work, because breaking up now would be way too costly.

What we need is a reform of the euro. In terms of incentives, you need to tell countries that they will not face economic crises alone, that there is going to be money from the European Union that will help the Netherlands going through a rough patch in the same way that federal taxes and transfers will help if California suffers a bad period. That would imply, for instance, moving toward a bigger European Union budget and creating some European bond system. There is a lot of discussion among European economists about how to design such a thing.

But there also need to be constraints. For this to be sustainable, fiscal discipline and cleaning up the house really needs to be done. There has to be a great bargain between those who point out the need for making financial and economic crises easier to go through and those who emphasize that, in the long run, rules are very important. That's the big question mark: Is the political process within Europe going to be able to deliver that solution?

**EF: Which economists have influenced you the most?**

**Fernández-Villaverde:** Let me start with an economist I have only read about: Milton Friedman. The reason I

became an economist is that I read *Free to Choose* when I was in high school. It's not that I got convinced by all his arguments; it was his enormous ability to show that economics could help you think about many problems, that economics was not the stock market. That book was really eye opening in the sense of truly appreciating the power of economics as a general field of inquiry.

With respect to people I have met: Tom Sargent. I actually told him when we became co-authors that part of the reason I wanted to write textbooks is because of his. He wrote some very influential textbooks about macro in the late 1970s, and we used the first chapters of that textbook translated into Spanish in my undergrad macro class. That showed me how beautiful macro research could be and that I should go to the United States. I have always admired Tom because of his ability to combine data with theory. He also has a couple of great books in economic history that by themselves would probably make him a top professor at a university, even forgetting about everything he wrote in macro.

The third person I would say influenced me the most is Ed Prescott, who was the chair of my dissertation committee in Minnesota. What is amazing about Ed is his incredible ability to say what standard economics can explain and what standard economics cannot. One of his most-cited papers is the one about the equity premium puzzle, where he asked a trivial question: Can a standard model account for the equity premium? No. And that generated 30 years of finance literature.

**EF: What are you working on next?**

**Fernández-Villaverde:** I mentioned before the work on safe assets. The second thing I am working on is machine learning, which perhaps is the new hype. But I use it a different way than other people do — not to understand how people behave or to make predictions about the world, but as a way to solve a model. Agents within the model act as machine learners, and that helps you solve the model in situations that otherwise you would not be able to solve. This makes sense because in real life none of us accomplish perfect computations. Rather, we use algorithms as a way to solve our problems in ways that resemble machine learning. A paper that I am presenting these days is a model where agents use a machine learning algorithm to keep track of the distribution of assets and equity in the model. This is relatively easy to incorporate into standard macro and then you can solve many, many more models.

The third thing I'm working on is trying to wrap up the textbook with Dirk and another one that I have on economic history. I have written roughly 700 pages. I need to write another 100, and that's about 50 percent of the total. The problem I'm having is every time I reach a new chapter I think I need to read all these other books. Then it takes me a month to read all the books!

**EF**