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PAPER: DEMAND-DRIVEN INFLATION

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EBERLY: Okay, if we could all take our seats. So far, Giorgio is starting with negative time, so we can't do that. Great. Let's get started. The speaker, the presenter of the next paper is Giorgio Primiceri on demand-driven inflation

PRIMICERI: Thank you very much for putting the paper in the program. This is joint work with Domenico Giannone. In the paper, we study the drivers of post-pandemic inflation. And let me start with the punchline, which is very simple. We're gonna argue that the recent inflation surge was predominantly driven by unexpectedly strong demand forces, and this is true not only in the US, but also in the euro area.

These demand forces, there are three main contributing factors to this large boom in demand. The first is private demand. So after the restraints of the pandemic, the economy reopened, and that released a substantial pent-up private demand.

The second contributing factor is fiscal policy, which was unusually supportive of incomes and spending. And just to put some numbers on the table, think that relative to its level in 2019, the primary deficit to GDP ratio of the government in the US in 2020 increased by nine percentage points, and by seven percentage points in 2021. And in the euro area, it increased by seven percentage points, so a large number as well.

And the third contributing factor to the boom in demand was an extraordinarily accommodative monetary policy. Again, to put some numbers on the table, the Fed first increased its policy rate in the middle of March 2022, when the latest reading on CPI inflation was seven point nine percent, and the ECB did the same in July of the same year, when the latest reading on HICP inflation was eight point nine percent.

Now, to be clear from the start, we're not denying at all that these two economies were hit by large negative supply shocks. Our point here is that these large negative supply shocks, without these demand forces at play, would have likely produced perhaps an even more severe recession and sluggish recovery, but less inflation.

I'm gonna try to convince you of this punchline using three set of complementary evidence. I'm gonna start with a very simple model with minimal identifying assumptions, a structure VAR. Then I'm gonna turn some very basic economic intuition based on aggregate demand and aggregate supply. And last, I'm gonna present some evidence based on real-time observations of forecast errors by the ECB and the Survey of Professional Forecasters. In the model, we also have some evidence based on an estimated DSGE model, but I won't have time to present that here.

So to set the stage, because before talking about the drivers, let me just show you how similar the inflation experience post-COVID was for the US and the euro area.

I'm gonna start with the broader measure of inflation, CPI inflation for the United States in blue, and HICP inflation for the euro area. This is the headline index. This is year-on-year inflation. And we can see that they're almost identical, except for the fact that inflation peaked with a six-month delay in the euro area.

This is inflation excluding energy, which is also very similar. A byproduct of this, perhaps surprisingly, is that, is that energy inflation behaved very similarly in the United States and in

the euro area. And at the bottom, to push this point even further, we have inflation for goods and services separately.

Again, they are essentially the mirror image of each other, except for the phase shift. Okay, so let's take this for granted. Inflation behaved nearly identically in the euro area and the US, except for the two quarters delay with which it peaked in the euro area. So given this evidence, perhaps you will not find particularly surprising, and when it comes to the drivers, we will also find that the drivers have been similar in both regions.

And so let's turn to the drivers and let me motivate our study of the drivers using the basic lesson of you know, the, the most familiar model of monetary theory, which tells us that central banks should respond quite vigorously to demand shocks because demand shocks drive output away from trend and they increase inflation, so there's no trade-off. Instead, when it comes to supply shocks, central banks are supposed to be more accommodative because supply shocks, they might raise inflation and reduce output, so they create a trade-off. So this is why it's important to distinguish between these two type of drivers of the recent inflation surge.

Our first pass at answering these questions about whether inflation was driven by demand or supply involves estimating a very simple model, like a bivariate structural VAR. This is a model estimated with an output variable, real GDP, and a price variable, CPI in the case of the US and HICP in the case of the euro area. It's gonna be a quarterly model with four lags.

We're going to identify two shocks using sign restrictions, a demand shock and a supply shocks. They are identified of the co-movement that they induce in the data. A demand shock is going to induce a positive co-movement between prices and quantities, and a supply shock is going to induce a negative co-movement. We're going to estimate the model using data from 1997 to 2019, and uses the estimated parameters, we're gonna perform a decomposition of the dynamics in 2020 and after.

And so this is an important graph in the paper that presents the results of this decomposition. On the left-hand side, we have the US. On the right-hand side, we have the euro area. The top row is GDP growth, and the bottom low row is year-on-year inflation. The solid line with a diamond represent the actual realization of the data, while the dashed line represents a pre-COVID forecast.

So the distance between the solid and the dashed lines are the forecast errors. The extent to which the data turned out to be different from what people, the model in this case, expected them to be in 2019. And what the model does, it decomposes this forecast error into demand and supply sources. Demand is in yellow and supply is in green.

And what we can see is that, sure, there are some important adverse supply conditions that have constrained economic activity, both in the US and in the euro area. But when it comes to inflation, the role of the supply shocks is gonna be more limited relative to the role of this unusually large expansion in demand, which drives about two-thirds of the increase in inflation.

Now, what I want to be upfront about is that this is a very simple model with only two variables, but this result is extremely robust. So you can change the identification of the shocks, or you can pursue, for instance, the approach of Baumster and Hamilton. You can

control for the COVID factor of Stock and Watson, of last year's Brookings paper of Stock and Watson. You can introduce other variables such as interest rates and monetary policy shocks, such as energy prices and energy supply shocks, fiscal variables et cetera, et cetera, and this result survives. And we think that the reason why it survives is because there is a very strong economic intuition behind it, which is gonna-- I'm gonna try to convey next.

So let's think about a very basic diagram with aggregate demand and aggregate supply. Before doing that, so on the horizontal axis, we have GDP in deviations from its trend, and on the vertical axis, we have inflation. Here is where the US economy was approximately sitting in twenty nineteen, with GDP approximately at its trend level and inflation at two percent.

In the second quarter of 2022, at the peak of the inflation episode in the US, GDP was already essentially back to trend, and inflation was approximately nine percent. So somehow, the US economy must have moved from here to there. Now, let's start with a standard positively sloped aggregate supply curve.

So if the US economy has moved from here to there, the aggregate supply curve must have shifted to the left during that time, and this is completely in line with the conventional view that this economy was hit by important negative supply shocks. But the important thing here is to realize that the ability of a left shift in the aggregate supply shock to explain a rise of inflation of seven percentage points depends entirely on the slope of the aggregate demand.

And the slope of the aggregate demand is an endogenous object. In particular, it is endogenous to policy. The more strongly policy reacts to inflation deviations from the target, the less the Fed tolerates inflation's deviations from a two percent, the flatter is the aggregate demand.

So let me show you three examples. Two of them are gonna be extreme, the third one is supposed to be more realistic. So I'm gonna start with the first case of a central bank that is so obsessed with inflation that essentially conducts monetary policy based on a principle of strict inflation targeting. That's an hypothetical case. It's not supposed to be realistic. In that case, the aggregate demand curve will be completely horizontal, and a left shift in the aggregate supply will produce a very severe recession, but no increase in inflation at all. And the only way to observe a rise in inflation will be a shift of the aggregate demand curve. So in that case, all the inflation that we observe will be entirely demand-driven.

Now let me turn to the opposite case, the case of a central bank that responds extremely weakly to inflationary pressures. Think about Latin America. And in that case, my my aggregate demand will be vertical or nearly vertical. And in that case, a left shift in the aggregate supply could explain entirely the increase in inflation that we have observed. So in this second extreme case, inflation will be entirely supply driven.

Now the question is, in reality, and in a case like the US and the euro area, is the aggregate demand curve closer to an horizontal line or closer to a vertical line? And while it's true that neither the Fed nor the ECB are strict inflation targeters, it's also true that in the last three decades, both central banks have established a very good reputation of inflation fighters. And so you shouldn't be particularly surprised when I tell you that according to our estimates, the aggregate demand curve in both economies looks approximately like this,

which means that only about a third of the increase in inflation is driven by supply. But you require a relatively large increase in shift in the aggregate demand to explain the remaining increase in inflation. This is why this is the intuition of why we find that most of inflation was, sorry, demand driven.

Now let me turn to the last piece of evidence, which is based on the direct observations of forecasters. Right? In the end of the day, what the VAR does or a DSG does It extracts model-based forecast errors. But perhaps we can observe these forecast errors directly, and in fact, this is what we do. The ECB staff produces quarterly projections that they are published in real time. For the Fed, it's not so easy because there is a five-year embargo, but for the US, we use the survey of professional forecasters.

So we compute forecast errors of inflation and GDP, and we examine whether they were positively or negatively correlated. So the idea here being that if this forecast error for prices and quantities in 2021 and 2022 were positively correlated, then it is more likely that agents, central bankers, or survey professional forecasters were surprised by demand being unexpectedly strong. Okay? And we think of this, we call this a sniff test. We think of this as a less model-dependent test of whether inflation was primarily demand-driven.

Let me start with the euro area, where we observe the ECB staff projections, and let me start with inflation. So this is kind of a sanity check, right? This sorry, the solid line is the actual inflation. The diamonds are the nowcast produced in the middle of the quarter by the ECB staff, and the dashed lines are various vintages of forecaster. The ECB underpredicted inflation. This is hardly surprising. Almost everybody did. Okay? So that's we passed the sanity check.

Let me turn now to GDP, which is more interesting. I want to see whether while they were underpredicting inflation, they were also underpredicting GDP. So I'm gonna show you a little movie here, a little animation. So this is the nowcast of the ECB in the middle of the first quarter of 2020. They were forecasting a mild recession and a recovery. Okay? This is the forecast in April, in the middle of the second quarter, when it was clear that COVID was producing devastating effects on the economy. And these were the GDP data that they were observing at that point. They couldn't observe the current quarter. Okay?

And now I'm gonna move through time. And so these are the forecast. This is GDP forecast, GDP. And as you can see, these forecast errors, they clearly starts to become positive. They were forecasting GDP to be too low relative to the actual observations. And notice also that sometimes this line changes, and this is a function of Eurostat's data revisions. And as you will notice, Eurostat progressively revised their estimates of GDP upwards. And so we go through time, we go through time. And then this is the final graph, where it's clear that most of the forecast errors of the ECB staff were positive. Okay? So what we see as far as the ECB goes is that they underpredicted both inflation and real activity, which suggests, it's not a definite test, but suggests that strong demand played a very important role.

Let me show you the same thing-- I'm over time. I'm gonna show you the movie for the US. Not surprisingly, the movie is gonna be identical. So this is the US. These are the survey professional forecasters, okay? These are not the Fed forecast same thing for the revisions. The Bureau of Economic Analysis revised these things upward. And so also for the US, the Survey of Professional Forecasters has underpredicted both inflation and GDP.

And so the pattern of this forecast error is consistent with the view that demand played an important role, and it also explains why real-time data might have masked some of the strong demand forces and supported a little bit more the supply side narrative. All right.

EBERLY: Thank you.

The first discussant is Gauti Eggertsson

EGGERTSSON: Thanks a lot for having me here. This is just this paper and as I was preparing it, I heard people speak about AI. I do not wanna hear any ill, nothing bad spoken about AI because it is a wonderful thing, including allowing me to replicate empirical work before I discuss, which I've done.

So I'm gonna focus my discussion mostly on, on the US. You saw these pictures were similar. Also for a reason you're gonna see, I have a little bit more data there. And overall I share the assessment. I know that they got a quite a bit of pushback when they presented this first, I think, at the Cintra. And when I started first talking about the great this inflation surge, I also was surprised by how adamant people were saying that this was all supply driven. And I think now just looking back on it, you know, it was difficult for people to accept that anything had gone wrong with fiscal policy or monetary policy when there was a big election coming up. It's kind of obvious, but I was too naive to think about it that way. But it was a very strong the narrative of supply shocks was very strong, although I think people are a little bit more open for it now.

So I share that basic assessment. What is gonna be the difference that I have is a little bit in the details of how that demand is translated into inflation. So that's where we're gonna differ a little bit. But sort of the general picture I like and I particularly appreciate the very simple bar. And then they have actually didn't talk much about that they have a full scale DST model that is also pretty-- is very well done and has all the usual bells and whistle.

Well, this you all know, this is the inflation surge you know, that we see taking off. This is sort of the American Rescue Plan in March and just, you know, just right after that it took off and this is a particular definition of inflation surges that I don't want to go into the details of, but I've used for historical data. And then you see that it really starts coming down when the Fed starts lifting rates in March 2022. But there was, of course, another major monetary policy commitment here where there was a forward guidance issued saying that the Fed wants to achieve maximum employment and inflation above two percent. And there was almost-- If you could read the forward guidance as if there was no lid on inflation, they're just gonna get full employment. Now, of course you know, it was pretty aggressive.

Okay. So what I'm gonna focus on here, what I want to be talking about is this surge period here. This is what I'm gonna call the inflation surge which is April '21 to May '23, and I'm just using here a definition when CPI goes above four percent and then goes below it again. Okay. So I mean, this is just basic. I mean, this is I guess Benanke would show us when he was convincing us that Japan was had to have something to do with demand. He would just point that nominal GDP growth and, you know, from 2010 until COVID, you know, nominal GDP was growing about four percent per annum, and then we split, you know, two point four between real growth and then one point six in inflation. So like sixty/fifty. But then you look at the period I call a surge, and there you see nominal GDP increasing by eight point six percent, but now sort of it's mostly showing up in prices.

So that at least I always thought by Ben was a clear sign of a demand inflation. I'm not gonna die on that hill but I think it's a useful thing to observe. So, this year-- So because he didn't talk specifically about numbers, but my numbers are gonna be slightly different than the paper because I'm gonna focus especially on that surge part, the inflation surge part.

So they have this very simple here, VAR for the sign restrictions and you know, this is sort of the-- And this year basically captures, if I remember one year in response to a shock, I think yeah, this is a sort of a reduced form characterization of what they have here, and I'm putting some numbers on it, or they put some numbers on them for illustration.

And then, you know, they just identify demand shock if output inflation is going up at the same time and a supply shock if inflation is going up and output down. And if you look at the surge you know, defined in the way I just did, you know, replicating this bar, I computed that, and that's about seventy-three percent that is due to demand.

And they're reading, you know, prices rose to the output near trend. There was aggregate demand that was shifting. Okay. So the thing that I want to kind of harp on a little bit is not so much that I'm gonna contest much the fact that I think aggregate demand did it. I think we just need to I'm gonna challenge a little bit in a minute how we can think about aggregate demand having, having been able to have that large of an effect.

Okay. So, and the first thing I just want to point out to you, so you notice here one suspicious thing missing. I don't want to say suspicious. I mean, I think it's a very nice clear, simple example, but you don't have any inflation expectations there, right? Sort of know from the last great inflation that was, you know, what a lot of people thought was the culprit or one of the big culprit for them, that inflation expectation were going up.

So one thing I do here is I just added labor market tightness. So this is vacancies relative to unemployment. And then I added also inflation expectation from the survey of professional forecasters. And then I impose sign restriction. And the point here is really just that once you add these two variables, well, you have some change in the various decomposition. I mean, the role of demand goes down quite a bit. But I think what I want to just emphasize was that this here is the response of inflation expectation with to a one percent increase in inflation, and it's relatively small. Inflation expectation as measured by the Survey of Professional Forecasters one year ahead was barely moving during this time. And that I think has some implications that is useful to think about.

So, they later in the paper go into a DSGE model where demand is explaining basically ninety-four percent and but the aggregate supply is extremely flat. Meaning, you know, this is a simplified version of their model. But what I'm suggesting, so here I'm talking about the Phillips curve, I call aggregate supply. It's extremely flat. So, you know it increased output with annual rise by, you know, one percent. There should be very little effect on inflation.

And that's a bit of a problem because, you know, compared to sort of the simple exposition I was showing you that they computed from their VAR, which of course is more reduced form compared to their structural model. That's a bit of a problem because-

Well, what was going on with expectations? And there I'm gonna get to you know, what I want to do then next is to ask-- So the key thing, what they do, of course, is that they have, and I'm not gonna blame them for them, we all do it. They have a rational expectation model,

so it's model consistent expectations. And so it turns out in their model that, you know, the model predicts pretty high inflation, but nobody else will. Okay. So, what I did here was very simple. I took the DSG model, and I did the same estimation, and I just replaced... And I mean, it's a little hokey. I mean, I'm a discussant. I can get away with stuff. But I just took the expectations here, and I didn't bother with doing it on the demand side, and I just put in the survey of professional forecasters. And it's not moving a lot, right? So then you're gonna have a problem.

So if you just do that, basically the demand goes from explaining point nine four to point o five. Okay? And the reason is just, you know, you can just see it right here. It's just very hard to get anywhere if inflation expectation are not moving. And they get somewhere with it because they are moving, because they have model consistent expectations. Which then brings us to the question, and in a way, I think you just sort of undermined the case a little bit by showing that people were generally wrong in that they under-- so this here shows you FOMC summer effect on economic projections. So people were consistently underestimating the rise in inflation, which is consistent with, you know, what we saw also, which basically is just what I said.

So basically, every projection before mid 2021 had inflation back within two years. So the surge was pretty unexpected. So if you just compare here, this is realized inflation so, you know, and basically what people are expecting. And you see here, this is the survey of professional forecaster one a period ahead. You know, the model doesn't pick up right away, but it at least does so eventually with a lag. And that's just, you know, not consistent with what we saw in, And you can look at other, And by the way, here you could put in also the Michigan survey. You could put in any of the-- or market-based survey measures. So, so this is the problem then, that how are you gonna get here to here without expectations moving? So I believe the shift in demand, but it is difficult to see how you would have simultaneous shift in supply to accommodate it.

So what leads me to what is my sort of pet theory here, which is was inspired by this picture, just the first picture by Pascal. It was in a paper where prices were fixed, and they were just talking about V over U as above one, which they thought was socially inefficient. And I mean, it just so happened, you know, I just noticed when you look at this, that whenever it is above one, well, I mean, it's mainly wartime, you have an autocratic inflation, except for one time in the 1970s. And we know what happened there.

Well, then inflation expectation actually moved. So if you look at this data, this is just data scatterplot. So this is the last inflation surge we had before 1970. So this is the Vietnam War. And we see something that looks very much like a backward inverse Phillips curve. So what I did here was that I put the basically this here, that is a model that Pierpaolo and I developed. I put it into the same DST model, and then we find demand is playing a role, but we also find more role here for for supply.

And so this is then our explanation here or my explanation. You don't need any shift in expectation if you're willing to entertain the possibility that at some point you're going to run out of people to hire, you're going to hit some capacity constraints. I mean, we model labor, but, you know, there are all sorts of capacity constraints. And then you're gonna get then you're gonna be easily explained, even if under normal circumstances, the aggregate supply curve is flat you know, you hit some what we call the battery threshold, and then more people firms looking for people to work than workers looking for firms.

Okay, I am out. So, that's it. So the same shirt, same window but there is this difference in, in interpretation about how demand is transmitted into you know, how demand is triggering this inflation. And there, I think we need to confront the you know, aggregate supply side and expe-- in particular, this expectation-augmented supply and the fact that most of this was unexpected. Okay. Thank you.

EBERLY: Thank you.

The second discussant is Karel Mertens.

MERTENS: Okay. So, thank you very much to the organizers for inviting me to discuss this paper. I hope they were not expecting me to take the opposite side and argue it was all supply shocks, because that is not what I'm gonna do. Before I begin I want to point out that these are my views and not the one ones of the Federal Reserve.

So I broadly, just like Gauti, I broadly agree with the idea that unexpectedly strong demand forces were behind the, the surge of inflation we saw during the pandemic. I'm gonna focus my comment a little bit on the exercise of using models that we were sort of all, you know, using to analyze pre-pandemic pandemics as a lens, as a filter to retrieve shocks during the pandemic.

You know, I think that kind of assumes that we were just living in a similar world with similar propagation mechanisms. It's just that we had very large shocks. And I just want to argue that doesn't strike me as very likely, and that we need to think of how either aggregate demand or aggregate supply may have looked or be differently sloped. And that was, of course, is gonna change the answer in terms of whether it was supply shocks or demand shocks.

And also my second comment is gonna be, it's a little bit... You know, it's simple to just look at aggregate output and inflation. But under the hood, if you look at the sectoral composition, this looked very different from previous recessions. And somehow I feel that you cannot ignore that when analyzing the dynamics of the pandemic. Gonna make a similar point to Gauti the labor market, the non-linearities there were important. And then I'm gonna make a comment about, you know, of course economists within the Fed, unless outside the Fed, they were all using a similar lens in real time, and yet they kind of, at least initially, arrived at different answers. And I think most of them sort of, arguing that it was supply shocks.

Okay. So, on the left here, I'm just showing log levels of output and log consumption quantities periods of trend over the last ten years. And to me, this is really a striking picture. If you think of everything that has happened over the last ten years this output has been remarkably resilient and relatively stable around a linear trend. But of course, the exception, the brief exception of the pandemic itself the, the recovery, the return to trend, both in terms of output and consumption, was much, much more quickly than I think the recessions that we've seen in decades before.

It's particularly true of consumption, and I kind of, marked three similar dates to Gauti, sort of beyond the onset of the pandemic in March 2020. 2021 March, you know, I think a big event was the American Rescue Plan stimulus payments, when consumption really shot up and rejoined the pre-pandemic trend. I think the other main event that we shouldn't forget, and I dated it here as slightly more early, was in terms of the change, the pivot in monetary policy.

Liftoff was in March '22 but my sense is that the language and the direction and the signaling really changed before that. And sort of for me, that is December '21 where that happened.

But what is remarkable is that, you know, eventually the Federal Reserve did raise interest rates very quickly and quite substantially. And yet, you know, it didn't really seem to have, in the aggregate at least, the kind of effects that I think many of us, including me, were expecting based on experiences with the historical similarly episodes. So this is a similar graph. It gets really important to think of why output has remained so resilient even though inflation went through this large surge and then came back down. So, you know, similar simple aggregate demand, aggregate supply. We have κ as the slope of aggregate supply. Δ here is the slope of aggregate demand.

So to me, You know, if you want to explain why we've had so much movement in inflation, yet not too much in terms of output, you know, it almost requires, I think, too much of a coincidence that whatever was shifting supply was sort of exactly offsetting the shift in demand. That could be but it strikes me as a little bit too much of a coincidence.

Now the alternative, of course, is that either one of these demand or supply schedules just was very steep at the time, and then you don't need sort of this coincidence to explain sort of the, the pattern in the data. Of course, I think most of us, when we think of the slopes of these curves, you know, in the decades before the pandemic, think of both aggregate demand and aggregate supply as being fairly flat. And aggregate demand being flat precisely because of the, sort of the large weight and the reaction function of the central bank on inflation. So I think we need to really think carefully about how these, either the slope of the aggregate demand or the slope of the aggregate supply may have just been very different to explain this phenomenon to explain the data.

So how does that translate into understanding what were the contributors to the inflation surge? So if you assume that, you know, somehow magically the demand and the supply shifts magically offset, then the relative contribution of demand shock is determined by the relative slopes of the two the demand and the supply curves. And then sort of the fundamental identification assumption behind the paper is that we'll just, you know, assume values before the pandemic, and then, you know, you end up concluding that was mostly demand shocks.

Of course, it is possible that the aggregate supply shock, the aggregate supply schedule was much steeper because of capacity constraint, maybe there was state-dependent pricing. And if you believe that, that would tilt you towards judging the demand shocks were re-relatively more important. But I think there are equally good reasons to think of the aggregate demand slope being unusually steep at the time.

If that's true, you would reach the opposite conclusion, and you would judge that supply shocks were relatively more important. So why was the aggregate demand slope high? Well, I'm thinking at least initially you could think of the, the, the monetary policy reaction function not exactly following a simple Taylor rule. And I think that it's quite clear, even in real-time data that there was large deviations from conventional Taylor rules. But it's also kind of necessary to explain how when the Fed eventually did respond pretty aggressively, that had a very little effect on economic activity, at least in the aggregate.

So another possibility for a relatively steep aggregate demand curve was just that the demand wasn't very interest rate sensitive. Okay. I think, you know, there's tons of evidence that supply did matter. On the left here, I'm just showing us inventory to sales ratios on the goods side. And, you know, after the, the onset of the pandemic, you know, inventories were running low. That's clear. But it started recovering fairly quickly after a few months. But then the big step down in pandemic really was the following the issuance of the stimulus check under the American Rescue Plan. In particular for cars there was just very few cars on the lot, and there were indeed some supply chain issues, the shortage of microchips, et cetera. So I think, you know, there is definitely a role for supply shocks.

Labor supply was definitely constrained as well. On the right figure here, I'm just showing you the sort of the growth accounting decomposition of the output path of the US economy. And in the right here, you see that hours worked labor input recovered much more slowly than output itself. And then what offset that was mainly a rise in utilization and in, in measured TFP. And utilization is really just a translation of average weekly hours worked. So to me, that really is one way you can see labor supply shortages.

I think sectoral heterogeneity is really important as well because the composition of the, the reaction, the dynamics of different components of consumption was really unusual. I think we all know that. So I classified here all consumption categories into four buckets according to their behavior in the pandemic.

We all know the contact sensitive sorry, contact intensive things like hospitals, restaurants, et cetera, et cetera they collapsed and they kind of recovered, but they lacked the recovery of overall output. You had goods that we all used at home: groceries, alcohol at home, games, toys, they went up immediately and actually still you know, above the pre-pandemic trend.

You had big ticket durables which contracted a lot at the very beginning, but then they saw a huge surge and have remained sort of above pre-pandemic trend as well. And there's just some categories like housing and essentials that weren't really affected by the pandemic as well at all. Despite sort of these big differences in some categories rising a lot and others recovering more slowly than in the aggregate, you know, inflation was kind of, broad-based. Initially, it was kind of concentrated in these big-ticket durables and somewhat in the contact-intensive categories. And that I think that led to the perception of the supply chain constraints being very targeted towards certain goods, but inflation then broadened out.

To me, it's quite clear that demand hitting supply constraints here was a major issue. Labor shortages were there across all of these categories, and labor was sort of slow to recover in all consumption types. Wage growth, again, was similar across all these sectors and wage growth was very strong, and coinciding with the inflation surge. So to me, there's a lot of evidence for the story that, that Goudie is telling as well, that labor supply was a real issue.

Then a final comment is that one thing that puzzled me about the paper is that if you know, we were all using VDRs supply-demand decompositions estimated DSGE models, and I think you know, then the results or the interpretation of the results was in real time somewhat different from the findings of the, the authors in the sense that, you know, these models had very flat Phillips curves, expectations weren't moving, and so it has to be markup shocks.

And historically, in previous decades, we thought of these shocks as fairly transitory, and so that led, I think, to the narrative of its transitory supply shocks. So the irony, I think is that the sooner you sort of abandon the lens of the pre-pandemic inflation dynamics I think the more quickly you stop trying to fight the last war. And that concludes my discussion.

EBERLY: Thank you.

Okay. Let's start with Ryan Decker and then Maury Obstfeld.

DECKER: Yeah, so super interesting paper. I like the intuitive appeal of the VAR, Ps and Qs moving different directions. It's a very elegant way to think about this. The authors probably know, but I'm interested in hearing their thoughts on earlier work doing this.

So Adam Shapiro at the San Francisco Fed was doing this a few years ago. You can still go look on the Fed website and see the real time. Finds a larger role for supply than you all are finding. I think like half supply and then like a third demand, and then there's an ambiguous part. And then at the board, Robin Brown and co-authors did this with the manufacturing PPI, and there they were able to supplement the Ps and Qs VAR with data from the survey of plant capacity, where businesses are allowed to say, "We've got a shortage of materials right now," or "We have not enough orders right now." So you have supply and demand measures that they supplemented the VAR with, and I think they likewise find a bigger role for supply. So just thinking about where to put you in that literature would be great.

EBERLY: Okay. Maurice, and then Jim Stock.

OBSTFELD: Yeah. One observation that supports the interpretation of the paper comes from comparing the post-pandemic experience of emerging economies broadly and advanced economies broadly. Both groups face common global conditions. But what you see in the data is that while emerging market inflation, you know, was consistently higher before, during, and after the post-pandemic it rose considerably less in 2021, 2022. And this is very consistent with the fact that in these emerging markets, leaving aside the remark about Latin America, central banks generally raised interest rates before they did in the advanced economies. And also there was much less fiscal space to support people and during the pandemic than than was deployed in the advanced economies.

EBERLY: Jim Stock?

STOCK: Yep. Thanks. So it's just terrific to see all of this discussion. It's, you know, really important for us all to be able to take collective lessons out of that episode, and it's great to see continued debate.

I guess, I just think it's useful to-- I just want to make a couple of points. Point number one yesterday we presented work suggesting that the sign has changed that's in the-- for energy shocks in the US, and that they seem to be more of a demand shock in the United States, oil price shocks do, than supply shocks. I think that, you know, might help in terms of some of these decomposition results.

Second comment is that it's useful to think about this episode as having a, a couple of sections. So if you recall the overall PCE less food and energy plot, there's the initial rise,

which is arguably associated with the demand growth from the ARP plus the the very sectorally shifted supply constraints.

And then there's this second piece, which is the additional, after a shoulder, the additional hump. And that's in the decompositions and I think in lots of other work, largely associated with the energy supply shock price-- energy supply shocks that are associated with the Ukraine invasion.

So, it might well be the case we just have to hold that in our heads that there are these multiple things going on. They each have different timing. They each have different compositions, and it was an extremely complex period.

EBERLY: Okay. Don Kohn and then Mike Kiley.

KOHN: So I agree with Jim very strongly. This is a great exercise. We've got to figure out what went wrong. Now, we do have a task force for that, right? An inflation task force. If you were on the task force, what would you be advising the Federal Reserve about how to get this right, this sort of complex, unprecedented situation right in real time as they're making policy?

I think I know Gauti's answer. V over U and nonlinearities in the Phillips curve. But I wondered what the authors answer, what they would contribute to the task force. Thank you.

EBERLY: Mike Kiley.

KILEY: Just one small extension of both Gauti and Karel's emphasis on, you know, in the paper, using a linear framework and assuming that the slopes or the elasticities are the same as history, you know, naturally leads to is it demand or supply? In a nonlinear world, it's neither demand nor supply. It's how they're interacting. And so making sure that in a policy context, you're asking the question of what's the balance of demand and supply, and are we in a particularly sensitive period or not? And that's of course, an obvious point to everyone here, but it is the case that a great deal of debate goes into the is it demand or is it supply? And the important question is how are demand and supply interacting, and where are we on that nonlinear relationship?

EBERLY: Okay. Could you pass the mic down to Claudia Sahm?

SAHM: Great. So I really appreciated in the paper when you talked about demand, you also brought in that private demand or the pent-up demand, and I think that's so important in this episode, and it gets to this point about what's supply, what's demand, right?

I mean, the pandemic itself was its own kind of supply shock, right? People either couldn't go out, like, 'cause there were social distancing orders, or people were afraid of the virus and they didn't go out. So you had a massive drop-off in service spending, which we saw in one of the discussions. So you had forced savings that was happening, and I didn't quite see in the paper it quantified that, that piece of demand, but, like, there was a study by Aladangady and co-authors at the Fed that in the spring of 2021, they had estimates of, like, a trillion dollars of excess savings to the top quar- quartile of income, households by income, and that

was basically all forced savings. So it was a huge amount of savings. So that was something I didn't appreciate at the time how much pent-up demand there was.

And then in the spring of 2021 when we were doing the American Rescue Plan, that also coincided with massive vaccine rollout, lots of states dropping their lockdown orders. That also can get you some of the, like, across-the-world coordination 'cause a lot of, I mean, the vaccine was going out broadly, and then that unleashed this pent-up demand. So yes, it was demand, but you had a technology, if we call the pandemic that, like, created the demand, and then you had another technology of the vaccine that let it loose.

And the last thing I'd say that was a surprise to me is one of the things we had studied, like, spending around hurricanes and, like, with Hurricane Matthew, so this was well before the pandemic, and we always found that there wasn't the makeup spending. Like, you'd see the loss in the hurricane, but then it didn't get spent later. And I think with the pandemic, and this is the question kind of to the current, when you have supply shocks, the duration matters so much in terms of how it plays out afterwards. And so I just think the whole ... To me, this the pent-up demand is a piece that's, like, really important to understand, so I love seeing it, like, highlighted in the paper.

EBERLY: Can I go over here and then have the mic behind me? So let's start with Marc Goldwein.

GOLDWEIN: Thanks. This is a little bit repetitive of what people just said, but I want to be a little bit more pointed but quick. This is kind of an obvious comment, but it's not just the slope of the supply curve, it's where you are, right? It's a nonlinear supply curve. So if we're at the end, there's only so many workers we may be just at a very steep point. And then the question is: Can these same tools that sort of try to disaggregate, or some of them that try to disaggregate supply from demand, disaggregate where the demand has come from? How much of it is the pent-up savings? How much is fiscal policy? How much is monetary policy, et cetera?

EBERLY: Okay. Martín Beraja and Bob Gordon.

BERAJA: Yeah, great stuff, Giorgio. I think I would just want to echo what Claudia just said, that, you know, when I'm not thinking about AI and the Pope, I'm thinking about durables, fiscal stimulus, and pent-up demand. And some of the... Like, what I wanted to add to what Claudia says is when we did some of those exercises, trying to quantify, you know, how much you can get just out of fiscal stimulus, when you account for durables, how much can you get out of just pent-up demand, you really can get in state-of-the-art models, like doing very careful work, I think. Like, you really can get the type of inflation surge that we've seen.

And then something else that Claudia said, I think she's spot on when, like, something that seemed very special that can account for some of this is that if you compare to historical episodes, just the persistence of the shock itself looks quite different precisely because the vaccine, I think, arrived much earlier than anyone anticipated.

And so I was wondering whether you can think about that, where if you have a shock that everyone believes is going to be pretty persistent, maybe just extrapolating from what we've seen in the Great Recession before that was very protracted, and then all of a sudden it just turns out to unwind very fast, whether that can look like a demand surge.

And and I don't know. But that seems to be kind of like a big... I mean, I remember in 2020, no one thought that we're gonna get out of the recession in one year and we did.

GORDON: Three points. First of all, what was this supply shock? In this building or across the street about three years ago, Ben Bernanke and Olivier Blanchard wrote a Phillips curve paper about this, the last 30 years, and their variable that best explained the inflation we're talking about was the number of Google mentions of the word shortage. So why did we have the supply shock? We had a massive shift from spending on services to spending on goods in the year 2020. This spilled over to 2021. You saw the second discussant showed some nice time series charts of inventory behavior. We know we had shortage of cars, shortage of computer chips. We had 100 ships lined up outside Long Beach Harbor. They couldn't get the ships into the harbor because there wasn't enough port capacity. So we all remember that. It was a genuine shortage situation. And Jim has reminded us that on top of that, then we have the Ukraine war starting in early 2022.

Second point, what is the mechanism? What is the nature of the word cause? Was it caused by supply or demand? And here let's go to Giorgio's graph, where we have inflation on the vertical, real GDP on the horizontal. By definition, constant demand in the form of constant nominal GDP growth gives us a minus 45-degree slope for the demand curve. So we have the supply curve shifts up because of all these shortages.

50 years ago, we used the words accommodate or extinguish. The demand curve, the nominal GDP growth, if it's accommodating the supply shock, it shifts up. We can wind up where Giorgio shows up in the original level of real GDP, or it can extinguish it and try to get all the inflation out of the system with big recession and a big decline in real GDP. So the important thing is that the demand was reacting to the supply. It's not a question of whether the whole thing was caused by demand or the whole thing was caused by supply. It's a reaction to an initial cause that was almost entirely supply.

Now, the third point is, how did this nominal GDP thing just sort of effortlessly glide up there and accommodate all of the supply shocks? I think there are at least three mechanisms. One is the fiscal stimulus. We all know about that. There were three separate fiscal stimuluses, two under Trump and one under Biden.

Second, of course, the Fed didn't-- waited a long time to raise interest rates. That meant that it was accommodating. It was allowing the growth of the money supply to rise because it was not raising interest rates.

And the third thing, which a couple of you, I think, have already alluded to we had a big recovery of the stock market very shortly after the pandemic. We had a lot of wealth floating around in upper income levels going out to buy all these goods, all these exercise bicycles and cars. And then on top of it, you had the lower half of the income distribution buoyed by the fiscal stimulus.

So, the whole thing doesn't seem so mysterious, at least as long as we remember that the whole thing was started by supply shortages.

EBERLY: Okay. Christiane Baumeister and then Jonathan Wright

BAUMEISTER: Yeah I just want to raise a few methodological points within the linear framework that the authors are using. Because in order to be able to draw strong economic conclusions about the economic objects such as elasticities, it's important to be very clear, I think, about those objects and how they are identified, because it determines the relative importance of supply and demand shocks in driving inflation.

So my first point is, if I understand correctly based on the paper your definition of elasticities or the slopes that you derived and that the numbers that Gauti reported in his discussion are actually at the one-year horizon. But that actually is not the concept of an elasticity, right?

So an elasticity asks the question, what happens to the, the quantity demanded and supplied in response to an increase in in the price. And so, that means you have data at quarterly frequency, and so that should happen within the quarter. Whereas if you're looking at the one-year horizon, then you're actually mixing the slopes with some dynamics. So you're talking about long-run elasticities.

And so I was wondering how representative these numbers are. Now you I mean, we talked about this before, that basically your baseline model using sign restrictions is only set identified, and that means that implicit priors resulting from the a-algorithm that you use to implement the sign restrictions play a role.

Now, in the paper, now you report the the priors, but again, at the one-year horizon, and you show how the posterior shifts relative to the prior. But again, the data are only informative about the dynamics. If you were to look at the implicit prior on impact, so basically at the within the quarter then you would find that the prior and the posterior are actually, I mean, the same.

So you do not learn anything about the, about it from the data, about the, the slopes. Now, you then now supplement and I was very happy to see that you actually followed up on my suggestion to use the informative priors and be explicit about them, like Jim and I suggest in our framework.

But then I was a little bit disappointed to see that you're using priors that are for the supply and demand elasticities that are centered at one and minus one. So, which I guess are not the numbers that you're, for example, using in in your DSGE model. But also Jim and I, in our GME paper, we derived or we did a careful analysis of where these where prior information comes from, and we had some different numbers.

And in fact, if you were to use the ones that we supply for that we suggest for the supply and demand elasticities you would actually arrive at different conclusions. All that to say, I don't think that the empirical exercise that you conduct here is really able to settle the debate about the quantitative importance of supply and demand shocks in driving inflation. Thank you.

EBERLY: And Jonathan.

WRIGHT: You noted that there was a difference in the timing of the peaks between the U.S. and the euro area, but you didn't talk about the interpretation. And I think that's got to be almost a hundred percent the war in Ukraine, which was a supply shock and had a bigger impact on Europe because of its dependence on Russian gas than on the U.S.

So, while I can certainly imagine that there's big demand shocks earlier getting back to what Jim said I think in 2022 if your identification doesn't have a big role for supply, that leads me to think there's something suspect about the identification.

EBERLY: Okay. Rick Mishkin and Joe Beaulieu.

MISHKIN: So I have a comment, a question and a comment. So question, I'm very US-centric. So, we look at the US and I always felt that there were two things that the Fed actually missed, which was the huge fiscal expansion that we've talked about, and secondly was this issue that there was forced saving and the pent-up demand.

Can you tell me a little more about what happened in Europe that was very similar? Because I just don't know enough about it. But, you know, what was the fiscal stance and with the pent-up demand. So it-- you said it was very similar to the US, but I'd like a little more details. That would be very helpful.

Let me make a comment, and it relates to this whole thing about the task force. Because nobody's mentioned this, but I think it's really critical to understand that a, a part of the mistakes that were made were because there was a misinterpretation of the Phillips curve as a structural relationship as estimated. And in work that that I did for the US Monetary Policy Forum and Tenorio Mc- I think it's McCleary McClay, that if you think about what is gonna happen to the Phillips curve as estimated, there's a classic theorem in optimal control, which is if you're doing optimal policy, there'll be no correlation between the instrument and what actually happens.

And and indeed, when you actually look at this you find that the Fed actually changed the way it did policy. It became less preemptive, one of the criticisms of it. And that would actually mean that the Phillips curve would come back again. So, you know, we talked about is the Phillips curve dead or is it hibernating? And we said, this was actually before 2020, I think it was 2019, that it was hibernating and would come back if the Fed didn't do its job properly. And I think that's exactly one of the things that, that happened.

We also did look at this nonlinearity thing, which I'm very sympathetic to. So, I think that when we think about this, that it's not just the nonlinearity that, that Gaudi emphasized. I think there is some of that, but one of the ways of looking at this was to actually look at a case where, in fact, there was no endogenous monetary policy. And that's where we looked at states and what happened in terms of Phillips curves for states. And you do see a little bit of nonlinearity. So it's not that I would rule it out, but I think it's there. But in fact you actually see the Phillips curve not changing very much and always having a serious slope.

So when we think about this task force, this is, I think when I think about the big mistakes, one was plain forecasting mistakes. They didn't take account of the, the demand shocks that were important, and this paper emphasizes. But very important was a misunderstanding of the Phillips curve. And in fact I actually did talk to both Jay and Rich Clarida about it at the Fed before this episode. But We didn't have-- I didn't have any impact.

But I think that's gonna be extremely important in terms of rethinking these issues, and nobody's mentioned it yet.

EBERLY: Joe and then Jon.

BEAULIEU: So a question and a comment. So my question is how satisfied are we with the strategy of sign restrictions in identifying shocks, especially in an environment where you might think the timing and dynamics are different?

So, I mean, we all scratched out phase diagrams with saddle point equilibrium in grad school, and we know that prices can react, you know, at least in theory, should be reacting much faster than activity. As more of a general comment some people brought up semiconductors and vehicles, but the fact is that, you know, over twenty-twentyone, half of the acceleration in inflation was in vehicle, was just due to new and used vehicles, and more of it actually in used vehicles than new vehicles, which is interesting in itself.

So I'm suggesting that there probably is a richer narrative to tell if you go through the period and focus on, like, a few things as possible. So like some-- one of the discussants mentioned, "Oh, well, you know, in the various timing of these things, here are some of the big events." But clearly the auto industry was one of the first things that kinda set this thing off.

And I know that as like macroeconomists, we're supposed to like kind of ignore that stuff and just say, "Well, you know, if the-- if-- That's a relative price shock. That isn't actually inflation." But in the real world, the timing is not as ideal as you would like.

STEINSSON: So one thing I learned from working with the authors on this paper, helping to edit it, was just how tricky it is conceptually, the question that they're posing. You know, we're trying to you know, ask whose fault it was, demand or supply, but that depends on the counterfactual that is being proposed.

And very often, when you're doing that kind of an exercise, the counterfactual is very natural. Nothing happened. But in this case, there's a counterfactual for monetary policy. Okay? So in that counterfactual, what is monetary policy doing? Well, one, one counterfactual is a very-- this came out very well in the presentation, is a counterfactual where the AD curve is very flat. Well, in that counterfactual, monetary policy is not doing nothing. It's reacting extremely strongly to the things that are happening on the supply side of the economy. So, so you can take that to an extreme where it's a strict inflation targeter. That's one counterfactual. That's kind of the counterfactual where inflation is always and everywhere a monetary phenomenon, right?

But in that counterfactual, the answer has to be 100% demand. It can't be anything else. Now, Giorgio was a little bit dismissive of the other counter-- the, the other extreme, where the AD curve is vertical. But to me, that's actually the counterfactual where monetary policy is doing nothing. That's a counterfactual where real interest rates are constant.

So to me, actually, that's not a ridiculous counterfactual. But I mean, that's also a tricky counterfactual because in that case, supply shocks can't have any effect on output. So the whole exercise is kind of difficult and the-- you know, they're very clear about it in the paper. There is a counterfactual that's being put forth, and the answer depends very heavily on that counterfactual.

EBERLY: Is there-- Gian Maria, you had a question? And Wendy-- and could we keep these short 'cause we're over time, and I wanna go back to the authors.

MILESI-FERRETTI: Yeah. The whole discussion has been on the US. I think the shock in Europe was very different. It is not the same across countries because the commodity that increased the most in price, which is natural gas, does not have a unified price across the world.

I think the shock the magnitude of the supply shock in Europe coming from the gas shortage after the beginning of the war is much larger than the shock in the US. Policy is less accommodative overall. I just struggle to see how one would come up with a conclusion that in Europe, most inflation has been driven by demand, and that you can really compare the Europe and US experience on that score.

EDELBERG: Because this conversation got into like what are the lessons learned and what did we get wrong at the time I think it was clear at the time that demand was constrained and it was going to explode in some way, shape, or form regardless of fiscal policy. But fiscal policy made that more so. And that supply was constrained and something was gonna happen with supply.

My mistake at least was I assumed that they were going to improve together, and that I assumed that demand was going to recover at the same time that all of the things that were constraining the economy because of COVID were also going to improve. And I didn't anticipate that supply was going to recover much fast... Sorry, demand was going to recover much, much faster than supply. So I just, I think the lesson is that I'm not sure that's a very specific lesson to COVID. But both the demand and supply issues were pretty obvious at the time.

EBERLY: Okay. Let's go back to the authors, Giorgio and Domenico.

PRIMICERI: So I'm gonna try to address some of these comments. I can't possibly respond to all, and I'm gonna try to combine them perhaps. I'm gonna start from the end more or less. Christiane, first of all, thank you because Christiane saw a version of this paper a couple months ago, and she made almost exactly the same comments, so we had time to address them.

From my perspective, now they're fully addressed in the appendix, in particular about priors. I wanna stress that we set up priors such that a priori demand and supply have exactly the same chance of explaining the surge on inflation, and demand comes out as a winner. You know, not like 100%, but the probability that it was demand is higher than supply, and there's a full analysis of prior and posteriors in the paper.

A brief comment about Shapiro's work. Shapiro's work is very related and some of the other sectoral work. What we note in the paper is that we find that it's more demand than Shapiro because at the sectoral level, the aggregate demand curve is less flat because the Fed responds to the aggregate economy, does not respond to sectoral imbalances.

About pent-up demand, this is another very important question. Identifying directly pent-up demand is very difficult, so our attempt at doing it is as a residual. We have a model in which we expand the demand side, and we introduce fiscal variables, identify fiscal shocks, monetary variables. We identify monetary shocks and the residual demand shock in that model, we interpret it as a pent-up demand. That's the best we can do. It's probably pent-up

and something else. In our results, it accounts for about a third of the surge in inflation, especially in the later period in the US, and much less in Europe.

Thank you for your comment on the counterfactuals. That's very important. That's a very subtle point, and I think you explained it very well. It is a problem that any decomposition of this type has to face, whether they tell you or not, an assumption is implicit there. And I wanna thank the discussants for especially, it was a great discussion. And I want to combine some of the comments of the discussants, but also of some other questions into this idea that we are decomposing the COVID shocks using parameters and slopes from the pre-COVID period.

This is a very important point, and this is true both for the demand and for the supply. But I think the way we should think about the changes in the slope for demand and supply is very different. Because I completely buy the point that the supply might have been steeper as we got closer to capacity constraints, and that might have amplified the role of demand shifts.

So actually, what both Karel and I interpret what both Karel and Gaudi mentioned about the slope of the supply curve as a refinement of the mechanism going on in in our paper. As for a change in the slope of the demand, I think that's less important in the following sense. The point cannot be that the Fed in 2021 and 2022 has become less aggressive about inflation, because there's really no difference in the short run between a large monetary shock and responding zero to inflation.

They're both monetary policy accommodations. They're both policy choices that manifest themselves in exceptionally strong demand and ultimately in inflation. So the slope of the demand curve might have changed during 2021, but the economic interpretation of that change is exactly the same as a, a monetary policy shock, so a demand side shock.

And I don't know if Domenico wants to add anything.

GIANNONE: Oh, yes. Thanks everybody for comments, Karel and Gaudi especially. So I think I want to address one of the, the comment by by Donald on on the, our suggestion for the task force. Actually, there is another task force that is about measurement, and my main suggestion is that these two should work a lot together.

And this is also related to the, one of the comment by Gaudi about the expectations. So why expectations on inflation were not were so distorted on the downside. And one of the reason is because at the time, in real time, we didn't see how strong was the recovery. And as Giorgio was showing, this was due to real time data. Actually, this is not only in the US, also in Europe. And this week, there were some data revisions in the, in Italy. Actually, according to... In 2022, according to real-time data, Italy GDP was below 2019. Nowadays, we know that it was above. So there has been a lot of revisions. So this can explain why we missed the inflation in in our forecast. So I think that's an important part.

Another thing I want to comment, actually two things. One is about energy prices. We have in the paper, in the appendix, an analysis of a model with energy prices there. And an important thing that comes out is that energy prices are endogenous, and they are driven a lot by demand. So with the reopening, there was a lot of demand, and energy prices went up. And actually, in you know, in several occasions, people even use commodity prices as

indicators of world demand. So we have to, like, you know, just seeing energy prices doesn't tell us that that supply.

And the same it's the case for congestion. You know, like, there was a discussion about the number of times you know, congestion was used, and people have been using delivery times and supply chain problems, and so on. We shouldn't forget that actually, these are also... congestion can be generated by demand. At the time of COVID, I was working in the industry, and you know, congestion, especially where I was working, it was e-commerce, was mainly coming from demand and not from supply. And actually, if you look at delivery time, is typically used as an indicator of business cycle. And actually, there was just a couple of quarters at the beginning of the pandemic in which they went the opposite way relative to the general to the general business cycle and and sentiment.

One last thing, to Jonathan. An interesting... in Europe, and for some reason, there was a lot of discussion about energy prices, and especially household gas. Actually, what happens, and indeed it was much higher than in in the United States. However, in the United States, the transportation gas, transportation energy prices went up just as much. And so in aggregate, you know, like, the cost of energy in Europe and in US was was very similar. And by the way, energy prices in Europe were already quite high before the Russian invasion of Ukraine.

EBERLY: Okay.

GIANNONE: But thank you very much.

EBERLY: Thanks very much. Thanks very much. I, I wanted to mention there was one question online from Joe Gagnon, who, which is a question for Gauti.

So we'll, I'll convey that to you separately so the two of you can talk about V over U and how to augment the Phillips curve with V over U . Got it. All right, thanks very much. We're gonna come back at 12:10 and for the last session.