THE BROOKINGS INSTITUTION

FALK AUDITORIUM

SLOW GROWTH IN PRODUCTIVITY: CAUSES, CONSEQUENCES, AND POLICIES

Washington, D.C.

Thursday, September 8, 2016

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Welcome:

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Session 1: Is the Slowdown Real or Just Mis-Measurement?:

DAVID WESSEL, Moderator
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JAN HATZIUS
Goldman Sachs

CHAD SYVERSON
University of Chicago

HAL VARIAN
University of California at Berkeley

Lunch:

MARTIN FELDSTEIN
Harvard University

Session 2: What Do the Microdata Show?:

LOUISE SHEINER
Hutchins Center on Fiscal and Monetary Policy
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Paper:

DAN ANDREWS
OECD

PARTICIPANTS (CONT'D):

Discussant:

CAROL CORRADO
The Conference Board

Paper:

JOHN HALTIWANGER
University of Maryland

Discussant:

BRONWYN HALL
University of California at Berkeley

Session 3: Perspectives From Overseas:

MARTIN BAILY, Moderator
Business and Public Policy Initiative
The Brookings Institution

Paper:

JOHN FERNALD
Federal Reserve Bank of San Francisco

Discussant:

ERA DABLA-NORRIS
International Monetary Fund

Paper:

ISABELLE ROLAND
London School of Economics and Political Science

PARTICIPANTS (CONT'D):

Discussant:

MARSHALL REINSDORF
International Monetary Fund

Closing Remarks:

MARTIN BAILY, Moderator
Business and Public Policy Initiative
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P R O C E E D I N G S

MR. BAILY: So it is now just past 11:00, so if everybody could sit down, that would be great.

MR. WESSEL: Wow, Martin, that was very impressive. Good morning, I'm David Wessel. I'm the director of the Hutchins Center here at Brookings, and Martin Baily from the Initiative on Business and Public Policy, welcome you to this. We're pretty excited about this because I think it's obvious to everybody the importance of productivity growth and the disappointments we've had recently, but also the urgency and understanding better what's going on, how much is measurement. To the extent it's not measurement, what is causing it and what can we do about it?

So I want to particularly thank Rebeka Sundin and Lilia Cherchari of, our staffs who did a lot of the work arranging this, and I want to thank you all for coming. A couple of housekeeping announcements before we get going. We were really pleased that so many distinguished people wanted to

come, and so we have kind of taxed the limits of this setup in the room. If there's an empty seat at the table, you're welcome to join us. We've tried to make sure that all of the presenters could sit at the table, so they could have a chance to be seen.

What we're going to try, though, is to make it a group conversation. We have a couple of these handheld mics so that when we get to the discussion phase, no priority will be given to people who are sitting at the table. If a mic doesn't get to you and you can lean over and talk to one of the table mics, that would be great. We hope that people will be a little flexible on the seating because we're going to have the speakers up here, and then we may swap seats. So just bear with us.

The speakers are aware of their time limits, but Carrie has an iPad here with a countdown to warn them when they're running out of time. We're going to try to stick to schedule because we do have a lot to do. I think you have a copy of the agenda? Yes?

So we're going to just go over it really

quickly. We're going to start with a panel Jan Hatzius, Chad Syverson, and Hal Varian on measurement issues. Then we're going to break for lunch. Lunch will be a buffet, bring it back in here. And then we have the pleasure of hearing from Marty Feldstein while we eat our lunch, and then we have two sessions this afternoon. We'll close by about 4:45 with some concluding remarks by Martin, and then you're welcome, if you're interested and able, to join us in the room across the hall for drinks and light hors d'oeuvres.

As you may know, I should have observed that although we didn't open this to the public, this is on the record. We will make a transcript of it, so be aware of that.

Tomorrow we have a more public-facing event, when this room will be set up in the more conventional stage/auditorium style. You're certainly welcome at that. It starts at 9:30. Martin Baily's going to give an overview and then we have a panel with Bob Barro, Brad DeLong, John Edwards from GW, and Bronwyn Hall. But anyways, the temp there is to take some of

the lessons of this morning and this afternoon and share them with the public and then have a panel of people with very different views talking about what policies have a prayer of increasing productivity growth.

Anything else I've forgotten? Okay. If you go to WiFi, it's Brookings Guest and they may --

MR. BAILY: And then you just say, "proceed."

MR. WESSEL: You don't need to log in.

MR. BAILY: No, no need for --

MR. WESSEL: Right. And so for the speakers, here's the deal: either use the table mic or you're welcome to use this handheld or another one. And I have the clicker and if it doesn't work somebody other than me will help you.

There are a couple of seats up here if anybody needs one and there are a couple of seats along the side, so squeeze in.

The goal of this morning is to basically present the best case that the slowdown has a lot to

do with mis-measurement, and it doesn't, so we're going to start with Jan Hatzius from Goldman Sachs, and then Chad followed by Hal. Each of them will have 10 minutes and then we'll have time for a discussion with them and others.

So, Jan, do you want to start?

MR. HATZIUS: Yes. Could I just have the clicker, please? Thank you.

MR. WESSEL: I should say that all of the slides and the papers that we have are on the event page website.

MR. HATZIUS: All right. Thank you for inviting me and I look forward to the discussion of measurement issues in productivity.

So, of course, the official numbers show a sharp slowdown in productivity growth and, I think, attribute most of that to less contribution from information technology. That was the conclusion from the Byrne, Oliner, and Sichel paper a couple of years ago. Contribution from IT was about 1.5 percentage points in the late '90s, early 2000s; is now less than

half a percentage point, and that roughly corresponds to the cut in consensus estimates of longer-term productivity growth from about 2.5 percent in the early 2000s, to somewhere like 1.5 percent or maybe a little less.

So I think that's what the official data showed. Reasons to be somewhat skeptical that that is the whole story are for me basically twofold. One is basically the behavior of the economy. To me it doesn't look like behavior that I'd expect if there had been a large tech-driven slowdown in productivity growth. What would I expect if that's what we were seeing? I'd probably expect somewhat more inflation because of basically a leftward shift of the aggregate supply curve. I'd expect weakness in corporate profit margins because corporates are the residual claimant, and should be hit by weakness in productivity growth. I'd probably expect weakness in the equity market and probably, particularly, a pronounced weakness in the technology sector of the equity market.

And I would say, by and large, that's what

we did see in the 1970s, the last uncontroversial slowdown in productivity growth that we had. But we're really not seeing that now. So that's just one observation. Obviously, there are other explanations for each of these developments, but it doesn't really smell like a big tech-driven productivity slowdown at first glance.

The second reason why I'm somewhat skeptical is that I think there's a very straightforward story for what could have driven, and I think has driven, a significant part of the slowdown, namely a shift in the technology sector away from goods and items that are measurable, where quality improvement is measurable and where there are quantitative metrics, such as processor speed, memory or storage capacity, two sectors where it's much more difficult to come up with good quantitative metrics of how quickly quality is improving.

And the chart here just shows the value added share in percent of non-found GDP for technology sectors, computers and electronic products,

manufacturing, software publishing, data processing, Internet, and computer systems design, and shows the big increase in the software and digital products sectors. Actually, this chart understates the shift somewhat, the shift from more easily measurable to less easily measurable items, basically because the computers and electronic products manufacturing sector has shifted more in the direction of specialized IT products that suffer from some of the same difficulties of measurement as the software sectors.

So, a big shift in the direction of things that are harder to measure and, of course, if something's harder to measure, then the default assumption is, if you don't have good criteria, to basically assume that prices haven't changed significantly in quality adjusted terms, and that is essentially what we see. If you look at the deflater's for these different sub-sectors we see a big drop cumulatively in computer and electronics manufacturing and in the official price indices, but basically no changes in any of the other sectors.

And again, the computers and electronic products' price index, of course, has also been affected by the shift towards specialized IT equipment recently. That's probably held down the measure and pace of decline in recent years. So I think, to me, that is really the key issue, that we've moved into sectors where the official price indices don't really show any deflation, so the official indices basically say that if you spend $100 on software now, you're still getting essentially the same amount of real value as you did 10 or 20 years ago, which to me seems quite implausible.

Now, how large is the impact? Of course, that's much more difficult to say. I think we can get a rough sense of the magnitudes by just looking at what's happened to the GDP shares of these different sectors. So now the software digital product sectors account for about 4 percent of non-found business GDP. So if you have understatement of quality adjusted price declines in those sectors of 5 percentage points a year, that would give you about 2/10ths of a

percentage point. If you have 10 percentage points per year in understatement, that would give you about 4/10ths of a percentage point. And those numbers have obviously risen gradually over time as the sector has expanded. So I think that's part of the mis-measurement issue.

I think the other part of the mis-measurement issue related to the tech sector is the question of how to treat free goods: Facebook, Google Maps, and the like. And Hal will talk more about that, but at least some of the estimates do suggest that the contribution of those free goods to at least consumer surplus could be quite substantial. Studies based on the opportunity cost of time can give you several tenths of a percentage point of additional growth if you wanted to translate that into GDP terms.

Now, obviously, you can't just take studies that are based on the opportunity cost of time and just add those to GDP growth. That's outside the logic of the GDP accounts, but I do think there are probably ways that you could bring those types of

goods or products into the GDP calculations that would be more consistent with how we normally think about GDP.

For example, we could think about the ability to us Facebook and Google Maps as essentially a feature of products that are paid for, such as Internet service or cell phone charges. And so you probably could think about an approach where you say, I'm still paying $50 or $100 a month for Internet and cell phone service, but I'm now just getting a lot more for it than I did previously. So we could basically focus on an aggressive quality adjustment of those components of the conventional GDP accounts and, I think, probably get some significant numbers. Obviously, the uncertainty is very large, but I do think that both of these issues are probably significant.

Now, before I finish I do want to talk just very briefly about some of the counter arguments, and I'm sure we'll get into that more, but just to note where I stand on some of them. I think Chad is

probably going to make the argument that you can't explain the entire productivity slowdown with tech because it's just too big. And I basically agree with that.

I do think that if you go beyond tech into other sectors, such as healthcare, then maybe you have a little more of a possibility of explaining a large share. I'm reminded of something that Alan Blinder likes to say. He says when he speaks to large audiences he likes to ask them whether they would prefer today's healthcare, today's nominal prices, or 1975 quality healthcare at 1975 nominal prices and the vast majority say they want today's healthcare.

Now, if that's right and if that's representative, then it basically suggests that all of the nominal price increases in the healthcare sector since 1975 have been due to unmeasured quality improvement. That's about 5 percentage points a year. The healthcare sector accounts for 18 percent of GDP now. It accounted for 8 percent of GDP back in 1975, so you can do the math and you can get some pretty

sizeable numbers in terms of increased understatement out of those types of calculations.

Second argument is the paper by Byrne, Fernald, and Reinsdorf that was presented here at the spring Brookings panel, which basically says -- I mean, it says a lot of different things, but I think one key argument is that the sharp drop in computer manufacturing in the Unites States has reduced mis-measurement because computer manufacturing is quite badly mis-measured, and I think that's a good point. And they list some studies that I think make a convincing case that there is an issue there, but I do think that where I don't agree is in the assumptions about software mis-measurement. They make some very small assumptions there and some very small corrections to the software price numbers. And I guess my view is that the reason why there are a lot fewer studies on software price mis-measurement than on hardware price mis-measurement, it's the same reason why there's already a lot more quality adjustment in the hardware deflaters than in the

software deflaters, namely that there are quantitative methods. And so I think if you made a more, perhaps, aggressive attempt to account for mis-measurement in software prices you get significantly bigger numbers.

And then the last point is something that is a point that Bob Gordon has made, of course, many times. And it's basically that information technology doesn't really measure up to past inventions. If you look at the great inventions of the 20th century -- electricity, mass transport, and the like -- ICT is just not in that league. Maybe it's not as much of a point about mis-measurement, but really more a sense of scale. And I would say again, on that I agree. I basically agree that indoor plumbing is more essential to have than an iPhone 7 and, I guess, especially if that iPhone 7 doesn't come with a headphone jack.

(Laughter)

MR. WESSEL: With a headphone jack.

MR. HATZIUS: So let me leave it there.

MR. WESSEL: Thank you. I'm tempted to -- you know what Matt Lauer said last night? "You're not

allowed to attack your opponent until the opponent gets to make his case." Who's got the -- oh, there we go.

MR. SYVERSON: There we go.

MR. WESSEL: The productivity just declined by 50 percent.

MR. SYVERSON: Yeah, no kidding. Well, thank you for the invitation to be here -- to be back, actually. I spent my last year in grad school as a fellow here, so it's nice to be back at Brookings. And I'm happy to talk to you today about some work I did looking at the notion that the productivity slowdown might be a figment of measurement problems.

I don't usually start papers or presentations with quotes, but I'm going to today. And this is from author and cultural commentator and fellow North Dakotan, Chuck Klosterman, who said, "Everyone knows the Internet's changing our lives, mostly because somebody in the media has uttered that exact phrase every single day since 1993." (Laughter)

And I think this kind of speaks to one of

the notions behind the mis-measurement hypothesis that there's this sense in the air -- and I had it, too -- that technology was changing faster than ever and we're on the cusp of -- we're not on the cusp, we're living through an era of great technological change and progress. But, of course, the reason we're here is because we don't see that in the data. So productivity growth since 2004 has fallen in half. This is through 2015, and, of course, the first two quarter numbers from 2016 aren't going to help this any. It'll make it worse, indeed.

So how much is missing? What are we talking about when we have to explain away in terms of some productivity measurement issue? Well, had productivity growth not slowed down after 2004, conservatively -- and this is taking no account that the BLS labor productivity numbers don't quite capture the whole economy -- it's about 75 percent, but GDP would be probably $3 trillion higher now, in 2015, than it was, okay? So that's $9,200 for every single one of us, all of our parents and children. That's

$24,000 per household, okay?

This is the entire healthcare sector. It's 18 percent of GDP. That's gone, okay? That's what's missing, if you think we've got measurement problems. Or to be more accurate, if you think measurement problems are the whole story here, we've just lost the healthcare sector or something that size.

If this continues for another decade, we're going to be missing one-third of GDP. In other words, the missing chunk will be half as large as the stuff we observe, okay? So that's the sort of scale that we're talking about here. So the mis-measurement hypothesis is that something about new products and service are just difficult to capture in the way we measure our economic statistics, and in our productivity numbers in particular.

So, for example, things you often see cited are there's a lot of products that people use, but are free to use on the margin. They're not paying for them every time they do a Google search or when they go on Facebook and post things or look at their

friends' postings or when they use GPS on their phone, et cetera. And in a sense GDP is, of course, essentially all expenditures. In the economy if you're not expending the idea, as well, we're missing all that stuff, even though it's delivering a large amount of consumer surplus. So you get this divergence between consumer surplus, or welfare, and what shows up in output.

So this is a plausible story. But it's a story, and so what I wanted to do is look at some things in the data. And what I ended up with was looking at -- I thought of four different things that ought to be true or should give some indication about whether the mis-measurement hypothesis was right. Each one of them comes at it from a different conceptual angle and uses different data. I wouldn't say they're completely orthogonal draws from the bucket, but they're pretty close. I think there's a lot of independent information in each one.

So, what are they? First, has the productivity slowed down that we saw in the U.S.

happened elsewhere? And if it has, is the size of that slowdown related to the size of the IT sector in that country's economy? Which is what you would expect to find if this was about free goods or something related to digital and IT products.

The second thing, there is literature already that's tried to measure the consumer surplus from online stuff. And that started about 15 years ago, but there's been more recent things. I took everything I could find from that, updated their methods with the newest data, and then calculated the implied surplus from goods related to broadband access, basically.

Third, let's just suppose that $3 trillion existed and we were able to capture it in our GDP statistics. What does that imply about the size of the IT sector of the economy? Okay, we say it's too small if the mis-measurement hypothesis is right. How much too small is it?

And fourth, look at the difference between total income and total expenditure, okay? We know

they are conceptually equal by an accounting identity, but they aren't in the data. They're calculated from different numbers and, in fact, they've been diverging in a particular way that might be consistent with the mis-measurement hypothesis. And so we'll dig into that a little further.

So those are the four things that I did, okay? This is how many were consistent with the mis-measurement hypothesis: none of them. So I'm just going to walk you through briefly what I found and we can talk more about it in the discussion later.

Okay, so first, if you look at the relationship between the size of the productivity slowdown across countries and whether it's related to the size of the IT sector in those countries, this is a plot of OECD, the size of the productivity slowdown. It's the same calculation as from that slide I showed you for the U.S. It's just 1995 to 2004 productivity growth subtracted from 2005 to 2014. This is for the 30 OECD countries I had data for.

First thing to notice here, on the vertical

axis, 29 of them are below 0, okay? So the productivity slowdown has been widespread. Spain is the only exception and I think that's because so many people lost their jobs that labor productivity actually went up. (Laughter)

The second thing to notice is the horizontal axis is the share of households with broadband access. There's no relationship between that metric and the size of the productivity slowdown, okay? That's the demand-side measure of the importance of IT. If you look at a supply-side measure, which is the size of the IT sector in terms of value added as a share of the entire economy in the country, you also get no relationship. You fit a line to that plot right there and you get zero. And I don't mean just a statistical zero, I mean an economic zero. The correlation is miniscule.

Second, if you go to that earlier literature that's already been trying to calculate the consumer welfare that comes from IT products that are tied to broadband access and you update the numbers, most

estimates imply a surplus in the neighborhood of $200 billion, okay? Now remember, $3 trillion is what's missing, right, so you don't get quite there, you don't even quite get 10 percent there.

The largest in the literature, and largest by some distance, is $850 billion and that's still just one-third of what's missing. Too, this is consumer surplus. This isn't trying to parse what ought to be in GDP and what ought to be in surplus that we never measure. This is just saying of everything that's welfare-related at all, maybe we can get -- maybe -- we can get close to a trillion dollars. It's not necessarily saying all of that would have gone in GDP in this counterfactual world where we're measuring everything correctly.

And I'll say more broadly the stuff I'm looking at here, all these four tests, don't really require a close parsing of what's in consumer surplus versus what's in producer surplus and, therefore, GDP. So I think even though for measurement reasons the standard errors are tighter on what you can say about

what's going on with GDP growth, I think that it's also indicative that the rate of growth of welfare has slowed, just like labor productivity has slowed, all right? So I just wanted to make that point before moving on to the third.

The third, again, which is let's suppose we caught that $3 trillion in our measures. How much larger would the IT sector have been than it is now? Well, you do the numbers. IT-related industries are $1.4 trillion in measured value in 2015, $810 billion. So that's a total real value-added measured growth of $600 billion. You add the $3 trillion that we're missing, attributing that to the IT sector, that says, well, the sector ought to be six times as large, okay? So we don't measure things perfectly. Do you think we measure things so imperfectly that we hit one-sixth of the actual activity? That's sort of what this number implies.

Moreover, the implied labor productivity growth ---- again, if you attribute this missing $3 trillion to the sector -- would be 415 percent over

the period rather than the observed 80 percent. That's faster than has ever been seen for any sector, including durable goods production during the 1995-2004 slowdown. It's way bigger.

And it also seems to me inconsistent with -- I'm not sure, I'd agree with Jan Hatzius. I don't see patterns that look like there's a slowdown going on. It seems if there's truly a 415 percent labor productivity growth in the sector, I would think a lot more investment would be going on and just massive amounts of resources would be flowing to the sector, much more than are currently.

And the bottom line for these numbers is the whole IT sector -- and I think it's generously defined; I can get into it later -- is about 8 percent of the economy in 2004. Can we rely on this thin slice of the economy to explain a missing 16 to 17 percent now? That requires a whole lot of growth that's unobserved.

Finally, this observation that Gross Domestic Income had been larger than Gross Domestic

Product since the slowdown started -- and this, by the way, I thank Hal for pointing this out to me in the first place -- by about half a percentage of the size of the economy on average since 2004. And then the idea is, well, okay, what might be going on here is companies are paying people to make these products that they're then, essentially, giving away. So we see it in the income statistics, but we don't see the product in the expenditure GDP statistics.

That is consistent with this number. However, if you go further back in time this gap opened up seven years before 2004. It was positive every single year since 1998 and that was during a productivity acceleration. Moreover, if you look at where the growth in GDI is coming from, it's not coming from labor income, it's coming completely from capital income. So it's not that we're paying workers to make stuff that companies are giving away for free. It is that companies are making higher profits than they have in a long time and that's been shown independently in other cases. And that's just not

consistent with the world where companies are giving away all this great stuff for free.

All right, a few last points before I close out. Just remember, GDP is mis-measured. It always has been mis-measured, even as a notion of what it's supposed to measure, much less as trying to capture overall welfare, okay? If you want to explain the slowdown, you have to say it's more than just GDP is mis-measured. You have to say there has to be a systematic change in mis-measurement, starting around 2004 and, moreover, that change has to go in a certain direction. In fact, David, John, and Marshall's paper show where you look at one plausible change, it actually goes the wrong way.

Moreover, I took as granted in the introduction that you could have these free products that people are enjoying, but not paying for, but you have to buy complementary goods to consume Google and GPS and your camera phones. You've got to buy the phone, you got to buy broadband access. Unless these companies are incompetent, they ought to be pricing

the value of those things into the prices of those complementary products. So it doesn't mean those things are gone from GDP. It just means that they're in the price of the other products.

And then you look at a hedonic, and lots of people have run lots of hedonics on smartphones, the price of the camera, the price of the features of that phone are in there, right? It's showing up, it moves around, and prices it. Inputs, or as the components of the phone get better, the price of the camera goes up.

And I'll just note the other work that's been done. I already mentioned the Bryne, Fernald, and Reinsdorf paper, but other people have done work looking at the same problem that I'm looking at, but in very different ways and with different data, and finding something consistent with this.

So, where do we end up? Well, it's kind of depressing. I think this is real. I think you can definitely reject that all of the slowdown is measurement. I'm not sure you can reject that mis-

measurement is zero. I wouldn't rule it out that it's positive, but I'm not sure that you can reject that there's not mis-measurement issue going on at all. So it's a little depressing, but that's the way it is.

MR. WESSEL: Thank you. Can you pass the clicker to Hal?

MR. SYVERSON: Sure.

MR. VARIAN: I'll see if I can lift that air of gloom in the next 10 minutes.

MR. SYVERSON: Sorry. (Laughter)

MR. VARIAN: So I'm going to look at this from a microeconomic point of view and here's what a microeconomist looks like -- this way? No, no. All right, it didn't show up.

Okay, so I want to start with the premise that GDP isn't equal to welfare, and what we'd like to do is look at a standard of living measure and see how that works. Everybody would agree that GDP is not equal to welfare, but I think in practice they tend to be confounded in a lot of arguments.

So what's the problem? GDP is a value of

market prices of all final goods and services produced in a given country in a given time period. So we aren't measuring the unpriced goods, as we just heard. Final, it excludes from intermediate goods --

SPEAKER: Let's move this a little closer.

MR. VARIAN: It excludes from intermediate goods and services, such as marketing, embedded software, and so on. It's the goods produced in a given country, which is very important because welfare depends on consumption, not on production. And in a given country it has become much more ambiguous in the last 15 years or so because of global supply chains. So these are the features that I think are important, and several of them are a relatively recent phenomenon.

So the unmeasured quality changes, the non-monetary transactions of global supply chain, and I'll say a word or two about semiconductors at the end.

All right, photos. There were 80 billion photos taken back in 2000. That was easy to measure because there were only three companies who produced

film. In 2015, according to my estimates there are 1.6 trillion photos taken -- 20 times as many. It's very hard to get an estimate of that number, but I think I have a reasonable way to do it. The price per photo has gone from 50 cents to 0 cents. So anybody who looked at that and used productivity in the noneconomic, normal sense of the term would say, gee, there's a huge increase in productivity. Quantity has gone up by a factor of 20 and price has gone from 50 cents apiece to 0.

But if you get a look at the price index from the BLS, that includes the price of film, developing, camera, all of which are gone. They're no longer relevant. And furthermore, photos are not sold typically. Typically they're shared, so it's a nonmonetary transaction. And GDP went down when cameras were absorbed into smartphones because you saw the sales of cameras drop and you saw no quality adjustment for smartphones in the official data. It's true that people have done hedonics, but that's not done currently in the U.S. numbers.

And here's a little picture, you can see the film cameras in gray, the digital cameras in blue, and then what happened when smartphones got cameras, it just collapsed, the entire market.

Go look at GPS, vehicular monitoring systems for trucking contributed significantly to productivity back in the early 2000s. The price of a GPS system was over $1,000; productivity growth in trucking was twice the average aggregate productivity growth. They got cheaper, cheaper, cheaper. Households got them, prices fell a few hundred dollars, and now, of course, they're free because they're incorporated into your smartphone. GDP went down when those GPS systems were absorbed for exactly the same reason I just described. People stopped buying GPSes and there isn't any quality adjustment that captures that on the smartphone side.

Now, that's just two examples. Mobile phones, substitutes for camera, GPS, landline, game machine, eBook reader, computer, movie player, audio player, map, you can go on and on and on, and in all

of those cases, when you absorb those functionalities into the smartphone, they reduce GDP because you reduce the sales of those substitute products. And it is kind of funny when you think about it because when price goes down, real GDP can go up. It's not too hard to see that. But then when the price hit zero it's taken out of GDP. So it's like down, down, down -- poof, it's gone.

So that makes sense for economic activity, which is what GDP is supposed to measure, but it really doesn't make sense for standards of living because people love their smartphones. *The New York Times* ran a survey that said what technology would you take back to 1990? Number one was the smartphone. Medicine was number five. (Laughter)

All right, global supply chain. This is really an interesting one. Where's the iPhone made? Well, it's designed, engineered, software marketing, all that's done in Coopertino, Shenzhen, Foxcon, labor and parts from 28 different countries. The labor cost is $5 to $10, depending on who you ask. Suppliers

from 28 countries: China, Japan, U.S. is number three. And if you look at the supplies that come from these different countries, the second-most costly item in the iPhone is the screen made by Corning with Corning intellectual property. Maybe it's made in Kentucky, South Korea, Japan, Taiwan? It doesn't really matter, it's all the same product wherever it's made.

The processor, that's actually designed by Apple. They're a fabulous production unit, so it's produced in the lab somewhere, Taiwan maybe. Cellular modems, that's Qualcomm, a U.S. company, U.S. intellectual property. Again, the chips are made in Germany, Singapore, New York, Vermont, whatever. It costs $15. The low value parts -- the screws, the nuts, the case, all this stuff -- mostly comes out of various places in Asia.

Now, how does this show up in GDP? And this is really tricky, believe me. I've spent a long time trying to understand it. So let's look at a scenario where a phone is designed in the U.S., it's produced

in China, and it's consumed in France. So when Apple sends those designs and software to China, that actually counts as zero in the transaction. The design counts as zero. Manufacturing costs about $150. The U.S. parts that I described -- the screen, the chips, and all this stuff -- they count for some amount of the value, somewhere around $50, let's say.

And then, when it goes to France it counts as an import to France with $350 -- that's the wholesale price -- and then there's some marketing costs in France, as well. But you notice that there's $200 worth of value missing there? The $350 wholesale price minus $150 manufacturing price, what's in that $200? Well, I would say a reasonable interpretation is that's the value of the software, that's the value of the design, that's the value added by that activity in Coopertino. So that should really count, I would claim, as a $200 export from the U.S. to France by way of China.

Now, if we look at Android, which is 80 percent of the world mobile phone market, it's even

worse because the U.S. GDP measurement counts the Android-OS at zero because it's open source. Anybody can go to a website and download that Android system. The phones in this case are typically designed in the country that they're made: in China or Korea or somewhere in Asia. So it's an import. It doesn't show up in GDP, so the quality adjustments won't show up at all because it's mostly foreign hardware and it's open source U.S. software. So again, you're missing a big chunk of the value that's created in that market.

It's a $400 billion world market. If the smartphone software is about $200 billion of exports to the rest of the world, that's 1 percent of GDP, or about half of the trade deficit. So there's a problem there in terms of how the accounting is done.

People love their smartphones. Smartphones reduce the sales of special purpose devices. The quality adjustment smartphones should, in principle, offset reduced sales as special purpose devices, but all that hardware is imported and the software, at

least in the case of Android, is kind of zero priced, so there's no offset there. So I claim it's a big loss in measured GDP, despite all that love that people have for their smartphones.

Now, it's not just high tech. There's semiconductors, vehicles, consumer electronics, furniture, toys, clothes, there's a lot of products that are designed in the U.S., and then we have them outsourced to production in other places in the world. The design is a big component of the value of those products and because it's a big component of the value of their products, it's actually missing from the GDP calculation.

If you look at clothes, when The Gap sends designs for clothes to China or Vietnam or wherever, to be made the wholesale cost of those clothes is 20 percent of the retail price. Some of that retailing is just retail services that are done in the U.S., but some of that value comes with the design and choice of features in the clothes or the furniture or toys or any of these other things. And that intangible slips

through the cracks in most cases of accounting.

By the way, here's a picture of Chinese imports and multifactor productivity. Now, of course, as every macroeconomist knows, everything looks like that. Everything is correlated with everything else, but at least there is the same general features in terms of what the imports and MFP look like.

SPEAKER: Whose MFP is that?

MR. VARIAN: That's from Fred.

SPEAKER: Is that U.S. or China?

MR. VARIAN: Oh, U.S., yeah. So the country where the IP is held is relevant, so the big winner last year in the GDP sweepstakes was Ireland. It grew by 26 percent. A huge rise in investment because intellectual property that was previously held in the U.S. got moved into Ireland, and a huge rise in net exports because of all those exports that were attributed to exports to the U.S. now end up being attributed to exports in Ireland. And there's a little picture of what happened and the same thing will happen next year because there's a change in the

tax law that the double Dutch sandwich is no longer edible and the double Dutch sandwich is going to move from the intellectual property that's sitting in the Bahamas is going to move to Ireland. So I think we're going to see a big growth there, as well.

Finally, last word on semiconductors. Here's a picture of the quality change in semiconductors. The hedonic adjustments used by the BLS refer to clock speed primarily, and if you look at clock speed, there's been no change since 2005.

Is that really true in terms of measure and productivity? The answer: No, because what's happened is we switched to multi-core processors, so now you can get your CPU and it has 8 cores on it or 16 cores, and if you utilize that effectively you can get 8 times or 16 times the throughput into any calculations. So the productivity growth in semiconductors is actually much larger than indicated by the simple clock speed. And this is a paper by Byrne, Oliner, and Sichel. They attribute the change to Intel pricing problems, a little bit of the issue;

the multi-core, a big piece of the issue.

And if you look at that multi-core capability, it makes no difference whatsoever to any of us because we don't really have the software in the desktop to make much difference from having those extra cores, but I can tell you it makes a huge difference in the data centers that Amazon, Google, and Microsoft and others are running because you could do a massive amount of parallel processing, and the productivity in that computation has gone up dramatically.

On top of that, the CPUs are no longer as relevant because so much of the activity these days is built around GPUs, the Graphical Processing Units, which we use for the machine-learning calculations. One of my colleagues at Google said, look, by going from CPUs to GPUs, we increased the efficiency of our machine-learning calculations by a factor of 10. And by going to GPUs to our special purpose, specially designed chips for machine-learning we get another factor of 10. So that's a 100 times improvement in

productivity on the chip design that's not really showing up because the hedonics have not caught up with the actual usage.

And I think -- that must be my last slide.

MR. WESSEL: Good.

MR. VARIAN: I can't go any further.

(Laughter)

MR. WESSEL: So let me just ask one question. So if I asked each of you what fraction of the slowdown do you think can be explained by mis-measurement, we look at productivity growth since 2004, the slowdown that's been described, what's the range? What percentage do you think can be explained by mis-measurement? Jan?

SPEAKER: Let me ask a clarifying question. There's an issue of mis-measure and of GDP, and the question of, well, it's not GDP that's the standard of living that we're concerned with. So, are we measuring the wrong thing or are we measuring the right thing wrongly?

MR. WESSEL: I wasn't trying to ask an

epistemological question. (Laughter) So let me say it this way. If I look at the measured slowdown in productivity, the measured official results from the BLS, what fraction of that do you think can be explained by mis-measurement?

SPEAKER: So, another clarifying question: Labor productivity or TFB?

MR. WESSEL: Labor productivity. I'm beginning to regret my question. (Laughter) I should have known better in this crowd.

MR. HATZIUS: So, I think the slowdown -- I think one other clarifying question --

MR. WESSEL: Okay, I give up. (Laughter)

MR. HATZIUS: Well, now the necessary clarification is what do we mean by the slowdown? If you look at Chad's numbers, it goes from 2.8 to 1.3, but I think that overstates the decline in consensus estimates of the underlying trend. That was more like a percentage point, not 1.5 percentage points.

Of that, I'd say, lots of uncertainty. There is the question about consumer surplus versus

GDP, but I'd say half.

MR. SYVERSON: Okay, I'll talk about the BLS numbers. Of that drop, I don't think you can reject zero, that none of it's mis-measurement. Maybe I wouldn't rule out as much as a third.

MR. HATZIUS: Okay.

MR. SYVERSON: And I think, like I said, I see nothing in the stuff I've done that indicates there's been a divergence between consumer welfare and GDP, so I think you could say the same thing about overall welfare.

MR. WESSEL: Okay, so Hal, answer the question in any terms you want, but give me a number.

MR. VARIAN: So I'd say one-third comes from mis-measuring the GDP, in large part due to this global supply chain I was talking about. And about one-third comes from not measuring consumer welfare, but instead measuring GDP. And I don't even need to go to something elaborate like consumer surplus, just in terms of measuring consumption, per capita consumption, as opposed to total factory productivity.

MR. WESSEL: Okay, so I want to make sure that everybody on the periphery understands that you have just as much claim to airtime as anybody else. I'm going to start with John Fernald. If you have a sign, put it up, but Anna has a mic there and there's another one here. Steve Braun over there has one.

ANNA: I'm also going to remind you that sometimes these mics don't pick up, so please pull them close to you when you speak.

MR. WESSEL: Yeah, that, too. John?

MR. FERNALD: This is great, and covers the wide range. I think there's no question mis-measurement's an issue, it's always been an issue and that has come up. I guess the fact is, as I see it, there's a broad-based slowdown in labor productivity in TFP across industries when you try to look that way, and across the economy.

So if you look at smartphones, if the changes help businesses throughout the economy are working, that should already be counted in the value of their output. So that's why, of course, what Hal

highlighted is how much it changed how we entertain ourselves, how we communicate with our friends and family, and people love them. But then Chad's numbers incorporate that and even with pretty big numbers for wellbeing, it doesn't look like that alone is enough to fill the gap.

The second comment that I would make is, if adjusting investment goods, if it's mis-measurement of software prices, that doesn't solve the slowdown either, because it was not only labor productivity, but TFP. So we did some calculations in our paper on that, and even over a decade, basically you were getting both more output, but you were also getting more capital services. And even over a decade, the capital services almost exactly offset it. So the TFP effect is about zero. In the longer run it's actually makes the TFP slowdown worse, so I don't think you can -- you can adjust investment as much as you want, it's not going to solve the challenge of the slowdown.

MR. WESSEL: Jaana?

MS. REMES: I'm Jaana Remes and I'm from the

McKinsey Global Institute. I was intrigued, Jan, by your description of the software share rise in the ICT industry and the flat price indices. But when I start thinking about where we would see dramatic declines in prices if you offer quality improvement in software, I think of WordPerfect 20 years ago when I was writing my Ph.D. thesis, it wasn't dramatically different from the way I use what I use today.

Or if you think of many of the big enterprise softwares, they still use those old large systems because they haven't been able to move out from them. So it's hard, at least for me, immediately I can't come up with great examples the same way we clearly can come up with those examples from the hardware side. I mean, the speed and capacity to manipulate a lot of data, those are dramatically different now than they were earlier.

I would love to hear some of those stories where you can see actually that kind of performance improvement that actually translates to productivity changes at the company level.

MR. WESSEL: Why don't we take some of these before people start responding? Steve and -- I guess it would be helpful it you would identify yourselves since not everybody knows --

MR. BRAUN: In the Consumer Price Index --

MR. WESSEL: Steve Braun from the Council of Economic Advisors.

MR. BRAUN: In the Consumer Price Index a smartphone is no different than a cell phone and so there's been no increase in productivity from that sector in many years.

MR. WESSEL: That's right.

MR. BRAUN: And I think that's a failure of imagination by the U.S. statistical system. Hal Varian put a list of all the things that an iPhone does. It's a GPS, it's a compass, it's an Internet connection, it's a camera, you can watch movies on it, you can listen to the radio on it, okay? So now you could imagine someone going into a big Walmart-type store with a whole shopping basket and buying a VCR, a radio, and a GPS, and all the things that go into

making up a smartphone now, and that's what a smartphone should be priced against, okay?

And nobody at BLS is doing that now nor have they ever. BLS is following strict rules, they're doing the same thing they always have. But we have a failure of imagination. We need to be able to expand the kind of ways that we quality adjust prices for things that are like Swiss Army knives that do multiple things. And if we did that, I think we'd make a big contribution to the way the productivity is measured in the Unites States.

This is not new. I mean, when vinyl records came out, they replaced going to the concert. So it cost $80 to get a concert ticket and now you can buy a long-playing record, okay? But you can listen to a symphony either way. So to do this honestly, we'd have to go back in time and that leaves open the question of whether we're mis-measuring productivity any more than we've always mis-measured productivity?

But the faulty prices that we're measuring are really the problem, and it's a problem inside of

the federal statistical system. And by the way, the difference between GDP and GDI is totally irrelevant because we use precisely the same price index for deflating both of them. So it has to be in the government's prices.

MR. WESSEL: Thank you. Erica, if you want to respond, say so.

MS. GROSHEN: Let's listen to some more.

MR. WESSEL: Okay. Bob Gordon?

MR. GORDON: I think there's too much emphasis here so far on the slowdown from the 1995-2004 rapid productivity growth decade to the decades since 2004. Rather we should have a broader context of the whole post-war period. We had 20+ years of slow productivity growth between 1973 and 1995, and so perhaps we should be looking -- and I know that's John Fernald's view, I know it's Martin Baily's view -- we should look at the glorious decade after 1995 as an aberration and ask what changed in measurement from slow growth before 1995 to fast growth after 1995? The acceleration wasn't due to a change in measurement

techniques. And so the slowdown after 2004 is very unlikely to be affected by measurement techniques.

I appreciate Jan agreeing with me, but he misstated my position and so let me try to clarify that. (Laughter) I think that IT is a very important innovation, right up there with the motorcar, and maybe not as important as electricity, but what's different is that those great inventions of the late 19th century, there were just so many of them that spanned every aspect of human existence, including curing infectious diseases, cutting infant mortality from 20 percent of children dying to less than 1 percent in 50 years. And if we wanted to stack up the IT revolution compared to those great inventions, the IT revolution created the decade in which productivity growth -- at about 3 percent in the non-farm, private business sector -- was comparable to what it was between 1920 and 1970.

The difference was that the previous inventions gave us 50 good years of productivity growth whereas the IT revolution only gave us one

decade of good productivity growth. My emphasis has been on the fact that most of the ways that IT innovation improved productivity was in changes in business practices that were more or less complete by 2005: changing from the typewriter, the calculating machine, paper, and file cabinets to flat screens and software that took place all through the 1980s and 1990s with the invention of the personal computer. And that's more or less over.

The smartphone is mainly a consumer device that's creating a lot of consumer surplus for people outside of their working life and much less of a change inside of their working life.

MR. WESSEL: Thank you, Carol?

MS. CORRADO: Yes, thank you. Well, let me just sort of actually pick up on the comment that Bob just made.

MR. WESSEL: I don't think your mic is on.

SPEAKER: Carol, try this one. It's on, it's on.

MS. CORRADO: Okay, thank you. So let me

just pick up on Bob's comment, and a little bit follow-on to John, about the impact of ICT and how we should think about it, from a business perspective here.

So I think one of the points that both of these authors have emphasized in their very good work is that somehow what appears to be happening is that the beneficial impacts of adopting ICT technologies within business have just sort of run its course. And I think we have to realize that there's ebbs and flows of such, like things when -- I mean, the PC took a long time to get embedded in business processes and the transformation of firms from mainframes to PCs famously took a long time and there's been studies of it.

And now we have a new platform that's come along, namely the Cloud platform, that is not being measured appropriately because it is challenging. But we see firms spending a lot of money, either on Cloud services, per se, or transferring their own IT departments to private Clouds. And what we're not

seeing is the concomitant productivity -- cost savings -- that comes along with it. And these cost savings are significant. You're talking about being able to run the same amount of capital services with one server that you previously did with 10, maybe 15, depending upon what generation private Cloud you install.

You can forget all about that and go to Google and they'll do it for you. We've had other structural change go on, but against that backdrop of a financial recession and other things. There has been ongoing changes within the business sector that have yet to show through in the productivity statistics, just like it took a long time for the client server model to show through.

MR. WESSEL: So your argument is we're measuring it right, we just have to be patient. It's mostly not mis-measurement, it's mostly fundamentals and we'll get there, and we should be optimistic that some time in the future we'll see a surge in measured productivity?

MS. CORRADO: No, we're not measuring Cloud services right. We're not measuring the contribution to overall MFP of the Cloud services companies at all. And that's all domestic production. Forget about imports.

MR. WESSEL: Okay.

MS. CORRADO: But still, they're very efficient, they're very lean.

MR. WESSEL: Okay.

MS. CORRADO: They don't spend that much money, so it's maybe a third.

MR. WESSEL: Okay. David Byrne?

MR. BYRNE: A follow-up on what Carol said and then a couple quick measurement points. So, consistent with the idea that there's this new platform entrain, if you look at intangible investment in recent years, as Carol and colleagues have measured it with a much more theoretically consistent scope than is currently in the NPPAs, intangible investment has been phenomenal.

And that's consistent with the idea that

businesses are reorganizing, they're investing in software R&D to adopt these new platforms. And that's due to the idea that we fully adjusted to these things. We take for granted these smartphones and tablets and Cloud services. They haven't been around for that long, it's easy to forget. So that's one thing.

And then just a very simple measurement point. I don't see anybody from the BLS jumping up to defend themselves, so I will. (Laughter) Just conceptually, it seems that some of the comments have made the implicit assumption that if you're not doing hedonic analysis, you're not capturing quality, and that's just wrong. If you have the right kind of data, with the right kind of granularity, you can catch quality with a matched model index.

And so the issue is the quality of data, and in particular for smartphones which are primarily imported. You know, import prices look totally implausible, but more than likely that's an issue of having the right kind of data. Now, adjusting that

using hedonics works, too. It's just a matter of using the right methods for the data that you have in hand.

And then there's this question, too, of -- there's a lot of focus on how much of the slowdown could be attributed to mis-measurement. I'm not going to take a stand on that, but I think --

SPEAKER: Oh, come on. (Laughter)

MR. BYRNE: I think the more interesting question is, in the face of the mis-measurement that's very clearly there in the usual IT suspects -- and also the apparent opportunity for further research that Jan emphasized in special purpose electronics where there's been no research at all, except for one study of MRI machines -- the level of confidence that we have and whether we're getting this stuff right is very, very low.

And in addition there's this factor, this production issue, that Hal referred to. I think the BEA is getting the nominal exports of those right to a certain extent, but the issue is how are we deflating

those things? How are we accounting for the huge quality contribution that comes from Google and the like. As far as I know, we're deflating that using the Wholesale Price Index for wholesale trade, and that's just ridiculous.

MR. WESSEL: I'm tempted to say, on behalf of the BEA and the BLS, if like the Federal Reserve they could print money, they too could do this research. Martin Baily? (Laughter)

MR. BAILY: Just a quick point on the issue that Hal raised about the fact that we don't manufacture a lot of stuff anymore. There's a lot of valuable stuff that's not manufactured here and so we're missing quite a bit of the productivity growth.

And, first of all, if you look at manufacturing, it has contributed a great deal historically to U.S. productivity growth. So, as it gets smaller and smaller -- and lately it's gotten slower and slower, the productivity -- but it's contribution has gone down a lot. But then, can we emphasize how important that is? And you put some

numbers up here, but I was trying to think of -- if you think some fraction of the profitability that companies earn overseas, it's actually attributable to what's done in the U.S., so that Gross National Product is higher than the Gross Domestic Product because of that. So that may be one part of it.

Presumably there's another part, which is that the labor income earned by a lot of the people who work in Apple and Google, they make a lot of money, and that part is somehow being deflated away or is not counted in the total. But I'm just looking for ways that we could maybe size how much of this value chain actually should be attributed, or could be attributed, back to the United States.

MR. WESSEL: Erica and Brent? Do you want to weigh in? Brent, do you want to weigh in? Erica's volunteering.

MS. GROSHEN: Well, so let me just go down a few of the different things. For those of you who don't know me, I'm Erica Groshen. I'm the commissioner of BLS.

And so I wanted to talk about a few of the different things that have been brought up. One has been pricing of free goods or attributes. The second has been new goods. Then there's been the factory list goods production. So let me run through those just a little bit.

The basic way that we do pricing, as much as we can, is with the matched model, and that's really the cornerstone of the price adjustments that we use. So, as much as we possibly can, we find products that are identical and we trace what happens to the prices of the products that are identical. And when you do that you capture any price decline that comes from the difference between what people paid for this thing when it was the new shiny thing and they were the first person on the block to get it, and willing to pay for that, all the way down to when it's a commodity. So we are capturing that decline.

Now, when we talk about goods that are free in some sense, that's always been an attribute in the economy. For example, a TV is free, but it's paid for

by advertising. So the top line numbers for a lot of the things -- for instance, if these free goods of some sort help to sell something else that's traded on the market, we are capturing that. If they're not, if there's no output associated with this thing that's given for free, then the reason we don't measure it is because we've decided, when we defined what GDP was, that that was out of scope, that we are measuring market production.

So that's behind our strategy. The whole factory-less goods production issues are something that we are concerned about and thinking about. And I agree that this is something that we need to continue to look at and that's ongoing.

So I would say that nothing that I've heard here is new. Does it concern us? Yes, we always need to be changing and adapting, and we welcome all sorts of new ideas on how we can do our job better and how we can do it better on a production basis, which is also one of our challenges. A, there are things we'd love to do that we can't afford to do and, B, we have

to be able to do them within a month's time and get the new number off. So those are some of the barriers.

But this issue of what belongs in GDP and what doesn't belong in GDP is actually -- it's not just a definitional issue. It's not splitting hairs, it's actually at the core of some of the confusion, and the difference between what the people are seeing in the numbers and what they might have otherwise expected.

MR. WESSEL: Thank you. Brent?

MR. MOULTON: Thanks. Brent Moulton at the Bureau of Economic Analysis. Well, I think this is a very useful discussion. I think we've always tried to be clear that GDP is not intended as a broad measure of consumer welfare and that kind of thing. And I think trying to develop an alternative measure that could supplement GDP and use more for that purpose would be a very interesting endeavor, but I think there's also value to the existing GDP definitions.

And I think the rationale for not including

free goods in there is that generally when a for-profit company gives away something for free, such as open source software, we're assuming that they're complementary goods or services that they're providing, which they're using as part of the platform that's driven by that open source software.

And just another thing to mention, the actual development of the open source software is in GDP, as own account software. It's simply we don't price the copies of that software when they are given away for free. So the actual development of that software is counted.

Intellectual property in general is a relatively recent addition to GDP. Software's been in there a little over 15 years. R&D is only three years ago that we added it. I think we recognize that these things are very difficult to price and have price indexes. We'd really appreciate any contributions from researchers, because they don't lend themselves to the traditional types of repeat sale type of price indexes. Each product is sort of unique.

I think the globalization also raises a lot of very interesting challenges for us and, particularly, when intellectual property is part of that. We really have to capture the intellectual property where it's owned, which is often not where it's used. And without transactions to guide us on the relationship between those two, it's very difficult to describe the relationship between the intellectual property held in one country that may be used in many different countries by a multinational.

MR. WESSEL: And taxed in none. Let me, Antoine, I'm going to give the panel a chance and then if we have time we'll go back. So, Hal, do you want to respond to -- I know some, and I know that both Jan and Chad want to --

MR. VARIAN: Yeah, I want to respond to a few points. On Martin's point, the GNP-GDP gap isn't big enough. I looked at that and I was hoping it was, but it's not large enough to make a difference. And as you just said, the software investment is counted as part of GDP, so it's not as if you have people

writing software that produces nothing, it produces that asset. However, as you also said, that it's not counted as an export when you add copies of that software to mobile phones, and the designs aren't either, as far as I can tell. But as you say, how would you value that? It's really hard to do from a viewpoint of having that intangible property.

The advertising issue, the way advertising works, as I understand it, it's looked at as part of marketing, so it's an intermediate good. But it does, of course, show up in the final price. So that what you want to do is look at things that are really free, like the Brookings website is really free and it produces a lot of value.

MR. WESSEL: Well, you haven't seen my overhead bill, have you? (Laughter)

MR. VARIAN: So there's a lot of stuff like that because, literally, the cost of publication in the general sense of the term has dropped to zero. And so we have much more information flowing than we ever had before. I think the more difficult problem

with the quality adjustment of the smartphone, which the BLS is trying to do -- I know a team working on that, I've talked to them about it -- but it is conceptually difficult because most of the hardware is an import and the software is not counted, so that's a gap there. And I don't know that you can do anything, there's no quick fix on that, but it is some missing value that's created.

And, finally, this point about GDP versus some other measure. Of course, the trouble with some other measure is everybody wants to throw their piece into it and get this big, unwieldy measure of welfare surplus or something like that. I would rather start with a much, much more modest goal of saying, well, let's just look at consumption Let's just look at per capita consumption.

Per capita consumption has grown twice as fast as multifactor productivity over the last five years and it's certainly grown much faster over the rest of the post-war period. So it is a measure of what people are actually consuming, including imports,

not just a measure of production. That's valuable, no question about it. But if you want to talk about quality of life or standard of living, you'd better start talking about what's consumed, not just what's produced.

MR. WESSEL: Thank you. Jan?

MR. HATZIUS: I just want to push back a little bit against the idea that if you're arguing for mis-measurement, you somehow have to find $3 trillion that nobody has seen. So, one, I think it's a somewhat extreme view that you can account for all of the slowdown with mis-measurement. I, certainly, couldn't make that argument.

Two, I think that 1.5 percentage points slowdown that you're using in that calculation overstates certainly the decline in people's estimates of trend productivity growth.

And then, finally, I think it's not really about missing nominal spending that just isn't out there. It's really a question of whether we're using the right price indices. So I think that gives you a

somewhat different sense of the potential scale of the mis-measurement.

On the question about software, WordPerfect being no better than it was. This is obviously a pretty broad sector, they have a lot of things in them. There is a working paper by Carol Corrado and David Byrne that looks at mis-measurement in areas of the software indices and finds some pretty sizable numbers in some areas. And, presumably, there is still a lot of additional work you can do in other parts of the software sector.

And then the last point is a question, actually, for Brent Moulton, whether you think it would make sense to, for example, treat Google Maps as an attribute of an iPhone since you get it alongside? You don't pay for it and it provides quite a lot of value, as an example.

MR. WESSEL: What would happen if you did that?

MR. HATZIUS: Well, you'd get presumably bigger quality adjusted price declines for iPhones

because it's now become a much better product.

MR. SYVERSON: I actually have to make one correction. It's actually the Apple Maps software which comes with your iPhone. (Laughter)

SPEAKER: Exactly.

MR. SYVERSON: You have to get -- you can install the Google, which I'm sure you do.

SPEAKER: For free, for free. (Laughter)

MR. SYVERSON: For free. They look a lot alike these days, but they're really different in terms of quality. (Laughter)

MR. WESSEL: Jack, do you say anything?

MR. FERNALD: Yeah, sure. I'm not sure that this isn't about missing nominal dollars. I mean, that's just what would be implied if you rolled forward the growth to now. Yes, the deflater is talking about the growth between 2004 and 2015, but if you're saying, what would we be at counterfactually, you can express that in nominal dollars.

And speaking of -- everyone talks about the smartphones. There's about 160 million smartphones

sold a year. The average price, I don't know, what, $500. That's $80 billion. Let's round it up to $100 billion. For some reason these companies are incompetent at pricing and they're missing a lot of value, it's worth five times that much. That's $500 billion. That's an incremental $400 billion. That's our best example and I'm being generous and I'm saying, okay, maybe there's $400 billion there. I don't know, that just doesn't -- again, I'm not saying there's not progress or smartphones aren't great or whatever, but it doesn't add up. It just doesn't add up to something that big.

And the same thing on this mis-measurement of IT. I mean, people in this room have forgotten more before breakfast than I'll ever know about that issue. I'm not saying there isn't any. But, by golly, if it's big, why isn't there a covariance between the size of the IT sector and the size of the productivity slowdown as we look across economies? We know we might not measure it well within economies on the level, but why shouldn't there be a covariance if

this is a big thing? I don't mean to dismiss it as nonexistent. It just doesn't seem to add up to something big. And so that's kind of where I'm left.

And one more issue about the welfare issue. And there's a lot of notion that, well, people spend a lot of time on these things, this huge consumer welfare. That's possible, but we always have 24 hours to spend on something and if you take time spent on something and multiply it by the wage, you're always going to get a big number, no matter what period you look at.

People weren't trying to explain away the productivity slowdown in the early '90s by saying, well, people are watching "Must See TV," and we're just not counting that. So I think you've got to be careful there.

The real conceptual value is the incremental willingness to pay for this leisure good as compared to the substitute you would otherwise consume. And that doesn't have to be related to the wage. The wage is not necessarily a good measure of the opportunity

cost of people's leisure time. So I'll just stop at that point, thanks.

MR. WESSEL: Okay, and I think --

MR. MOULTON: Can I ask a word? I'm sorry, I wanted to respond.

MR. WESSEL: Yes, please, yes.

MR. MOULTON: So I think you're absolutely right that just looking at one little sector is not enough, but if you look at the examples I had of goods that were designed in the U.S. and manufactured abroad, there was $10,000 worth of household income there in such goods: furniture, clothes, some automobiles, almost all of consumer electronics, on and on.

So, yes indeed, the whole accounting should be done. I haven't done it, but there's a lot of stuff in that category where I think that design -- the intangible design -- is not being valued. It's hard to value. I'm not saying that's an easy job, but it's not going to happen.

But I will tell you the thing that does

worry me the most about this kind of technological example. If you look at smartphones, they do show up in production. I had a crew of people come in to do some work at my house. They were taking pictures with their phones, they were communicating with their friend at the hardware store. They were sending texts to this guy to come, the plumbing needed to be done at this time, on and on and on. So it was a remarkable improvement in the coordination of activity that's possible now compared to what would happen. So why isn't that in GDP? My answer is at this point, which is a little lame, is that there's still a lot of excess capacity in the residential building sector and what happened is, it wasn't as if they went on to the next job. They went home because they didn't have a next job.

So there's still slack in the economy in places and the kinds of productivity improvement that we are seeing in some sectors isn't translating into overall increase in output. Now, maybe that's true, maybe it's not. It's just a conjecture, but if it is

true we would expect to see some significant improvement in productivity stats in the next few years.

MR. WESSEL: And on that optimistic note, here's the plan. Carrie, can you explain the plan for lunch?

CARRIE: So we have about 10 minutes and a buffet out in the hallway, drinks, coffee. Grab yourself a plate, bring it back in here, and then we're going to have remarks beginning in about 10 minutes.

MR. WESSEL: Let's say 15 minutes to be practical, so 12:35. And, Antoine, you get the first question after Marty Feldstein speaks because I think we want to keep on schedule, but I don't want to deny you the right. Is that okay with everybody? Okay.

So, we're going to clear out this thing. We may have to readjust the seats, but thank you. And thank you for a very lively panel.

(Recess)

MR. WESSEL: One of the things that has been a joy for me in the years that I was a reporter at the Wall Street Journal and then coming to Brookings is the number of times that some subject has come up that either Marty Feldstein has written about himself, or some student of Marty Feldstein has written about. In fact, I'm not sure there are many issues of public policy and economics that I couldn't find at least one student of Marty's who's done seminal work.

So Marty has some views on productivity, and as he said to me, you know, some of what he wants to talk about is not quite relevant to the panel we had this morning, but because of his experience and because of course that he's one of the people at the Advisory Committee at the Hutchins Center, which I should mention, but mostly because I have so much respect for a guy who has been at this game for so long, what we're doing to do is Marty is going to speak -- that was a compliment. (Laughter) No, a lot of people at your stage of life, Marty, have stopped thinking and are still living off what they wrote in

the past. And you're unusual in that respect that you haven't stopped thinking. And so -- yeah (laughter), I'm going to stop now before I really get in trouble. Anyway, Marty is going to speak for some time and then we'll have time for a little bit of questions and then we'll convene again with the afternoon program and Louise will handle the moderation of that.

MR. FELDSTEIN: Well, thanks very much. I really am delighted to be part of this and I'm sorry that I'm here only for a little part of the day. So I will look forward to learning later what some of the conclusions are of what happens after lunch.

So I agree that this decline in productivity growth is a major and an important puzzle. And thanks to the work of Chad and of David and co-authors, I think we know that we can't explain it just by the omission of Google and a few other things. So it's a challenging subject, but it's not a subject on which I feel I have any extra expertise. And I think David and Martin invited me because they know I've been studying the broader problem of measuring changes in

real GDP, in real incomes, in real output and productivity over time. So I haven't been focusing on the issue of what's been happening recently. But I think it's useful to put the recent slowdown in officially measured growth in that longer-term context. So I think I'm here not just to demonstrate my longevity (laughter) and the fact that I had many good students over many decades.

Let me remind you, the official figures tell us that real GDP grew at an average rate of 2.3 percent during the past 20 years. So on a per capita basis that was 1.4 percent. And I think these figures, which are so widely reported in the press and referred to by politicians of both parties, shape the public's perception of the economy's performance. I'm struck by the difference between how people judge their own economic growth, their own economic improvements, and their view of the economy as a whole. So in a recent survey of U.S. households a substantial majority reported that relative to five years ago they were either living comfortably or doing

okay. But when asked how the U.S. economy as a whole is doing a majority of respondents say that the U.S. economy is doing badly. Well, of course they know something about their role in personal experience, but they depend on the reported official statistics to judge how the economy as a whole is doing. And while the government is careful to say this is GDP, it's not how well you're doing, nevertheless there is this temptation on the part of the press, on the part of politicians, and on the part of the public to think that that's happening.

So I've been studying the methods used by BLS and the BEA, and I must say I've been grateful to Erika for her help and David Friedman at BLS, not a former student of mine (laughter), for helping me to understand it all. And I've concluded that the official statistics substantially underestimate real growth of output, which translates of course into lower growth of productivity and of GDP. And I don't mean recently, I mean over a much longer time. And I think that underestimation and the resulting public

perception is important; is important not just to us as economists trying to understand exactly where the economy is moving, but is important for a variety of reasons. I think the sense that real incomes, especially middle quintile real incomes, are not rising very much reduces people's faith in the political and in the economic system. I think it creates a pessimism that contributes to political attitudes, including anti globalization, anti free trade, and a general distrust of government policies. And I think it reinforces concerns about economic mobility. People think their incomes aren't rising, they worry that their children are going to be stuck and won't be able to enjoy upward mobility. So I think it's important to understand this.

So why do I think the official methods underestimate real growth of output and incomes? It's not because of omissions in nominal GDP. So let me give you a brief summary of what I understand to be the official methods, and then I'll be happy to answer questions.

So the government collects, thinking about it in terms of GDP, the government collects the value of nominal output, the market value of sales of goods and services. But then comes the difficult part, it has to convert that to annual changes in real output by constructing a price index. So it needs to have a price index to go from nominal output to the real value to consumers and other final users. The problem is in getting that price index to convert nominal to real.

So there are really two problems involved in that. One is the change in quality of existing products and services, and the other is the value created by new products. Now in the case where there are identical products, so we simply have to know how much more was being spent on those additional products, then the so-called match model index works. But what if there is a perception of a quality change or a potential quality change, what if there are wholly new products? So I knew these were difficult problems, but I must say, after studying the

procedures in detail I'm convinced that the results are really even worse than I had anticipated.

So the official changes in real output and real income, and therefore the changes in prices, just don't capture what has been happening, don't capture adequately what has been happening to changes in quality and changes in the introduction of new products. So the official methods really I think tell us more about the increase in inputs, in other words in the cost of production and not much about the increased value to consumer when there are changes in products or the introduction of new products. And this is true for goods as well as for services, although doing it for services is even more difficult than it is for goods.

Let me explain by looking at how the government statisticians deal with quality change for goods. That's about 25 percent of GDP. Now for a small fraction of these good in GDP the government uses hedonic regression. And I think in this group I don't have to describe what hedonic regression is.

But the point I would emphasize is that for GDP as a whole this is a small fraction of goods. The BLS says that the most common procedure for evaluating quality change is what they call the resource cost method. So the BLS follows a very large number of product categories, and for each it asks the manufacturer or the producer the following question, has the product changed since last year? And if there's been no change then there's no issue about having to deal with quality change. Any change in price is correctly regarded as inflation and there's no quality change to be accounted for. But -- and here's the key part -- if the manufacturer says this year's model is different from last year's the BLS then asks the following question, what is the marginal cost of the new input requirements that are directly tied to changes in product quality? Let me say it again, what is the marginal cost of the new input requirements that are directly tied to changes in product quality?

So if the manufacturer says well, no, there wasn't any increased cost, then there's no quality

change. So if and only if there is an increase in the cost of making the product does the BLS conclude that there has been a quality improvement. And that's a very narrow, and in my judgment, incorrect way to measure quality change. If it doesn't cost more to make the new product there's no quality improvement. In reality, of course, produces improve products in ways that don't cost more to produce or may even cost less. And that's what I think as economists we think of as true technical progress. But the official government method, the resource cost method, focuses on the increased cost of inputs. And that's why I said that the government doesn't really measure output changes in connection with quality improvements or the value to consumers, but just the increased volume of inputs. So the official method misses the increased real GDP and the increase in productivity due to changes in product quality.

And the measurement of output changed for services, which is 3 times as large, about 75 percent of GPD, is also based on the cost of inputs. The

change in the market value of sales is divided by the change in the price of inputs, which is generally wages. So there's no attempt to measure the value of the service to the consumers or the increased value to consumers of the service. That's of course true for healthcare where we've seen enormous improvement in the effect of treatment over the years. So it's perhaps not surprising that if you break down the productivity numbers by industry we see -- and this has been true for a long time and not just in the U.S. -- we see that in the healthcare industry productivity is declining. Well, let me be clear, I think measuring the value to consumers of quality change is a very hard problem. So I'm not being critical of the efforts of the BLS and the BEA. My point is that their estimates are in a sense mislabeled and misinterpreted. When it comes to quality change, what is called the growth of real output is really the growth of real inputs. The result is a major, I think, underestimation of the increase in real output and in real GDP growth. The other source of

underestimation of real growth and productivity change is the failure to capture the benefit of new goods and services.

So here's how the current procedure works, a new product is developed and it's sold to the public. Its market value enters into nominal GDP and into the nominal value of industrial production. These nominal values of GDP are converted to real values using price indices that don't reflect the new product at all. Why? Because the new product is too small in the beginning to be worth changing the weight in the GDP index. But over time, if the new product represents a large enough amount of spending, the BLS includes the changes in its price, explicitly in the price index. Well, after that the BLS tracks increases and decreases in the price of the product like any other existing product. But the process that I've described never tries to take into account the value created by the new product per se. And that's true for smart phones, it's true for tablets, it's true for new pharmaceutical products, it's true for many, many

other products.

So I think about statins, the remarkable drug that lowers cholesterol and reduces deaths from heart attacks. By 2003 statins were the best selling pharmaceutical product in history. So by then it was in the price index. And when patents expired and generic forms of the statins became available the prices fell and the BLS recorded that, implying a rise in real incomes. But it was never anything for the improvement in health that came about as a result of the introduction of statins. Well, how big a deal was that? Here's quick history to give you a sense of the importance of this ignored health effect. In 1994 researchers published a 5 years study of 4000+ patients and they said that taking a statin caused a 35 percent reduction in cholesterol and a 42 percent reduction in the probability of dying of a heart attack. Well, didn't take long for statins then to become the best selling product with dramatic effects in the public, on cholesterol, and on heart attacks. So here are some official U.S. figures on that:

between 2000 and 2007 the percentage of men 65 and older taking a statin doubled, doubled to about 50 percent of men over age 65. High cholesterol levels declined by more than half among men and women over age 75, and the death rate from heart disease among those over 65 fell by 1/3. Pretty impressive. So this was a remarkable contribution to the public's well being over a relatively short number of years, and yet this new product is now reflected in real output, or at least that contribution of the new product is not reflected in real output or real growth of GDP. And this of course is just one example of a myriad of new goods and services that get introduced year after year.

So despite their value to consumers the value is not part of the official statistics of real growth. So, in short, when I look at all of this I think the official data on real growth substantially underestimates the rate of growth of real GDP and of real output. Unfortunately I don't know by how much, but I can certainly imagine it being an understatement

of two percent or more a year, but I have no hard evidence to demonstrate that. I think it's important if you can do more to understand where this understated growth comes from and how large it is because even that small amount, even two percent a year would dramatically change our perception of what's been happening to real growth in real incomes, more than doubling the growth of real per capital income.

So I'm convinced that improving the measurement of output growth, including trying to get a better handle on the contribution of changes in quality and the contribution of new product really deserves serious attention. And doing so may help to explain the recent slowdown, but it would be worth doing even if it didn't.

So I'll stop there.

SPEAKER: All right. So you have a few minutes for -- open the floor to questions.

MR. FELDSTEIN: Bob?

MR. ARNOLD: This conference is about the

productivity slowdown primarily. Much of Marty's remarks echo the Boskin Commission Report of 1996, a report in which I was one of five members. And at that time we estimated that the upward bias in the Consumer Price Index was 1.1 percent a year, somewhat less than it had been prior to 1992 because of improvements in the methodology. And subsequent improvements in methodology at the CPI after our report, and in partly a response to our report, brought that bias down below 1 percent. Now you can argue with the Boskin Report, but we did go through, category by category, and did the hard slog work of trying to come up with rough estimates of how much the new goods bias, the failure to link in a quality change, all the things that you have just talked about, would cause the Consumer Price Index to overstate inflation. And that's the result that we came up with.

Our Report, in its own way, was an echo of the 1961 Stigler Report, which started this whole chain of critiques of the BLS methodology. So it goes

back to 1960, it's nothing new, price index has been biased upwards since the CPI began in 1914 and earlier. So I'm not sure that we learn much from CPI bias about the particular topic of this conference, which is understanding why productivity growth has been so slow in the last decade.

MR. FELDSTEIN: So I began by saying that I'm not talking about the recent slowdown and that maybe it's helpful to see this longer-term problem, maybe it's not helpful, but I didn't claim that it was about the recent slowdown.

I went back and I read the Boskin Report and you couldn't have a smarter group of people pull together the five folks, including Bob, who were challenged to come up with some estimate. And as Bob said, they went back and they thought about each category. But as far as I can tell it was all introspection. So it was how much more would people be willing to pay for access to fresh fruits and other consumer goods that were not available 20 years earlier. Thinking about apartment rents, apartments

have gotten better, they have more utilities, more space, how much more would people be willing to pay for that. But there was no hard number there, it was all introspection. So I didn't come away after reading that with a feeling I learned anything about what had really happened, except that a bunch of smart people thinking about what had been happening over time came to those conclusions.

QUESTIONER: So I'd like to just expand. This isn't about the deceleration, although the health sector is growing, so maybe a little small part of it. But just kind of amplify Marty's focus on mismeasurement of quality in healthcare because the problem is even worse than what Marty said.

So let's take the patient who suffers the heart attack from not getting cholesterol under control and is admitted to the hospital. For the past five years or so the probability of a hospital acquired infection has declined substantially and the probability of being readmitted to the hospital after being discharged for that initial heart attack

treatment has also gone down substantially, both of which have a direct effect of reducing measured GDP, and therefore also productivity in the health sector. But I don't think any of us would think that the hospitals are there for doing a worse job or that the right measure of the quality of the healthcare administered hasn't improved as a result.

And I think in area after area after area, when you delve into healthcare in particular, which has been noted as 18 percent of GDP, you see similar types of problems with expenditure based approaches that don't adjust for quality sufficiently. And I would note, as the sector digitizes it will become easier to try to do some of that -- we're never going to be perfect, but to do a better job of this. And I really think relative to all of the attention that's gone into mismeasurement in the IT sector, the economics community has woefully under invested in studying potential biases in the health sector.

MR. FELDSTEIN: You know, Brookings has had a long history of studies in this area, a whole series

of reports. Barry Bosworth, who was here, is here, was one of the key authors of those, and they pointed out how the healthcare sector, which keeps growing and growing, it just very, very badly measured. And it's just a fact. And the question of whether even the improvements should be counted or whether they are beyond the scope of GDP. But it seems to me when you have something that saves so many lives it seems a pity to not have a way of including that.

QUESTIONER: So the Boskin Commission was quite a fascinating time at BLS and definitely helped to move some of the price measurement issues forward.

What I want to comment on is that interestingly enough most of the research that the Boskin Commission used to make its recommendations was research done at BLS and at BEA. So these were problems that BLS and BEA had long been aware of and were working very hard at solving. And we've been able to implement a number of those changes since then and are ongoing. So right now about a third of our prices are quality adjusted on an ongoing basis and we

are looking at others, including the cell phones that people talked about.

In healthcare, that's a good example of where BEA and BLS are making some real progress. If you think about the introduction of say statins or giving people with appendicitis antibiotics instead of operating on them, then that pushes you towards thinking about disease based price indexes rather than procedure based indexes. And BEA and BLS now both of them have experimental indexes of medical care prices on a disease based basis.

And so that's an important part of getting towards being able to handle medical care well. That's only part of the problem though. The other part -- what Marty has referred to -- is the quality adjustment, if people's quality of life improves. And that's a place where we really welcome all the serious thinking in this room and beyond to how to get that right. We started with a part of it that is most tractable, but we will need to go onto those other parts.

So, you know, many of the issues that Marty points out quite rightly are ones that we face and many of them are actually things that frankly with more resources we could make much faster and better progress on. So that is a limitation for us. And I urge anybody who has strong feelings about the data to express them to those who could actually do something about it.

So let me stop there.

QUESTIONER: Well, this really goes back to the previous panel. Two points. One is, I mean this has been a very contested issue and many of the contestants are around the table here. And I was surprised to hear, if I understood it directly, Jen say that the mismeasurement was around half of one percent, and Chad say it was, you know, something like a third of one and a half percent, both of which are a half percent. (Laughter) So I thought what is all the fuss about, but that's -- besides that. I had one point that I want to put forward for potential research and I don't quite know where to take this,

but, you know, many of the tech companies, whether they admit that or not, kind of keep their money abroad and keep some of their taxes not paid here. And I wondered how much of an impact that actually has. This is for anyone in this room. There are plenty of researchers in this room who might want to take a look at that.

MS. SHEINER: Okay. So, now we're going to move on from the question of mis-measurement, and assume that not all of the productivity slowdown is a measurement issue. And to the extent that it's not, what possibly could it be from? And we have two papers that look at the question from a micro perspective that look firm level to try to say, what do we know that might be related to the productivity slowdown? So, our first paper is going to be presented by Dan Andrews from the OECD, so Dan? Thank you.

(Discussion off the record)

MR. ANDREWS: Okay. I'd like to start by thanking Brookings for inviting me here today,

particularly Martin and Louise, who have given us some great feedback on the paper.

I'm going to present a paper on the global productivity slowdown, technology divergence and public policy. This is a joint effort with Chiara Criscuolo and Peter Gal sitting in the middle here, from the OECD. And hopefully, they'll get a chance to sort of also respond to some of the comments and the discussion later on.

So, I think it's pretty easy to motivate a paper on the level of productivity slowdown. One way we do that at the OECD is in terms of potential output, which is one metric of our ability to make good on the promises to current and future generations.

So, when you look on average across OECD countries, what you see is that the annual pace of potential output has fallen by about 1 percent since the late '90s to today. And this is entirely driven by a pre-class crisis slowdown in multi-factor productivity and more recent weakness in capital

deepening.

Now, it is this pre-crisis slowdown in MFP that sparked an intense debate about the future productivity. And you know, when we first started this work in 2013, one of the things that struck was that this debate was very aggregate in nature, very macro in perspective in a sense, and I guess, most famously, it was typified by a debate about prospects or innovation of the global frontier as classified by Gordon and (Inaudible).

Now, when we started this work, we were struck by actually how little we actually knew about these frontier firms, and let alone whether their productivity growth rate had slowed over recent decades. So, this motivates our paper, which comes up with essentially four main outcomes.

Now, the first is, is that despite the slowdown in aggregate productivity growth, we see that level productivity growth at the global frontier remained relatively robust, but we see that laggard firms fell increasingly behind.

The second thing is that this divergence in laggard productivity reflects a divergence in revenue based MFP. So once -- if we control for capital deepening, it's still there. And once we adjust for differences in our mark up behavior between frontier firms and laggards, we see that the divergence remains, which leads us to think that this might be a story about divergence and technology.

And when we say technology, we define this in broad terms, not just in terms of differences in the uptake of hard technologies, but also, differences in the ability to tacitly combine various intangibles, which Carol's done a lot of work on.

Now, there could be many explanations for this divergence, and we just touch on a couple of those. In a sense, we adopt the smoking gun's approach here, and we find some evidence that it could be consistent with the winner take all dynamic, propelling growth at the frontier. You know, at the same time, we also find evidence that in a sense, laggard firms fell increasingly behind. And this

could be symptomatic of a breakdown in the technological diffusion process in the global economy, and stalling market dynamism, which raises questions about the contestability of markets more fundamentally.

And finally, what we do is, is we try to link this to public policy. Some interesting finding is that this divergence between frontier firms and laggard firms was much more pronounced in countries and sectors where the rate of product market reform lagged, which could suggest that basically, there is a policy dimension to the slowdown in agra-productivity.

Okay. So, what we do is, we use a cross country (Inaudible) database for 24 countries. We focus on firms with at least 20 employees on average, as a sample, and we exclude essentially the finance insurance industry. So, this is non-foreign business (Inaudible) bought out.

So, that the key chart in our paper is this one. So, we start out with labor productivity, which we define we value added (Inaudible) working, and what

we do is, we look at two groups of firms. The first is the global frontier, which essentially is defined in terms of the top 5 percent in terms of labor productivity levels in each two digit sector in each year. And the laggards are classified as everyone else.

We do this at the two digit sector. Then, what we do is essentially take an unweighted average between each of these groups for different years. And essentially, what we see here is that you know, frontier labor productivity has progressed at a relatively robust rate, but laggard productivity has stagnated. And interestingly, this divergence is most pronounced in the services sector, which is a bit of a smoking gun, because we know that services tends to be more sheltered from international competition, and traditionally, more heavily regulated. So, this provides a few clues about what might be going on, which we'll talk more about later.

The next thing we do is, is essentially, we try to control for differences in capital deepening

here. So, we do the same exercise, but in terms of a revenue based MFPR based on the water ridge approach. And what we see here is that divergence remains. So, this suggests that it's not differences in capital deepening or tangible capital deepening driving this.

However, we can't rule out that there is something going on with intangibles, which -- and then finally, this divergence just could be because frontier firms have market power. They're increasingly charging markups, which drives this difference in measured MFPR. So, what we did in this chart is try to adjust out our MFPR data for differences in market power using the markup methodology outlined by Delocker and Wazinski.

And what we see here is that markup behavior makes very little difference when you look at the manufacturing sector. In the services sector, once we adjust the MFPR for markups, we still see divergence, although the divergence in the pre-crisis period before 2007 is reduced by about one third. So, this leads us to suspect that this divergence between

frontier firms and laggard firms may, in fact, reflect a technological divergence of some kind.

So in the second part of the paper, we hypothesize what may be driving this divergence. And you know, we're pretty clear that we don't have solid proof on theory or the other. We should have tried a sort of investigative couple plausible drive-its. And the first one we look at is this idea of winner take all dynamics, which could be propelling growth of the frontier.

So, when we think about this, we think about for instance, structural changes in the global economy, such as digitalization, globalization and the rising importance of tacit knowledge could essentially be driving growth at the frontier and propelling frontier firms at the expense of everyone else. And so if this was plausible, you would probably expect this to be the most apparent in the ICT intensive services sectors.

So what we see here is that that is indeed, the case. So firstly, divergence in MFPR is more

intense in ICT intensive services on the left, as opposed to the other sectors. And secondly, when you look inside the frontier grouping, you see a small cadre of frontier firms. i.e., the top 2 percent, actually pull away from the rest of the frontier firms, as well. So, that could be consistent with some winner take all dynamic.

A second smoking gun is that when you look at sales, you see that the market share of frontier firms in ICT intensive services, that's the left panel, has actually increased a lot more relative to normal ICT intensive services. So, you know, one explanation for this could be that you know, digitalization is basically -- digital technologies are scalable.

So, if you're the best producer in the market, you may be able to catch with your whole market, at the expense of the next best producer, because of this technology. And you expect globalization to basically exacerbate that through market size effects. There could also be some network

externality story going on here, which we discuss in more detail in the paper.

Now, one of the interesting things is that you may ask, well, what does this have to do with the slowdown? And this is something that Louise pointed out. And you know, you could think of reasons why this could be good for aggregate productivity. It could be sort of suggesting that the frontier is actually expanding at a rapid rate, and also, this implies that there could be improving allocated efficiency to the extent that the market share of more productive firms is increasing.

Yet what we see when we try to match our product MFP gaps to the aggregate data is that sectors that had above average gaps between the global frontier and the laggard firms on average, had weak MFP performance over the sample period. This is up to the pre-crisis period, due to data constraints.

So obviously, this leads us to emphasize a second story, and that's essentially -- potentially a breakdown in diffusion, which is curtailing the catch

up of laggard firms. And we have a few pieces of evidence that may consistent with this. One is that we run a series of firm level regressions from 1998 to 2013, and we see that the pace of convergence of laggard firms in the global frontier has declined over time. And most of this decline and catch up occurs before the crisis. This also controls for a battery of fixed effects and firm characteristics.

The second thing is that when you look at entry into the global frontier, it's becoming increasingly unlikely over time that firms outside the top quintile of the productivity distribution enter the global frontier. So in a sense, this could be explained by a number of factors. One could just be that this has something to do with global frontiers getting intangible technology and making these complementary investments, like workplace organization that goes hand in hand with ICT. That's entirely plausible. Another explanation is that something is happening in the economy where market contestability is breaking down.

So what we did here is we tried to look at metrics of firm (Inaudible) using our data and then also relative productivity. So, what we see here is that using our proxy for entry, we see that on average a truss out sample -- the share of young firms in the economy has declined. And this is consistent with the work by Professor Haltiwanger and Co. for the U.S., and more generally, the great work that Chiara has done on a cross country basis.

The second thing we see is that our proxy for basically those firms on the margin of exit, these are loss making firms older then 10 years old. Sorry, that should actually be not 6 to 10. It should be 10 plus. We've seen that the proportion of these firms has actually increased over time. So in a sense, this is suggesting that entry is declining and exit may be declining, as well.

The second thing we see is that conditional on entry, the relative productivity of young firms relative to incumbents has increased over time. And secondly, what we see is on the exit margin,

essentially, the relative MFP of these firms on the margin of exit has collapsed. So in a sense, you know, this is consistent with a story where entry barriers may be rising, in a sense. So, you're seeing decline firm turnover coupled with basically, a rising gap or rising MFP gap between entrants and firms that should be exiting.

The second thing is that I think it raises questions that the extent of market contestability may be declining over time. And we can link this to productivity diffusion to the extent that if you have less new firms entering, that places indirect pressure on incumbents to innovate. And the (Inaudible) of this is that it's becoming easier for laggard firms that remain in the market without adopting the latest technologies of the time. And that's shown by the nonviable firms.

So, this raises a number of questions about what's happening in the economy, and it certainly motivates a link with competition policy. So what we do in the formal part of the paper is we do a cross

country exercise where essentially, we ask to what extent is this divergence in productivity related to product market (Inaudible) or the lack thereof.

And we saw a lot of literature that links competitive pressures to -- within firm productivity gains and technologic adoption, and also, more efficient allocation of resources. And what we see when we look at the OECD indicators of product market reforms or product market regulation is that, you know, there's much dispersion in the amount of regulation across countries, and in some sectors, such as professional services, we've seen a slowdown in the rate of reform, and there's still much scope through a lot here.

So, there's a big issues with basically product market regulations and professional services. These are things like barriers to entry, and also, things like occupational licensing. So, what we do here is we run a series of cross country regressions where we relate the change in the MFP gap based on the number of definitions to the change in the rate of

product market reform over time, and we control for a battery of country fix to fix and other variables to make sure this is robust.

We also do an instrumental variable analysis to control for potential endogeneity between product market regulation and central economic conditions. And essentially, what we see here is that the MFP gap between the global frontier and laggard firms increased a lot more in those sectors where the (Inaudible) reform is more sluggish.

So what we have here is that the fastest deregulating sectors in our sample is in telecommunications, and this essentially tries to estimate for the other services sectors how much of the increase in the gap is actually due to slow deregulation. And on average, we see about 50 percent of this gap or this increase in the MFP gap across countries can be explained by the fact that pragmatic reforms didn't continue at the same pace they did in the best practice sector.

So in a sense, what we conclude is that even

though productivity divergence was perhaps inevitable due to these structural changes in these global economy, so digitalization, globalization and in stories about intangibles and in rising importance, it didn't have to be this way. So, we could have seen a less pronounced increase in productivity divergence, which could however, I guess, (Inaudible) against the wind of this slowdown in aggregate productivity. So I'll it at that. Thank you.

MS. SHEINER: Great. Thank you so much. Carol, do we have --

MS. CORRADO: Do you want me to come up there?

MS. SHEINER: You can if you want to? Or we can do it from there, whatever you --

MS. CORRADO: Well, I won't be able to --

MS. SHEINER: -- see there either. Okay.

(Discussion off the record)

MS. CORRADO: Okay, well it gives me great pleasure --

(Discussion off the record)

MS. CORRADO: So, how is this? Okay?

MS. SHEINER: Yeah.

MS. CORRADO: Okay. It's really great to be here and to discuss this paper. I had a lot of fun sort of sinking my teeth into it and its predecessor, and its predecessor (Laughter). And what I mean by that is that this paper -- well, you know, what you just heard about reflects, I guess, a multi-year investment by the OECD in creating a database that allows them to you know, measure and study firm level productivity.

It's allowed them to determine and analyze what they call the global frontier, and then, they have this fascinating set of stylized facts that they've generated, one of which is that this divergence between the frontier firms and the laggard firms has increased. That's the fundamental finding that they have. They have associated it with the slowdown under a couple of different stories.

But most importantly, I think even if it didn't sort of explain the slowdown, they've

attributed this gap and the speed of divergence between firms that are on the frontier and not to the process of product market regulations in certain industries, in certain countries, and they sort of control through all of that. By the way, the U.S. was not part of that analysis, if I read the paper right.

Now, I like this finding. I'm not going to challenge this finding. You know, I think -- there is Martin across the room. I'm reminded of a book by William Lewis, the founding director of the McKinsey Global Institute, who wrote a book I think in 2004, called *The Power of Productivity*, where he just started off saying, you know, we at MGI have you know, been on the ground studying different industries in different countries and doing comparative analysis.

And one thing has come through, no matter what industry we study and what sets of countries we're comparing, and that is the role of competition and product markets. And quite frankly, I never read something that was quite so powerful as that, the way he wrote it. And then the whole book was essentially

a series of case studies that sort of illustrated his basic point. And then, how do I -- could you point on that? I have --

(Discussion off the record)

MS. CORRADO: There's another reason why I'm not surprised by it (Laughter). And that's because in my work on intangible investment, we have found that intangible investment tends to be higher in countries with fewer product market regulations. Now, what does that mean, or what could that possibly mean?

Well first of all, intangible investments broadly construed could be thought of as input to innovations, in the case of R&D spending, or you know, the kind of spending you need to reinvent your managerial processes. Now, can you go back?

So, I've got two reasons why -- I'm not going to challenge what is really sort of the bottom line of their paper. Well, I guess the -- well, if I backed up a little bit, I could say, well how much do I believe about you know, this global frontier. When I read their second paper -- there were three papers.

There was one that describes the construction of the database, and your really have to be intrepid to go into that (Laughter).

Then, there's a paper that they wrote a year or so ago that introduced this notion of the global frontier and the divergence between those on the frontier and the laggards. But gosh, it ended in 2009, and you go, ehh, well, I'm just seeing the financial crisis. You know.

But still, you know, I talked to a lot of people about that paper at the time, and they would say, I just don't understand how this frontier is calculated or what it sort of really means. And I've satisfied myself that the way Dan described it is just -- I mean, it's a calculation of the top 5 percent of firms in any given two digit industry that are up there. And you might want to know, well, how much churning is -- I mean, if it was John Haltiwanger, he would have told you -- well, how much churning is this (Laughter)? I mean, what's sort of really going on?

And he sort of threw out a number. It's

like 20 percent. Twenty percent of the people who are on that frontier in any given year -- it's all the same firms. But the rest -- everybody else is always somewhere else. And once you figure that out, and it is buried in one of the first two papers, you go okay. I mean, you know, there's a lot of churning.

You know, it's not -- maybe not necessarily because this model that they're estimated has a lot of air, but as I -- so this sort of went ahead. Okay, good. But you have to sort of realize, this is really remarkable. I believe the findings. I believe the creation of the frontier. That means I must believe this MFP that they're constructing. And then when you realize they're using a common model, one model over 50,000 observations, that's what's generating that MFP.

Now, is that model like set out in this paper or the previous paper, or even the data paper? No. Not really. It's all in words. It makes it very hard for a reviewer to try to write down some equations. But they sent me some (Laughter), and I'm

going to put them up for you to stare out, because I found staring at it fascinating. And you have to sort of realize, all else flows from whether you think that is reasonable.

I mean, the whole markup thing, ehh, you know, (Laughter) it's -- all else flows from this. And there's a lot of macro economists in this room, and they're going to go ooh. But the micro economists will be very familiar, but you know -- so we'll try to sort of relate the two.

So real quick, I could say something about the data. You know, this is what they call Orbis, which is the old Amadeus, if that means anything to you. It's mostly European firms, but they argue they have representation of the U.S. and OECD Asia. I'm not so sure about the U.S., but that's because that part on sampling weights in that first paper was impossible.

And they establish value added. We all know you do not get value added in corporate reports. So, they need to estimate labor share. I mean, all you

get from a corporation is employees. So, they're going to go to an external source, if they don't have labor cost, and get wage cost per employee for the industry that that firm is in, and that's going to be their labor share -- you know, the value of labor in value added.

And then the profits are earnings before interest, taxes and depreciation, but the amortization is thrown out. So Dan's mining firms in Australia may be getting a short hook here, but this is their -- you know, remember it's a common model.

Capital includes the account fixed assets, so R&D, which is now in national accounts and other intangible assets, whether they are in national accounts or not are not included. And software may or may not be included, because these are corporate reports, and most laws let corporations choose, you know, how they report software. If you're a software producer, you're probably counting it.

If you read the paper and you soft glossed over the phrase two-digit industry, and went oh, geez,

this is microdata. What are they doing? That's really equivalent to like our three-digit NAIC, since it's for the U.S.-centric audience here. So, you're talking excluding forms financials and the non-market sectors that you exclude, what, 50, 60 industries? That's the level at which they're working.

So, they estimate productivity. It's up to date, you know, the best econometric techniques, you would say that you know, these people know what they're doing. So, it's the Olley-Pakes method, which some people may be familiar with this in this room, where to avoid the simultaneity bias, they're going to use what's called a proxy control function, where materials cost is the proxy for productivity.

It's a Cobb-Douglas production function that they're estimating; cost of shares relative to the macro stuff that we're all used to. You know, we knew that these shares should vary over time. They vary both because of composition of inputs and factor utilization, and part the Olley-Pakes technique -- you know, controls for the utilization. But there's all

kinds of other things that are going on that they can't account for and could not, in any reasonable, you know, set of circumstances or set of resources.

Real capital includes tangible capital only. Well, so let me just show what they're excluding. Could you press that little button? Because when these assets are growing in importance, MFP is surely going to be overstated. And Dan alluded to this, you know, in his comments.

This is the United States 1977 to 2014, and these are investment rates. In other words, it's the value of gross investment relative to GDP, so let's say, like if you have two different investment rates, two different savings rates. You can see one is up and one is down. And the one that's going up is intangibles. And they can also see the relative size. The largest component of gross investment in private industries is not in their study.

(Discussion off the record)

MS. CORRADO: Now, that was the U.S., so here is Europe, because most of what they're doing

here -- and remember, a lot of the country variation is across many European countries. Now, I've switched --these aren't investment rates. Here, we have real investment. So for the U.S., on the right, we have the same figures not relative to GDP.

So, you can see the index to 2007. So you can see the relative dynamism in the U.S. prior to the recession, and actually, afterwards. Europe, and I'm sorry to say, I think this is only 11 EU countries that were used in a growth accounting paper that I'm now in the process of writing, so this would have more variation if we used all 18 countries that were on a previous graph.

But anyway, here, you see, gosh, just this incredible diversion, you know, after the crisis. And so this is what Dan referred to as every -- particularly from the European perspective, since investment is so weak, this is the problem with labor productivity now. So, you can see the tangible investment tanked and never really came back. So, now if you could press that -- the little button.

(Discussion off the record)

MS. CORRADO: Okay, so equations. This is what they sent me, and believe it or not, it helps to understand the paper, and I'm not going to dwell on it for very long, and there's only really one more slide. I just elaborate on this a little bit.

So, what is the YIT -- because I want to be really basic here -- the data? So, this would be say, Siemens in the U.S., a company. The K would be the capital of Siemens that's located in the U.S. The labor, the workers of Siemens in the U.S. And then, let's skip over that funny looking term. And then next is the country control. That would be U.S.

So you could have Siemens Italy be the same thing, but the country control would be Italy. You would have no way of knowing from this equation that the blueprints for all of those industrial controls that both of those firms produce is actually you know, located in Germany or Ireland. We don't really (Laughter) -- wherever they are. But they belong somewhere else, and they're not counted here.

And not only -- and I think what's interesting, because I go to try to help them out here. What's interesting isn't that that blueprint isn't there if it's not a multi-national firm, but if it is a multi-national firm, it probably means there's a blueprint somewhere, or some managerial expertise somewhere, and there is a body of literature that shows that multi-national as all else equal, tend to have better productivity than others.

So I think there's some ways that they can go through using the data they have to control for a multi-nationality as a characteristic. There is the Cobb-Douglas version of the MFPR that they're using. I think -- I don't know why they don't put in the Olley-Pakes control function, which is that funny looking thing, but I don't have time to talk about it. But from an economist's eyes, not an econometrician's eyes, that's just some terms that sort of transform this into a trans-log production function, and it is part of MFP, and it would better purge MFP of factor utilization effects. They've estimated it. They

should take it out.

So this is my final slide. There's a bunch of modeling issues, and I think they can put firm effects in this equation. You tend to not do it when you're doing Olley-Pakes, because you think you need to interact them. And then the number of variables explodes.

But some people have argued that you can have firm fixed effects, and I would put in a control firm multi-nationality. There's a lot of precedent literature that suggests that this helps explain you know, differences across firms, and they can do it with their data. And they can do it -- I won't say easily. Nothing is easy when you're working with 50,000 observations, but you know, that is part of the nature of the data that they're working with.

But more fundamentally, I think they really need a broad measure of K and that it would reduce MFP. Will it reduce the dispersion? I think it would, but you know, I don't really know. Nobody can know. And if you want to say why -- you know, how can

I do that? Well, let's see. I guess I would point to Bronwyn over here. (Laughter) She's done -- you know, she's estimated firm level production functions from accounting data, accumulated the R&D, having the stocks in the production function. It can be done.

Then there's some more obscure literature that has tried to you know, estimate intangibles from the SGNA component and the accounting data. And I don't know how well that works. So the bottom line, this is extremely valuable work. It gives us a global picture of productivity. I didn't dwell on that equation, but you know, when I looked at that equation, it's estimated that firm level -- sorry, that industrial level term that has the time dimension, you know, is giving you for each industry -- you are getting a global productivity time series.

And you know, you just can't look at that any other way in an easy way from anywhere else. And there's lots of things that could be done with the model that they have right now. So, this is only the tip of the iceberg, but you know, I have these four

recommendations. The top of the list is maybe talk to Bronwyn. You know, better exploit you know, your multi-nationality.

I didn't dwell on the third point. I didn't develop it, rather, in my comments, but I think you know, all of the techniques that they're appealing to, and quite rightly, they're appealing to the right things. But you have to sort of realize like Yanda Loker develops this markup technique, and it's very cool. But all of the tests are on Chilean microdata for manufacturing only.

MS. SHEINER: Carol?

MS. CORRADO: You know, it just may not be working for you.

MS. SHEINER: Carol (Laughter).

MS. CORRADO: For your services.

MS. SHEINER: Carol?

MS. CORRADO: Okay. And so time is up.

MS. SHEINER: (Laughter) Thank you. I'm sorry. That's the worst part of this job. I hate doing that for great comments (Laughter). Okay,

great. So, we're going to open up to the floor for comments. I just want to say, I really enjoyed reading this paper. When I think, you know, from a macro perspective, we talk about productivity. We think, you know, it's technology. There's a little A and it changes, and it's the same for every firm, every year.

And it's sort of trying to think about well, of course, it's not and how important is thinking about different firms and diffusion. It's something that was completely new to me, and I think really interesting and exciting. So anyhow, comments.

Again, let me reiterate, people who are not at the table, please do not feel like you have any less right to make comments. We'd love to hear from you. Either the mic is being passed around or come up to the table. Harry?

MR. HOLZER: So this is very interesting work. I want to slightly shift the focus a little bit. No one has mentioned labor at all today, and labor still matters in production functions. And

labor quality and labor skills and their growth over time might be part of this story in a way that I think no one has acknowledged yet.

So, I want to say something about what I think is happening on the supply side of skills and on the demand side of skills, but I want to use that to challenge this notion that somehow productivity -- I'm sorry, that competition and regulation are key to the story, because I don't think those things have anything to do with what's going on in the labor market, either on the supply side or the demand side.

So throw out -- so something on supply, I think there's sort of a pretty strong consensus in the research literature that over the 45 year period -- not less -- and over the 45 year period that the supply of labor skills has not kept pace with growth and the demand for those skills, hence the large rising premium to education and a lot of us know that story.

And even though the returns of investment have gone way up, the amount of investment completed -

- we send all kinds of people to college, and many of them to finish anything -- you know, it's not necessarily purely an incentive problem. If anything, the evidence seems to suggest that things happening very early in people's lives create a large achievement gap. And once that achievement gap exists, it's very hard to create the kind of skills people need and the kind of educational attainment, and I don't think competition in the product market is going to solve that problem. So, I just want to throw that out as a caution.

But separate from that, I also want to talk a little bit more about the demand side, and maybe these laggard firms, and I want to throw out a possibility and a couple of pieces of suggested evidence that in fact, from a labor point of view, you can be a low productivity producer and be very profitable; and that in fact, perhaps, that tendency has risen over time with certain trends in globalization and technology.

We've known for a long time in labor

economics that firms -- there's not one market wage. In fact, there's a range of wages and a range of production techniques, and firms often choose whether they want to be in a sort of high wage, high productivity or law wage, low productivity equilibrium, often within the same industry and the same regions. And of course, you know, John, the LEHD data have told us a lot about that; the distribution of -- so we've known that.

And now the question is whether, for various reasons, some firms have shifted. And I'm thinking in terms of the evidence. I'm thinking about the sort of -- we know from labor economics that there's been a shift in demand from the middle of the skill distribution to the bottom. David Autor is probably the best known person.

I've actually written some things saying that I think sometimes that's overstated or over interpreted, but you know, and that it's drive a lot by the decline of clerical and production employment. But it's clearly happening. And I want to suggest the

possibility that some firms are switching from middle skill to lower skill employment, and doing very well in the process. And that's not going to be very good for productivity numbers, but it might be very good for their profits.

A couple bits of evidence on that. We know that at least in the last 10 years, there's been this very large shift towards independent contractors in the labor market, and a quite dramatic shift within a 10 year period. And it's likely those independent contractors are often not -- firms are not investing in their productivity, and that might be -- so that's a piece of evidence at least within.

Or of course, the other story is that shifting across sectors -- that in sectors where the production work is being shifted overseas, and what we're keeping in the United States is sort of the sales and the marketing, that there's a shift from middle to bottom productivity and wage going on there, too. So, this is more speculative. There's less consensus here than there is on the supply side.

I just want to throw out that possibility that firms, for various reasons, can do very well and be very profitable if they shift to lower productivity and lower cost methods, and that's at least possible that that could be part of the story we're seeing here over the last 45 years, or even the last 10 years, and that competition product market competition and regulation stories are not going to help us with that.

SPEAKER: So, I guess two things. One is just to underscore Louise's point, that I think the evidence, even if it's suggested that it's strong along a whole variety of dimensions, that firm level dynamics have the potential to have macro economic -- significant macro economic effects; that we need to invest more in setting those firm level dynamics, which has been a kind of lonely Davis-Haltiwanger kind of phenomenon for too long.

The second point is, I think there is -- it may be -- I'm not saying it is, but there may be more of a product marketing competition impact even on labor markets. Two things that did not come up in

this discussion -- one is that there has been a very significant increase in the variants -- not the mean, but the variance of capital returns, whether it's the return on equity or better, the return on vested capital. I mean, just dramatic changes.

And secondly, that whether you look at Richard Freeman's work or the (Inaudible) work, there is a very significant share of the rise in wage inequality, whether it's a half or two-thirds or three-quarters, it's not zero, that has to do with between firm, rather than within firm evolution.

MS. CORRADO: Yeah.

SPEAKER: And that in turn may be -- I'm getting out over my ski tips here, though, that may in turn be -- depending on whether that's worker sorting or some sort of compensating differential impact, if it's the latter, it could actually be reflecting on product market imperfections. So, I think we just don't know yet, and that just brings me back to my first point, which is we need to be delving into this a lot more, because it does seem to be having -- it

has the potential to have non-trivial macro economic effects, or to be exerting them.

SPEAKER: Yes, I have two quick questions. One, I mean, you're dropping (Inaudible) on employees. That's a huge chunk of the whole database. So, I'm wondering what's your take on -- I mean, I guess you are underestimating the results, maybe by dropping them. I don't know what is your take on that.

And then the second question: When you try to take these findings to try to explain the aggregate productivity dynamics, I wonder if you've thought on like how to disentangle the story of diffusion, which I mean is what you're emphasizing, I guess, by saying that this distortion is slowing down all aggregate growth. How can you disentangle that from maybe a story of some sort of dynamic misallocation in which policies are constantly misallocating their resources to a small and less productive firm year after year?

MS. SHEINER: In the back -- questions?

SPEAKER: Sorry. I borrowed Marshall's name tag because I was apparently supposed to be up there.

(Laughter) So I very much like this paper. You know, I think the authors ought to be congratulated for the enormous amount of data work they've done over the last few years to put this together.

I did have some non-trivial quibbles with, I call it the labels -- not so much their facts, but the labels they put on, and I think in terms of how you interpret it. So, they very much like us to think about that there's something going on in the global frontier that's different than the laggard firms. And to me, I could equally interpret exactly what they've got. It's just rising dispersion within industry productivity.

So if indeed what's going on is, as the last comment suggests, any number of frictions or distortions or wedges that are preventing kind of the resources from being reallocated from less productive to more productive businesses, and you even have some evidence on this for the low productivity firms to exit, for the high productivity firms to grow, this can contribute to rising dispersion, and so you will

see a gap with rising dispersion between what you call the frontier firms and the laggard firms.

So, I don't know that we want to say, take away from that saying oh, the guys at the top are growing just as fast. We just want to say there's actually more dispersion. So, I don't dispute that fact at all. But I think that that label of the frontier makes you then think that the key friction might be diffusion. And it's not so clear to me that that is the key friction. I think it's an important friction. You know?

Think about models of diffusion. They are about costly adoption of new techniques and learning frictions. And they're important frictions, but there's lots of other frictions out there in the economy, as just was talked about; various kinds of dynamic misallocation frictions in product markets, in labor markets, in credit markets. We can go down the list. And I think there's a huge identification problem. By the way, I'm not to talk. We face the same problem (Laughter), but I don't think we

necessarily can put a diffusion label on it.

MS. SHEINER: Again? Do you have a question about that, John? So, if you're saying it could be dispersion, so like the mean may be the same, but just the -- so there's just more at the top. But when I think about like putting it into like a macro model again, doesn't it still mean, though, that the possibility of increasing labor productivity over time is actually not slowed so much as the average?

And is that something when I think about well, what do we owe -- I'm trying to think about what are new ideas versus what are -- how fast they're adopted. Is it not telling me something about the new ideas that are still pushing labor productivity up?

MS. SHEINER: Okay, great. Okay, let me give the authors that need time to respond.

MR. ANDREWS: Yes, thanks very much for the great comments, and in particular, Carol. I'll just make a few points, and then I'll give my coauthors a chance to respond. So, look, you're absolutely spot on about the role of intangibles, and you know, we

can't really say whether this is a story about technological adoption or misallocation or intangibles, for sure. But I'll come back to misallocation shortly.

But you know, from a policy perspective, when I think about MFP and intangibles, I mean, intangibles have -- in a sense, is the investment to produce innovation, in a sense, and it has a lot of qualities that make me care about them more than, say, physical business investment, because we know that often they're the non-rival that give rise to spillover.

So in a sense, I guess, you know, even if we are overstating the increase in MFP dispersion, because we can't pull out intangibles, for me, it's still -- and to the extent we can link that to policy, it's still important. So, whether it's actually MFP or intangibles, both matter for growth. Both have these key characteristics that we care about. So, I think you know, that would be my response to that, although, you know, you're right. It's just not clear

what we can do about that at the current point.

We have tried to match (Inaudible) to the database before. We're in the process of doing that again, and Chiara and I have done some work with that. And the other point is about the multi-nationals, which is a good point. In our first version of this paper, we did have a match with the multi-nationals, and for instance, we looked at the characteristics of the frontier.

So for instance, global firms were about twice as likely to be a multi-national than the average laggard, so we think this is important. So what Peter has done has been trying to sort of -- look what happens when, for instance, we can take out firms that actually a subsidiary of other groups, for instance. So then you're just left with the independent firms and the headquarters, and you still see kind of this dispersion. So, we want to do a lot more on this, but I think it's a really important point, and we'll try and make some progress on that.

Just in terms of the other comments, in

terms of Harry Holzer's comment about this isn't anything to do with product markets, if you think it's to do with labor quality. So you know, I can think of reasons why product market regulation could affect growth through the laggard channel, as one is the actual reallocation of skills.

So, we have some work at the OECD that shows that for instance, the U.S. does very, very well at actually matching skills to jobs in terms of skill mismatch. And that's strongly correlated across countries with things like product market regulations. So, even though product market regulations might not affect the level of skills in the economy, they could very well affect the allocation of those skills to jobs.

In terms of the point about -- that Peter also had made about the links of wage inequality, I think it's a really good one. Chiara's doing some work on this, so I'll leave that to her. And then the two final things are that you know, Professor Haltiwanger made the point about -- the question about

whether this is really something about what's happened in the frontier or just a dispersion story, in general.

And I guess one of the interesting things is, a slide I showed you on the MFPR dispersion for ICC services versus non-ICC intensive services. And we see that basically in those ICC intensive services within the frontier grouping, the top 2 percent pulls away a lot more than for instance, the top 10 percent. But you don't see that in other sectors. So, if it was purely a story about -- just a general story about dispersion, I guess, why would you see these differences across sectors when we think, you know, that the winner-take-all dynamic could be more relevant in ICC intensive services, and we see that accentuated dispersion there, even at the top. So, that's one response to that.

The final point about whether this is diffusion or misallocation; that's a really valid thing. I think they're very inter-related. So, the incentives to actually adopt new technologies would

depend on the efficiency of the reallocation mechanisms in the economy. So if you think that experimenting with new ideas and intangibles, for instance, is very risky and a lot can go wrong, well, you know, in the good state of the world when that sort of experimentation comes off, you want to be able to rapidly scale up that investment. So, you can do that in an economy where reallocation mechanism are good.

If things go pear-shaped on the downside, you want to be able to sort of exit or basically scale down that investment. And that will be a lot harder when there's frictions in the reallocation mechanism. So I think, you know, we can't actually fully distinguish between these or tease out the relevant contributions of these things. We think they're related.

We've showed you the chart where we've got basically a turnover, and then the relative productivity. You know, you could argue that you know, a decline in business dynamism could be related

to misallocation, so there's less entry. But then that creates less market pressure on an incumbent firm to adopt the latest technology. So then it becomes a diffusion story.

So, it's very difficult to actually separate between the two, and the important thing is for the OECD is we have a lot of evidence that policies, particularly product market regulations can affect both of those things, and ultimately matter for MFP. So, thank you. Chiara, do you want to quickly --

MS. CRISCUOLO: So perhaps let me pick up on this last point, on whether it's all just economic misallocation. I think we have one bit of evidence in the paper, which is -- sorry, I'm a bit small, so --

(Discussion off the record)

MS. CRISCUOLO: So you know, I think one big of evidence that we have that is not just economic misallocation is the fact that we have declining convergence as well. So, if you want that's more within firm level. So I think the two things are going on at the same time, and I hope that in the

paper, you know, also thanks to the comment of Louise and Martin, we tried to make that point a bit better.

One thing on multi-national, this is really something that takes a huge amount of time in (Inaudible), so that's not why it's not in this version of the paper, but it's very much in our to-do list.

And exactly, also, the matching with patent, and Dan mentioned the problem with matching patent, and I think he's now going to capture -- given the nature of you know, patent and the sectors where patenting happens, is that we are now going to capture the divergence in the services sector, where I completely agree there is a big measurement issue. We just had a discussion with Bronwyn before. And I'm not sure we'll have a very good answer to -- you know, we should measure it better and try to capture network externalities that Dan also mentioned. So, this is in our to-do list. I'm not sure exactly how we are going to do it.

On the dropped 20 employees point, our main

-- you know, that I think Danny made -- I think it's more a matter of you know, the problem with our samples when we were trying to correct you know, for the problems in our data. But we have ongoing work where we tried to use official databases and you know, do proper sort of way -- I think to capture the whole population of business. So, the sort of 90 percent that we drop right now.

And we see, like in many countries, the divergence coming both from the sort of 90 to 50 dispersion, and the 50 to 10. And we are trying to do some work to make it with wage -- between firm wage dispersion, and we see that the between firm wage dispersion is dispersion is very much linked with the between firm productivity dispersion. And we tried to link these two policies.

I mean, obviously, we just have correlations right now, but we see that, for example, strong and permanent protection legislation weakens that link. So, this is something we are trying to explore. And I mean, I leave it to Peter to go more into detail, but

--

MR. GAL: Thanks. I mean, I just had some few points about measurement and data. So, thanks, Chiara, for spending some time on explaining more the methodology for MFP estimation, but knowing all the difficulties of different assumptions, so we did try to experiment with various methods. And just to reflect here the basic, you know, (Inaudible) conclusion. And there's a divergence.

This holds for a very simple solid residual type of you know, MFP measure, which is something also for the macro (Inaudible) I guess very much, that just uses you know, labor shares and constant readjusted shares. So that is not sensitive to -- so the main story is not sensitive to the you know, peculiarities of the MFP measurement.

But intangibles, if I may qualify a bit, because indeed, there were several variants of the database, because the data provider itself always improves it, and the description of the data in 2013 was referring to different variants of the database.

So right now, they do include more of the intangible elements. As long as the book value is contained, it was intangible elements. So it comes down to accounting drills of what they include. So we're going to be leaving out a lot of the important factors, but not only tangible. That's what I wanted to emphasize.

(Inaudible comment)

MR. GAL: Yeah, we're just mitigating it. And also, for the 20 employees, I just wanted to say that the key problem with the Orbis data, of course, is that it tends to be under represented for the small segment. So, this under representation may change by country and over time, so wanted to get rid of this issue completely, and just hope it's on the -- sort of the mid-sized company grouping starting from 20.

MR. ANDREWS: Thank you.

MS. SHEINER: Thank you so much --

(Audio dropout)

(Discussion off the record)

MR. HALTIWANGER: Well, thanks very much for

having us. This is joint work with Ryan Decker, who is here, and Ron Jarmin and Javier Miranda, who will also be -- both here. So, we're also going to take a look at the microdata. We're going to look at the microdata for the United States, in particular.

We're going to come at this from a related, but slightly different angle. We're going to start with the facts that we've been accumulating -- us and a number of folks, including some -- there was a very nice Brookings paper earlier this year about declining indicators of business dynamism -- the declining pace of job reallocation and worker reallocation and the like, and declining entrepreneurship.

We're going to start with those facts. I'm going to go over those very quickly, because we want to think about what the implications are for productivity. It's pretty clear something fundamentally is going on differently in terms of the dynamics of U.S. businesses and U.S. jobs than before. And the question is, does it have productivity implications? And we think it probably does.

So, let me just go over the facts really quickly. So, from a whole variety of datasets -- the upper left hand side from BLS, the lower from Consensus Bureau -- these are comprehensive datasets. These are datasets that cover every U.S. establishment, every U.S. firm in the United States and the private sector. We see a declining pace of job reallocation. That's one of many kinds of measures of business dynamism.

Why might we -- since we're about productivity here today, we think that there's potentially a role for productivity, because lots of us have studied the relationship between reallocation and productivity, and found that the reallocation, particularly in advanced countries like the United States, is largely productivity enhancing. It represents the ongoing process of moving resources away from less productive to more productive businesses. And the U.S. has sort of had a hallmark of being able to do that well.

But then taking more than a second to think,

I said wait a second. If this is all a drag on productivity, this seems to be going on for a couple of decades. And what about the surge in productivity? What's going on? So, we're at least going to need to think about that.

A key part of this declining indicator to dynamism is decline in the pace of entrepreneurship in the United States, a variety of indicators. One that's simple is just the startup rate. These are all U.S. private, non-formed sector firms. Pretty remarkable decline in the pace of startups over the last couple of decades, and you can see -- you know, we took a really big hit in the great recession, and actually, these are the latest numbers of the BDS that showed up this week. We really haven't recovered yet.

As part of that, not surprisingly, if you don't have much startups, you don't have much activity in young firms. And so the U.S. is getting older. And by older, I mean not just like us, but older in terms of firms (Laughter). Okay? So activity is much more concentrated in mature firms. And is this

necessarily a bad thing? No, not necessarily.

But in some key sectors, at least, we've often sort of had the idea. We both have theory and evidence to suggest that there are transformational entrepreneurs, young businesses that play a critical role in innovation and productivity growth. And the question is, again, is this a drag?

Now, to start reconciling -- and we've been working on this for now a number of years. So to start reconciling -- how could it be this, you know, long-term decline in dynamism that doesn't seem to match up with the productivity dynamics. It's actually useful to even just cut the data by broad sector, and you see quickly that the patterns are actually quite different across sectors.

So the sector that dominates -- I'm going to over tell this story, but I've only got 15 minutes (Laughter). The sector that sort of dominates the decline in both startups and indicators of reallocation and so on is the retail trade sector in the 1980s and 1990s. And in that sector -- we've done

lots of work on this. Actually, that's a sector where this represents, we think, a change in the business model.

We've moved away from largely delivering goods and services in retail trade from single unit establishment firms called Mom and Pop firms to large national chains. What do we see in the data in terms of large national chains? They're both much more productive and they're much more stable. So, this is actually a kind of a form of reallocation that has led to a decline in startups, dynamism, but is productivity enhancing.

And so this is just sort of reminding you, you know, we don't want dynamism for dynamism's sake. There's lots of emerging economies out there, for example, that have incredibly high startup rates, yeah, because there's a lot of basically market stands out in the -- you know, in the informal market. So, you don't want just startups for startup's sake. You want dynamism to be contributing to productivity.

But notice, in the information sector --

this is just a broad kind of a data -- very different pattern. Actually, I'm going to show you one chart out of this. But in the information sector, you actually see a rising pace of reallocation over the 1990s. If I showed you the entry rates, you'd see rising rates of entry over this period of time.

And not only that, in this sector, what you also see in the information, and I'm going to talk more broadly about the high tech sector, because high tech is more than just the information sector, because obviously, there are important parts of manufacturing that are high tech. One of the things that's very much been true -- was true of the information sector up to about 2000 or so, was it was the sector with the most skewed distribution -- the right skew distribution in growth rates.

So, we're just characterizing this simply here. Look at the difference between the 90th percentile firm in terms of growth and the 50th percentile versus the 50/10. And it's a huge gap, and it's actually the sector that just dominates this.

And when I say exactly, approximately about the time when we started to see this decline in productivity growth in these kinds of sectors, we see a decline in high growth firms.

And if we push it further, we can actually just -- as I said, I'm going to go talk about the high tech sector more broadly, and I'm going to use that when I go look at productivity. So by high tech, I mean most of the information sector. We get rid of things like newspapers and publishing, and then we bring in the other components of high tech, like computers and semi-conductors and the like.

You see that again, it was a sector with -- again, I'm just showing the 90th percentile and the 50th percentile. And again, what one is so struck by is, you hit the 2000th period of time, and again, what do we see? We see declining dynamism in terms of reallocation. We see declining startups, and we see declining high growth firms. And it turns out, if I had more time, I would show you it was high growth young firms. So, it looks -- this as at least, you

could say suggestive evidence that the transformational entrepreneurs, at least in terms of high growth rates, seem to be reduced in key sectors, like high tech.

Okay. So, the question is, is this connected to productivity? That's what we here about today. So for us, in the last couple of papers, we've been going -- because they just backed the basic firm dynamic models, and models that relate growth and productivity. Let me just sort of review those for you.

So the standard kind of model is a model in which there are firms that are subject to idiosyncratic shocks, and by shocks, these actually might be endogenous in this instance, and may reflect a kind of experimentation and innovation and things of that sort that lots of us have been talking about today.

So what is the of economical model? Well, who do I have in mind, having models of people like Hoppenheim and Pakus and Yovanovich and the like? So,

what goes on in these models is some firms get high draws. Perhaps you know, they experimented and they were the successful ones. Others get low draws. And in this class of models, because of dynamic frictions, it takes time to reallocate resources from the less productive to more productive businesses.

And so just in an accounting sense, you can decompose the growth rate distribution. Remember, I've all been about the growth rate distribution, into kind of two components; the driving forces, the shocks, and then the responsiveness of those shocks. And so what we've been trying to do is measure both of those things in the last couple of papers.

Now that's not so easy, particularly on the shock side. Right? Because for the most part, we don't actually observe the perimeters. What we'd really like to do is measure the idiosyncratic technology shocks -- idiosyncratic demand shocks, and so on. Instead, what we measure are things like what we're going to talk about here; revenue like our productivity today or revenue total factor

productivity or multi-factor productivity. Those are outcome variables, all right, that reflect shocks, but also, the responsiveness to shocks. And I think this is a really critical point. It's related to both our work and the previous paper.

So given this -- so think about a world in which there has been some increased dispersion in the shock process. Well, that will tend to -- for a given amount of adjustment dynamics or frictions, that will lead to increased dispersions. And that can be a good thing, not a bad thing. Alternatively, let's suppose that the shock processes stay the same, but again, what goes on is you get firms that get hit by positive shocks and grow; firms who get hit by negative shocks who shrink.

And so what does that do, when these shocks come along? You know, it's simple. This is Economics 101. It creates dispersion in marginal revenue products. And what should be happening is the guys with high marginal revenue products ought to be increasing capital and labor. The guys with low

marginal revenue products ought to be shrinking capital and labor.

And to the extent that that process slows down, for whatever reason -- we just were talking about it just a couple of minutes ago, it could be frictions in the labor market; it could be frictions in the credit markets. It could be frictions in the product market. It could be learning frictions in the diffusion process. I'm open to all those, but as a core identification problem, if there is a slowdown in the process through which marginal review products are equal -- they're never equalized, but that tendency for them to become equalized, you'll see rising dispersion.

Now, do we have any hope of being able to investigate? Yeah, because I think we can go look at particular sectors. We can look at particular kinds of changes, and so on, but we can also look not just at dispersion; we can go look at the covariance between growth and productivity, because regardless of the fact that I don't have good measures or

perimeters, it should be the case that the guys that are high in the productivity distribution are growing, and the guys that are low in the productivity distribution are shrinking, and to the extent that that's changing over time, that's telling us something about the dynamic process.

It doesn't tell us what, but then we can potentially go and say oh, well now that I see this, can I go see it in particular kinds of sectors or particular kinds of firms? And this is much along the lines of what we just sort of saw in the previous paper.

Now, not only this simple decomposition you could say, and the dispersion and responsiveness also has the benefit that we can do some simple accounting exercises that can quantify the extent to which the -- if there is a reduced pace of reallocation due to the reader's responsiveness, how big a drag on productivity? And I'm going to give you some numbers in two slides on that.

So, the first thing we do is, we're taking

advantage of a new database that actually this team helped build. So, most of the work that we've done in this area, and this came up even in the prior remarks -- all the work I've done and many of the folks in this room on productivity and reallocation, both the United States and around the world is for manufacturing. And that's because that's where we got the data to potentially measure certainly (Inaudible), but even good measures of labor productivity.

In retail trade we can do okay, but in other sectors we struggle. So a new database that a team with the Census Bureau has put together is for essentially all firms in the U.S. private sector. I want to say that everything I showed you before was literally everybody.

Now, for a revenue database, there are administrative data that are basically from corporate tax reports and so on, that we can actually merge that into that same kind of data that we've talked about, and for 80 percent of the U.S. private sector -- and it turns out it's actually a fairly random 80 percent,

fortunately, we adjust for the extent of non-randomness inverse to (Inaudible) score weights. And by the way, our results are completely robust using the weights or not. So, I know this is a big sample. In the last paper, we're tracking roughly four million U.S. private sector firms from the tiniest. They only have to have one employee every year in these charts. Okay?

So, what do we see? Actually, we see something similar to what we just saw. We see rising within industry, revenue labor productivity dispersion. Now us, this came up in the last talk, too, we intentionally sweep out six digit NAICS effects. And there's lots of reasons you want to do that. We especially need to do that, perhaps relative to the prior paper, because we only have revenue. We don't have value added. All right?

And it's certainly far from perfect, but in sectors where we've actually got TFPR and value-added pro-worker and revenue pro-worker, and we have all that. And if we sweep out six digit effects, we find

that they're actually highly correlated with each other. And that's not so surprising, because in part, you're sort of saying -- you're basically making the assumption about similar material shares across firms within the same very narrow industry. Still need to work on this.

So what do you see again? On the upper left-hand panel you see -- by the way, especially for the information sector, you see rising dispersion, but overall, in the overall economy, we see rising dispersion. Something is going on in the economy. Now, is this necessarily bad news? No. And indeed, I think actually the little blip in the late 1990s is probably a sign of good things. It's a sign of lots of experimentation going on in the high tech sector.

So as I said, remember, dispersion alone isn't an efficient statistic. It's entrusting. We want to track it, but it may reflect good things including changes in driving forces. But nevertheless, it's continued to increase, and we know one possibility of a way there could be increasing is

a change in -- some sort of change in frictions or wedges or distortions that are changing the relationship between growth and productivity.

Do we find that? Well, the answer is yes, we do. And we have a fairly elaborate econometric setup. Essentially, what we're trying to do is relate the growth of a firm between T&T plus 1 to its realization of productivity at T, and controlling for lots of things, because we know there's lots of things we need to, including the business side. So, we try to sweep out all of the cyclical effects that are kind of interesting.

So, here I'm showing you essentially estimates -- these are basically parameter estimates that vary over time in the relationship between growth and productivity. And in sort of lay terms, they're asking the question, for a firm that finds itself high in the productivity distribution, what is its propensity to grow? Or for a business that's low in the productivity distribution, its propensity to shrink -- has that changed over time, and

particularly, over the period of time we care about. And the answer is yeah, it actually has changed pretty dramatically, and notice especially in the high tech parts of the economy, but it's also done this in the other parts of the economy, and especially for young firms.

So now, go back and remember some of the basic facts that I told you about. I said we have evidence that there are fewer startups and fewer transformation entrepreneurs in the high tech part of the economy. And now I'm telling you that part of what seems to be going on is there still are firms way out in the right tail of the distribution -- this is related to the earlier discussion. So, there's firms way out in the tail. They're just not growing as fast as they used to.

How big a kick do you get out of this? Okay? So again, I'm not going to go through the equations. We do this in the paper. We can do essentially a simple diff and diff exercise. I'll go to the chart and describe the diff and diff exercise.

What is it? We can ask the question, what were the gains from reallocation if we use the -- you could say the adjustment dynamics in 1997, the initial level with a current period distribution.

And then we could ask the question, what are the gains from reallocation if we use the fact that we're seeing a decline in responsiveness, and we take the difference between these two, that's why it's a diff and diff, and say that's the drag on productivity we're getting. So, let's look at a number. By 2013, we're almost at 5 percent. That's a huge number. Okay? How do we interpret that 5 percent?

Well, it partly reflects cumulative factors, remember, given the dynamics that I talked about. So, what it reflects is, remember over time -- I've already showed you, there's this declining responsiveness. So that says you know, as the shock processes were hitting these businesses, instead of margin revenue products being equalized, or they're getting equalized less rapidly; therefore, dispersion is rising.

So that means there is, you could say, lots of pinup potential gains from reallocation that have built up over the last 15 years because of these lower dynamics. And so this 5 percent, you could say -- I'm not saying it's a one-time gain, but it's the immediate gain if you suddenly said ahh, I've got all this dispersion out there. Let's clear it out back to 1997 levels. That's a pretty kick, and I don't know relative to Chad's numbers this morning or whatever, whether that -- what fraction that accounts for, but it's a pretty big kick. All right?

So, I'm basically out of time. I'll summarize very quickly. I think the evidence is overwhelming that there has been a change in business dynamism on a whole variety of indicators -- paces of job reallocation, worker reallocation, startups, high growth young firms and the like. I think there has been a change in the nature of that dynamism post 2000, particularly in sectors like the high tech and information sector. It's in that period of time where we saw declines in startups, declines in dynamism, but

also, a decline in these high growth young firms.

The second thing we've seen you could say that's very much new to this paper is for the first time, we've been able to look at the dispersion of productivity and the growth of productivity relationship for essentially the whole U.S. economy. And our numbers are admittedly crude in lots of ways, but you could say our coverage is great. Okay? (Laughter)

So, what do we see? We see this widening dispersion in productivity. And as I said, that's not a sufficient statistic. Lots of things could be going on, including good things. And indeed, I think there's even some evidence, if we dug further -- I think it's like a Gordon Klepper story, for those people who know that kind of story. Any sector that kind of goes through a rapid technological change, often goes through periods of time with lots of dispersion in productivity and lots of dispersion in growth.

But you could say the troubling thing that

we've seen is, as we move through the 2000s, is the relationship between growth and productivity has declined. That's helpful for our initial question. It helps account for the decline in dynamism. Right? Because indeed, if there's this big dispersion out there, but firms aren't responding, then indeed, you're essentially in an accounting sense, not in a deep sense, you've accounted for why there's a decline in dispersion -- a decline in dynamism.

So the big question is why, of course. All right? So let me just -- I know I'm out of time, and because it's something I expect Bronwyn is going to bring up, but I think we should be -- it would be interesting to talk about more broadly. So as I've suggested, it could be any number of things. It could be increased frictions in literally any sets of the markets we're talking about that make it so that businesses that find themselves way out in the productivity distribution upper -- you know, high or low, aren't growing or shrinking as much.

Now, one thing that's true about all the

work we're doing here is when I talk about growth, what am I talking about? Employment growth. And so it may be that part of what's going on is high productivity businesses are growing, but just not by hiring any workers. All right? And so what do we know about that? We're just beginning to investigate that. For the manufacturing sector, by the way, we had a hypothesis is -- well, maybe they're not workers. Basically, they're hiring machines. So there's a capital labor story. It didn't work. Okay?

Another story which has also come up today, which both has conceptual and key measurement issues, and I'll probably end with this one. No, I've got one more to think about before. But it's critical. You might say that in key parts of the economy, high productivity firms used to grow in the United States. And so if you were -- back in the 1990s, if your way (Inaudible), you increased domestic operations. What do you do now? We heard lots about this today. You don't increase domestic operations. You decrease global operations.

Interestingly, in the manufacturing sector, we have found this declining responsiveness that I talked about to be especially large in exactly the sectors where the import penetration ratio in the high tech sectors to China has gone up a lot. Just suggestive, but it says oh yeah, maybe there's really something going on here on this global value chain.

But the real concern is, of course, has the U.S. become more sclerotic in some of its markets; product markets and labor markets and credit markets. And a whole bunch of us are investigating this. I think actually I'm going to say unfortunately, the evidence is not in yet, but I think there's some suggestive evidence that labor markets have become more sclerotic in the United States.

So, Steve Davis -- I won't go into great detail, but Steve Davis and I wrote a paper at the Jackson Hole conference a couple of years ago that documented things like declining employment at will doctrine, occupational licensing increases and other things that look to be drags on the labor market. Do

they account for everything I talked about here today? I have no idea (Laughter). But nevertheless, it's something we need to go after the look at.

MS. SHEINER: Thank you so much.

MS. HALL: -- if I go over. Okay (Laughter)? I don't quite have Chiara's problem, but I --

MS. HALL: So first of all, I really have to thank Martin and David and Louise for inviting me to discuss this paper, because I've always been a big admirer that John and Javier and Rob and all the people that you know, have worked together on the census data. So, I was very happy to have this to read and discuss. But of course, as in the previous discussion, I ended up also reading another paper, and then I ended up reading two more papers, including one joint with Chad, which I really enjoyed.

So, I mainly want to talk about my interpretation, which is closely related to some of the things Carol said, but I wanted to throw out a few explanations for declines in dynamism, just to you

know, get them out there. The first thing that occurs to me when I see that graph is demographics. So, I think about the supply of entrepreneurs. You know? And that's related to the fact that I started a firm at the beginning of that series in 1981 (Laughter), and I know when I was born, which was 1945. (Laughter) So, I'm a pre-baby boomer.

But I wondered about the post-war baby boom, and whether that you know -- startups may just be partly a function of age distribution in the population. I did wonder about regulatory changes. I sort of vaguely looked at around at U.S. -- I know there's a lot of cross country work, but it's -- in the U.S., I don't think there's been as much work done with the state level regulation, and that's really what matters for most of these firms. It's really state level regulatory stuff.

I have observed, myself, in the construction industry, which like Hal and all of us do this in California -- I've also been dealing with the construction industry. And you can see the regulatory

changes have raised construction costs enormously, without actually having anything change in which you get as output because of rules that have to do with environment, rules that have to do with earthquakes, rules that have to do with trying to save energy, blah, blah, blah. All that stuff.

I wonder about health insurance. I've talked to at least two people in the last year who essentially were going into work at a regular job rather than self employed, which is what they'd been because of the health insurance, essentially. I mean, that was the reason. They wanted a secure supply of health insurance.

And I'm wondering if there's a preference for stable job attachment or something, you know, that's coming from that, because the cost is really -- for individuals, has really gone up over the 30 years he's looking at. And then, there's this anti-trust enforcement -- you know, whether there is less competitive pressure out there in general. You know, has our anti-trust enforcement changed as a result of

the impact of all of the economists that came from Berkeley and Stanford and told them about networks and things like that?

So, I think that you can argue against it, because you have these employment concentration figures that you mentioned that only show increased concentration in trade and services, but not in manufacturing. So, you know, it's not the only thing.

Now naturally, I focused on high technology, because of course, my first reaction is labor productivity -- what's that? In a lot of these firms, that's not the big input in the high tech sector, in the information sector and so forth. And even capital is just not terribly important. You saw Carol's figures for intangible investment, and the reality is that it's very big in some of these firms, even some of the manufacturing firms, again, partly for off-shoring reasons.

So my first reaction was that we did have a big shock in '95. We had a shock before from the PC, but the Internet was a big shock, and it caused a lot

of entry, not all of which was successful. And I'm wondering if we just -- we had a lot of boost from moving transactions to the Internet, because that was something we could do relatively easily.

And that was possibly not sustainable, but I don't think we're done. I mean, I think there's a lot more benefit from the wireless connectivity to come, that you know, it takes longer for it to diffuse to all firms. I think one of the obstacles in the U.S. is broadband availability. I mean, you know, even in Silicon Valley, it's not great. You know?

I mean, we're behind a number of other countries on broadband availability, and there's a lot of things you can't do if you don't have real broadband. You can't do real time. I won't work on the cloud, for example, because I live next to a university which has tons of students downloading Netflix and things like that (Laughter), and so I can't work on the cloud, because it would be too slow. You know? So, that's my thinking about -- that that may be one explanation. It may be transitory.

I think the increasing returns in network sectors, which was referred to already by a different name, is probably a big part of the gaps in some of these sectors, which is to say that once you've established a strong position, it's a little hard to lose it. You will lose it, but you don't lose it in a year. And so those network effects kind of mean that if you were successful in the late '90s, you might be locked in.

Obviously, you're not always locked in, because we look at things like Yahoo and so forth. So, not all the unicorns out there were born you know, before 2000, but some were. Some of the bigger ones were. So, that's another -- and I think that may extend to the whole information sector, not just to the network effect, not just to the technology part of the information sector.

So, let me go back to the production function. The production function in these sectors is capital, labor and intangible capital. I probably left some things out, but there's materials. But

that's probably one of the better measured things. So, my guess is that there is very high dispersion in the productive left out intangibles across firms in a lot of these sectors; not just confining myself to high tech, but mostly this is a high tech story.

So labor productivity isn't really telling us anything about productivity, because they have to pay for those intangibles. So in some sectors, labor is going to be not a very good indicator of input. I mean, you really needed a lot of other stuff. Even with six digit industry dummies, partly because some of this is about the success of your intangibles, and not about the fact that you invested in them. But it's that you happened to be the guy who invested at the right time, and yours was appealing, so yours is worth more than another guy who is in the same six digit industry, like -- well, I won't use an example.

The thing about that argument, it just means that we haven't measured productivity correctly. It doesn't mean that -- we still might think that high revenue labor productivity firms might grow faster.

Right? I mean, we still might think that. You know, they happen to be successful. Their intangibles are worth a lot. They're throwing out a lot of return.

Now, it could be that they have to reinvest, and so they're not quite as successful as we think they are. I think the most constructive suggestion I could give right off the top of my head, unless I've missed something, in the reallocation front, I think that you used only employment growth on productivity, and it seems to me the obvious way to check the hypothesis that employment -- that the problem here is that they're getting rid of employees. You know, that they're sending employees overseas, or their Uber -- they're contracting out the employees or whatever.

The obvious way to check that is to do revenue growth on productivity. It seems to me that's the first thing to do, because if revenue growth shows the same behavior, then it's not the employment that they're -- you know, if revenue growth shows the same fall and reallocation from productivity, then it's not the fact that they're getting rid of employees that's

making this look the way it does. At least I think that's correct.

So, they're making a lot more money, but they're not hiring new employees, or if they are, they're hiring them overseas. So, that's the one constructive thing I could think of; just kind of poke at it a little bit more. I also wondered if you could look much more closely at the high tech sector broken into manufacturing information and services, because they have different characters, and that might help to tease out the red curves. You know -- exactly what they are.

Now, for those of you who didn't -- I printed out at one point the high tech sector. The high tech sector is high tech manufacturing, and it's information services, but it also includes computer design, and it also includes pharmaceuticals, aerospace and some scientific research and development services and things like that. So, there are other things in it.

Now, I'm almost out of time. I guess I had

one comment on the measurement. All of the discussion that we heard about quality change and so forth, which you know, was interesting, and yes, I remember the Boskin Commission and all of that. But all of that -- we're still not doing anything about new products, and another possible statement about -- except for when we do hedonics, we try to do something about new products.

One possible correction for the deflator would be that for some reason, that things have gotten worse because more new things are happening. Right? So even if yeah, we said it didn't -- you know, it's been going on for a long time. It still could be true that it's getting worse, and in fact, I suspect that it is, the new product thing. I'll stop because that's time.

MS. SHEINER: Okay, let's open the floor.

SPEAKER: Thanks very much. That was a really interesting paper. I've got a couple of questions. The first is do with the relative contributions of reallocation, and within firm

productivity growth, the slowdown. So you know, a previous approach would be to use an FHKD composition where you look at the respective contributions within firm productivity reallocation and so forth.

And you know, does this -- first of all, how much of the productivity slowdown is to do with in-firm productivity growth in that type of framework? And then, what's the relative contributions of reallocation in that framework and in this new framework?

Second is, you know, do you see a correlation at all between decline in entry rates in sectors and within firm productivity growth in those sectors? So, is there sort of like -- that might tell you something about a pressure to adopt the latest technologies?

And finally, what's the policy implication in all of this? So, let's say, for instance, that what matters here for the slowdown is just declining reallocation. Does that mean policy interventions that are only aimed that improving, for instance,

within firm productivity are declining and affecting this over time? So for instance, is an R&D tax (Inaudible) becoming less effective in driving growth than the past, because basically, these firms can't scale up as much?

MS. SHEINER: John?

SPEAKER: Can you use your mic?

SPEAKER: John, use the mic.

MR. HALTIWANGER: Sorry. On that last point, are there more new things happening, to the extent that you know, startups are an important channel for new things to happen, then the fact that we're getting -- you know, a declining startup rate might reinforce the argument that it's not a measurement problem, but something real, regardless of all the other problems of interpreting the dynamism.

MS. CORRADO: It sort of depends on whether you think not having a headphone jack is improving the quality or not. (Laughter) You know?

SPEAKER: I've spent the last five years looking at startups, and I've been impressed by the

pace, and also, the breadth of the startup productivity all over the country. But of course, that's right after your data stopped. And it led me to two questions. First question is -- and it wasn't quite clear from what you showed, were you talking about basically the success, or startups declining, or startups declining (sic)?

And then second of all, my question is, could there have been a combined effect of first basically, the shake-out of what I would call the high tech bullshit artist, which was 2000 (Laughter), followed then, five, six years later by the crisis? And those two things together ought to have had at least some significant effect.

(Discussion off the record)

MR. HALTIWANGER: So, I'm not completely sure I understand the dynamic, John. If you have a lot of startups, you would expect to see a real drop in productivity, because they're spending all that time trying to make their product. So, you look at a typically software startup in Silicon Valley, you've

got a half a dozen guys, they're working and they're code based. They've got terrible revenue productivity, because all their work is going to an investment.

Now from an investment point of view, they're building up their code base, and then hopefully when they release, maybe they succeed, maybe they don't. But certainly, startups in general are going to be correlated with reductions and revenue productivity, at least, and maybe even broader measures.

SPEAKER: I have a question, actually, as input for our research, because we are thinking at the McKinsey Global Institute of looking at some of the industries and looking at the industry changes that are happening right now. And mostly, I think we would love to help to shed light into the gap between the macroeconomic growth numbers and the fascinating microeconomic work that you are doing.

So, my question to you, both of you actually -- both Dan and John would be, if you had three top

hypotheses that you would like to us to look at, at the sector level, what would you suggest we focus on?

MR. HALTIWANGER: So, I want to go back to something that I said earlier, but also, Bronwyn talked about the cases where you're going to have high revenue, and I'd also say high profitability with low productivity, and whether there's -- so John, I think you have firm level data on profitability that you could look at whether some of those productivity laggards actually do well in terms of productivity, which would explain, I think, maybe some of the awesome dynamism.

But another version of that story might be, there's been a lot of employment that's shifted towards retail trade, leisure and hospitality, personal services, nursing homes, that part of healthcare, which are low productivity sectors; low K, high L, but still quite profitable. And I wonder if across those sectors you could have a reallocation story that combines all these stylized facts that still leads us to an outcome where low productivity

firms will do fine and stick around a long time.

MS. SHEINER: Martin?

MR. FELDSTEIN: Well, I'm sort of looking at both these papers, which I think have made a terrific contribution, and I'm going back to the point Carol mentioned about competition, and you've also mentioned it again. And I was -- and Yanner and I were both part of the team, slogging away, showing some of these competition effects.

It would seem, on the face of it, that there's been a lot of deregulation in the United States, so if we wanted to blame the slowdown on regulation -- now you know, people do, and they talk about well, healthcare is maybe more regulated, and some things in the labor market are more regulated. But there was a lot of deregulation that got started in the '70s that went all the way through to the Reagan years and the '80s, and even in the Clinton years, there was deregulation, some of which we've learned to regret, perhaps.

But it's sort of a puzzle in a way, that

after all these years of deregulation, we should suddenly be running into a productivity slowdown, if we think that it's regulation that's maybe caused the problem. So, I wonder if you have any comments on that, particularly maybe as it relates down to Europe, where you've had sort of selected deregulations, or some of the economies deregulated, some of them did not.

MS. SHEINER: Great. John, I'm going to give you a chance to answer the question.

MR. HALTIWANGER: These are generally great comments, and maybe the easiest way, I'll just say I agree (Laughter). And Bronwyn's comments were, I think, right on about all kinds of possible factors, and also -- and I very much liked her suggestions of things we can go look at.

One kind of reaction both to Bronwyn, maybe, but to also everybody is, again, I'll come back again to these sort of two core facts we've got in this paper relative to the dynamism -- earlier work. We see rising dispersion. And I agree, there's a ton of

factors that could account for the rising dispersion. It's harder, but not impossible to account for the declining responsiveness.

Now some of that could be, for example, decline in product market competition, or it could be increased product differentiation -- all kinds of things. But I think that that covariance is sort of very hard to account for, for lots of other explanations. So for example, the demographic story -- yeah, there's clearly a story there, and people are working on that. People have written down theoretical models. They're calibrating models to see how much -- what we get can be accounted for by demographics. But it still should be the case that the firms that find themselves way out on the right tail of the productivity distribution ought to grow.

So, let me kind of jump way ahead to Hal's sort of very nice point. I agree Hal, with you completely. There's a very rich dynamic that goes on in a period of rapid technological change and innovation, and I think actually, that's partly what

you even saw in the data in terms of the rising dispersion over that period of time.

What I couldn't show you, because I didn't have time, is that we've done earlier work that says what is very interesting about the high tech manufacturing sector -- unfortunately we can't do it for the other parts, because we just don't have the data pre late 1990s. In the high tech manufacturing part, that was a period of time where there was rising dispersion, rising startups, and actually, rising reallocation and rising responsiveness.

Businesses that found themselves -- you know, they developed experimentation you talked about. Who knows whether they were going to make it or not? The ones that found themselves way up in the distribution took off, and took off big time. And the contribution -- we actually found a rising contribution of reallocation over that period of time. So, you do see this kind of rich dynamic that you're talking about, but nevertheless, and I'm going to come back to something that Chad Syverson talked about in

his sort of survey paper.

One of the most ubiquitous findings in the literature is that of these various indicators of firm performance, whether it's revenue labor productivity or total factor productivity or profitability -- people have brought that up -- you tend find in well-functioning economies, the ones way up in the distribution grow, the ones way down in the distribution shrink and exit.

And again, this comes back again to my covariance point. There seems to be a decline in the extent to which that's true. One piece I didn't talk about is, I was mostly talking about the growth dynamics of continuing firms and some suggestive work we've done. It's also the case that the guys at the bottom are less likely to exit than they were before. And again, that almost can't be a healthy thing in the economy. We could start telling product differentiation stories and the like.

And then finally, I want to come back to the question about -- from McKinsey. I think our findings

suggest that young entrepreneurs aren't doing what they did back in the 1990s. All right? That somehow, they're doing something different. And so what I've always greatly admired about the McKinsey in-depth -- I'll call it case studies. Maybe you don't like that term. But really go down is -- let's go try to figure out what's going on with the young entrepreneurs in the right tail of the distribution. So, I think doing some, I'll call it right tail economics at a case study level would be great. I'll stop.

MS. SHEINER: Dan?

MR. ANDREWS: Okay, just quickly. So, three top hypotheses? Yanner, I can think of two, but maybe Chiara can jump in. I guess this relates also to what Carol was saying earlier. You know, if you go into these firms and it's -- sorry -- in sectors where you're seeing a lot of dispersion, it would be interesting to firstly ask, you know, are the firms actually making these complementary investments in soft technology?

So, thinking about you know, the (Inaudible)

type managerial quality type of things and workforce reorganization, which we know has to be done when you adopt new technologies. So, our firm is actually spending money on that now, and we're not seeing the effects on output until later on, or are they not doing it at all? That would be interesting.

Second thing would be, then, links within industries between dispersion and competition, and particularly, you know, are firms that are more distant to market more likely to be low productivity and able to survive? Or you know, where there's less natural competitive pressure around them? And then Martin's point -- look, when you dig into the microdata in Europe, there's extremely strong correlations between countries that have poor structural policy settings.

So this is you know, bad product market regulations, very restrictive employment protection legislation, very high exit costs; so, insolvency ratings that punish failure, and poor productivity outcomes. So, Chiara can show you, regressions of you

know, firm growth. We can show you regressions on for instance, the (Inaudible) gap. It's there, and it's compelling.

MS. SHEINER: All right. Thank you so much for really two great sessions. We're going to take a 10 minute break and start back up at 3:00.

(Recess)

MR. BAILY: We are on to our final session. We are down to the diehards, so if you haven't had a seat at the table and would like to come up and sit at the table, please do. I think there are some available seats.

We are going to start with the paper by John Fernald, and -- I'm going to massacre your name -- Era Dabla-Norris is the discussant. John is going to do the initial presentation. John?

MR. FERNALD: Thanks very much. A lot of discussion today was about how productivity growth in the U.S. has been pretty disappointing in the past dozen years, since about 2004, the date most people

picked. We had a little bit of other countries in the OECD talk that Dan gave.

One of the things that is striking is if you go back to 2004 and on, people in the rest of the world look at the U.S. and think how good productivity growth is in the U.S., and that's even more true if you go back further to the mid-1990s.

A lot of the main point is if we look at the U.S. or if you look at other countries, there was a lot going on before the great recession as well as since. So, it's not just a great recession story when it comes to productivity growth.

As motivation, I'll start with this picture, which I will build in stages. It is going to use data from my co-author, Gilbert Cette, and his collaborators, on levels of TFP in major economies. In this case, I'll show everyone TFP levels relative to the United States. For these purposes, I'll take the U.S. as the frontier. Of course, when you dig into the data the way the OECD team did or if you look

at industry data, you might qualify that, but for these purposes, I'll stick there.

I will look at everyone relative to the U.S. Now, here, it is staring in the mid-1980s. Productivity comparisons, if you go back further, are driven by convergence. For GDP levels, they kind of look like convergence has taken place by the mid-1990s or maybe earlier, maybe mid-1980s, for GDP per hour by the mid-1990s. What we have seen since then is much more of a divergence.

I started by just showing you the U.K., because the U.K. actually looks very good. The U.K. and TFP levels, according to these data, was at U.S. levels in 1995 and it has moved actually up until the great recession. For the U.K., which we will hear about next, the great recession really was an important part of the story.

If you look at France and Germany, they were at U.S. levels of TFP in the mid-1990s, and they have drifted down since, so even before the great recession

they had lost ground and they have lost further ground since.

If you look at Southern Europe, here I show Italy and Spain, what's striking is just the complete collapse of TFP, not just in relative terms where Italy was at U.S. levels and has lost a quarter relative to the U.S., but Spain as well. It is the absolute growth rates of TFP growth have been negative in these economies for two decades.

For the story that I will tell, I will start right now with the only thing I have to say about the U.S. for about 30 seconds, and I'll say that because that is a comparison for everything else I have to say.

My basic story on the U.S. is, as Bob Gordon mentioned earlier, what was exceptional was the 1995 to 2004 period. In the past 40 years, that's what stands out as a strong growth period. Every analysis that looks at it at different levels points to the role of information technology in different ways, whether it is the production or the use and

reorganizations associated with it, including, I think, Bosworth and Triplett talking about market services. I'll come back to that as a place where information technology was crucial.

My basic take since 2004 in the U.S. is we have gotten back to something normal and ongoing and incremental. Then when you get to France and Germany, back in 2004, you had tons of papers, hundreds of paper being written, why didn't Europe get the gains the U.S. did, and the basic story was structural rigidities in labor markets and product markets that made it harder to reorganize to take advantage of information technology, and papers since then, in the past few years, find much the same thing, continue to find evidence of that.

Well, when you get to negative TFP growth for two decades, it's not just structural rigidities that keep reallocations from happening, the best stories I know are ones that emphasize that the reallocations that took place actually made things worse. There was rising misallocation, and at least

one hypothesis for that is capital inflows associated with the introduction of the Euro.

If it's an IT story, should it apply equally everywhere, and I think the answer is not necessarily. The way I think of it is ideas flow across borders, but they have to be implemented locally. So, how operationally would I think of that? I would think about that very much the way Carol and her collaborators have in terms of the intangible investments that can very easily differ in their timing across countries, and barriers may matter at different times in different countries.

That is certainly the theory that I've written down in a paper in the early 2000s as well, as consistent with that kind of idea.

Very briefly, let me just look at some industry data to say what's going on in core Europe. One of the big parts of that story is they didn't get the same boost in market services that we heard about earlier today. I won't actually show it at a given time.

What this shows is TFP growth by sub-period from the EU KLEMS data for Germany and France. The height of the bars is TFP growth during those sub-periods, and I've broken it into some subgroups that I won't say much about given time today.

The first point was TFP growth was positive throughout this period. I stop in 2007 because the EU KLEMS data stop in 2010. The great recession would require me to change the scale in the negative direction. That is a different issue, it is sort of peak to trough, not peak to peak in any kind of way.

The only other thing I would point out is the red bar, which is what is going on in market services. That is wholesale and retail trade, especially transportation, information, and business services. In red, that was basically adding nothing in the late 1990s or the early 2000s, adds a little bit positively in the run up to the great recession but nothing like enough to make up for the shortfalls.

If I had done this for the U.S., that would have been adding a percentage point during the

productivity boom, and here it's adding nothing during that period, and only barely makes it up.

I actually don't have any new evidence to suggest on that other than to point to what was going on kind of in the literature, which really highlights institutional barriers that held back continental Europe.

Essentially, this is the reorganizations and the reallocations that didn't happen because of labor and product market rigidities. If you have labor market rigidities, that makes it -- in a phrase I think I stole from a John Van Reenen paper -- it makes it harder to hire and fire and pay and promote in ways that enhance profitability and productivity.

A number of papers look at product market rigidities, and if you are protected from competition, that can affect your incentives to implement and exploit the latest innovations.

There is lots of evidence that matters, but when you get to that, how does that explain Italy and Spain, where you have negative TFP growth. Well, the

best story -- well, in the industry data, what does that look like? This shows that same EU KLEMS figure for Italy and Spain. Here, what is striking is once you get to the mid-1990s, not the far left but the other bars, in the run up to the great recession, for all of these sub-periods, TFP growth was negative overall. The bar is below zero. It is not just in the EU KLEMS data. It is true in any other data that I can find.

You need to get negative TFP growth for two decades. If you look at the industry composition, there is not a smoking gun of one industry, it was pretty broad-based across industry groups. If you think about Spain on the right, a lot of people point to the importance of construction and the construction boom, thinking that fueled misallocation.

Well, construction here is what I call the "bubble sector," I called it "bubble" in a previous paper, thinking about we were doing crazy things in the U.S. especially in the mid-1990s, construction finance, even mining and agriculture, where your

prices were doing crazy things, so construction would be in there. That is a cross-hatched component of this bar, now you had negative TFP growth, but so did everyone else.

In fact, if you look at market services in red, that was just amazingly negative throughout. That is consistent with what the OECD was finding going on, large sectors of the economy were not doing that well.

The best story I know to explain this is rising misallocation. You have to get two decades of negative TFP growth. There are lots of stories why TFP growth is not technology in the short run, and things that are missing, but getting two decades of this is hard.

The micro evidence on this or the firm level evidence does suggest that misallocation was going on. I cite here a few papers that are sort of consistent with what the OECD did, focus on Southern Europe in general, something related for Italy, and Spain. They all find misallocation.

You can have sort of the average firm may not have been improving as much as the frontier. The average firm could have been getting worse.

One set of stories that I will highlight now in my remaining four minutes points to the role of the Euro. The misallocation stories, those are data. When you want economics of what was causing it, one factor that people have pointed to is the Euro.

Nominal interest rates. Of course, this makes a nice picture because as you approach the Euro entry in the late 1990s, interest rates across Europe converge, and they are basically at the same level up until the crisis. Well, in real terms, you have to think about the fact that Southern Europe had higher inflation.

When you look at real interest rates, you see a larger decline in real interest rates in the periphery, or in Southern Europe, than in the core.

The figure isn't quite as pretty because there are a lot of lines, but if you look back in the mid-1990s, Italy in green and Spain in orange, were

above Germany, which is black in this picture. Real interest rates were higher.

By the time you get into the 2000s, now Italy and Spain in green and orange are well below Germany, and in Spain, are even negative.

If you look at debt accumulation, you see a big run up in private non-financial corporate debt in Spain, you also see in Italy where it started out kind of in terms of GDP, debt relative to GDP, and it was kind of at the same levels as the Euro average in 1999 and even before the crisis, by 2007, it was sort of at the high end.

What's the story for how that worked? Well, different models, people have modeled it in different ways, but related ways. Ricardo Reese in a Brookings paper, Gobanoff, et al, tell a story of capital inflows interacting with financial friction. Essentially, you are getting lots of capital inflows. In these stories, funds were flowing to less productive projects.

For example, interest rates go down, businesses want to borrow more, but the most productive firms are already at their borrowing limit, they can't borrow, so banks lend to the next firm on the list who is less productive. So, the average efficiency goes down even if the marginal guy is the same, or in Gobanoff, et al, they lend to firms who have lots of net worth because you think you are more likely to get repaid, rather than the firms that have the best productivity prospects. Either way, these are stories in which these capital inflows and low interest rates led to rising misallocation.

Now, it's hard to test these models even if you have the firm level data, you have short samples. If this is the right story, then you think it would show up in the macro data, that you have lots of long time series on macro data, so we can try to look at whether an exogenous decline in the real interest rate leads to low productivity growth.

Again, the channel would be low productivity firms are getting financed and the average

productivity of firms falls. We look at that by doing a vector on our regression with labor productivity or TFP growth, I'll show you one with labor productivity and real interest rates, and do kind of a standard in the macro literature identification of ordering things, so the real interest rate will come last, meaning the interest rate can respond to productivity contemporaneously, but not vice versa.

I will just focus on one impulse response that you get from this, a simple minded VAR, but it goes in the direction of the box I highlighted, that when the long term real interest rate goes up, according to these data, productivity, the level of productivity is persistently higher for a while.

Now, in the 2000s what this would say is interest rates going down would hold productivity growth down for a while. Now, I think in the interest of time I won't show you the fitted values, the historical decomposition. We do this country by country.

What you find is according to SVAR, the historical decomposition, interest rates explain nothing of what's going on in core Europe, like nothing if you do this for the U.S. That's not the story for the U.S. or for France or Germany. If you look in Italy and Spain, you get something, half a percentage point a year, according to this particular identification.

This says it only matters in the periphery largely because that's where you have the biggest moves in real interest rates.

To finish up, today we haven't really focused on the role of the great recession. There are lots of reasons you might think the great recession might affect productivity growth, but I think it is important to remember that a lot was going on before the great recession, so there is an analogy to what was going on in the 1970s when productivity growth slowed down around the same time as the oil prices spiked, but by and large, we figured out and kind of decided with time it wasn't oil prices that caused two

decades of slow productivity growth, and similarly, I think it's important to keep in mind that even though the timing is similar, it's not just the great recession that's driving things here.

Now, it is especially hard to explain negative TFP growth. There are lots of stories for why TFP might be mis-measured, why things might go different ways, but it's harder to get negative growth out of that in the periphery.

The story I told kind of has three parts. I didn't say much about what I think was going on in terms of technology at the frontier, where I think we have been getting ongoing incremental improvements. That's my hypothesis on this, but it's at the rate we were getting in the 1970s and 1980s, not with the rate we got in the late 1990s.

Continental Europe by and large had trouble even taking advantage of those and getting those gains because of structural rigidities and labor and product markets, but possibly also, especially when you get to thinking about Southern Europe in terms of capital

flows, things like workings of financial markets and legal systems, which can affect the allocation of capital and the quality of investment projects that get funded.

Now, if you think about any of these stories, the future is highly uncertain about where technology is going to go in the future. It's pretty clear that you need flexibility to keep up with the frontier. That came up in the earlier stories as well as thinking just across country experience. That can be costly for people, so even if you do that, those challenges, it's important to think about how to design a safety net that protects people rather than specific jobs with specific firms.

Thanks.

MR. BAILY: Thank you, John. Our discussant, Era?

MS. DABLA-NORRIS: Thank you very much to the organizers for inviting me to this very interesting workshop. I really enjoyed reading John's paper.

Advanced countries as a group have seen a secular decline in labor productivity growth and a trend that has actually predated the crisis. Various stories have been told, some earlier today, in terms of what was the reason underlying it. What is important to note is there is a lot of variation within the group of advanced economies.

The theory that is particularly interesting is in the 1990s, mid-1990s onwards, productivity growth in the U.S. in particular surged and the TFP gap, if you will, between the U.S. and other countries in North and South Europe increased, so there was greater divergence across advanced economies.

What this paper does, it draws on the notion of conditional convergence to explain productivity developments in the U.S. and in other advanced economies, and the narrative rests on three arguments.

The first is that the technology frontier has slowed. This is proceeded by declining productivity growth, TFP growth in the U.S. since the mid-2000s, and the basic idea is this is associated

with growth effects of ICT as a general purpose technology, so there was a slow in technological progress in both ICT producing sectors as far as ICT intensive sectors, and this has somehow spilled over, so the slowdown of the frontier has spilled over into other advanced economies.

Some recent research within the IMF by some colleagues at the IMF shows that indeed, TFP growth shocks in the U.S. do spill over into other advanced economies, so this impulse response function shows that a one percentage point change in TFP growth in the United States leads to a 0.4 percentage point increase in advanced economies' TFP growth over the medium term. There are these spillover effects into other countries.

The second component of the narrative is that somehow structural rigidities or labor and product market rigidities in Europe are impeding convergence, and they impeded convergence particularly in the 1990s. The left-hand side figure shows product market regulations in particular tend to be much

higher in both core Europe as well as in Southern Europe relative to the United States, and the paper posits this is associated with slower adoption of ICT and slower diffusion of ICT, particularly in the services sectors in Europe.

This is a mechanism through which large gaps begin to emerge between Europe and the U.S., so that is the second part of the story.

The third part of the story has to do with rising misallocation in Southern Europe, as John pointed out. The conjuncture is that low real interest rates following adoption and ensuring capital inflows lowered allocative efficiency in Southern Europe, and there are a number of papers that posit why this could be the case.

What the paper does is it provides some very tentative empirical evidence to support this hypothesis, and in particular, it does two things. It shows by variant VARs to examine the impact of interest rate shocks on aggregate productivity, and historical decomposition based on this VAR analysis

shows this effect of real interest rates on productivity was higher for Spain and Italy relative to other advanced economies.

The second piece of evidence the paper provides is effects of regressions of country specific real interest rates on industry level productivity, and the paper shows there is some type of correlation between the two.

So, I like this paper in that it provides a nice narrative, sort of a framing device, if you will, to think about what has been happening and productivity drivers or productivity gaps between the U.S. and other countries in Europe, as well as divergence within Europe.

There are a number of things, a number of important parts of the story that are missing, and this is important. These missing parts of the story are important because they then feed into what are the policy implications and what does this imply in terms of how we should think about productivity developments going forward.

The first part of the story, and this was very compellingly made by the paper of Professor Haltiwanger, it's not simply a technology story, and what is very puzzling is this generalized decline in dynamism in the frontier, so this is the U.S., and we see concentration has risen which points to the possibility of entry barriers, labor market turnover has fallen.

Understanding the extent to which this slowing dynamism of the frontier has implications for productivity development in the frontier is very important. That is the first part of the story which is sort of missing in the paper.

Why convergence stalled, why did Europe, particularly core European and Southern European countries, not converge -- sorry -- to diverge from the U.S. TFP levels observed in the U.S., and here there are a number of elements that I feel are missing in the paper.

First, more broadly, what role has structural change played? Here, I'm referring to

three different things. The first is structural transformation, the movement of resources from low to high productivity sectors and activities, and this is a very important part of the story from any advanced economies.

If you look at the convergence history of Southern Europe, the productivity gains from structural transformation were very large in the early parts of the catch up process, but all these productivity gains petered out, the question is why, and why was there a growing misallocation, so this is one aspect of the story.

The second aspect of structural change that is important has to do with globalization. What is the role played by trade induced changes in market, what is the role of China, what is the role of outsourcing in all of this, and how did this interact with the kind of industry shifts that we observed across Europe. That is the first part of the story.

A related issue has to do with the notion of misallocation, and there are a number of factors.

There was a lot of discussion about misallocation across sectors, within narrowly defined sectors, across firms, within firms.

It's not entirely clear where the misallocation came from. Where is the misallocation and how does this differ across different countries in Europe. Is it really a story of misallocation across sectors? Some evidence from the industry level seems to suggest there are large payoffs for Southern European countries from eliminating distortions that prevent efficient allocation of resources across industries, but much of the literature has found within sector misallocation or within firms' misallocation can account for a large share of productivity gaps across countries, so what exactly is the story in this regard.

Some recent work for Portugal using firm level data for Portugal find misallocation also can vary across sectors within an economy, and this is also an important part of the story. Within manufacturing, efficiency gaps relative to the U.S.

are not very significant, whereas these gaps would be much more significant within the services sector.

How does this explain the productivity dynamics that we observed in Italy and Spain and other parts of Europe.

This sort of leads to my third point. What is the relative contribution of labor markets, relative to policies, relative to credit market frictions in explaining divergence in productivity gaps across countries.

Which of these factors are more important, having a better understanding of which of these factors were really driving sort of this divergence across countries, I think, would be an important item for research.

The last point that I'm going to make has to do with the empirical evidence on the link between real interest rates and productivity. I didn't find this evidence to be very convincing, I have to say.

Does the empirical strategy, a panel VAR between real interest rates and productivity really

capture misallocation? What are the mechanisms? Is it capturing with in sectors, is it capturing across sectors, misallocation? Was misallocation higher in those sectors that were less or more financially independent?

There are big issues of causality, of course, and productivity growth has a bearing on real interest rates. There is an issue of potential misspecification, issues of identification. One would expect other global factors to have a bearing on both real interest rates and productivity growth, so these factors should be controlled.

I think in your previous work you have talked about the importance of adjusting TFP to control for cyclical factors, and that would be particularly important when we are looking at quarterly data in a VAR.

The pre versus post-practice impact, not very clear from the results. Interestingly, the panel regressions found that the effect of real interest rates was larger for manufacturing versus the services

sectors. This doesn't exactly tally with some of the more recent literature coming out, the micro-literature, which found that misallocation tends to be much higher in the services sector of the economy.

How should we think about capital inflows to the U.S. over the same period? Was this because of differences in initial conditions or average productivity growth?

I think there are a number of issues that come up with the empirical evidence that could be better discussed and the robustness checked.

The paper concludes with some policy implications, I am just going to very briefly go over this. It's hard to sort of dispute with any of these areas the fact that many of the countries in Southern Europe need to tackle legacies from the crisis, but I think there is also an important need to understand whether misallocation has increased in the current low interest rate environment, particularly in countries with weak financial systems. Do we actually observe higher misallocation? If that is the story that has

been posited in the paper, what are we observing in the post-crisis period? Has misallocation actually increased in countries with weak financial systems?

The important of product and labor market performance to boost productivity at the frontier level and to foster divergence, it's hard to dispute. A more important question, why don't countries just do them. Clearly, there is some more work that needs to be done to better understand why reforms matter, where, what should be the appropriate sequencing of reforms. What are the fiscal costs. Are those the barriers in the current environment?

Investing in knowledge capital innovation, again, this is very country specific. Are we talking about R&D, facilitating technology transfer, entrepreneurship. All of these are important, but could be more relevant for some countries versus others, and I think when we think about policies, these need to be better calibrated in terms of where countries stand relative to the technology frontier.

Let me stop here. Thank you.

MR. BAILY: Thank you. While people are raising their cards, I'm just going to throw a couple of questions at John. One is that I remember conversations around 2004, and I remember asking why is productivity growth so lousy in Spain, and the story back then seemed to be there was a huge influx of low skilled labor.

You mentioned the construction story. I don't think it was just in construction. I think it was broader. I think some parts of market services may have been impacted, and there has actually been a turnaround, a lot of those folks have had to go back, many of them came from North Africa.

I just wondered if you had factored that in to some of your calculations.

A second point, you have made in this paper and in previous papers the argument that the slowdown was not a result of the great recession, it happened before the great recession started. I followed you down that road in my own paper, so I've got a vested interest in you being right. (Laughter)

When I looked at your Figure 5, I have to say -- this is the one that shows the different countries. When you put it up this time, you left off the 2007 to 2010. Boy, you certainly see TFP getting whacked in every one of those countries, 2007 to 2010.

It made me sort of reconsider a little bit -- there are people, Larry Summers, and so on, that say we could get more productivity going. I just was very struck by the fact of how hard all four of those countries in that table were hit, and maybe we are still seeing some of the lingering effects of that today.

Carol?

MS. CORRADO: Thank you, Martin. Actually, let me make one sort of elaboration of your point about the performance of Europe post-2004. Remember, John's story was about the U.S., and what you see in France, Germany, and even looking at the negative rates of growth of TFP in Italy and Spain, you see from 2004 to 2007, until the great recession, that growth picks up.

It looks like Europe was starting to finally, you know, I don't know, get some gains from ICT that the U.S. had already previously absorbed. I don't know what the story is. Just the raw numbers are such that if you look at an average of growth in Europe, say eight major countries -- I have always wondered about this myself because I've seen it in my own tables that I generate, it goes up while the U.S. slows.

I think a trajectory of the continents as they were hit by the great recession was different in this regard. I don't have any answers to it.

In terms of the paper, I want to say first I really liked this paper, John, and I really appreciated a lot of the points the discussant made. The way I read it, I wanted to take away whether this was like really telling me something about how if I wanted to run a panel regression, aggregate data, and this is something I sometimes do, well, are there spillovers to R&D, are there intangibles.

It seemed to me that playing on the international cross section -- what you are telling us here, if we are to believe there is this causality issue, that we should be putting the real interest rate in panel regressions, particularly if they have the European data, because that is needed to account for the impact of misallocation due to the influx of capital flows to Southern Europe that followed the introduction of the Euro.

It didn't come out in your presentation like oh, the Euro was really bad for Italy and Spain, according to your model, and that is explained by the abnormally low real interest rates that ensued -- that followed the introduction of the common currency.

I just sort of wondered if you could expound on whether you would say this is the way somebody should run an aggregate sort of panel regression or not. Thank you.

MR. BAILY: Thank you. Romain Duval?

MR. DUVAL: Thank you. I'm from the IMF Research Department. I know the paper is about the

pre-crisis slow down, so I'm going to ask a slightly different question, about the post-crisis slow down and how it fits as one of the drivers of the pre-crisis slowdown that you highlighted, which was easy credit conditions following the Euro inception in Southern Europe.

Post-crisis, there was this large tightening in credit conditions which in ongoing research we find at the Fund to have had detrimental effects on productivity, both within firms or the firms that had a large share of debt, post-Lehman, who faced a big decline in TFP, and there are a whole bunch of stories you can think of in the literature.

More interesting, we saw actually an increase in misallocation of resources following the tightening of credit conditions in the sectors that were more dependent on external finance.

The overarching conclusion would be actually tight credit conditions actually worsened the productivity growth, in particular where credit

conditions were tightened the most, which was in Southern Europe.

You had a story under which easy credit conditions lowered productivity growth, and there is another story more post-crisis under which tightening credit conditions lowered productivity growth.

I just wanted to hear your views on how we can square that, right?

MR. BAILY: Never change interest rates. (Laughter) Javier?

MR. MIRANDA: I just want to pick up on some of the stories that Martin brought up right away and Harry Holzer earlier. The story is one of rising misallocation in Southern Europe, financial markets, interest rates are dropped, and you have all these financial flows going to less productive firms.

I want to pick up on this idea that less productive firms are necessarily less profitable, not profitable firms, less profitable firms. Of course, what also happened during that time in Spain is that there was huge unemployment, and there was a huge

rising in employment, particularly for populations that had been historically left out of the labor market, young people and women.

I wonder what you think of these types of stories, right, different firms choose different production functions, partly because of the labor that's available to them, so it's not necessarily the case that its misallocation. In fact, there is huge employment growth, and where those types of stories fit in your results.

QUESTIONER: I'll be brief. I made some of the same points. I think the story of the Euro being a bad thing is kind of an odd story in some ways, right? If we were meeting in this room back when the Euro was coming in, we would say financial market integration and product market integration is likely to be a good thing.

We can kind of rationalize that perhaps there is some misallocation that goes on, but again, I think it's kind of a complicated story. It seems like if we really thought that financial market integration

kind of reduced frictions in financial markets and this would be a good thing, but it seems like what we perhaps have in mind is risk was very much mispriced in Europe over this period of time, and now why exactly that was the case.

Back to Romain's comments, we suddenly discovered in a crisis things are completely screwed up in terms of the allocation of risk, so there were adverse effects of this.

Again, I think it's a pretty complicated misallocation story that can't simply be oh, we integrated financial markets, this is a bad thing.

QUESTIONER: I wasn't quite clear on the mechanism through which lower interest rates -- is it just that you are running down the marginal product curve, and if so, for any reasonable slope of the MPK curve, do we think you can get that big of a drop in productivity from that sort of drop in interest rates, or is it more this drop in the average rate is indicative of some greater misallocation of the

covariates between the individual rates that firms face in their marginal private capital?

I think the second one may be quantitatively more realistic. Either way, it seems to me one way to get at these misallocation stories would be to look at multinationals who operate both in -- we will just call it North and South. They ought to correct some of the misallocations internally, so if you compare multinational with South and North operations, to firms with either South and North, but in the same industries, you ought to see that gap differentially open up for the firms that aren't in both countries as opposed to the ones that can reallocate any capital that gets misallocated.

MR. REINSDORF: Marshall Reinsdorf, IMF. Just sort of thinking about what happened as Southern Europe was going downhill, you know, the rise of China also competed with some of their industries. You think about leather goods, it got very heavily impacted in Spain and Italy.

Then they are exposed to all kinds of new competition, I guess, from the rising Eastern Europe, and then there is just a lot of impetus to change the structure of their economy because they are now in a different world, and structural change is usually slow and hard.

So, you can just sort of see these external impacts as part of the story.

MR. ANDREWS: Dan Andrews, OECD. I will just add one thing, the focus on misallocation in Southern Europe being in the pre-crisis period, if you look in the post-crisis period, there's evidence that things got worse. It's not necessarily through the low interest rate channel.

In Italy, we estimate that basically 20 percent of the capital stock is sunk in firms that can't cover their interest payments.

I guess it's a pretty depressing story in a sense that financial distortions ruined things before the crisis.

MR. FERNALD: Lots of questions, I'm not sure my notes got all of them. I apologize if I don't respond to something. First of all, great discussion.

One of the most substantive thing you were objecting to was the mis-specification and interest rate channel. That came up a number of times in the discussion. In principle, the VAR controls for that. I can think of ways in which the mis-specification should go, higher interest rates should be associated with a slowing economy and a slowing and declining utilization, which will go the opposite direction. There are different stories that it's not obvious to me that the mis-specification would work.

In any case, it only worked in Italy and Spain to explain anything. It didn't quantitatively explain any of what was going on in productivity elsewhere. Whether it is right, whether it is mis-specified or just by chance, that came through.

Now more broadly, was it the Euro? That is a particular shocks and institution story. I know people looking at Southern Europe have argued why was

productivity growth so dismal in Southern Europe after the introduction of the Euro. That is a coincidence that needs to be explained.

Now, the rise of China was around the same time, so that's an alternative story. Even with the Euro story, we think that has to be good, but then you realize you have to intermediate it efficiently and effectively, and we have lots of reasons for thinking there are financial frictions, more reasons now than we thought in 2006.

In that sense, easy credit can in these models be a problem if bad firms are getting financed. That's exactly the story for China, but also many other places. Tight credit can be bad for productivity if good firms don't get financed, and the firms that should be rising.

It's not whether it's interest rates, per se, the problem is thinking about financial frictions in that class of models. There is certainly more to be done even in the shocks and institutions story,

what was the macro shock that the institutions couldn't deal with.

Labor quality, that came up, both with Javier and Martin. In principle, both the EU KLEMS and The Conference Board data controlled for labor composition. Now, to the extent that isn't picking it up right, well, that's a measurement problem that would be in there, but in principle, the data are trying to get that.

On the great recession, cyclical adjustment is challenging. I've written lots of papers trying to do that in different ways. Even 2004 to 2007, Europe was doing great. Germany was booming, and the unemployment rate was plummeting, and productivity growth looked good. That kind of fits a cyclical story.

That is why I wanted to emphasize the 1995 on period, because that is sort of where things diverged, even that is not enough of a pick up to explain the flip. Also, of course, it could be they

were implementing things that the U.S. had done earlier. It's hard to tell.

Yet, the great recession. The U.S. TFP growth plunges, bounces right back, and then looks like it continues on this pre-great depression kind of flat, modest pace. If you look in Europe, of course, it plunges, which is what you have in the EU KLEMS, then they get another downturn with sovereign debt concerns, the Euro crisis. Even now, most estimates would have the output gaps still very large in Europe. I think that makes it harder to interpret the European data since 2007.

There are lots of reasons to think that all of those big shocks could affect the allocation of resources in ways that would be picked up in the firm data. I think it is still very hard especially in Europe to know how that shows up.

I'll stop there.

MR. BAILY: Thank you very much. We will move to our next paper that Isabelle Roland is going

to present, and Marshall Reinsdorf is going to discuss.

MS. ROLAND: Thank you, Martin, for inviting me. This is an exceptional opportunity. Thank you, Marshall, for your comments so far.

I'm going to present results from a joint paper with Simbasia Delacy and John Van Reenen, who suddenly has left the sinking boat to go to MIT. (Laughter) I don't mean to say CEP is a sinking boat, Britain is a sinking boat. (Laughter)

You see Britain with its deflated productivity tire, those two guys have lost their jobs recently. This is going to be a very specific case study of the U.K., also specific in the sense that we are going to try to understand or quantify the impact of credit market frictions on productivity performance.

It's very specific, but the methods that we used can be applied to any other country, conditioned on data availability.

This is the picture I wanted to start from. This is GDP per hour. The dotted line is post-1979 trend, and the red line is the actual performance. You can see at the end of 2015, we had a 16 percent shortfall. You can also see on this graph, it really happens at the onset of the financial crisis, because before 2007, the U.K. was pulling ahead of a lot of other countries.

The slowdown stands out in U.S. historical perspective. I can show you -- I probably won't have time -- previous recessions were not followed by such a sharp decline, and it also stands out in the international perspective, maybe you want to focus on the U.S. here and the U.K., so this is again GDP per hour, normalized at the onset of the financial crisis, so the U.K. is the black dotted line and the U.S. is the full black line on top.

It has slowed down, but you are well beyond the pre-crisis level, and we are just below the pre-crisis level. We had a bit of a pickup in 2010 and 2011, but then things have gotten worse.

We started by looking at the literature on misallocation, so how firm level distortions translate into aggregate productivity losses. The problem with this literature, as was said before, is that it's really hard to pin down a specific channel. It's a bit of a black box.

What we want to do is really isolate financial frictions, so we decided to write our own model to do two things. First, to motivate a way of measuring credit frictions at the firm level, and the second thing is embed this in a model with heterogeneous firms so we can quantify the aggregate impact.

The final stage is to take those theoretical concepts to our dataset, which I will talk about later, but administrative firm level data.

I'm going to repeat myself. That is the theoretical challenge that we faced. Step number one is to a proxy for firm level credit conditions or frictions, and preferably, we would like to have a measurable proxy.

Our model suggests that we can focus on perceived default risk at the firm level to capture firms' credit conditions. This we can estimate empirically using a credit scoring model.

Step two, we embed this in a model with heterogeneous firms, and then we can answer different questions and do different counter-factual exercises. We can look at how has average default risk evolved, and also maybe more importantly for people who are interested in the misallocation literature, we can look at how firms' specific shocks to default risks were distributed across the distribution of firm level TFP.

A quick overview of our results. We find that credit frictions matter a lot. In the U.K., they substantially depress outwards in labor productivity. I have to clarify the benchmark we used here to quantify the losses, a perfect economy where there is absolutely no default whatsoever. It's a bit farfetched, but that's all we can do for now.

To quantify the impact, our sample period is 2004 to 2012, and over that sample period, on average, the U.K. output was 7 to 9 percent lower than it could have been in the absence of default risk.

We find that the impact wasn't during the crisis, and then lingered thereafter. There is heterogeneity across sectors and firm sizes, but I doubt I will have a lot of time to go into that.

Of course, we wanted to know how much of the productivity puzzle we can account for, given those results. At the end of 2012, the gap that I showed you on the first graph was only 11 percent, so it's growing. I think now it is about 17 percent. At the end of 2012, it was 11 percent, a 11 percent shortfall, and we can account for between a fourth and a third of that, also the productivity for 2008-2009 during the recession.

A few words about the datasets. We used administrative data from the Office of National Statistics. The great thing about it is that we have

direct measures of real growth, value added, capital expenditures, employment.

The bad thing about it is that it is a census of large businesses, and only a random sample of small firms, "small" meaning firms with fewer than 250 employees. That means we are going to have to use sampling weights in order to reflect the aggregate productivity developments.

Our measure of productivity is real value per employee because we don't have data on hours, which would have been better. Given that we have capital expenditures, we can estimate firm level capital stocks for all the firms in the sample, and also estimate TFP, and at the moment, this is work in progress. We just do a simple sort of residual.

I know this is going to come, so we are only taking into account physical capital, so buildings, vehicles. There are no intangibles nor R&D. We can discuss that later.

In terms of measuring the fault risk, which is the key item in our study, we used a credit scoring

model that was developed by Standard & Poor's. You input company accounts, the model takes into account also some macroeconomic factors and sector specific factors, and then spits out the risk score.

You can score private firms, public firms. These firms don't need to be rated. You can get a credit score for any firm, as long as you have a minimum amount of data.

What we do is we match those risk scores to historical default rates, because what we want to know is say you were a lender in 2007, what was your perceived default risk back then in 2007. We want to know how the firm was perceived in the past.

This is the aggregate picture we get for the evolution of perceived default risk in the U.K. You can see the black line is for SMEs, fewer than 250 employees, and the dotted one is for large firms. You see there is a really big difference in terms of levels and developments as well. The SMEs always systematically have high default risk, which makes

sense, they have less collateral, they don't have a track record, et cetera.

A second observation is that the default risk as perceived by lenders has been going up, especially sharply since 2007.

Large firms also had an increase during the recession, so 2008 and 2009, but it stabilized and it is pretty much at the level where it was pre-crisis.

This tells us that credit frictions play a more important role amongst small firms, which is not surprising.

I'm not going to go through all the technical details of the model, but I just need to give you a few basic details so you know what's going on.

The first step was to motivate a measure of credit frictions at the firm level, so we have this credit market model with heterogeneous firms. There is a difference in the amount of collateral they had, also in their level of fundamental TFP.

Managers have to assert some costly efforts, and that will determine their probability of default. We have competition among banks, and they tailor contracts due to firms' characteristics. Competition is just represented by switching costs, and the access of funds, which is a funding rate.

The only equation I want to show you is very simple, it is a profit maximizing incentive compatible credit contract which equalizes the marginal productivity of capital to the funding rate faced by banks divided by the probability of repayment, so one minus the probability of default, PD.

In a frictionless economy, that PD would be zero and the marginal productivity of capital would be equal to the funding rate faced by banks.

The PD is a result of the model, it depends on the conditions in the banking sector, it depends on the state of the firm, its collateral, its productivity. The firm is more likely to be able to repay its obligations if it is more productive, if it

has more collateral, if there is greater competition among banks, and bank funding costs are lower. Shocks to all these factors will be summarized in the perceived default risk.

While we assume a very simple production function, also we don't have any frictions on the labor markets for now, this is still work in progress, and we derived some firm level implications. We were interested in the aggregate outcomes, but what we want to do is actually validate that measure that we have that comes out of that credit scoring algorithm by confirming it behaves in a way the model predicts.

The model simply says that a firm that is perceived as a higher risk will grow less, will employ fewer people, will invest less, and have a smaller capital stock.

We do have some equations for output in investment. I am just showing you the one for output here, Y is output, and it is a function of the probability of repayment, for which we have a time varying estimate, then it is a function of a bunch of

macroeconomic things, and then the fundamental productivity of the firm.

We do a bunch of regressions with firm fixed effects, and we found indeed there is a significant correlation between perceived default risk and the performance of the firm in the way the model predicts. You can see there is a negative correlation between the probability of default, employment, total assets, fixed assets, capital stock that we have estimated, capital expenditures, and also TFP. These are all things that the model predicts, so we now have a good proxy for what we actually want to capture.

I'm not showing this now because we don't have entry and exit right now, but we also find if you have a higher risk of default, you are more likely to exist.

The more interesting part of the paper is where we derived the aggregate implications. We derived them in an expression for aggregated expected output, and it is a function of a bunch of things, macroeconomic conditions, technology, but more

importantly for us, it is a function of aggregate default risk.

Conceptually, this is a weighted average of repayment probabilities, and the weights are relative productivity weights. This is between 0 and 1, so it scales output up and down. In a perfect world where there is no default risk, it will be equal to one. If there is default risk, it will be lower than one, and output will be scaled down.

It is a weighted average of repayment probabilities, so two things can happen in the aggregate. You can have an aggregate shock to the default risk of all the firms, which will push that term down, or you could also have misallocation effects. For example, take a firm that is relatively very productive, but it is hit by a really bad shock to its perceived default risk and faces financing constraints, if that's the case, then it is going to be misallocated.

We have four different methods of estimating that aggregate financial friction term, I'm just going

to show you some baseline results. It is important for us to have several estimation methods because the first one relies on some TFP estimates, which will be very noisy.

MR. BAILY: We had you a little bit too close to the mike.

MS. ROLAND: The first estimation method relies on TFP estimates, which are very noisy. Luckily, we can recover an estimate of FITA using just data on employment. That is really well measured. The results varied in magnitude, but the patterns are really stable.

In this table, in column one, what I call "credit friction" is just an estimate of that term "FITA." As you can see, it is lower than one, meaning credit markets in the U.K. are not perfect. More importantly, that term is going down throughout the sample period, from 2004 to 2012, it is starting to go down very sharply at the onset of the financial crisis.

In the second column, we have computed the percentage of output loss studies associated with the level of financial frictions measured in column one. Take, for example, 2007, the 7.4 number there means output was 7.4 percent lower than what it could have been in a perfect world.

You can see in the last row the average percentage output loss over the sample period was 8.6 percent.

In the last column, we match the estimates in column one to labor productivity growth. Take, for example, 2008, you have -1.4, this means changes in credit frictions pushed down labor productivity by 1.4 percent.

This is one of the key results. We find that credit frictions matter. I understand the benchmark, the perfect economy, is a bit farfetched.

Given these numbers now, we asked how much of the productivity shortfall can we explain. The first counter-factual exercise we do is to say okay, let's fix credit frictions at their level in 2007 and

see what kind of output we get in 2012. We estimate that labor productivity would be 3.7 percent higher in 2012, if credit frictions had not deteriorated the way they did, and compared to a 11 percent shortfall at the end of our sample period, that is roughly a third of the puzzle.

Changes in credit frictions can also explain roughly 30 percent of the fall in labor productivity during the recession, 2008 and 2009.

I probably won't have time to go into --

MR. BAILY: Yes, you're running out of time.

MS. ROLAND: Heterogeneity across sectors and across firm sizes, most of the deterioration in credit frictions comes from SMEs, so on average, higher output losses among SMEs due to those credit frictions, and the aggregate deterioration is also triggered by SMEs, which is consistent with the picture that we got on the aggregate perceived default risk by firm size.

The second question we asked was is this due to misallocation, because it could just be an

aggregate shock, all the firms suddenly are perceived to be at a higher risk of default, or it could be firms of different productivity levels experience heterogeneous shocks to their perceived probability of default.

Without going into the numbers now, we find we don't really find evidence of significant misallocation in the U.K., which seems to be in line with other contributions.

The contribution, which is in column three -- I should mention what we do here exactly is we give every single firm in an industry its industry average probability of default, so that allows us to look at between firm effects. The conclusion is we don't find significant output losses or labor productivity losses from misallocation. So, aggregate shock matters more.

I conclude, we did a very specific exercise with the U.K., but most importantly, trying to pin down the impact of credit frictions. We developed a theoretical empirical framework to do that because the existing literature doesn't really allow us to

pinpoint credit frictions, so we proposed an empirical measure for firm level credit conditions and applied this to administrative firm level data, and found there was substantial output losses mainly among SMEs, and we also found this may be due to an aggregate shock to firms' perceived risk of default rather than misallocation.

Thank you.

MR. BAILY: Thank you. Marshall? Let's see what you can do with the microphone.

MR. REINSDORF: I like to talk loud, so maybe I can keep it further back. Let me see if I can get this clicker to work. There it is.

I appreciate the opportunity to discuss this paper, and I thought it was a very interesting paper to read. I'm going to start off by just sort of reviewing what I call the highlights or takeaways to remember.

We are trying to look at credit market frictions. I noted in the old days we mostly focused on how the banks had all these problems with bad

loans, zombie loans on their books, or maybe there was a credit crunch in 1991, where they supposedly were all undercapitalized and couldn't make loans, so this paper flips over and looks at the borrower side. That is one thing that was a little different.

Another thing that was different, we had a very nice model that actually had equilibrium where lending was affected by probabilities of default. There was also decreasing returns to scale assumption which helps pin down the model.

They had a price of capital which is one plus the interest rate, sort of opportunity cost of funds for the lender.

If there were no default, the first order of condition in the paper would be marginal product capital was equal to -- if you have a puzzled look, I'll answer your questions in a minute, if I'm seeing puzzled looks on people's faces.

Introduce the probability of repayment, which is one minus default, so now the marginal

capital comes divided by this fee, and it varies by firm.

The point here is the fee gets a little bit lower, than the marginal product capital has to be higher, so then your optimal level of capital is lower, and that is what constricts lending, and of course, fees vary across firms, so you can have some misallocation.

Managerial effort determines fees, so the theory is if you have more to lose from defaulting, you try harder not to default, so with more collateral, you don't default. If there is more money given to the borrower, if they succeed, they don't default. The lender could demand a little bit more from the borrower, this makes the fee a little lower, so there are more defaults, but it is worth it because they get a bigger piece of the pie even though they are making the pie smaller.

You get some scale effects and some input substitution effects as default costs go up. That gives you in a nutshell how the model works.

What is really clean and has very clean predictions, because this probability of repayment becomes an efficient statistic for calculating an output loss and a predicted effect on labor productivity.

I was maybe foolish enough or intrepid enough to write the equation for the output loss, but the main point is the fees are probabilities of default, the omegas are weights. In baseline calibration, the power is actually two. The outside power is actually a third as far as I can tell. We are basically taking the average of the square probabilities of repayments and then raising it to the one-third power, and that is giving us our output loss.

It is a nice, clean formula. I did note a couple of assumptions here in the output loss calculation. One is if default occurs, there is zero output, so that is one reason the power on fee is pretty big, and the other, when they do their

exercise, W moves around. If the price of capital goes up, the price of labor goes down.

There is a prediction for change in aggregate labor productivity which depends on the fees, the technologies, and the interest rates. I'll pause and make a very technical point, which is they actually predict a marginal product of labor in that equation, but in the Cobb-Douglas world, the marginal product of labor changes in direct proportion to the average product of labor, so you are kind of rescued, because average product of labor, you only care about rates of change.

One thing that kind of bothered me is this whole cost of capital, user cost of one plus the interest rate, effectively capital is assumed to last for one year, so you can get instantaneous adjustment. That is kind of unappealing. On the other hand, if you start to make a more realistic user cost of capital model, the way Dale Jorgenson would do it, you get a much larger impact on the cost of capital from default. That is my third bullet point.

Basically, if you correct a model to let capital live a long time, you're going to have a depreciation rate plus an interest rate plus some kind of large default cost.

Effectively, you end up with maybe four or five times bigger impact, but then you can say the adjustments may be four or five times slower, so maybe it doesn't work out so bad in terms of the ultimate impacts.

Empirical results, one thing that is really impressive, the data, where they estimate these default probabilities from this big sample of microdata, they prove default probabilities behave in a plausible way, they prove the sample is more or less representative of what it is supposed to represent, so really interesting data work.

We have a reduction in output. I decided to break it to look at the slowdown, right. The first half, there is only a 6.6 percent reduction in output, and in the post-slowdown period, 10.5. You're getting a little bit of an impact of the slowdown here.

On the other hand, they had an equation for a predicted marginal product of labor, that thing didn't do much at all for the slowdown. So, their marginal product of labor that they predicted didn't change at all, so by my take, one version of their labor productivity estimate doesn't get you any traction. I think that is because the falling interest rate implies more capital.

They also take a look at the small and medium-sized enterprises where you figure it is going to be bigger, and lo and behold, it is a little bit of a bigger impact, as you would expect. You get -.7 after the crisis, -.3 before the crisis. You can pick up a little more of the slowdown within the small enterprises.

They also look at misallocation. They have two ways. One is a covariance method. I wasn't fully convinced the labor share quite catches the misallocation I'm interested in. The second one where they did the counter-factual making everybody equal, I thought that was an interesting way to proceed.

The authors say they didn't get anything out of it, but I drew the opposite conclusion, because I looked at the early years and the later years, and actually the misallocation did get worse after the crisis, so you can at least say you could help explain the slowdown. You get something there.

One thing I thought the paper would benefit a lot is from some charts, some things to kind of show you a little bit more of what's really going on in the data. One, which I'm not going to show you, I'd like to know what happened to actual default probabilities, because they have default probabilities rising after the crisis and staying high, but I bet you if they showed you the actuals, it rose after the crisis and then went back down. Maybe I'm wrong, but it would be useful to see.

Here is the other one I really wanted to see, which is since this is really a theory about capital deepening not occurring any more, what happened to capital deepening in the U.K.? Here, I borrowed from a paper by I think another LSE

colleague, Nick Golten, where he did a very careful job of capital stock, capital services, and this is an index of capital intensity, basically the capital-labor ratio.

You can see what happens is it is growing nicely in the U.K., actually, the U.K. had really pretty good productivity growth for many years before the crisis. The crisis year, it takes a big jump up, so that's 2009. That is not because of a burst in investment. That's because all the labor was let go. It is kind of an anomaly, right, the capital-labor ratio improved because everybody is fired.

But a couple of years later, you start to return to more normal conditions in the labor market, people are going back on board, and what do we see? We actually see capital intensity kind of trending down.

When I look at this chart, there really was a break in the trend of capital deepening in the U.K., and okay, it's not zero any more, but it is way slower than it was before the crisis, so I do think there is

a little bit of an impact from reduced capital deepening that you can see in the data. This would kind of help maybe with your paper.

Here are a few concluding thoughts. It is an elegant model. I really enjoyed reading it. It's not so hard to implement because it has this one fee you have to estimate, but of course estimating a fee is not such an easy task. If you ignore the problem with estimating fee, it is really easy to estimate.

It is really nice to think about frictions, misallocation, we heard earlier about people's ability to post collateral is possibly distorting allocation, and it does in this paper as well. You could have a little bit of some hesitation, this decreasing returns to scale with three-quarters can get you really big movements in optimal capital stock, if you move the price a little bit, and that would tend to overstate the impact of default.

As a minor -- maybe not a minor point to those of us who like models, you need to put the price of capital in the model, so you can't set the computer

price equal to one plus the interest rate. You need physical units of computers times pound/sterling per computer times the interest rate. You need PK in there. That gets the units correct and it also allows you to think about what is happening to the price of capital goods, which I do think is part of the story for the slowdown and for why the impact of change in investment might be looking like it did.

So, that brings me to the end of my comments, and I didn't go over by very much.

MR. BAILY: Thank you very much. Questions from the floor? We are getting a little bit towards the end of the day here. Let's get us started. Romain Duval?

MR. DUVAL: Thanks. It was a very interesting paper. Just based on the representations, of course, I haven't read the paper, basically there is a big slowdown in labor productivity and TFP as well in the U.K., right? One would be the misallocation story, that eventually you ruled out, so

you were left with the effect of the common shock on productivity of all firms; right?

That seems to me, and maybe I'm wrong, to rest essentially on the non-return to scale assumption, right? I'm left with a mixed impression regarding the paper, because there is no misallocation story, and the other story relies on the assumptions. I just wanted to hear your views on this.

QUESTIONER: The TFP story, that is where the U.K. had a break in TFP, but on the capital intensity side, the picture you have looks like the U.S. one, where you fire a lot of workers and the capital-labor ratio shoots up, and then they come down. That is a systematic pattern you see around recessions, more intense this time than in the past.

MR. BAILY: Why don't you respond to those comments? In particular, I agree with Marshall. I thought it was a fantastic model. It was the application of it I wasn't quite always sure I understood. If you can speak to some of the points raised, and in particular, the extent to which you

identified TFP, because there has been a big decline in TFP in the U.K., right? We are looking for a TFP effect as well as a capital intensity effect.

MS. ROLAND: So, to answer your question, we have been downplaying misallocation. We are doing some tests to see how the results vary with the degree of returns of scale that we are assuming, but this is a work in progress. You are right.

I'm not sure I understood your question. Was there a question?

QUESTIONER: (off mic)

MR. ROLAND: Yes, unfortunately, we only had access to the credit scoring model for the U.K., country specific products. This could be easily replicated for other countries.

Your question?

MR. BAILY: We know your model predicts you have less capital. The TFP, does that come because of the returns to scale assumption?

MS. ROLAND: We don't actually look into TFP that much. We assume TFP is fixed, so we take the

average TFP over the sample period to measure the relative productivity of the firm relative to its industry. This goes into the computation of the weights.

The exercise we do in terms of misallocation, looking at how the perceived default risk change across distribution of TFP, so we take TFP as a fundamental at the firm level. We could actually estimate the impact of that in outputs and labor productivity, but we haven't gotten there yet, and it's not really of interest in our paper because it is independent of those credit frictions.

There are two effects of credit frictions, credit frictions will affect the perceived default risk, and we have the aggregate output expression, where you are going to capture demand shocks. We haven't estimated that part.
I don't know if that makes sense.

MR. BAILY: I'm just trying to sort of draw broad lessons from these papers, group of papers that we put together. John's paper suggests there was sort

of misallocation of capital, and that had quite a bit to do with or that explains the adverse experience, productivity experience, in Spain and Italy.

My understanding of John's paper was you were sort of giving capital to the wrong people, you were keeping zombie firms alive or whatever.

You actually find that there is some difference between SMEs and larger firms, but the sort of big effect is the fact that everybody's default probability goes up, so they have less access to capital.

MS. ROLAND: Yes, driven by how long is the perceived default risk.

MR. BAILY: A lot of people would say the desire of companies to borrow actually is what got hit in the downturn, so how would you identify the effect that you're describing, which is they can't access money from the alternative, because we have the same discussion in the United States, particularly for small and medium sized enterprises, has financial

regulations prevented small businesses from borrowing, and it's very hard to identify those two.

MS. ROLAND: Yes, the default risk sort of captures demand and supply at the same time because in the model it's an equilibrium result, which depends on firm characteristics, which depends on the competition in the banking sector, so it's really hard to disentangle demand and supply, but there has been research done by the Bank of England which shows that most of the credit contraction was supply driven. Well, that's what they argue. We can't really disentangle those in the paper.

The banking markets in the U.S. are quite dysfunctional when it comes to serving SMEs. There have been very long-standing problems, a lot of reports written about it, and nothing ever done about it. The results are consistent with the fact that the SME market is not well served.

We don't really look at policy implications in the paper, it is mainly a measurement exercise, but one possible implication would be to improve the

functioning of the SME banking sector. Competition is really low, concentration is really high.

Another thing that relates to our results is the argument that credit scoring models do not do SMEs a favor, so it is very much debated, there is no agreement. Some research shows that it is the introduction of those credit scoring models have actually expanded access to credit for SMEs, but in the U.K., it doesn't seem to be the case. SMEs don't have collateral, they don't have a track record, so those models really look at company accounts, short term results, they don't really look at your potential to grow your productivity the way we view productivity. It seems the system is not working well for SMEs.

CLOSING REMARKS

MR. BAILY: Okay, good. There was some talk, and I'm not trying to summarize the proceedings today -- please read my paper which summarizes this quite a bit. I guess I'll say a couple of things.

First of all, an administrative point, we do have a reception, which I think is next door, right? Please come and join us at the reception.

We do have an event tomorrow, which is a public event. I'll be giving my paper, and we will have a policy panel, which will tell us what we are going to do about productivity growth.

I do think this has been a great set of papers, every single one, and the panel discussion in the beginning, and I've learned a great deal, and I hope everyone else has.

I think my summary of the measurement outcome would be I don't think we have overturned the result that the slowdown was not purely or even mainly a measurement issue. On the other hand, I certainly think we have plenty of evidence that measurement is not always done well, and that is not the fault of the measuring agencies, it is the fact that we don't as an economy put enough resources into the measurement problem.

Sectors like health care, that are growing bigger and bigger, are the ones that are not measured, but also financial services, professional services, many of the other parts of the service economy are not being well measured. So, that doesn't necessarily tell us productivity is a lot faster than the measured, but at least it tells us there is a lot of uncertainty about that measurement side, and something that we clearly need to do something about.

I think these micro papers and John's paper really added a great deal to our understanding of what's going on. I think it's sort of a hopeful sign, if you like, given how slow productivity growth has been, it is sort of hopeful there appears to be some firms that are continuing to do well, both in Europe and the United States.

I think the alternative, which is if we were all in a slump together, would be even worse, and would be a projection that things are going to stay as bad as they are. The fact that some firms are doing well makes us want to look for barriers to why the

other firms are not catching up, but also suggests that maybe with the passage of time, with innovations, we might actually see a faster rate of growth going forward.

I did not, I think, going into this session, put that much weight on sort of financial misallocation and credit issues as being major factors, and I think I've learned from these two papers that I need to take these very seriously, and I haven't yet been convinced that they are the main reason for the slowdown, but I think it is certainly something that both authors have told us we need to look at more carefully.

All right. Why don't I stop there, and we will go to the reception. Thank you everybody for coming. I think it has been a great conference.

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Expires: November 30, 2016