

General Discussion: Polanyi's Paradox and the Shape of Employment Growth

Chair: Peter Blair Henry

Mr. McAfee: This is my first time here at this gathering, so thank you for the invitation. I'm a colleague of David Autor's at MIT and I think I'm part of what he refers to as contemporary manifestation of discussion around technologies impact on the labor force. I wrote a book earlier this year with colleague Erik Brynjolfsson called "The Second Machine Age," where we take a sharper view of technology's impact on the labor force, than David's. David, my question for you is, could I ask you to speculate a little bit about what would happen if we were to actually to overcome Polanyi's paradox with software. The reason I ask is, most technology geeks that I talk to in Silicon Valley lay out a litany that leads me to believe if we are not going to totally overcome that paradox, we are going to make a lot of progress very quickly and it goes to this broad category of approach in computer science that you call machine learning—the ability to get computers to do things without teaching them the rules. We have been trying to do that for decades; it's been really largely underwhelming up until very recently. The only industrial application of machine learning that any of us came across was the fact that our ATM's could recognize handwritten numbers on checks. That was the sole triumph. That was the case until just about two years ago and since then the number of areas where machine-learning techniques are at least as

good as us or even better is starting to grow pretty quickly and to become impressive. Super-human performance has been achieved in recognizing traffic signs in the wild, recognizing cell mitosis as its happening, detecting breast cancer and recognizing handwritten Chinese characters. When I describe that litany and I talk about that with colleagues in Silicon Valley the main thing I hear from them is fasten your seat belts because we have not seen anything yet, and they say there are really rapid advances being made along three fronts. The first one is the ability to not just be confined to one type of data. All the examples I gave are one type of data. What we are able to do now, very recent advances let us combine disparate types of data and draw correct inferences, the pilot example there is to look at both radiology images and a doctor's texted notes about a patient and arrive at a correct diagnosis. The second thing they say is that even without teaching computers what we want them to get good at they are making correct inferences and recognizing things about the world. You talked about the Google cat recognition video, which sounds a little bit cute until you recognize that what that technology was actually able to do is extract the notion of catness from a huge body of YouTube videos. I think that is simultaneously cute and kind of impressive. The third thing that they say is the improvement curves of all these technologies are pretty drastic. For example, that cat recognition task was replicated recently, not with 16,000 processors but with one. The technologies are getting very much better, very quickly. It feels to me like again, I don't think we are going to overcome Polanyi's paradox completely, we are making a huge amount of headway against it and I'm wondering if you could talk about what you think the implications of that are?

Mr. Kocherlakota: I have a comment which I think applies to both papers. I think that there is a vision, and this may run into some of the other papers we're going to see as well, these papers are trying to establish the contours of the boundaries what we believe we can achieve with regard to monetary policy. I want to offer, I guess, some caution about trying to draw some inferences along those lines. I'll make two points in that vein. One is if you look at Chart 7 in David Autor's handout, he points as it being potentially an important expiatory factor in the data he is looking at, this is private fixed

investment. If that is a key explanatory factor for what is happening in the labor market, well we can certainly think about monetary policies potentially having influence on private fixed investments and therefore affecting the capacity of what we see in the labor market. The second comment I'll make along these lines would be about employers' willingness to train workers. Training is when you invest up front in exchange for benefits down the road. Again, low interest rates are going to be something that will provide stimulus for that kind of activity and again something that may seem to be beyond the control of monetary policy influence becomes something inside the boundary of monetary policy. I think we have seen historical examples, and this is more of a reach, but if you look at the Great Depression, TFP growth, which is often treated as endogenous in macroeconomic thinking, and modeling fell sharply before Franklin Roosevelt came to office. After that, it rose extraordinarily rapidly, one of the fastest rates of increases in U.S. history. If you recall work by Hal Cole and Leo Hanián, it's hard to point at supply-side issues as having to be responsible for that rapid growth of TFP. It seemed to be coming instead from the demand-side influences.

Mr. Haltiwanger: I'll comment a little bit about the poll, which I was a participant in, but related obviously to the paper. Back in 1994, when we thought about the rise in wage inequality, we used to think about skill biased technical change versus international trade as competing explanations. We don't think that way anymore. I think we think about them as being very tightly linked. I think this is relevant for this paper and I would like you to talk a little more about it. I was struck in reading your paper that you didn't really talk much about globalization until toward the end. Then you said that "Oh this might help us explain why we are seeing some of the puzzling patterns in the post-2000 period." I actually think that may be because of the relationship between globalization and IT. What's IT enabled us to do? It has enabled firms to change their organizational structure globally. We have certainly seen in this in the retail trade sector but have also seen this in key sectors like manufacturing and in high tech. So we know there are increasingly factory-less manufacturers. We do design here in the U.S. but the production is increasingly offshore. So again, it is not globalization versus IT but instead

globalization and IT and their interaction. I would like to hear your thoughts about that.

Mr. Autor: Let me first respond to Lisa Lynch. Thank you very much for your comments. A couple of points. I want to make it clear I'm not a uncausal exponent. I don't think that skill biased technological change is the only cause behind rising wage inequality, in fact, I'm one of the respondents in the poll who choose "other" and "unknown" as a leading cause. What I was actually referring to (in choosing "other") was the deceleration in supply of college educated workers, which is the largest single factor contributing to the growth of the college wage premium since 1980. Second, this question of Mishel, Shierholz and Schmitt's paper, "Don't Blame the Robots." There is a distinction or a lack of distinction that people make between employment polarization and wage polarization, and I hope I clarified it a bit in my talk. Employment polarization is the growth of low-skilled and high-skilled jobs simultaneously, and that is something that is much more pronounced within the last three decades than earlier, particularly the growth of in-person services and particularly among noncollege workers. If you look at types of jobs held by noncollege workers, they have moved very much out of blue collar, very much out of clerical and very much into personal services like food service, cleaning, security and driving a little bit.

I think what drives Mishel and others insane is linking that phenomenon to wage polarization—that is, saying that employment polarization explains why wages are rising and falling for different groups. The point I've tried to stress in my talk is because of labor supply to personal service occupations there is no reason that growth in those occupations will generally grow in wages. This is the point that Baumol made a long time ago. Why do wages of barbers rise over time? Because they need to be compensated for being barbers instead of something else that has a rise in productivity. It's really determined by opportunity cost, and we see that in the data. I want to make clear that these are distinct but related phenomena, and we should not infer that because employment becomes more numerous in in-person service occupations, these occupations will become better remunerative. This points to the empirical and conceptual challenge.

I completely agree with Lisa: to the degree we are going to have a fair amount of employment in these activities, making those jobs of reasonable quality is a huge challenge. Technology certainly is working in the opposite direction. I wish *The New York Times* would write a story about every example of miserable working conditions in low wage jobs so, for example, the CEO of Starbucks or whatever organization, would quickly change policy. (I'm sure you followed this last week when *The New York Times* wrote about Starbucks and the scheduling software that was making people's lives miserable. Immediately the CEO of Starbucks, Howard Schultz, changed the policy, eliminated the software, changed it right away.) More than minimum wages, I actually think that labor standards that guarantee workers some expectation of what their hours will be a week in advance, that give them some control of their lives, would be enormously beneficial. Employers often talk about the benefits of flexibility. But low-wage workers are the people least able to supply flexibility. Getting their kids taken care of, getting reliable transportation, knowing what they are going to be doing on any given day—that is really challenging. High-skill workers in career jobs can supply flexibility. They can hire people to help with domestic resources. They have all kinds of resources to address scheduling challenges. That's not what low-wage workers need. They need predictability. I believe this is actually a huge policy challenge.

The other huge policy challenge as part of labor market change is the ongoing rise of the top 1 percent of households, something I feel we don't understand completely. I would have predicted that there would have been a dramatic contraction in the top 1 percent after the Great Recession. That has not occurred, so I think that deserves our attention.

Let me now turn to Andy McAfee's question. There are two questions really. One is, am I wrong about how fast this will change? Are we on the second half of the chess board, to use the analogy from Brynjolfsson and McAfee? The other question is what would happen if I am wrong? Let me just say that I could be wrong. I already gave the example from *Popular Mechanics* in 1949 predicting that the ENIAC that may "only" weigh one-half ton someday, so clearly one can be unduly

pessimistic about what is happening. Let's say I was wrong. Let's say that tomorrow, you went to Amazon.com and you saw that the Bezos Bot was just introduced and it was only \$1,000 and it would cook you meals and drive your kids to school and clean your house; you could get it with Amazon Prime, so no shipping cost. That would obviously be extremely disruptive because it would displace the comparative advantage of many workers whose best paid activity right now is doing personal services—cleaning, driving and so on. There is no question that these disruptions are costly. And just like international trade they are generally not Pareto improving, even though they raise aggregate output. The Bezos Bot would be great for people in this room, correct? My life would be 7 percent better tomorrow if I could get the Bezos Bot for the \$1,000 they've priced it at. What does that tell us? There are two concerns, one about the specific subset of workers who are directly impacted, and the other about the implications for aggregate employment. Clearly for the subset of workers who compete directly with advancing machinery, they can see falling wages—which is what we have seen. Although we have a lot of low-skilled jobs in our economy, we have many more low-skilled workers relative to low-skilled jobs than we used to. Hence wages are falling in those jobs. And if technological progress moves rapidly enough, as Andy McAfee expects, we will see more of that. The way we have dealt with this historically is by educating ourselves—but that is a long-run solution. In the short run, we do need policies, in my option, that make work pay, including for example an expansion of the EITC for males without dependents.

Again, we see that the technology is improving. Whether it is accelerating exponentially is less clear, as I discuss in my paper. Many computer scientists argue that computer learning will only ever get it right “on average,” and will miss all the important cases. That's because the learning is statistical, and does not do a good job of handling informative exceptions. Contrary to Andy, I don't think that most machines understand the essence of catness, actually. I think they recognize things that look like cats, which are fairly easy to identify. I'll give you an example discussed in the paper for understanding chairness. You could look at a traffic cone and a toilet seat and you could say “Which of these is a chair?” Well from the perspective of machine recognition they both look a lot like chairs. If you really thought about

chairness, however, you might say from the perspective of the human anatomy the traffic cone does not look so appealing. That requires thinking about what something is for, not just what its attributes are.

On Narayana Kocherlakota's point, monetary policy is something I have so little expertise in, it is amazing that I'm even standing here. I think that the importance of the investment issue was brought home to me as I was thinking about IT investment, and how important that appears to be. To the degree that Fed policy has effects, stimulatory effects on investment in training, investment in human capital and physical capital, I think that is a very good thing.

Finally on John Haltiwanger's question about international trade and globalization: I think that he is right that they should not be thought of as substitutes, because they are in many ways complementary. Much of our deep integration with Asia is enabled by information technology. I think there is also a more policy-driven component of this, which is that China's accession to the World Trade Organization in 2001 proved to be far more disruptive to the U.S. labor market than people had anticipated. No one anticipated the surge in trade that occurred. In recent work with Daron Acemoglu, David Dorn, Gordon Hanson and Brandon Price (an MIT Ph.D. student), we try to estimate the employment consequences of this trade expansion, not only in U.S. manufacturing but looking at all the upstream and downstream sectors, inside and outside manufacturing. We estimate that the associated employment reduction between 1999-2007 was on the order of a couple million jobs, which is larger than the direct effect in manufacturing. So, I think that trade has been extremely disruptive. I don't think that is an argument against trade, per se, though it might be an argument to worry about trade deficits more than we do. Regardless, I think that trade is a big underappreciated factor in the dislocation that we have seen. Yes, I agree that going forward, information technology enables this type of deep supply chain integration. It's no longer about trade or technology. It becomes trade and technology.

Ms. Groshen: So, I would like to hear more about, obviously speculative, but how is it that these middle skills will be particularly complementary to the advances, the machine learning and the environmental impact as compared to the other advances before us?

Mr. Spriggs: My question gets to this issue of what we can infer from your work, because actually your data for 2004 show that we actually had declining shares for everyone except for a very few occupations at the top, and falling wages for everyone. If the theme of the conference becomes, after the Haltiwanger paper, that the economy is going to have higher unemployment, and lower wages then people might conclude “Oh well, we can stop quantitative easing sooner because the world is different, it has higher unemployment and lower wages.” The correction I think you need in thinking about the inference of technology on wages, though, is found in the case of food service workers, whom you appear to suggest are passed over by technology. But, in the old days if you worked at McDonald’s you had to count paper cups, you had to do physical inventory. Today when you push the sales button, McDonald’s knows in real time what its inventory is. So, even low-wage workers are very much complemented by technology. Their wage is not. If we had full employment then we might see a world in which even low-wage workers could bid up their share of the productivity gain, so I think you should look at this issue of low-wage workers as endogenous to high unemployment rates, will allow a different view, that at low unemployment rates these workers would be reallocated and that they are far more skilled than they use to be.

Mr. Feldstein: Two comments. David in his paper refers to the effects of globalization and international trade. It seems to me that’s enormously important and deserves more space in the discussion. That is, manufacturing production workers have declined in the share of the labor force dramatically over these last few years. What happened to those workers? They got displaced into the service activities where they were paid much less than they had been as manufacturing production workers. A separate point about the comparison of policy changes and compensation. That depends on how you measure real compensation. In particular, what you use as the price index for it. It would be surprising if somehow compensation didn’t mirror productivity more closely. It does mirror it if you use the price index for output in the nonfarm business sector. You get these big gaps because the price index that is used for measuring real compensation is a consumer price index, which has a lot of components

which have nothing to do with nonfarm business sector. It includes import prices, housing and a whole bunch of other things.

Mr. Autor: So, let me start with Bill Spriggs' question about wage growth in low-end service occupations. I agree there are examples of complementarity exactly as you said. For example, Dave Wessel sent me an email yesterday. In typical Dave Wessel style it said "footnote 20 of your Jackson Hole paper," that was the subject, and the content "what about check-out clerks?" I was scratching my head, "footnote 20?" He was actually making the same point as you are—that you can give examples where productivity has been dramatically increased by automation in service activities—bar codes and so on—and yet wages have not risen in these occupations, or at least not by much. The countervailing force stressed in my paper is labor supply changes. Particularly, building on Marty Feldstein's point about workers displaced out of middle-skill occupations, workers are increasingly competing downward into lower-wage occupations. There is a kind of musical chairs phenomena, also documented work by Chris Smith of the Federal Reserve Board, the work of Nir Jaimovich and his co-authors, and also the work of Chris Foote and Richard Ryan of the Boston Federal Reserve. I think we see downward mobility from middle-skill jobs that places downward pressure on lower-wage service occupation jobs because the barriers to entry into those occupations are so low. Clearly the thing that works well for raising wages in lower-wage occupations is a tight labor market, a tight macroeconomy. Almost all the wage growth we have seen that was broadly shared in the last 30 years, all occurred between 1995-99. So if you, Chair Yellen, know how to produce a tight macroeconomy, count me on the in-favor side for that one. That's obviously incredibly important for how productivity gains are shared.

On Martin Feldstein's point about globalization, I am heartened to see that the fraction of economists who think that international trade is a big deal has doubled in the unscientific poll. I think that trade has changed. It's not simply that we revised the old facts. It's that trade used to be much more among high-wage countries; it was North-North trade, and now we have more North-South trade. This latter category is much more about substitution of labor intensive

tasks rather than trading in high-end goods. I think that is extremely important. I've done a great deal of work on this topic with Gordon Hanson and David Dorn recently. I didn't think I could cover it here, but I agree it's very much worth talking about.

On Erica Groshen's question on middle-skills complementarity, I think this is a really important point. How do these things interact? The leading example where you'll see complementarity between technology and human flexibility is in the occupation of medical technicians. There are many medical-technical jobs that require at most college or in many cases lower education. These jobs have strong long-term employment prospects because they virtuously combine technical expertise, which is scarce, with human talents that are hard to substitute with machinery, including empathy, interactivensness and also all the kind of diagnosing and communicating. What you want to be as a worker, is someone who has a body of scarce technical skills complemented by automation but also a set of Polanyi-type job tasks that are not going to be automated away in the near future. There are great opportunities in such jobs. Many of these jobs are in the professions. However, increasingly such jobs are found in the middle of the skill distribution. There are fewer clerical workers as a share of employment than there used to be. But the clerical workers who remain are people who are problem-solvers. In medicine you see nurse practitioners that do things doctors used to do. That's a downward movement. You will see this in the trades, in construction, in skilled repair. I think there is a limit to how many routine tasks will be automated out of existence (at least for workers). In some cases, automation will allow less-expensive workers to do tasks formerly performed by more-expensive workers—for example, the many diagnosing and prescribing tasks performed by nurse practitioners that formerly were only done by medical doctors. I provide more examples at the end of my paper, but in the interest of time, I'll stop here. Thank you.