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Does mismeasurement explain low productivity growth?

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Abstract The "mismeasurement hypothesis" holds that the recent slowdown in recorded productivity growth merely reflects a fall-off in our ability to measure productivity rather than an actual deceleration in economic growth, in large part reflecting benefits people gain, but don't pay for, from using new technology applications. If this hypothesis is valid, we should see that national drops in productivity growth are connected to usage of these services, we should be able to ascertain large gains in surplus related to them, growth in the technology sector should be sharply understated, and labor incomes should be swelling relative to output. None of these arenas show evidence that recent miscounts of aggregate productivity are notably large compared to the past.

Keywords Productivity · Mismeasurement · Technology

In this study, I investigate productivity growth—specifically, the so-called "mismeasurement hypothesis." This is the notion that even though measured productivity growth has slowed considerably over the last decade or so, the true productivity growth has actually continued apace. It's just that our ability to measure productivity growth has fallen off over the years. The hypothesis posits the slowdown is an illusion of measurement rather than actually reflecting falls in the growth rates of output or economic wellbeing.

Based on a presentation made at the session, "Understanding Productivity Growth: New Evidence and Insights," at the NABE Annual Meeting, September 11, 2016 (Syverson, 2016).

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Table 1 shows average annual labor productivity growth (the nonfarm private business series from the BLS) over four historical periods. From 1995 to 2004, labor productivity growth averaged 2.8% a year, which was considered the dawn of the IT era, and Dan Sichel et al. (2007) did a great amount of work showing how that productivity boom happened and where it came from. But since the mid-2000s, productivity growth has slowed down, by more than half. (These numbers are through the end of 2015, but let me tell you, if you were to add the first two quarters of 2016, it isn't going to look any better.)

I think a useful way to frame discussions about the mismeasurement hypothesis is to actually quantitatively define the size of the puzzle. If we are just missing actual productivity growth in our statistics, how much is missing?

If you make the simple calculation of extrapolating the 1995–2004 productivity growth rate through 2015—that is, assuming productivity growth didn't slow after 2004—GDP would now be $3 trillion higher (conservatively, as there's a little bit of slush there because the productivity numbers don't quite cover the entire economy). In other words, the mismeasurement hypothesis implies our economic statistics miss $3 trillion a year of output: That's $9200 per capita—for each one of us, all of our parents, and all of our kids, $24,000 per household. It is as if we are somehow missing something the size of the entire healthcare sector in our statistics. This is a really big number. If this were to continue for another decade, we will be missing one-third of GDP. In other words, the stuff we would be missing would be half the size of the stuff we are measuring.

The story behind the mismeasurement hypothesis is straightforward and intuitive. We started making things in the mid-2000s that are hard to capture in our economic statistics. In particular, what makes them difficult to capture is they are consumed at zero price or very low price

Table 1 Nonfarm business productivity growth

Period	Average annual labor productivity growth (%)
1947–1973	2.7
1974–1994	1.6
1995–2004	2.8
2005–2015	1.2

relative to their value. Think about using Google, or going on Facebook, or using GPS or the camera on your phone. You're not paying for the use of those products on the margin. The idea is that people spend a very good amount of time and get a very good amount of enjoyment out of things like this while not paying for them. Therefore, utility is going up…surplus is going up…growth is happening. It's just that we don't capture it in our output statistics, which rely on measuring dollar-valued transactions.

That is a very plausible story. But it's just a story. I think the useful exercise is to say, "If the story is true, does it have implications for other things that are observable in the data even if it's not there directly?" That's what I did in this paper: look through four different lenses—each coming at the issue from different directions and using different data—to explore where the mismeasurement hypothesis is right or not.

Let me briefly discuss what those four things are. The first thing I looked at is whether the slowdown has happened outside the U.S. And if it has, is the size of the slowdown related to the importance of IT products (of the type I just mentioned) in that country's economy? The mismeasurement hypothesis would imply you should see a larger slowdown if IT is more important in that country, because productivity mismeasurements are supposedly attached to these kinds of products.

The second analysis involves going back to a research literature that started about 15 years ago, which has tried to measure the consumer surplus of digital goods, especially those tied to broadband access. I use the methods in those papers with updated data and ask how much implied surplus there is, and whether this could explain the supposedly missing output posited by the mismeasurement hypothesis.

Third, I ask the question, "Let's suppose what is allegedly being mismeasured was actually measured. How big would the IT sector be if we were measuring it 'correctly?'"

Fourth, I see if total income is systematically higher than total output, it turns out this has been true on average in the national accounts since the slowdown began. Some have said, "Well, that's because we're paying people to make stuff that is being given away for free." Thus, we see this activity in the income account (GDI) but not in the expenditure account (GDP) because people aren't paying to consume it. I look more deeply into this GDI–GDP discrepancy to see if it could reflect similar mismeasurement issues.

I'm going to look at these four stories. They're different. They are not completely orthogonal draws from the statistical bucket, but they're pretty independent. I believe each one has a separate bit of information and something to say about the hypothesis. As you will see, when you look at the results of these analyses after all is said and done, none of them end up being consistent with the mismeasurement hypothesis.

Therefore, is the productivity slowdown widespread? Yes. The OECD has labor productivity growth numbers for 30 countries over this period. 29 exhibited a productivity slowdown between 1995 and 2004 and 2005–2014, just as the U.S. did.

However, the size of that slowdown is completely unrelated to the importance of IT products in that country's economy. I measured this importance in two ways. One is on the supply side: the share of value added accounted for by IT-producing industries. The other is on the demand side: broadband penetration in the country.

Figure 1 is a plot of the change in labor productivity growth in a country versus IT-producing industries' share of aggregate value added (the country's GDP). These are raw data for the 30 countries I mentioned. The first thing to notice is on the vertical axis: 29 of the countries saw slowdowns in productivity growth just as the U.S. did. (The exception was Spain. I think that's because they fired so many people that productivity growth actually went up despite a huge drop in output.)

More relevant to the issue at hand, there is no relationship between the size of that slowdown and the importance of IT in that country's economy. If you fit a curve to this plot, you get a line with zero slope. And I don't mean just a statistical zero; you get an economic zero. The correlation is miniscule.

Figure 2 is a similar plot, but comparing the size of a country's productivity slowdown to the demand-side measure of IT importance, the country's fraction of households with broadband. Again, there is no relationship between the importance of IT products in the economy and the size of the productivity slowdown.

The second test asks, "Well, what does the literature that has tried to measure the total surplus of broadband-linked goods say about what we might be missing?" That literature has produced a range of estimates, but if you had to pick the median, it would be somewhere in the neighborhood of $200 billion.

Remember the size of the puzzle is $3 trillion. That $200 billion doesn't get you that far. Moreover, the literature is trying to estimate consumer surplus. This isn't something we captured in GDP even in times when no one was

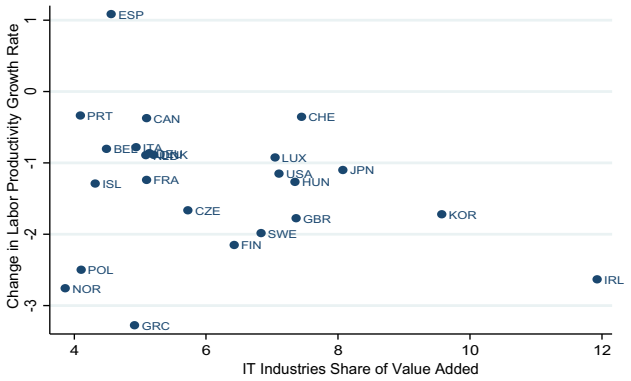

Fig. 1 Productivity growth slowdown is widespread, but not related to IT

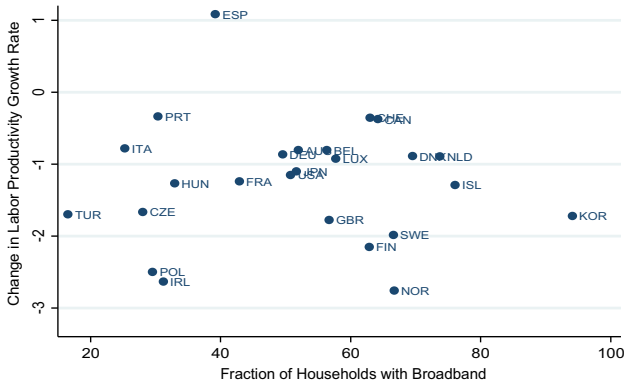

Fig. 2 Productivity slowdown and household broadband usage

alleging the mismeasurement hypothesis. Thus, even if you put all of that $200 billion into GDP—and we might think we never would have—you're still not getting very close to the missing $3 trillion.

The largest number in this literature by some distance, almost double the second largest estimate, is $850 billion. Again, that's reflecting consumer surplus that plausibly never would have been fully measured, and it still does not get you more than one-third of the way.

The third test asks, "Let's suppose mismeasurement was in fact happening. What would that imply about the size of the IT sector if we were actually measuring it 'correctly,' in a way we were apparently able to do before the mid-2000s."

As measured, IT-related industries produced $1.4 trillion of measured value added in 2015. That's up from $810 billion in 2004 (expressed in real 2015 dollars). Therefore, real value-added growth in the official statistics was about $600 billion. Suppose the missing $3 trillion from the productivity slowdown actually existed and was somehow captured in the statistics, this would imply the IT sector didn't just grow by $600 billion between 2004 and 2015, but instead by about $3.5 trillion.

So how badly do you think our statistics miss economic activity? Do you think they only measure one-sixth of the growth that has happened? We're only capturing 17% of what's going on out there? I'm not going to answer that question for you, but I find it a little too hard to swallow.

Relatedly, with the "missing" growth added, the IT sector's implied labor productivity growth would be 415% over 2004–2015, instead of the 80% observed in the official statistics. Now, 80% is very robust. 415% is beyond anything we've ever seen in any sector, ever, in measured data. To me, the observed quantities of investment and movement of factors of production don't seem to line up with a sector that is delivering 415% productivity growth.

These figures aren't inherently dispositive. They are numbers plausibility of which you can decide on yourself. I come down thinking that even if you seek to only explain half the puzzle that still implies the true size of the IT sector is multiple times that actually measured in the data. That, to me, again, just doesn't seem plausible.

These numbers are a reflection of a simple fact: the entire IT sector (defined in a way I believe is reasonably generous) accounted for about 8% of GDP in 2004. The missing $3 trillion is 17% of the economy. Do we think we can attribute an incremental missing 17% of the economy to a sector that in total was only 8% of the economy when the slowdown started?

The fourth part of this look at the mismeasurement hypothesis is the issue of income versus output. Conceptually, GDI and GDP are equal by an accounting identity. But they never are exactly equal as measured because they are compiled from different data. As it happens, GDI as measured has been larger on average than GDP since the productivity slowdown started–not every single year, but pretty consistently since 2004 (Fig. 3). The mismeasurement hypothesis-related argument for this is that workers are being paid to make these things that are given away. Their wages show up in GDI, but there is no corresponding expenditure on the product to show up in GDP.

However, this GDI–GDP gap didn't open up right when the productivity slowdown started. Instead, it opened up in 1998, in the heart of a fast productivity growth period (Fig. 4). This doesn't seem to be a slowdown-related phenomenon.

Moreover, if you look where that GDI differential is coming from by breaking it into factor-specific components, all of the increment reflects growth in capital income, not labor income. Employee compensation's share of GDI fell by 2.2% points between 2004 and 2015. Of course, capital income grew commensurately.

It isn't that we are paying workers to make stuff that is given away for free. Instead, it is that companies are making much higher profits than in the past (This profit fact, of course, has been shown in other ways by a number

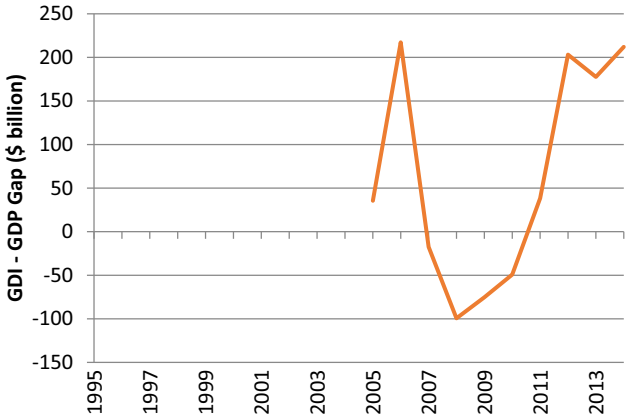

Fig. 3 Gap between GDP and GDI: 2004–2015

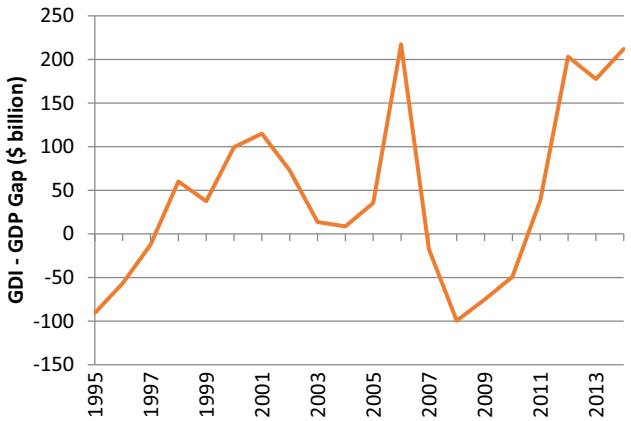

Fig. 4 Gap between GDI and GDP, 1995–2015

of different people.) This just isn't consistent with a story where people are being paid to make things that are then sold at zero or abnormally low prices. In fact, if anything, it implies expenditures are high relative to labor income.

Those are the four tests I conduct in my study. Now, just a few additional notes about the issues that aren't explored deeply in the paper but I think are relevant.

The first is that a large number of people say, "Well, look, there are plenty of good reasons to think GDP is mismeasured." I completely agree. But this has always been true. Measured GDP doesn't always capture what we specifically define it to capture, and it certainly hasn't ever captured total surplus (though sometimes people shorthand GDP as a measure of total wellbeing). However, to explain the productivity slowdown through the mismeasurement hypothesis, one needs to be able to do more than just demonstrate there is mismeasurement. One needs to show that there is some form of mismeasurement starting differentially in the mid-2000s. Moreover, this incremental mismeasurement has to go in the direction necessary to explain a slowdown. A recent paper by Byrne et al. (2016) looks at this issue. They find that if anything measurement actually became better at capturing IT-related output after 2004, not worse. Thus, by their rights, the measured slowdown would be actually larger than we see it in the data.

The second point is that in my four analyses, I took as given the possibility that, as the mismeasurement hypothesis asserts, many new goods post-slowdown are missed in the product accounts because of low or zero prices. However, it is not clear at all that this assertion is correct. To enjoy all these free goods—Facebook, the camera on your phone, Google searches, etc.—you have to purchase complementary goods. You need a smart phone, an iPad, broadband access, and mobile telephony. If companies that sell those complements know what they are doing, they ought to be pricing the value of those "free goods" into the price of the complementary products. Therefore, it isn't like these products are pure zeros in the national accounts. Their value ought to be captured in the value of the complementary products that are required to consume them.

Finally, I'll note that about the same time I was conducting this study, some other folks were finishing other work that also looked at the mismeasurement hypothesis. Their approaches used different methods and data than mine, yet they came to the same conclusion. Thus, we seem to have a fairly robust set of results finding that mismeasurement, while being a plausible source of the productivity slowdown, does not hold up once you actually press it with the data.

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Chad Syverson J. Baum Harris Professor of Economics, The University of Chicago Booth School of Business. His research spans several topics, with a particular focus on the interactions of firm structure, market structure, and productivity. He has authored or coauthored dozens of scholarly articles and is the coauthor (with Austan Goolsbee and Steve Levitt) of the intermediate-level textbook, *Microeconomics*. He is an editor of the *Rand Journal of Economics* and a research associate of the National Bureau of Economic Research. He has served on multiple National Academies' committees and is also on the board of the Chicago Census Research Data Center. He had earned two bachelor's degrees from the University of North Dakota in 1996, one in Economics and one in Mechanical Engineering. After a brief stint working as a mechanical engineer for Unisys Corporation and Loral Defense Systems, he went on to earn a PhD in Economics from the University of Maryland in 2001. He joined the University of Chicago faculty the same year.