Identification and Measurement of the Digital Economy: The Mismeasurement Hypothesis in India

By Mousumi Ganguly, MA Financial Economics, Maastricht University (The Netherlands)

Introduction

A well known problem in measuring the real output, and changes therein, is that issues can often arise due to the introduction of new goods and services in the economy. According to the latest World Economic Outlook published by the IMF in January 2020, global output to grow at 2.9% in 2019, continuing a broadly stagnant, if not outright declining, trend since 2017 (output growth was 3.6% in 2018 and 3.8% in 2017). As India's Gross Domestic Product growth is also dependent on global headwinds, the deceleration of domestic GDP growth since 2017 also mirrors the fall in world output.

A previous edition of the WEO, released in October 2019, estimated India's economy to be the fifth largest in the world, valued at an estimated USD 2.9 trillion. According to the latest figures released by the National Statistical Office, India's GDP grew at 4.8% in H1 of 2019-20. However, the Consumer Confidence Survey conducted by the Reserve Bank of India in January 2020 has a different story to tell – the current situation index has deteriorated considerably over the past 5 years, registering a fall of approximately 15% from 2014 levels, although the future expectations index remained approximately constant compared to 2014 levels.

The contrast between the two is revealing – consumer confidence of the current situation depends on individuals' personal and direct experience, whereas future expectations are also influenced by other factors. When official statistics on economic growth project a glowing narrative, public expectations are influenced accordingly.

There is also a long running debate about the extant to which national income measures output. Under the initial hypothesis of national accounts developed by Simon Kuznets (1934), which is perpetuated to this day, goods and services produced within the home are excluded from computations of output. An early study conducted by the National Bureau of Economic Research in the US in 1921 found that housewives contributed an additional conjectural value equivalent to 30% of the traditional defined national income (Mitchell, King & Macaulay, 1921). More recent estimates peg household production at a range of 31 to 47% of money earnings (Franzis & Stewart, 2011).

Output and income estimates also ignore the impact of introduction of new products, as well as improved quality. A study by Redding and Weinstein (2016) attempted to quantify the same by analyzing a large data set on bar-coded package goods (prices and quantities) over time. By applying a constant-elasticity-of-substitution utility function, they found that conventional price indexes overstate inflation for this set of goods by as much as 5 percentage points because the conventional measure ignores quality and new goods biases.

Furthermore, the advent of the Internet has ushered the economy into a new digital age, where sharing is the order of the day, thus giving rise to free services which are not necessarily captured by conventional statistics. For instance, services like Google, Facebook & Youtube, along with other information on the internet, are available for anyone with an Internet connection for zero marginal payment. Uber's ridesharing revolution, for example, is an example of tapping into unused marginal productivity of capital, which has eventually led to the development of uncaptured GDP.

The figure below summarizes the processes involved here. Because of the better value proposition offered by Uber, there is a shift from usage of regular taxis to Uber rideshares, thus leading to a rise in the price of regular taxis (and correspondingly lower demand), as well as a fall in the price of Uber taxis due to a rise in the total number of trips travelled. Thus, this virtuous cycle of low cost and a more valuable service offering leads to a disruptive business model that has helped Uber to succeed.
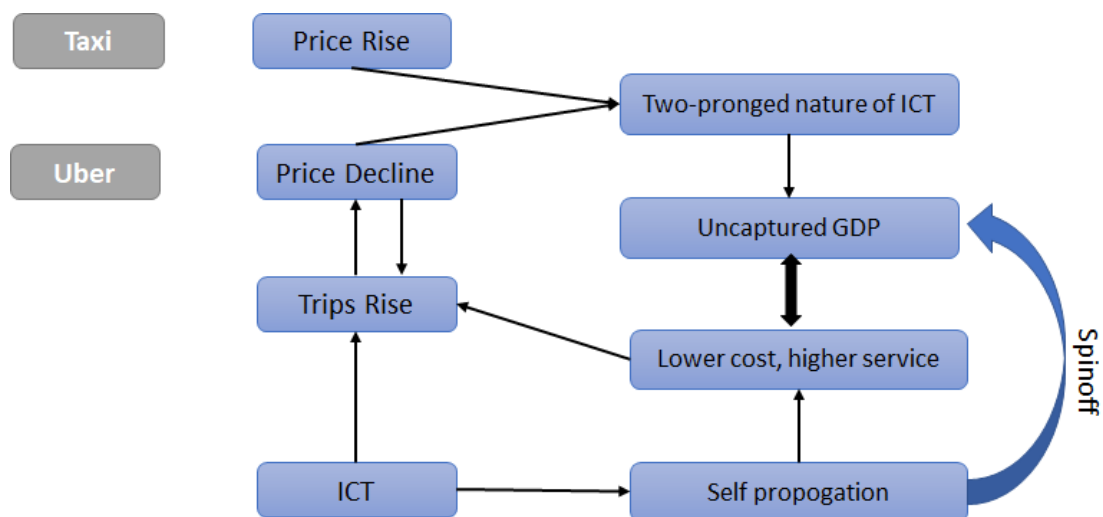

This paper attempts to quantify the impact of the uncaptured GDP due to mismeasurement of the digital economy by focusing on labor productivity growth.

Productivity slowdown

Labor productivity is defined as the ratio of real output to the number of hours worked by all employed persons. The problems with measure output i.e. the numerator, have been discussed in the previous section. Because changes in the quality of existing products and introduction of new products have not been incorporated, real output has grown faster than measured output and therefore the rate of productivity growth suffers from mismeasurement leading to chronic underestimation. A study by Triplett and Bosworth (2004) found that the productivity growth was negative i.e. that productivity had actually declined in service industries like entertainment, health care ,etc. An actual productivity decline in these sectors was unlikely given general macroeconomic trends at the time, and hence the results were probably reflective of a measurement problem.

The labor productivity slowdown is not a unique phenomenon limited to India – it has been observed in multiple developed economies as well. The United States, for example, registered an average labor productivity growth of 2.8% annually from 1995 to 2004, which slowed to an average annual labor productivity growth of 1.3% from 2005 to 2015 (Syverson, 2016). This is a well documented phenomenon in multiple academic research articles, some of which have been discussed in the paragraphs below.

The impact of low labor productivity growth could be attributed to the global financial crisis and recession a decade ago, due to consumer uncertainty about recovery. However, data indicates that the labor productivity slowdown began before the onset of the recession (though lack of consumer confidence may very well be a continuing factor in hampering growth). Cowen (2011) puts forward the hypothesis that since the lowest hanging fruit in terms of the easy innovations have already been exploited, which means that growth levels must necessarily be lower than those recorded previously. According to him, as technology advances, there is an initial rise in prices due to development of new functionalities. However, prices soon drop sharply as technology makes it easier to develop competitive offerings at a lower price, leading to mass standardization. The figure below, from Cohen (2011), illustrates the emergence of uncaptured GDP due to technological advancement.
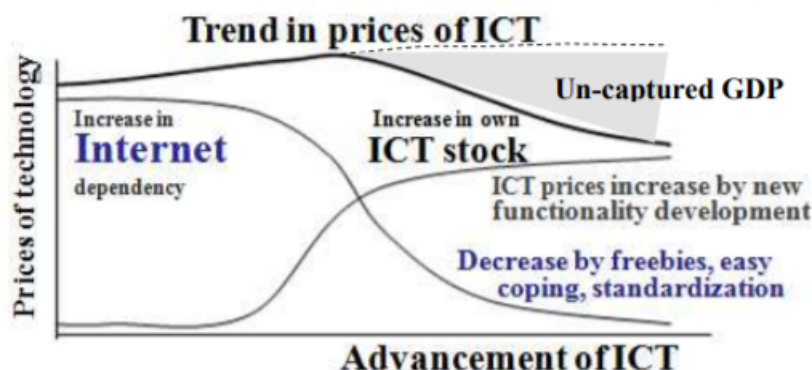
Yet another view puts forth the argument that the IT revolution boosted productivity to abnormally high levels in the first decade of this century, and the present slowdown in labour productivity growth is no slowdown at all, but rather a return to historically average levels (Gordon, 2013).
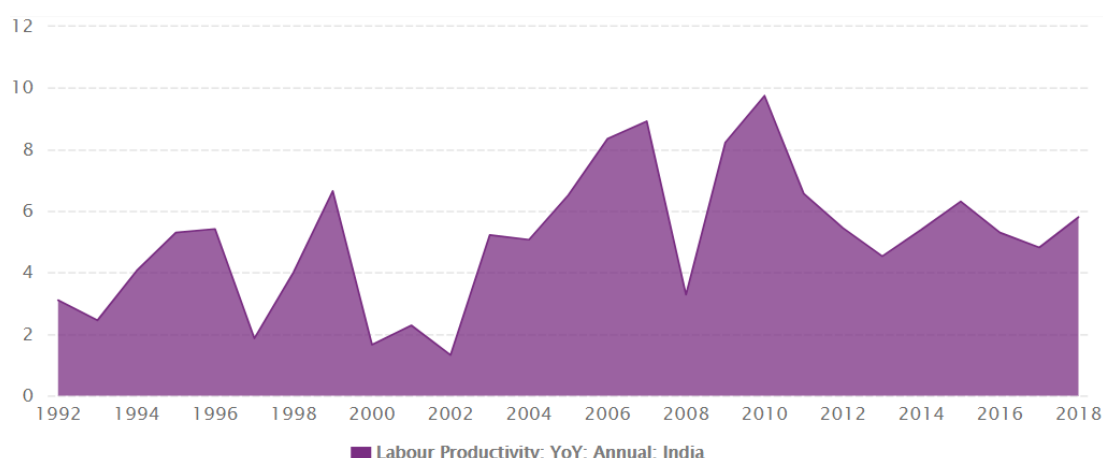
The chart above depicts the annual labor productivity growth in India since liberalization. Over the past decade, since 2002-10, the labor productivity grew consistently, with a dip in 2008 to account for the global financial crisis. However, 2010 onwards, the growth in labor productivity has slowed down. Though it is still positive, it is nowhere near the levels that need to be achieved if India is to achieve its goal of becoming a $5 tn economy.

The Mismeasurement Hypothesis in labor productivity: Research Questions

Conventional wisdom suggests that with increasing digitalization and automation, labor productivity should also have risen commensurately. However, the opposite has occurred, giving rise to the mismeasurement hypothesis. This mismeasurement hypothesis holds that conventional methods used to measure GDP are failing to capture new "digital" products and services, which end up getting excluded from official economic statistics. Thus, this research

paper tries to quantify the extent of mismeasurement, if any, by trying to answer the following questions?

1. Is this fall in productivity limited to India, or has it happened elsewhere as well? How is it related to technology intensity?
2. Technologies such as broadband that enable to the Internet have resulted in productivity synergies. How can they be quantified?
3. If the missing GDP growth were added back to the economy, how large would the IT sector be? Does it seem plausible?
4. Is there a major difference between income and output i.e. GDI & GDP?

Labor productivity & Technology Intensity

As discussed previously, the trend of declining labor productivity is one that has been widely observed across developed economies and confirmed by multiple studies (Connolly and Gustafsson, 2013; Pessoa and Van Reenen, 2014; Cette, Fernald, and Mojon, 2016).

These research papers also posit that the productivity slowdown began well before the financial crisis. To determine whether the slowdown in these economies was caused by mismeasurement linked to the IT industry, the relevance of the technology industry has been compared vis-à-vis the extent of a slowdown in a country. In addition to India, I considered 20 countries from the OECD, and compared the change in labor productivity with the percentage of household with broadband access and the percentage of IT value added products (both metrics used as proxies for technology intensity to determine the importance of the IT industry to the overall economy of that particular country). The results are depicted in the table below.

Country Name	Labor Productivity Growth%	%HH with broadband	%IT GVA
ESP	0,85	65	5,15
PRT	-0,5	62	4,3
ITA	-0,38	55	4,65
TUR	-1,35	34	2,35
CZE	-0,83	75	1,55
HUN	-0,65	63	2,6
POL	-2,65	55	3,1
IRL	-2,3	60	11,5

FRA	-1,65	68	4,55
BEL	-1,25	70	3,25
DEU	-1,3	78	4,1
AU	-1,42	71	5,6
USA	-1,57	68	6,15
KOR	-0,77	88	9
FIN	-2,45	67	8,5
NOR	-2,25	85	5,15
NLD	-0,9	83	7,65
CAN	-1,51	75	4,65
SWE	-2	76	3,15
IND	4.35	8	7,2

As the above data shows, the labour productivity slowdown is a constant across all developed economies – India and Spain are the only two economies which have witnessed a marginally positive growth in labor productivity over the time period considered. Furthermore, upon conducting a covariance analysis between the percentage of households with broadband access and the extent of the labor productivity slowdown, no relationship makes itself apparent. A similar statistically insignificant relationship is obtained when the change in labor factor productivity is regressed upon the IT gross valued added. Thus, based upon the above data, we may conclude the extent of decline in labor productivity is not influenced by ICT related measures of consumption. These results are in line with those presented in a research paper by the IMF, which found that slowdown in total factor productivity growth are uncorrelated with measures of IT intensities. A caveat regarding the validity of the results, however – the rise of mobile data has not been considered as a measure of IT intensity, which could potentially affect the results.

Quantification of Productivity Synergies

The phenomenon of technology leading to very high productivity synergies vis-à-vis the expenditure incurred on them has been discussed previously in this paper. In a study by Goolsbee & Klenow (2006), the total consumption of a good included not only the financial expenditure, but also the time commitment. Thus, in order to assess the value of digital technologies, the total time spent online was used as a metric. Based on 2005 levels, they found that the consumer surplus of internet access, (valued at actual spend +value of leisure time) was valued at around USD 3,000 per person annually, based on the median household

income of their data set. Brynjolfsson et al (2019) extended the Goolsbee & Klenow time use model with an updated data set, and valued the gain from digital services at over USD 120 billion for the US economy.

In this research paper, I extend the Goolsbee & Klenow model to the Indian economy. The disposable income per capita amounted to around Rs. 23,485 annually as of 2018. According to the time use survey by the Ministry of Statistics & Program implementation, as of 2013, out of 168 hours in the week, the average male spends around 42 hours on productive activities, and the average female spends around 19 hours. The average person spent around 6.5 hours a day on non work related activities. Assuming that all these 6.5 hours are leisure time, valued at the minimum wage rate of Rs. 48 per hour, implies that the value of leisure time is Rs. 1,13,880/- per person per annum. Adding this back to the per capita disposable income gives a net value of Rs. 1,37,365/-. However, due to limited access to the internet across households, working on the assumption that only 25% of individuals are able to access the internet and thereby benefit from digital products and enjoy consumer surplus, implies that the aggregate benefit from digital products is around USD 66.29 bn i.e. which amounts to around 3% of India's total GDP.

This calculation is based on multiple assumptions, such as limited access to internet, but as mobile telephony rates continue to become more affordable and human capital formation increases sufficiently to the extent that internet penetration is able to percolate to the bottom of the pyramid, the value of uncaptured GDP should keep increasing as well.

**The "Missing" GDP growth vis-à-vis the IT industry**

If GDP is being mismeasured due to the digital economy, then the i.e. the IT and tech industries, then this should make itself apparent in the size of the IT industry. The following sectors of National Industrial Classification system by the Central Statistics Organization have been included – Division 26 (Manufacture of computer, electronic and optical products), Division 27 (Manufacture of electrical equipment), Division 62 (Computer programming, consultancy and related activities), Division 63 (Information service activities) have been considered as part of this analysis.

In 2005, the total revenue generated by these sectors on GVA basis in India was USD 21.85 bn. As of 2017, it increased to USD 128.62 bn. Therefore, these sectors added a net value of USD 106.77 bn. I had previously estimated that the uncaptured GDP due to mismeasurement of consumer surplus amounted to an additional 3% of total GDP annually

i.e. the IT industry would have to generate annual revenues of well over over USD 500 bn in 2017in order for the mismeasurement hypothesis to hold good.

Income & Output

There is always a difference between GDP and GDI – although the two concepts are similar in theory – because of the nature of the data used to construct both measures. The chart below, developed by the RBI, shows the statistical difference (SD) between GDP and GDI for multiple economies:
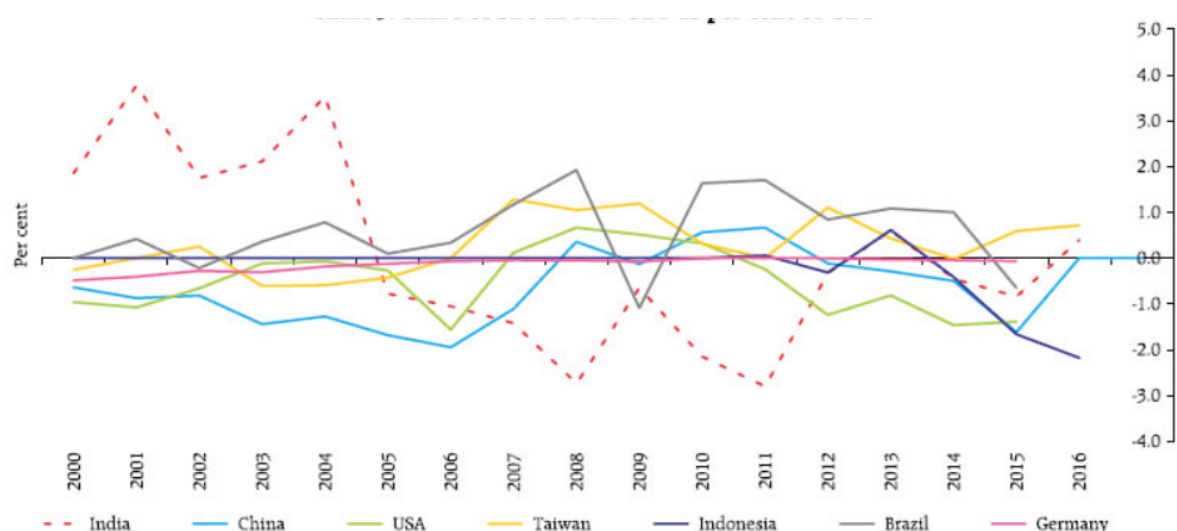
As the chart depicts, the SD can quite large at times, with GDI consistently outpacing GDP for the period 2005-12 for India. Thereafter, for the period 2012-16, although the extent of the SD has lessened, it is nonetheless significant. Thus, this could be indicative of the fact that employees (whose earnings form part of GDI) are being paid to provide services which are "sold" at highly discounted prices (thus reducing the effect of GDP). However, several arguments can be made against this conclusion, namely:

- For other countries in the data set, such as China and the US, the SD began making itself apparent before 2005 i.e. prior to the tech revolution and the beginnings of the mismeasurement problem.
- Other countries like Germany, with a significant degree of digital intensity as well as IT GVA for the economy, do not exhibit any divergence between GDI and GDP.
- Furthermore, it is entirely possible that other factors (and not rise in wages) are responsible for the increase in GDI, such as a rise in capital expenditure, depreciation or reduction in taxes.

Conclusion & Areas of future research

At the outset, I had framed the following research questions. In the paragraphs below, a brief summary of the results have been outlined:

1. Is this fall in productivity limited to India, or has it happened elsewhere as well? How is it related to technology intensity?

The slowdown in labor productivity growth is not unique to India, but has occurred in multiple developed economies as well, where the magnitude is much more severe. Furthermore, the extent of IT intensity of a particular economy does not appear to be correlated to the extent of the slowdown.

2. Technologies such as broadband that enable to the Internet have resulted in productivity synergies. How can they be quantified?

Based on estimates of consumer surplus due to digital access (analysis previously carried out for the US but now extended for India), indicates that we could potentially add as much as 3% to GDP, using by valuing leisure time very generously. However, this would require making changes to the calculation of GDP as well.

3. If the missing GDP growth were added back to the economy, how large would the IT sector be? Does it seem plausible?

For the mismeasurement hypothesis to substantially affect GDP, the real size of the technology industry would have to be nearly 3 times its current size, which does not seem plausible.

4. Is there a major difference between income and output i.e. GDI & GDP?

When comparing GDI with GDP, it is observed that GDI is on the higher side vis-à-vis GDP, perhaps because workers are being paid to produce things that are sold for free. However, there could be multiple explanations for these observations unrelated to mismeasurement of the digital sector.

In order to further quantify the extent of mismeasurement, further research would be required in order to determine the reasons for divergence between GDP and GDI. Furthermore, determining the exact value of "free" digital products and services would also be helpful in quantifying their contribution to the GDP.

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