

Good Study. Should be put up.

Need to include a formal section on

Overlooking Taxes in GDP (Mis)estimation.

Is this Justified?

Hypothesis testing.

Enhance contentions

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Background and Motivation

"India changed its data sources and methodology for estimating real gross domestic product (GDP) for the period since 2011-12"¹.

Arvind Subramanian, (former Chief Economic Advisor of Indian Government and Currently, Professor at the Harvard School of Business), published a paper "India's GDP Mis-estimation: Likelihood, Magnitudes, Mechanism, and Implications"¹ which proposes that the changes in the methodology of estimation have ~~to lead~~ ^{led} to "significant overestimation of growth". The official estimates place annual average GDP growth between 2011-12 and 2016-17 at about 7 percent. Whereas the paper¹ that estimates "that actual growth may have been about 4 1/2 % with a 95 % confidence interval of 3 1/2 - 5 1/2 %". Hence, the author tries to prove that there is a misestimation of India's GDP in the Post Period ^(citation)

In paper¹ the author divides the study¹ into two periods 2001-2011 and 2012-2016, which we will refer to as the Pre-2011 and Post-2011 periods. To establish the problem of overestimation of GDP, the author studies the correlation between 17 "real indicators" of economic growth, with annual GDP growth. These indicators include electricity consumption, 2-wheeler sales, petroleum consumption, cement, steel, etc.

✓ The argument is that if there is no misestimation or overestimation of India's GDP in the post-period, then the correlation between these economic indicators and GDP growth should be similar in the Pre and Post Period.

After establishing a problem, the author identifies specific indicators that co-move with growth and are easy to produce. Then, the author relates these indicators with the GDP growth rate for a comparable set of countries for the pre-2011 and post-2011 period, to study whether India shows the same trend as compared to other countries or it is an outlier in one or both of these periods. The point that we need to note here, is that the

- ① Quotes directly picked up need references.
- ② Other minor comments in writing.
- ③ Hypothesis Testing section

author has not taken tax as an indicator of GDP in his study. In the follow-up paper "Validating India's GDP Growth Estimates"², he provides an argument for not including tax in his original paper¹.

The argument in the follow up paper² is based on the fact that the India's Tax-GDP ratio rose in the Post-2011 period from 10% in 2011-12 to 11% in 2016-17, which suggests that the "rising revenue-GDP ratios tend to suggest surging growth."² However, as stated in the paper², "revenues are affected by more than just economic growth; they are also affected by changes in tax policies and administration". Hence, due to factors like increase in-direct tax collection due to the fall in petroleum prices in the international markets in 2014³ and decreasing direct tax growth rate in the post-2011 period, taxes cannot be used to infer much about GDP growth. Therefore, the author has not taken tax as an indicator of GDP in his study¹.

Problem / Analysis Query

We propose to perform an extensive econometric analysis of these claims and test whether tax data should have been included or not included while testing the misestimation of the GDP of India.

The Economic Advisory Council to the Prime Minister (EAC-PM) in its rebuttal⁴ to (Arvind Subramanian paper)^{Subramanian(2014)} stated that :

"Unlike many indicators, tax data is not collected through surveys or by agencies through arcane techniques, these are hard numbers and should be an important indicator of growth. Further, there have been no major changes in tax laws until the end period in the author's analysis (31st March 2017). GST was introduced on 1st July 2017. The author's logic of not using tax data appears to be a convenient argument meant to avoid inconvenient conclusions based on hard facts."

The EAC-PM raised concerns over the fact that Arvind Subramanian didn't include taxes in his study¹, but as stated, taxes are "hard numbers and should be an important indicator of growth." EAC-PM also argues that the tax plays an essential role in the GDP growth rate of the country, and should be considered as one of the fundamental indicators of growth of a country.

Therefore, we propose to perform an extensive econometric analysis of these claims and test whether tax should have been included or not included while testing the misestimation of the GDP of India.

1. *Prima facie*, is there a problem?

We will replicate the author's econ analysis including tax indicators. CSS

[We will first test whether a problem exists in the estimation of GDP.] The author has done the same analysis by calculating the correlation between India's GDP growth and Growth Indicators for two periods. We will perform the corresponding analysis, but with the addition of Tax in the growth indicators.

Using this, we can infer :

- Whether tax behaves similar to other indicators in the two periods/ Which can be used to test the EAC-PM argument.
- Is there a difference in the relation between GDP and tax, in the Pre-2011 and Post-2011 period. We are thereby testing whether a problem of misestimation exists or not.

Regressions

$$GDP\ Growth_i = \beta_0 + \beta_1 * Credit\ Growth_i + \beta_2 * Export\ Growth_i + \beta_3 * Import\ Growth_i + \beta_4 * India\ Dummy + \epsilon_i \quad \text{----- (1)}$$

β_1 - Represent the magnitude change in GDP with respect to a unit change in Credit Growth

β_2 - Represent the magnitude change in GDP with respect to a unit change in Export Growth

β_3 - Represent the magnitude change in GDP with respect to a unit change in Import Growth

β_4 - Coefficient of dummy variable, (captures if India is significantly different from other countries) [SS]

$$GDP\ Growth_i = \beta_0 + \beta_1 * Credit\ Growth_i + \beta_2 * Export\ Growth_i + \beta_3 * Import\ Growth_i + \beta_4 * India\ Dummy + \beta_5 * Tax(\% \text{ of GDP}) + \epsilon_i \quad \text{----- (2)}$$

β_1 - Represent the magnitude change in GDP with respect to a unit change in Credit Growth

β_2 - Represent the magnitude change in GDP with respect to a unit change in Export Growth

β_3 - Represent the magnitude change in GDP with respect to a unit change in Import Growth

β_4 - Coefficient of dummy variable

β_5 - Represent the magnitude change in GDP with respect to a unit change in Tax

$$GDP\ Growth_i = \beta_0 + \beta_1 * Credit\ Growth_i + \beta_2 * Export\ Growth_i + \beta_3 * Tax(\% \text{ of GDP}) + \beta_4 * Import\ Growth_i + \beta_5 * India\ Dummy * t + \beta_6 * India\ Dummy + \beta_7 * Credit\ Growth_i * t + \beta_8 * Export\ Growth_i * t + \beta_9 * Import\ Growth_i * t + \beta_{10} * Tax(\% \text{ of GDP}) * t + \epsilon_i \quad \text{----- (3)}$$

β_1 - Represent the magnitude change in GDP with respect to a unit change in Credit Growth

β_2 - Represent the magnitude change in GDP with respect to a unit change in Export Growth

β_3 - Represent the magnitude change in GDP with respect to a unit change in Tax

β_4 - Represent the magnitude change in GDP with respect to a unit change in Import Growth

β_5 - Coefficient of dummy variable for post period

β_6 - Coefficient of dummy variable for India

β_7 - Represent the magnitude change in GDP with respect to a unit change in Credit Growth in post period

β_8 - Represent the magnitude change in GDP with respect to a unit change in Export Growth in post period

β_9 - Represent the magnitude change in GDP with respect to a unit change in Import Growth in post period

① What is t-?

dummy for time periods $\left\{ \begin{array}{l} \text{Pre} \\ \text{Post} \end{array} \right\}$ [SS]

② Hypothesis (G comment)

β_{10} - Represent the magnitude change in GDP with respect to a unit change in Tax in post period

2. Omitted Variable Bias

Omitted variable bias occurs when a relevant variable is excluded from a statistical model.

We will test for omitted variable bias in the regression (1), due to the exclusion of tax. In this, we will calculate correlation of Tax Revenue(% of GDP) with the GDP Growth Rate, Domestic credit to the Private sector, Exports of Goods and Services and Imports of Goods and Services. \rightarrow growth rates/ absolutes?

We will analyze these correlation values, and see if these conditions for Omitted variable bias exist.

1. The tax variable is significantly related to one of the predictors.
2. Tax variable is a significant determinant of GDP growth.

If the two conditions above follow, it would result in the violation of OLS assumption $E(UX)=0$, which would result in an omitted variable bias.

We will also compare the adjusted R-squares of the regression models (1) and (2), to find how well the variation in the GDP growth is explained with and without inclusion of Tax.

3. Regression Analysis

To study the relation of taxes with GDP, the author has studied the regression (1) and regression (3) (with the exclusion of taxes). We will perform the same regression (1) and regression (2), (which is the same as regression (1), but with the inclusion of taxes), for the period (Pre-2011 and Post 2011) for a set of countries.

For the regression (3) the author states that :

"Statistically speaking we are deploying the spirit of a "difference-in-differences" technique. Here the treatment is the methodology change in India; the treatment period is post-2011. We are then testing whether the treatment had a differential impact on the relationship between the indicators and GDP growth in the post-2011 period: put differently, was India differentially affected in the post-2011 period compared to countries." (Arvind Subramanian, 2019, p. 9)

Since we are interested in understanding what happens after we add the tax to the original analysis in the paper, ~~Therefore~~ ~~There~~ we will perform ~~the~~ regression (3) using which we can infer whether India is still an outlier in the Post-2011 period or not.

Note: (Don't Calculate)

1. Electricity: We have not selected electricity consumption along with other Indicators. The government of India has put in policies to achieve 100 percent electrification during the post-2011 period⁵. Due to which electricity consumption for India could behave differently from the other countries selected. Electricity can, therefore, become a proxy indicator of India dummy variable, since it behaves very differently as compared to other countries. Due to which we would not be able to test whether India is an outlier, using India's dummy variable. ✓
2. Period: We have selected the post-2011 period from 2011 to 2015 and excluded 2016 from our analysis as demonetization happened in India in November 2016, which served as an internal shock to the Indian economy. Therefore, we have decided no to include 2016 in our analysis. ✓
3. Countries Selection: We have selected the top 50 countries, listed by their GDP as per the United Nations. Since we needed a group of countries whose GDP is comparable to India, hence we have selected the top Countries ranked by their GDP in our analysis. ✓
4. Tax: To include tax as an indicator of GDP, in the original analysis, we have included Tax Revenue(% of GDP). Because it is a percentage, not an absolute value, therefore can be used to compare Tax revenue of different countries easily. ✓

Variables and Their Descriptions. :

S.No.	Variable	Description	Notation
1	GDP growth (annual %)	The annual GDP growth of a country	GDP Growth
2	Domestic credit to private sector (% of GDP)	Domestic credit to private sector refers to financial resources provided to the private sector by financial corporations, such as through loans, purchases of non-equity securities, and trade credits and other accounts receivable, that establish a claim for repayment. ⁷	Credit Growth
3	Exports of goods and services (annual % growth)	The annual growth rate of exports of goods and services based on constant local currency. Aggregates are based on constant 2010 U.S. dollars. Exports of goods and services represent the value of all goods and other market services provided to the rest of the world. They include the value of merchandise, freight, insurance, transport, travel, royalties, license fees, and other services, such as communication, construction, financial, information, business, personal, and government services. They exclude compensation of employees and	Exports Growth

		investment income (formerly called factor services) and transfer payments. ⁸	
4	Imports of goods and services (annual % growth)	The annual growth rate of imports of goods and services based on constant local currency. Aggregates are based on constant 2010 U.S. dollars. Imports of goods and services represent the value of all goods and other market services received from the rest of the world. They include the value of merchandise, freight, insurance, transport, travel, royalties, license fees, and other services, such as communication, construction, financial, information, business, personal, and government services. They exclude compensation of employees and investment income (formerly called factor services) and transfer payments. ⁹	Import Growth
5	Tax revenue (% of GDP)	Tax revenue refers to compulsory transfers to the central government for public purposes. Certain compulsory transfers such as fines, penalties, and most social security contributions are excluded. Refunds and corrections of erroneously collected tax revenue are treated as negative revenue. ¹⁰	Tax Growth

Note :

- All Variables in the above table were acquired from WDI Database([Link](#)).

Summary Statistics

Sno	Variable Name	Mean	Standard Deviation	Minimum	Maximum
1.	GDP growth (annual %)	3.315	4.2	-33.10	54.16
2.	Domestic credit to private sector (% of GDP)	82.54	51.8	0	206.67
3.	Exports of goods and services (annual % growth)	4.94	8.9	-30.01	85.61

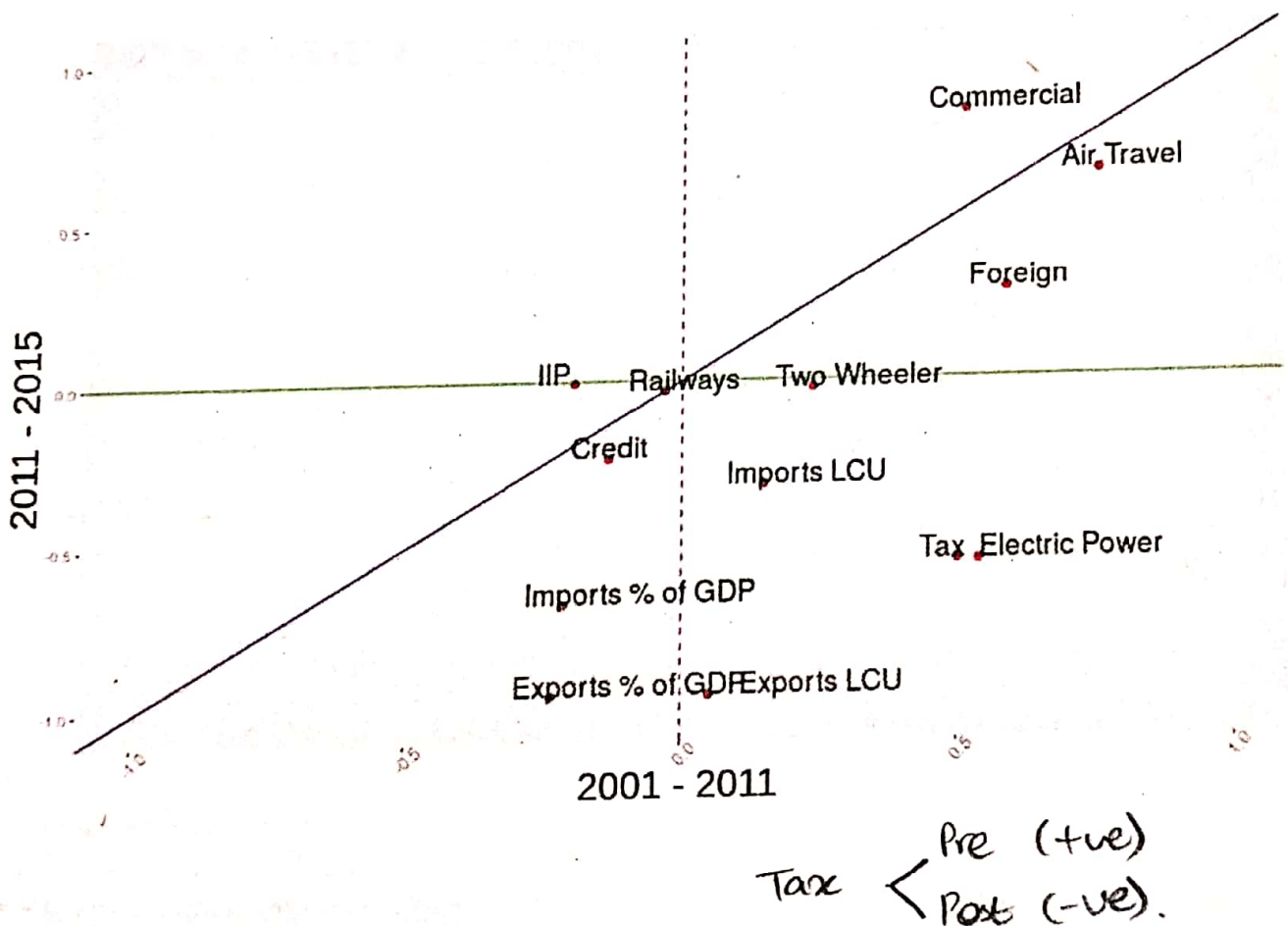
① outliers check -?

4.	Imports of goods and services (annual % growth)	5.46	10.74	-50.05	84.74
5.	Tax revenue (% of GDP)	14.6	8.90	0	36.50

Results

1. Relation Between GDP And Indicators

The correlations of GDP and indicators is depicted in figure.



- Each point X-coordinate depicts the correlation of GDP Growth rate and the growth of the indicator rate for the Pre-2011 period, and the Y-coordinate depicts the same for Post 2011 period.
- What we find is that 8 out of 13 indicators are positively correlated with the GDP growth in the Pre-2011 period, whereas 10 of these 13 indicators have a negative correlation with the GDP growth in the Post-2011 period.
- The Tax Revenue(% of GDP) (referred to as Tax hereafter), has +0.5 correlation with GDP Growth Rate in Pre-2011 period with p-value of 0.11 at 95% confidence level. However, with -0.5 correlation with GDP Growth Rate with p-value of 0.44 at 95% confidence level. (significant in both cases)
- Thus, we can infer that Tax is behaving similar to other growth indicators, which were changing like Electricity, Steel etc.

Figure 1

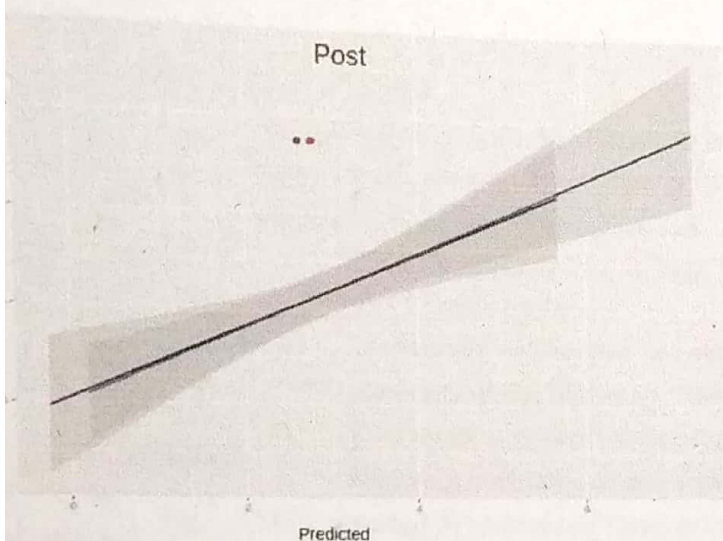


Figure 2(a)

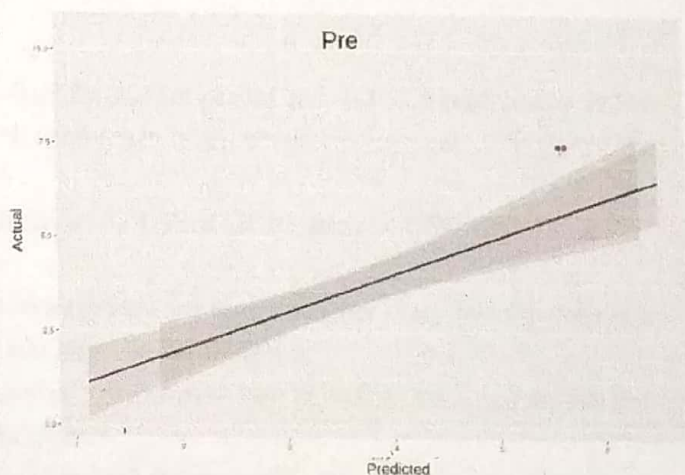


Figure 2(b)

- WITHOUT TAX
- WITH TAX

2. Omitted Variable Bias

- Tax is a significant predictor of GDP growth, which is evident from Table no. 3 and Table no. 4, where tax variable is significant at 0.1% confidence level for both the periods.

0.1%

• The tax is correlated with Domestic Credit to the private sector variable, with a correlation coefficient of 0.46, with high significance (refer table no. 6) for the Pre-period and with a correlation coefficient of 0.44, with high significance for the Post-period.

Both these observations confirm the correlation between tax and domestic credit variables. This implies that the basic OLS assumption that $E(X/U)=0$, is not satisfied when tax is not included. Thus excluding tax leads to an omitted variable bias in the estimation of GDP.

Moreover, on comparing R-squared values of Regressions (1) and (2) (see Table5), it is clear that including taxes in the regression helped to explain more about the variation in the GDP growth.

1. Regression Analysis

- a. The estimated β_5 in the regression(2) is -0.08 for the pre period and -0.10 for post period (refer Table 3 and Table 4) , significant at 0.1% confidence level, which implies that GDP growth rate and tax revenue are inversely related.
 - i. If the tax revenue of a country decrease by 1(% of GDP), then its GDP Growth rate should increase by 0.1
 - ii. This should not happen because, if a country has higher tax revenue, then the country's government has higher income, has more power to spend.
 - iii. This result supports Dr. Subramanian's decision of not including tax, since tax are not behaving normally, as other indicators.
- b. The estimated β_5 variable of Regression (3) is 2.39 at 1% significance level, which represents that India behaved as an outlier in the post period, which was our treatment period for diff-in-diff analysis.
- c. Moreover, Fig -2(a) and Fig -2(b), which depict the plot for actual versus predicted GDP growth for the two periods, clearly show that India behaved as an outlier for the post period, irrespective of whether tax was included or not. India lies far up from the predicted-actual GDP growth line.

but, the tax revenue is also as a % age of GDP. Rewrite w/ this caveat. [SS]

Conclusion

- EAC-PM was valid to suggest the inclusion of taxes in the estimation of GDP.

- There are structural changes in the GDP in the Post-2011 period, which was more apparent after the inclusion of taxes.
- There is an Omitted variable bias in the regression. *Explain - Incomplete.*
- The author's decision of the exclusion of taxes is also verified from our study. ✓

References

- [1] (n.d.). India's GDP Mis-estimation - Harvard Kennedy School. Retrieved November 7, 2019, from <https://www.hks.harvard.edu/centers/cid/publications/faculty-working-papers/india-gdp-overestimate>
- [2] (n.d.). Validating India's GDP Growth Estimates | Harvard Kennedy Retrieved November 12, 2019, from <https://www.hks.harvard.edu/centers/cid/publications/faculty-working-papers/india-gdp>
- [3] (2014, December 8). Why the oil price is falling - The Economist explains. Retrieved November 12, 2019, from <https://www.economist.com/the-economist-explains/2014/12/08/why-the-oil-price-is-falling>
- [4] (2019, June 19). EAC-PM Paper on GDP Estimates in India - Economic Retrieved November 12, 2019, from https://eacpm.gov.in/wp-content/uploads/2019/06/EAC-Paper_GDP-estimation_19-June-2019.pdf
- [5] (2018, April 30). As Modi Claims 100% Electrification Feat, Govt Data Show 94 Retrieved November 12, 2019, from <https://www.news18.com/news/india/as-modi-claims-100-electrification-feat-govt-data-shows-94-villages-were-already-electrified-1734107.html>
- [6] (2018, September 1). India's Demonetization Drive: A Necessary Jolt Towards A Retrieved November 12, 2019, from <https://www.forbes.com/sites/nusbusinessschool/2018/09/01/indias-demonetization-drive-a-necessary-jolt-towards-a-more-digital-economy/>
- [7] (n.d.). Domestic credit to private sector (% of GDP) by ... - IndexMundi. Retrieved November 7, 2019, from <https://www.indexmundi.com/facts/indicators/FS.AST.PRVT.GD.ZS>
- [8] (n.d.). Exports of goods and services (annual % growth ... - IndexMundi. Retrieved November 7, 2019, from <https://www.indexmundi.com/facts/indicators/NE.EXP.GNFS.KD.ZG>
- [9] (n.d.). Imports of goods and services (annual % growth ... - IndexMundi. Retrieved November 7, 2019, from <https://www.indexmundi.com/facts/indicators/NE.IMP.GNFS.KD.ZG>
- [10] (n.d.). Tax revenue (% of GDP) by Country - IndexMundi. Retrieved November 7, 2019, from <https://www.indexmundi.com/facts/indicators/GC.TAX.TOTL.GD.ZS>

Tables

2001-2011 Without Tax				
Variables	Estimate	Std. Error	t-value	Pr(> t)

Intercept	3.26	0.35	9.41	2e-16***
India_Dummy	1.07	1.20	0.89	0.000549 ***
Domestic credit to the private sector	-0.01	0.003	-3.48	0.000549 ***
Exports of goods and services	0.06	0.02	2.68	0.007527 **
Imports of goods and services	0.12	0.02	6.49	1.99e-10 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 3.892 on 534 degrees of freedom

Multiple R-squared: 0.22, Adjusted R-squared: 0.22

F-statistic: 38.24 on 4 and 534 DF, p-value: < 2.2e-16

Table - 1

2011-2015 Without Tax

Variables	Estimate	Std. Error	t-value	Pr(> t)
Intercept	3.22	0.37	8.661	1.95e-15 ***
India_Dummy	4.35	1.32	3.29	0.001 **
Domestic credit to the private sector	-0.01	0.003	-3.58	0.0004 ***
Exports of goods and services	0.08	0.03	2.42	0.02 *
Imports of goods and services	0.18	0.03	5.99	1.03e-08 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 3.845 on 533 degrees of freedom

Multiple R-squared: 0.2428, Adjusted R-squared: 0.2357

F-statistic: 34.19 on 5 and 533 DF, p-value: < 2.2e-16

Table - 2

2001-2011 With Tax				
Variables	Estimate	Std. Error	t-value	Pr(> t)
Intercept	3.94	0.39	10.18	2e-16 ***
India_Dummy	1.01	1.19	0.85	0.40
Domestic credit to the private sector	-0.01	0.003	-1.86	0.06
Exports of goods and services	0.05	0.02	2.38	0.018 *
Imports of goods and services	0.12	0.02	6.70	5.4e-11 ***
Tax revenue	-0.08	0.02	-3.77	0.000183 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 3.845 on 533 degrees of freedom
 Multiple R-squared: 0.24, Adjusted R-squared: 0.24
 F-statistic: 34.19 on 5 and 533 DF, p-value: < 2.2e-16

Table - 3

2011-2015 With Tax				
Variables	Estimate	Std. Error	t-value	Pr(> t)
Intercept	4.24	0.42	10.02	<2e-16 ***
India_Dummy	4.19	1.26	3.32	0.03 *
Domestic credit to the private sector	-0.01	0.003	-2.23	0.03 *
Exports of goods and services	0.07	0.03	2.26	0.02 *
Imports of goods and services	0.20	0.03	6.81	1.26e-10 ***

Tax revenue	-0.10	0.02	-4.43	1.58e-05 ***
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1				
Residual standard error: 2.474 on 190 degrees of freedom				
Multiple R-squared: 0.3883, Adjusted R-squared: 0.3722				
F-statistic: 24.12 on 5 and 190 DF, p-value: < 2.2e-16				

Table - 4

R-Sq Comparison		
Time Period	Without Tax R-sq (Adjusted)	With tax R-sq (Adjusted)
2002 - 2001	0.21	0.23
2011 - 2015	0.31	0.37

Table - 5

Time Period	Correlation Value	GDP Growth	Domestic credit to private sector (% of GDP)	Exports of goods and services (annual % growth)	Imports of goods and services (annual % growth)
Pre (2001 -11)	Correlation coefficient	-0.24	0.46	-0.15	-0.11
	P Value	5.124e-08	< 2.2e-16	0.0009	0.01
Post (2011 -15)	Correlation coefficient	-0.36	0.44	-0.04	0.04
	P Value	1.054e-06	1.075e-09	0.57	0.58

Table 6

Regression 3				
Variables	Estimate	Std. Error	t-value	Pr(> t)
Intercept	3.92	0.36	11.04	<2e-16 ***
Domestic credit to the private sector	-0.006	0.003	-2	0.45 *
Exports of goods and services	0.05	0.02	2.58	0.01 *
Imports of goods and services.	0.12	0.02	7.30	7.60e-13 ***
Tax revenue....of.GDP.	-0.08	0.03	-4.08	4.86e-05 ***
India_Dummy	1.86	1.09	1.70	0.08 .
T	0.30	0.70	0.43	0.66
India_Dummy:T	2.38	2.10	1.13	0.25 **
Domestic credit to the private sector.:T	-0.002	0.006	-0.23	0.81
Exports of goods and services:T	0.02	0.05	0.36	0.71
Imports of goods and services:T	0.07	0.04	1.63	0.10
Tax revenue:T	-0.02	0.04	-0.65	0.52

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 2.474 on 190 degrees of freedom
 Multiple R-squared: 0.3883, Adjusted R-squared: 0.3722
 F-statistic: 24.12 on 5 and 190 DF, p-value: < 2.2e-16

OVERLOOKING TAXES IN GDP (MIS) ESTIMATION :
Is this justified?

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which paper cite properly

use of a acronym before full form is bad habit informally up

1 Introduction

Arvind Subramanian (Former CEA to the Government of India) in his paper stated that "because of the major changes in direct and indirect taxes in the post-2011 period which render the tax-to-GDP relationship different and unstable, and hence make the indicators unreliable proxies for GDP growth." The Prime Minister Economic Advisory Council's made a rebuttal to Subramanian's paper stating that Taxes are hard numbers and should definitely be considered as one of the factors while modelling the GDP growth. In the follow-up paper, Arvind Subramanian has elaborated upon his claim of excluding taxes as an indicator of GDP, with the argument that India's tax to GDP ratio rose in the post-2011 period, which suggests that tax is an indicator of GDP. However, the author claimed that growth in both revenues and GDP does not indicate "surging growth" in the Indian Economy. The author supports his claim with arguments, which include the demonetization effect on taxes and the changes in the tax policies and administration by the government in that period. To determine whether taxes are estimators of GDP or not, in this project, we propose to study the relation between GDP and taxes. The Indian taxation system can be broadly divided into two parts -

arguments not articulated well. Much scope for improvement.

cite it properly

Direct taxes: The taxes that are directly paid by the tax-payer to the government. Example: Personal Income tax, corporate tax, etc

Indirect taxes: These are the taxes that are applied to sales of goods and services. These include custom duties, excise duties, central sales tax, etc.

Hence, there is a clear structural difference between direct and indirect taxes, which occur from a basic nature of collection of taxes. In order to confirm that there are structural differences, we will try to explain and study the relationship between direct and indirect taxes, by correlating the two taxes and checking how they move over time. Which will help us to understand how the two types of taxes are affected by the introduction of new government policies like increase in petroleum prices and demonetization.

reverse dir. Understand and then explain

linkage this

Then we will study the correlation between GDP growth with direct and in-direct taxes separately over the two time periods i.e. we will look at the correlation of direct and indirect taxes with GDP growth separately for periods 2001-2010 and 2011-2019 and the correlation of direct and indirect taxes growth with GDP separately for periods 2001-2010 and 2011-2019. Using the above analysis, we can check whether taxes have a similar or different relation

idea
 → growth to compare with other indicators also
 with GDP as compared to other indicators of growth like steel, petroleum (which behave differently across two periods) or like Electricity (which have similar correlation in both periods).

appropriate specificity
 In order to show whether taxes are indicators, we propose to model GDP growth of a set of countries, as a factor of taxes and other indicators of growth like Credit Growth, Electricity Growth, etc. If the coefficient of taxes are statistically different from zero, hence we can infer that taxes are indicators of GDP. And if they are not statistically different from zero, hence we can be sure that taxes are bad estimators of GDP. OK

We choose to select the OECD group of countries for our model because all the countries included in this group have had their GDP calculation methodology changed. This will create a dataset of countries that have had a similar line of change in their GDP calculation methodologies. Then, we will check for consistency for our model, by adding more data points i.e., choosing more similar countries data, apart from OECD countries and re-model using our new dataset. If the variance of our new estimators is less, then our model can be considered to be a consistent model, but if it doesn't, this would imply that our model is not a consistent one.

In the end, we will argue that the above correlation between GDP and taxes is not causation, by supporting the arguments provided by the author in support of not using taxes as an estimator of GDP.

I do not understand this. Seems problematic

what do you mean where will you get such info.
 how? you seem biased from the outset. V. bad idea while research on a topic

2. Setup or formally propose the statistical model and statistical tests for your analysis. Defend your proposal.

$$r_{xy} = \frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum(x_i - \bar{x})^2 \sum(y_i - \bar{y})^2}}$$

Using Correlation Analysis :

Correlation between Direct and In-direct taxes of India: We will use the above formula to calculate the correlation between the direct and indirect taxes as a percent of GDP and also make a line plot to represent the value of the taxes over the time period. This will help us understand how different or similar the two tax systems are from each other. Moreover, it would help us map the movement of the two taxes with introduction of Government policies like petroleum prices rise and demonetization.

We will calculate correlation between :

- Direct Tax and GDP growth for period 2001-2011.
- Direct Tax and GDP growth for the period 2012-2018.
- In-Direct Tax and GDP growth for the period 2001-2011.
- In-Direct Tax and GDP growth for period 2012-2018.
- Direct Tax growth and GDP for period 2001-2011(%)
- Direct Tax growth and GDP for period 2012-2018(%)
- In-Direct Tax growth and GDP for period 2001-2011(%)
- In-Direct Tax growth and GDP for period 2012-2018(%)

? what remains in panel

Using the above co-relation data we can infer :

1. Is there any difference in the relation between GDP and indicator over two periods? ✓
2. Whether tax data moves similar to other indicators of growth (by comparing them with the values given in the paper). Hence, we can argue whether Taxes can be considered a reliable estimator as other reliable estimator. ✓

Table 1: Identify all the variables that you will be using to address your problem, along with the data source (link to the dataset). Provide a table with columns: Variable, Description, Source.

Sno.	Variable	Description	Source
1.	GDP Growth	GDP growth of countries for period 2001-2019	Link
2.	Credit Growth	Credit growth of countries for period 2001-2019	Link
3.	Electricity Growth	Electricity growth of countries for period 2001-2019	Link
4.	Export Growth	Export growth of countries for period 2001-2019	Link
5.	Import Growth	Import growth of countries for period 2001-2019	Link
6.	Tax revenue (percent of GDP)	Tax collection growth of countries for period 2001-2019	Link
7.	Tax revenue (current LCU)	Tax collection growth of countries for period 2001-2019	Link
8.	Taxes less subsidies on products (constant LCU)		Link
9.	Taxes on goods and services (percent of revenue)		Link
10.	Taxes on goods and services (percent value-added of industry and services)		Link
11.	Taxes on goods and services (current LCU)		Link
12.	Personal income taxes (of India)	An income tax is a tax that governments impose on income generated by businesses and individuals within their jurisdiction.	Link
13.	Other Direct Taxes (of India)		Link
14.	Corporate tax (of India)	A corporate tax is a levy placed on a firm's profit by the government.	Link
15.	Indirect tax (of India)		Link
16.	EXCISE REVENUE FROM PETROLEUM AND NON-PETROLEUM (of India)	Excise duty is a levy paid by the manufacturer on items manufactured within the country.	Link
17.	GST (of India)	The goods and services tax (GST) is a value-added tax levied on most goods and services sold for domestic consumption.	Link
18.	CUSTOM REVENUE FROM IMPORT DUTIES (of India)	Customs duty is the charge levied when goods are imported into the country, and is paid by the importer or exporter	Link

3 Model Between GDP Growth and Indicators of Growth:

$$GDP_{(i)} = \beta_0 + \beta_1 * CG_{(i)} + \beta_2 * EG_{(i)} + \beta_3 * ExG_{(i)} + \beta_4 * IG_{(i)} + \beta_5 * TR_1 + \beta_6 * TR_2 + \beta_7 * TR_3 + \beta_8 * TR_4 + \beta_9 * TR_5 + \beta_{10} * TR_6 + E(i)$$

Equation Legends

- CG-Credit Growth of i^{th} country.
- EG-Electrical Growth of i^{th} country.
- ExG-Export Growth of i^{th} country.
- IG-Import Growth i^{th} country.
- TR_1 -Tax Revenue(% of GDP) i^{th} country.
- TR_2 -Tax revenue (current LCU) i^{th} country.
- TR_3 -Taxes less subsidies on products (constant LCU) for i^{th} country.
- TR_4 -Taxes on goods and services (% of revenue) for i^{th} country.
- TR_5 -Taxes on goods and services (% value added of industry and services) for i^{th} country.
- TR_6 -Taxes on goods and services (current LCU) for i^{th} country.

can all of these enter at once?
Think about this

Interpretation of coefficients

- β_1 - Represents the magnitude change in GDP with respect to a unit change in Credit Growth.
- β_2 - Represents the magnitude change in GDP with respect to a unit change in Electric Growth.
- β_3 - Represents the magnitude change in GDP with respect to a unit change in Export Growth.
- β_4 - Represents the magnitude change in GDP with respect to a unit change in Import Growth.
- β_5 - Represents the magnitude change in GDP with respect to a unit change in Tax Revenue(% of GDP)
- β_6 - Represents the magnitude change in GDP with respect to a unit change in Tax revenue (current LCU)
- β_7 - Represents the magnitude change in GDP with respect to a unit change in Taxes less subsidies on products (constant LCU)
- β_8 - Represents the magnitude change in GDP with respect to a unit change in Taxes on goods and services (% of revenue)
- β_9 - Represents the magnitude change in GDP with respect to a unit change in Taxes on goods and services (% value added of industry and services)
- β_{10} - Represents the magnitude change in GDP with respect to a unit change in Taxes on goods and services (current LCU)

We will formulate a null hypothesis :

$$\beta_5 = 0, \beta_6 = 0, \beta_7 = 0, \beta_8 = 0, \beta_9 = 0 \text{ and } \beta_{10} = 0.$$

- Using the T-test, we can check whether these values are statistically different than zero or not.
- If we fail to reject the null hypothesis this would imply that for a country with similar condition (in terms of methodological changes), It's GDP growth would be dependent upon any form of tax and would show that tax is an estimator of GDP.

Think more

Joint hypothesis or not?

References

- [1] "Validating India's GDP Growth Estimates | Harvard Kennedy" <https://www.hks.harvard.edu/centers/cid/publications/faculty-working-papers/india-gdp>. Accessed 26 Sep. 2019.
- [2] "India's GDP Mis-estimation: Likelihood, Magnitudes" <https://www.hks.harvard.edu/centers/cid/publications/faculty-working-papers/india-gdp-overestimate>. Accessed 26 Sep. 2019.

- [3] <https://www.investopedia.com/terms/c/corporatetax.asp>
- [4] <https://www.investopedia.com/terms/i/incometax.asp>
- [5] <https://www.moneycontrol.com/news/trends/advertising-trends/-1385555.html>
- [6] "India's GDP Mis-estimation - Harvard Kennedy School." <https://www.hks.harvard.edu/centers/cid/publications/faculty-working-papers/india-gdp-overestimate>. Accessed 26 Sep. 2019.