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Similarity Index for Estimating Tax Reform Program and Its Impact on Tax Revenue: Indonesia Case Study

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ABSTRACT

Tax reform in Indonesia begins with implementing self-assessment approach for elevating voluntary tax compliance. We use 16 developed countries' tax structures as a benchmark for measuring Indonesia's tax reform with the Similarity Index. The result of the Similarity Index shows Indonesia Tax Reform fluctuating trend in 40 years, which started at 72,56% in 1980 and ended at 55,84% in 2019. Furthermore, with the VAR model and international trade openness as variable outside the model in our study, we found that GDP per capita, and inflation, altogether with tax reform had created a 20% positive causality impact on tax revenue in the first three years and 5% in the year tenth. Negative causalities impact which shown in the fourth to ninth year is relevant to the declining trend of Indonesian tax reform that we previously measured. Therefore, it is important for the government to critically focus on developing the structure of the direct tax, indirect tax, and international tax after the first three years of period to maintain the positive impact of tax reform for growing tax revenue in the long term.

Keywords: tax reform, tax revenue, similarity index, vector autoregressive

1. INTRODUCTION

1.1 Background

The rise of uncertainty in the global economy caused by COVID-19 pandemic has affected tax revenue in many countries. Even though the Indonesian government has other alternative revenue, such as Non-Tax State Revenue, tax is still the nation's main revenue in the long term. It becomes an important concern for the government to keep tax revenue stable during economic activity decline.

Reaching optimal tax revenue is not easy for a developing country like Indonesia. Therefore, the Directorate General of Taxes (DGT) as Indonesia's tax authority, has implemented a couple of tax reform programs for over 40 years in the hope of increasing the effectiveness of tax revenue collection.

Currently, through the PSIAP (Tax Administration Core System Reform) program, DGT is trying to carry out comprehensive tax reform. As per Presidential Regulation number 40 year 2018; PSIAP, through the development of a COTS (Commercial Off-the-Shelf) based information system and business process redesign, accompanied by improving the tax database; Is expected to improve tax administration system to

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become easier, more reliable, integrated, accurate, and certain. On the launching of PSIAP, the Indonesia Ministry of Finance, Sri Mulyani, stated that the main goal of tax reform is significant growth of tax revenue and tax ratio. Sri Mulyani even pointed out the minimum growth of at least double from current tax revenue ("DDTC NEWS", 2020).

Silvani and Baer (1997) explain that tax administration reform is a part of fiscal reform for aiming macroeconomic stability and restructuring taxation. Tax reform aim to improving the tax administration system, so it becomes more efficient, not easily distorted by the market, and easier to administrate. Indonesia has implemented tax reform programs since 1983, but is it affecting positively for tax revenue? Eka (2019) argued differently, that tax administration reform in Indonesia negatively affects tax revenue. He found that post implementation of tax administration reform program, the variable of tax revenue potential is not affecting tax revenue collected. Which, he argued, indicates there is a problem in DGT productivity.

Many studies have tried to find a correlation between tax reform and tax revenue. However, we have not found any studies that try to measure tax reform with an adequate estimator. Tax revenues result from so many factors: domestic fiscal and monetary policies, changes in international commodity prices, and social and political situations. How to separate one factor, namely tax reform alone? To test and estimate tax reform programs that have been conducted and their impact on tax revenues in Indonesia, it is necessary to determine an estimator that could estimate as accurately as possible. In this paper, we attempt a model to estimate tax reform so we can evaluate its impact on tax revenue in Indonesia.

2. THEORETICAL FRAMEWORK

To define the scope of the tax reform program conducted in Indonesia, we cite several resources and findings, including regulations that govern tax reform programs. The Tax Regulation Harmonization Law infers that the lawmaker in order to increasing sustainable economic growth and accelerating economic recovery, the government needs a fiscal consolidation strategy that focuses on improving the nation's budget deficit and tax ratio (Indonesia Government, 2021). That strategy includes implementing tax collecting performance, tax reform programs, tax base expansion, designing a taxation system that considering equality and law certainty as priority, and increasing taxpayer's voluntary compliance. In an attempt to improve the tax ratio, the Tax Regulation Harmonization sets out that the government needs to conduct several efforts such as tax reform programs that focus on organization, human resources, information-based data technology, business processes, and regulation (Indonesia Government, 2021).

Satya (2017) mentions that the tax reform program is changing the taxation system significantly and comprehensively improving tax administration, regulation, and base so tax revenue's growth could become more robust, eg: improving tax revenue collection, tax base expansion, and better taxpayer compliance (OECD, 2010). One of the major aims of tax reform in Indonesia in the long term is reaching a tax ratio of 11,5% in 2020 (CNBC, 2019). In addition, Sinaga (2017) explains that tax reform is conducted to elevate the tax system to reach a higher level of fairness and more comprehensive and valid data could be provided for expanding the tax base in order to increase short-term and long-term tax revenues in more sustainable way.

The tax reform program is carried out because of the need to creating stronger, more reliable, and more accountable tax institution. Therefore, tax reform should restructure human resources, budget, business processes, information systems, and infrastructure of tax institution and tax regulation so tax institution has the capability to detect untapped tax potential and manifest it in tax revenue efficiently and effectively.

According to Bawazier (2011), prior to 2011, the Directorate General of Taxes carried out tax reform programs with mixed results. There were notable successes, but there were also unsatisfied

results. He noted that the first tax reform conducted in 1983 was the building block of Indonesia's present tax system. The 1983 reform changed the paradigm of the Indonesian tax system into self-assessment. The reorganization also happened by abolishing the Tax Inspection Office and establishing the Tax Office, which focused on providing services for taxpayers. There were also regulation reforms with a couple of new laws replaced the old such as value-added tax subtituted sales tax and new income tax law.

Bawazier (2011) favored the 1983 tax reform as a success, followed by the 1994 and 1997 reforms. The 1994 reform and the 1997 reform were logical consequences as a result of evaluating previous reforms' implementation, especially the implementation of the self-assessment system. In the 1994 and 1997 reforms, new tax laws were introduced as an improvement of laws that had been passed in 1983.

Bawazier (2011) argued that tax reforms executed in 1983, 1994, and 1997 were a big success because they could transform Indonesia's budgeting into tax-based revenue, with more than 70% of income streamed from tax. Post 1997, He argued that although no evaluation nor research has been carried out on its success or failure, there were strong indications that reforms after 1997 had missed their targets with shreds of evidence such as unimproved tax ratio, high cost of tax reform that financed from foreign debt, corruption within tax institution, etc

The Directorate General of Taxes, Indonesia's tax institution, has conducted four periods of tax reform programs as follows (Abdul et al., 2021).

- In 1983, Indonesia reformed its taxation system from official assessment to self-assessment, with notable and continious improvements on self-assessment approach in 1994 and 1997.
- From 2002 to 2008, DGT's tax reform focused on improving human resources, organization, and business processes. It resulted in the modernization of institutional units based on taxpayer segmentation, which consist of Regional Tax Office, Large Tax Office, Medium Tax Office, and Tax Office.
- From 2009 to 2016, DGT's tax reform focused on ease of business for facing economic decline after the global financial crisis.
- Lastly, from 2016 to this day, DGT's tax reform focuses on five main pillars in tax administration: organization reinforcement, increasing human resource quality, improving business processes, renewal of information systems and databases, and regulation refinement.

Based on the explanations above, we conclude that there are four main elements in defining a tax reform program, which are: (1) significant change in taxation structure or system, (2) improvement of tax regulations, (3) improvement in tax administration and procedure, and (4) the main goal is to raise tax revenue and tax ratio.

We found several studies that attempted to learn the relationship between tax reform programs and tax revenue. Kusi et al. (1998) describe that the government needs to implement a taxation system that is responsive to economic growth because it has a high potential for growing tax revenue without adding unpopulist fiscal policy such as increasing tax rates in a careless way.

Taxation system also need to take an interest in consumption tax. Based on the Government Act on Tax Harmonization, we can see Indonesia has their concern on consumption tax by increasing VAT (Value Added Tax) rate from 10% to 11%, which will eventually rise to 12% no later than 2025. Also at the same time, decrease income tax rate. Gnagnon and Brun (2019), using analysis of tax reform indicators based on the semi-metric Bray-Curtis dissimilarity index, suggest that the tax reform index has a positive effect on increasing tax revenue.

Basri et al. (2020) studied how the introduction of MTO (Medium Tax Office) affects tax revenue. The introduction of MTO is part of the tax reform program that DGT took in the 2000s, which administrated tax payer based on the size of

their business in each region. They noted that administering taxes through the MTO drastically increased tax paid by the firms that previously were not handled in MTO and with a very low cost of collection. The similar impact can be generated from increasing tax rate significantly high, so the implementation of MTO is more preferable because it's less distortion.

Basri et al. (2020) concluded that tax administration reform in the form of MTO is the preferred approach to increase tax revenue, and the impact increases over the subsequent six-year period. However, Eka (2019) found different finding. He explained that tax administration reform had a negative impact on tax revenues, but it was able to increase compliance for individual taxpayers. Based on those studies' founding and theoretical framework, we hypothesize that tax reform programs have a positive impact on improving tax revenue in the long term.

3. RESEARCH METHODOLOGY

3.1 Estimating Indonesia Tax Reform Programs

Our paper basically consists of two stages of measurement. First, we estimate the value of the tax reform program in Indonesia. Second, we measure the tax reform program's impact on Indonesia's tax revenue.

We came across several papers that aimed to estimate the effectiveness of tax reform programs. Desai and Hines (2003) proposed an international tax reform for the United States using two benchmarks - CON (capital ownership neutrality) and NON (national ownership neutrality). According to their findings, a tax system in which all countries exempt foreign income from taxation would fulfill the CON concept. This would ensure that differences in tax rates do not affect the backgrounds of capital owners, enabling market players to allocate capital to the most productive places. Exempting taxes on foreign income of domestic companies (NON) would maximize national prosperity. On contrary, harmonizing foreign income taxes between capital exporting countries (CON) would maximize global prosperity.

Rosen (1976) suggesting the way of evaluating taxation system changes in United States based on how it impacted social welfare. Chan et al. (1999) and Sajadifar et al. (2012) use General Equilibrium approach for evaluating tax reform performance, spesifically on value added tax changes and its social welfare impact in Iran and Vietnam. Each tries to evaluate the performance of value added tax reform on aggregate social welfare.

To estimate the scope of the tax reform program in Indonesia, we attempt to quantify it by comparing how similar Indonesia's tax structure to those of developed country using the Similarity Index. The Similarity Index is derived from the Bray-Curtis Dissimilarity Index, a method usually used in ecology studies to quantify the differences between samples (Bray et al., 1957; Greenacre, 2018). The bray-Curtis Dissimilarity Index equation is presented as follows:

$$d_{xy} = \frac{\Sigma_j |x_j - y_j|}{\Sigma_j |x_j + y_j|} \quad (1)$$

x and y represent two different country samples and j is tax structure component from those countries. Gnangnon and Brun (2019) mention that the tax structure component could be proxied using direct tax to GDP ratio, indirect tax to GDP ratio, and international tax to GDP ratio, so we use those variabel for measuring tax structure components on country sample. Gnangnon and Brun (2019) eliminate tax revenue from natural resources from the equation because it could be a misleading indicator from policy perspective due to its volatile nature.

Therefore, Dissimilarity Index of Indonesia's tax reform in year t, d_{it}, to developed countries equation is presented as follows:

$$d_{it} = \frac{|Direct\ Tax_{it} - Direct\ Tax_{at}| + |Indirect\ Tax_{it} - Indirect\ Tax_{at}| + |Int\ Trd\ Tax_{it} - Int\ Trd\ Tax_{at}|}{(Direct\ Tax_{it} - Direct\ Tax_{at}) + (Indirect\ Tax_{it} + Indirect\ Tax_{at}) + (Int\ Trd\ Tax_{it} + Int\ Trd\ Tax_{at})} \quad (2)$$

In this equation, $Direct\ Tax_{it}$, $Indirect\ Tax_{it}$, and $Int\ Trd\ Tax_{it}$ are Indonesia's tax structure components in year t. $Direct\ Tax_{at}$, $Indirect\ Tax_{at}$, and $Int\ Trd\ Tax_{at}$ are the average of developed countries' tax structure components in year t. We choose Australia, Austria, Belgium, Canada, Denmark, France, Germany, Japan, Dutch, New Zealand, Portugal, Swedish, Switzerland, English, and the United States as developed countries (Gnangnon and Brun, 2019).

A value of zero in the Bray-Curtis Dissimilarity Index means that the samples compared are identical and a value of one means that the samples are totally different (Greenacre, 2018). For measuring the similarity index of tax structure Indonesia with developing countries, we use equation as follows:

$$Tax\ Reform = (1 - d_{it}) * 100\ \% \quad (3)$$

By substracting d_{it} value from 1 we obtain a similarity index which is a reference for estimating tax reform. This equation indicate that the higher $Tax\ Reform$ value, the higher similarity rate of Indonesia tax structure with that of developed countries. On the other side, the lower $Tax\ Reform$ value show high distinctiveness of Indonesia tax structure to developed countries tax structure (Bray et al., 1957; Gnangnon & Brun, 2019; Greenacre, 2018).

After determining similarity index, we measure the impact of tax reform program to tax revenue. There is limitation on calculating tax reform index because the index depend on tax revenue variable, while tax revenue variabel also depends on several factors. We try to capture these factors and formulate them into a VAR (Vector Autoregressive) equation. VAR is a statistical method for research that is often used to analyze macroeconomic data. VAR model has advantage on analyzing multivariate data that presented in a time series (Warsono et al., 2019). VAR equation is presented as follow:

$$Y_t = \beta_{10} + \beta_{11}Y_{t-1} + \cdots + \beta_{1p}Y_{t-p} + \gamma_{11}X_{t-1} + \cdots + \gamma_{1p}X_{t-p} + u_{1t}$$

$$X_t = \beta_{20} + \beta_{21}Y_{t-1} + \cdots + \beta_{2p}Y_{t-p} + \gamma_{21}X_{t-1} + \ldots + \gamma_{2p}X_{t-p} + u_{2t} \quad (4)$$

In the VAR model, a vector of time series variables is regressed on the lag vector of the variable in question. The lag vector is symbolized by p so VAR(p) model consist of two variable as described in equation number (4). Generally, VAR model based on two or more endogenous variable (Warsono et al., 2019). However, in this study, we use exogenous variable in VAR model so the model become VARX (VAR with exogenous variable), which is known as dynamic model as suggested by Warsono et al. (2019). VARX equation as follow:

$$\mathbf{\Gamma}_t = c + \sum_{i=1}^{p} \varphi_i \mathbf{\Gamma}_{t-i} + \sum_{i=1}^{p} \varphi_j \mathbf{\Psi}_{i-j} + \epsilon_t \quad (5)$$

In this equation, Γ is endogenous variable, p is lag, Ψ is exogenous variable, and q equal to zero (Warsono et al., 2019).

We conducted two test for achieving best interpretation from VARX model, which are testing causality between endogenous variable use Granger Causality and long term cointegration between variable use Johansen Cointegration Test. We also testing data stasionery use Augmented Dickey-Fuller, optimal lag determination use FPE (Final Prediction Error) criteria, AIC (Akaike Information Criterion), SC (Schwarz Information Criteria), and HQ (Hannan-Quinn Information Criteria), and VAR test stabilization, Autocorellation test, and Normality test to residual.

3.2 Operational Variable Definition

To determine the correlation between tax reform and tax revenue, we use previous studies about the structural determinant of public revenue. Variables we use in this research as endogenous variables are: TAXREV (Tax Revenue), TAXREF (Tax Reform), GDPC (GDP per Capita), and INF (Inflation), while TRD_OPEN (international transaction openness) is an exogenous variable.

We use the tax revenue ratio to GDP as a proxy for measuring tax revenue variable. For the tax reform variable, we use estimation results based on equation number (3). International

transaction openness is generally measured by the trading openness indicator, which is calculated by the sum of the export and import of goods and services to GDP. For testing equation model number (5), we transform variable data into a log (Baunsgaard & Keen, 2005; Desai & Hines, 2003; Gnangnon & Brun, 2019).

3.3 Data Selection and Collection

We use secondary data as follows.

1. Indonesia's tax revenue and developed countries' tax revenue from: Australia, Austria, Belgium, Canada, Denmark, France, Germany, Japan, Netherland, New Zealand, Portugal, Sweden, Switzerland, England, and United States; year 1980 to 2019 based on World Development Indicators bank data, which consists of.
   a) Central tax revenue.
   b) Tax revenue from income, profit, and capital gain.
   c) Tax revenue from good and service transaction.
   d) Tax revenue from International trade.
2. Indonesia's GDP year 1980 to 2019 based on World Development Indicators bank data.
3. GDP per capita year 1980 to 2019 based on World Development Indicators bank data.
4. Indonesia's inflation rate year 1980 to 2019 based on World Development Indicators bank data.
5. Export and import Indonesia year 1980 to 2019 based on World Development Indicators bank data.

4. RESULTS AND DISCUSSION

4.1 The Similarity Index

We utilize the Similarity Index by using 16 developed countries' tax structures as a benchmark to measure Indonesia's Tax Reform. Based on our calculations from 1980 to 2019 as we previously explained, we found there's a fluctuating trend in Indonesia's Tax Reform Structure from 1980 to 1988 in the range of 70% to 80%. However, there was a significant decline in Indonesia's Tax Structure from 77,34% to 45,61% in 2000, as it gradually grew to approximately 60% until 2013. Unfortunately, the Indonesian Tax Structure had a declining trend in the next six years afterward into 55,84% in 2019. The graph is shown as follows.

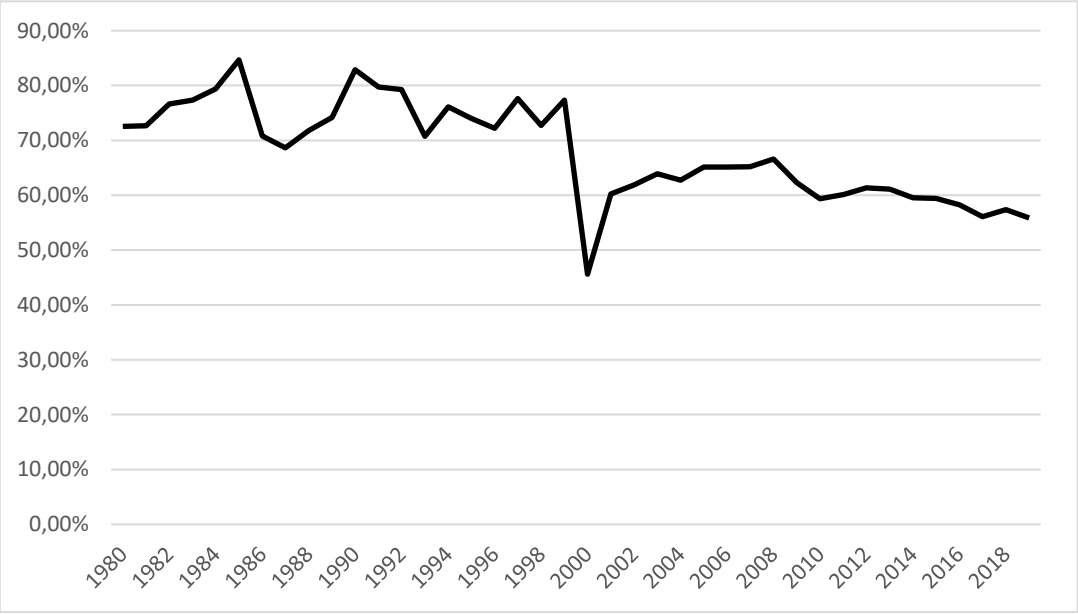

Figure 1 Tax Reform Indonesia
Source: Processed by Mohammad using Excel

Table 1 Statistic Description
Source: Processed by PG and Aristokra using eviews application

	TAXREV	TAXREF	GDPC	INF	TRD_OPEN
Mean	0.056864	0.224604	6.694934	0.037671	0.183395
Median	0.056035	0.224272	6.769772	0.0321	0.182046
Maximum	0.086169	0.266414	7.767182	0.199895	0.292668
Minimum	0.03479	0.163187	5.488854	0.012966	0.138054
Std. Dev.	0.013286	0.02305	0.746402	0.030207	0.028272

4.2 Statistic Data Variable Description

We use secondary data from World Development Index bank data to test the model. We converted the data to log form. The log transformation is the most popular transformation among the various types of transformations used to change the skewness of data so that it approaches normality. For data with values smaller than 1, the author uses transformation:

$$\mathrm{L(x)} = \mathrm{sign(x)} \times \log\left(|x| + 1\right)$$

Data variable description presented as table 1.

4.3 Unit Root Test

We conduct unit root test to every variable data separately and simultaneously with Augmented Dickey-Fuller test. The test result shows that all data are stationary in point level, inclunding point of 1st difference as presented in table 2.

The results of the data stationarity test are shown to be in α value of 5% with the Null Hypothesis (H0) being that the data is not stationary. From the test results, as shown in table 3, apart from the INF (inflation variable) which is stationary at point level, all data is stationary at the 1st difference level. Unit root testing was also carried out on all the variables simultaneously and the data obtained were stationary at point level. Thus, the variable has passed the stationarity test and VARX testing can be carried out.

4.4 Optimal Lag Determination

Lag is the time interval required for an independent variable to respond to the dependent variable. Determining the optimal lag is important because a lag that is not optimal contain risk of causing multicollinearity or loss of degree of freedom which results in errors in the interpretation of the results (Hacker and Hatemi-J,

Table 2 Unit Root Test Result on Every Variable
Source: Processed by PG and Aristokra using eviews application

Unit Root Test (*Augmented Dickey-Fuller*)	TAXREV	TAXREF	GDPC	INF	TRD_OPEN
Probablity in level point	0.2157	0.5365	0.5887	0.0003	0.0734
Probablity in 1st difference	0.00000	0.00000	0.00002	0.00000	0.00000

Table 3 Unit Root Test Result to Each of Variable
Source: Processed by PG and Aristokra using eviews application

	Statistic	Prob.**	Cross- sections sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-1.680507	0.0464293	5	193
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-2.559629	0.0052391	5	193
ADF - Fisher Chi-square	27.027194	0.0025787	5	193
PP - Fisher Chi-square	29.001312	0.0012454	5	195

2008). To determine the optimum lag that can be used, we use the FPE, AIC, SC, and HQ.

The test results show that the optimal lag used in this study is 4. Those results shown in table 4 shown as follow.

Schwarz Information Criteria favors 2 lag, while other criterias propose 4 lag. We choose 4 lag because we follow recommendation from majority of the criteria beside *Schwarz Information*. The selection of 4 lags also takes into account the condition of the residual data from the model as shown through the normality test and autocorrelation test (Koehler and Murphree, 1987).

4.5 Stability Model Test and Residual Diagnostic

Model stability testing is performed to determine whether the test model with specific lag criteria is in stationary conditions. An unstable VAR/VARX model can make the interpretation of test results invalid. Whether the model is stable or not is known if the inverse roots of are characteristic polynomial has a modulus below one or is within the unit circle, then the VAR/VARX model is declared stable (Nwafor et al., 2016). The results of the model stability test are stated in Table 5, presented in as follow.

Table 4 VAR Lag Order Selection Criteria
Source: Processed by PG and Aristokra using eviews application

Lag	LogL	LR	FPE	AIC	SC	HQ
0	412.6704	NA	1.07e-15	-23.12403	-22.76852	-23.00130
1	443.2360	50.65148	4.70e-16	-23.95634	-22.88982	-23.58818
2	472.6842	42.06886	2.29e-16	-24.72481	**-22.94727***	-24.11120
3	485.7246	15.64845	3.08e-16	-24.55569	-22.06713	-23.69664
4	513.2793	**26.76744***	**2.03e-16***	**-25.21596***	-22.01639	**-24.11147***

Table 5 Roots of Characteristic Polynomial
Source: Processed by PG and Aristokra using eviews application

Root	Modulus
0.146458 - 0.866777i	0.879064
0.146458 + 0.866777i	0.879064
-0.830931 - 0.239473i	0.864750
-0.830931 + 0.239473i	0.864750
0.510286 - 0.591157i	0.780934
0.510286 + 0.591157i	0.780934
0.740453 - 0.199648i	0.766897
0.740453 + 0.199648i	0.766897
-0.281465 - 0.663160i	0.720419
-0.281465 + 0.663160i	0.720419
-0.559317 - 0.309112i	0.639051
-0.559317 + 0.309112i	0.639051
0.055351 - 0.546825i	0.549619
0.055351 + 0.546825i	0.549619
-0.054610 - 0.323481i	0.328059
-0.054610 + 0.323481i	0.328059

Table 6 Probability Normality Residual Test
Source: Processed by PG and Aristokra using eviews application

	TAXREV	TAXREF	GDPC	INF	Joint
Skewness	0.331	0.5276	0.871	0.6632	0.816
Kurtosis	0.4143	0.5324	0.1091	0.5393	0.406
Jarque-Bera	0.4468	0.6741	0.2734	0.7533	0.6963

Table 7 Autocorrelation Residual Test
Source: Processed by PG and Aristokra using eviews application

Lag	LRE* stat	Df	Prob.	Rao F-stat	Df	Prob.
1	23.87276	16	0.0923	1.692929	(16, 31.2)	0.1017
2	14.35653	16	0.5722	0.889569	(16, 31.2)	0.5861
3	12.74512	16	0.6913	0.772273	(16, 31.2)	0.7026
4	15.03164	16	0.5223	0.940202	(16, 31.2)	0.537

For testing the residual diagnostic, we use normality and autocorellation test. Null Hypothesis in normality test is accepted if p-value on variables tested less than 0,05. We conduct the Normality Test in lag 4 and *α value* 5% for residual model generate Residual multivariat normal, as shown in table 6.

Null Hypothesis in autocorrelation test is accepted if the result show there's no serial correlation to lag h. Based on Table 7, We find no problem of autocorrelation in lag 4 with α value of 5%. Therefore, the model can give a proper estimation so the hypothesis test can be proceed.

4.6 Causality Tax Reform to Tax Revenue

We use the Granger Causality test to understand the capability of tax reform casuality to tax revenue. The Granger Causality Test is a statistical hypothesis test for determining whether time series data is reliable for predicting other time series data. If the changes of the variable could predict other variable values in the future, it means that the variable is granger-cause other variables (Granger, 1969).

Null Hypothesis accepted in Granger Causality means TAXREF, GDPC, and INF with four degrees of freedom has a lower Chi-Square value than its critical value, which can be interpreted that there's no causality impact of TAXREF to TAXREV. In the other side, The Granger Causality Test Model on TAXREF, GDPC, and INF with four degrees of freedom has a higher Chi-Square value than its critical value, it means that the test model rejecting the null hypothesis and accepting the causality impact of TAXREF to TAXREV. Based on the Granger Causality test for the model, tax reform, GDP per Capita, and inflation Granger-cause variable of tax revenue with probability of overall in 0,0000 (α value 5%). Our Granger Causality test does not estimate casuality of the international trade variable, the exogenous variable.

Table 8 Granger Causality Tests Model Result
Source: Processed by PG and Aristokra using eviews application

Variable	Chi-sq	Df	Prob.
D(TAXREF)	16.38428	4	0.0025
D(GDPC)	17.99296	4	0.0012
D(INF)	16.3272	4	0.0026
All	67.40859	12	0.0000

We conducted a cointegration test with the Johansen Cointegration Test to find the long-term cointegration of variables (Johansen, 1991). The cointegration test result in Table 9 identified two cointegration vectors that could disturb the interpretation, so we used the VECM (vector error correction model)

Table 9 *Johansen Cointegration Test*
Source: Processed by PG and Aristokra using eviews application

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.799259	91.44256	47.85613	0.0000
At most 1 *	0.571269	36.84747	29.79707	0.0065
At most 2	0.171116	8.051976	15.49471	0.4599
At most 3	0.04796	1.671024	3.841466	0.1961

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

to overcome this problem. The Granger Causality test result in the VECM model, as shown in Table 10, shows TAXREF, GDPC, and INF variables Granger-Cause the TAXREV variable with an overall probability of 0,0000 (α value 5%). These results are in line with casuality test with the VARX model, which concluded that TAXREF, GDPC, and INF as independent variables have a Granger-Cause relation with TAXREV as dependent variable in the short term and long term.

Tabel 10 *Granger Causality Tests* VECM Result
Source: Processed by PG and Aristokra using eviews application

Variabel	Chi-sq	Df	Prob.
D(TAXREF)	16.96300	4	0.0020
D(GDPC)	18.39659	4	0.0010
D(INF)	12.77498	4	0.0124
All	62.36539	12	0.0000

We conducted an IRF (Impulse Response Function) test to find the range of dependent variables react to the change of variable in one standard deviation or standard-error-shock to another variable. Based on the IRF analysis result as shown in Figure 2, the shock of TAXREF, along with GDPC and INF, created a positive impact of up to 20% growth of TAXREV in the first three-year period. However, the positive impact gradually decreased on TAXREV up to under 5% in year seventh and begin declining into negative impact at year ninth. Despite the negative impact, it started growing towards a positive impact in year tenth.

The fluctuating positive impact of TAXREF, along with GDPC and INF, on TAXREV is relatively following the fluctuating growth of the TAXREF trend that we previously measured in the Similarity Index. The decreasing of TAXREF reveals its ineffectiveness on TAXREV, so we found that Tax Institutions in Indonesia should critically improve the collection of direct tax, indirect tax, and international tax after the first three year period to utilize the effects of TAXREF to gather TAXREV for the long-term. We believe the tax ratio to GDP is a key indicator for improving the Tax Structure

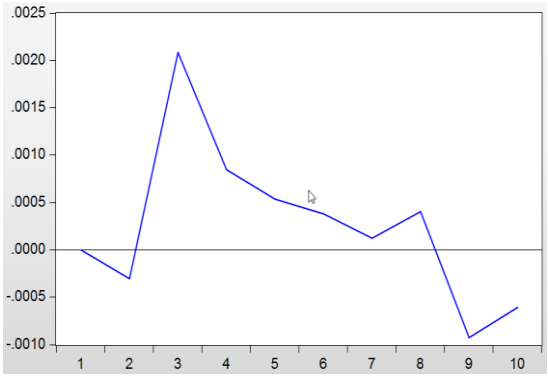

Figure 2 *Impulse Response* Tax Reform to Tax Revenue in 10 periode Graphs
Source: Processed by PG and Aristokra using eviews application

as we're using 16 developed countries as a benchmark.

5. CONCLUSION

Tax reform policy is well known for elevating tax revenue. For example, tax reform in East Europe countries had been conducted focused and partially during their economic transition. On the other side, Japan, other Asian Countries, and Europe Countries developed their tax reform in long period of time because of significant change and redesign their taxation system (Brys, Matthews, & Owens, 2011).

In Indonesia, several tax reform programs have already taken place and done successfully. Bawazier (2011) explain the substantial change of official assessment to the self-assessment system in 1983 reform show Indonesia's direction to set national budgeting heavily relies on tax revenue. Despite tax reform had successfully raising the tax ratio in 1994 and 1997, there was no strong evidence of successful tax reform after 1997. Eka (2019) conducted a study of Indonesia's tax reform on administration, which concluded that tax administration reform negatively impacts tax revenue but increases taxpayer compliance. Meanwhile, there is also evidence of successful tax administration reform in Indonesia as Basri et al. (2020) stated, that the introduction of a Medium Tax Office dramatically increases tax revenue with minimal cost of collections. Gnagnon and Brun (2019) also found that tax reform has a positive impact on tax revenue in developing countries. Following those findings, we understand there's fluctuation trend of positive and negative impact of tax reform implementation in Indonesia to tax revenue.

We understand the lack of empirical study in tax reform because of the difficulty of choosing a proper proxy for estimating the elements of Indonesia's tax reform comprehensively. In this study we feature the Similarity Index, a simple modification of the Bray-Curtis Dissimilarity index, for estimating Indonesia's tax reform. The Similarity Index estimates Indonesia's tax structure compared to developed countries' tax structures. If the index is near to value one, then it indicates the similarity rate is high.

We use the result of the similarity index as a proxy for the tax reform variable so we can conduct a test for finding the relation of the tax reform variable with the tax revenue variable. Based on our VARX and VECM model results, we concluded that the tax reform variable has causality in the short and long term toward the tax revenue variable. Our analysis results are in line with Basri et al. (2020) and Gnangnon and Brun (2019), but opposite to Eka (2019) findings.

Furthermore, based on the VECM-IRF test, tax reform had predicted positive impact up to 20% for three years, but gradually declining until year ninth with the lowest at approximately negative 10%, then started the recover in year tenth. Since the ineffectiveness of tax reform is a source of failing to improve tax ratio, we suggest tax authorities to critically assess the effectiveness of implemented tax reform, specifically on direct tax, indirect tax, and international tax structure, after three years to maintain the growth of tax revenue caused by tax reform in long term. These results can be used as a reference by the tax authorities to carry out reviews or changes to tax policies adequately.

6. IMPLICATIONS AND LIMITATIONS

Our study tries to estimate Indonesia's tax reform in numerical units which is then used as a basis for testing its relationship with tax revenues. This research was done as much as possible to be able to estimate all the elements that describe tax reform. However, because of limited resources, time, and data, we acknowledge that we have not fully captured all elements of tax reform, especially regarding good corporate governance that tax reform tried to aim for. Our suggestion for further research is to develop a formula to estimate tax reform so that it can capture elements that could not be revealed in this study.

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