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CORPORATION INCOME TAXATION IMPACT ON UNEMPLOYMENT RATE: VAR MODEL APPROACH

Abstract

Corporate income tax is an important tax for the state to regulate budget revenue and is an important tool for encouraging and promoting production and business development to create jobs. This study investigated the relationship and impact between corporate income tax and unemployment in Vietnam, China, and South Africa to investigate whether higher corporate income tax contributes to higher unemployment. Data on corporate taxation and unemployment rates from 2000 to 2020 are collected, and the VAR model, cointegration, and impulse response tests were applied to estimate the impact of taxation on the unemployment rates of developed, developing, and underdeveloped countries. The corporate tax and unemployment rates have a close relationship: South Africa, China, and Vietnam correspond to 82%, 54.3%, and 47%, and the majority of the model's variables for the three countries are non-stationary at lag I(0), with the exception of the variable for China's unemployment rate, which demonstrates that the probabilities of the model's variables for Vietnam and South Africa are greater than the alpha of 0.05 and are, respectively, 0.6193, 0.7299, 0.3421, and 0.6347. Thus, variables have a lag after year, in this case, assuming that other factors remain unchanged if the corporate tax rate decreases by 1%, South Africa's unemployment rate decreases by 10%. Similarly, Vietnam's unemployment rate decreased by 1.1%, but China's unemployment increased by 2.9%. The suggestion is that the government adjusts tax laws to better match micromanagement and regulate and balance the relationship between taxes and unemployment.

Keywords employment, policy, duty, reinvestment, macroeconomics, enterprise, jobless, correlation

JEL Classification H25, H21, J08, J18

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INTRODUCTION

Corporate income tax is the state budget's major source of revenue, so, corporate income tax is a direct tax, which is a tax directly on the enterprises' taxable income. The economic aspect shows that an increase in taxes leads to an increased state budget, but a decrease in corporate profits leads to a firm's limited expansion of the production scale, which is also the reason for the increase in the unemployment rate, which needs to be solved in this study. Moreover, increased unemployment also causes economic inflation and affects income and workers' lives. Unemployed workers, that is, those losing their jobs, will lose their source of income; therefore, the lives of the workers themselves and their families are difficult, and this is a matter of concern for all countries. This is a problem that the study needs to solve, and the article has applied the VAR model to explore the relationship between corporate income tax and the unemployment rate in Vietnam.

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1. LITERATURE REVIEW

Corporate taxes may be the major source of revenue in state budgets; if the government increased revenues from this source, it would not have suffered budget deficits but would have lost the enterprise's necessary capital for reinvestment, leading to its decreased size, which relates to jobs. If so, it lasts for the long term, causes an economic recession, and generates more unemployment. The literature focuses on the impact of corporate taxation on high employment, with the aim of directly evaluating the impact of reducing corporate income tax rates to the extent possible to reduce unemployment. The author empirically studied 15 European Union member countries using a least-squares regression (OLS) equation to consider that corporate taxation can significantly impact the unemployment rate (Meyer, 2018). Feldmann (2011) empirically studied the impact of corporate taxes on the unemployment rate using annual data on 19 industrialized countries for the period 1979–2005. The literature shows that higher corporate taxes positively affect unemployment, that is, a high corporate tax rate reduces unemployment, which differs from the literature mentioned above. The literature examines the variations among OECD countries in terms of corporate income tax revenue relative to GDP. The empirical results show that the revenue-maximizing corporate income tax rate was 33% for the entire sample. Although this study does not mention the unemployment rate, it analyzes the impact of corporate income tax on economic growth (GDP) when economic growth is closely related to the unemployment rate, that is, the economy is in recession, leading to an increase in unemployment, and vice versa (Clausing, 2007; Zellner & Ngoie, 2015; Dinh, 2020a). The impact of corporate tax on unemployment is currently the government's concern, so, the research literature on this issue (Zirgulis & Šarapovas, 2017) investigated the effect of corporate taxation on unemployment using a group of dynamics covering 41 countries within 11 years. The results show that the average tax rate increased, which is consistent with the results of other studies. In addition, Eichner and Runkel (2009) studied multinational corporate income tax related to unemployment and found that corporate tax policy caused unemployment when the corporate income tax rate was high; thus, the wages of workers were reduced to cut the cost of products, which caused temporary unemployment because workers wanted to find better jobs in other countries, moreover, several studies have the same opinion on how tax affects unemployment rates (Hashemzadeh & Saubert, 2004; Bhattarai, 2010). Therefore, based on data from 41 countries over 11 years, several studies on the impact of corporate taxation on unemployment have investigated how changes in corporate income tax affect the unemployment rate. Besides, some literature also used the generalized method of moments (GMM) to estimate this impact, and showed that increased corporate tax rates significantly increased the unemployment rate (Zirgulis & Šarapovas, 2017; Rahat et al., 2019). Other studies have shown that low corporate tax rates promote economic growth and reduce unemployment because when the corporate tax rate is low, enterprises' refinancing increases with income redistribution, which encourages them to expand their investment size (Meric et al., 2013; Martinez-Vazquez et al., 2012; George-Anokwuru & Okowa, 2021). Moreover, several studies examined the impact of corporate income tax on unemployment and found that reducing corporate income tax rates is related to faster job creation, income tax, and high corporate income, making it difficult for enterprises to refine their investments. Inappropriate tax policy is also a cause of unemployment (Miyagiwa, 1988; Dinh, 2020c; Da Rin et al., 2011). The literature has assessed the effects of taxes on economic growth in 35 OECD countries, which is a very broad field of study for the Organization for Economic Co-operation and Development, and has discovered factors that influence key macroeconomic decisions such as inflation, unemployment, and government spending. This is different from other studies in that the tax factor has a positive relationship with economic growth as the tax rate increases by 1%, which increases gross domestic product by 0.29%. However, government taxes on goods and services harm economic growth; when a tax is a 1% increase, it causes a 0.60% decrease in gross domestic product. Further, these studies implied that tax policy is positively correlated with economic growth through corporate taxes, and negatively correlated with economic growth through consumption taxes (Andrašic et al., 2018; Yahaya & Bakare, 2018; Djankov et al., 2010). In addition, a study on the relationship between corporate tax rates and

economic growth showed a negative relationship between corporate taxes and long-run economic growth in countries using panel regression and test methods to assess this correlation in European Union countries. Thus, governments raise corporate income tax, which causes economic growth to decrease, leading to an increase in unemployment, and vice versa (Baranová & Janíčková, 2012; Wang & Sun, 2022; Eichner & Runkel, 2009). The literature also studied taxation, public policy, and unemployment, showing that high tax rates and wages are the main causes of persistently high unemployment in Europe over the past 15 years and in some other countries. This is also consistent with the fact that high taxation rates and payroll affect unemployment, because tax increases and high wages lead to an increase in product costs and enterprises' decreased competitiveness. As a result, the enterprise may downsize or go bankrupt, so some studies have attempted to provide direct evidence of the general equilibrium effect of the corporate income tax on unemployment using cross-country data (Stiglitz, 1999; Chen et al., 2018). Additionally, empirical studies have provided evidence that high corporate tax rates impact unemployment. As previously mentioned, studies have used cross-country or country data to find evidence of this effect and its correlation, using different methods. At the same time, the research results are only relevant in the context of economic development and the scope of one or more countries' data selected for the study (Tagkalakis, 2013; Shuai & Chmura, 2013; Kawano & Slemrod, 2016).

Studying the impact of fiscal policy on unemployment in South Africa using annual time series data for the years 1980 to 2010 and applying a vector error correction model to determine the impact of fiscal policies on unemployment in South Africa, the study also demonstrates that higher corporate income taxes are the cause of high unemployment. The findings demonstrate that while government spending and taxation have a favorable impact on unemployment, government investment spending has a negative impact on it in South Africa (Murwirapachena et al., 2013). However, this study uses data selected from public companies in three countries (Vietnam, China, and South Africa) to compare the impact of the corporate tax rate on unemployment because these countries have different economic developments, such as underdeveloped, developing, and developed countries. Therefore, these studies provided a general rule that increasing or decreasing corporate tax rates affects unemployment in the context of changing tax rates across countries (Gale et al., 2019; Leigh, 2018). A corporate tax is a direct tax on enterprises' profits and taxes paid on their taxable income, which includes sales, the other revenue, financial revenue minus the cost of goods sold, administrative and business expenses, sales and marketing, R&D, depreciation, other expenses, and financial expenses, etc. It is known that corporate tax or company tax, is a direct tax levied by the government on the income or capital of companies or similar legal entities. It is therefore imposed on the net income of a firm (Battaglini & Coate, 2016). As a result, a country's corporate tax may be imposed on corporations that are domestically incorporated, businesses that operate there using income from that nation, foreign businesses with a permanent presence in the nation, and corporations that are treated as residents of that nation for the purposes of its tax laws (Dinh, 2020d).

The issues mentioned above show that between corporate income tax and the unemployment rate, there is much controversy, and each literature was studied in different aspects; however, the literature review is a basis to explore the impact of corporate income tax on economic growth. So, this study aims to determine the impact of corporate income tax on the unemployment rate and build a predictive model of this effect to help the government adjust tax policies accordingly compatible with the economy.

To analyze the impact of the corporate tax rate on the unemployment rate, it is necessary to test the correlation coefficient (r) because this test is a statistical measure of the closeness of the relationship between the two variables, the correlation coefficient between the two variables was considered 1 to –1, and the hypothesis was as follows:

- The two variables have a close link if the correlation coefficient progressively increases to 1.
- The two variables' correlation system is loose if the correlation coefficient steadily decreases to zero, the two variables are not connected if the correlation coefficient is 0.

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Testing hypotheses:

H_0: $\beta = 0$ *($Unemp_t$ and Tax_t are the non-stationary data time-series).*

H_1: $\beta < 0$ *($Unemp_t$ and Tax_t are the stationary data time-series).*

The two quantitative variables have a very close correlation coefficient; however, there is no relationship at all. Whether there is a close correlation between two variables, or they have no relationship depends on the data of the random sample, which is clarified in the methodology section.

2. METHODOLOGY

The correlation coefficient has a negative value, meaning that when the corporation tax rate goes up, the unemployment rate goes down, and vice versa, when it goes down, the unemployment rate goes up (Dinh, 2020c). When the corporate tax rate rises, the unemployment rate also rises; conversely, when the corporate tax rate reduces, the unemployment rate also reduces r > 0, the correlation coefficient value is positive). If the test results show that the correlation between the unemployment rate and corporate income tax rate is reasonably close and statistically significant, the continuous data is collected to be studied using the VAR model. If this correlation coefficient is positive, this means that the two variables have a positive relationship. If it is negative, this means that the two variables have a negative relationship (Dinh, 2018; Granger & Newbold, 1974; Yule, 1926).

This study examines two independent and dependent variables, with the corporation tax rate (*Tax*) serving as the independent variable and the unemployment rate (*Unemp*) serving as a dependent variable. The regression model is expressed as follows:

$$\widehat{Unemp}_t = \hat{\alpha} + \hat{\beta} Tax_t + \omega_t. \quad (1)$$

For regression analysis related to time-series data, the application of the autoregressive model is appropriate, because the results of this model show the present and lagged values (past values) of the explanatory variable. Thus, the model can be expressed as:

$$Unemp_t = \alpha + \sum_{t=j}^{p} \beta_t Unemp_{t-j} + \\ + \sum_{t=j}^{p} \gamma_t Tax_{t-j} + u_{1t}, \quad (2)$$

$$Tax_t = \alpha + \sum_{t=j}^{p} \beta_t Unemp_{t-j} + \\ + \sum_{t=j}^{p} \gamma_t Tax_{t-j} + u_{2t}. \quad (3)$$

The unit root test and the cointegration relationship are used to assess the VAR model, which is used to avoid false regression by taking into account time series of stationary variables. As a result, the Dickey and Fuller (DF) and extended Dickey and Fuller (ADF) tests were created (Dickey & Fuller, 1981). The unit root test and ADF extended unit root test model were run using the ADF test as follows:

$$\Delta_{Unemp_t} = \alpha_0 + \beta Unemp_{t-1} + \\ + \sum_{j=1}^{k} \partial_j \Delta Unemp_{t-j} + \varepsilon_t, \quad (4)$$

Table 1. Description of variables

Variable	Acronym	Description	Source
The corporate tax rate	*Tax* (%)	Corporate income tax rate is a tax levied on companies' net income that companies earn from their business, and it is calculated as a proportional tax rate. Data are collected in Vietnam, China, and South Africa from 2000 to 2020	Data are available on the website of the Organization for Economic Co-operation and Development. (OECD, n.d.)
Unemployment rate	*Unemp* (%)	Unemployed are people who are out of work and who are actively looking for work, the unemployment rate is calculated by dividing the number of unemployed by the total number of the labor force. Data are also collected in Vietnam, China, and South Africa from 2000 to 2020	Data are available on the website of the World Bank Group, which is like a cooperative, made up of 189 member countries. World Bank Group (2020)

$$\Delta_{Tax_t} = \alpha_0 + \delta_t + \beta Tax_{t-1} + \\ + \sum_{j=1}^{k} \partial_j \Delta Tax_{t-j} + \varepsilon_t, \quad (5)$$

where $\Delta_{yt} = y_t - y_{t-1}$; y_t is time-series; k is order lag; and ε_t is white noise.

The difference between models (4) and (5) is that model (5) includes a trend variable t time (_t), which has values ranging from th 1 to th n, where th 1 denotes the first observation in the data, and th n denotes the last observation in the data series. The classical assumption that white noise has a mean value of zero, constant variance, and is not autocorrelated led to the creation of this random error term. Additionally, the best k lag for the ADF model is chosen using the ADF test result, which is Akaike's information criterion. So, when the AIC was the smallest, the k value was chosen (Akaike, 1973).

The paper applies the causality test method to consider whether the variables are causality or not, and it is written as follows:

$$\Delta_{Unemp_t} = \alpha_0 + \sum_{j=1}^{k} \beta_j Tax_{t-i} + \\ + \sum_{j=1}^{k} \partial_i \Delta Unemp_{t-j} + u_{it}, \quad (7)$$

$$\Delta_{Tax_t} = \alpha_0 + \sum_{j=1}^{k} \delta_i Tax_{t-i} + \\ + \sum_{j=1}^{k} \theta_j \Delta Tax_{t-j} + u_{2t}. \quad (8)$$

With the change of regression coefficients β_j, δ_j, the relationship between two variables Δ_{Unempt} and Tax_{t-1} is determined as follows:

- If $\beta_j \neq 0$ and is statistically significant, but i is not significant, the $Tax_{t-}1$ variation is the causality of the Δ_{Unempt} variation.
- If β_j is not statistically significant, but $\delta_j \neq 0$ and is significant, the Δ_{Unempt} variation is the causality of the Tax_{t-1} variation.
- If $\beta_j \neq 0$ and $\delta_j \neq 0$ and is statistically significant, the Tax_{t-1} and the Δ_{Unempt} are causality with each other.
- If β_j and δ_j are not statistically significant, the Tax_{t-1} and Δ_{Unempt} are independent.

The cointegration relationships between the dependent and independent variables were examined using Johansen's cointegration test, which is applied in a multivariate context. To determine if the variables are I (0) or I (1), which is the beginning point in Johansen's (1995) ARDL model for order p, this study utilizes this model (Johansen, 1995; Pesaran & Shin, 1999; Johansen, 1991).

$$Z_t = AZ_{t-1} + \ldots + A_n Z_{t-n} + \beta X_t + \varepsilon_t, \quad (9)$$

where Z_t is the vector for the degree of difference 1 (I (1)) between the independent and dependent variables (Y_t and X_t); X_t is the vector of the non-random variable, and ε_t is the error correction term. To explore the impact of the corporate tax rate on unemployment rates in Vietnam, China, and South Africa, general VAR models (2) and (3) were applied to each country to analyze and compare the similarities and differences between the three economies.

Where X_t is the vector of the non-random variable, Z_t is the vector representing the degree of difference 1 (I (1)) between the independent and dependent variables (Y_t and X_t) and ε_t is the error correction term. General VAR models (2) and (3) were used to examine and compare the similarities and differences between the economies of Vietnam, China, and South Africa in order to investigate the effect of the corporate tax rate on unemployment rates in each of these nations.

3. RESULTS

The empirical results show that the results of the correlation coefficient and statistical description variance are the basis of the correlation and their impact (Dinh, 2019b).

The following are the results of applying the unit root test to test the delays of unemployment and corporation tax rates, which is a method typically used to determine if a time series is stationary or non-stationary (Gujarati, 2003).

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Table 2. Countries' covariance, correlation coefficient, and descriptive statistics

Source: Author's analysis.

Item	China		South Africa		Vietnam	
	Tax	Unemp	Tax	Unemp	Tax	Unemp
Covariance						
Tax	15.09297	–	8.073948	–	0.224906	–
Unemp	–0.711111	0.113651	1.962222	0.712018	0.930170	17.39229
Correlation						
Tax	1.000000	–	1.000000	–	1.000000	–
Unemp	–0.542955	1.000000	0.818389	1.000000	0.470309	1.000000
Probability						
Tax	–	–	–	–	–	–
Unemp	0.0110	–	0.0000	–	0.0314	–
Descriptive statistics						
N	21	21	21	21	21	21
Maximum	25.000	3.000	28.000	22.410	20.000	1.000
Minimum	33.000	5.000	30.000	33.290	32.500	32.760
Mean	28.0476	4.4333	28.6190	27.2333	25.6905	1.8129
Std. Deviation	3.98091	0.34545	0.86465	2.91164	4.37339	0.48595

Table 3. Countries' unit root test at lag I(0)

Source: Author's analysis.

Item	Alpha level	China		South Africa		Vietnam	
		D(Tax) I(0)	D(*Unemp*) I(0)	D(Tax) I(0)	D(*Unemp*) I(0)	D(Tax) I(0)	D(*Unemp*) I(0)
Augmented Dickey-Fuller test statistic		Prob.* 0.6347	Prob.* 0.0182	Prob.* 0.0732	Prob.* 0.6193	Prob.* 0.7299	Prob.* 0.3421
		t-Statistic	t-Statistic	t-Statistic	t-Statistic	t-Statistic	t-Statistic
		–1.242118	–3.559640	–2.843701	1.276357	–0.990696	–1.861738
Test critical values	1%	–3.808546	–3.857386	–3.886751	–3.808546	–3.920350	–3.808546
	5%	–3.020686	–3.040391	–3.052169	–3.020686	–3.065585	–3.020686
	10%	–2.650413	–2.660551	–2.666593	–2.650413	–2.673459	–2.650413

Note: * MacKinnon (1996) one-sided p-values.

The results in Table 3 show that most of the variables are non-stationary, excluding the China's unemployment rate variable, which is stationary at the alpha of 5% and 10%, which is one of the basic and important methods. Therefore, the best way to make a time-series stationary is to differentiate between them (Dinh, 2020b).

Most of the three countries' variables of the model are non-stationary at lag I(0), except for the variable of China's unemployment rate, which shows that the variables of the model of Vietnam and South Africa have probabilities of 0.6193, 0.7299, 0.3421, and 0.6347, respectively, which are greater than the alpha of 0.05, or that

Table 4. Countries' unit root test at lag I(1)

Source: Author's analysis.

Item	Alpha level	China	South Africa		Vietnam	
		D(Tax) I(1)	D(Tax) I(1)	D(*Unemp*) I(1)	D(Tax) I(1)	D(*Unemp* I(1)
Augmented Dickey-Fuller test statistic		Prob.* 0.0033	Prob.* 0.0019	Prob.* 0.0293	Prob.* 0.0004	Prob.* 0.0002
		t-Statistic	t-Statistic	t-Statistic	t-Statistic	t-Statistic
		–4.358899	–4.640402	–3.303431	–5.590719	–5.652597
Test critical values:	1%	–3.831511	–3.831511	–3.831511	–3.920350	–3.831511
	5%	–3.029970	–3.029970	–3.029970	–3.065585	–3.029970
	10%	–2.655194	–2.655194	–2.655194	–2.673459	–2.655194

Note: * MacKinnon (1996) one-sided p-values.

Table 5. Countries' VAR lag order selection criteria of corporate tax and unemployment rates

Source: Author's analysis.

Item	Lag	Log*L*	LR	FPE	AIC	SC	HQ
China	0	–50.80387	NA	0.673545	5.280387	5.379960	5.299824
	1	–27.87493	38.97919*	0.101907*	3.387493*	3.686213*	3.445806*
South Africa	0	–62.41095	NA	2.150086	6.441095	6.540668	6.460533
	1	–34.24242	47.88650*	0.192637*	4.024242*	4.322962*	4.082556*
Vietnam	0	–67.41963	NA	3.547970	6.941963	7.041536	6.961401
	1	–39.33844	47.73802*	0.320668*	4.533844*	4.832564*	4.592157*

Note: * indicates lag order selected by the criterion; LR: sequential modified LR test statistic (each test at 5% level).

the absolute value of the test critical is greater than the absolute value of the t- statistical, so the variables are lagged at the first difference I(1) to determine the time-series lag. The empirical results show that the models of Vietnam and South Africa have a similar lag, that is, when the government issues a tax policy that does not affect unemployment immediately, this policy affects the unemployment rate in the following year (see Tables 2 and 3).

To determine the optimal lags, a VAR model is applied to determine the number of lags based on the *SC* criteria information (Schwarz, 1978), *HQ*: Hannan-Quinn (Hannan & Quinn, 1979), *AIC* (Akaike, 1973), *LR*: Likelihood Ratio and *FPE*: Final Prediction Error, to be able to choose the optimal lag, but this paper chooses AIC (Akaike Information Criterion) to select the optimal lag for the model.

After testing for optimal lag, the results show that the time series is stationary at lag (1). However, to obtain reliable empirical results, the Hansen model was applied to test the cointegration of the variables and consider the long-run equilibrium relationship between the variables (Dinh, 2019a).

Similar to an autoregressive model, each variable has an equation that models its evolution over time. The variable's lagged (past) values, the lagged values of the other variables in the model, and an error term are all included in this equation (Dinh, 2019b).

Table 6. Countries' unrestricted cointegration rank test (Trace) of corporate tax and unemployment rates

Source: Author's analysis.

Item	Hypothesized No. of CE(s)	Eigenvalue	Trace statistic	0.05 critical value	Prob.***
China	None *	0.481782	18.44252	15.49471	0.0175
	At most 1**	0.307347	6.610064	3.841466	0.0101
South Africa	None	0.512710	13.11248	15.49471	0.1107
	At most 1	0.009529	0.172345	3.841466	0.6780
Vietnam	None	0.193749	4.734193	15.49471	0.8364
	At most 1	0.046533	0.857706	3.841466	0.3544

Note: * 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.

Table 7. Countries' vector autoregression estimates of corporate tax and unemployment rates

Source: Author's analysis.

Item	China		South Africa		Vietnam	
Covariance	*Unemp*	Tax	Unemp	Tax	Unemp	Tax
Unemp	0.505316	–0.537214	0.927008	0.072564	0.640611	0.233322
Tax	–0.004981	0.852056	0.303077	0.672770	0.007161	0.916201
C	2.404554	6.138437	10.60846	7.304443	0.457795	1.134036
R-squared	0.575145	0.809168	0.747777	0.894581	0.458547	0.909218
Adj. R-squared	0.525162	0.786717	0.718104	0.882178	0.394847	0.898538

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Table 8. Tested causality of countries' tax and unemployment variables

Source: Author's analysis.

VAR Granger Causality/Block Exogeneity Wald Tests									
Item	**China**			**South Africa**			**Vietnam**		
Dependent variable	**Unemployment**			**Unemployment**			**Unemployment**		
Excluded	Chi-sq	df	Prob.	Chi-sq	df	Prob.	Chi-sq	df	Prob.
Tax	13.31076	1	0.0206	5.045064	1	0.0247	1.691292	1	0.8900
All	13.31076	1	0.0206	5.045064	1	0.0247	1.691292	1	0.8900
Dependent variable	**Tax**			**Tax**			**Tax**		
Excluded	Chi-sq	df	Prob.	Chi-sq	df	Prob.	Chi-sq	df	Prob.
Unemployment	16.27333	1	0.0061	0.136295	1	0.7120	11.48145	1	0.0426
All	16.27333	1	0.0061	0.136295	1	0.7120	11.48145	1	0.0426

To determine if a change in the X variable causes a change in the Y variable and vice versa, the Granger causality test is utilized. Each set of variables in the VAR model is regressed based on its historical value, as well as the values of other variables.

It is frequently difficult to explore the empirical results of the individual coefficients of the estimated VAR model, researchers applied the Impulse Response Function (IRF) to shock analysis of economic variables.

When it comes to the VAR model's stability, it is deemed stable if the residual is a stationary series, all the characteristic polynomial solutions fall within the unit circle, or if the computable modules are less than 1.

The results of the cointegration test of the model for Vietnam and South Africa are similar because the models do not have a cointegration relationship; that is, the relationship between the corporate income tax rate and the unem-

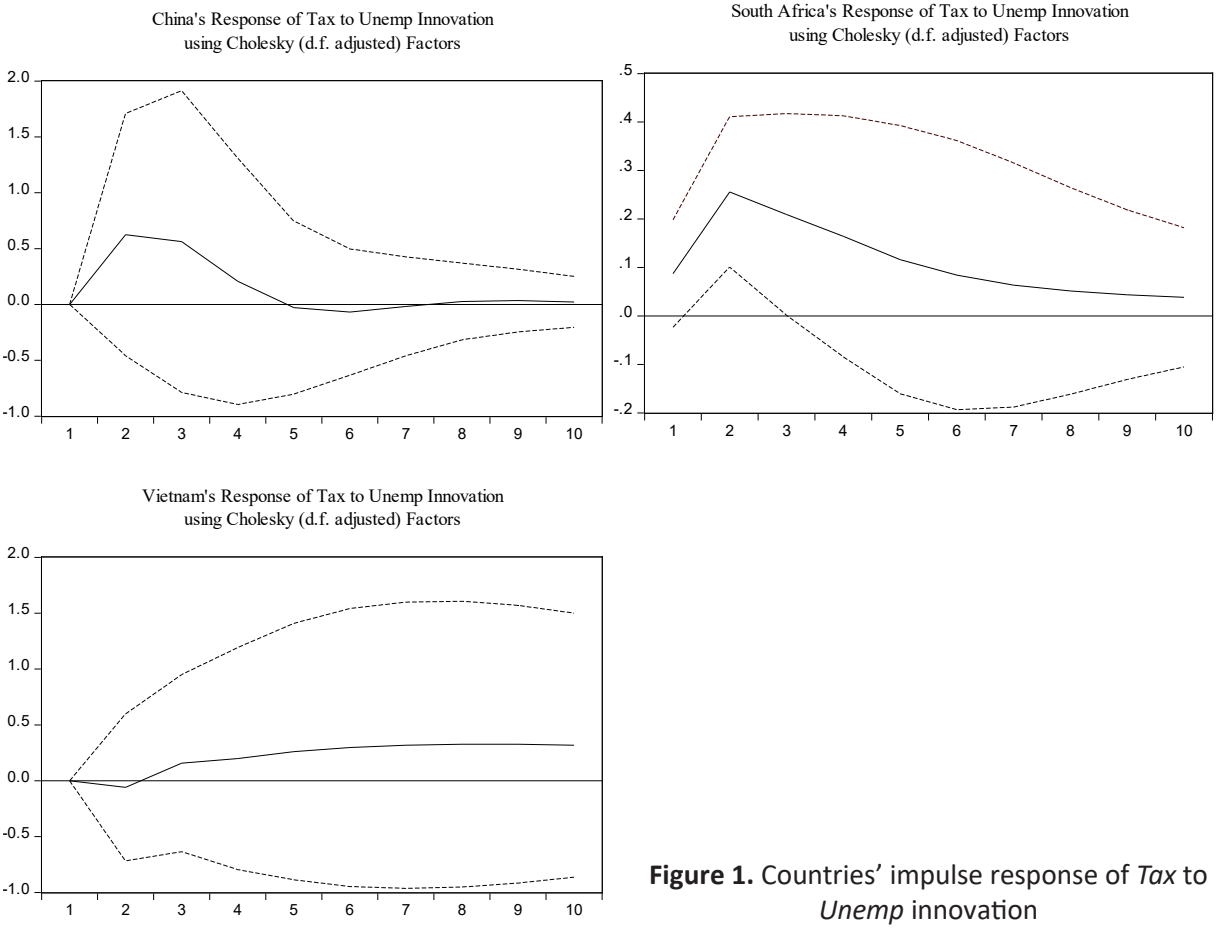

Figure 1. Countries' impulse response of *Tax* to *Unemp* innovation

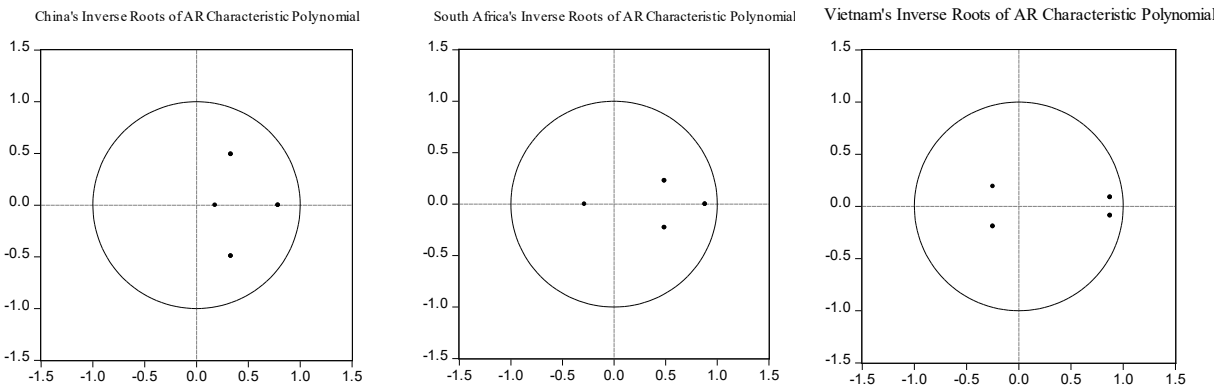

Figure 2. Countries' inverse roots of AR characteristic polynomial

ployment rate is a short run, which is different from the long-run relationship of China's model. The models of Vietnam and South Africa have a positive correlation between the corporate income tax rate variable and the unemployment rate, which is different from the correlation of China's model (see Tables 2 and 6). The countries' forecast models select the optimal lag in the first difference I (1), that is, in the first difference I(1), the model provides highly reliable empirical results and forecasts the impact of the corporate tax rate on the exact unemployment rate. Simultaneously, the optimal delay results form the basis for forecasting empirical results using the VAR model (see Table 5). All the unit points of the models of the three countries are already within the unit circle. In other words, the model points are less than one, so the forecast model of the three countries is stable and consistent with the data (see Figures 1 and 2).

This study applies this methodology to explore the impact of the variables of countries' corporate taxes on the unemployment rate according to each model and the relevant testing methods, showing that the empirical results are exceptionally reliable and consistent with the model, because the proposed hypotheses, such as the correlation hypothesis, nonstationary data and data hypothesis, and cointegration hypothesis, are accepted.

4. DISCUSSION

China: The empirical results show that the corporate income tax rate has a relatively close negative relationship with the unemployment rate. Considering that (r) = 55%, (r) < 0, and Sig = 0.011 < 0.05, the empirical results are highly reliable and statistically significant. Additionally, the covariance test results show that the unemployment rate variable is negatively related to the corporate income tax rate variable, because the tax is negative. This shows that when income tax and unemployment rates decrease, enterprises must pay more tax, and the state budget also increases. The mean corporate income tax rate is 28.0476%, and the mean unemployment rate is 4.4333%; thus, China's economy has always maintained a single-digit unemployment level, which is a reasonable level for economic growth and competition in the labor market (see Table 2), the experimental results are similar to those of Bettendorf et al. (2009), who found that the unemployment and welfare effects of corporate taxes differ significantly among European countries (Bettendorf et al., 2009). The unemployment rate variable lagged at the difference at I(0), 5%, and 10% alpha levels, and the corporate income tax variable has lagged at the difference at I(1), alpha of 1%, 5%, and 10%. This means that when a government tax policy is issued, it does not immediately affect economic growth, which affects it after a year (see Tables 3 and 4). In addition, the results of the cointegration test show that the model has cointegration at the level of 0.05, that is, the impact of the corporate income tax rate on the unemployment rate and long-run relationships between the two variables (see Table 6). The forecast for the corporate income tax rate showed a relatively high unemployment rate in the first three years after the shock, with a gradual decline in the next two years. According to previous research, these results were consistent

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and exceptionally reliable (Liu & Altshuler, 2013). There has been a steady trend between the corporate income tax rate and unemployment rate in later years, so, China's forecast model was established as follows:

$$China's\,Unemp_t = 2.404554 + \\ +0.50531Unemp - 0.004981Tax, \quad (10)$$

$$China's\,Tax_t = 6.138437 - \\ -0.537214Unemp + 0.852056Tax. \quad (11)$$

Assuming that the other variables remain unchanged, the unemployment rate increases by 2.9% when the corporate income tax rate decreases by 1%. Thus, the forecast model shows that the unemployment rate fluctuates as the corporate income tax rate changes. The results in Table 8 show that the probability of 0.0206 is less than the alpha of 0.005; therefore, it is statistically significant. Thus, the corporation tax and unemployment variables are casualty, and it has two-way causality, which means that the corporation tax causes the unemployment variable. Therefore, the government should maintain its current corporate income tax rate to attract foreign investments. If the government excessively raises taxes, foreign investors shift to countries with low corporate tax rates. A comparison of the results of previous studies shows that empirical results also show a close relationship between corporate income tax and unemployment (Meyer, 2018).

It is suggested, the government should have two solutions: first, it should improve the investment environment effectively from the state budget to contribute to increased GDP and create high jobs; finally, it should reduce the corporate tax rate to attract foreign investment and encourage and promote domestic investment; however, it needs to reduce taxes to create high employment.

South Africa: The correlation been the corporate income tax rate and the unemployment rate is very close at (r) = 82%, Sig. = 0.0000 is less than the alpha level of 0.0. Therefore, it is statistically significant, and the empirical results are highly reliable and positively correlated; in other words, if the government wants to reduce the unemployment rate, it must reduce the corporate income tax rate so that non-state enterprises can retain their profits to reinvest and expand their scale; the mean corporate tax rate is 28.6%. The mean unemployment rate is 27.3%, which shows that South Africa's mean corporate tax rate is as high as China's mean corporate income tax rate, but South Africa's mean unemployment rate is double the digits, which is higher than the mean unemployment rates in China and Vietnam (see Table 2). The corporate income tax rate strongly shocks the unemployment rate in the first three years, gradually reduces in the next three years and stabilizes in the later years (see Figure 1), so, South Africa's forecast model was established as follows:

$$South\ Africa's\,Unemp_t = 10.60846 + \\ +0.927008Unemp + 0.303077Tax, \quad (12)$$

$$South\ Africa's\,Tax_t = 7.304443 + \\ +0.072564Unemp + 0.672770Tax. \quad (13)$$

In this case, assuming that other factors remain unchanged if the corporate tax rate decreases by 1%, the unemployment rate decreases by 10%, that is, the forecasting models show an increase in the corporate tax rate. The results in Table 8 show that the probability of 0.0247 is less than alphas of 0.005, so it is statistically significant, thus, the corporate tax and unemployment variables are causal and have one-way causality, which is different from China's results.

Vietnam: The correlation between the unemployment rate and corporate income tax rate is positive and relatively close (r) = 47%, sig. = 0.0314. This shows that the data is reliable and statistically significant, and the empirical results indicate that if the government wants to have a high employment policy, it should reduce the corporate income tax so that non-state enterprises have more profits to reinvest and expand their company size, which is an important factor for high employment, because, non-state enterprises have more efficient investment activities than state-owned enterprises, so they create more jobs to reduce the unemployment rate. The mean corporate tax rate is 25.7%, and the mean unemployment rate is 1.82%, which shows that the tax rate is lower than that in China and South Africa, and the unemployment rate is lower than that in China and South Africa). This shows that the empirical results are consistent

with the results of a previous study (Abraham & Katz, 1986). The government gradually reduced the corporate tax rate from 32% to 20% over the 20 years, resulting in an extremely low unemployment rate (see Table 1), Vietnam's forecast model is established as follows:

$$Vietnam's\,Unemp_t = 0.457795 + \\ +0.640611Unemp + 0.007161Tax, \quad (14)$$

$$Vietnam's\,Tax_t = 1.134036 + \\ +0.233322Unemp + 0.916201Tax. \quad (15)$$

Similar to the cases of the forecast models mentioned above, assuming other unchanged factors, if the government increases the corporate income tax rate by 1%, then the unemployment rate increases by 1.1%. This shows that the corporate income tax rate affects the unemployment rate, which is incredibly low, at 0.1%. The impact of the corporate income tax rate on the unemployment rate in China, South Africa, and Vietnam is 1.9%, 9%, and 0.1%, respectively. Thus, Vietnam's unemployment rate had the lowest impact, and South Africa's unemployment rate had the highest impact. This is similar to the results of previous studies, a 1% cut in tax rates, on the other hand, lowers the unemployment rate to 0.34%, according to a study that examines the effects of changes in corporation tax rates on unemployment rates (Estache & Gersey, 2018). The results in Table 8 indicate that the probability of 0.0426 is less than alpha of 0.005; therefore, it was statistically significant. Thus, the corporate tax and unemployment variables are causal, and it has one-way causality, which is different from South Africa's results.

CONCLUSION

The purpose of the study is to explore the countries' forecast models on the corporate income tax impact on the unemployment rate, which shows the degree of corporate income tax impact on the unemployment rate is different, and the study has shown the following results.

The forecast results show that the unemployment rate is 4.4333%, which is the ideal unemployment rate because it is competitive in the labor market to promote the development of high-quality resources. The corporate income tax rate is 28.0476%, which is consistent with that of other countries in the region. Moreover, the government effectively invested in the state budget, contributed to an increase in the GDP, and created high employment. Besides, the empirical result forecast is different from China's result forecast in that the corporate tax rate and unemployment rate are positively correlated, which means that if the government reduces the corporate tax rate, the corporate tax rate unemployment also decreases, and vice versa. Currently, the unemployment rate is 28.6190%, which is extremely high, and has led to reduced production. Thus, the economy can have a redundant labor force because of underemployment, which causes difficulties in social life. Furthermore, the corporate income tax rate is 27.2333%, although it is not higher than China's corporate tax rate, which is seven times higher than China's unemployment rate. So, the forecast results differ from those for China and South Africa in terms of unemployment and corporate income tax rates. Currently, the corporate tax rate is from 20 to 22%, which is a low rate compared to the tax rates of both countries, as the government is encouraging and attracting foreign investment and non-state enterprises, which has increased GDP growth and created jobs. In addition, the unemployment rate is 1.8%, which is the lowest among all countries. Thus, unemployment can cause labor shortages and reduce the competitiveness of labor resources. In an economy, the unemployment rate frequently oscillates around its natural rate. Due to the economic cycle, production declines when the economy is in a crisis. The unemployment rate is higher than the natural unemployment rate, and the actual output is lower than the potential level. On the other hand, as production rises across the board, it becomes necessary to recruit more people, which lowers the unemployment rate below the natural rate.

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AUTHOR CONTRIBUTIONS

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Data curation: Nguyen Ngoc Son.
Formal analysis: Nguyen Ngoc Son.
Investigation: Nguyen Ngoc Son.
Methodology: Nguyen Ngoc Son.
Resources: Nguyen Ngoc Son.
Validation: Nguyen Ngoc Son.
Visualization: Nguyen Ngoc Son.
Writing – original draft: Nguyen Ngoc Son.
Writing – review & editing: Nguyen Ngoc Son.

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