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IMPACT OF ECONOMIC VOLATILITY ON CORPORATE INCOME TAX RATE: THE CASE OF 20 ASIAN COUNTRIES

MASTER OF ARTS IN DEVELOPMENT ECONOMICS

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ABSTRACT

This paper examines the impact of economic volatility on the corporate income tax rate in the context of globalization and international taxation competition. The impact is analyzed by two models, direct and indirect effect model. The former investigates directly the relationship of corporate income tax rates and economic volatility in terms of interest rate, exchange rate, and growth rate. The latter applies a system of equations to examine simultaneously the determinants of tax rate and tax base. The study finds out that economic volatility impacts negatively on corporate income tax rate and also negatively on foreign direct investment (FDI) inflows. Moreover, corporate income tax rate affects negatively and significantly on FDI inflows, meanwhile FDI inflows influence corporate income tax rate with positive and significant impact.

CONTENTS

CHAPTER ONE: INTRODUCTION

In order to attract more capital inflows, governments compete each other by reducing corporate income tax rate (Genschel and Schwarz, 2011), because a corporate income tax rate rise conducts to a decline in multinational investment (Hong and Smart, 2010). Moreover, in high tax rate countries, governments face with the problem of profit shifting to lower tax rate countries (Becker and Fuest, 2012). Therefore, governments also restrain that process by competing in reducing the effective average tax rate and statutory tax rate (Devereux, Lockwood, and Redoano, 2008).

To that extent, economic volatility is believed as a determinant of tax reform (Feldstein, 1976). It is considered as disincentive for investments because it distorts the location decision for investments to other stable economy instead of the volatile one. In order to stimulate FDI inflows, corporate income tax rates have to be kept at a sufficient low level in order to reduce costs of capital and enhance investment incentives (Panteghini and Schjelderup, 2006). Consequently, the corporate income tax setting process is influenced by economic volatility (Ghinamo, Panteghini, and Revelli, 2010).

Using the dataset of 20 Asian countries from 1982 to 2011, this research investigates corporate income tax rate setting process under the impact of economic volatility in terms of real interest rate, nominal exchange rate, and GDP growth rate. Moreover, the impact is assessed in the context of globalization, in particular, capital mobility in terms of FDI inflows into a country. To that extent, this study examines the influence of economic volatility on FDI inflows and the simultaneous effects between FDI inflows and corporate income tax rate. The highlight of the paper is that the lag effects of public policies and investment decisions are taken into account.

CHAPTER TWO: LITERATURE REVIEW

2.1. Corporate income tax rate

Corporate income tax rate is analyzed under three functions. Firstly, corporate income tax rate is regarded as an effective way to raise tax revenue without affecting economic behavior. However, this function is only effective in a closed economy. In case of existing capital mobility, the choice for location of investments is distorted by high tax rates. Secondly, corporate income tax is perceived popularly as fair charges for public goods and services consumed by companies. To fund these public investments, government levies on the profits of companies at a fair share of taxation. Thirdly, corporate income tax is considered as a reasonable substitute or a "backstop" for personal income tax (Slemrod, 2004). However, this role is weakened in the context of capital mobility. The owner of the capital gains may reside in a different country from where the company locates so that the individual capital profits are levied at the different tax rates (Bird, 1996; Devereux and Sørensen, 2006; Mintz, 1995).

Corporate incomes are taxed at first at corporate income tax level, then at the personal income tax level when dividends are paid to shareholders, causing the rise of effective tax rate on the return of corporate investments. In case of higher tax rate on personal income compared to that on corporate income, the shareholders tend to accumulate those incomes with the company in order to avoid these taxes (Rosen, 2004), meanwhile individuals tend to shift their income by bending the reported payments to reduce their tax liabilities (Gordon, MacKie-Mason, and Hubbard, 1995; Gordon and Slemrod, 1998). For example, an employee receives qualified stock options instead of wage payments or a self-employed person accumulates his profits within the company and finances company's expenses as his consumption so that labor income might be reclassified into business income. Therefore, government reacts by balance the statutory tax rate on corporate income and on personal income (Slemrod, 2004). Otherwise stated, corporate income tax acts as a backstop to personal income tax.

Devereux et al. (2008) examined the tax reaction function for exploring the investment stimulation created by the tax regime via three measures. The first, effective marginal tax rate, is defined as tax rate on new investments. In other words, the scale of a firm's operation is determined through this measure. The second, effective average tax rate, is defined as the proportion of tax payment on true economic profit. Otherwise stated, the firm's location is determined through this measure. Thirdly, the statutory tax rate is adjusted by governments to contest for the inward location of firms.

Because this research aims to investigate the taxation on corporate income in the circumstance of tax competition among countries, consequently, statutory tax rate is the proper measure. Besides, the statutory rate assists in demonstrating the profit shifting and decision of investment location of MNCs, Ghinamo et al. (2010) used this measure in their study as the dependent variable.

2.2. Economic volatility

Economic volatility, the instability in economic factors, especially in terms of uncertainty, is considered as an important parameter in the theory of tax reform (Feldstein, 1976). The fact of choosing particular tax rates not only influences social welfare, but also alters the information available for later decisions. To that extent, changing a tax rate imposes a gamble that reduces expected utility. Gamble argument implies that if value of information, regarding economic volatility parameter, is not taken into account, the variance in optimal tax may exert a smaller difference than normal. Therefore, Eaton and Rosen (1980) debated that if ignoring volatility, estimates of optimal tax rates may be biased to incorrect results.

With the aim of investigating the time varying volatility with respect to actual changes, standard deviation is the suitable measure, as in similar strategy of Ramey et al. (1994) and Aghion et al. (2005). However, this costs considerable data loss. Accordingly, in order to entirely make the most of the information in the data set, a kind of moving average of the standard deviation is computed through the value in the previous five

years of the relevant variable. This measurement approach seizes the general moments in economic volatility and the risk over time (Chowdhury, 1993; Cushman, 1988; Ghinamo et al., 2010; Koray and Lastrapes, 1989).

$$V_t = \left[1/m. \sum_{i=1}^{m} (K_{t+i-1} - K_{t+i-2})^2 \right]^{1/2}$$

Where V_t is volatility, K is the relevant variable, m is the moving average order. The moving average order is defined based on the time length of the dataset so that m with 5 years is chosen to smooth the value of observations.

In this research, economic volatility is examined through variation in real interest rate, nominal exchange rate and productivity growth rate. The two former variables reflect the behavior of government in monetary policy decision. The latter shows the state of the performance of the economy in macro level.

Real interest rate volatility

Irreversible investments are sensitive to volatility in many forms, for instance, uncertainty in future interest rates causes the increase in operating costs. These costs alter the cash flows of a project, affect the return as well as the timing of investments. Consequently, these reduce the investment stocks (Pindyck, 1991; Rodrik, 1991).

Ghinamo et al. (2010) considered interest rate volatility as the crucial taxation factor in forming the financial structure of a firm. Because of deductibility from taxable income, interest expenses are usually regarded as a tax shield by utilizing the internal and external credit market. Multinational companies can utilize the debt shifting option in which incomes and tax burden can be shifted to the lower tax rate countries by using internal debt among affiliates. Therefore, in order to obtain the optimal debt/asset ratio or internal/external debt structure, changes in external credit market of a firm or that of their foreign affiliates could affect the decision of investing in uncertain countries.

Nominal exchange rate volatility

Pindyck (1991) stated that exchange risk will descend direct investment by analyzing the cost of capital in terms of sunk costs of entry and exit to estimate the effect on investment by volatility in exchange rate and prices. He debated that exchange rate affects on investment decisions of both domestic firms and foreign subsidiaries. However, according to a study of Diebold and Nerlove (1989), bilateral flows of direct investment have a positive relationship with uncertainty in exchange rate.

Growth volatility

Higher economic volatility associates with a lower growth, with economic volatility measured by per capita annual growth rates. Based on the precautionary motive for savings, Ramey et al. (1994) debated that a higher volatility should conduct an increase in saving rates, enhancing the investment rate, considered as a premise for growth rising. Besides, Down (2007) measured the domestic and global volatility by calculating the standard deviation of growth rate in terms of purchasing power parity, and per capita real GDP.

2.3. Investment

Bernanke (1983) pointed out that there are three important characteristics of investment: irreversibility, uncertainty, and optimal investment timing[1]. The negative effect of investment timing depends on the Bad News Principle that volatility in terms of uncertain information retards the current rate of investment. His central theory examines how the investment decision is affected by the new-arriving information (Keynes, 2006).

To analysis this effect, Bernanke (1983) presumed two assumptions. Firstly, real investments are strictly irreversible. Secondly, new information that is used to estimate investment return arrives continuously as cost of waiting or economic volatility. Due to

[1] These characteristics are confirmed in the studies of Pindyck (1991), Dixit and Pindyck (1994).

the irreversibility of investment, investors will have a tendency to defer his investment decision to wait for new information. This causes expenditures regarded as sunk costs of the investments. Besides, the firm has an option to invest or not and to choose where to invest, called opportunity cost of investing. Due to a postponement tendency on decision to wait for new information and the high sensitivity of the opportunity cost in investing to variation in the future economic conditions, uncertainty impacts negatively and seriously on the expenditure and timing of investment. This postponement defines the dynamics in investment decision (Pindyck, 1991).

2.4. Tax competition

Tax competition theory originates from Tiebout hypothesis as the theory of efficient tax competition, based on theory of local public good provision. Tiebout (1956) stated that competition for mobile households or mobile firms improve social welfare. Assuming that landowners control local government, they aim to maximize the after-tax value of their land. Therefore, they offer public goods as utilities financed by local taxes to attract individuals to reside on their land. In contrast, Oates (1972) debated that society is worse off in competition for capital between local governments. For the purpose of attracting business investment, local governors may make an endeavor to keep taxes low by maintaining expenditure less than the level at that marginal benefits equal marginal costs. It means taxation impact negatively on business investment by increasing marginal costs. Because of these additional costs, public expenditure and taxes will be diminished to the level of a new equilibrium. Consequently, none gain a competitive advantage or, in other words, it conducts a wasteful tax competition or inefficient tax competition. This cause the “race to the bottom” in corporate income tax rates in recent decades.

Wilson (1999) confirmed the wasteful competition between independent governments, which cause the reduction in tax rates and levels of public expenditure for scarce capital. Based on the Nash equilibrium concept, equilibrium economy is defined as a status where the objective function of the region’s strategy is maximized with the given strategies of other regions. Particularly, the fact of choosing tax rate of a region in

comparison with that of other regions influences the equilibrium of capital return. Because an increase in the tax rate of a region causes a capital outflow which is considered to be a capital inflow to another region due to the assumption of scarce capital. To that extent, the fact that local taxes are kept low enough in order to tempt individuals to inhabit in the region, with the given public goods, will cause tax competition. Similarly, Wildasin (1989) contributed departure of the existence of "fiscal externality" which occurs when a region gains capital at the expense of others by decreasing its tax rate on mobile capital. Moreover, Hines (1999) indicated that high tax rates exert a strong and negative influence on investment decision, particularly on the volume and location of FDI, due to the reduction of after-tax returns. In addition, cost of capital will be exaggerated through an increase in tax rate (Devereux, Griffith, and Klemm, 2002). This effect conducts a diminution in capital inflow or an enlargement of outflow stock of capital. Because an increase in the cost of capital is equivalent to an increase in required rate of return, a raise in corporate income tax rate leads to a reduction in investment incentives.

Based on theories of tax competition, Panteghini and Schjelderup (2006) contributed an analysis of the tax competition with regard to economic volatility. They used a two-period model in which investments are regarded to be irreversible and multinational companies can shift their profit among countries. At the first stage, governments set their tax rates. At the next stage, multinational companies decide whether to do or deter their abroad investment operations. Therefore, the behaviors of multinational companies are based on the argument of timing investment.

Panteghini and Schjelderup (2006) proved the existence of equilibrium tax rate at which taxation achieves the same value of social marginal cost and social marginal benefit. The equilibrium tax rates will decrease as a result of expanding uncertainty in profit income. By analyzing the effect of globalization process on taxation, economic volatility is interpreted as consequence of deepening globalization, causing a great deal of unpredictable factors in the economy (Heckman, Agell, Gertser, and Friedrich, 2003).

For given tax rate, raising volatility will lead to a rise in cost of capital because of the higher risk in the investment. This descends the expected profits so that firms who have plans to invest tend to delay the investment decisions to wait for new information (Bernanke, 1983; Pindyck, 1991). Those who receive good news will invest, the remaining will cancel the investment plan. Consequently, the total number of firms exerting investment decrease. In other words, economic volatility reduces the current investment rate into a country (Dixit and Pindyck, 1994). Ultimately, the government will react by lowering the tax rate to counteract the negative effect of increased volatility. This illustrates the dynamics in taxation setting.

In contrast, Ghinamo et al. (2010) contributed the insight that an increase in FDI as a result of globalization allows a higher tax rate setting. Globalization means tighter integration or surge in market openness so that technical barriers are reduced, causing reduction in investment costs. On the other hand, globalization leads to lower transportation costs and increased skill-oriented technologies as well as widened information systems. Moreover, the diminution in transaction and financial costs of e-banking services eases the ability of profit shifting, boosting the average profitability in investments. Additionally, FDI operations are encouraged so that the number of FDI firms grow, enlarging tax base of the country. This allows the two competing countries to set a higher tax without deterring FDI. Eventually, globalization increases volatility of domestic economy so FDI inflows are discouraged. Therefore, government will lower tax rate to alleviate the negative effect. In summary, FDI impacts corporate income tax rate positively.

CHAPTER THREE: ECONOMIC VOLATILITY AND CORPORATE INCOME TAX: DESCRIPTIVE AND DATA ANALYSIS

This paper focuses on the period from 1982 to 2011, in attempts to handle two goals. First, this period covers the sharp surge in financial openness among countries in the world. Second, a long sample could capture the long-term capital flows without disproportionate effects of financial crises or the world business cycle (Gourinchas and Jeanne, 2013). The dataset is collected from a variety of sources: World Tax Database, KPMG, Trading Economics, World Development Indicators, Penn World Tables, Chinn and Ito KAOPEN, UNCTAD (see Appendix C.3 for details). According to test's result in Appendix B.1, multicollinearity is not a problem in this paper.

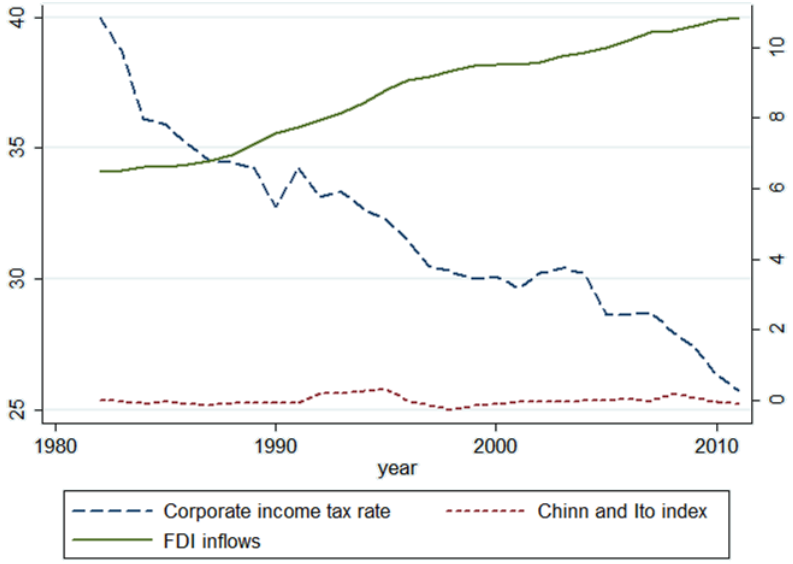

Figure 3.1 Corporate income tax rate, capital openness index and FDI inflows (1982-2011)

Figure 3.1 performs the consistent increase of average FDI inflows through the period. Meanwhile, the average top statutory rate of corporate income tax decreases from 40% in 1982 to around 25% in 2011. This might be the consequence of the escalation in the international tax competition, which conducts the "race to the bottom" in the tax rate setting process (Wilson, 1999; Zodrow and Mieszkowski, 1986). During the whole period, the average Chinn and Ito index of capital market openness holds a steady level. However, this index rises right before 1997 and 2007 then turns down sharply after that (see Appendix A.1). In the context of globalization, the capital openness relaxation

among territories motivates the global tax competition. Hence, statutory and effective tax rates keep driving down (Devereux et al., 2008). Garretsen and Peeters (2007) used volume of inward FDI as a proxy measurement of global capital openness.

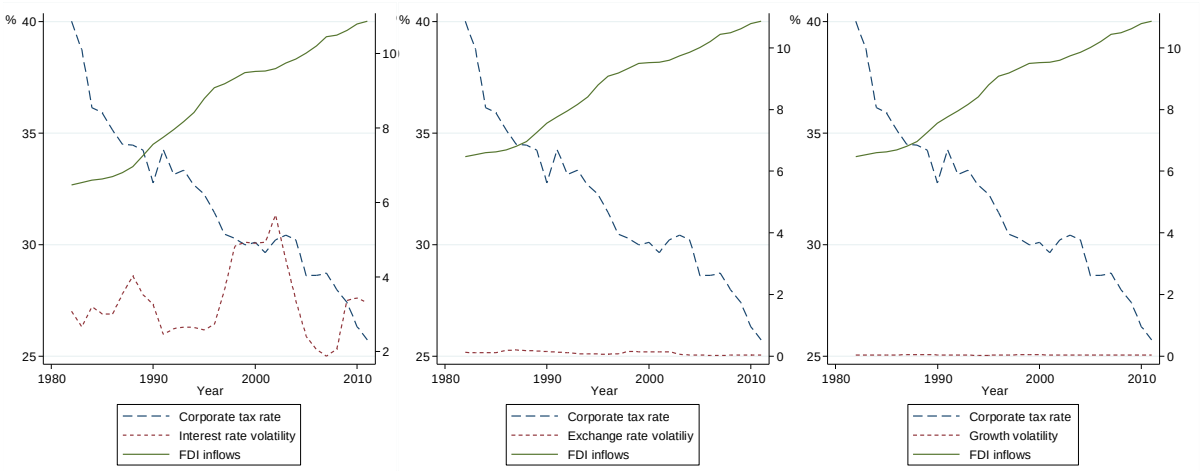

Figure 3.2: Corporate income tax rate, Real interest, Exchange rate, Growth volatility, and FDI inflows (1982-2011)

Figure 3.2 illustrates that the average real interest rate volatility varies around a horizontal line, although it expanded the scale of variation from 1997 to 2008. These are the landmarks of the two great crises, the Asian financial crisis in 1997-1998 and the global financial crisis in 2007-2008. Virtually, it is remarkable that an increase in interest rate volatility goes with a decrease in statutory corporate income tax rate and vice versa. However, exchange rate volatility does not vary much throughout the time period. Because this index is calculated by the standard deviation of exchange rate growth, reducing and smoothing the variation of the exchange rate by the moving average order with 5 years. Based on the tendency performed in the graph, the exchange rate volatility has negative impact on the corporate income tax rate as well as FDI inflows. Similar conclusion does the growth volatility have.

CHAPTER FOUR: METHODOLOGY AND RESULTS

This chapter illustrates two models representing the direct and indirect effects of economic volatility on corporate income tax rate by two approaches. Each approach is analyzed through the specifications of the model and method. At the end of each approach, results will be performed to illustrate the specifications which have presented.

4.1. Direct effect model

4.1.1. Model specification

To evaluate to what extent the economic volatility of a country influences the corporate tax setting process, the corporate income tax rate determination is investigated under a direct approach as a reaction function with a dynamic model:

$$Ctax_{it} = \alpha_0 + \alpha_1 CtaxL1_{it} + \alpha_2 Volatility_{i(t-1)} + \alpha_3 lGDP_{i(t-1)} + \alpha_4 EmpRate_{i(t-1)} + \alpha_5 GDPpwgr_{i(t-1)} + \alpha_6 GovExp_{it} + \alpha_7 young_{it} + \alpha_8 old_{it} + \alpha_9 Ptax_{it} + \alpha_{10} CapO_{it} + \varepsilon_{it} \quad (4.1)$$

The variables are defined in the table below with *Volatility* consisting of *IntRateSd*, *XRateSd*, and *GrowthSd*.

Table 4.1: List of variables in direct effect model

Variable	Description	Expected sign	Reference
Ctax	Statutory corporate income tax rate		
CtaxL1	Lagged corporate income tax rate	(+)	Ghinamo et al. (2010)
IntRateSd	Interest rate volatility	(-)	Pindyck (1991)
XRateSd	Exchange rate volatility	(-)	Dixit (1989)
GrowthSd	GDP per worker growth rate volatility	(-)	Ghinamo et al. (2010)
lGDP	Country size - Log of GDP	(+)/(-)	Gordon and Hines (2002)
CapO	Capital market openness	(-)	Ghinamo et al. (2010)
GovExp	Government expenditure	(+)/(-)	Wildasin (1989), Wilson (1999)
GDPpwgr	GDP per worker growth rate	(-)	Arulampalam, 2012
EmpRate	Employment rate	ambiguous	Ghinamo et al. (2010)
old	Share of population aged more than 65	ambiguous	Ghinamo et al. (2010)
young	Share of population aged up to 14	ambiguous	Ghinamo et al. (2010)
Ptax	Personal income tax rate	(+)	Slemrod (2004)

The equation (4.1) illustrates the corporate taxation setting process as a reaction function of corporate income tax rates. Particularly, this model aims to clarify the impact of economic volatility on the desirable and feasible corporate income tax rates (*Ctax*) that national governments are dealing with.

Firstly, corporate taxation setting process is determined through examining the influence of economic volatility under the measures of real interest rate, nominal exchange rate, and GDP per worker growth rate variability (*IntRateSd, XRateSd,* and *GrowthSd* respectively). These variables reflect the stability of the economy, portraying the governments' competence in dealing with any variation in the economy. Therefore, economic volatility plays an important role in determining corporate income taxation (Rodrik, 1991).

Secondly, the international tax competition is the cause of reduction in tax rates on firms' profit in many countries (Mintz and Smart, 2004). A country tends to lower the corporate income tax rate to appeal multinational firms to locate their plants on its territory. In other words, the government could set higher tax rates due to the inelastic tax base in case of boundaries applied on capital inflows. Hence, capital openness (*CapO*) is a vital figure in the measurement of the government behavior in circumstance of the international openness of capital.

Thirdly, equation of determining corporate taxation is built as a dynamic model or autoregressive model, including lagged dependent variable (*CtaxL1*) on the right hand side of the equation. This form of dynamic econometric models holds the purpose of capturing the persistence in corporate income tax rate over time, rather than allowing the residuals of serial correlation (Gupta, 2007). Besides, this type of model is also applied widely in public policy studies (Keele and Kelly, 2006) because it seizes the "drag" effects of changes in the corporate income tax rate (Achen, 2000), in which the government decision making in previous periods will matter to that today on the ground that the public remember the past.

Lastly, in efforts to control the internal feature of the country, the model takes into account the measures of tax base with country size (*lGDP*) and employment rate (*EmpRate*), the measures of fiscal needs with the demographic population structure in terms of ratios of young/old people to population (*young* and *old* respectively) and government expenditure (*GovExp*), the measure of backstop theory as personal income tax rate (*Ptax*), and other control variables (Slemrod, 2004).

4.1.2. Method specification

Lagged dependent variable (*CtaxL1*) might be overestimated while other variables might be underestimated, called "dynamic panel bias", especially with the presence of serial correlation or serious trending exogenous variables (Achen, 2000; Keele and Kelly, 2006). This will lead to biased results with ordinary least square (OLS) estimator (Nickell, 1981) or with fixed effect (FE) estimator (Bond, 2002).

In addition, this model suffers from the problem of potential endogeneity of some explanatory variables, country size (*lGDP*), government expenditure (*GovExp*), personal income tax rate (*Ptax*), and lagged dependent variable (*CtaxL1*). Theoretically, country size (*lGDP*) is calculated from the natural logarithm of GDP, which is regarded as a proxy measurement of tax base. Similarly, government expenditure (*GovExp*) reflects the fiscal needs of a country while personal income tax rate (*Ptax*) is explained as a means of income shifting based on "backstop theory" (Slemrod, 2004). Therefore, IV and GMM are feasible as solutions (Gupta, 2007; Hanson, 2005; Windmeijer, 2005). Nevertheless, IV brings about the reduction of the sample owing to the dropping unavailable lagged values (Holtz-Eakin, Newey, and Rosen, 1988). Moreover, IV reaches inefficiency under circumstances of heteroskedasticity. Whereas, GMM can handle the problem of heteroskedasticity and autocorrelation (Roodman, 2009). By virtue of those, GMM is supposed to be the viable remedy.

4.1.3. Results

Table 4.2: Direct approach in various methods with interest rate volatility

	(1)	(2)	(3)	(4)
Corporate income tax rate	OLS	FE	IV	GMM
Lagged corporate income tax rate	0.883***	0.789***	0.864***	0.795***
	(0.0245)	(0.0350)	(0.0311)	(0.0358)
Lagged log of GDP	0.191	-1.329	0.282**	0.424***
	(0.117)	(0.896)	(0.137)	(0.0965)
Lagged employment rate	-1.631	0.929	-2.554	-3.493
	(2.511)	(7.657)	(2.952)	(2.525)
Lagged GDP per worker growth rate	-2.165	-1.743	-2.969	-9.750
	(2.477)	(2.626)	(2.795)	(13.06)
Government expenditure	-2.497	-4.944	-1.102	5.330*
	(3.047)	(4.710)	(3.262)	(3.208)
Young	0.0804**	0.0200	0.0879**	0.103*
	(0.0375)	(0.0984)	(0.0426)	(0.0572)
Old	0.114*	0.0367	0.129*	0.133
	(0.0665)	(0.109)	(0.0770)	(0.142)
Personal tax rate	0.0487***	0.0287	0.0437**	0.0212
	(0.0143)	(0.0251)	(0.0214)	(0.0298)
Capital openness	0.0759	0.0814	0.0765	-0.0560
	(0.114)	(0.285)	(0.131)	(0.121)
Lagged interest rate volatility	-0.0153	0.0271	-0.0353	-0.127**
	(0.0581)	(0.0684)	(0.0639)	(0.0579)
_cons	-2.675	22.17	-3.136	-2.479
	(2.078)	(13.61)	(2.191)	(1.936)
N	315	315	286	315

*, **, *** serve as significant level of 10%, 5%, and 1% respectively
Standard errors in parentheses.

Table 4.2 shows the results from estimating the equation (4.1) by four estimators, OLS, FE, IV, and GMM respectively. The "dynamic panel bias" mentioned by Keele and Kelly (2006) and Achen (2000) surfaces with inflating in the lagged dependent variable and deflating in the others. Particularly, comparing the results of other estimators to that of GMM, coefficient of the lagged corporate income tax rate (*CtaxL1*) reduce from the range of (0.864, 0.883) to the range of (0.789, 0.795), meanwhile that of lagged interest rate volatility (*IntRateSdL1*) goes from the range (-0.015, -0.035) to -0.127. Because

CtaxL1 is a predetermined variable, based on Durbin-Wu-Hausman test (Appendix B.2). Moreover, FE estimation might return a biased result due to the autocorrelation of the error term, based on Wooldridge autocorrelation test (Appendix B.3) (Bond, 2002).

On the other hand, the model gets the problem of endogeneity. According to Durbin-Wu-Hausman tests for endogeneity (Appendix B.4), endogenous variable is personal income tax rate (*Ptax*) in case of interest rate volatility (*IntRateSdL1*) and lagged corporate income tax rate (*CtaxL1*) in case of exchange rate and growth volatility (*XRateSd* and *GrowthSd*). As a consequence, IV and GMM, with lags of endogenous variables as instruments, are applicable treatments to deal with the endogeneity problem (Wooldridge, 2012) which might be caused by variable omission (Appendix B.5) and possible measurement error. Nevertheless, the IV method with lags as instruments conducts the reduction in sample (Holtz-Eakin et al., 1988) and inefficient estimation under the situation of heteroskedasticity (Appendix B.6) and autocorrelation (Roodman (2009). Therefore, GMM comes up as a proper estimator (Bond, Hoeffler, and Temple, 2001).

In Table D2, the four GMM estimations are confirmed the validity of applied instruments due to Arellano-Bond test for autocorrelation and Hansen test for overidentification.

In respect of volatility, column [1] and [2] depict the significant negative impact of interest rate (*IntRateSd*) and exchange rate volatility (*XRateSd*) on the statutory corporate income tax rate (*Ctax*). At mean values, a rise of 1 percent in the volatility of real interest rate (*IntRateSd*) reduces the statutory corporate income tax rate (*Ctax*) by 0.127 percentage points, meanwhile an increase of 1 percent in the volatility of nominal exchange rate (*XRateSd*) decreases it by 1.527 percentage points. This result is consistent with the theoretical expectations in chapter 2. However, column [3] show the negative but not significant effect of GDP per worker growth rate volatility (*GrowthSd*).

Country size (*lGDP*), measured by the natural logarithm of annual GDP volume, impacts positively and significantly on corporate income tax rate, in line with the explanation

that the larger country charges at the higher tax rate (Haufler and Stähler, 2013). Larger country will have lower tax elasticity so that face fewer cost of public funds at the margin (Bucovetsky, 1991; Gordon and Hines, 2002; Wilson, 1991), meanwhile smaller countries are more motivated in undercutting their tax rates as policy instruments to attract inward capital (Han, Pieretti, and Zou, 2014).

Table 4.3: GMM estimation with and without volatility in three proxies

	[1]	[2]	[3]	[4]
Corporate income tax rate	**RIR**	**XRGr**	**GDPGr**	**None**
Lagged corporate income tax rate	0.795***	0.781***	0.750***	0.750***
	(0.036)	(0.071)	(0.059)	(0.055)
Lagged log of GDP	0.424***	0.428***	0.377***	0.470***
	(0.097)	(0.159)	(0.110)	(0.126)
Lagged employment rate	-3.493	-7.292*	-8.186**	-9.401**
	(2.525)	(4.299)	(3.234)	(3.650)
Lagged GDP per worker growth rate	-9.750	-2.724***	-2.902***	-2.368***
	(13.060)	(0.687)	(1.007)	(0.691)
Government Expenditure	5.330*	3.288	6.153*	5.161
	(3.208)	(4.106)	(3.639)	(3.548)
Young	0.103*	0.103***	0.119***	0.103***
	(0.057)	(0.032)	(0.027)	(0.032)
Old	0.133	0.186***	0.207***	0.193***
	(0.142)	(0.057)	(0.057)	(0.061)
Personal tax rate	0.021	0.056**	0.071***	0.0644***
	(0.030)	(0.027)	(0.021)	(0.025)
Capital Openness	-0.056	-0.016	0.117	0.018
	(0.121)	(0.125)	(0.107)	(0.088)
Lagged interest rate volatility	-0.127**			
	(0.058)			
Lagged exchange rate volatility		-1.527***		
		(0.488)		
Lagged GDP per worker growth volatility			-1.256	
			(4.643)	
_cons	-2.479	-2.141	-1.716	-1.519
	(1.936)	(2.129)	(1.291)	(2.259)
N	315	380	380	380
Arellano-Bond test for AR (1): zstat.	-2.51**	-2.32**	-2.30**	-2.40**
Arellano-Bond test for AR (2): zstat.	1.23	0.74	0.66	0.72
Hansen test: chi2	5.37	8.88	4.12	8.86

*, **, *** serve as significant level of 10%, 5%, and 1% respectively

Standard errors in parentheses.

Similarly, a rise in government expenditure (*GovExp*) as well as young (*young*) and old (*old*) population, which are considered as the burden of public budgets, tends to participate in the escalation of corporate income tax rates (*Ctax*). Oates (1972) explained that because local governments attempt to stimulate investment by keeping taxes low, causing lower tax revenues, and holding public expenditure below the equilibrium level. This leads to an uneconomical international competition by means of cutting off public expenditure along with lowering tax rates (Wilson, 1999). Meanwhile, demographic structure of the population as the proportion of young (below the age of 14) and elderly (above the age of 65) reflects the pressures on tax revenues and the fiscal needs of the countries (Ghinamo et al., 2010; Oates, 1972). Therefore, corporate income tax rate may be pushed up to afford the burden.

With the positive relationship to corporate income tax rates (*Ctax*), personal income tax rates (*Ptax*) reveals the illustration for the "backstop theory" mentioned by Slemrod (2004). In reverse, employment rate (*EmpRate*) and productivity (*GDPpwgr*) manifest the negative and significant influences on the statutory corporate income tax rates (*Ctax*). Employment rate measures the labor tax base composed of wages and salaries. This index captures the importance of labor as alternative tax base which depends on personal income tax rate. Meanwhile, tax payments raise the pre-tax rate of return without effect on post-tax rate of return. The rise in the pre-tax rate of return causes the capital withdrawing, which reduces labor productivity and the immobile domestic labor force will suffer. Therefore, the burden of the tax will be shifted away from the owners of capital to the labor force (Arulampalam, Devereux, and Maffini, 2012). It leads to the biased valuation of labor productivity in the context of income shifting. Bartelsman and Beetsma (2003) stated that for the purpose of tax burden reduction, income shifting among countries distorts the productivity measurement. Because over-reported returns and under-reported inputs are employed in the low tax countries. In conclusion, the negative relationship between corporate income tax rate and productivity is expected.

Lastly, a special variable, the Chinn and Ito index of capital openness (*CapO*), exposes an insignificant effect with inconsistent signs through the four estimations. This will be considered with the indirect approach for the clearer view in the next section's results.

4.2. Indirect effect model

4.2.1. Model specification

In attempts to evaluate the impact of economic volatility on the corporate income tax rates, FDI inflow is the channel to reflect the context of the international tax competition. Therefore, a two-equation structural model is constructed based on the equation (4.1) of determination of corporate income tax rate setting process (Brett and Pinkse, 2000). This model determines simultaneously the internal determinants of the tax rate equation, including FDI outflows and the endogenously determined FDI inflows (Ghinamo et al., 2010), and the determinants of FDI inflow in the tax base equation, consisting of corporate income tax rate (De Mooij and Ederveen, 2003), respectively:

$$Ctax_{it} = \beta_0 + \beta_1 Ctax_{i(t-1)} + \beta_2 FDIi_{i(t-1)} + \beta_3 FDIo_{i(t-1)} + \beta_4 lGDP_{i(t-1)} + \beta_5 EmpRate_{i(t-1)} + \beta_6 GovExp_{it} + \beta_7 young_{it} + \beta_8 old_{it} + \beta_9 Ptax_{it} + \beta_{10} CapO_{it} + \eta_{it} \quad (4.2)$$

$$FDIi_{it} = \gamma_0 + \gamma_1 Ctax_{i(t-1)} + \gamma_2 IntRateSd_{i(t-1)} + \gamma_3 lGDP_{i(t-1)} + \gamma_4 GDPpwgr_{i(t-1)} + \gamma_5 GovExp_{it} + \gamma_6 CapO_{it} + v_{it} \quad (4.3)$$

The variables are defined in the table below:

Table 4.4: List of variables in indirect effect model

Variable	Description	Ctax	FDIi
CtaxL1	Lagged corporate income tax rate	(+)	(-)
lGDP	Log of GDP	(-)/(+)	(+)
GovExp	Government expenditure	(-)/(+)	(-)
GDPpwgr	GDP per worker growth rate - Productivity	(-)	(+)/(-)
old	Share of population aged more than 65	(-)	(-)
young	Share of population aged up to 14	(-)	(-)
CapO	Capital openness	(-)	(+)
FDIi	Log of FDI inflows	(+)	
FDIo	Log of FDI outflows	(+)	
EmpRate	Employment rate	ambiguous	
Ptax	Personal income tax rate	(+)	
IntRateSd	Interest rate volatility		(-)

Instead of measuring the effect of economic volatility on corporate income tax rate directly as in the equation (4.1), the equation (4.2) reflects the effects of FDI inflow and FDI outflow volume in order to evaluate the pressure of international tax competition for capital mobility on corporate income tax rate setting of the host country. The internal determinants of the corporate income tax rate setting are identified in terms of variables that may have influence on the corporate income tax rate directly but not related to FDI determination (Ghinamo et al., 2010).

With respect to the equation of the country's FDI inflow, Blonigen, Davies, Waddell, and Naughton (2007) regarded FDI as a dimension of fascination for investment locating in a country. In that manner, corporate income tax rate is determined as a dynamic specification, lagged corporate income tax rate, based on the assumption that corporate income tax rate changes in last period give rise the "drag" effect on current FDI decision (De Mooij and Ederveen, 2003). Similarly, productivity and economic volatility with a lag is deemed to impact on FDI inflow directly, rather than on the corporate income tax rate, so that they are included in the equation (4.3) and excluded from the equation (4.2). Besides, both equations are influenced by the lagged country size and contemporaneous level of government expenditure, and capital openness as control variables (Ghinamo et al., 2010).

There are some considerable advantages of approach by a system of equations. (i) An exogenous variable in the single equation estimation can turn into a dependent variable in another behavior function in a system of equations. (ii) A system of equations can capture the complex impacts of endogenous variables. (iii) A system of equations can illustrate the economic and social mechanisms through which policy makers can observe the direct and indirect influences among variables. Moreover, simultaneous effect is seized via a system of equations (Nguyen, 2014). In consideration of the simultaneity, the recursive form of the system implies an explicit causal ordering in the model. Given an initial FDI inflow ($FDIi_{i(t-1)}$), the government determines the next period corporate income tax rate, $Ctax_{it}$. In the interim, foreign investors in current period, measured as

$FDIi_{it}$, decide whether to penetrate the domestic market based on the last period corporate income tax rate $Ctax_{i(t-1)}$.

4.2.2. Method specification

That a system of equations is estimated with ordinary least square estimator (OLS) would yield inconsistent and biased estimates in case of jointly determined variables existing in the system (Stock and Watson, 2003). Therefore, this issue is solved with alternative methods, two-stage least squares (2SLS), seemingly unrelated equations (SURE) or three-stage least squares (3SLS). In that, 3SLS is a system estimation method that more widespread over 2SLS or SURE (Wooldridge, 2012).

In case of endogenous explanatory variables, 2SLS is the better estimator than SURE. Because SURE does not consider the endogeneity in equations but only counteracts the correlation between equations' residuals. Meanwhile, 2SLS takes into account the endogeneity but disregards information of correlation of error terms among equations in the system. In contrast, 3SLS adds the third step to 2SLS, in which residual correlation are dealt with (Davidson and MacKinnon, 1993; Greene, 2003). Consequently, 3SLS is the appropriate method for estimating the structural model in this research.

4.2.3. Results

Breusch-Pagan test for independence of disturbances between the two equations (Appendix B.8) shows that the disturbances between the two equations are correlated. This leads to inefficient outcomes from 2SLS estimation. In addition, Durbin-Wu-Hausman tests for endogeneity (Appendix B.7) point out that among the right-hand side variables, personal income tax rate and lagged dependent variable are endogenous in the tax rate equation, meanwhile lagged country size and lagged corporate income tax rate are endogenous in the tax base equation. This causes biases in the result from SURE estimation. As a consequence, iterated 3SLS estimation is proper and meaningful in this research's situation with satisfied test for identification condition (Appendix B.9).

Table 4.5: Indirect approach with interest rate volatility with four estimators

	(1)	(2)	(3)	(4)
	OLS	**2SLS**	**SURE**	**3SLS**
Corporate income tax rate				
Lagged corporate income tax rate	0.853***	0.848***	1.188***	1.228***
	(0.027)	(0.033)	(0.031)	(0.037)
Lagged FDI inflows	-0.473**	-0.872***	1.489***	1.139***
	(0.211)	(0.238)	(0.209)	(0.236)
Lagged FDI outflows	0.0960	0.233*	0.110	0.279**
	(0.131)	(0.137)	(0.130)	(0.136)
Lagged log of GDP	0.308*	0.401*	-1.394***	-1.504***
	(0.185)	(0.215)	(0.202)	(0.232)
Lagged employment rate	1.061	-1.192	1.804	-0.842
	(2.616)	(2.983)	(2.593)	(2.948)
Government expenditure	-3.228	4.414	1.422	7.877*
	(3.196)	(3.540)	(3.904)	(4.271)
Young	0.070*	-0.013	0.063*	-0.019
	(0.036)	(0.039)	(0.037)	(0.039)
Old	0.127*	0.036	0.097	-0.014
	(0.066)	(0.071)	(0.066)	(0.071)
Personal tax rate	0.034*	-0.014	0.027	-0.018
	(0.019)	(0.025)	(0.019)	(0.024)
Capital openness	0.045	0.056	-0.732***	-0.748***
	(0.123)	(0.130)	(0.145)	(0.152)
_cons	0.236	6.510***	-8.271***	-1.256
	(2.339)	(2.470)	(2.541)	(2.671)
FDI inflows				
Lagged corporate income tax rate	-0.167***	-0.186***	-0.166***	-0.185***
	(0.008)	(0.008)	(0.008)	(0.008)
Interest rate volatility	-0.036	-0.061**	-0.025	-0.050**
	(0.029)	(0.029)	(0.022)	(0.022)
Lagged log of GDP	0.862***	0.936***	0.867***	0.938***
	(0.042)	(0.044)	(0.042)	(0.044)
Lagged GDP per worker growth rate	-0.462	-1.956*	-0.718	-1.722**
	(1.054)	(1.047)	(0.776)	(0.776)
Government expenditure	-1.715	-0.494	-1.767	-0.628
	(1.150)	(1.192)	(1.134)	(1.172)
Capital openness	0.390***	0.401***	0.392***	0.402***
	(0.038)	(0.037)	(0.038)	(0.037)
_cons	4.527***	4.128***	4.439***	4.056***
	(0.534)	(0.540)	(0.516)	(0.523)
N	296	280	296	280

*, **, *** serve as significant level of 10%, 5%, and 1% respectively. Standard errors in parentheses.

As expressed in Table 4.5, top statutory corporate income tax rate affects negatively and significantly on the FDI inflows, meanwhile FDI inflows impacts positively on the top statutory corporate income tax rate with high statistical significance. These results confirm the theory explanation for the behavior of foreign investors that they tend to change their investment location if the aimed territory raises its statutory corporate income tax rate in the previous year. On the contrary, policy makers incline to adjust the statutory corporate income tax rate downward to counteract the decrease in FDI inflows in the last period (Ghinamo et al., 2010).

In respect of economic volatility, the real interest rate standard deviation is estimated to influence the FDI inflows negatively and significantly. On average, with a rise by 1 percentage point in real interest rate, FDI inflows will decrease by 4.24%. This confirms the argument that economic volatility tends to discourage the inward FDI in terms of uncertainty in macroeconomic index, such as the inflation adjusted interest rate in this case (Bernanke, 1983).

Country size has significant impacts in the both equations. The negative effect of country size on corporate income tax rate solidifies the argument of Prud'Homme (1995) that richer countries tend reduce their tax rates because of their greater and more stable tax base. Besides, the lower tax rates in the richer countries will gain favor of investors to settle there, contributing more to tax base and compensating for tax loss by the tax rate reduction. Meanwhile, the positive impact of country size on FDI inflows reflects the "home market bias" that a larger countries are preferred to place firms due to the ability of charging a higher price as well as avoiding trade costs (Haufler and Wooton, 1999; Kinoshita and Campos, 2003).

Productivity determines the productivity of the labor force of a country and also reflects indirectly the wage level in the country. A raise in labor productivity may be turned correspondingly into an increase in wage (Sharpe, Arsenault, and Harrison, 2008; Wakeford, 2004). Additionally, Cushman (1987) reveals that increase in wages of a host

country proportionally dejects FDI into that country. This point is further reinforced by the negative impact which is found in the coefficient of the productivity on the FDI flows.

The Chinn and Ito index of capital market openness is estimated to affect significantly and negatively on the statutory corporate income tax rate but positively on FDI inflows. These results are different from those in the direct effect model in which the index has an insignificant impact on the statutory corporate income tax rate. In accordance with explanation of Ghinamo et al. (2010), the impact of the capital openness index on the statutory corporate income tax rates is opposite to that on the size of FDI inflows, giving rise to the effacement of the index's influence in the direct effect model. Because these reverse impacts of the index cause their tendency to nullify each other.

Government expenditure influences positively and significantly on corporate income tax rate, in line with the arguments of Oates (1972) and Wilson (1999), but negatively and insignificantly on FDI inflows, matching the insights of Albuquerque, Loayza, and Servén (2005) and Calvo, Leiderman, and Reinhart (1996). If FDI flows are poured in a country persistently, the domestic currency tends to appreciate. Thus, the government would tighten fiscal policy in order to control that appreciation and simultaneously inhibit the economy from becoming too hot. Moreover, as a responding signal to an increase in tax rate, the rising in government expenditure impedes the inward FDI flows.

FDI outflows performs a positive and significant relationship with the statutory corporate income tax rate, illustrating the tendency in which FDI outflows will rise with the higher statutory corporate income tax rate (Buettner, 2002). However, employment rate, young, old, and personal tax rate have no significant effects, in line with Ghinamo et al. (2010).

CHAPTER FIVE: CONCLUSIONS

5.1. Major findings

The results reflect the expectation and consistent through the estimations of two models. The results confirm the negative and significant effect of economic volatility on the corporate income tax rate. Similarly, the negative and significant impact of interest rate volatility on FDI inflows is also proved in the empirical work. Moreover, FDI inflows affect positively and significantly on corporate income tax rate, meanwhile corporate income tax rate influences FDI inflows with negative and significant impact.

Nevertheless, there are differences in the results from the two models in terms of capital openness and personal income tax rate. The reason is that the system of equations gets an advantage over the single equation. It could capture the simultaneity in tax rate and tax base determinants. Furthermore, the impacts of globalization in terms of capital mobility is also measured via the effects of FDI inflows and outflows in the indirect effect model.

With regards to capital openness, the system substantiates that capital openness influences positively on FDI inflows, whereas affects negatively on the statutory corporate income tax rate. These reverse impacts may combine into the null influence on the corporate income tax rate in the direct effect model by cancelling each other out. This phenomenon is in line with empirical results of Ghinamo et al. (2010).

With respect to personal income tax rate, the results through two models illustrate the standpoint on the substitution function of corporate income tax for personal income tax though this role is weakened in the context of capital mobility (Bird, 1996; Devereux and Sørensen, 2006; Mintz, 1995). This is demonstrated by the insignificant effect in the indirect effect model instead of the positive and significant effect in the direct effect model.

5.2. Limitations and suggestions for further study

Firstly, the three-stage least square estimation suffers heteroskedasticity problem (Appendix B.10). Heteroskedasticity existing in the system of equations can lead to inconsistent though not biased results. Hence, a more consistent result will be obtained with a more efficient estimator.

Secondly, economic volatility is calculate by standard deviation at the level of five years. Although this number is applied in a variety of studies, other authors also consider the moving average order at the level of 12, 8 or 4 years (Chowdhury, 1993; Kenen and Rodrik, 1986). Analyzing data through many moving average order is suggested for examining the sensitivity of the volatility proxies in future studies.

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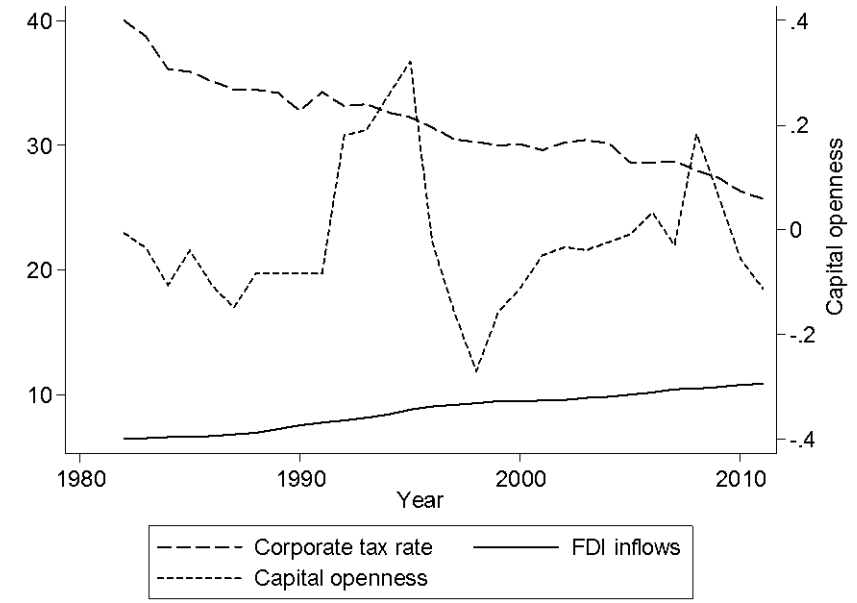
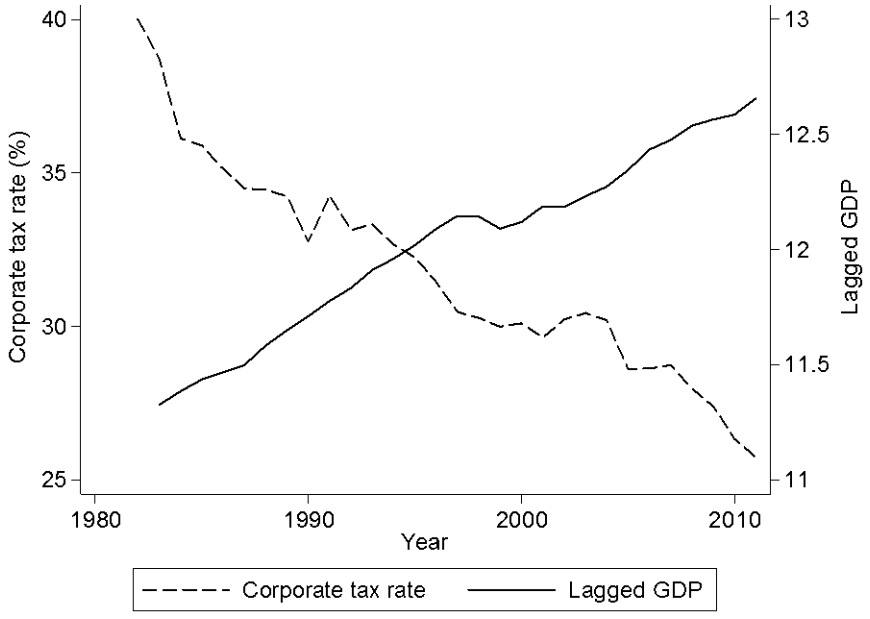
APPENDICES

A. Graphs

A.1 Zooming out capital openness index



A.2 Correlation between corporate income tax rate and lagged GDP



B. Tests

B.1. Test for multicollinearity

Collinearity Diagnostics

Variable	VIF	SQRT VIF	Tolerance	R-Squared
Ctax	3.83	1.96	0.2610	0.7390
Ptax	3.69	1.92	0.2708	0.7292
IntRateSd	2.62	1.62	0.3816	0.6184
GrowthSd	1.97	1.40	0.5069	0.4931
XRateSd	2.35	1.53	0.4253	0.5747
GDPpwgr	1.21	1.10	0.8239	0.1761
CapO	2.50	1.58	0.3998	0.6002
old	5.48	2.34	0.1826	0.8174
young	7.41	2.72	0.1350	0.8650
EmpRate	3.99	2.00	0.2505	0.7495
FDIi	12.79	3.58	0.0782	0.9218
FDIo	13.16	3.63	0.0760	0.9240
GovExp	2.66	1.63	0.3759	0.6241
lGDP	6.49	2.55	0.1540	0.8460
Mean VIF	5.01			

	Eigenval	Cond Index
1	4.5138	1.0000
2	2.7084	1.2910
3	1.8912	1.5449
4	1.3415	1.8343
5	1.0074	2.1168
6	0.7451	2.4612
7	0.4738	3.0865
8	0.3980	3.3679
9	0.3140	3.7916
10	0.2206	4.5235
11	0.1738	5.0967
12	0.1040	6.5873
13	0.0645	8.3662
14	0.0440	10.1334

Condition Number 10.1334
Eigenvalues and Cond Index computed from deviation sscp (no intercept)
Det(correlation matrix) 0.0000

B.2. Test CtaxL1: predetermined in direct effect model

Test with lags from the first level as instruments

```
Tests of endogeneity of: CtaxL1
H0: Regressor is exogenous
    Wu-Hausman F test:                 2.95103  F(1,256)    P-value = 0.08703
    Durbin-Wu-Hausman chi-sq test:     3.05415  Chi-sq(1)   P-value = 0.08053
```

Test with lags from the second level as instruments

```
Tests of endogeneity of: CtaxL1
H0: Regressor is exogenous
    Wu-Hausman F test:                 1.96159  F(1,256)    P-value = 0.16255
    Durbin-Wu-Hausman chi-sq test:     2.03792  Chi-sq(1)   P-value = 0.15342
```

B.3. Wooldridge test for autocorrelation in direct effect model

```
H0: no first-order autocorrelation
    F(  1,      14) =     30.381
           Prob > F =      0.0001
```

B.4. Durbin-Wu-Hausman endogeneity test in direct effect model

- In case of interest rate volatility

```
Tests of endogeneity of: Ptax
H0: Regressor is exogenous
    Wu-Hausman F test:                  2.85519  F(1,274)    P-value = 0.09222
    Durbin-Wu-Hausman chi-sq test:      2.94950  Chi-sq(1)   P-value = 0.08590
```

- In case of exchange rate volatility

```
Tests of endogeneity of: CtaxL1
H0: Regressor is exogenous
    Wu-Hausman F test:                  9.61830  F(1,291)    P-value = 0.00212
    Durbin-Wu-Hausman chi-sq test:      9.69451  Chi-sq(1)   P-value = 0.00185
```

- In case of growth volatility

```
Tests of endogeneity of: CtaxL1
H0: Regressor is exogenous
    Wu-Hausman F test:                  9.19615  F(1,291)    P-value = 0.00264
    Durbin-Wu-Hausman chi-sq test:      9.28204  Chi-sq(1)   P-value = 0.00231
```

B.5. Test for omission in direct effect model

```
H0: no omitted variables
       F(  3,   301) =    2.13
            Prob > F =    0.0968
       F( 30,   274) =    1.89
            Prob > F =    0.0044
```

B.6. Pagan and Hall's test of heteroskedasticity in direct effect model

```
IV heteroskedasticity test(s) using levels of IVs only
Ho: Disturbance is homoskedastic
    Pagan-Hall general test statistic   :  21.460  Chi-sq(13) P-value = 0.0643
```

B.7. Test for additional endogenous variables – Indirect effect model

The Tax rate equation

```
Regressors tested:    CtaxL1 Ptax
Tests of endogeneity of: CtaxL1
H0: Regressor is exogenous
    Wu-Hausman F test:                  3.26806  F(1,301)    P-value = 0.07164
    Durbin-Wu-Hausman chi-sq test:      3.36184  Chi-sq(1)   P-value = 0.06672
Tests of endogeneity of: Ptax
H0: Regressor is exogenous
    Wu-Hausman F test:                  6.94902  F(1,301)    P-value = 0.00882
    Durbin-Wu-Hausman chi-sq test:      7.06300  Chi-sq(1)   P-value = 0.00787
```

The Tax base equation

```
Regressors tested:    CtaxL1 lGDPL1
Tests of endogeneity of: CtaxL1
H0: Regressor is exogenous
    Wu-Hausman F test:                 16.42246  F(1,261)    P-value = 0.00007
    Durbin-Wu-Hausman chi-sq test:     15.92388  Chi-sq(1)   P-value = 0.00007
Tests of endogeneity of: lGDPL1
H0: Regressor is exogenous
    Wu-Hausman F test:                  9.83286  F(1,261)    P-value = 0.00191
    Durbin-Wu-Hausman chi-sq test:      9.76632  Chi-sq(1)   P-value = 0.00178
```

B.8. Breusch-Pagan test of independence of equations in system

```
Ho: independence of residuals
Correlation matrix of residuals:
        Ctax    FDIi
Ctax    1.0000
FDIi    -0.6886 1.0000
Breusch-Pagan test of independence: chi2(1) =   140.339, Pr = 0.0000
```

B.9. Test for identification condition in the system of equations

```
Endogenous coefficients matrix

            Ctax  FDIi

Ctax       -1

FDIi        0       -1

Exogenous coefficients matrix

     FDIiL1  FDIoL1  lGDPL1  EmpRateL1  GovExp  young   old  Ptax   CapO   CtaxL1  IntRateSdL1   GDPpwgrL1

Ctax     .5      .5      .5         .5      .5     .5    .5    .5     .5        0            0           0

FDIi      0       0      .5          0      .5      0     0     0     .5       .5           .5          .5

Eq 1 is identified

Eq 2 is identified

System is identified
```

B.10. Heteroskedasticity test in the system of equations

```
================================================
* System Heteroscedasticity Tests (3sls)
================================================
*** Single Equation Heteroscedasticity Tests:
  Ho: Homoscedasticity - Ha: Heteroscedasticity

 Eq. Ctax  : Engle LM ARCH Test: E2 = E2_1  =  0.2476 P-Value > Chi2(1) 0.6187
 Eq. Ctax  : Hall-Pagan LM Test: E2 = Yh    = 22.9500 P-Value > Chi2(1) 0.0000
 Eq. Ctax  : Hall-Pagan LM Test: E2 = Yh2   = 28.2831 P-Value > Chi2(1) 0.0000
 Eq. Ctax  : Hall-Pagan LM Test: E2 = LYh2  = 16.7281 P-Value > Chi2(1) 0.0000
--------------------------------------------------------------------------------
 Eq. FDIi: Engle LM ARCH Test: E2 = E2_1 =187.1776 P-Value > Chi2(1) 0.0000
 Eq. FDIi: Hall-Pagan LM Test: E2 = Yh   =  4.5096 P-Value > Chi2(1) 0.0337
 Eq. FDIi: Hall-Pagan LM Test: E2 = Yh2  =  4.3032 P-Value > Chi2(1) 0.0380
 Eq. FDIi: Hall-Pagan LM Test: E2 = LYh2 =  4.9856 P-Value > Chi2(1) 0.0256
--------------------------------------------------------------------------------
*** Overall System Heteroscedasticity Tests:
 Ho: No Overall System Heteroscedasticity

- Breusch-Pagan LM Test         = 132.6629       P-Value > Chi2(1)   0.0000
- Likelihood Ratio LR Test      = 179.7786       P-Value > Chi2(1)   0.0000
- Wald Test                     = 213.7072       P-Value > Chi2(1)   0.0000
```

C. Others

C.1 List of measurements for economic volatility

The wide variety of general types of measurements for economic volatility, which have been applied in several studies is presented as following:

No.	Measures of volatility
1	Absolute value of percentage change
2	Average absolute value of percentage change
3	Moving average of the standard deviation of percentage change.
4	Standard deviation from a trend equation.
5	Standard deviation from a first-order autoregressive equation.
6	Long-run volatility as V and U measures from Perée and Steinherr (1989)'s models.
7	Residuals from ARIMA model.
8	Conditional variance from ARCH, GARCH, GARCH-M, SWARCH models.
9	Variance from Linear moment models.
10	Variance around trend predicted from ($\ln V_t = \beta_0 + \beta_1 t + \beta_2 t^2 + \varepsilon_t$, where t presents for time period)
11	Non-parametric techniques

Source: McKenzie (1999), (Ćorić and Pugh (2010)) and author's compilation.

C.2 List of Asian countries in the dataset

Bangladesh, Brunei, Cambodia, China, Hong Kong, India, Indonesia, Japan, Korea, Republic of, Lao People's Democratic Republic, Macau, Malaysia, Myanmar, Pakistan, Philippines, Singapore, Sri Lanka, Taiwan, Thailand, Vietnam.

C.3 Variables description and data sources

	Variable	Notation	Description	Measurement	Data source
1	Corporate income tax rate	Ctax	Reflects the international tax competition	The top statutory corporate income tax rate	World Tax Database KPMG Trading Economics
2	Interest rate volatility	IntRateSd	Affects operating costs of so influences the investments' return	Standard deviation in the five previous years of real interest rate	World Development Indicators
3	Exchange rate volatility	XRateSd	Affects costs of capital so influences the investments' return	Standard deviation in the five previous years of the growth of nominal exchange rate	World Development Indicators
4	Growth volatility	GrowthSd	Affects the saving rates so influences the investments' rate into a country	Standard deviation in the five previous years of GDP per worker growth rate	Penn World Tables
5	Country's size	GDP	Reflects the market size and the wealthy of a country	Log of real GDP measured in expenditure-side	Penn World Tables
6	Capital openness	CapO	Presents to what extent a country's capital market is open	Chinn–Ito capital openness measure	Chinn and Ito KAOPEN
7	Government expenditure	GovExp	Reflects the fiscal needs of a country	Government expenditure as a share of GDP	Penn World Tables
8	Productivity	GDPpwgr	Reflects the attractiveness of a country in terms of human capital factor	Growth of GDP per person employed	Based on Penn World Tables
9	Employment rate	EmpRate	Reflects the labor tax base and current labor force	Total employment over total population	Penn World Tables
10	Old	old	Reflects the pressures on tax revenues	Share of population aged more than 65	World Development Indicators
11	Young	young	Reflects the pressures on tax revenues and the labor force in future	Share of population aged up to 14	World Development Indicators
12	Personal income tax rate	Ptax	Reflects the taxation reaction which corporate and personal income tax act as substitutes for each other	Top personal income tax rate	World Tax Database World Tax Indicators KPMG Trading Economics
13	FDI inflows	FDIi	Reflects the capital mobility, also the motivation of public policies	Log of FDI inflows	UNCTAD
14	FDI outflows	FDIo	Reflects the capital mobility	Log of FDI outflows	UNCTAD