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"Corporate Effective Tax Rates in Asian Countries"

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Corporate Effective Tax Rates in Asian Countries

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Abstract

This paper aims to (a) calculate Devereux and Griffith's (2003) forward-looking effective tax rates for 12 Asian countries over a span of 30 years, (b) show the impact of tax holidays on the effective tax rate in Asian countries, and (c) empirically explore the possibility of tax competition among Asian countries. Through relevant analyses, I arrive at three key conclusions. First, while small countries with little rent in domestic markets set their effective tax rates at almost zero, large countries maintain much higher effective tax rates. Second, for countries that have generous capital allowance systems, tax holidays may lead to a rise in not only the effective marginal tax rates (EMTR), but also the effective average tax rates (EATR). Third, some Asian countries may engage in tax competition, at least over the EATR, for a limited period of time. However, while some countries have raised their effective tax rates in recent years, others have continued with tax reductions. These results indicate that the recent tax interactions among Asian countries differ from the simpler interactions seen among the European countries.

Keywords: Corporate income tax; Effective tax rates; Tax incentives; Tax competition;
JEL Classifications: H25, H87

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1 Introduction

This paper aims to construct corporate effective tax rates for Asian countries and empirically examine the possibility of tax competition among these countries. Tax competition has become more important for policy makers as firms expand their business activities globally, particularly in integrated areas like the EU. Many studies have shown empirical evidence of tax competition among the European and OECD countries, and suggest that countries compete primarily on the statutory tax rates (STR). Another form of tax competition involves granting tax incentives such as tax holidays. Klemm and Van Parys (2012) examined tax competition via tax incentives in Latin American, Caribbean, and African countries, and found evidence of tax competition based on STR and tax holidays. However, their study did not include Asian countries. Since Asian countries have used tax incentives aggressively for decades, it may be apt to examine them in the context of tax competition via tax incentives. Moreover, Asian countries are at different stages of development. Hence, an investigation of their policy interactions may highlight a new feature of tax competition that is unseen among countries at similar stages of development.

One of the difficulties in analyzing Asian tax competition is that there is no ready data for effective tax rates of Asian countries. Therefore, this paper seeks to first create a dataset of effective tax rates for Asian countries, and then empirically examine whether there is tax competition among them.

Based on these analyses, I arrive at three key conclusions. First, small Asian countries, like Singapore, set effective tax rates at almost zero in order to attract foreign capital. This finding is consistent with a simple theoretical model of tax competition in which the optimal behavior of small countries spurs a "race to the bottom" in source-based taxation (Gordon, 1986; Zodrow and Mieszkowski, 1986; etc.). I also found that India, Indonesia, and Japan maintain relatively high effective tax rates. This finding is consistent with the work related to asymmetric tax competition (Bucovetsky, 1991; Wilson, 1991), and the "new trade theory" (Haufler and Wooton, 1999; Baldwin and Krugman, 2004; etc.). The

theory of asymmetric tax competition suggests that because of the difference in elasticity of capital between large and small countries, the former set higher tax rates at equilibrium. The new trade theory argues that countries with large domestic markets can maintain higher tax rates vis-à-vis small countries because of agglomeration forces.

Second, this paper confirms the previous work by Mintz (1990) and Klemm (2010) that highlights that when countries have generous capital allowance schemes, tax holidays do not necessarily reduce the effective marginal tax rate (EMTR) because the capital allowance reductions outweigh the merits of tax holidays. My results demonstrate that in Asian countries, given generous capital allowance schemes, both the EMTR and the effective average tax rate (EATR) can rise due to a short tax holiday. I also find that while countries that have generous capital allowances grant long tax holidays, those that have less generous capital allowances tend not to use tax holidays to attract firms. This suggests that governments may make rational decisions in order to avoid significant revenue losses from tax holidays.

Third, tax competition is observed in Asian countries after the 1990s. By restricting the estimation period to 1991–2012, I find a significant interaction, at least as far as the EATR is concerned. However, in recent years, there has been a considerable change in the way countries set their tax rates. While Japan, South Korea, Thailand, and Indonesia continued to reduce their effective tax rates, China and Taiwan have raised them. The recent evidence is, thus, in sharp contrast to the simple model of tax competition.

The rest of the paper is structured as follows. Section 2 describes the method used to calculate the Devereux-Griffith effective tax rates and the associated assumptions. Section 3 provides a comparison of the effective tax rates of 12 Asian countries. Section 4 discusses the impact of tax holidays on effective tax rates. Section 5 empirically examines whether there is tax competition among Asian countries. Section 6 provides the conclusion.

2 Previous Studies

This paper involves three related literature. Previous studies for each literature are summarized in **Table 1**.

Table 1 Research objectives of the three related literature

	1. Calculation of the Devereux-Griffith effective tax rate	2. Impact of tax holidays on the effective tax rate	3. Empirical analysis of tax competition
European or developed countries			
Devereux et al. (2002)	16 EU and G7 countries from 1982–2001.		
Devereux et al. (2008)	21 OECD countries from 1982–1999.		21 OECD countries from 1982–1999.
Devereux et al. (2009)	28 EU countries from 1998–2009, and 7 other developed countries from 2005–2009.		
Overesch and Rincke (2011)	32 European countries from 1983–2006.		32 European countries from 1983–2006.
Asian or developing countries			
Mintz (1990)		Marginal effective tax rate for 5 developing countries.	
Botman et al. (2010)	6 Asian countries in a single year	Devereux-Griffith's EATR and EMTR for 6 Asian countries.	
Klemm and Van Parys (2012)	40 Latin American, Caribbean, and African countries from 1985–2004.		40 Latin American, Caribbean, and African countries from 1985–2004.
Abbas and Klemm (2013)	50 countries in Asia, Africa, Latin America, and Developing European countries from 1996–2007.		
This paper	12 Asian countries from 1981–2012.	Devereux-Griffith's EATR and EMTR for 12 Asian countries.	12 Asian countries from 1985–2012.

The first literature includes the studies on Devereux and Griffith's (2003) corporate effective tax rate. Using the Devereux-Griffith methodology, Devereux, Griffith and

Klemm (2002) examined the forward-looking EATRs and EMTRs for the OECD countries from 1982–2001[1]. Devereux et al. (2009) extended their earlier study by calculating the EATRs and EMTRs for the member nations of the European Union from 1998–2009, and for other developed countries from 2005–2009.

There are fewer studies related to the effective tax rate for developing countries as compared to that for developed countries. Botman et al. (2010) made the first attempt to calculate the EATRs and EMTRs from data collected for select Asian countries. However, their research utilized data for only seven countries (all of which have relatively similar tax systems) for a single year of observations. Major Asian economic powers, like China, South Korea, and Singapore were not included in their analysis. Abbas and Klemm (2013) presented the most comprehensive work related to effective tax rates for developing countries. Their work is based on data from 50 countries in Asia, Africa, Latin America, and developing European countries from 1996–2007. However, they did not report each country's effective tax rate, and their calculations were limited to the period of 1996–2007. I want to highlight that, so far, the data for analyzing governments' behaviors on corporate tax rate settings in Asian countries is inadequate. In order to take forward the previous work on this subject, I create a dataset of effective tax rates for 12 Asian countries from 1981–2012.

Second, other studies have examined the relationship between tax holidays and effective tax rates. Extant research has shown that this relationship is heavily contingent on a country's capital allowance system. Mintz (1990), for example, first indicated that tax holidays do not necessarily lead to a reduction in the effective marginal tax rates in countries with generous capital allowances. Klemm (2010) confirmed this conclusion using the Devereux-Griffith framework, arguing that the EMTR may rise with short tax holidays, while the EATR falls due to tax holidays. Botman et al. (2010) extended past research to explore the impact of tax holidays on the effective tax rates of seven Asian countries. They found an inverse relationship between the size of a country's capital

[1] Data up to 2005 is provided by Alexander Klemm on the web page of the IFS.

allowance rates and the impact of tax holidays, and concluded that tax holidays were a greater incentive for FDI and new investments, rather than incremental investment. In this study, I seek to confirm the findings of Botman et al. (2010) using a larger and more heterogeneous sample of Asian countries.

Lastly, there are many empirical studies on tax competition. As a benchmark study, Devereux et al. (2008) demonstrated positive interactions on STRs and EMTRs for 21 OECD countries over 1982–1999. They also found that countries with high effective tax rates are more sensitive to tax rates in other countries. Overesch and Rincke (2011) reevaluated the tax competition among European countries for a sample period that covered recent years. Using tax data from 32 European countries for a 23-year period between 1983 and 2006 for their analyses, they concluded that tax competition leads to a decline in corporate tax rates in European countries. In their study of the effects of the EU expansion, Davies and Voget (2008) found that EU members react more strongly to each other's tax rates than non-EU members. Similarly, Crabbe and Vandenbussche (2009) highlighted that a country's geographic distance from new, low-tax members is positively associated with its likelihood of maintaining higher tax rates. The neighboring countries of the new EU members, namely Germany, Italy, Sweden, and Denmark, reacted strongly to the tax rate settings of the new members.

While there are several studies on tax competition, most of them focus on the developed countries. The only exception is the one by Klemm and Van Parys (2012) that examined the tax competition in Latin American, Caribbean, and African countries; however, tax competition among Asian countries has not been examined so far.

3 Effective tax rates

Corporate effective tax rates play an important role in firms' foreign and domestic investment decisions. In their study of the impact of effective tax rates on corporate decision making, Auerbach, Devereux, and Simpson (2010) argued that since the EATR impacts the firms' post-tax profits (including excess profits), it influences their decision to

produce overseas. The EMTR measures the tax burden on the cost of capital. Since firms invest until the marginal product of capital equals the cost of capital, the EMTR is related to either the scale of investment in new plants or the incremental investment in existing plants. The STR affects only the incentives for profit-shifting via transfer prices or internal debt in a multinational group. Based on this theory, host countries implement strategies to attract foreign capital via the EATR, and use the EMTR to boost investments.

3.1 Methodology

Of the multiple variants of corporate effective tax rate, the most common one in the literature is by Devereux and Griffith (2003). The effective tax rate uses Jorgenson's (1963) framework to measure the tax burden associated with a hypothetical investment project. The EATR is defined as follows:

$$EATR = \frac{R^* - R}{p \,/\, (1 + r)}$$

where R^* is the present discounted value (PDV) of the economic rent in the absence of taxes, R is the PDV of the economic rent in the presence of taxes, p is the profit rate, and r is the real interest rate.

Since Devereux and Griffith's effective tax rate, based on a hypothetical investment, reflects only the tax burden on future cash flows under the current tax system, it is considered "forward-looking." In contrast, the traditional effective tax rate, calculated as the ratio of tax payments to pre-tax profits using tax return data of firms, is considered "backward-looking" because it reflects firms' investment behaviors. While the tax system affects firms' investments, the firms' behaviors affect their backward-looking tax burden,

as reflected in the change in capital stock for tax purposes[2]. These characteristics of the backward-looking measure make it difficult to identify the tax incentives for investment. Hence, forward-looking measures have become the norm for determining the impact of taxes on investment as well as the governments' behavior[3].

However, since Devereux and Griffith's (2003) effective tax rates are based on a two-period model, we cannot analyze the impact of tax holidays on the effective tax rates. Klemm (2012) extended Devereux and Griffith's (2003) two-period model into a multi-period model for analyzing the impact of tax holidays. To create a dataset of effective tax rates for Asian nations, I follow Klemm's (2012) calculation method. Considering the impact of the investment for infinity, the EATR is modified as follows:

$$EATR = \frac{R^* - R}{p \,/\, (r + \delta)}$$

where δ is the capital depreciation rate. The effective tax rates calculated using these two methods are equal when there is no tax holiday. In this paper, I modify Klemm's model so that it reflects the combination of tax holidays and rate reductions. The details of these calculations are outlined in **Appendix A**.

3.2 Assumptions regarding the effective tax rates

In this paper, I calculate the effective tax rate for two tangible assets, machinery and buildings, using the same basic assumptions as Devereux et al. (2002)[4]. The useful lives of machinery and buildings are 8 years and 25 years, respectively. The EATRs and EMTRs

[2] The capital stock for tax purposes also reflects a firm's activity under past tax systems.
[3] This does not imply that backward-looking measures are never applicable. Backward-looking measures provide more information than forward-looking measures. In case of forward-looking measures, information regarding tax systems is limited to those elements that can impact the tax liability for a hypothetical investment project. In contrast, backward-looking measures provide all information regarding tax systems and firms' behaviors, including tax avoidance.
[4] Based on the U.K. tax system, Devereux et al. (2002) use the terms 'machinery and equipment' and 'industrial buildings' respectively.

are calculated as the weighted average of the rates for machinery and buildings (64:36). The economic depreciation rate for machinery is 12.25% and for buildings is 3.61%, real interest rate is 10%, inflation rate is 3.5%, and profits rate is 20%. I assume that all investments are financed entirely with equity, and that there is no dividend tax at the individual level. Given these assumptions, the effective tax rates are determined by the STRs, capital (or depreciation) allowances, and tax incentives (e.g., tax holidays, investment tax credits, etc.)[5]. I gathered data pertaining to each country's tax system for the last 30 years from publications, including PricewaterhouseCoopers's "Worldwide tax summaries" and Ernst & Young's "Worldwide corporate tax guide," as well as from various certified public accountants, tax consultants, and government officials in each country.

There are two caveats associated with calculating the effective tax rate for a hypothetical or a typical investment project. First, with respect to capital allowances for assets, as has been done in previous research, I compare the tax burden on the same asset in different countries. For example, in the U.K., each year's capital allowance for machinery is calculated using the eight-year declining-balance (DB) method. The same machine is depreciated for tax purposes using the 10-year straight-line (SL) method in China[6]. Hence, it is imperative to take care in not only selecting a depreciation method, but also determining the period for which the assets are depreciated for capital allowances in each country. Moreover, some countries allow firms to select from among options the method for calculating the depreciation on their assets. In such cases, I assume that firms select the depreciation method that has the highest PDV of capital allowance. When firms can utilize tax holidays, it is beneficial to choose a depreciation method that has the lowest PDV of capital allowance during the holiday as this will

[5] If an investment was partially financed by debt, the effective tax rate would change depending on the debt ratio.

[6] For countries that have a more detailed classification for machinery, I assume that a hypothetical machine is used for producing industrial goods (e.g., car parts, other machines, etc.). Based on the assumption that the machinery produces lighter assets, the associated depreciation period may be shorter. Thus, the PDV changes as a function of the hypothetical asset, which may result in subtle differences between studies.

guarantee the highest PDV of capital allowance after the holiday period. In this case, I assume that the firm chooses the depreciation method that has the lowest PDV of capital allowance[7].

Second, I consider typical (rather than maximum) tax incentives for a typical investment. In reality, while some countries give tax holidays to a relatively wide range of industries, others limit them to those firms that engage in qualified techniques. Moreover, in some countries, there are no clear guidelines regarding the qualifications for tax holidays, or the amount of tax incentives for firms. It is, therefore, difficult to ascertain the tax incentives applied to a typical investment. Previous studies avoided this problem by applying the maximum allowable period for tax holidays to a hypothetical investment project. However, given that only a small fraction of firms can use the maximum allowable tax holiday in some countries, the assumption of maximum tax incentives may yield misleading results in some cases. Therefore, I use the typical (or average) tax incentives for a typical investment project based on actual usage[8].

The assumptions regarding tax incentives for all countries in my sample are summarized in **Table 2**. The details about these tax incentives and capital allowance schemes are given in **Appendix B**. Although tax incentives are often applicable to both domestic and foreign firms, most of them effectively target the more productive foreign firms. As such, many Asian countries have used tax incentives to attract foreign firms to conduct business.

[7] In principle, I assume a firm cannot change its depreciation method afterwards.
[8] Despite its utility, this approach has another shortcoming — it is difficult to determine the type of investment that a typical project is.

Table 2　Assumptions regarding Tax Incentives (1981–2012)

Singapore	Ten-year tax holiday
Thailand	Eight-year tax holiday and 50% reduction in corporate income tax for five years after the holiday period
Philippines	No tax holidays until 1986; eight-year tax holiday (by BOI) from 1987–1994; eight-year tax holiday and 5% corporate income tax rate after the holiday period
Malaysia	Five-year tax holiday till 1991; exemption of up to 70 % of the pre-tax annual income against 60% of the investment cost since 1992
Indonesia	Two-year tax holiday till 1983; no tax holiday since 1984
India	None
Vietnam	10% corporate income tax rate (basic rate) and four-year tax holiday from 1997–2003, 50% reduction in corporate income tax for four years after the holiday period; since 2004, 50% reduction in corporate income tax for nine years after the holiday period
China	From 1991–2007: Two-year tax holiday followed by a 50% reduction in corporate income tax for three years
South Korea	Investment tax credit (3–10%) until 2011 Since 1999, five-year tax holiday followed by a 50% reduction in corporate income tax for two years
Taiwan	Five-year tax holiday until 2009
Hong Kong	None
Japan	None

4　Forward-looking effective tax rates in Asia

In this section, I examine the forward-looking effective tax rates in Asian countries. **Figure 1 and 2** illustrate the change in the STRs and EATRs for the Asian countries in the sample[9].

The EATRs (see **Figure 2**) paint quite a different picture from the STRs (see **Figure 1**) due to the variety of tax incentives across countries. The level of and the change in EATRs highlight some interesting aspects of the Asian corporate tax rates. First, the EATRs in Singapore, Thailand, the Philippines, and Vietnam are only a few percentage points above zero[10], which supports the zero capital tax rate hypothesis suggested by Gordon (1986) and other researchers. Except Thailand, these countries are relatively small in size

[9] See Appendix C for the EMTRs.

[10] As shown in **Appendix 1**, in the calculation of the effective tax rate, profits are generated infinitely. However, if one assumes that machinery will be replaced after eight years of depreciation, then a ten-year tax holiday in Singapore yields an effective tax rate of zero for machinery.

and population, and are endowed with few natural resources. This suggests that in an open economy, countries that have little location-specific rents engage in a "race to the bottom." This finding is consistent with the empirical evidence provided by Abbas and Klemm (2013) regarding special regimes in developing countries, most notably in Africa.

Second, the EATRs in large countries are relatively high. Japan, India, and Indonesia have consistently maintained higher tax rates than their smaller Asian counterparts. In recent years, China has also raised its EATRs. These trends support the theory of tax competition among size-asymmetric countries (Bucovetsky, 1991; Wilson, 1991). This finding is also consistent with the contention that a core country with a large domestic market can maintain a higher tax rate in the presence of trade costs or agglomeration forces (Haufler and Wooton, 1999; Baldwin and Krugman, 2004; etc.).

Figure 1　STRs in Asian Countries

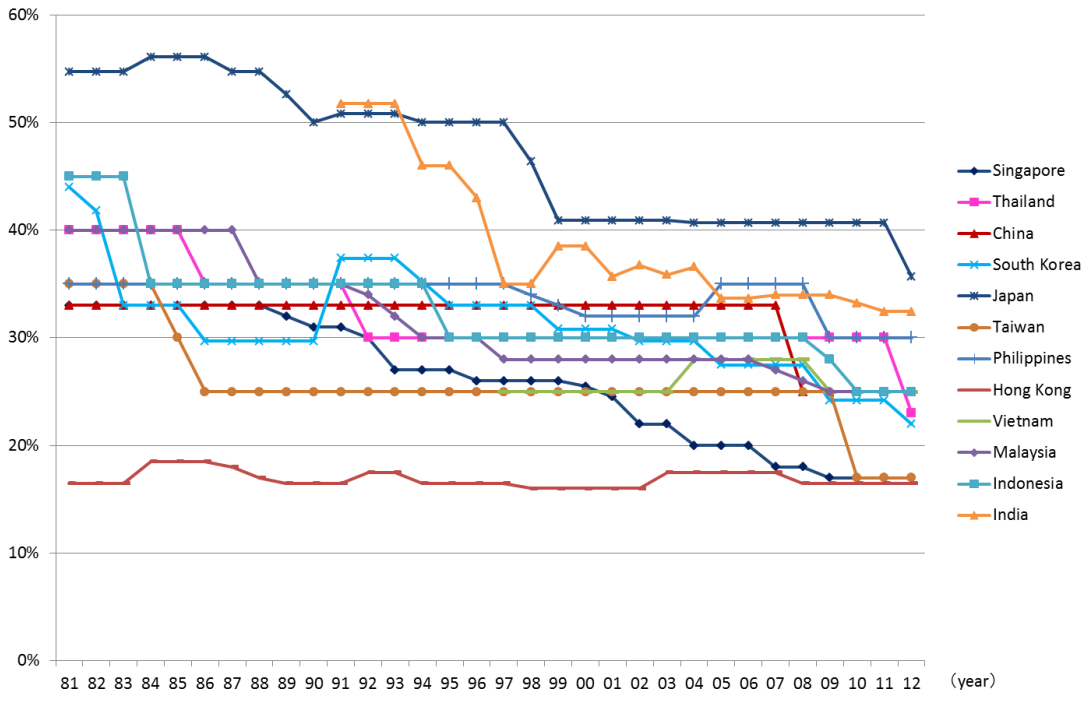
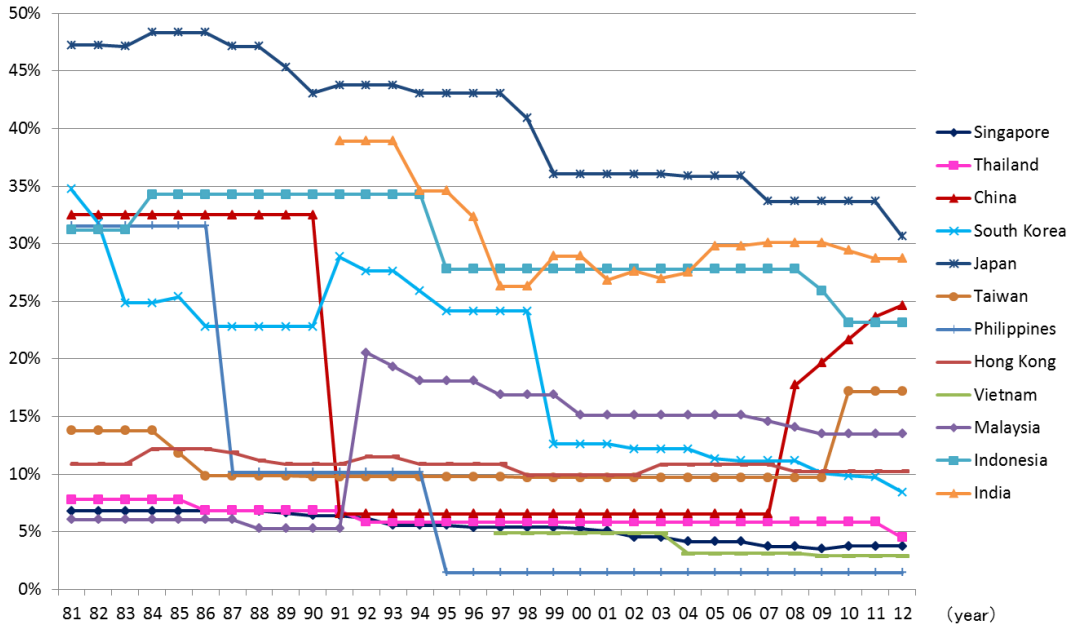


Figure 2　EATRs in Asian Countries



Third, these findings show that some countries were similar in that they reduced their STRs and broadened their tax bases by eliminating tax incentives. From 1991–2007, China had one of the lowest EATRs since it gave a two-year tax holiday followed by a 50% rate reduction for three years. However, by abolishing tax incentives in 2008, China raised its EATRs substantially. Simultaneously, it decided to reduce the STR from 33% in 2007 to 25% in 2008. In a similar fashion, Taiwan also raised its EATRs by abolishing tax holidays for important manufacturing industries and reducing its STR from 25% to 17%.

Such a rate reduction accompanied by a broadening of the tax base is often seen in developed countries. While this may imply that tax competition is reducing, there is a counterargument that when preferential tax regimes are abolished, each government competes for firms over the STR, thereby expanding the range of tax competition and aggravating welfare loss from tax competition (Keen, 2001). It will be interesting to see whether the recent tax changes in China and Taiwan will lead to tax competition over the STR.

5 Impact of tax holidays on effective tax rates in Asia

In this section, I describe how tax holidays influence the EATR for machinery under the 2012 tax rules[11]. With the exception of Malaysia (which allows maximum 70% tax exemption during a tax holiday), I assume a complete (i.e., 100%) tax exemption during tax holidays. I calculate the impact of a tax holiday for countries that implement tax holidays in practice and those that do not.

5.1 Impact of tax holidays on the effective tax rates

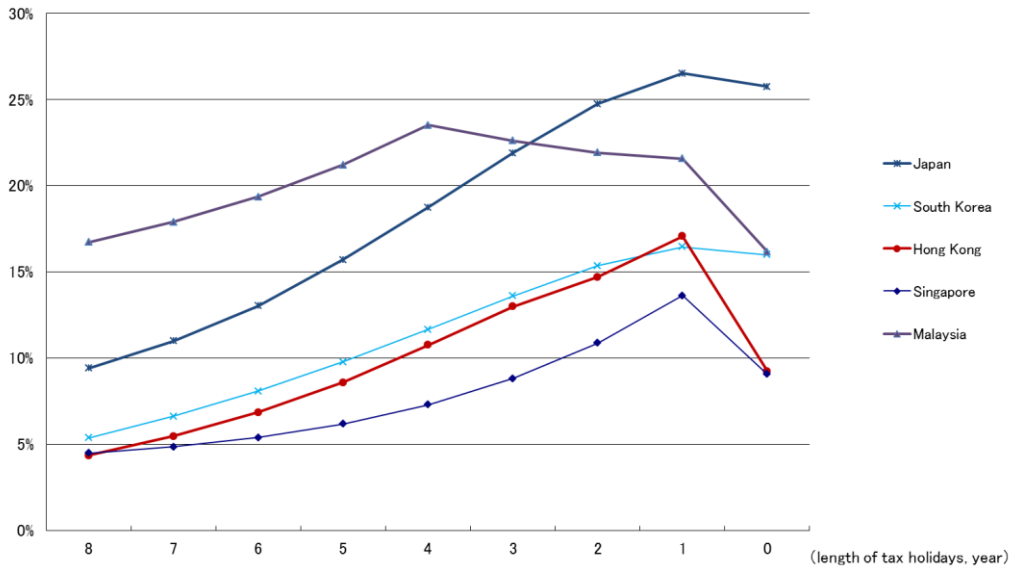
I categorize the sample countries into two groups based on the impact of tax holidays. The first group comprises countries that have generous depreciation schemes i.e., Japan, South Korea, Hong Kong, Malaysia, and Singapore. A generous depreciation rate suggests that short tax holidays may not necessarily lead to a reduction in the effective tax rate, as outlined above. Results demonstrate that for a reduction in the EATR (assuming 10% excess profit), tax holidays in Japan and South Korea must be for two years or more, those in Singapore must be for three years or more, and those in Hong Kong must be for five years or more. For a reduction in Malaysia's EATR, tax holidays must exceed eight years (see **Figure 3**)

In Singapore, firms can use a capital allowance for 75% of assets in the first year and the remaining 25% in the second year[12]. Without a tax holiday, the EATR is only 9% given the generous capital allowance scheme. Tax holidays of less than three years raise the EATR because firms are unable to use the capital allowance. Hong Kong is a more extreme case. It grants firms 100% capital allowance for machinery assets in the first year, thereby necessitating a tax holiday of five years or more in order to reduce the EATR. Similarly, for Malaysia, high depreciation rates and a 70% tax exemption necessitate a longer tax holiday in order to reduce the EATR.

[11] See Appendix C for the EMTRs.

[12] In case of a tax holiday that exceeds two years, it is assumed that firms choose normal capital allowance (20% as initial allowance and the remaining 80% as annual allowance) instead of accelerated depreciation, in order to get the higher PDV of capital allowance after the tax holiday.

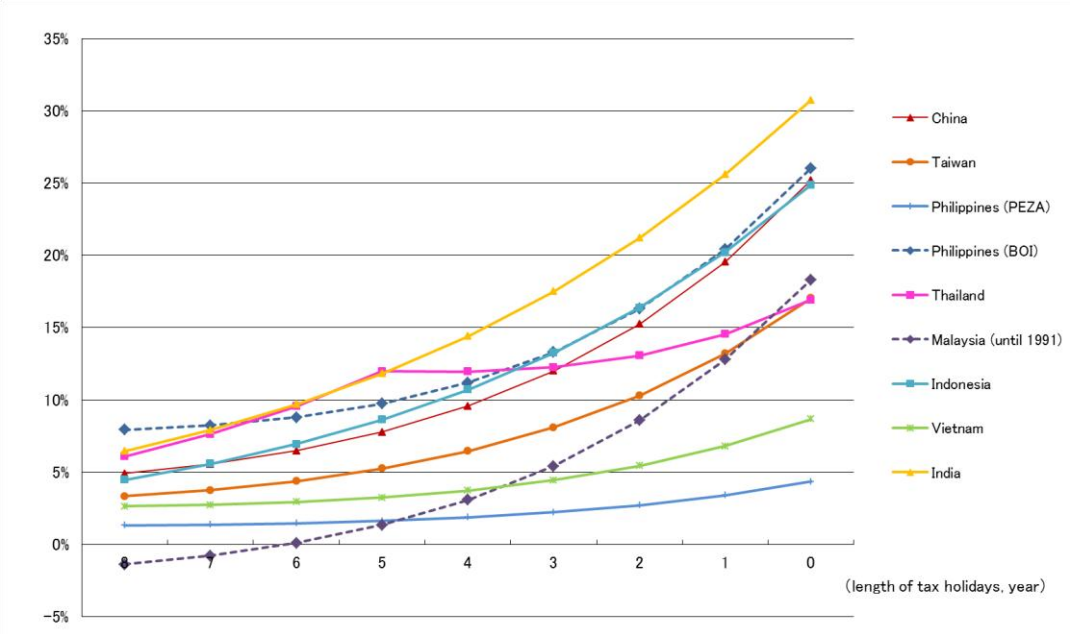
Figure 3　Impact of tax holidays coupled with generous depreciation rates on EATR



Note: Based on the assumption of a 10% excess profit

Unlike countries with generous depreciation rates, countries with low depreciation rates can reduce the EATR with a one-year tax holiday. In China, for example, a one-year tax holiday reduces the EATR by around 5%, and a two-year tax holiday reduces it by around 10% (see **Figure 4**). From 1991–2007, China granted foreign firms a two-year tax holiday and a 50% tax rate reduction after the holiday expired. This suggests that despite the short length of tax holidays in China, they were powerful tools for attracting firms to conduct business there. In the Philippines, companies that invest in the PEZA zone are allowed an eight-year tax holiday, but the impact of the tax holiday is small because the nominal tax rate is only 5% in the PEZA zone. Conversely, a tax holiday of the same length granted for investments outside the export zones (where the nominal tax rate is 30%) leads to a significant reduction in the effective tax rate. Thus, the BOI's eight-year tax holiday would reduce the EATR by around 20%.

Figure 4　Impact of tax holidays coupled with lower depreciation rates on EATR



Note: Based on the assumption of 10% excess profit.

The scenarios described above are different in case of high profitability. For example, if the profit rate is 50%, even a one-year tax holiday will decrease the EATR for all countries except Hong Kong[13]. This is due to the fact that, in terms of present value, a generous capital allowance substantially offsets future normal profits rather than pure profits. For a highly profitable project, despite a generous capital allowance, governments can reduce the EATR by granting a short tax holiday.

5.2　Interpretation of the differences in the impact of tax holidays on EATRs

There are some caveats associated with the results illustrated in **Figures 3–4**. These analyses assume that profits are generated in the first year. However, many firms fail to generate profits in their early years of operation, which can diminish the impact of tax holidays on the effective tax rates. Moreover, while some Asian countries allow firms to use tax holidays after profits are generated, others do not. Consequently, the impact of

[13] A two-year tax holiday is sufficient to lower the EATR in Hong Kong.

tax holidays is contingent upon the detailed rules of a country's tax holiday system. Considering these issues, the impact of tax holidays discussed above should be interpreted with care.

Despite these few shortcomings, it seems that my findings for the 12 Asian countries sampled here are consistent with the results of the previous studies. Botman et al. (2010) showed that the EMTR for seven Asian countries (Thailand, Malaysia, the Philippines, Indonesia, Vietnam, Cambodia, and Laos) can rise by introducing tax holidays. While my results reaffirm the findings of Botman et al.'s (2010), they also highlight that tax holidays may raise the EATR in Asian countries that have generous capital allowances.

Moreover, a comparison of **Figure 3** and **Figure 4** highlights another interesting fact. Some countries in **Figure 3** that have higher capital allowance rates aggressively use tax holidays to attract firms. This may be a coincidence, given that some governments have deployed a wide range of strategies to attract foreign capital (including tax holidays and capital allowance). However, for these countries, the costs of tax holidays are lesser than they seem like. Such countries may use tax holidays to highlight the generosity of their tax policies to foreign firms at little cost to their revenues. In contrast, some countries that have low capital allowance rates do not adopt tax holidays as a form of investment incentive, probably, because they fear revenue losses. Most countries shown in **Figure 4** currently do not allow tax holidays for typical investments. China and Taiwan, for example, have abolished tax holidays in 2008 and 2010, respectively. Similarly, Indonesia and India do not allow tax holidays for typical investment projects. Only the Philippines uses tax holidays as an investment incentive.

6 Empirical analysis of tax competition in Asian countries

Finally, in this section, I use the forward-looking corporate effective tax rates to evaluate the possibility of tax competition among Asian countries. Generally, the existence of interactions between various countries' tax rates does not necessarily imply tax competition. For example, interactions among different countries' tax rates could be

"yardstick competition" (Besley and Case, 1995), a relationship in which residents compare the performance of their country's government with that of the neighboring countries, or a simple change in common perception that low tax rates are better for economic activities. While there are several ways in which tax rates of neighboring countries relate to one another, I interpret the evidence of tax interaction to mean tax competition.

6.1 Empirical specification and data

6.1.1 Empirical specification

Most empirical studies (e.g., Devereux et al., 2008) utilize a model for tax interaction that is based on the Nash equilibrium[14]. In this study, I follow the specification used in most of the previous studies, and assume that the Nash equilibrium is relevant. The specification is as follows:

$$R_{it} = \rho \sum_{j \neq i} w_{j,t} R_{j,t} + x_{it-1}^{'} \beta + T_t + \eta_i + \varepsilon_{it} \quad (1)$$

where R_{it} represents the corporate tax rates in country i in year t, $\sum_{j \neq i} w_{j,t} R_{j,t}$ is the weighted average of tax rates in other countries' (i.e., the spatial lag), x_{it} denotes a vector of control variables, T_t is a common time trend, η_i denotes country fixed effects, and ε_{it} is an independent and identically distributed error term.

As a weighing matrix ($w_{j,t}$), I used simple and weighted average based on an inverse of distance[15]. Control variables are lagged by one year because governments' decisions regarding tax rates are based on the indicators for the previous year.

6.1.2 Data

My database comprises an unbalanced panel of 12 Asian countries for the period 1985–

[14] Altshuler and Goodspeed (2002) assume the Stackelberg equilibrium.
[15] Indicators of distance are obtained from the CEPII.

2012. The estimation period is limited primarily because of data availability[16]. Data for India and Vietnam begins from 1991 and 1997, respectively, because these countries had restrictive regulations for inward foreign direct investment before that. I was, therefore, unable to effectively measure the effect of tax interactions among governments seeking capital for India and Vietnam before 1991 and 1997, respectively.

I select three tax measures as dependent variables: the STR, the EATR, and the EMTR. Tax interactions related to these three tax rates can be interpreted differently. Tax interaction on the STR implies tax competition over paper profits, while that on the effective tax rates (EATR or EMTR) implies competition over location or incremental investments.

The control variables include the top marginal rate of personal income tax (PITR), GDP per capita, population, openness, general government final consumption expenditure as a percentage of GDP, old dependency ratio, and young dependency ratio. The PITR is a benchmark for the corporate income tax rate, because governments tend to align the corporate tax rate with the individual tax rate to prevent tax avoidance. I expect that the PITR will be positively related to the STR. GDP per capita and population determine the domestic market size, thereby making them useful proxies for size and agglomeration forces. Generally, there exists a positive relationship between the corporate tax rate and GDP per capita, because high-income consumers tend to require more public services. Openness illustrates the extent to which capital is mobile. The pressure to engage in tax competition increases with the mobility of capital. While there are several proxies for openness, I utilize Squalli and Wilson's (2006) openness measure, which avoids upward bias for small countries. I include government expenditure as a percentage of GDP in the model to control for preferences for public goods and governmental revenue constraints. The old dependency ratio and the young dependency ratio denote expenditure pressures; high dependency ratios warrant greater revenues. I

[16] The PRS data for control variables are available only from 1984; the individual income tax rate in Indonesia was introduced in 1984.

obtained data related to these control variables from the World Bank's "World Development Indicators" database.

In addition to the control variables outlined above, I also incorporate the "law and order" indicator from the PRS group. The inclusion of this indicator is meant to control the quality of institutional factors. This indicator is often used in previous empirical analyses related to FDI[17]. By including this indicator, I seek to account for the possibility that it may be important for firms to invest in developing Asian countries rather than developed European countries. A high "law and order" value indicates general safety and security in that country, thereby implying that it is a more attractive location for investment. Conversely, it also highlights the importance of low corporate tax rates as a means to attract capital, because a transparent system prevents corroboration between the government and firms.

Descriptive statistics associated with the variables outlined above are presented in **Table 3**.

Table 3　Descriptive Statistics (1985–2012)

Variable	Unit	Obs	Mean	Std. Dev.	Min	Max
STR	Percent	318	0.28	0.11	0.05	0.56
EATR	Percent	318	0.16	0.12	0.01	0.48
EMTR	Percent	318	0.14	0.13	−0.01	0.47
PITR	Percent	318	0.37	0.10	0.17	0.70
GDP per Capita	Thousands	318	9.68	11.62	0.25	46.24
Population	Millions	318	234	403	3	1,340
Openness	Percent	318	0.50	0.96	0.00	5.56
Government Expenditure	Percent	318	0.12	0.03	0.06	0.21
Old Dependency Ratio	Percent	318	0.10	0.05	0.05	0.37
Young Dependency Ratio	Percent	318	0.41	0.15	0.15	0.78
Law and Order	(Index)	318	4.10	1.19	1.00	6.00

Note: GDP per capita and the variables following it are from 1984–2011.

[17] Klemm and van Parys (2012) incorporated both "corruption" and "law and order" from the PRS database into their FDI regressions; however, since these indicators are correlated, I utilize only the "law and order" indicator.

6.1.3 Econometric issues

I explore whether the coefficient associated with the spatial lag is significantly different from zero (less than one). Because tax rates in one country are largely dependent on those in other countries, the spatial lags are endogenous. I use the fixed-effect estimation with instrument variables (FEIV) to address this endogeneity. I select the instrumental variables from the weighted average of the control variables in other countries ($\sum_{j\neq i} w_{j,t} x_{j,t}$), and test their validity using a standard overidentifying restriction test.

Although year dummies are often used to control for the variance associated with an annual time period in panel estimations, when the weighting matrix is a simple average, the spatial lag in equation (1) is not identified separately from the year dummy. As a result, I opt to use a linear time trend. This method is often used in the literature (e.g., Devereux et al., 2008).

6.2 Results

6.2.1 Baseline results

For the baseline case, I establish three estimation periods: 1985–2012 (India only from 1991 onwards, Vietnam only from 1997 onwards), 1991–2012 (Vietnam only from 1997 onwards), and 1997–2012 (all countries). Note that, the year 1991 was not only the year in which India was considered in the sample, but also when China began substantial tax incentives for foreign firms. The dataset for 1997–2012 is a balanced panel; hence, the effects of the special lag are not from the sample structure, but only from tax factors. The "inverse of distance" weighting matrix produced no significant results. Therefore, **Table 4** shows only the results for the simple average weighting matrix. For all regressions, the young dependency ratio as well as the "law and order" indicator served as instrumental variables.

Columns (1)–(3) provide results for the full sample from 1985–2012. In this sample, there are no significant coefficients for the spatial lags. As illustrated in Column (5)–(6), for the period 1991–2012, the spatial lags for EATR and EMTR are significantly positive

at the 5% and 10% significance level, respectively. The volumes of coefficients are generally consistent with those of previous studies[18]. The results suggest that Asian countries compete in terms of incentives for location and investment. There were no significant results for the period 1997–2012. This may be affected by the recent move by China and Taiwan to raise tax rates, unlike other countries.

Results show significant coefficients for some control variables. Consistent with the notion that corporate income tax is used as a backstop for individual income tax, the PITR is positive for some of the results. I also find evidence that the "law and order" indicator is negatively related to corporate tax rates in many cases.

[18] For example, Klemm and van Parys (2012) provided the spatial interaction coefficient of 0.44 on the STR for 40 Latin American, Caribbean, and African countries for the period 1985–2004.

Table 4　Results: Baseline Case

	1985-2012			1991-2012			1997-2012		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Neighbor's tax rate (STR)	0.323			0.377			0.419		
	(0.55)			(1.04)			(0.56)		
Neighbor's tax rate (EATR)		0.050			0.458**			0.352	
		(0.05)			(2.38)			(0.48)	
Neighbor's tax rate (EMTR)			0.667			0.477*			−0.065
			(0.71)			(1.89)			(−0.11)
PITR	0.142	0.057	0.036	0.186	0.266***	0.245***	0.202*	0.164***	0.135**
	(1.43)	(0.56)	(0.40)	(1.29)	(3.39)	(4.36)	(1.72)	(3.07)	(2.04)
GDP per capita	0.021	0.030	0.020	0.006	0.023	0.021	−0.013	0.027	0.030
	(1.23)	(1.15)	(1.37)	(0.25)	(1.08)	(1.15)	(−0.67)	(0.85)	(0.93)
Population	−0.192	0.164	0.033	−0.032	−0.100	−0.328**	0.034	−0.324*	−0.443**
	(−1.55)	(0.81)	(0.16)	(−0.30)	(−0.67)	(−2.55)	(0.25)	(−1.67)	(−2.04)
Openness	0.024*	0.020	0.031**	0.012	0.034***	0.038***	−0.013	0.016*	0.018**
	(1.68)	(1.34)	(2.19)	(0.91)	(3.20)	(3.64)	(−1.54)	(1.92)	(2.10)
Government Expenditure	−0.466	−1.317***	−1.217***	−0.315	−0.785***	−0.692***	0.092	−0.892**	−0.915***
	(−0.80)	(−3.28)	(−2.89)	(−0.51)	(−2.67)	(−2.58)	(0.41)	(−2.41)	(−2.73)
Old dependency ratio	0.632	0.915	0.811	0.682	−0.305	−0.788**	0.102	−0.955**	−1.311***
	(1.37)	(1.20)	(0.90)	(1.10)	(−0.85)	(−1.99)	(0.22)	(−2.22)	(−2.75)
Young dependency ratio	−0.44***	−0.279	−0.249	−0.426***	0.171	0.475***	−0.436***	0.348	0.641***
	(−2.95)	(−0.78)	(−0.58)	(−3.02)	(0.82)	(2.66)	(−2.89)	(1.41)	(2.61)
Law and order	−0.012	−0.021***	−0.015**	−0.012*	−0.008**	−0.007*	−0.005	−0.006	−0.002
	(−1.61)	(−3.78)	(−2.55)	(−1.71)	(−2.36)	(−1.95)	(−1.59)	(−1.05)	(−0.40)
Time trend	−0.007**	−0.011	−0.007	−0.007**	0.002	0.008**	−0.005	0.007*	0.011***
	(−2.30)	(−1.37)	(−0.97)	(−2.48)	(0.41)	(2.41)	(−1.36)	(1.71)	(2.62)
Number of observations	314	314	314	254	254	254	188	188	188
Hansen J test P-value	0.891	0.611	0.996	0.252	0.598	0.833	0.124	0.088	0.105

Cluster-robust t-statistics in parentheses, * p<0.1, ** p<0.05, *** p<0.01

6.2.2 Extension

In addition to the analyses and results presented above, I extend the study on several counts. First, I independently estimate the effective tax rates for machinery and buildings. In the baseline analysis, the EATRs and EMTRs are calculated using a combination of the rates for machinery (64%) and buildings (36%). In reality, however, every project may not have machinery and buildings in that ratio. Hence, it is important to examine tax competition by asset in order to more accurately predict governments' intentions in setting tax rates.

The results of this analysis are presented in **Table 5**. In case of machinery, a neighboring country's EATR and EMTR have a significant impact from 1991–2012 (see Column (3) and (4)). However, as illustrated in Column (5) and (6), the effects disappear for the period 1997–2012. These results suggest that in the 1990s and shortly thereafter, Asian countries competed over the EATR and EMTR for machinery; however, this tax interaction among countries has changed in recent years. For buildings, there were no significant effects of the special lags in the regressions.

Table 5　Results: Machinery

	1985–2012		1991–2012		1997–2012	
	(1)	(2)	(3)	(4)	(5)	(6)
Neighbor's tax rate (EATR)	0.478		0.476**		−0.038	
	(0.43)		(2.33)		(−0.05)	
Neighbor's tax rate (EMTR)		1.003		0.646*		−0.593
		(0.91)		(1.93)		(−0.95)
PITR	−0.043	−0.124	0.190***	0.101	0.121***	0.135***
	(−0.36)	(−0.85)	(2.90)	(0.97)	(2.97)	(2.60)
GDP per capita	0.021	0.016	0.021	0.021	0.028	0.038
	(1.06)	(1.03)	(1.08)	(0.99)	(0.85)	(1.09)
Population	0.122	−0.040	−0.191	−0.509***	−0.398*	−0.474**
	(0.52)	(−0.15)	(−1.43)	(−3.11)	(−1.85)	(−2.07)
Openness	0.028*	0.036**	0.041***	0.043***	0.019*	0.020
	(1.85)	(2.13)	(3.27)	(2.99)	(1.78)	(1.60)
Government Expenditure	−1.310***	−1.356***	−0.795***	−0.762***	−0.837**	−0.949**
	(−2.90)	(−2.77)	(−2.98)	(−2.64)	(−2.38)	(−2.27)
Old dependency ratio	0.835	0.372	−0.429	−1.368**	−0.999**	−1.496***
	(0.90)	(0.33)	(−0.95)	(−2.06)	(−2.01)	(−2.67)
Young dependency ratio	−0.293	−0.090	0.225	0.721***	0.337	0.733***
	(−0.69)	(−0.17)	(1.18)	(3.04)	(1.33)	(2.84)
Law and order	−0.017**	−0.013*	−0.005	−0.004	−0.002	0.004
	(−2.42)	(−1.69)	(−1.31)	(−0.96)	(−0.49)	(0.71)
Time trend	−0.009	−0.004	0.004	0.014***	0.009*	0.014***
	(−1.05)	(−0.38)	(0.95)	(2.78)	(1.90)	(2.91)
Number of observations	314	314	254	254	188	188
Hansen J test P-value	0.904	0.684	0.960	0.338	0.192	0.209

Cluster-robust t-statistics in parentheses, * p<0.1, ** p<0.05, *** p<0.01

As a second extension of the analyses presented above, I exclude Japan from the sample that utilizes data from 1991–2012. Japan is the only developed country throughout the sample period, which may have distinguished it from the other Asian countries in tax rate settings.

As shown in **Table 6**, the results of spatial lag of EATR for machinery and buildings are significantly positive (see Column (2)), and are similar to the results of the case including Japan (see Column (5) of **Table 4)**. The coefficients of EATR and EMTR for machinery (see Column (4) and (5) of **Table 6**) show somewhat stronger effects on the neighboring countries as compared to the results in Column (3) and (4) of **Table 5**.

Table 6　Results excluding Japan: 1991–2012

		Machinery and building		Machinery	
	(1)	(2)	(3)	(4)	(5)
Neighbor's tax rate (STR)	0.345				
	(0.91)				
Neighbor's tax rate (EATR)		0.469*		0.529**	
		(1.87)		(2.16)	
Neighbor's tax rate (EMTR)			0.534		0.792**
			(0.11)		(2.40)
PITR	0.143	0.282***	0.260***	0.199***	0.105
	(0.93)	(3.04)	(6.14)	(3.22)	(1.55)
GDP per capita	0.024	0.028	0.033	0.030	0.034
	(0.97)	(1.24)	(1.56)	(1.33)	(1.41)
Population	0.040	−0.104	−0.217*	−0.086	−0.301**
	(0.33)	(−0.79)	(−1.73)	(−0.63)	(−2.28)
Openness	−0.009	0.017	0.021*	0.027**	0.033***
	(−0.75)	(1.31)	(1.94)	(2.30)	(2.73)
Government Expenditure	−0.510	−0.836***	−0.904***	−0.971***	−1.108***
	(−0.76)	(−2.74)	(−3.59)	(−3.43)	(−4.04)
Old dependency ratio	2.206	−0.405	0.621	0.816	1.220
	(1.53)	(−0.40)	(0.69)	(1.09)	(1.50)
Young dependency ratio	−0.541***	0.274	0.401*	0.167	0.516**
	(−2.97)	(1.21)	(1.84)	(0.77)	(2.04)
Law and order	−0.013*	−0.007**	−0.007	−0.005	−0.003
	(−1.87)	(−2.21)	(−1.54)	(−1.07)	(−0.59)
Time trend	−0.013***	0.003	0.004	0.001	0.005
	(−2.71)	(0.79)	(0.92)	(0.01)	(1.00)
Number of observations	233	233	233	233	233
Hansen J test P-value	0.696	0.671	0.831	0.813	0.097

Cluster-robust t-statistics in parentheses, * p<0.1, ** p<0.05, *** p<0.01

Third, I limit the estimation period to 1991–2007. Thus, it does not include the time period after China and Taiwan significantly raised their effective tax rates. The period roughly corresponds to previous studies' estimation periods. As shown in Column (2) and (4) of **Table 7**, the coefficients of EATR have a significantly positive effect for both machinery and buildings and for machinery alone, while those of EMTR are not significant.

Table 7　Results: 1991–2007

		Machinery and building		Machinery	
	(1)	(2)	(3)	(4)	(5)
Neighbor's tax rate (STR)	0.430				
	(1.3)				
Neighbor's tax rate (EATR)		0.503**		0.505**	
		(2.05)		(2.39)	
Neighbor's tax rate (EMTR)			0.427		0.632
			(1.26)		(1.40)
PITR	0.194	0.279***	0.259***	0.208***	0.142
	(1.29)	(3.82)	(4.79)	(3.27)	(1.32)
GDP per capita	0.027	0.019	0.012	0.019	0.013
	(1.42)	(1.32)	(1.19)	(1.61)	(0.69)
Population	−0.113	0.263	−0.112	0.152	−0.333
	(−0.63)	(1.37)	(−1.23)	(1.09)	(−1.57)
Openness	0.038	0.022**	0.025**	0.026**	0.023*
	(1.46)	(2.22)	(2.50)	(2.07)	(1.77)
Government Expenditure	−0.640	−0.323	−0.284	−0.420	−0.378
	(−0.83)	(−0.96)	(−0.85)	(−1.18)	(−1.10)
Old dependency ratio	0.998	0.663	−0.016	0.490	−0.648
	(0.93)	(1.24)	(−0.04)	(0.81)	(−0.73)
Young dependency ratio	−0.389	−0.199	0.191	−0.07	0.495**
	(−1.18)	(−0.71)	(1.15)	(−0.34)	(1.99)
Law and order	−0.013**	−0.006*	−0.005	−0.004	−0.003
	(−2.01)	(−1.90)	(−1.19)	(−1.02)	(−0.53)
Time trend	−0.008	−0.008	0.001	−0.005	0.009
	(−1.30)	(−1.27)	(0.61)	(−1.16)	(1.53)
Number of observations	198	198	198	198	198
Hansen J test P−value	0.833	0.522	0.630	0.852	0.598

Cluster−robust t−statistics in parentheses, * p<0.1, ** p<0.05, *** p<0.01

Finally, I consider the case for non-preferential tax regimes that exclude tax holidays, investment tax credits, and special rates for particular industries. The purpose is to determine whether there is tax competition over general tax treatment for capital, other than in special tax regimes. There were no significant results obtained at a 5% significance level, although some coefficients of the EATR and EMTR are significantly positive at a 10% significance level (see Columns (4), (7), and (8) **of Table 8**). These results may suggest that Asian countries used general capital allowance as a measure of tax competition less than tax incentives for particular investments.

Table 8　Results: Non-preferential regime

	Machinery and building				Machinery			
	1991–2012		1991–2007		1991–2012		1991–2007	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Neighbor's tax rate (STR)								
Neighbor's tax rate (EATR)	0.231		0.413		0.453		0.599*	
	(0.50)		(1.54)		(0.75)		(1.80)	
Neighbor's tax rate (EMTR)		0.390		0.516*		0.719		0.788*
		(0.77)		(1.72)		(0.96)		(1.85)
PITR	0.257***	0.237**	0.300***	0.289***	0.192**	0.146	0.249***	0.224**
	(3.47)	(2.42)	(4.40)	(3.37)	(2.47)	(1.29)	(3.40)	(2.20)
GDP per capita	−0.009	−0.006	0.014	0.016	−0.008	−0.004	0.016	0.020
	(−0.76)	(−0.49)	(1.60)	(1.44)	(−0.62)	(−0.26)	(1.54)	(1.26)
Population	0.072	0.064	−0.058	−0.090	0.018	−0.034	−0.076	−0.122
	(0.93)	(0.58)	(−0.63)	(−0.63)	(0.21)	(−0.27)	(−0.68)	(−0.61)
Openness	0.005	0.006	0.009	0.011	0.004	0.005	0.008	0.009
	(0.89)	(0.98)	(0.90)	(0.96)	(0.54)	(0.49)	(0.70)	(0.69)
Government Expenditure	0.262	0.279	0.206	0.179	0.267	0.308	0.154	0.101
	(1.36)	(1.33)	(1.05)	(0.95)	(1.37)	(1.28)	(0.82)	(0.53)
Old dependency ratio	0.094	−0.053	−0.124	−0.243	−0.207	−0.581	−0.301	−0.523
	(0.26)	(−0.11)	(−0.33)	(−0.45)	(−0.56)	(−1.16)	(−0.70)	(−0.76)
Young dependency ratio	−0.360*	−0.287	−0.205	−0.112	−0.264	−0.129	−0.117	0.030
	(−1.74)	(−1.24)	(−0.88)	(−0.41)	(−1.30)	(−0.54)	(−0.50)	(0.10)
Law and order	−0.003	−0.003	−0.003**	−0.003	−0.001	−0.0003	−0.002	−0.002
	(−1.22)	(−1.05)	(−1.97)	(−1.59)	(−0.53)	(−0.09)	(−1.55)	(−0.84)
Time trend	−0.005	−0.004	−0.002	0.000	−0.002	0.001	0.0002	0.003
	(−1.50)	(−1.02)	(−0.41)	(0.00)	(−0.71)	(0.13)	(0.07)	(0.50)
Number of observations	254	254	198	198	254	254	198	198
Hansen J test P-value	0.243	0.220	0.531	0.593	0.407	0.456	0.964	0.745

Cluster-robust t-statistics in parentheses, * p<0.1, ** p<0.05, *** p<0.01

6.2.3 Discussion

The estimation results demonstrate that Asian countries competed at least with regard to EATR after the 1990s, but that competition has changed after 2007, as reflected in the estimation results for 1997–2012. Simple tax competition models are unable to explain why China and Taiwan raised their effective tax rates in recent years, and Japan, South Korea, India, and Indonesia reduced theirs. Although the tax competition results are consistent with previous literature on the topic, the recent change in tax competition may indicate a new finding. I offer a possible technical explanation regarding why empirical evidence for recent years contradicts the manner in which existing tax competition models predict various tax rates.

First, in the specification for estimations, some factors that affect corporate tax rate

settings may be missing. Although the estimation incorporated control variables that were used in prior empirical studies, there may be other factors that affect governments' decisions regarding tax rate setting. For example, Asian countries are diverse in terms of stage of development, political framework, history, religion, natural resources, and other characteristics. As such, the impact of these factors on the way a government handles tax rates may be more pronounced in Asian countries than in European countries.

Second and more importantly, the effective tax rates calculated in this paper only represent the tax burden on a typical investment project. Despite the abolition of tax incentives for general investment, high-tech firms in some countries may still receive them. For instance, China, which largely eliminated tax incentives in 2008, continues to grant them to high-tech firms. In addition, Singapore has made significant efforts to attract high-tech firms in order to exert positive externality and increase the productivity of the entire economy. These cases suggest that although tax competition for average firms has all but disappeared, there remains intensive tax competition in context of high-tech firms.

7 Conclusions

This paper is the first empirical study on tax competition among Asian countries during 1985–2012 based on the Devereux-Griffith methodology of corporate effective tax rates. I gained some insights into the corporate tax rate settings in Asian countries.

First, whereas small Asian countries have lowered their EATR such that they are effectively zero, large countries have maintained relatively high tax rates. This suggests that while small countries with low location-specific rent engage in a "race to the bottom," large countries with high location-specific rent avoid tax competition. These characteristics are consistent with the theoretical views on tax competition.

Second, Asian countries use tax holidays as a tool for attracting foreign capital, but the impact of tax holidays on the effective tax rates differ, depending on the capital allowance systems. Tax holidays for a typical investment may raise not only the EMTR,

but also the EATR, because some Asian countries have extremely generous depreciation policies. The adverse impact on the EATRs for countries with extremely generous depreciation policies may be a new finding in the literature.

Lastly, based on empirical analysis, this paper found evidence for tax interaction among Asian countries regarding the EATR since the 1990s. This evidence is consistent with the results of the previous studies on European countries. However, I also found some evidence that was different from the European results. In Asia, while some countries have raised their effective tax rates in recent years, other countries continued to reduce theirs. This finding contradicts the results suggested by a simple tax competition model.

However, we have to bear in mind that the conclusion on tax competition is limited to the typical investment. The tax competition for high-tech firms may possibly remain in recent years. The analysis of such tax competition is a challenge for the future.

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References

Abbas, A. and A. Klemm (2013), "A Partial Race to the Bottom: Corporate Tax Developments in Emerging and Developing Economies", *International Tax and Public Finance*, 20, 596-617.

Altshuler, R. and T. Goodspeed (2002), "Follow the Leader? Evidence on European and U.S. Tax Competition", Rutgers University Working Paper.

Auerbach, A., M. Devereux, and H. Simpson (2010), "Taxing Corporate Income", in J. Mirrlees et al. (eds.), *Mirrlees Review: Dimensions of Tax Design*, Oxford University Press, 837-93

Baldwin, R. and P. Krugman (2004), "Agglomeration, Integration and Tax Harmonisation", *European Economic Review*, 48, 1-23.

Besley, T. and A. Case (1995), "Incumbent behavior: vote-seeking, tax setting, and yardstick competition", *American Economic Review*, 85, 1-23.

Botman, D., A. Klemm, and R. Baqir (2010), "Investment Incentives and Effective Tax Rates in the Philippines: A Comparison with Neighboring Countries", *Journal of the Asia Pacific Economy*, 15, 166-91.

Bucovetsky, S. (1991), "Asymmetric Tax Competition", *Journal of Urban Economics*, 30, 167-81.

Crabbe, K. and H. Vandenbussche (2009), "Are Your Firm's Taxes Set in Warsaw? Spatial Tax Competition in Europe", CEPR Discussion Paper, 7159.

Davies, R. and J. Voget (2008), "Tax Competition in an Expanding European Union", Institute for International Integration Studies Discussion Paper Series.

Devereux, M., C. Elschner, D. Endres, and C. Spengel (2009), "Effective Tax Levels Using the Devereux/Griffith Methodology", Intermediate Report for the European Commission, ZEW.

Devereux, M. and R. Griffith (2003), "Evaluating Tax Policy for Location Decisions", *International Tax and Public Finance*, 10, 107-26.

Devereux, M., R. Griffith, and A. Klemm (2002), "Corporate Income Tax Reforms and Tax Competition", *Economic Policy*, 17, 449-95.

Devereux, M., B. Lockwood, and M. Redoano (2008), "Do Countries Compete over Corporate Tax Rates?", *Journal of Public Economics*, 92, 1210-35.

Gordon, R. (1986), "Taxation of Investment and Savings in a World Economy", *American Economic Review*, 76, 1086-1102.

Haufler, A. and I. Wooton (1999), "Country Size and Tax Competition for Foreign Direct Investment", *Journal of Public Economics*, 71, 121-39.

Jorgenson, D. (1963), "Capital Theory and Investment Behavior", *American Economic Review*, 53, 247-59.

Keen, M. (2001), "Preferential Regimes Can Make Tax Competition Less Harmful", *National Tax Journal*, 54, 757-62.

King, M. and D. Fullerton (1984), *The Taxation of Income from Capital: A Comparative Study of the United States, the United Kingdom, Sweden, and West Germany*, University of Chicago Press.

Klemm, A. (2010), "Causes, Benefits, and Risks of Business Tax Incentives", *International Tax and Public Finance*, 17, 315-36.

Klemm, A. (2012), "Effective Average Tax Rates for Permanent Investment", *Journal of Economic and Social Measurement*, 37, 253-64.

Klemm, A. and S. Van Parys (2012), "Empirical Evidence on the Effects of Tax Incentives", *International Tax and Public Finance*, 19, 393-423.

Mintz, J. (1990), "Corporate Tax Holidays and Investment", *The World Bank Economic Review*, 4, 81-102.

Overesch, M. and J. Rincke (2011), "What Drives Corporate Tax Rates Down? A Reassessment of Globalization, Tax Competition, and Dynamic Adjustment to Shocks", *Scandinavian Journal of Economics*, 113, 579-602.

Squalli, J., and K. Wilson (2006), "A New Approach to Measuring Trade Openness", EPRU Zayed University Working Paper, 06-07.

Wilson, J. (1991), "Tax Competition with Interregional Differences in Factor Endowments", *Regional Science and Urban Economics*, 21, 423-51.

Zodrow, G. and P. Mieszkowski (1986), "Pigou, Tibout, Property Taxation, and the Underprovision of Local Public Goods", *Journal of Urban Economics*, 19, 356-70.

Appendix A: Effective tax rates based on calculations by Devereux and Griffith, and Klemm

The forward-looking effective tax rate used in this paper is based on the work of Devereux and Griffith (2003), and Klemm (2012). In this paper, I assume that — (a) there is no capital income tax in the household sector, and (b) investment is financed by equity or retained earnings.

The NPV of a hypothetical investment is calculated as:

$$R_t = dV_t = \sum_{s=0}^{\infty} \frac{dD_{t+s}}{(1+\rho)^s} \quad \text{(A.1)}$$

where V_t denotes the equity value, D_t is the dividend paid by a firm, ρ denotes shareholders' discount rates. Since there is no capital income tax on the household sector, $\rho = i$ (i.e., risk-free interest rates).

The dividend paid by a firm is restricted by cash-flow, which is calculated by subtracting the investments and the depreciation of assets from the output.

$$D_t = Q_t(K_{t-1})(1-\tau) - I_t + \tau\phi(I_t + K_{t-1}^T) \quad \text{(A.2)}$$

In (A.2), $Q(K_{t-1})$ represents output, τ denotes the STR, I_t is investment, ϕ denotes tax allowance rates, K_{t-1} represents capital stock, and K_{t-1}^T is capital stock for tax purposes. Capital stock and the value of capital stock for tax purposes are distinguished as shown in equations (A.3) and (A.4). In (A.3), δ represents capital depreciation rates.

$$K_t = (1-\delta)K_{t-1} + I_t \quad \text{(A.3)}$$

$$K_t^T = (1-\phi)K_{t-1}^T + I_t \quad \text{(A.4)}$$

Based on equations (A.1) through (A.4), NPV (R_t) can be expressed as shown in equation (A.5).

$$R_t = \sum_{s=0}^{\infty} \frac{dD_{t+s}}{(1+\rho)^s} = \sum_{s=0}^{\infty} \frac{dQ_{t+s}(1-\tau)}{(1+\rho)^s} - \sum_{s=0}^{\infty} \frac{dI_{t+s}}{(1+\rho)^s} + \tau\phi \sum_{s=0}^{\infty} \frac{dI_{t+s} + dK^T_{t+s-1}}{(1+\rho)^s} \quad \text{(A.5)}$$

Following Klemm (2012), I consider a scenario in which a firm invests in period t, and thereafter maintains the capital stock level ($dI_t = 1$, $dI_{t+s} = 0 \quad \forall s \geq 1$)[19]. Given this, equation (A.5) can be written as equation (A.6) by using $1+\rho = (1+r)(1+\pi)$, where r represents the real interest rate and π is the inflation rate.

$$\begin{aligned} R_t &= \sum_{s=0}^{\infty} \frac{dQ_{t+s}(1-\tau)}{(1+\rho)^s} - \sum_{s=0}^{\infty} \frac{dI_{t+s}}{(1+\rho)^s} + \tau\phi \sum_{s=0}^{\infty} \frac{dI_{t+s} + dK^T_{t+s-1}}{(1+\rho)^s} \\ &= \sum_{s=1}^{\infty} \frac{(p+\delta)(1-\tau)(1+\pi)^s (1-\delta)^{s-1}}{(1+\rho)^s} - 1 + A \quad \text{(A.6)} \\ &= \frac{(p+\delta)(1-\tau)}{r+\delta} - 1 + A \end{aligned}$$

In equation (A.6), A represents the PDV of depreciation allowances multiplied by τ. The PDV is calculated with equation (A.7) or (A.8), depending upon the depreciation method, i.e., DB or SL[20]. T shows the depreciation period.

$$PDV_{DB} = \phi \left\{ 1 + \left(\frac{1-\phi}{1+\rho} \right) + \left(\frac{1-\phi}{1+\rho} \right)^2 + \cdots \right\} = \frac{\phi(1+\rho)}{\rho+\phi} \quad \text{(A.7)}$$

$$PDV_{SL} = \phi \left\{ 1 + \left(\frac{1}{1+\rho} \right) + \left(\frac{1}{1+\rho} \right)^2 + \cdots + \left(\frac{1}{1+\rho} \right)^{T-1} \right\} = \frac{\phi(1+\rho)}{\rho} \cdot \left\{ 1 - \left(\frac{1}{1+\rho} \right)^{1/\phi} \right\} \quad \text{(A.8)}$$

[19] Devereux and Griffith (2003) considered a scenario in which the capital stock increases only in period t ($dK_t = 1, dK_s = 0, \forall s \neq t$).

[20] However, the PDV as calculated in equations (A.7) or (A.8) may not be applicable to all countries for all periods. Depreciation systems for some countries are characterized by greater flexibility or complexity (e.g., when companies can change the depreciation method from the DB method to the SL method).

When there is no corporate income tax, the firm's rent (R^*) is determined with equation (A.9).

$$R_t^* = -1 + \frac{(1+\pi)(p+\delta)}{1+i}\left[1 + \frac{(1+\pi)(1-\delta)}{1+i} + \left(\frac{(1+\pi)(1-\delta)}{1+i}\right)^2 + \cdots\right] = \frac{p-r}{r+\delta} \quad \text{(A.9)}$$

EATR is calculated as the present value of corporate income tax ($R_t^* - R_t$), divided by the profits rate (p). Profits rate is divided by $r+\delta$ because we consider the impact of the investment for infinity.

$$EATR_t = \frac{R_t^* - R_t}{p/(r+\delta)} \quad \text{(A.10)}$$

Assuming $R = 0$, solving for p would yield the cost of capital ($\tilde{p}$).

$$\tilde{p} = \frac{(1-A)(r+\delta)}{1-\tau} - \delta \quad \text{(A.11)}$$

EMTR is calculated by substituting (A.11) with (A.10), or by using (A.12) (King and Fullerton, 1984).

$$EMTR = \frac{\tilde{p} - r}{\tilde{p}} \quad \text{(A.12)}$$

When there are tax holidays of Y years, the first term in (A.6) is changed as follows (Klemm, 2012):

$$\sum_{s=1}^{Y} \frac{(p+\delta)(1+\pi)^s(1-\delta)^{s-1}}{(1+\rho)^s} + \sum_{s=Y+1}^{\infty} \frac{(p+\delta)(1-\tau)(1+\pi)^s(1-\delta)^{s-1}}{(1+\rho)^s}$$

$$= \sum_{s=1}^{\infty} \frac{(p+\delta)(1+\pi)^s (1-\delta)^{s-1}}{(1+\rho)^s} - \tau \sum_{s=Y+1}^{\infty} \frac{(p+\delta)(1+\pi)^s (1-\delta)^{s-1}}{(1+\rho)^s}$$

$$= \frac{p+\delta}{r+\delta}\left(1 - \tau\left(\frac{1-\delta}{1+r}\right)^Y\right) \quad \text{(A.13)}$$

where $A = \frac{\tau\phi(1+\rho)}{\rho+\phi}\left(\frac{1-\phi}{1+\rho}\right)^Y$ is used with the DB method of depreciation and

$A = \frac{\tau\phi(1+\rho)}{\rho}\left[\left(\frac{1}{1+\rho}\right)^Y - \left(\frac{1}{1+\rho}\right)^{1/\phi}\right]$ $\forall Y \leq 1/\phi$ is used with the SL method of depreciation.

In this paper, I consider a scenario in which firms avail of not only tax holidays, but also the 50% reduction in STRs. Thus, the first term in equation (A.6) is modified as follows:

$$\sum_{s=1}^{Y} \frac{(p+\delta)(1+\pi)^s (1-\delta)^{s-1}}{(1+\rho)^s} + \sum_{s=Y+1}^{Y+Z} \frac{(p+\delta)(1-0.5\tau)(1+\pi)^s (1-\delta)^{s-1}}{(1+\rho)^s}$$
$$+ \sum_{s=Y+Z+1}^{\infty} \frac{(p+\delta)(1-\tau)(1+\pi)^s (1-\delta)^{s-1}}{(1+\rho)^s}$$

$$= \frac{p+\delta}{r+\delta}\left[1 - \tau\left(\frac{1-\delta}{1+r}\right)^{Y+Z} - 0.5\tau\left(\frac{1-\delta}{1+r}\right)^Y \left\{1 - \left(\frac{1-\delta}{1+r}\right)^Z\right\}\right] \quad \text{(A.14)}$$

For limited tax exemption of 70% in Malaysia, the first term in equation (A.6) is modified as follows:

$$\sum_{s=1}^{Y} \frac{(p+\delta)(1-0.3\tau)(1-\delta)^{s-1}}{(1+r)^s} + \sum_{s=Y+1}^{\infty} \frac{(p+\delta)(1-\tau)(1-\delta)^{s-1}}{(1+r)^s}$$

$$= \sum_{s=1}^{\infty} \frac{(p+\delta)(1-\delta)^{s-1}}{(1+r)^s} - \tau \sum_{s=Y+1}^{\infty} \frac{(p+\delta)(1-\delta)^{s-1}}{(1+r)^s} - 0.3\tau \sum_{s=1}^{Y} \frac{(p+\delta)(1-\delta)^{s-1}}{(1+r)^s}$$

$$= \frac{p+\delta}{r+\delta}\left(1 - \tau\left(\frac{1-\delta}{1+r}\right)^Y\right) - 0.3\tau \cdot \frac{p+\delta}{r+\delta} \cdot \left(1 - \left(\frac{1-\delta}{1+r}\right)^Y\right) \quad \text{(A.15)}$$

Appendix B : Tax incentives and capital allowances in 12 Asian countries

(1) Tax incentives

- Singapore: The government is making significant efforts to attract foreign companies in order to increase economic productivity. To accomplish this, the Economic Development Board (EDB) identifies profitable companies and determines the appropriate tax incentives for them. The primary tax incentive granted by the government is the tax holiday. In the 1960s, companies that qualified for pioneer status could take advantage of tax holidays up to five years. The maximum period for tax holidays was increased to 10 years in 1975, and 15 years in 2004.
- Thailand: Established in the 1960s, the BOI is responsible for attracting businesses to Thailand. Initially, the maximum period for tax holidays was set at two years, but was extended to eight years in 1972. Since 1989, tax incentives have been contingent on the location of the investment. In Zone 1, which comprises Bangkok and its five neighboring provinces, a three-year tax holiday is permitted. In Zone 2, which comprises the neighborhood of the capital and Phuket, companies are permitted a maximum five-year tax holiday. In the underdeveloped areas of Zone 3, companies can avail a tax holiday up to eight years followed by a 50% reduction in the corporate income tax rate.
- The Philippines: The BOI implemented an eight-year tax holiday in 1987. Many export processing zones for foreign companies were set up by other institutions. Companies that invest in the zone and avail the tax incentives must export more than 70% of the goods they produce. Although this condition seems difficult to fulfill, it is not so because the limited size of the Philippines' domestic market curb the profitability of domestic sales. Hence, companies in the export processing zones find it relatively easy to export most of their goods. The PEZA, established in 1995, has implemented generous tax incentives for companies operating in their special zones. For example, companies operating in PEZA zones are eligible for an eight-year tax holiday and a 5% STR after the tax holiday expires. Other special zones in the Philippines have implemented tax incentive systems similar to those of the PEZA.
- Malaysia: Tax holidays for manufacturing companies were introduced in 1968 through the Investment Incentive Act. In 1986, the Promotion of Investment Act extended the applicability of tax holidays to companies in the service sector. It also led to the creation of the Malaysian Investment Development Authority (MIDA). The MIDA allowed companies with pioneer status to utilize a maximum five-year tax holiday, unlike previous policies, which allowed a two-year tax holiday with the potential for a three-year extension. Until October 1991, tax holidays were applied to the pre-capital allowance income, which allowed companies to fully utilize capital allowance after the holidays expired. Since October 1991, however, tax holidays have been limited to 70% of the post-capital allowance income. The change in the income level at which a company is eligible for tax exemption implies that capital allowance is used during tax holidays and is reduced after the holiday expires. Rather than rely on tax holidays, under the new system, pioneer

companies can opt for the ITA. Under ITA, companies are granted an allowance of 60% of the total investment cost for five years, and it can be set-off against up to 70% of the pre-tax income every year.

- Indonesia: Until 1983, Indonesia allowed companies to avail of a two-year tax holiday. In 1984, however, tax holidays were abolished. In 1997, they were reinstated, but only for certain companies that were revived on an ad-hoc basis. In 2000, the Indonesian government implemented a system of double deduction of depreciation for certain industries and companies. Further, the government pioneered a new system of tax incentives wherein 30% of the investment is deductible for six years. The range of industries eligible for tax holidays was widened in August 2010, though these incentives were applicable only to those projects that were valued at more than USD 1 million, a level too high for a typical investment in Indonesia.
- Vietnam: In 1987, following significant economic reforms (Doi Moi), the Vietnamese government implemented the Foreign Investment Law. This law was thoroughly revised in November 1996. In January 1999, the corporate income tax law (for domestic companies) and the foreign investment law (for foreign companies) were unified into the new corporate income tax law, which was applicable to both domestic and foreign companies. Consequently, the corporate income tax rate was set at 28% in 2004. Tax incentives in Vietnam depend upon the industry in which the company operates and the company's location. Since these characteristics are not clearly defined, the Foreign Investment Agency sometimes decides on a company's eligibility for tax incentives. Typically, a tax incentive comprises a basic rate that is lower than the standard rate, tax holidays, and a 50% reduction in the corporate income tax rate. For example, a tax incentive may include a 10% basic rate for 15 years, a four-year tax holiday, and a 50% reduction in the corporate tax rate (i.e., 5%). Companies can utilize the 50% reduction in the corporate tax rate for up to nine years. Thus, a company would pay no taxes from Year 1 to Year 4, a 5% tax rate from Year 5 to Year 13, a 10% tax rate for Years 14 and 15, and a 25% tax rate thereafter.
- India: With the introduction of economic reforms in 1991, India opened its markets to foreign companies. However, these reforms did not mitigate the restrictions imposed by some regulations on foreign companies. Because of these difficulties, it was not until the early 2000s that inward foreign direct investment increased in India. Tax incentives in India are categorized as (a) location-based (underdeveloped areas), (b) industry-based (energy, infrastructure, and telecommunications), or (c) export-based (special economic zones, among others). Tax holidays of 5–10-years are given to qualified companies, but typical companies cannot avail of tax holidays at all. For example, automakers that wish to sell their cars in Indian markets are not given tax incentives unless they invest in underdeveloped areas.
- China: From July 1991 until the end of 2007, foreign companies could enjoy a reduced tax rate of 15% in national development zones and 24% in local development zones. Both these tax rates were lower than the standard rate of 33%. Foreign companies could avail a

two-year tax holiday and a 50% rate reduction for three years after the holiday expired. High-tech companies could continue to avail of the 50% reduction in tax rates beyond the time frame if they exported more than 70% of what they produced. However, since January 2008, tax incentives only for foreign companies have been discontinued. Reduced rates and tax holidays in development zones have been abolished, and the standard STR is down to 25%. Tax incentives for high-tech companies remain, but the production and export requirements to maintain the reduced tax rate are too difficult for most companies to meet.

- South Korea: Traditionally, South Korea has allowed an investment tax credit of 3-10%, depending on the year and area. However, at the end of 2011, investment tax credits were abolished and replaced by another type of tax credit. In 1999, the South Korean government granted tax holidays to foreign companies that invested beyond the Seoul area. Specifically, foreign companies could take a tax holiday of up to five years and enjoy a 50% rate reduction for two years after the holiday expires.
- Taiwan: Under the Statute for Investment Incentive of 1960, companies could use a five-year tax holiday. Further, the Statute for Upgrading Industries continued with five-year tax holidays for companies in industries critical for Taiwan's economic activities. However, the statute was replaced in May 2010. Notably, the new statute completely abolished tax incentives.
- Hong Kong: There are no tax incentives.
- Japan: There are no tax incentives.

(2) Depreciation methods or capital allowances

The depreciation (or capital allowance) methods listed here are for the time period 1981–2012. If companies utilize tax holidays, it is assumed they use a depreciation method that yields the lowest PDV during the holiday in order to get as much depreciation allowance as possible after the holiday period.

- Singapore

・Machinery (SL Method)

1981–1983: 20% as an initial allowance, the remaining 80% depreciated annually over eight years.

1984–2008: Accelerated depreciation over three years.

2009 onwards: Accelerated depreciation over two years — 75% in the first year, 25% in the second.

・Buildings (SL Method)

Till 1981: 25% of the acquisition cost granted as initial allowance, 3% of the acquisition cost granted as annual allowance.

2010 onwards: Depreciation was discontinued.

- Thailand

・Machinery (SL Method)

20% depreciation rate

・Buildings (SL Method)

5% depreciation rate

- The Philippines

No particular depreciation method specified for either machinery or buildings. An asset must be depreciated in accordance with its useful life as well as corporate accounting rules. The SL method is often used for both for machinery and buildings. The eight-year SL method for machinery and the 25-year SL method for buildings are included in the assumptions regarding the effective tax rate.

- Malaysia

・Machinery (SL Method)

1981–1999: 20% of the acquisition cost granted as initial allowance, 14% of that granted as annual allowance.

2000 onwards: Annual allowance rate was increased to 20%.

・Buildings (SL Method)

1981–2001: 10% of the acquisition cost granted as initial allowance, 2% of that granted as annual allowance.

2002 onwards: Annual allowance rate increased to 3%.

- Indonesia

・Machinery (DB Method)

1981-1994: 10% depreciation rate.

1995 onwards: 12.5% depreciation rate.

・Building (SL Method)

5% depreciation rate.

- Vietnam

Eight-year SL method for machinery and 25-year SL method for buildings are included in the assumptions regarding the effective tax rate.

- India

・Machinery (DB Method)

1981–2004: 25% depreciation rate.

2005 onwards: 15% depreciation rate.

・Buildings (DB Method)

1981–2004: 5% depreciation rate.

2005 onwards: 10% depreciation rate.

- China

SL method for both machinery and buildings (10% residual value). The depreciation period is 10 years for machinery and 20 years for buildings.

- South Korea

・Machinery (DB Method)

Pre-1995, there were detailed rules for depreciation. However, 1995 onwards, the length of the assets' useful lives were determined by the industry, and companies could set a depreciation period within a ±25% range of that set by the industry.

1981–1998: Six years depreciation (5% residual value)

1999 onwards: Eight years depreciation (5% residual value)

・Buildings (SL Method)

30-year depreciation period.

- Taiwan

・Machinery (SL Method)

10-year depreciation period. However, annual depreciation is calculated as "acquisition cost / (depreciation length + 1)". Depreciation for buildings is also calculated as per this method.

・Building (SL Method)

1981–1989: 45-year depreciation period.

1990–1997: 40-year depreciation.

1998 onwards: 35-year depreciation period.

- Hong Kong

・Machinery (SL Method)

1981–1997: 60% of acquisition cost granted as initial allowance, 30% annual allowance against the remaining 40% of acquisition cost.

1998 onwards: 100% allowance of the acquisition cost.

・Building (SL Method)

20% granted as initial allowance, 4% as annual allowance against acquisition cost.

- Japan

・Machinery (DB Method)

1981–2006: 200% DB (10% residual value).

2007 onwards: 250% DB. Switching to the SL method during the depreciation period is permitted.

・Buildings (SL Method)

1981–1997: 45-year depreciation period.

1998 onwards: 38-year depreciation period.

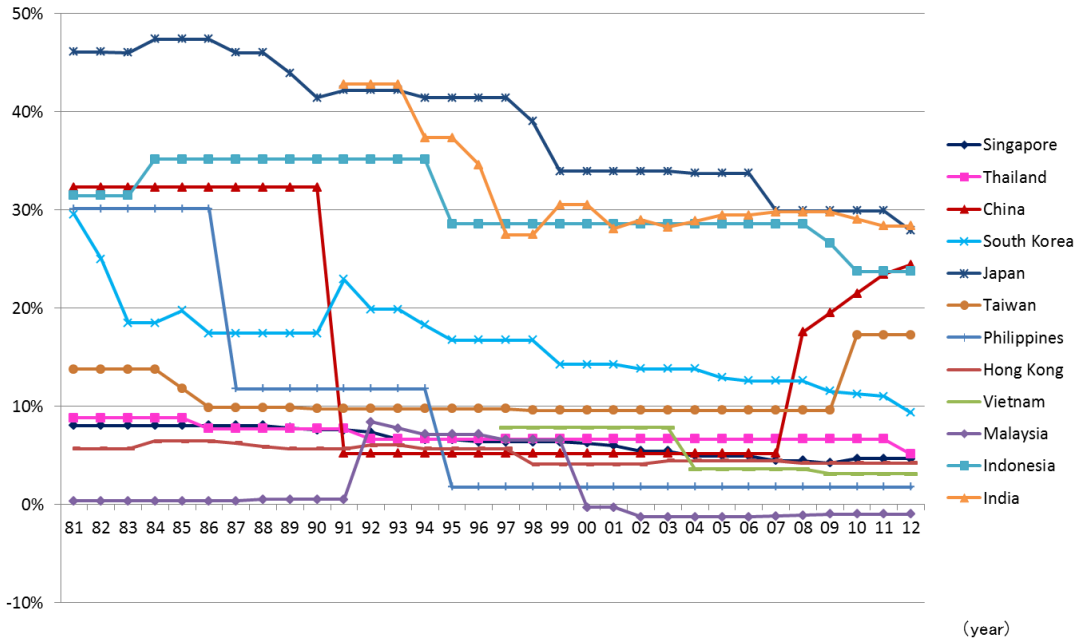
Appendix C : Results for EMTRs

C.1 EMTRs for Asian countries

Although the characteristics of EMTRs are similar to that of the EATRs, there are some differences between the two. First, Malaysia's EMTRs were bordering zero till 1991, and were sub-zero from 2000 onwards (see **Figure C-1**) on account of negative EMTRs for machinery of around -10% till 1991 and -7% to -8% since 2000 (**Figure C-2**). The negative EMTRs were a result of tax holidays and in accordance with the full capital allowance till 1991[21], and the enlarged capital allowance in combination with the ITA since 2000.

Second, Hong Kong has maintained EMTRs for machinery at zero since 1998, because 100% capital allowance can be permitted for qualified machinery investment (see **Figure C-2**). While 100% capital allowance may not be applicable for all machines, it is applicable to a wide range of assets including a "typical" investment in the manufacturing sector.

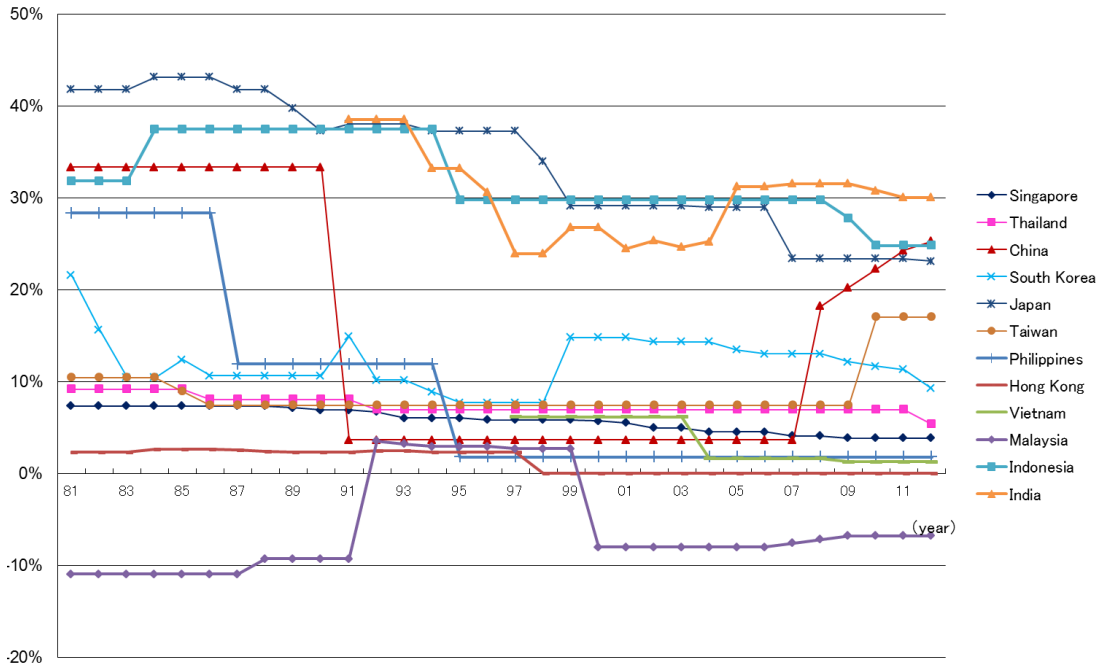
Figure **C-1** EMTRs in Asian Countries



[21] Mintz (1990) has already highlighted the characteristics of this Malaysian case.

Third, contrary to popular perception that Japan has the highest corporate tax rates in the world, Japan's EMTRs for machinery are currently not the highest among the Asian countries (see **Figure C-2**). Japan's EMTRs are lower than that of India, China, and Indonesia because Japan has a narrower tax base than these countries with respect to machinery. This aspect is often overlooked when STRs serve as the only method by which tax rates are gauged[22].

Figure **C-2** EMTRs for Machinery in Asian Countries

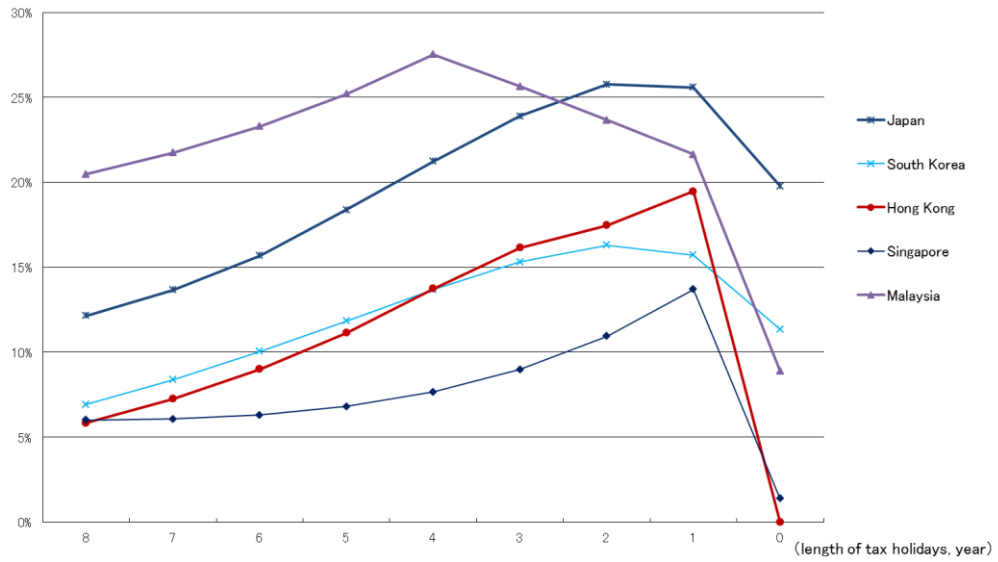


C.2 Impact of tax holidays on the EMTRs

The adverse impact of tax holidays on the EMTR is greater than that on the EATR. For example, EMTRs for Singapore, Hong Kong, and Malaysia are much higher with eight-year tax holidays than with no tax holidays (see **Figure C-3**). Japan and South Korea require a tax holiday of around five years to reduce the EMTR.

[22] A narrower tax base leads to lower EMTRs rather than lower EATRs.

Figure C-3　Impact of tax holidays coupled with generous depreciation rates on EMTR



In contrast, for countries that have less generous capital allowances, the EMTR (like the EATR) can be easily reduced with tax holidays. China can reduce the EMTR by around 10% with only a two-year tax holiday (see **Figure C-4**). Taiwan, the Philippines, Indonesia, and India can also reduce their EMTRs with short tax holidays. The only exception to these trends is Thailand, whose EMTR with a three-to-five-year tax holiday is higher than that with no tax holiday.

Figure C-4　Impact of tax holidays coupled with lower depreciation rates on EMTR